# Validation of 'sasLM' Package

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## Contents

# 1 Books used for the Validation


1. Harvey WR. Least-Squares Analysis of Data with Unequal Subclass Frequencies. USDA, Agriculture Research Service, ARS 20-8. 1960. reprinted with corrections as ARS H-4, 1975, also reprinted 1979.
2. Snee RD. Computation and Use of Expected Mean Squares in Analysis of Variance. J Qual Tech. 1974:6(3);128-137.
3. Goodnight JH. The General Linear Models Procedure, Proceedings of the First International SAS User's Group, SAS Institute, Raleigh, N.C. 1976.
4. SAS for Linear Models 4e. John Wiley & Sons Inc. 2002.
5. Sahai H, Ojeda MM. Analysis of Variance for Random Models Volume 2 Unbalanced Data. 2005.
6. Federer WT, King F. Variations on Split Plot and Split Block Experiment Designs. John Wiley & Sons Inc. 2007.
7. Searle SR, Gruber MHJ. Linear Models 2e, Kindle Edition. 2016.


```
require(sasLM)
require(car)
```

## 2 ARS20-8

### 2.1 p8

(1) MODEL

```
p8 = read.csv("C:/G/Rt/ANOVA/ARS20-8p8.csv")
p8 = af(p8, c("PigNo", "Ration"))
GLM(Barrow ~ Ration, p8)
```

```
$ANOVA
Response : Barrow
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL            2 11.111  5.5556  1.2626 0.3113
RESIDUALS       15 66.000  4.4000
CORRECTED TOTAL 17 77.111

$`Type I`
       Df Sum Sq Mean Sq F value Pr(>F)
Ration  2 11.111  5.5556  1.2626 0.3113

$`Type II`
       Df Sum Sq Mean Sq F value Pr(>F)
Ration  2 11.111  5.5556  1.2626 0.3113

$`Type III`
       Df Sum Sq Mean Sq F value Pr(>F)
Ration  2 11.111  5.5556  1.2626 0.3113

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)        5    0.85635  5.8387 3.261e-05 ***
Ration1           -1    1.35401 -0.7385    0.4716
Ration2            1    1.13284  0.8827    0.3913
Ration3            0    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 2.2 p42

(2) MODEL

```
p42 = read.csv("C:/G/Rt/ANOVA/ARS20-8p42.csv")
p42 = af(p42, c("Ration", "Pig", "Sire"))
GLM(Y ~ Sire + Ration, p42)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL            3 20.819  6.9397  1.7259 0.2075
RESIDUALS       14 56.292  4.0209
CORRECTED TOTAL 17 77.111

$`Type I`
       Df  Sum Sq Mean Sq F value Pr(>F)
Sire    2 11.1111  5.5556  1.3817 0.2834
Ration  1  9.7079  9.7079  2.4144 0.1425

$`Type II`
       Df  Sum Sq Mean Sq F value Pr(>F)
Sire    2 15.6829  7.8414  1.9502 0.1790
Ration  1  9.7079  9.7079  2.4144 0.1425

$`Type III`
       Df  Sum Sq Mean Sq F value Pr(>F)
Sire    2 15.6829  7.8414  1.9502 0.1790
Ration  1  9.7079  9.7079  2.4144 0.1425

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   5.2697    0.83682  6.2973 1.964e-05 ***
Sire1        -0.4607    1.34009 -0.3438    0.7361
Sire2         1.7416    1.18344  1.4716    0.1632
Sire3         0.0000    0.00000
Ration1      -1.6180    1.04129 -1.5538    0.1425
Ration2       0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(3) MODEL

```
GLM(Y ~ Sire + Ration + Sire:Ration, p42)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value  Pr(>F)
MODEL            5 51.044 10.2089  4.6997 0.01311 *
RESIDUALS       12 26.067  2.1722
CORRECTED TOTAL 17 77.111
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
```

```
            Df  Sum Sq Mean Sq F value   Pr(>F)
Sire         2 11.1111  5.5556  2.5575 0.118799
Ration       1  9.7079  9.7079  4.4691 0.056129 .
Sire:Ration  2 30.2255 15.1127  6.9573 0.009859 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
            Df  Sum Sq Mean Sq F value   Pr(>F)
Sire         2 15.6829  7.8414  3.6099 0.059238 .
Ration       1  9.7079  9.7079  4.4691 0.056129 .
Sire:Ration  2 30.2255 15.1127  6.9573 0.009859 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
            Df  Sum Sq Mean Sq F value   Pr(>F)
Sire         2 21.0007 10.5004  4.8339 0.028853 *
Ration       1  3.5919  3.5919  1.6535 0.222736
Sire:Ration  2 30.2255 15.1127  6.9573 0.009859 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)     5.4000    0.65912  8.1927 2.944e-06 ***
Sire1          -2.9000    1.23311 -2.3518   0.03659 *
Sire2           2.9333    1.07634  2.7253   0.01843 *
Sire3           0.0000    0.00000
Ration1        -2.4000    1.61452 -1.4865   0.16294
Ration2         0.0000    0.00000
Sire1:Ration1   5.4000    2.18607  2.4702   0.02948 *
Sire1:Ration2   0.0000    0.00000
Sire2:Ration1  -1.3333    1.94041 -0.6871   0.50506
Sire2:Ration2   0.0000    0.00000
Sire3:Ration1   0.0000    0.00000
Sire3:Ration2   0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 2.3 p101

(4) MODEL

```
p101 = read.csv("C:/G/Rt/ANOVA/ARS20-8p101.csv")
p101 = af(p101, c("Line", "Sire", "Dam", "Steer"))
GLM(Gain ~ Line + Sire + Dam + Line:Dam + Age + Weight, p101)
```

```
$ANOVA
Response : Gain
                Df Sum Sq  Mean Sq F value   Pr(>F)
MODEL           16 2.4972 0.156073  3.0675 0.001364 **
RESIDUALS       48 2.4422 0.050879
CORRECTED TOTAL 64 4.9394
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
         Df  Sum Sq  Mean Sq F value  Pr(>F)
Line      2 0.38009 0.190046  3.7352 0.03107 *
Sire      6 0.92634 0.154391  3.0345 0.01347 *
Dam       2 0.11894 0.059471  1.1689 0.31940
Line:Dam  4 0.64889 0.162222  3.1884 0.02113 *
Age       1 0.16462 0.164622  3.2356 0.07835 .
Weight    1 0.25828 0.258283  5.0764 0.02886 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
         Df  Sum Sq Mean Sq F value  Pr(>F)
Line      0
Sire      6 0.95299 0.15883  3.1217 0.01155 *
Dam       2 0.32039 0.16019  3.1485 0.05190 .
Line:Dam  4 0.46516 0.11629  2.2856 0.07373 .
Age       1 0.34830 0.34830  6.8456 0.01185 *
Weight    1 0.25828 0.25828  5.0764 0.02886 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
         Df  Sum Sq Mean Sq F value  Pr(>F)
Line      0
Sire      6 0.95299 0.15883  3.1217 0.01155 *
Dam       2 0.12469 0.06234  1.2253 0.30268
Line:Dam  4 0.46516 0.11629  2.2856 0.07373 .
Age       1 0.34830 0.34830  6.8456 0.01185 *
Weight    1 0.25828 0.25828  5.0764 0.02886 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  2.95068    0.51867  5.6889 7.461e-07 ***
Line1        0.08058    0.14600  0.5519  0.583562
Line2        0.25898    0.13801  1.8765  0.066672 .
```

```
Line3         0.00000    0.00000
Sire1         0.07353    0.13054  0.5633  0.575872
Sire2        -0.12448    0.13720 -0.9072  0.368814
Sire3         0.00000    0.00000
Sire4        -0.23837    0.12753 -1.8692  0.067704 .
Sire5         0.00000    0.00000
Sire6         0.10359    0.13013  0.7960  0.429928
Sire7        -0.02129    0.12129 -0.1756  0.861372
Sire8        -0.33135    0.12662 -2.6168  0.011834 *
Sire9         0.00000    0.00000
Dam3          0.36999    0.11530  3.2090  0.002375 **
Dam4          0.27711    0.10444  2.6533  0.010777 *
Dam5          0.00000    0.00000
Line1:Dam3   -0.44415    0.19686 -2.2562  0.028649 *
Line1:Dam4   -0.30365    0.16070 -1.8896  0.064862 .
Line1:Dam5    0.00000    0.00000
Line2:Dam3   -0.26743    0.19635 -1.3620  0.179554
Line2:Dam4   -0.35600    0.17540 -2.0297  0.047954 *
Line2:Dam5    0.00000    0.00000
Line3:Dam3    0.00000    0.00000
Line3:Dam4    0.00000    0.00000
Line3:Dam5    0.00000    0.00000
Age          -0.00815    0.00312 -2.6164  0.011845 *
Weight        0.00197    0.00087  2.2531  0.028860 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(5) MODEL

```
GLM(Gain ~ Sire + Dam + Line:Dam, p101)
```

```
$ANOVA
Response : Gain
                Df Sum Sq  Mean Sq F value   Pr(>F)
MODEL           14 2.0743 0.148162  2.5856 0.006996 **
RESIDUALS       50 2.8651 0.057302
CORRECTED TOTAL 64 4.9394
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
         Df  Sum Sq  Mean Sq F value  Pr(>F)
Sire      8 1.30644 0.163305  2.8499 0.01089 *
Dam       2 0.11894 0.059471  1.0379 0.36172
Dam:Line  4 0.64889 0.162222  2.8310 0.03412 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
         Df  Sum Sq  Mean Sq F value  Pr(>F)
Sire      6 1.06000 0.176667  3.0831 0.01202 *
Dam       2 0.11894 0.059471  1.0379 0.36172
Dam:Line  4 0.64889 0.162222  2.8310 0.03412 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
         Df  Sum Sq  Mean Sq F value  Pr(>F)
Sire      6 1.06000 0.176667  3.0831 0.01202 *
Dam       2 0.02569 0.012844  0.2242 0.79999
Dam:Line  4 0.64889 0.162222  2.8310 0.03412 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  2.35075    0.09704 24.2246 < 2.2e-16 ***
Sire1        0.20311    0.14084  1.4422  0.155488
Sire2       -0.06287    0.13258 -0.4742  0.637414
Sire3        0.16834    0.15153  1.1109  0.271905
Sire4        0.18107    0.14313  1.2650  0.211718
Sire5        0.31743    0.14313  2.2178  0.031143 *
Sire6       -0.01585    0.13038 -0.1215  0.903749
Sire7       -0.11844    0.12299 -0.9630  0.340164
Sire8       -0.42213    0.13012 -3.2442  0.002102 **
Sire9        0.00000    0.00000
Dam3         0.33813    0.12177  2.7768  0.007706 **
Dam4         0.27529    0.11078  2.4849  0.016348 *
Dam5         0.00000    0.00000
Dam3:Line1  -0.45707    0.20303 -2.2512  0.028796 *
Dam3:Line2  -0.38540    0.20378 -1.8913  0.064384 .
Dam3:Line3   0.00000    0.00000
Dam4:Line1  -0.38180    0.16807 -2.2717  0.027443 *
Dam4:Line2  -0.43029    0.18374 -2.3418  0.023215 *
Dam4:Line3   0.00000    0.00000
Dam5:Line1   0.00000    0.00000
Dam5:Line2   0.00000    0.00000
Dam5:Line3   0.00000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 3 Snee EMS ANOVA 1974

(6) MODEL

```
Snee = read.csv("C:/G/Rt/ANOVA/Snee_EMS_ANOVA1974.csv")
Snee = af(Snee, c("Machine", "Analyst", "Test", "Day"))
GLM(Y ~ Day/Machine/Analyst/Test, Snee)
```

```
Warning in sqrt(diag(bVar)): NaNs produced

$ANOVA
Response : Y
                 Df Sum Sq Mean Sq F value Pr(>F)
MODEL           167 751.27  4.4986
RESIDUALS         0   0.00
CORRECTED TOTAL 167 751.27

$`Type I`
                          Df Sum Sq Mean Sq F value Pr(>F)
Day                       41 365.58  8.9166
Day:Machine               42 196.59  4.6807
Day:Machine:Analyst       42 118.80  2.8285
Day:Machine:Analyst:Test 42  70.31  1.6739

$`Type II`
                          Df Sum Sq Mean Sq F value Pr(>F)
Day                       41 365.58  8.9166
Day:Machine               42 196.59  4.6807
Day:Machine:Analyst       42 118.80  2.8285
Day:Machine:Analyst:Test 42  70.31  1.6739

$`Type III`
                          Df Sum Sq Mean Sq F value Pr(>F)
Day                       41 359.44  8.7669
Day:Machine               42 199.40  4.7477
Day:Machine:Analyst       42 118.80  2.8285
Day:Machine:Analyst:Test 42  70.31  1.6739

$Parameter
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                        11.3
Day1                               -2.5
Day10                              -2.0
Day11                              -7.3
Day12                              -1.6
Day13                              -6.7
Day14                              -9.2
```

```
Day15                -1.6
Day16                -1.3
Day17                -1.1
Day18                -2.1
Day19                -0.5
Day2                 -3.2
Day20                -1.9
Day21                -1.0
Day22                -1.0
Day23                -3.0
Day24                 0.3
Day25                -1.9
Day26                 0.0
Day27                 0.1
Day28                -1.7
Day29                -9.1
Day3                 -3.9
Day30                -4.7
Day31                 0.2
Day32                -2.2
Day33                -6.7
Day34                -3.4
Day35                -2.3
Day36                -3.2
Day37                -1.9
Day38                -0.4
Day39                -2.3
Day4                 -3.3
Day40                -3.5
Day41                -2.0
Day42                -4.5
Day5                 -1.8
Day6                 -2.1
Day7                  1.5
Day8                 -2.1
Day9                  0.0
Day1:Machine1        -2.2
Day1:Machine2         0.0
Day10:Machine1        1.0
Day10:Machine2        0.0
Day11:Machine1        6.0
Day11:Machine2        0.0
Day12:Machine1       -0.9
Day12:Machine2        0.0
Day13:Machine1        2.1
Day13:Machine2        0.0
Day14:Machine1        6.8
Day14:Machine2        0.0
```

```
Day15:Machine1                0.2
Day15:Machine2                0.0
Day16:Machine1               -1.8
Day16:Machine2                0.0
Day17:Machine1               -2.7
Day17:Machine2                0.0
Day18:Machine1               -2.6
Day18:Machine2                0.0
Day19:Machine1               -7.7
Day19:Machine2                0.0
Day2:Machine1                 0.1
Day2:Machine2                 0.0
Day20:Machine1               -2.2
Day20:Machine2                0.0
Day21:Machine1                0.4
Day21:Machine2                0.0
Day22:Machine1               -1.9
Day22:Machine2                0.0
Day23:Machine1               -0.7
Day23:Machine2                0.0
Day24:Machine1                1.0
Day24:Machine2                0.0
Day25:Machine1                0.2
Day25:Machine2                0.0
Day26:Machine1                1.3
Day26:Machine2                0.0
Day27:Machine1               -0.6
Day27:Machine2                0.0
Day28:Machine1               -4.5
Day28:Machine2                0.0
Day29:Machine1                4.4
Day29:Machine2                0.0
Day3:Machine1                 0.6
Day3:Machine2                 0.0
Day30:Machine1                2.0
Day30:Machine2                0.0
Day31:Machine1                1.0
Day31:Machine2                0.0
Day32:Machine1                1.3
Day32:Machine2                0.0
Day33:Machine1                6.0
Day33:Machine2                0.0
Day34:Machine1               -0.7
Day34:Machine2                0.0
Day35:Machine1               -1.2
Day35:Machine2                0.0
Day36:Machine1               -3.7
Day36:Machine2                0.0
```

```
Day37:Machine1                  -0.7
Day37:Machine2                   0.0
Day38:Machine1                   0.3
Day38:Machine2                   0.0
Day39:Machine1                   1.3
Day39:Machine2                   0.0
Day4:Machine1                   -1.5
Day4:Machine2                    0.0
Day40:Machine1                  -0.8
Day40:Machine2                   0.0
Day41:Machine1                  -1.6
Day41:Machine2                   0.0
Day42:Machine1                   0.8
Day42:Machine2                   0.0
Day5:Machine1                   -7.2
Day5:Machine2                    0.0
Day6:Machine1                   -5.2
Day6:Machine2                    0.0
Day7:Machine1                   -1.1
Day7:Machine2                    0.0
Day8:Machine1                   -2.4
Day8:Machine2                    0.0
Day9:Machine1                   -0.8
Day9:Machine2                    0.0
Day1:Machine1:Analyst1           0.0
Day1:Machine1:Analyst2           0.0
Day1:Machine2:Analyst1           0.0
Day1:Machine2:Analyst2           0.0
Day10:Machine1:Analyst1          0.3
Day10:Machine1:Analyst2          0.0
Day10:Machine2:Analyst1          0.0
Day10:Machine2:Analyst2          0.0
Day11:Machine1:Analyst1         -1.6
Day11:Machine1:Analyst2          0.0
Day11:Machine2:Analyst1          0.0
Day11:Machine2:Analyst2          0.0
Day12:Machine1:Analyst1          1.8
Day12:Machine1:Analyst2          0.0
Day12:Machine2:Analyst1          0.0
Day12:Machine2:Analyst2          0.0
Day13:Machine1:Analyst1          0.5
Day13:Machine1:Analyst2          0.0
Day13:Machine2:Analyst1          0.0
Day13:Machine2:Analyst2          0.0
Day14:Machine1:Analyst1         -0.9
Day14:Machine1:Analyst2          0.0
Day14:Machine2:Analyst1          0.0
Day14:Machine2:Analyst2          0.0
```

```
Day15:Machine1:Analyst1          -1.2
Day15:Machine1:Analyst2           0.0
Day15:Machine2:Analyst1           0.0
Day15:Machine2:Analyst2           0.0
Day16:Machine1:Analyst1           0.5
Day16:Machine1:Analyst2           0.0
Day16:Machine2:Analyst1           0.0
Day16:Machine2:Analyst2           0.0
Day17:Machine1:Analyst1          -0.7
Day17:Machine1:Analyst2           0.0
Day17:Machine2:Analyst1           0.0
Day17:Machine2:Analyst2           0.0
Day18:Machine1:Analyst1           0.0
Day18:Machine1:Analyst2           0.0
Day18:Machine2:Analyst1           0.0
Day18:Machine2:Analyst2           0.0
Day19:Machine1:Analyst1           4.0
Day19:Machine1:Analyst2           0.0
Day19:Machine2:Analyst1           0.0
Day19:Machine2:Analyst2           0.0
Day2:Machine1:Analyst1            1.4
Day2:Machine1:Analyst2            0.0
Day2:Machine2:Analyst1            0.0
Day2:Machine2:Analyst2            0.0
Day20:Machine1:Analyst1           2.8
Day20:Machine1:Analyst2           0.0
Day20:Machine2:Analyst1           0.0
Day20:Machine2:Analyst2           0.0
Day21:Machine1:Analyst1          -1.2
Day21:Machine1:Analyst2           0.0
Day21:Machine2:Analyst1           0.0
Day21:Machine2:Analyst2           0.0
Day22:Machine1:Analyst1          -0.7
Day22:Machine1:Analyst2           0.0
Day22:Machine2:Analyst1           0.0
Day22:Machine2:Analyst2           0.0
Day23:Machine1:Analyst1           1.2
Day23:Machine1:Analyst2           0.0
Day23:Machine2:Analyst1           0.0
Day23:Machine2:Analyst2           0.0
Day24:Machine1:Analyst1          -0.4
Day24:Machine1:Analyst2           0.0
Day24:Machine2:Analyst1           0.0
Day24:Machine2:Analyst2           0.0
Day25:Machine1:Analyst1           0.8
Day25:Machine1:Analyst2           0.0
Day25:Machine2:Analyst1           0.0
Day25:Machine2:Analyst2           0.0
```

```
Day26:Machine1:Analyst1          -2.0
Day26:Machine1:Analyst2           0.0
Day26:Machine2:Analyst1           0.0
Day26:Machine2:Analyst2           0.0
Day27:Machine1:Analyst1          -0.2
Day27:Machine1:Analyst2           0.0
Day27:Machine2:Analyst1           0.0
Day27:Machine2:Analyst2           0.0
Day28:Machine1:Analyst1           2.2
Day28:Machine1:Analyst2           0.0
Day28:Machine2:Analyst1           0.0
Day28:Machine2:Analyst2           0.0
Day29:Machine1:Analyst1           0.4
Day29:Machine1:Analyst2           0.0
Day29:Machine2:Analyst1           0.0
Day29:Machine2:Analyst2           0.0
Day3:Machine1:Analyst1           -1.3
Day3:Machine1:Analyst2            0.0
Day3:Machine2:Analyst1            0.0
Day3:Machine2:Analyst2            0.0
Day30:Machine1:Analyst1          -1.6
Day30:Machine1:Analyst2           0.0
Day30:Machine2:Analyst1           0.0
Day30:Machine2:Analyst2           0.0
Day31:Machine1:Analyst1          -3.3
Day31:Machine1:Analyst2           0.0
Day31:Machine2:Analyst1           0.0
Day31:Machine2:Analyst2           0.0
Day32:Machine1:Analyst1           1.3
Day32:Machine1:Analyst2           0.0
Day32:Machine2:Analyst1           0.0
Day32:Machine2:Analyst2           0.0
Day33:Machine1:Analyst1           0.0
Day33:Machine1:Analyst2           0.0
Day33:Machine2:Analyst1           0.0
Day33:Machine2:Analyst2           0.0
Day34:Machine1:Analyst1           3.2
Day34:Machine1:Analyst2           0.0
Day34:Machine2:Analyst1           0.0
Day34:Machine2:Analyst2           0.0
Day35:Machine1:Analyst1           0.6
Day35:Machine1:Analyst2           0.0
Day35:Machine2:Analyst1           0.0
Day35:Machine2:Analyst2           0.0
Day36:Machine1:Analyst1           2.4
Day36:Machine1:Analyst2           0.0
Day36:Machine2:Analyst1           0.0
Day36:Machine2:Analyst2           0.0
```

```
Day37:Machine1:Analyst1           1.4
Day37:Machine1:Analyst2           0.0
Day37:Machine2:Analyst1           0.0
Day37:Machine2:Analyst2           0.0
Day38:Machine1:Analyst1          -0.2
Day38:Machine1:Analyst2           0.0
Day38:Machine2:Analyst1           0.0
Day38:Machine2:Analyst2           0.0
Day39:Machine1:Analyst1          -0.3
Day39:Machine1:Analyst2           0.0
Day39:Machine2:Analyst1           0.0
Day39:Machine2:Analyst2           0.0
Day4:Machine1:Analyst1            0.7
Day4:Machine1:Analyst2            0.0
Day4:Machine2:Analyst1            0.0
Day4:Machine2:Analyst2            0.0
Day40:Machine1:Analyst1           1.0
Day40:Machine1:Analyst2           0.0
Day40:Machine2:Analyst1           0.0
Day40:Machine2:Analyst2           0.0
Day41:Machine1:Analyst1          -0.5
Day41:Machine1:Analyst2           0.0
Day41:Machine2:Analyst1           0.0
Day41:Machine2:Analyst2           0.0
Day42:Machine1:Analyst1           1.2
Day42:Machine1:Analyst2           0.0
Day42:Machine2:Analyst1           0.0
Day42:Machine2:Analyst2           0.0
Day5:Machine1:Analyst1            4.8
Day5:Machine1:Analyst2            0.0
Day5:Machine2:Analyst1            0.0
Day5:Machine2:Analyst2            0.0
Day6:Machine1:Analyst1            5.0
Day6:Machine1:Analyst2            0.0
Day6:Machine2:Analyst1            0.0
Day6:Machine2:Analyst2            0.0
Day7:Machine1:Analyst1           -1.9
Day7:Machine1:Analyst2            0.0
Day7:Machine2:Analyst1            0.0
Day7:Machine2:Analyst2            0.0
Day8:Machine1:Analyst1            1.2
Day8:Machine1:Analyst2            0.0
Day8:Machine2:Analyst1            0.0
Day8:Machine2:Analyst2            0.0
Day9:Machine1:Analyst1            0.4
Day9:Machine1:Analyst2            0.0
Day9:Machine2:Analyst1            0.0
Day9:Machine2:Analyst2            0.0
```

```
Day1:Machine1:Analyst1:Test1      -0.5
Day1:Machine1:Analyst1:Test2       0.0
Day1:Machine1:Analyst2:Test1       0.0
Day1:Machine1:Analyst2:Test2       0.0
Day1:Machine2:Analyst1:Test1       0.0
Day1:Machine2:Analyst1:Test2       0.0
Day1:Machine2:Analyst2:Test1       0.0
Day1:Machine2:Analyst2:Test2       0.0
Day10:Machine1:Analyst1:Test1     -0.9
Day10:Machine1:Analyst1:Test2      0.0
Day10:Machine1:Analyst2:Test1      0.0
Day10:Machine1:Analyst2:Test2      0.0
Day10:Machine2:Analyst1:Test1      0.0
Day10:Machine2:Analyst1:Test2      0.0
Day10:Machine2:Analyst2:Test1      0.0
Day10:Machine2:Analyst2:Test2      0.0
Day11:Machine1:Analyst1:Test1      2.1
Day11:Machine1:Analyst1:Test2      0.0
Day11:Machine1:Analyst2:Test1      0.0
Day11:Machine1:Analyst2:Test2      0.0
Day11:Machine2:Analyst1:Test1      0.0
Day11:Machine2:Analyst1:Test2      0.0
Day11:Machine2:Analyst2:Test1      0.0
Day11:Machine2:Analyst2:Test2      0.0
Day12:Machine1:Analyst1:Test1     -2.3
Day12:Machine1:Analyst1:Test2      0.0
Day12:Machine1:Analyst2:Test1      0.0
Day12:Machine1:Analyst2:Test2      0.0
Day12:Machine2:Analyst1:Test1      0.0
Day12:Machine2:Analyst1:Test2      0.0
Day12:Machine2:Analyst2:Test1      0.0
Day12:Machine2:Analyst2:Test2      0.0
Day13:Machine1:Analyst1:Test1      1.2
Day13:Machine1:Analyst1:Test2      0.0
Day13:Machine1:Analyst2:Test1      0.0
Day13:Machine1:Analyst2:Test2      0.0
Day13:Machine2:Analyst1:Test1      0.0
Day13:Machine2:Analyst1:Test2      0.0
Day13:Machine2:Analyst2:Test1      0.0
Day13:Machine2:Analyst2:Test2      0.0
Day14:Machine1:Analyst1:Test1      2.2
Day14:Machine1:Analyst1:Test2      0.0
Day14:Machine1:Analyst2:Test1      0.0
Day14:Machine1:Analyst2:Test2      0.0
Day14:Machine2:Analyst1:Test1      0.0
Day14:Machine2:Analyst1:Test2      0.0
Day14:Machine2:Analyst2:Test1      0.0
Day14:Machine2:Analyst2:Test2      0.0
```

```
Day15:Machine1:Analyst1:Test1      0.6
Day15:Machine1:Analyst1:Test2      0.0
Day15:Machine1:Analyst2:Test1      0.0
Day15:Machine1:Analyst2:Test2      0.0
Day15:Machine2:Analyst1:Test1      0.0
Day15:Machine2:Analyst1:Test2      0.0
Day15:Machine2:Analyst2:Test1      0.0
Day15:Machine2:Analyst2:Test2      0.0
Day16:Machine1:Analyst1:Test1     -1.6
Day16:Machine1:Analyst1:Test2      0.0
Day16:Machine1:Analyst2:Test1      0.0
Day16:Machine1:Analyst2:Test2      0.0
Day16:Machine2:Analyst1:Test1      0.0
Day16:Machine2:Analyst1:Test2      0.0
Day16:Machine2:Analyst2:Test1      0.0
Day16:Machine2:Analyst2:Test2      0.0
Day17:Machine1:Analyst1:Test1     -1.0
Day17:Machine1:Analyst1:Test2      0.0
Day17:Machine1:Analyst2:Test1      0.0
Day17:Machine1:Analyst2:Test2      0.0
Day17:Machine2:Analyst1:Test1      0.0
Day17:Machine2:Analyst1:Test2      0.0
Day17:Machine2:Analyst2:Test1      0.0
Day17:Machine2:Analyst2:Test2      0.0
Day18:Machine1:Analyst1:Test1      2.3
Day18:Machine1:Analyst1:Test2      0.0
Day18:Machine1:Analyst2:Test1      0.0
Day18:Machine1:Analyst2:Test2      0.0
Day18:Machine2:Analyst1:Test1      0.0
Day18:Machine2:Analyst1:Test2      0.0
Day18:Machine2:Analyst2:Test1      0.0
Day18:Machine2:Analyst2:Test2      0.0
Day19:Machine1:Analyst1:Test1      4.4
Day19:Machine1:Analyst1:Test2      0.0
Day19:Machine1:Analyst2:Test1      0.0
Day19:Machine1:Analyst2:Test2      0.0
Day19:Machine2:Analyst1:Test1      0.0
Day19:Machine2:Analyst1:Test2      0.0
Day19:Machine2:Analyst2:Test1      0.0
Day19:Machine2:Analyst2:Test2      0.0
Day2:Machine1:Analyst1:Test1      -1.1
Day2:Machine1:Analyst1:Test2       0.0
Day2:Machine1:Analyst2:Test1       0.0
Day2:Machine1:Analyst2:Test2       0.0
Day2:Machine2:Analyst1:Test1       0.0
Day2:Machine2:Analyst1:Test2       0.0
Day2:Machine2:Analyst2:Test1       0.0
Day2:Machine2:Analyst2:Test2       0.0
```

```
Day20:Machine1:Analyst1:Test1      0.3
Day20:Machine1:Analyst1:Test2      0.0
Day20:Machine1:Analyst2:Test1      0.0
Day20:Machine1:Analyst2:Test2      0.0
Day20:Machine2:Analyst1:Test1      0.0
Day20:Machine2:Analyst1:Test2      0.0
Day20:Machine2:Analyst2:Test1      0.0
Day20:Machine2:Analyst2:Test2      0.0
Day21:Machine1:Analyst1:Test1     -0.4
Day21:Machine1:Analyst1:Test2      0.0
Day21:Machine1:Analyst2:Test1      0.0
Day21:Machine1:Analyst2:Test2      0.0
Day21:Machine2:Analyst1:Test1      0.0
Day21:Machine2:Analyst1:Test2      0.0
Day21:Machine2:Analyst2:Test1      0.0
Day21:Machine2:Analyst2:Test2      0.0
Day22:Machine1:Analyst1:Test1     -2.0
Day22:Machine1:Analyst1:Test2      0.0
Day22:Machine1:Analyst2:Test1      0.0
Day22:Machine1:Analyst2:Test2      0.0
Day22:Machine2:Analyst1:Test1      0.0
Day22:Machine2:Analyst1:Test2      0.0
Day22:Machine2:Analyst2:Test1      0.0
Day22:Machine2:Analyst2:Test2      0.0
Day23:Machine1:Analyst1:Test1     -0.3
Day23:Machine1:Analyst1:Test2      0.0
Day23:Machine1:Analyst2:Test1      0.0
Day23:Machine1:Analyst2:Test2      0.0
Day23:Machine2:Analyst1:Test1      0.0
Day23:Machine2:Analyst1:Test2      0.0
Day23:Machine2:Analyst2:Test1      0.0
Day23:Machine2:Analyst2:Test2      0.0
Day24:Machine1:Analyst1:Test1     -2.6
Day24:Machine1:Analyst1:Test2      0.0
Day24:Machine1:Analyst2:Test1      0.0
Day24:Machine1:Analyst2:Test2      0.0
Day24:Machine2:Analyst1:Test1      0.0
Day24:Machine2:Analyst1:Test2      0.0
Day24:Machine2:Analyst2:Test1      0.0
Day24:Machine2:Analyst2:Test2      0.0
Day25:Machine1:Analyst1:Test1     -1.0
Day25:Machine1:Analyst1:Test2      0.0
Day25:Machine1:Analyst2:Test1      0.0
Day25:Machine1:Analyst2:Test2      0.0
Day25:Machine2:Analyst1:Test1      0.0
Day25:Machine2:Analyst1:Test2      0.0
Day25:Machine2:Analyst2:Test1      0.0
Day25:Machine2:Analyst2:Test2      0.0
```

```
Day26:Machine1:Analyst1:Test1     -0.3
Day26:Machine1:Analyst1:Test2      0.0
Day26:Machine1:Analyst2:Test1      0.0
Day26:Machine1:Analyst2:Test2      0.0
Day26:Machine2:Analyst1:Test1      0.0
Day26:Machine2:Analyst1:Test2      0.0
Day26:Machine2:Analyst2:Test1      0.0
Day26:Machine2:Analyst2:Test2      0.0
Day27:Machine1:Analyst1:Test1     -3.6
Day27:Machine1:Analyst1:Test2      0.0
Day27:Machine1:Analyst2:Test1      0.0
Day27:Machine1:Analyst2:Test2      0.0
Day27:Machine2:Analyst1:Test1      0.0
Day27:Machine2:Analyst1:Test2      0.0
Day27:Machine2:Analyst2:Test1      0.0
Day27:Machine2:Analyst2:Test2      0.0
Day28:Machine1:Analyst1:Test1      4.2
Day28:Machine1:Analyst1:Test2      0.0
Day28:Machine1:Analyst2:Test1      0.0
Day28:Machine1:Analyst2:Test2      0.0
Day28:Machine2:Analyst1:Test1      0.0
Day28:Machine2:Analyst1:Test2      0.0
Day28:Machine2:Analyst2:Test1      0.0
Day28:Machine2:Analyst2:Test2      0.0
Day29:Machine1:Analyst1:Test1     -1.0
Day29:Machine1:Analyst1:Test2      0.0
Day29:Machine1:Analyst2:Test1      0.0
Day29:Machine1:Analyst2:Test2      0.0
Day29:Machine2:Analyst1:Test1      0.0
Day29:Machine2:Analyst1:Test2      0.0
Day29:Machine2:Analyst2:Test1      0.0
Day29:Machine2:Analyst2:Test2      0.0
Day3:Machine1:Analyst1:Test1       1.9
Day3:Machine1:Analyst1:Test2       0.0
Day3:Machine1:Analyst2:Test1       0.0
Day3:Machine1:Analyst2:Test2       0.0
Day3:Machine2:Analyst1:Test1       0.0
Day3:Machine2:Analyst1:Test2       0.0
Day3:Machine2:Analyst2:Test1       0.0
Day3:Machine2:Analyst2:Test2       0.0
Day30:Machine1:Analyst1:Test1      1.0
Day30:Machine1:Analyst1:Test2      0.0
Day30:Machine1:Analyst2:Test1      0.0
Day30:Machine1:Analyst2:Test2      0.0
Day30:Machine2:Analyst1:Test1      0.0
Day30:Machine2:Analyst1:Test2      0.0
Day30:Machine2:Analyst2:Test1      0.0
Day30:Machine2:Analyst2:Test2      0.0
```

```
Day31:Machine1:Analyst1:Test1      4.2
Day31:Machine1:Analyst1:Test2      0.0
Day31:Machine1:Analyst2:Test1      0.0
Day31:Machine1:Analyst2:Test2      0.0
Day31:Machine2:Analyst1:Test1      0.0
Day31:Machine2:Analyst1:Test2      0.0
Day31:Machine2:Analyst2:Test1      0.0
Day31:Machine2:Analyst2:Test2      0.0
Day32:Machine1:Analyst1:Test1      0.4
Day32:Machine1:Analyst1:Test2      0.0
Day32:Machine1:Analyst2:Test1      0.0
Day32:Machine1:Analyst2:Test2      0.0
Day32:Machine2:Analyst1:Test1      0.0
Day32:Machine2:Analyst1:Test2      0.0
Day32:Machine2:Analyst2:Test1      0.0
Day32:Machine2:Analyst2:Test2      0.0
Day33:Machine1:Analyst1:Test1      3.6
Day33:Machine1:Analyst1:Test2      0.0
Day33:Machine1:Analyst2:Test1      0.0
Day33:Machine1:Analyst2:Test2      0.0
Day33:Machine2:Analyst1:Test1      0.0
Day33:Machine2:Analyst1:Test2      0.0
Day33:Machine2:Analyst2:Test1      0.0
Day33:Machine2:Analyst2:Test2      0.0
Day34:Machine1:Analyst1:Test1     -0.4
Day34:Machine1:Analyst1:Test2      0.0
Day34:Machine1:Analyst2:Test1      0.0
Day34:Machine1:Analyst2:Test2      0.0
Day34:Machine2:Analyst1:Test1      0.0
Day34:Machine2:Analyst1:Test2      0.0
Day34:Machine2:Analyst2:Test1      0.0
Day34:Machine2:Analyst2:Test2      0.0
Day35:Machine1:Analyst1:Test1     -1.9
Day35:Machine1:Analyst1:Test2      0.0
Day35:Machine1:Analyst2:Test1      0.0
Day35:Machine1:Analyst2:Test2      0.0
Day35:Machine2:Analyst1:Test1      0.0
Day35:Machine2:Analyst1:Test2      0.0
Day35:Machine2:Analyst2:Test1      0.0
Day35:Machine2:Analyst2:Test2      0.0
Day36:Machine1:Analyst1:Test1     -0.3
Day36:Machine1:Analyst1:Test2      0.0
Day36:Machine1:Analyst2:Test1      0.0
Day36:Machine1:Analyst2:Test2      0.0
Day36:Machine2:Analyst1:Test1      0.0
Day36:Machine2:Analyst1:Test2      0.0
Day36:Machine2:Analyst2:Test1      0.0
Day36:Machine2:Analyst2:Test2      0.0
```

```
Day37:Machine1:Analyst1:Test1     -0.9
Day37:Machine1:Analyst1:Test2      0.0
Day37:Machine1:Analyst2:Test1      0.0
Day37:Machine1:Analyst2:Test2      0.0
Day37:Machine2:Analyst1:Test1      0.0
Day37:Machine2:Analyst1:Test2      0.0
Day37:Machine2:Analyst2:Test1      0.0
Day37:Machine2:Analyst2:Test2      0.0
Day38:Machine1:Analyst1:Test1      0.0
Day38:Machine1:Analyst1:Test2      0.0
Day38:Machine1:Analyst2:Test1      0.0
Day38:Machine1:Analyst2:Test2      0.0
Day38:Machine2:Analyst1:Test1      0.0
Day38:Machine2:Analyst1:Test2      0.0
Day38:Machine2:Analyst2:Test1      0.0
Day38:Machine2:Analyst2:Test2      0.0
Day39:Machine1:Analyst1:Test1     -1.4
Day39:Machine1:Analyst1:Test2      0.0
Day39:Machine1:Analyst2:Test1      0.0
Day39:Machine1:Analyst2:Test2      0.0
Day39:Machine2:Analyst1:Test1      0.0
Day39:Machine2:Analyst1:Test2      0.0
Day39:Machine2:Analyst2:Test1      0.0
Day39:Machine2:Analyst2:Test2      0.0
Day4:Machine1:Analyst1:Test1       2.1
Day4:Machine1:Analyst1:Test2       0.0
Day4:Machine1:Analyst2:Test1       0.0
Day4:Machine1:Analyst2:Test2       0.0
Day4:Machine2:Analyst1:Test1       0.0
Day4:Machine2:Analyst1:Test2       0.0
Day4:Machine2:Analyst2:Test1       0.0
Day4:Machine2:Analyst2:Test2       0.0
Day40:Machine1:Analyst1:Test1      0.9
Day40:Machine1:Analyst1:Test2      0.0
Day40:Machine1:Analyst2:Test1      0.0
Day40:Machine1:Analyst2:Test2      0.0
Day40:Machine2:Analyst1:Test1      0.0
Day40:Machine2:Analyst1:Test2      0.0
Day40:Machine2:Analyst2:Test1      0.0
Day40:Machine2:Analyst2:Test2      0.0
Day41:Machine1:Analyst1:Test1     -0.6
Day41:Machine1:Analyst1:Test2      0.0
Day41:Machine1:Analyst2:Test1      0.0
Day41:Machine1:Analyst2:Test2      0.0
Day41:Machine2:Analyst1:Test1      0.0
Day41:Machine2:Analyst1:Test2      0.0
Day41:Machine2:Analyst2:Test1      0.0
Day41:Machine2:Analyst2:Test2      0.0
```

```
Day42:Machine1:Analyst1:Test1     -0.4
Day42:Machine1:Analyst1:Test2      0.0
Day42:Machine1:Analyst2:Test1      0.0
Day42:Machine1:Analyst2:Test2      0.0
Day42:Machine2:Analyst1:Test1      0.0
Day42:Machine2:Analyst1:Test2      0.0
Day42:Machine2:Analyst2:Test1      0.0
Day42:Machine2:Analyst2:Test2      0.0
Day5:Machine1:Analyst1:Test1       1.0
Day5:Machine1:Analyst1:Test2       0.0
Day5:Machine1:Analyst2:Test1       0.0
Day5:Machine1:Analyst2:Test2       0.0
Day5:Machine2:Analyst1:Test1       0.0
Day5:Machine2:Analyst1:Test2       0.0
Day5:Machine2:Analyst2:Test1       0.0
Day5:Machine2:Analyst2:Test2       0.0
Day6:Machine1:Analyst1:Test1      -0.5
Day6:Machine1:Analyst1:Test2       0.0
Day6:Machine1:Analyst2:Test1       0.0
Day6:Machine1:Analyst2:Test2       0.0
Day6:Machine2:Analyst1:Test1       0.0
Day6:Machine2:Analyst1:Test2       0.0
Day6:Machine2:Analyst2:Test1       0.0
Day6:Machine2:Analyst2:Test2       0.0
Day7:Machine1:Analyst1:Test1       0.0
Day7:Machine1:Analyst1:Test2       0.0
Day7:Machine1:Analyst2:Test1       0.0
Day7:Machine1:Analyst2:Test2       0.0
Day7:Machine2:Analyst1:Test1       0.0
Day7:Machine2:Analyst1:Test2       0.0
Day7:Machine2:Analyst2:Test1       0.0
Day7:Machine2:Analyst2:Test2       0.0
Day8:Machine1:Analyst1:Test1       1.0
Day8:Machine1:Analyst1:Test2       0.0
Day8:Machine1:Analyst2:Test1       0.0
Day8:Machine1:Analyst2:Test2       0.0
Day8:Machine2:Analyst1:Test1       0.0
Day8:Machine2:Analyst1:Test2       0.0
Day8:Machine2:Analyst2:Test1       0.0
Day8:Machine2:Analyst2:Test2       0.0
Day9:Machine1:Analyst1:Test1       0.1
Day9:Machine1:Analyst1:Test2       0.0
Day9:Machine1:Analyst2:Test1       0.0
Day9:Machine1:Analyst2:Test2       0.0
Day9:Machine2:Analyst1:Test1       0.0
Day9:Machine2:Analyst1:Test2       0.0
Day9:Machine2:Analyst2:Test1       0.0
Day9:Machine2:Analyst2:Test2       0.0
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ Day/Machine/Analyst/Test, Snee), type=3, singular.ok=TRUE)
```

# 4 Goodnight

## 4.1 Type I SS

### 4.1.1 p7

(7) MODEL

```
p7 = read.csv("C:/G/Rt/ANOVA/Goodnight-p7.csv")
p7 = af(p7, c("A", "B"))
GLM(y ~ A + B + A:B, p7)
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            3 13.6027  4.5342   2.807 0.1721
RESIDUALS        4  6.4613  1.6153
CORRECTED TOTAL  7 20.0639

$`Type I`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A    1 10.8113 10.8113  6.6929 0.06087 .
B    1  1.3122  1.3122  0.8123 0.41839
A:B  1  1.4792  1.4792  0.9157 0.39279
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A    1 10.8113 10.8113  6.6929 0.06087 .
B    1  1.3122  1.3122  0.8123 0.41839
A:B  1  1.4792  1.4792  0.9157 0.39279
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A    1 10.8113 10.8113  6.6929 0.06087 .
B    1  1.3122  1.3122  0.8123 0.41839
A:B  1  1.4792  1.4792  0.9157 0.39279
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    6.610     0.8987  7.3551  0.00182 **
A1            -1.465     1.2710 -1.1527  0.31324
```

```
A2             0.000     0.0000
B1             0.050     1.2710  0.0393  0.97050
B2             0.000     0.0000
A1:B1         -1.720     1.7974 -0.9569  0.39279
A1:B2          0.000     0.0000
A2:B1          0.000     0.0000
A2:B2          0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(8) MODEL

```
GLM(y ~ A + A:B + B, p7)
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            3 13.6027  4.5342   2.807 0.1721
RESIDUALS        4  6.4613  1.6153
CORRECTED TOTAL  7 20.0639

$`Type I`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A    1 10.8113 10.8113  6.6929 0.06087 .
A:B  2  2.7914  1.3957  0.8640 0.48764
B    0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A    1 10.8113 10.8113  6.6929 0.06087 .
A:B  1  1.4792  1.4792  0.9157 0.39279
B    1  1.3122  1.3122  0.8123 0.41839
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A    1 10.8113 10.8113  6.6929 0.06087 .
A:B  1  1.4792  1.4792  0.9157 0.39279
B    1  1.3122  1.3122  0.8123 0.41839
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value Pr(>|t|)
```

```
(Intercept)    6.610     0.8987  7.3551  0.00182 **
A1            -1.465     1.2710 -1.1527  0.31324
A2             0.000     0.0000
A1:B1         -1.670     1.2710 -1.3140  0.25914
A1:B2          0.000     0.0000
A2:B1          0.050     1.2710  0.0393  0.97050
A2:B2          0.000     0.0000
B1             0.000     0.0000
B2             0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(9) MODEL

```
GLM(y ~ B + A + A:B, p7)
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            3 13.6027  4.5342   2.807 0.1721
RESIDUALS        4  6.4613  1.6153
CORRECTED TOTAL  7 20.0639

$`Type I`
    Df  Sum Sq Mean Sq F value  Pr(>F)
B    1  1.3122  1.3122  0.8123 0.41839
A    1 10.8113 10.8113  6.6929 0.06087 .
B:A  1  1.4792  1.4792  0.9157 0.39279
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df  Sum Sq Mean Sq F value  Pr(>F)
B    1  1.3122  1.3122  0.8123 0.41839
A    1 10.8113 10.8113  6.6929 0.06087 .
B:A  1  1.4792  1.4792  0.9157 0.39279
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value  Pr(>F)
B    1  1.3122  1.3122  0.8123 0.41839
A    1 10.8113 10.8113  6.6929 0.06087 .
B:A  1  1.4792  1.4792  0.9157 0.39279
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    6.610     0.8987  7.3551  0.00182 **
B1             0.050     1.2710  0.0393  0.97050
B2             0.000     0.0000
A1            -1.465     1.2710 -1.1527  0.31324
A2             0.000     0.0000
B1:A1         -1.720     1.7974 -0.9569  0.39279
B1:A2          0.000     0.0000
B2:A1          0.000     0.0000
B2:A2          0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(10) MODEL

```
GLM(y ~ B + A:B + A, p7)
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            3 13.6027  4.5342   2.807 0.1721
RESIDUALS        4  6.4613  1.6153
CORRECTED TOTAL  7 20.0639

$`Type I`
    Df  Sum Sq Mean Sq F value Pr(>F)
B    1  1.3122  1.3122  0.8123 0.4184
B:A  2 12.2905  6.1452  3.8043 0.1187
A    0

$`Type II`
    Df  Sum Sq Mean Sq F value  Pr(>F)
B    1  1.3122  1.3122  0.8123 0.41839
B:A  1  1.4792  1.4792  0.9157 0.39279
A    1 10.8113 10.8113  6.6929 0.06087 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value  Pr(>F)
B    1  1.3122  1.3122  0.8123 0.41839
B:A  1  1.4792  1.4792  0.9157 0.39279
A    1 10.8113 10.8113  6.6929 0.06087 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    6.610     0.8987  7.3551  0.00182 **
B1             0.050     1.2710  0.0393  0.97050
B2             0.000     0.0000
B1:A1         -3.185     1.2710 -2.5060  0.06634 .
B1:A2          0.000     0.0000
B2:A1         -1.465     1.2710 -1.1527  0.31324
B2:A2          0.000     0.0000
A1             0.000     0.0000
A2             0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(11) MODEL

```
GLM(y ~ A:B + A + B, p7)
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            3 13.6027  4.5342   2.807 0.1721
RESIDUALS        4  6.4613  1.6153
CORRECTED TOTAL  7 20.0639

$`Type I`
    Df Sum Sq Mean Sq F value Pr(>F)
A:B  3 13.603  4.5342   2.807 0.1721
A    0
B    0

$`Type II`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A:B  1  1.4792  1.4792  0.9157 0.39279
A    1 10.8113 10.8113  6.6929 0.06087 .
B    1  1.3122  1.3122  0.8123 0.41839
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A:B  1  1.4792  1.4792  0.9157 0.39279
A    1 10.8113 10.8113  6.6929 0.06087 .
B    1  1.3122  1.3122  0.8123 0.41839
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    6.610     0.8987  7.3551  0.00182 **
A1:B1         -3.135     1.2710 -2.4667  0.06920 .
A1:B2         -1.465     1.2710 -1.1527  0.31324
A2:B1          0.050     1.2710  0.0393  0.97050
A2:B2          0.000     0.0000
A1             0.000     0.0000
A2             0.000     0.0000
B1             0.000     0.0000
B2             0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(12) MODEL

```
GLM(y ~ A:B + A + B, p7)
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            3 13.6027  4.5342   2.807 0.1721
RESIDUALS        4  6.4613  1.6153
CORRECTED TOTAL  7 20.0639

$`Type I`
    Df Sum Sq Mean Sq F value Pr(>F)
A:B  3 13.603  4.5342   2.807 0.1721
A    0
B    0

$`Type II`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A:B  1  1.4792  1.4792  0.9157 0.39279
A    1 10.8113 10.8113  6.6929 0.06087 .
B    1  1.3122  1.3122  0.8123 0.41839
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value  Pr(>F)
A:B  1  1.4792  1.4792  0.9157 0.39279
A    1 10.8113 10.8113  6.6929 0.06087 .
B    1  1.3122  1.3122  0.8123 0.41839
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    6.610     0.8987  7.3551  0.00182 **
A1:B1         -3.135     1.2710 -2.4667  0.06920 .
A1:B2         -1.465     1.2710 -1.1527  0.31324
A2:B1          0.050     1.2710  0.0393  0.97050
A2:B2          0.000     0.0000
A1             0.000     0.0000
A2             0.000     0.0000
B1             0.000     0.0000
B2             0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 4.2 Type II SS

### 4.2.1 p14

(13) MODEL

```
GLM(y ~ A + B + A:B, p7[-8,]) # p16
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            3 12.7672  4.2557  2.0088 0.2906
RESIDUALS        3  6.3555  2.1185
CORRECTED TOTAL  6 19.1227

$`Type I`
    Df Sum Sq Mean Sq F value Pr(>F)
A    1 9.9567  9.9567  4.6999 0.1187
B    1 1.9225  1.9225  0.9075 0.4111
A:B  1 0.8880  0.8880  0.4192 0.5635

$`Type II`
    Df  Sum Sq Mean Sq F value Pr(>F)
A    1 11.1715 11.1715  5.2733 0.1053
B    1  1.9225  1.9225  0.9075 0.4111
A:B  1  0.8880  0.8880  0.4192 0.5635

$`Type III`
    Df Sum Sq Mean Sq F value Pr(>F)
A    1 9.5258  9.5258  4.4965 0.1241
B    1 1.3690  1.3690  0.6462 0.4803
A:B  1 0.8880  0.8880  0.4192 0.5635
```

```
$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    6.840     1.4555  4.6994  0.01823 *
A1            -1.695     1.7826 -0.9508  0.41183
A2             0.000     0.0000
B1            -0.180     1.7826 -0.1010  0.92594
B2             0.000     0.0000
A1:B1         -1.490     2.3014 -0.6474  0.56347
A1:B2          0.000     0.0000
A2:B1          0.000     0.0000
A2:B2          0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 4.2.2 p24

(14) MODEL

```r
p24 = read.csv("C:/G/Rt/ANOVA/Goodnight-p24.csv")
p24 = af(p24, c("A", "B", "C"))
GLM(Y ~ A + B + C, p24) # p27
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value  Pr(>F)
MODEL            6 45.924  7.6540  9.1615 0.00499 **
RESIDUALS        7  5.848  0.8354
CORRECTED TOTAL 13 51.772
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
  Df Sum Sq Mean Sq F value  Pr(>F)
A  1  4.724  4.7235  5.6538 0.04904 *
B  3 37.998 12.6660 15.1606 0.00191 **
C  2  3.203  1.6013  1.9167 0.21686
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
  Df Sum Sq Mean Sq F value Pr(>F)
A  0
B  2 0.4424  0.2212  0.2648 0.7747
C  2 3.2025  1.6013  1.9167 0.2169
```

```
$`Type III`
CAUTION: Singularity Exists !
  Df Sum Sq Mean Sq F value Pr(>F)
A  0
B  2 0.4424  0.2212  0.2648 0.7747
C  2 3.2026  1.6013  1.9167 0.2169

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   10.290    1.11945  9.1920 3.718e-05 ***
A1            -2.305    0.91403 -2.5218   0.03971 *
A2             0.000    0.00000
B1            -6.450    2.23891 -2.8809   0.02362 *
B2            -4.080    1.29263 -3.1563   0.01601 *
B3            -1.610    0.91403 -1.7614   0.12155
B4             0.000    0.00000
C1             1.065    2.23891  0.4757   0.64879
C2             1.760    1.29263  1.3616   0.21553
C3             0.000    0.00000
C4             0.000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 4.3 Type III SS

#### 4.3.1 p27

(15) MODEL

```
p27 = read.csv("C:/G/Rt/ANOVA/Goodnight-p27.csv")
p27 = af(p27, c("A", "B"))
GLM(y ~ A + B + A:B, p27) # p29
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value   Pr(>F)
MODEL            5 128.193 25.6386  53.469 6.77e-05 ***
RESIDUALS        6   2.877  0.4795
CORRECTED TOTAL 11 131.070
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value    Pr(>F)
A    2 89.580  44.790 93.4102 3.013e-05 ***
B    2 38.542  19.271 40.1901 0.0003351 ***
```

```
A:B  1  0.071   0.071  0.1471 0.7145464
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df  Sum Sq Mean Sq  F value    Pr(>F)
A    2 126.778  63.389 132.1977 1.093e-05 ***
B    2  38.542  19.271  40.1901 0.0003351 ***
A:B  1   0.071   0.071   0.1471 0.7145464
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq  F value    Pr(>F)
A    2 126.778  63.389 132.1977 1.093e-05 ***
B    2  38.542  19.271  40.1901 0.0003351 ***
A:B  1   0.071   0.071   0.1471 0.7145464
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   16.270    0.84809 19.1844 1.298e-06 ***
A1            -8.870    0.97929 -9.0576 0.0001015 ***
A2            -4.915    0.69246 -7.0979 0.0003927 ***
A3             0.000    0.00000
B1            -4.900    0.69246 -7.0762 0.0003993 ***
B2            -1.875    0.97929 -1.9147 0.1040334
B3             0.000    0.00000
A1:B1          0.000    0.00000
A1:B2         -0.460    1.19937 -0.3835 0.7145464
A1:B3          0.000    0.00000
A2:B1          0.000    0.00000
A2:B2          0.000    0.00000
A2:B3          0.000    0.00000
A3:B1          0.000    0.00000
A3:B2          0.000    0.00000
A3:B3          0.000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 4.3.2 p33

(16) MODEL

```r
p33 = read.csv("C:/G/Rt/ANOVA/Goodnight-p33.csv")
p33 = af(p33, c("A", "B"))
```

```r
GLM(y ~ A + B + A:B, p33) # p35
```

```
$ANOVA
Response : y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL            4 34.905  8.7261
RESIDUALS        0  0.000
CORRECTED TOTAL  4 34.905

$`Type I`
    Df  Sum Sq Mean Sq F value Pr(>F)
A    2 11.3739  5.6870
B    1 23.5225 23.5225
A:B  1  0.0081  0.0081

$`Type II`
    Df  Sum Sq Mean Sq F value Pr(>F)
A    1  3.0276  3.0276
B    1 23.5225 23.5225
A:B  1  0.0081  0.0081

$`Type III`
CAUTION: Singularity Exists !
    Df  Sum Sq Mean Sq F value Pr(>F)
A    1  3.0276  3.0276
B    1 23.5225 23.5225
A:B  1  0.0081  0.0081

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)     9.53        Inf       0
A1             -1.63        Inf       0
A2              0.02        Inf       0
A3              0.00
B1             -4.76        Inf       0
B2              0.00
B3              0.00
A1:B1          -0.18        Inf       0
A1:B2           0.00
A1:B3           0.00
A2:B1           0.00
A2:B2           0.00
A2:B3           0.00
A3:B1           0.00
A3:B2           0.00
A3:B3           0.00
```

```r
options(contrasts = c("contr.sum", "contr.poly"))
Anova(lm(y ~ A + B + A:B, p33), type=3, singular.ok=TRUE) # Error
```

# 5 SAS for Linear Models 4e

## 5.1 Chapter 2

### 5.1.1 p5

(17) MODEL

```
p5 = read.table("C:/G/Rt/SAS4lm/p5.txt", head=TRUE)
GLM(COST ~ CATTLE, p5) # p6 Output 2.2
```

```
$ANOVA
Response : COST
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            1 6582.1  6582.1   59.34 6.083e-07 ***
RESIDUALS       17 1885.7   110.9
CORRECTED TOTAL 18 8467.8
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 6582.1  6582.1   59.34 6.083e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 6582.1  6582.1   59.34 6.083e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
       Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 6582.1  6582.1   59.34 6.083e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   7.1965     4.3751  1.6449    0.1184
CATTLE        4.5640     0.5925  7.7032 6.083e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.1.2 p12

(18) MODEL

```
p12 = read.table("C:/G/Rt/SAS4lm/p12.txt", head=TRUE)
GLM(COST ~ CATTLE + CALVES + HOGS + SHEEP, p12)
```

```
$ANOVA
Response : COST
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            4 7936.7 1984.18   52.31 2.885e-08 ***
RESIDUALS       14  531.0   37.93
CORRECTED TOTAL 18 8467.8
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df Sum Sq Mean Sq  F value    Pr(>F)
CATTLE  1 6582.1  6582.1 173.5265 2.801e-09 ***
CALVES  1  186.7   186.7   4.9213 0.0435698 *
HOGS    1  489.9   489.9  12.9145 0.0029351 **
SHEEP   1  678.1   678.1  17.8773 0.0008431 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df  Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 2200.71 2200.71 58.0183 2.413e-06 ***
CALVES  1  136.08  136.08  3.5876 0.0790616 .
HOGS    1  113.66  113.66  2.9964 0.1054198
SHEEP   1  678.11  678.11 17.8773 0.0008431 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
       Df  Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 2200.71 2200.71 58.0183 2.413e-06 ***
CALVES  1  136.08  136.08  3.5876 0.0790616 .
HOGS    1  113.66  113.66  2.9964 0.1054198
SHEEP   1  678.11  678.11 17.8773 0.0008431 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   2.2884     3.3874  0.6756 0.5103160
CATTLE        3.2155     0.4222  7.6170 2.413e-06 ***
```

```
CALVES        1.6131     0.8517  1.8941 0.0790616 .
HOGS          0.8148     0.4707  1.7310 0.1054198
SHEEP         0.8026     0.1898  4.2282 0.0008431 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(19) MODEL

```
GLM(COST ~ CATTLE + CALVES + SHEEP, p12)
```

```
$ANOVA
Response : COST
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            3 7823.1 2607.69  60.673 1.281e-08 ***
RESIDUALS       15  644.7   42.98
CORRECTED TOTAL 18 8467.8
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df Sum Sq Mean Sq  F value    Pr(>F)
CATTLE  1 6582.1  6582.1 153.1443 2.835e-09 ***
CALVES  1  186.7   186.7   4.3432 0.0546701 .
SHEEP   1 1054.3  1054.3  24.5306 0.0001735 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 2519.8  2519.8 58.6265 1.471e-06 ***
CALVES  1  260.6   260.6  6.0634 0.0263909 *
SHEEP   1 1054.3  1054.3 24.5306 0.0001735 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
       Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 2519.8  2519.8 58.6265 1.471e-06 ***
CALVES  1  260.6   260.6  6.0634 0.0263909 *
SHEEP   1 1054.3  1054.3 24.5306 0.0001735 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   1.0709     3.5272  0.3036 0.7655951
CATTLE        3.3665     0.4397  7.6568 1.471e-06 ***
```

```
CALVES        2.1046     0.8547  2.4624 0.0263909 *
SHEEP         0.9267     0.1871  4.9528 0.0001735 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(20) MODEL

```
GLM(COST ~ CATTLE + CALVES + offset(1*HOGS) + SHEEP, p12)
```

```
$ANOVA
Response : COST
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            3 7823.1 2607.69  60.673 1.281e-08 ***
RESIDUALS       15  644.7   42.98
CORRECTED TOTAL 18 8467.8
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df Sum Sq Mean Sq  F value    Pr(>F)
CATTLE  1 6582.1  6582.1 153.1443 2.835e-09 ***
CALVES  1  186.7   186.7   4.3432 0.0546701 .
SHEEP   1 1054.3  1054.3  24.5306 0.0001735 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 2519.8  2519.8 58.6265 1.471e-06 ***
CALVES  1  260.6   260.6  6.0634 0.0263909 *
SHEEP   1 1054.3  1054.3 24.5306 0.0001735 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
       Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 2519.8  2519.8 58.6265 1.471e-06 ***
CALVES  1  260.6   260.6  6.0634 0.0263909 *
SHEEP   1 1054.3  1054.3 24.5306 0.0001735 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   1.0709     3.5272  0.3036 0.7655951
CATTLE        3.3665     0.4397  7.6568 1.471e-06 ***
CALVES        2.1046     0.8547  2.4624 0.0263909 *
```

```
SHEEP         0.9267     0.1871  4.9528 0.0001735 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(21) MODEL

```
GLM(COST ~ CATTLE + CALVES + I(HOGS + SHEEP), p12)
```

```
$ANOVA
Response : COST
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            3 7936.7  2645.6  74.726 3.011e-09 ***
RESIDUALS       15  531.1    35.4
CORRECTED TOTAL 18 8467.8
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
                Df Sum Sq Mean Sq  F value    Pr(>F)
CATTLE           1 6582.1  6582.1 185.9151 7.406e-10 ***
CALVES           1  186.7   186.7   5.2726   0.03649 *
I(HOGS + SHEEP)  1 1168.0  1168.0  32.9896 3.883e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
                Df  Sum Sq Mean Sq F value    Pr(>F)
CATTLE           1 2215.48 2215.48 62.5775 9.887e-07 ***
CALVES           1  155.03  155.03  4.3788    0.0538 .
I(HOGS + SHEEP)  1 1167.96 1167.96 32.9896 3.883e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
                Df  Sum Sq Mean Sq F value    Pr(>F)
CATTLE           1 2215.48 2215.48 62.5775 9.887e-07 ***
CALVES           1  155.03  155.03  4.3788    0.0538 .
I(HOGS + SHEEP)  1 1167.96 1167.96 32.9896 3.883e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                Estimate Std. Error t value  Pr(>|t|)
(Intercept)       2.2721     3.1899  0.7123    0.4872
CATTLE            3.2162     0.4066  7.9106 9.887e-07 ***
CALVES            1.6194     0.7739  2.0926    0.0538 .
I(HOGS + SHEEP)   0.8052     0.1402  5.7437 3.883e-05 ***
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(22) MODEL

```
REG(COST ~ CATTLE + CALVES + I(HOGS + SHEEP), p12, NOINT=TRUE)
```

```
                Estimate Std. Error t value  Pr(>|t|)
CATTLE            3.3000    0.38314  8.6131 2.100e-07 ***
CALVES            1.9672    0.59108  3.3281  0.004259 **
I(HOGS + SHEEP)   0.8068    0.13800  5.8466 2.479e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 5.2 Chapter 3

### 5.2.1 p63

(23) MODEL

```
p63w = read.table("C:/G/Rt/SAS4lm/p63.txt", header=TRUE)
p63l = reshape(p63w,
        direction = "long",
        varying = list(names(p63w)[2:9]),
        v.names = "fruitwt",
        idvar = c("irrig"),
        timevar = "bloc",
        times = 1:8)
p63l = af(p63l, c("bloc"))
GLM(fruitwt ~ bloc + irrig, p63l) # p64
```

```
$ANOVA
Response : fruitwt
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           11 445334   40485   12.04 6.643e-08 ***
RESIDUALS       28  94147    3362
CORRECTED TOTAL 39 539481
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
bloc   7 401308   57330 17.0503 1.452e-08 ***
irrig  4  44026   11006  3.2734   0.02539 *
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
bloc   7 401308   57330 17.0503 1.452e-08 ***
irrig  4  44026   11006  3.2734   0.02539 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
bloc   7 401308   57330 17.0503 1.452e-08 ***
irrig  4  44026   11006  3.2734   0.02539 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)    220.150     31.760  6.9316 1.553e-07 ***
bloc1          152.600     36.674  4.1610 0.0002725 ***
bloc2          249.600     36.674  6.8060 2.155e-07 ***
bloc3           83.400     36.674  2.2741 0.0308206 *
bloc4         -112.000     36.674 -3.0540 0.0049132 **
bloc5          115.400     36.674  3.1467 0.0038956 **
bloc6          101.800     36.674  2.7758 0.0097029 **
bloc7           45.000     36.674  1.2270 0.2300251
bloc8            0.000      0.000
irrigbasin      -9.250     28.993 -0.3190 0.7520625
irrigflood     -70.000     28.993 -2.4144 0.0225461 *
irrigspray     -75.875     28.993 -2.6170 0.0141421 *
irrigsprnkler   -7.625     28.993 -0.2630 0.7944806
irrigtrickle     0.000      0.000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.2.2 p72

(24) MODEL

```
p72 = read.table("C:/G/Rt/SAS4lm/p72.txt", header=TRUE)
p72 = af(p72, c("run", "pos", "mat"))
GLM(wtloss ~ run + pos + mat, p72) # p73
```

```
$ANOVA
Response : wtloss
               Df Sum Sq Mean Sq F value   Pr(>F)
```

```
MODEL            9 7076.5  786.28  12.837 0.002828 **
RESIDUALS        6  367.5   61.25
CORRECTED TOTAL 15 7444.0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value    Pr(>F)
run  3  986.5  328.83  5.3687 0.0390130 *
pos  3 1468.5  489.50  7.9918 0.0161685 *
mat  3 4621.5 1540.50 25.1510 0.0008498 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value    Pr(>F)
run  3  986.5  328.83  5.3687 0.0390130 *
pos  3 1468.5  489.50  7.9918 0.0161685 *
mat  3 4621.5 1540.50 25.1510 0.0008498 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value    Pr(>F)
run  3  986.5  328.83  5.3687 0.0390130 *
pos  3 1468.5  489.50  7.9918 0.0161685 *
mat  3 4621.5 1540.50 25.1510 0.0008498 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   210.25     6.1872 33.9815 4.325e-08 ***
run1            9.25     5.5340  1.6715 0.1456579
run2            7.00     5.5340  1.2649 0.2528101
run3           21.75     5.5340  3.9303 0.0077104 **
run4            0.00     0.0000
pos1            8.50     5.5340  1.5360 0.1754542
pos2           26.25     5.5340  4.7434 0.0031802 **
pos3            8.25     5.5340  1.4908 0.1866076
pos4            0.00     0.0000
matA           35.25     5.5340  6.3697 0.0007032 ***
matB          -10.50     5.5340 -1.8974 0.1065582
matC           11.25     5.5340  2.0329 0.0883093 .
matD            0.00     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
GLM(shrink ~ run + pos + mat, p72) # p73
```

```
$ANOVA
Response : shrink
                Df Sum Sq Mean Sq F value   Pr(>F)
MODEL            9 265.75  29.528  9.8426 0.005775 **
RESIDUALS        6  18.00   3.000
CORRECTED TOTAL 15 283.75
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value   Pr(>F)
run  3  33.25  11.083  3.6944 0.081254 .
pos  3  60.25  20.083  6.6944 0.024212 *
mat  3 172.25  57.417 19.1389 0.001786 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value   Pr(>F)
run  3  33.25  11.083  3.6944 0.081254 .
pos  3  60.25  20.083  6.6944 0.024212 *
mat  3 172.25  57.417 19.1389 0.001786 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value   Pr(>F)
run  3  33.25  11.083  3.6944 0.081254 .
pos  3  60.25  20.083  6.6944 0.024212 *
mat  3 172.25  57.417 19.1389 0.001786 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)    41.75     1.3693 30.4899 8.261e-08 ***
run1            0.50     1.2247  0.4082  0.697261
run2            1.25     1.2247  1.0206  0.346810
run3            3.75     1.2247  3.0619  0.022172 *
run4            0.00     0.0000
pos1            2.75     1.2247  2.2454  0.065859 .
pos2            5.00     1.2247  4.0825  0.006484 **
pos3            0.75     1.2247  0.6124  0.562764
pos4            0.00     0.0000
matA            6.75     1.2247  5.5114  0.001499 **
```

```
matB           -2.00     1.2247 -1.6330  0.153590
matC            2.75     1.2247  2.2454  0.065859 .
matD            0.00     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.2.3 p75

(25) MODEL

```r
p75w = read.table("C:/G/Rt/SAS4lm/p75.txt", header=TRUE)
p75l = reshape(p75w,
        direction = "long",
        varying = list(names(p75w)[4:9]),
        v.names = "Y",
        idvar = c("method", "variety", "trt"),
        timevar = "yield",
        times = 1:6)
p75l = af(p75l, c("variety", "yield"))
GLM(Y ~ method*variety, p75l) # p78
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           14 1339.0  95.645  4.8674 2.723e-06 ***
RESIDUALS       75 1473.8  19.650
CORRECTED TOTAL 89 2812.8
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
               Df Sum Sq Mean Sq F value    Pr(>F)
method          2 953.16  476.58 24.2531 7.525e-09 ***
variety         4  11.38    2.85  0.1448   0.96476
method:variety  8 374.49   46.81  2.3822   0.02409 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
               Df Sum Sq Mean Sq F value    Pr(>F)
method          2 953.16  476.58 24.2531 7.525e-09 ***
variety         4  11.38    2.85  0.1448   0.96476
method:variety  8 374.49   46.81  2.3822   0.02409 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
               Df Sum Sq Mean Sq F value    Pr(>F)
method          2 953.16  476.58 24.2531 7.525e-09 ***
variety         4  11.38    2.85  0.1448   0.96476
method:variety  8 374.49   46.81  2.3822   0.02409 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                 Estimate Std. Error t value  Pr(>|t|)
(Intercept)       12.5500     1.8097  6.9348  1.23e-09 ***
methoda            9.7833     2.5593  3.8226 0.0002707 ***
methodb            6.6667     2.5593  2.6049 0.0110772 *
methodc            0.0000     0.0000
variety1           5.8667     2.5593  2.2923 0.0246955 *
variety2           7.3667     2.5593  2.8784 0.0052049 **
variety3           4.7667     2.5593  1.8625 0.0664519 .
variety4           2.2833     2.5593  0.8922 0.3751569
variety5           0.0000     0.0000
methoda:variety1  -6.4333     3.6194 -1.7775 0.0795479 .
methoda:variety2  -7.8500     3.6194 -2.1689 0.0332634 *
methoda:variety3  -3.9667     3.6194 -1.0959 0.2766108
methoda:variety4   1.3500     3.6194  0.3730 0.7102090
methoda:variety5   0.0000     0.0000
methodb:variety1 -10.0000     3.6194 -2.7629 0.0072031 **
methodb:variety2 -11.3500     3.6194 -3.1359 0.0024473 **
methodb:variety3  -8.5333     3.6194 -2.3577 0.0210000 *
methodb:variety4  -8.0000     3.6194 -2.2103 0.0301340 *
methodb:variety5   0.0000     0.0000
methodc:variety1   0.0000     0.0000
methodc:variety2   0.0000     0.0000
methodc:variety3   0.0000     0.0000
methodc:variety4   0.0000     0.0000
methodc:variety5   0.0000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 5.3 Chapter 4

### 5.3.1 p94

(26) MODEL

```r
p94w = read.table("C:/G/Rt/SAS4lm/p94.txt", head=TRUE)
p94l = reshape(p94w,
        direction = "long",
        varying = list(names(p94w)[3:8]),
```

```
        v.names = "ct",
        idvar = c("package"),
        timevar = "sample",
        times = 1:6)
p94l$sampleA = floor((p94l$sample + 1)/2)
p94l$sampleB = 2 - (p94l$sample) %% 2
p94l$logct = log10(p94l$ct)
p94l = af(p94l, c("sample", "sampleA", "sampleB", "package"))
GLM(logct ~ package + sampleA %in% package, p94l) # p97
```

```
$ANOVA
Response : logct
                 Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            59 50.463 0.85531  22.229 < 2.2e-16 ***
RESIDUALS        60  2.309 0.03848
CORRECTED TOTAL 119 52.772
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
                Df Sum Sq Mean Sq F value    Pr(>F)
package         19 30.529 1.60680  41.760 < 2.2e-16 ***
package:sampleA 40 19.934 0.49836  12.952 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
                Df Sum Sq Mean Sq F value    Pr(>F)
package         19 30.529 1.60680  41.760 < 2.2e-16 ***
package:sampleA 40 19.934 0.49836  12.952 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
                Df Sum Sq Mean Sq F value    Pr(>F)
package         19 30.529 1.60680  41.760 < 2.2e-16 ***
package:sampleA 40 19.934 0.49836  12.952 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                   Estimate Std. Error t value  Pr(>|t|)
(Intercept)         3.02560    0.13870 21.8135 < 2.2e-16 ***
package1            0.31817    0.19616  1.6220 0.1100424
package10          -0.70207    0.19616 -3.5791 0.0006900 ***
package11           0.03927    0.19616  0.2002 0.8420172
package12           0.17644    0.19616  0.8995 0.3719839
```

```
package13           0.24985    0.19616  1.2737 0.2076669
package14          -0.50666    0.19616 -2.5829 0.0122522 *
package15          -0.38616    0.19616 -1.9686 0.0536211 .
package16           1.06635    0.19616  5.4362 1.049e-06 ***
package17          -0.05000    0.19616 -0.2549 0.7996621
package18          -0.45347    0.19616 -2.3118 0.0242394 *
package19           0.92320    0.19616  4.7065 1.530e-05 ***
package2           -0.39384    0.19616 -2.0078 0.0491774 *
package20           1.01238    0.19616  5.1611 2.924e-06 ***
package3            0.20244    0.19616  1.0321 0.3061898
package4            0.60840    0.19616  3.1016 0.0029318 **
package5           -0.36644    0.19616 -1.8681 0.0666346 .
package6           -0.65494    0.19616 -3.3389 0.0014498 **
package7            0.75615    0.19616  3.8548 0.0002847 ***
package8           -0.71501    0.19616 -3.6451 0.0005600 ***
package9            0.00000    0.00000
package1:sampleA1  -0.52570    0.19616 -2.6800 0.0094902 **
package1:sampleA2  -1.09124    0.19616 -5.5631 6.503e-07 ***
package1:sampleA3   0.00000    0.00000
package10:sampleA1  0.36835    0.19616  1.8779 0.0652619 .
package10:sampleA2 -0.57562    0.19616 -2.9345 0.0047275 **
package10:sampleA3  0.00000    0.00000
package11:sampleA1  0.30298    0.19616  1.5446 0.1277034
package11:sampleA2  0.34699    0.19616  1.7690 0.0819836 .
package11:sampleA3  0.00000    0.00000
package12:sampleA1  0.48746    0.19616  2.4851 0.0157584 *
package12:sampleA2  0.45769    0.19616  2.3333 0.0230013 *
package12:sampleA3  0.00000    0.00000
package13:sampleA1 -0.27369    0.19616 -1.3953 0.1680716
package13:sampleA2 -1.23093    0.19616 -6.2752 4.243e-08 ***
package13:sampleA3  0.00000    0.00000
package14:sampleA1  0.65235    0.19616  3.3256 0.0015089 **
package14:sampleA2  1.60043    0.19616  8.1590 2.625e-11 ***
package14:sampleA3  0.00000    0.00000
package15:sampleA1  0.84917    0.19616  4.3291 5.770e-05 ***
package15:sampleA2 -0.54462    0.19616 -2.7764 0.0073206 **
package15:sampleA3  0.00000    0.00000
package16:sampleA1  0.61863    0.19616  3.1538 0.0025178 **
package16:sampleA2 -0.19465    0.19616 -0.9923 0.3250282
package16:sampleA3  0.00000    0.00000
package17:sampleA1  0.32227    0.19616  1.6429 0.1056276
package17:sampleA2 -0.79379    0.19616 -4.0467 0.0001508 ***
package17:sampleA3  0.00000    0.00000
package18:sampleA1  0.94770    0.19616  4.8314 9.762e-06 ***
package18:sampleA2  0.18877    0.19616  0.9623 0.3397458
package18:sampleA3  0.00000    0.00000
package19:sampleA1 -0.16228    0.19616 -0.8273 0.4113450
package19:sampleA2 -0.81114    0.19616 -4.1352 0.0001120 ***
```

```
package19:sampleA3  0.00000    0.00000
package2:sampleA1   0.77575    0.19616  3.9548 0.0002049 ***
package2:sampleA2   0.98663    0.19616  5.0298 4.741e-06 ***
package2:sampleA3   0.00000    0.00000
package20:sampleA1 -1.01138    0.19616 -5.1560 2.980e-06 ***
package20:sampleA2 -0.59234    0.19616 -3.0197 0.0037126 **
package20:sampleA3  0.00000    0.00000
package3:sampleA1  -0.39744    0.19616 -2.0262 0.0472007 *
package3:sampleA2  -0.29306    0.19616 -1.4940 0.1404174
package3:sampleA3   0.00000    0.00000
package4:sampleA1  -0.31976    0.19616 -1.6301 0.1083175
package4:sampleA2  -1.63645    0.19616 -8.3426 1.278e-11 ***
package4:sampleA3   0.00000    0.00000
package5:sampleA1   0.88257    0.19616  4.4993 3.188e-05 ***
package5:sampleA2   0.61557    0.19616  3.1382 0.0026355 **
package5:sampleA3   0.00000    0.00000
package6:sampleA1  -0.73405    0.19616 -3.7422 0.0004105 ***
package6:sampleA2  -0.43175    0.19616 -2.2011 0.0315906 *
package6:sampleA3   0.00000    0.00000
package7:sampleA1  -0.56541    0.19616 -2.8825 0.0054684 **
package7:sampleA2  -0.06881    0.19616 -0.3508 0.7269701
package7:sampleA3   0.00000    0.00000
package8:sampleA1  -0.11367    0.19616 -0.5795 0.5644332
package8:sampleA2   0.37569    0.19616  1.9153 0.0602278 .
package8:sampleA3   0.00000    0.00000
package9:sampleA1  -0.27176    0.19616 -1.3854 0.1710573
package9:sampleA2  -0.08033    0.19616 -0.4095 0.6836214
package9:sampleA3   0.00000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.3.2 p116

(27) MODEL

```
GLM(Y ~ method + variety + method:variety, p75l) # p116
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           14 1339.0  95.645  4.8674 2.723e-06 ***
RESIDUALS       75 1473.8  19.650
CORRECTED TOTAL 89 2812.8
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
               Df Sum Sq Mean Sq F value    Pr(>F)
method          2 953.16  476.58 24.2531 7.525e-09 ***
variety         4  11.38    2.85  0.1448   0.96476
method:variety  8 374.49   46.81  2.3822   0.02409 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
               Df Sum Sq Mean Sq F value    Pr(>F)
method          2 953.16  476.58 24.2531 7.525e-09 ***
variety         4  11.38    2.85  0.1448   0.96476
method:variety  8 374.49   46.81  2.3822   0.02409 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
               Df Sum Sq Mean Sq F value    Pr(>F)
method          2 953.16  476.58 24.2531 7.525e-09 ***
variety         4  11.38    2.85  0.1448   0.96476
method:variety  8 374.49   46.81  2.3822   0.02409 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                 Estimate Std. Error t value  Pr(>|t|)
(Intercept)       12.5500     1.8097  6.9348  1.23e-09 ***
methoda            9.7833     2.5593  3.8226 0.0002707 ***
methodb            6.6667     2.5593  2.6049 0.0110772 *
methodc            0.0000     0.0000
variety1           5.8667     2.5593  2.2923 0.0246955 *
variety2           7.3667     2.5593  2.8784 0.0052049 **
variety3           4.7667     2.5593  1.8625 0.0664519 .
variety4           2.2833     2.5593  0.8922 0.3751569
variety5           0.0000     0.0000
methoda:variety1  -6.4333     3.6194 -1.7775 0.0795479 .
methoda:variety2  -7.8500     3.6194 -2.1689 0.0332634 *
methoda:variety3  -3.9667     3.6194 -1.0959 0.2766108
methoda:variety4   1.3500     3.6194  0.3730 0.7102090
methoda:variety5   0.0000     0.0000
methodb:variety1 -10.0000     3.6194 -2.7629 0.0072031 **
methodb:variety2 -11.3500     3.6194 -3.1359 0.0024473 **
methodb:variety3  -8.5333     3.6194 -2.3577 0.0210000 *
methodb:variety4  -8.0000     3.6194 -2.2103 0.0301340 *
methodb:variety5   0.0000     0.0000
methodc:variety1   0.0000     0.0000
methodc:variety2   0.0000     0.0000
methodc:variety3   0.0000     0.0000
```

```
methodc:variety4   0.0000     0.0000
methodc:variety5   0.0000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.3.3 p122

(28) MODEL

```
p122 = read.table("C:/G/Rt/SAS4lm/p122.txt", header=TRUE)
p122 = af(p122, c("et", "wafer", "pos"))
GLM(resista ~ et + wafer %in% et + pos + et:pos, p122)
```

```
$ANOVA
Response : resista
                Df  Sum Sq Mean Sq F value   Pr(>F)
MODEL           23  9.3250 0.40544  3.6477 0.001263 **
RESIDUALS       24  2.6676 0.11115
CORRECTED TOTAL 47 11.9926
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
         Df Sum Sq Mean Sq F value    Pr(>F)
et        3 3.1122 1.03739  9.3333 0.0002851 ***
et:wafer  8 4.2745 0.53431  4.8071 0.0012742 **
pos       3 1.1289 0.37630  3.3855 0.0345139 *
et:pos    9 0.8095 0.08994  0.8092 0.6125279
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
         Df Sum Sq Mean Sq F value    Pr(>F)
et        3 3.1122 1.03739  9.3333 0.0002851 ***
et:wafer  8 4.2745 0.53431  4.8071 0.0012742 **
pos       3 1.1289 0.37630  3.3855 0.0345139 *
et:pos    9 0.8095 0.08994  0.8092 0.6125279
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
         Df Sum Sq Mean Sq F value    Pr(>F)
et        3 3.1122 1.03739  9.3333 0.0002851 ***
et:wafer  8 4.2745 0.53431  4.8071 0.0012742 **
pos       3 1.1289 0.37630  3.3855 0.0345139 *
et:pos    9 0.8095 0.08994  0.8092 0.6125279
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   6.1775    0.23574 26.2044 < 2.2e-16 ***
et1          -0.8017    0.33339 -2.4046  0.024265 *
et2          -0.1792    0.33339 -0.5374  0.595934
et3          -0.0467    0.33339 -0.1400  0.889847
et4           0.0000    0.00000
et1:wafer1    0.7025    0.23574  2.9799  0.006508 **
et1:wafer2    0.8300    0.23574  3.5208  0.001750 **
et1:wafer3    0.0000    0.00000
et2:wafer1   -0.0800    0.23574 -0.3394  0.737295
et2:wafer2   -0.1650    0.23574 -0.6999  0.490709
et2:wafer3    0.0000    0.00000
et3:wafer1   -0.5125    0.23574 -2.1740  0.039796 *
et3:wafer2    0.4000    0.23574  1.6968  0.102675
et3:wafer3    0.0000    0.00000
et4:wafer1    0.6850    0.23574  2.9057  0.007755 **
et4:wafer2    0.4025    0.23574  1.7074  0.100660
et4:wafer3    0.0000    0.00000
pos1         -0.2000    0.27221 -0.7347  0.469628
pos2          0.0133    0.27221  0.0490  0.961339
pos3         -0.6433    0.27221 -2.3634  0.026551 *
pos4          0.0000    0.00000
et1:pos1     -0.0733    0.38497 -0.1905  0.850525
et1:pos2     -0.4500    0.38497 -1.1689  0.253910
et1:pos3      0.3100    0.38497  0.8053  0.428573
et1:pos4      0.0000    0.00000
et2:pos1      0.2767    0.38497  0.7187  0.479279
et2:pos2      0.2567    0.38497  0.6667  0.511307
et2:pos3      0.4933    0.38497  1.2815  0.212262
et2:pos4      0.0000    0.00000
et3:pos1      0.2433    0.38497  0.6321  0.533304
et3:pos2      0.2400    0.38497  0.6234  0.538882
et3:pos3      0.3233    0.38497  0.8399  0.409254
et3:pos4      0.0000    0.00000
et4:pos1      0.0000    0.00000
et4:pos2      0.0000    0.00000
et4:pos3      0.0000    0.00000
et4:pos4      0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.3.4 p136

(29) MODEL

```
p136 = read.table("C:/G/Rt/SAS4lm/p136.txt", header=TRUE)
p136 = af(p136, "rep")
GLM(drywt ~ rep + cult + rep:cult + inoc + cult:inoc, p136)
```

```
$ANOVA
Response : drywt
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           11 157.208 14.2917   20.26 4.594e-06 ***
RESIDUALS       12   8.465  0.7054
CORRECTED TOTAL 23 165.673
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
          Df  Sum Sq Mean Sq F value    Pr(>F)
rep        3  25.320   8.440 11.9646 0.0006428 ***
cult       1   2.407   2.407  3.4117 0.0895283 .
rep:cult   3   9.480   3.160  4.4796 0.0249095 *
inoc       2 118.176  59.088 83.7631 8.919e-08 ***
cult:inoc  2   1.826   0.913  1.2942 0.3097837
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
          Df  Sum Sq Mean Sq F value    Pr(>F)
rep        3  25.320   8.440 11.9646 0.0006428 ***
cult       1   2.407   2.407  3.4117 0.0895283 .
rep:cult   3   9.480   3.160  4.4796 0.0249095 *
inoc       2 118.176  59.088 83.7631 8.919e-08 ***
cult:inoc  2   1.826   0.913  1.2942 0.3097837
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
          Df  Sum Sq Mean Sq F value    Pr(>F)
rep        3  25.320   8.440 11.9646 0.0006428 ***
cult       1   2.407   2.407  3.4117 0.0895283 .
rep:cult   3   9.480   3.160  4.4796 0.0249095 *
inoc       2 118.176  59.088 83.7631 8.919e-08 ***
cult:inoc  2   1.826   0.913  1.2942 0.3097837
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)    31.4917    0.59389 53.0259 1.332e-15 ***
rep1            3.4000    0.68577  4.9579 0.0003319 ***
rep2            3.8000    0.68577  5.5412 0.0001275 ***
rep3            0.9333    0.68577  1.3610 0.1985240
rep4            0.0000    0.00000
cultA           0.6917    0.83989  0.8235 0.4262768
cultB           0.0000    0.00000
rep1:cultA     -2.0000    0.96982 -2.0622 0.0615275 .
rep1:cultB      0.0000    0.00000
rep2:cultA     -2.6000    0.96982 -2.6809 0.0200035 *
rep2:cultB      0.0000    0.00000
rep3:cultA      0.3333    0.96982  0.3437 0.7370149
rep3:cultB      0.0000    0.00000
rep4:cultA      0.0000    0.00000
rep4:cultB      0.0000    0.00000
inocCON        -5.5000    0.59389 -9.2609 8.156e-07 ***
inocDEA        -2.8750    0.59389 -4.8409 0.0004044 ***
inocLIV         0.0000    0.00000
cultA:inocCON   0.2500    0.83989  0.2977 0.7710547
cultA:inocDEA  -1.0250    0.83989 -1.2204 0.2457544
cultA:inocLIV   0.0000    0.00000
cultB:inocCON   0.0000    0.00000
cultB:inocDEA   0.0000    0.00000
cultB:inocLIV   0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 5.4 Chapter 5

### 5.4.1 p142

(30) MODEL

```
p142 = read.table("C:/G/Rt/SAS4lm/p142.txt", header=TRUE, na.strings=".")
p142 = af(p142, c("STUDY", "PATIENT"))
GLM(FLUSH ~ STUDY + TRT, p142) # Incomplete data, 56 lines are truncated.
```

```
$ANOVA
Response : FLUSH
                Df  Sum Sq Mean Sq F value  Pr(>F)
MODEL            5  3619.9  723.98   2.392 0.04607 *
RESIDUALS       71 21489.2  302.67
CORRECTED TOTAL 76 25109.1
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
      Df Sum Sq Mean Sq F value  Pr(>F)
STUDY  4 3553.9  888.46  2.9355 0.02638 *
TRT    1   66.0   66.04  0.2182 0.64185
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df Sum Sq Mean Sq F value  Pr(>F)
STUDY  4 3599.4  899.85  2.9731 0.02496 *
TRT    1   66.0   66.04  0.2182 0.64185
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
      Df Sum Sq Mean Sq F value  Pr(>F)
STUDY  4 3599.4  899.85  2.9731 0.02496 *
TRT    1   66.0   66.04  0.2182 0.64185
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  20.7038     5.1627  4.0103 0.0001481 ***
STUDY42      18.8049    11.1730  1.6831 0.0967562 .
STUDY43       3.3539     5.8408  0.5742 0.5676300
STUDY44      -9.6707     7.1273 -1.3569 0.1791234
STUDY45       9.6932     6.0879  1.5922 0.1157835
STUDY46       0.0000     0.0000
TRTA         -1.8583     3.9782 -0.4671 0.6418492
TRTB          0.0000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(31) MODEL

```
GLM(FLUSH ~ TRT + STUDY + TRT:STUDY, p142) # Different data
```

```
$ANOVA
Response : FLUSH
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            9  4093.7  454.86  1.4501 0.1851
RESIDUALS       67 21015.4  313.66
CORRECTED TOTAL 76 25109.1
```

```
$`Type I`
          Df Sum Sq Mean Sq F value  Pr(>F)
TRT        1   20.5   20.49  0.0653 0.79906
STUDY      4 3599.4  899.85  2.8688 0.02956 *
TRT:STUDY  4  473.8  118.45  0.3776 0.82383
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
          Df Sum Sq Mean Sq F value  Pr(>F)
TRT        1   66.0   66.04  0.2105 0.64783
STUDY      4 3599.4  899.85  2.8688 0.02956 *
TRT:STUDY  4  473.8  118.45  0.3776 0.82383
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
          Df Sum Sq Mean Sq F value Pr(>F)
TRT        1    1.9    1.93  0.0062 0.9377
STUDY      4 3339.4  834.85  2.6616 0.0400 *
TRT:STUDY  4  473.8  118.45  0.3776 0.8238
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
             Estimate Std. Error t value  Pr(>|t|)
(Intercept)   24.2321     6.6940  3.6200 0.0005671 ***
TRTA          -9.5030     9.8532 -0.9645 0.3382875
TRTB           0.0000     0.0000
STUDY42        4.1012    18.9334  0.2166 0.8291705
STUDY43        0.3108     8.1984  0.0379 0.9698723
STUDY44      -12.8822     9.8532 -1.3074 0.1955439
STUDY45        4.1451     8.5629  0.4841 0.6299091
STUDY46        0.0000     0.0000
TRTA:STUDY42  24.4078    23.8240  1.0245 0.3092815
TRTA:STUDY43   6.6743    11.9120  0.5603 0.5771416
TRTA:STUDY44   6.9476    14.5635  0.4771 0.6348740
TRTA:STUDY45  11.6841    12.4143  0.9412 0.3499931
TRTA:STUDY46   0.0000     0.0000
TRTB:STUDY42   0.0000     0.0000
TRTB:STUDY43   0.0000     0.0000
TRTB:STUDY44   0.0000     0.0000
TRTB:STUDY45   0.0000     0.0000
TRTB:STUDY46   0.0000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 5.5 Chapter 6

### 5.5.1 p171

(32) MODEL

```
p171 = read.table("C:/G/Rt/SAS4lm/p171.txt", header=TRUE)
GLM(score2 ~ teach, p171) # p173 Output 6.2, p174 Output 6.5
```

```
$ANOVA
Response : score2
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            2   49.74  24.868  0.5598 0.5776
RESIDUALS       28 1243.94  44.426
CORRECTED TOTAL 30 1293.68

$`Type I`
      Df Sum Sq Mean Sq F value Pr(>F)
teach  2 49.736  24.868  0.5598 0.5776

$`Type II`
      Df Sum Sq Mean Sq F value Pr(>F)
teach  2 49.736  24.868  0.5598 0.5776

$`Type III`
      Df Sum Sq Mean Sq F value Pr(>F)
teach  2 49.736  24.868  0.5598 0.5776

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   72.455     2.0097 36.0530   <2e-16 ***
teachJAY       3.545     3.3828  1.0481   0.3036
teachPAT       0.903     2.6855  0.3361   0.7393
teachROBIN     0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.5.2 p188

(33) MODEL

```
p188 = read.table("C:/G/Rt/SAS4lm/p188.txt", header=TRUE)
p188 = af(p188, c("a", "b"))
GLM(y ~ a + b + a:b, p188) # p189
```

```
$ANOVA
```

```
Response : y
                Df Sum Sq Mean Sq F value   Pr(>F)
MODEL            5 63.711 12.7422   5.866 0.005724 **
RESIDUALS       12 26.067  2.1722
CORRECTED TOTAL 17 89.778
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value   Pr(>F)
a    1  7.803  7.8028  3.5921 0.082395 .
b    2 20.492 10.2459  4.7168 0.030798 *
a:b  2 35.416 17.7082  8.1521 0.005807 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value   Pr(>F)
a    1 15.850  15.850  7.2968 0.019265 *
b    2 20.492  10.246  4.7168 0.030798 *
a:b  2 35.416  17.708  8.1521 0.005807 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value   Pr(>F)
a    1  9.641  9.6407  4.4382 0.056865 .
b    2 30.866 15.4330  7.1047 0.009212 **
a:b  2 35.416 17.7082  8.1521 0.005807 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   5.4000    0.65912  8.1927 2.944e-06 ***
a1           -4.4000    1.61452 -2.7253  0.018427 *
a2            0.0000    0.00000
b1           -2.9000    1.23311 -2.3518  0.036594 *
b2            2.9333    1.07634  2.7253  0.018427 *
b3            0.0000    0.00000
a1:b1         7.4000    2.18607  3.3851  0.005417 **
a1:b2         0.6667    1.94041  0.3436  0.737114
a1:b3         0.0000    0.00000
a2:b1         0.0000    0.00000
a2:b2         0.0000    0.00000
a2:b3         0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.5.3 p203

(34) MODEL

```
GLM(y ~ a + b + a:b,  p188[-8,])
```

```
$ANOVA
Response : y
                Df Sum Sq Mean Sq F value  Pr(>F)
MODEL            4 45.816 11.4539  5.2729 0.01097 *
RESIDUALS       12 26.067  2.1722
CORRECTED TOTAL 16 71.882
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df  Sum Sq Mean Sq F value   Pr(>F)
a    1  2.9252  2.9252  1.3466 0.268432
b    2 13.3224  6.6612  3.0665 0.083997 .
a:b  1 29.5681 29.5681 13.6119 0.003095 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df  Sum Sq Mean Sq F value   Pr(>F)
a    1  5.5652  5.5652  2.5620 0.135442
b    2 13.3224  6.6612  3.0665 0.083997 .
a:b  1 29.5681 29.5681 13.6119 0.003095 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value   Pr(>F)
a    1  0.3507  0.3507  0.1615 0.694881
b    2 16.0733  8.0367  3.6997 0.056021 .
a:b  1 29.5681 29.5681 13.6119 0.003095 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   5.4000    0.65912  8.1927 2.944e-06 ***
a1           -3.7333    1.07634 -3.4685  0.004644 **
a2            0.0000    0.00000
b1           -2.9000    1.23311 -2.3518  0.036594 *
b2            2.9333    1.07634  2.7253  0.018427 *
b3            0.0000    0.00000
```

```
a1:b1         6.7333    1.82503  3.6894  0.003095 **
a1:b2         0.0000    0.00000
a1:b3         0.0000    0.00000
a2:b1         0.0000    0.00000
a2:b2         0.0000    0.00000
a2:b3         0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.5.4 p215

(35) MODEL

```r
p215 = read.table("C:/G/Rt/SAS4lm/p215.txt", header=TRUE)
p215 = af(p215, c("irrig", "reps"))
GLM(yield ~ irrig/reps + cult + irrig:cult, p215) # p216 Book is wrong.
```

```
$ANOVA
Response : yield
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL           11  67.662  6.1511  0.6253 0.7636
RESIDUALS        6  59.023  9.8372
CORRECTED TOTAL 17 126.685

$`Type I`
           Df Sum Sq Mean Sq F value Pr(>F)
irrig       2  7.320  3.6600  0.3721 0.7042
irrig:reps  6 59.870  9.9783  1.0143 0.4933
cult        1  0.467  0.4672  0.0475 0.8347
irrig:cult  2  0.004  0.0022  0.0002 0.9998

$`Type II`
           Df Sum Sq Mean Sq F value Pr(>F)
irrig       2  7.320  3.6600  0.3721 0.7042
irrig:reps  6 59.870  9.9783  1.0143 0.4933
cult        1  0.467  0.4672  0.0475 0.8347
irrig:cult  2  0.004  0.0022  0.0002 0.9998

$`Type III`
           Df Sum Sq Mean Sq F value Pr(>F)
irrig       2  7.320  3.6600  0.3721 0.7042
irrig:reps  6 59.870  9.9783  1.0143 0.4933
cult        1  0.467  0.4672  0.0475 0.8347
irrig:cult  2  0.004  0.0022  0.0002 0.9998

$Parameter
```

```
             Estimate Std. Error t value  Pr(>|t|)
(Intercept)   30.6667     2.5609 11.9750 2.055e-05 ***
irrig1         2.6333     3.6216  0.7271    0.4945
irrig2         3.5833     3.6216  0.9894    0.3607
irrig3         0.0000     0.0000
irrig1:reps1  -4.9000     3.1364 -1.5623    0.1692
irrig1:reps2  -1.5000     3.1364 -0.4783    0.6494
irrig1:reps3   0.0000     0.0000
irrig2:reps1  -5.6000     3.1364 -1.7855    0.1244
irrig2:reps2  -3.3500     3.1364 -1.0681    0.3266
irrig2:reps3   0.0000     0.0000
irrig3:reps1  -1.7000     3.1364 -0.5420    0.6073
irrig3:reps2  -0.8000     3.1364 -0.2551    0.8072
irrig3:reps3   0.0000     0.0000
cultA          0.3667     2.5609  0.1432    0.8908
cultB          0.0000     0.0000
irrig1:cultA  -0.0667     3.6216 -0.0184    0.9859
irrig1:cultB   0.0000     0.0000
irrig2:cultA  -0.0667     3.6216 -0.0184    0.9859
irrig2:cultB   0.0000     0.0000
irrig3:cultA   0.0000     0.0000
irrig3:cultB   0.0000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Compare with SAS output
```

(36) MODEL

```
GLM(yield ~ reps + irrig + reps:irrig + cult + cult:irrig, p215)
```

```
$ANOVA
Response : yield
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL           11  67.662  6.1511  0.6253 0.7636
RESIDUALS        6  59.023  9.8372
CORRECTED TOTAL 17 126.685

$`Type I`
           Df Sum Sq Mean Sq F value Pr(>F)
reps        2 49.703 24.8517  2.5263 0.1600
irrig       2  7.320  3.6600  0.3721 0.7042
reps:irrig  4 10.167  2.5417  0.2584 0.8944
cult        1  0.467  0.4672  0.0475 0.8347
irrig:cult  2  0.004  0.0022  0.0002 0.9998
```

```
$`Type II`
           Df Sum Sq Mean Sq F value Pr(>F)
reps        2 49.703 24.8517  2.5263 0.1600
irrig       2  7.320  3.6600  0.3721 0.7042
reps:irrig  4 10.167  2.5417  0.2584 0.8944
cult        1  0.467  0.4672  0.0475 0.8347
irrig:cult  2  0.004  0.0022  0.0002 0.9998

$`Type III`
           Df Sum Sq Mean Sq F value Pr(>F)
reps        2 49.703 24.8517  2.5263 0.1600
irrig       2  7.320  3.6600  0.3721 0.7042
reps:irrig  4 10.167  2.5417  0.2584 0.8944
cult        1  0.467  0.4672  0.0475 0.8347
irrig:cult  2  0.004  0.0022  0.0002 0.9998

$Parameter
             Estimate Std. Error t value  Pr(>|t|)
(Intercept)   30.6667     2.5609 11.9750 2.055e-05 ***
reps1         -1.7000     3.1364 -0.5420    0.6073
reps2         -0.8000     3.1364 -0.2551    0.8072
reps3          0.0000     0.0000
irrig1         2.6333     3.6216  0.7271    0.4945
irrig2         3.5833     3.6216  0.9894    0.3607
irrig3         0.0000     0.0000
reps1:irrig1  -3.2000     4.4356 -0.7214    0.4978
reps1:irrig2  -3.9000     4.4356 -0.8793    0.4131
reps1:irrig3   0.0000     0.0000
reps2:irrig1  -0.7000     4.4356 -0.1578    0.8798
reps2:irrig2  -2.5500     4.4356 -0.5749    0.5863
reps2:irrig3   0.0000     0.0000
reps3:irrig1   0.0000     0.0000
reps3:irrig2   0.0000     0.0000
reps3:irrig3   0.0000     0.0000
cultA          0.3667     2.5609  0.1432    0.8908
cultB          0.0000     0.0000
irrig1:cultA  -0.0667     3.6216 -0.0184    0.9859
irrig1:cultB   0.0000     0.0000
irrig2:cultA  -0.0667     3.6216 -0.0184    0.9859
irrig2:cultB   0.0000     0.0000
irrig3:cultA   0.0000     0.0000
irrig3:cultB   0.0000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 5.6 Chapter 7

### 5.6.1 p232

(37) MODEL

```
p232 = read.table("C:/G/Rt/SAS4lm/p232.txt", header=TRUE)
p232 = af(p232, c("trt", "rep"))
GLM(final ~ trt + initial, p232) # p233
```

```
$ANOVA
Response : final
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            5 354.45  70.889  235.05 5.493e-13 ***
RESIDUALS       14   4.22   0.302
CORRECTED TOTAL 19 358.67
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
        Df Sum Sq Mean Sq F value    Pr(>F)
trt      4 198.41  49.602  164.47 1.340e-11 ***
initial  1 156.04 156.040  517.38 1.867e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df  Sum Sq Mean Sq F value    Pr(>F)
trt      4  12.089   3.022  10.021 0.0004819 ***
initial  1 156.040 156.040 517.384 1.867e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
        Df  Sum Sq Mean Sq F value    Pr(>F)
trt      4  12.089   3.022  10.021 0.0004819 ***
initial  1 156.040 156.040 517.384 1.867e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  2.49486    1.02786  2.4272  0.029298 *
trt1        -0.24446    0.57658 -0.4240  0.678022
trt2        -0.28027    0.49291 -0.5686  0.578630
trt3         1.65476    0.42943  3.8534  0.001756 **
trt4         1.10711    0.47175  2.3468  0.034170 *
```

```
trt5         0.00000    0.00000
initial      1.08318    0.04762 22.7461 1.867e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.6.2 p240

(38) MODEL

```
GLM(final ~ initial + trt + trt:initial, p232) # p240
```

```
$ANOVA
Response : final
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            9 355.84  39.537  139.51 2.572e-09 ***
RESIDUALS       10   2.83   0.283
CORRECTED TOTAL 19 358.67
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
            Df Sum Sq Mean Sq   F value    Pr(>F)
initial      1 342.36  342.36 1208.0336 9.211e-12 ***
trt          4  12.09    3.02   10.6645  0.001247 **
initial:trt  4   1.39    0.35    1.2247  0.360175
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
            Df  Sum Sq Mean Sq  F value    Pr(>F)
initial      1 156.040 156.040 550.5987 4.478e-10 ***
trt          4  12.089   3.022  10.6645  0.001247 **
initial:trt  4   1.388   0.347   1.2247  0.360175
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
            Df Sum Sq Mean Sq  F value    Pr(>F)
initial      1 68.529  68.529 241.8091 2.472e-08 ***
trt          4  1.696   0.424   1.4963    0.2752
initial:trt  4  1.388   0.347   1.2247    0.3602
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
             Estimate Std. Error t value  Pr(>|t|)
```

```
(Intercept)   -0.4318     2.1328 -0.2025    0.8436
initial        1.2239     0.1017 12.0298 2.854e-07 ***
trt1           5.6731     3.5715  1.5884    0.1433
trt2          -8.7175     8.9578 -0.9732    0.3534
trt3           5.2498     3.4875  1.5053    0.1632
trt4           4.7276     2.9399  1.6081    0.1389
trt5           0.0000     0.0000
initial:trt1  -0.2412     0.1398 -1.7256    0.1151
initial:trt2   0.2775     0.3358  0.8263    0.4279
initial:trt3  -0.1678     0.1509 -1.1123    0.2920
initial:trt4  -0.1670     0.1269 -1.3153    0.2178
initial:trt5   0.0000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.6.3 p241

(39) MODEL

```
p241 = read.table("C:/G/Rt/SAS4lm/p241.txt", header=TRUE)
p241 = af(p241, c("STORE", "DAY"))
GLM(Q1 ~ P1 + DAY + P1:DAY, p241) # p242
```

```
$ANOVA
Response : Q1
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           11 1111.52 101.048  4.6445 0.0008119 ***
RESIDUALS       24  522.15  21.756
CORRECTED TOTAL 35 1633.68
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df Sum Sq Mean Sq F value    Pr(>F)
P1      1 516.59  516.59 23.7444 5.739e-05 ***
DAY     5 430.54   86.11  3.9578  0.009275 **
P1:DAY  5 164.39   32.88  1.5112  0.223566
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df Sum Sq Mean Sq F value    Pr(>F)
P1      1 696.73  696.73 32.0243 7.925e-06 ***
DAY     5 430.54   86.11  3.9578  0.009275 **
P1:DAY  5 164.39   32.88  1.5112  0.223566
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
       Df Sum Sq Mean Sq F value    Pr(>F)
P1      1 554.79  554.79 25.4999 3.665e-05 ***
DAY     5 201.17   40.23  1.8493    0.1412
P1:DAY  5 164.39   32.88  1.5112    0.2236
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   73.273    13.4837  5.4341  1.39e-05 ***
P1            -1.225     0.2652 -4.6199 0.0001092 ***
DAY1         -54.597    19.7355 -2.7664 0.0107321 *
DAY2         -34.786    20.2511 -1.7177 0.0987253 .
DAY3         -27.943    29.4284 -0.9495 0.3518193
DAY4         -24.123    21.3933 -1.1276 0.2706307
DAY5           4.626    30.6284  0.1510 0.8812016
DAY6           0.000     0.0000
P1:DAY1        1.005     0.3941  2.5494 0.0175983 *
P1:DAY2        0.602     0.3988  1.5088 0.1444129
P1:DAY3        0.614     0.5703  1.0768 0.2922646
P1:DAY4        0.430     0.4151  1.0349 0.3110314
P1:DAY5        0.029     0.5703  0.0515 0.9593643
P1:DAY6        0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.6.4 p243

(40) MODEL

```
GLM(Q1 ~ DAY + DAY:P1, p241)
```

```
$ANOVA
Response : Q1
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           11 1111.52 101.048  4.6445 0.0008119 ***
RESIDUALS       24  522.15  21.756
CORRECTED TOTAL 35 1633.68
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df Sum Sq Mean Sq F value    Pr(>F)
```

```
DAY     5 250.40  50.079  2.3018 0.0764717 .
DAY:P1  6 861.13 143.521  6.5967 0.0003239 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df Sum Sq Mean Sq F value    Pr(>F)
DAY     5 250.40  50.079  2.3018 0.0764717 .
DAY:P1  6 861.13 143.521  6.5967 0.0003239 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
       Df Sum Sq Mean Sq F value    Pr(>F)
DAY     5 201.17  40.234  1.8493 0.1411648
DAY:P1  6 861.13 143.521  6.5967 0.0003239 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   73.273    13.4837  5.4341  1.39e-05 ***
DAY1         -54.597    19.7355 -2.7664 0.0107321 *
DAY2         -34.786    20.2511 -1.7177 0.0987253 .
DAY3         -27.943    29.4284 -0.9495 0.3518193
DAY4         -24.123    21.3933 -1.1276 0.2706307
DAY5           4.626    30.6284  0.1510 0.8812016
DAY6           0.000     0.0000
DAY1:P1       -0.220     0.2915 -0.7562 0.4568599
DAY2:P1       -0.624     0.2978 -2.0940 0.0470031 *
DAY3:P1       -0.611     0.5049 -1.2102 0.2379998
DAY4:P1       -0.796     0.3193 -2.4914 0.0200350 *
DAY5:P1       -1.196     0.5049 -2.3683 0.0262648 *
DAY6:P1       -1.225     0.2652 -4.6199 0.0001092 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
REG(Q1 ~ DAY + DAY:P1, p241, NOINT=TRUE) # Ouput 7.10
```

```
        Estimate Std. Error t value  Pr(>|t|)
DAY1      18.675    14.4110  1.2959 0.2073286
DAY2      38.487    15.1094  2.5472 0.0176863 *
DAY3      45.330    26.1576  1.7329 0.0959384 .
DAY4      49.149    16.6092  2.9592 0.0068366 **
DAY5      77.899    27.5007  2.8326 0.0092034 **
DAY6      73.273    13.4837  5.4341  1.39e-05 ***
DAY1:P1   -0.220     0.2915 -0.7562 0.4568599
```

```
DAY2:P1   -0.624     0.2978 -2.0940 0.0470031 *
DAY3:P1   -0.611     0.5049 -1.2102 0.2379998
DAY4:P1   -0.796     0.3193 -2.4914 0.0200350 *
DAY5:P1   -1.196     0.5049 -2.3683 0.0262648 *
DAY6:P1   -1.225     0.2652 -4.6199 0.0001092 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(41) MODEL

```
GLM(Q1 ~ P1 + DAY + P1:DAY, p241)
```

```
$ANOVA
Response : Q1
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           11 1111.52 101.048  4.6445 0.0008119 ***
RESIDUALS       24  522.15  21.756
CORRECTED TOTAL 35 1633.68
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df Sum Sq Mean Sq F value    Pr(>F)
P1      1 516.59  516.59 23.7444 5.739e-05 ***
DAY     5 430.54   86.11  3.9578  0.009275 **
P1:DAY  5 164.39   32.88  1.5112  0.223566
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df Sum Sq Mean Sq F value    Pr(>F)
P1      1 696.73  696.73 32.0243 7.925e-06 ***
DAY     5 430.54   86.11  3.9578  0.009275 **
P1:DAY  5 164.39   32.88  1.5112  0.223566
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
       Df Sum Sq Mean Sq F value    Pr(>F)
P1      1 554.79  554.79 25.4999 3.665e-05 ***
DAY     5 201.17   40.23  1.8493    0.1412
P1:DAY  5 164.39   32.88  1.5112    0.2236
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
```

```
(Intercept)   73.273    13.4837  5.4341  1.39e-05 ***
P1            -1.225     0.2652 -4.6199 0.0001092 ***
DAY1         -54.597    19.7355 -2.7664 0.0107321 *
DAY2         -34.786    20.2511 -1.7177 0.0987253 .
DAY3         -27.943    29.4284 -0.9495 0.3518193
DAY4         -24.123    21.3933 -1.1276 0.2706307
DAY5           4.626    30.6284  0.1510 0.8812016
DAY6           0.000     0.0000
P1:DAY1        1.005     0.3941  2.5494 0.0175983 *
P1:DAY2        0.602     0.3988  1.5088 0.1444129
P1:DAY3        0.614     0.5703  1.0768 0.2922646
P1:DAY4        0.430     0.4151  1.0349 0.3110314
P1:DAY5        0.029     0.5703  0.0515 0.9593643
P1:DAY6        0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(42) MODEL

```
GLM(Q1 ~ STORE + DAY + P1 + P2, p241)
```

```
$ANOVA
Response : Q1
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           12 1225.37 102.114  5.7521 0.0001688 ***
RESIDUALS       23  408.31  17.753
CORRECTED TOTAL 35 1633.68
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
STORE  5 313.42   62.68  3.5310   0.01629 *
DAY    5 250.40   50.08  2.8210   0.03957 *
P1     1 622.01  622.01 35.0377 4.924e-06 ***
P2     1  39.54   39.54  2.2274   0.14917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
STORE  5 223.83   44.77  2.5217  0.058346 .
DAY    5 433.10   86.62  4.8793  0.003456 **
P1     1 538.17  538.17 30.3150 1.342e-05 ***
P2     1  39.54   39.54  2.2274  0.149171
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
STORE  5 223.83   44.77  2.5217  0.058346 .
DAY    5 433.10   86.62  4.8793  0.003456 **
P1     1 538.17  538.17 30.3150 1.342e-05 ***
P2     1  39.54   39.54  2.2274  0.149171
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   51.700     9.7910  5.2803 2.333e-05 ***
STORE1        -7.645     2.6919 -2.8401  0.009273 **
STORE2        -5.602     2.4642 -2.2735  0.032650 *
STORE3        -7.363     2.4642 -2.9880  0.006573 **
STORE4        -4.365     2.4875 -1.7547  0.092620 .
STORE5        -5.021     2.4361 -2.0609  0.050799 .
STORE6         0.000     0.0000
DAY1          -5.830     2.5193 -2.3143  0.029934 *
DAY2          -4.900     2.4471 -2.0024  0.057172 .
DAY3           2.270     2.5403  0.8935  0.380834
DAY4          -2.652     2.4467 -1.0841  0.289545
DAY5           4.047     2.5566  1.5830  0.127078
DAY6           0.000     0.0000
P1            -0.830     0.1508 -5.5059 1.342e-05 ***
P2             0.149     0.0997  1.4925  0.149171
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.6.5 p250

(43) MODEL

```
p250 = read.table("C:/G/Rt/SAS4lm/p250.txt", header=TRUE)
p250 = af(p250, c("variety", "spacing", "plant"))
GLM(lint ~ bollwt + variety + spacing + variety:spacing + variety:spacing:plant,
     p250) # p252 Output 7.18, Parameter is different due to different order
```

```
$ANOVA
Response : lint
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            8 31.160  3.8950  80.704 < 2.2e-16 ***
RESIDUALS       40  1.931  0.0483
CORRECTED TOTAL 48 33.091
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
                      Df  Sum Sq Mean Sq  F value    Pr(>F)
bollwt                 1 29.0693 29.0693 602.3107 < 2.2e-16 ***
variety                1  1.2635  1.2635  26.1802 8.158e-06 ***
spacing                1  0.4666  0.4666   9.6689  0.003447 **
variety:spacing        1  0.0933  0.0933   1.9325  0.172169
variety:spacing:plant  4  0.2673  0.0668   1.3847  0.256548
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
                      Df  Sum Sq Mean Sq  F value    Pr(>F)
bollwt                 1 11.1186 11.1186 230.3745 < 2.2e-16 ***
variety                1  1.1973  1.1973  24.8084 1.259e-05 ***
spacing                1  0.4666  0.4666   9.6689  0.003447 **
variety:spacing        1  0.0933  0.0933   1.9325  0.172169
variety:spacing:plant  4  0.2673  0.0668   1.3847  0.256548
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
                      Df  Sum Sq Mean Sq  F value    Pr(>F)
bollwt                 1 11.1186 11.1186 230.3745 < 2.2e-16 ***
variety                1  0.9424  0.9424  19.5269 7.379e-05 ***
spacing                1  0.3748  0.3748   7.7666  0.008101 **
variety:spacing        1  0.0479  0.0479   0.9915  0.325350
variety:spacing:plant  4  0.2673  0.0668   1.3847  0.256548
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                            Estimate Std. Error t value  Pr(>|t|)
(Intercept)                  0.15083   0.163336  0.9234  0.361331
bollwt                       0.30561   0.020135 15.1781 < 2.2e-16 ***
variety213                  -0.42327   0.129645 -3.2649  0.002249 **
variety37                    0.00000   0.000000
spacing30                    0.06160   0.128765  0.4784  0.634964
spacing40                    0.00000   0.000000
variety213:spacing30        -0.02364   0.198980 -0.1188  0.906004
variety213:spacing40         0.00000   0.000000
variety37:spacing30          0.00000   0.000000
variety37:spacing40          0.00000   0.000000
variety213:spacing30:plant0  0.00000   0.000000
variety213:spacing30:plant3  0.33372   0.160556  2.0785  0.044120 *
variety213:spacing30:plant5  0.00000   0.000000
variety213:spacing40:plant0 -0.09849   0.111519 -0.8832  0.382418
```

```
variety213:spacing40:plant3  0.00000   0.000000
variety213:spacing40:plant5  0.00000   0.000000
variety37:spacing30:plant0   0.00000   0.000000
variety37:spacing30:plant3   0.08923   0.150334  0.5935  0.556164
variety37:spacing30:plant5   0.00000   0.000000
variety37:spacing40:plant0   0.00000   0.000000
variety37:spacing40:plant3  -0.02713   0.110857 -0.2447  0.807910
variety37:spacing40:plant5   0.00000   0.000000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.6.6 p254 Output 7.20

(44) MODEL

```
GLM(lint ~ bollwt + variety + spacing, p250)
```

```
$ANOVA
Response : lint
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            3 30.799 10.2665  201.65 < 2.2e-16 ***
RESIDUALS       45  2.291  0.0509
CORRECTED TOTAL 48 33.091
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
        Df  Sum Sq Mean Sq  F value    Pr(>F)
bollwt   1 29.0693 29.0693 570.9531 < 2.2e-16 ***
variety  1  1.2635  1.2635  24.8172 9.777e-06 ***
spacing  1  0.4666  0.4666   9.1655  0.004072 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df  Sum Sq Mean Sq  F value    Pr(>F)
bollwt   1 11.5717 11.5717 227.2815 < 2.2e-16 ***
variety  1  1.1973  1.1973  23.5168 1.516e-05 ***
spacing  1  0.4666  0.4666   9.1655  0.004072 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
        Df  Sum Sq Mean Sq  F value    Pr(>F)
bollwt   1 11.5717 11.5717 227.2815 < 2.2e-16 ***
variety  1  1.1973  1.1973  23.5168 1.516e-05 ***
```

```
spacing  1  0.4666  0.4666   9.1655  0.004072 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  0.13371   0.153949  0.8685  0.389718
bollwt       0.30144   0.019995 15.0759 < 2.2e-16 ***
variety213  -0.41066   0.084682 -4.8494 1.516e-05 ***
variety37    0.00000   0.000000
spacing30    0.20521   0.067782  3.0275  0.004072 **
spacing40    0.00000   0.000000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.6.7 p256

(45) MODEL

```
p256 = read.table("C:/G/Rt/SAS4lm/p256.txt", header=TRUE)
p256b = af(p256, c("bloc", "type", "logdose"))
GLM(y ~ bloc + type + logdose + type:logdose, p256b) # p258 Output 7.22
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            8  816.50 102.063  6.0641 0.0014 **
RESIDUALS       15  252.46  16.831
CORRECTED TOTAL 23 1068.96
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  12.04  12.042  0.7155 0.4109264
logdose       2 121.58  60.792  3.6120 0.0524231 .
type:logdose  2 144.08  72.042  4.2804 0.0338265 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  12.04  12.042  0.7155 0.4109264
logdose       2 121.58  60.792  3.6120 0.0524231 .
```

```
type:logdose  2 144.08  72.042  4.2804 0.0338265 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  12.04  12.042  0.7155 0.4109264
logdose       2 121.58  60.792  3.6120 0.0524231 .
type:logdose  2 144.08  72.042  4.2804 0.0338265 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
               Estimate Std. Error t value  Pr(>|t|)
(Intercept)      62.042     2.5123 24.6955 1.457e-13 ***
bloc1             7.667     2.3686  3.2368  0.005531 **
bloc2            -3.500     2.3686 -1.4777  0.160183
bloc3            -4.333     2.3686 -1.8295  0.087270 .
bloc4             0.000     0.0000
type1            -8.000     2.9009 -2.7578  0.014656 *
type2             0.000     0.0000
logdose0        -11.250     2.9009 -3.8781  0.001486 **
logdose1         -7.750     2.9009 -2.6716  0.017423 *
logdose2          0.000     0.0000
type1:logdose0   11.750     4.1025  2.8641  0.011824 *
type1:logdose1    8.000     4.1025  1.9500  0.070117 .
type1:logdose2    0.000     0.0000
type2:logdose0    0.000     0.0000
type2:logdose1    0.000     0.0000
type2:logdose2    0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.6.8 p261 Output 7.27

(46) MODEL

```
p256 = af(p256, c("bloc", "type"))
p256$logd2 = (p256$logdose)^2
GLM(y ~ bloc + type + logdose + logd2 + type:logdose + type:logd2, p256)
```

```
$ANOVA
Response : y
               Df  Sum Sq Mean Sq F value Pr(>F)
MODEL           8  816.50 102.063  6.0641 0.0014 **
```

```
RESIDUALS       15  252.46  16.831
CORRECTED TOTAL 23 1068.96
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  12.04  12.042  0.7155 0.4109264
logdose       1 115.56 115.562  6.8662 0.0193005 *
logd2         1   6.02   6.021  0.3577 0.5586917
type:logdose  1 138.06 138.062  8.2031 0.0118242 *
type:logd2    1   6.02   6.021  0.3577 0.5586917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  12.04  12.042  0.7155 0.4109264
logdose       1   0.39   0.389  0.0231 0.8811262
logd2         1   6.02   6.021  0.3577 0.5586917
type:logdose  1   0.81   0.812  0.0483 0.8290541
type:logd2    1   6.02   6.021  0.3577 0.5586917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  28.12  28.125  1.6711 0.2156736
logdose       1   0.39   0.389  0.0231 0.8811262
logd2         1   6.02   6.021  0.3577 0.5586917
type:logdose  1   0.81   0.812  0.0483 0.8290541
type:logd2    1   6.02   6.021  0.3577 0.5586917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)     50.792     2.5123 20.2175 2.697e-12 ***
bloc1            7.667     2.3686  3.2368  0.005531 **
bloc2           -3.500     2.3686 -1.4777  0.160183
bloc3           -4.333     2.3686 -1.8295  0.087270 .
bloc4            0.000     0.0000
type1            3.750     2.9009  1.2927  0.215674
type2            0.000     0.0000
logdose          1.375     5.2297  0.2629  0.796188
```

```
logd2            2.125     2.5123  0.8459  0.410926
type1:logdose   -1.625     7.3959 -0.2197  0.829054
type2:logdose    0.000     0.0000
type1:logd2     -2.125     3.5529 -0.5981  0.558692
type2:logd2      0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.6.9 p262 Output 7.28

(47) MODEL

```
GLM(y ~ bloc + type + type:logdose, p256b)
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL            8  816.50 102.063  6.0641 0.0014 **
RESIDUALS       15  252.46  16.831
CORRECTED TOTAL 23 1068.96
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  12.04  12.042  0.7155 0.4109264
type:logdose  4 265.67  66.417  3.9462 0.0220552 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  12.04  12.042  0.7155 0.4109264
type:logdose  4 265.67  66.417  3.9462 0.0220552 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
             Df Sum Sq Mean Sq F value    Pr(>F)
bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1  12.04  12.042  0.7155 0.4109264
type:logdose  4 265.67  66.417  3.9462 0.0220552 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
               Estimate Std. Error t value  Pr(>|t|)
(Intercept)      62.042     2.5123 24.6955 1.457e-13 ***
bloc1             7.667     2.3686  3.2368  0.005531 **
bloc2            -3.500     2.3686 -1.4777  0.160183
bloc3            -4.333     2.3686 -1.8295  0.087270 .
bloc4             0.000     0.0000
type1            -8.000     2.9009 -2.7578  0.014656 *
type2             0.000     0.0000
type1:logdose0    0.500     2.9009  0.1724  0.865459
type1:logdose1    0.250     2.9009  0.0862  0.932463
type1:logdose2    0.000     0.0000
type2:logdose0  -11.250     2.9009 -3.8781  0.001486 **
type2:logdose1   -7.750     2.9009 -2.6716  0.017423 *
type2:logdose2    0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 5.7 Chapter 8

### 5.7.1 p269

(48) MODEL

```
p269 = read.csv("C:/G/Rt/SAS4lm/fev1uni.csv")
p269 = af(p269, c("drug", "hour", "patient"))
GLM(fev1 ~ drug + patient %in% drug + hour + drug:hour, p269) # p271 Output 8.3
```

```
$ANOVA
Response : fev1
                 Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            92 296.65  3.2244  51.078 < 2.2e-16 ***
RESIDUALS       483  30.49  0.0631
CORRECTED TOTAL 575 327.14
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
             Df  Sum Sq Mean Sq F value    Pr(>F)
drug          2  25.783 12.8913 204.212 < 2.2e-16 ***
drug:patient 69 247.412  3.5857  56.801 < 2.2e-16 ***
hour          7  17.170  2.4529  38.857 < 2.2e-16 ***
drug:hour    14   6.280  0.4486   7.106 1.923e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
             Df  Sum Sq Mean Sq F value    Pr(>F)
drug          2  25.783 12.8913 204.212 < 2.2e-16 ***
drug:patient 69 247.412  3.5857  56.801 < 2.2e-16 ***
hour          7  17.170  2.4529  38.857 < 2.2e-16 ***
drug:hour    14   6.280  0.4486   7.106 1.923e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
             Df  Sum Sq Mean Sq F value    Pr(>F)
drug          2  25.783 12.8913 204.212 < 2.2e-16 ***
drug:patient 69 247.412  3.5857  56.801 < 2.2e-16 ***
hour          7  17.170  2.4529  38.857 < 2.2e-16 ***
drug:hour    14   6.280  0.4486   7.106 1.923e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                Estimate Std. Error  t value  Pr(>|t|)
(Intercept)      2.89349    0.10096  28.6606 < 2.2e-16 ***
druga            0.03458    0.14278   0.2422 0.8087105
drugc            0.63172    0.14278   4.4246 1.195e-05 ***
drugp            0.00000    0.00000
druga:patient201 -0.76375    0.12562  -6.0796 2.449e-09 ***
druga:patient202 -0.02375    0.12562  -0.1891 0.8501297
druga:patient203 -0.90875    0.12562  -7.2338 1.855e-12 ***
druga:patient204  0.31875    0.12562   2.5373 0.0114843 *
druga:patient205  0.32125    0.12562   2.5572 0.0108561 *
druga:patient206  0.20875    0.12562   1.6617 0.0972242 .
druga:patient207  0.00875    0.12562   0.0697 0.9444998
druga:patient208 -0.25500    0.12562  -2.0298 0.0429198 *
druga:patient209  0.31125    0.12562   2.4776 0.0135676 *
druga:patient210 -0.47500    0.12562  -3.7811 0.0001757 ***
druga:patient211  0.34375    0.12562   2.7363 0.0064421 **
druga:patient212 -1.29750    0.12562 -10.3283 < 2.2e-16 ***
druga:patient214  0.04125    0.12562   0.3284 0.7427837
druga:patient215  0.41000    0.12562   3.2637 0.0011777 **
druga:patient216  0.47250    0.12562   3.7612 0.0001899 ***
druga:patient217 -1.71625    0.12562 -13.6617 < 2.2e-16 ***
druga:patient218 -0.35000    0.12562  -2.7861 0.0055451 **
druga:patient219  0.07000    0.12562   0.5572 0.5776402
druga:patient220 -0.43875    0.12562  -3.4925 0.0005224 ***
druga:patient221  0.63125    0.12562   5.0249 7.106e-07 ***
druga:patient222 -0.04375    0.12562  -0.3483 0.7277982
druga:patient223  0.98500    0.12562   7.8408 2.887e-14 ***
druga:patient224  0.83625    0.12562   6.6567 7.624e-11 ***
```

```
druga:patient232  0.00000    0.00000                          
drugc:patient201 -0.53000    0.12562  -4.2189 2.933e-05 ***
drugc:patient202 -0.42250    0.12562  -3.3632 0.0008318 ***
drugc:patient203 -1.53375    0.12562 -12.2089 < 2.2e-16 ***
drugc:patient204 -0.21000    0.12562  -1.6716 0.0952434 .  
drugc:patient205  0.32375    0.12562   2.5771 0.0102586 *  
drugc:patient206  0.11750    0.12562   0.9353 0.3500901    
drugc:patient207 -1.72750    0.12562 -13.7512 < 2.2e-16 ***
drugc:patient208 -0.43625    0.12562  -3.4726 0.0005617 ***
drugc:patient209 -0.25500    0.12562  -2.0298 0.0429198 *  
drugc:patient210 -1.08250    0.12562  -8.6169 < 2.2e-16 ***
drugc:patient211 -0.74500    0.12562  -5.9303 5.765e-09 ***
drugc:patient212 -1.72375    0.12562 -13.7214 < 2.2e-16 ***
drugc:patient214 -0.68625    0.12562  -5.4627 7.522e-08 ***
drugc:patient215  0.09875    0.12562   0.7861 0.4322131    
drugc:patient216  0.05375    0.12562   0.4279 0.6689439    
drugc:patient217 -1.91875    0.12562 -15.2736 < 2.2e-16 ***
drugc:patient218 -0.78250    0.12562  -6.2288 1.023e-09 ***
drugc:patient219 -0.84875    0.12562  -6.7562 4.087e-11 ***
drugc:patient220 -1.01000    0.12562  -8.0398 7.105e-15 ***
drugc:patient221  0.23250    0.12562   1.8507 0.0648170 .  
drugc:patient222 -0.60625    0.12562  -4.8259 1.873e-06 ***
drugc:patient223  0.96000    0.12562   7.6418 1.164e-13 ***
drugc:patient224  0.22750    0.12562   1.8109 0.0707711 .  
drugc:patient232  0.00000    0.00000                          
drugp:patient201 -0.63250    0.12562  -5.0348 6.764e-07 ***
drugp:patient202 -0.04500    0.12562  -0.3582 0.7203440    
drugp:patient203 -1.27250    0.12562 -10.1293 < 2.2e-16 ***
drugp:patient204  0.34750    0.12562   2.7662 0.0058894 ** 
drugp:patient205  0.60625    0.12562   4.8259 1.873e-06 ***
drugp:patient206  0.11500    0.12562   0.9154 0.3604275    
drugp:patient207 -0.55875    0.12562  -4.4478 1.078e-05 ***
drugp:patient208 -0.57000    0.12562  -4.5373 7.199e-06 ***
drugp:patient209  0.35000    0.12562   2.7861 0.0055451 ** 
drugp:patient210 -0.36875    0.12562  -2.9353 0.0034909 ** 
drugp:patient211 -0.26375    0.12562  -2.0995 0.0362913 *  
drugp:patient212 -1.18000    0.12562  -9.3930 < 2.2e-16 ***
drugp:patient214 -0.30625    0.12562  -2.4378 0.0151363 *  
drugp:patient215 -0.06250    0.12562  -0.4975 0.6190549    
drugp:patient216  0.24000    0.12562   1.9104 0.0566680 .  
drugp:patient217 -1.80375    0.12562 -14.3582 < 2.2e-16 ***
drugp:patient218 -0.28750    0.12562  -2.2886 0.0225363 *  
drugp:patient219 -0.14375    0.12562  -1.1443 0.2530759    
drugp:patient220 -0.21125    0.12562  -1.6816 0.0932951 .  
drugp:patient221  0.78375    0.12562   6.2388 9.646e-10 ***
drugp:patient222 -0.06500    0.12562  -0.5174 0.6051056    
drugp:patient223  0.38000    0.12562   3.0249 0.0026199 ** 
drugp:patient224  0.79500    0.12562   6.3283 5.662e-10 ***
```

```
drugp:patient232  0.00000    0.00000
hour1             0.09458    0.07253   1.3041 0.1928336
hour2             0.16042    0.07253   2.2117 0.0274523 *
hour3             0.16583    0.07253   2.2864 0.0226619 *
hour4             0.13917    0.07253   1.9188 0.0556048 .
hour5             0.03625    0.07253   0.4998 0.6174473
hour6             0.08333    0.07253   1.1490 0.2511439
hour7             0.05250    0.07253   0.7238 0.4695140
hour8             0.00000    0.00000
druga:hour1       0.52083    0.10257   5.0777 5.464e-07 ***
druga:hour2       0.37833    0.10257   3.6884 0.0002513 ***
druga:hour3       0.16000    0.10257   1.5599 0.1194454
druga:hour4       0.04917    0.10257   0.4793 0.6319171
druga:hour5       0.15917    0.10257   1.5517 0.1213779
druga:hour6       0.03792    0.10257   0.3697 0.7118002
druga:hour7      -0.04208    0.10257  -0.4103 0.6817836
druga:hour8       0.00000    0.00000
drugc:hour1       0.58625    0.10257   5.7155 1.917e-08 ***
drugc:hour2       0.45583    0.10257   4.4440 1.096e-05 ***
drugc:hour3       0.40125    0.10257   3.9119 0.0001047 ***
drugc:hour4       0.29417    0.10257   2.8679 0.0043130 **
drugc:hour5       0.20292    0.10257   1.9783 0.0484656 *
drugc:hour6      -0.00833    0.10257  -0.0812 0.9352821
drugc:hour7      -0.08583    0.10257  -0.8368 0.4031156
drugc:hour8       0.00000    0.00000
drugp:hour1       0.00000    0.00000
drugp:hour2       0.00000    0.00000
drugp:hour3       0.00000    0.00000
drugp:hour4       0.00000    0.00000
drugp:hour5       0.00000    0.00000
drugp:hour6       0.00000    0.00000
drugp:hour7       0.00000    0.00000
drugp:hour8       0.00000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 5.8 Chapter 11

### 5.8.1 p390

(49) MODEL

```
p390 = read.table("C:/G/Rt/SAS4lm/p390.txt", header=TRUE)
p390$ca = ifelse(p390$a == 0, -1, 1)
p390$cb = ifelse(p390$b == 0, -1, 1)
p390$cc = ifelse(p390$c == 0, -1, 1)
```

```r
p390 = af(p390, c("rep", "blk", "a", "b", "c"))
GLM(y ~ rep/blk + ca*cb*cc, p390)
```

```
$ANOVA
Response : y
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           12  81.75  6.8125  33.601 6.618e-07 ***
RESIDUALS       11   2.23  0.2027
CORRECTED TOTAL 23  83.98
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
         Df Sum Sq Mean Sq  F value    Pr(>F)
rep       2  0.051   0.025   0.1256 0.8832237
rep:blk   3  7.432   2.477  12.2194 0.0007966 ***
ca        1 21.075  21.075 103.9487 6.090e-07 ***
cb        1  0.005   0.005   0.0224 0.8837872
ca:cb     1  1.723   1.723   8.4969 0.0140640 *
cc        1 37.776  37.776 186.3209 3.063e-08 ***
ca:cc     1  2.318   2.318  11.4332 0.0061285 **
cb:cc     1 11.340  11.340  55.9328 1.232e-05 ***
ca:cb:cc  1  0.031   0.031   0.1511 0.7049490
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
         Df Sum Sq Mean Sq  F value    Pr(>F)
rep       2  0.051   0.025   0.1256  0.883224
rep:blk   3  1.668   0.556   2.7416  0.093789 .
ca        1 21.075  21.075 103.9487 6.090e-07 ***
cb        1  0.005   0.005   0.0224  0.883787
ca:cb     1  1.723   1.723   8.4969  0.014064 *
cc        1 37.776  37.776 186.3209 3.063e-08 ***
ca:cc     1  2.318   2.318  11.4332  0.006129 **
cb:cc     1 11.340  11.340  55.9328 1.232e-05 ***
ca:cb:cc  1  0.031   0.031   0.1511  0.704949
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
         Df Sum Sq Mean Sq  F value    Pr(>F)
rep       2  0.051   0.025   0.1256  0.883224
rep:blk   3  1.668   0.556   2.7416  0.093789 .
ca        1 21.075  21.075 103.9487 6.090e-07 ***
cb        1  0.005   0.005   0.0224  0.883787
ca:cb     1  1.723   1.723   8.4969  0.014064 *
```

```
cc        1 37.776  37.776 186.3209 3.063e-08 ***
ca:cc     1  2.318   2.318  11.4332  0.006129 **
cb:cc     1 11.340  11.340  55.9328 1.232e-05 ***
ca:cb:cc  1  0.031   0.031   0.1511  0.704949
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  2.01062    0.25171  7.9879 6.627e-06 ***
rep1         0.32813    0.35597  0.9218  0.376420
rep2        -0.11000    0.35597 -0.3090  0.763085
rep3         0.00000    0.00000
rep1:blk1    0.20000    0.38995  0.5129  0.618170
rep1:blk2    0.00000    0.00000
rep2:blk1    0.87375    0.38995  2.2407  0.046645 *
rep2:blk2    0.00000    0.00000
rep3:blk1    0.66875    0.38995  1.7150  0.114346
rep3:blk2    0.00000    0.00000
ca           0.93708    0.09191 10.1955 6.090e-07 ***
cb           0.01375    0.09191  0.1496  0.883787
ca:cb       -0.26792    0.09191 -2.9149  0.014064 *
cc           1.25458    0.09191 13.6499 3.063e-08 ***
ca:cc        0.38062    0.11257  3.3813  0.006129 **
cb:cc       -0.84188    0.11257 -7.4788 1.232e-05 ***
ca:cb:cc    -0.04375    0.11257 -0.3887  0.704949
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.8.2 p394

(50) MODEL

```r
p394 = read.table("C:/G/Rt/SAS4lm/p394.txt", header=TRUE)
p394 = af(p394, c("a", "b", "c", "d"))
GLM(y ~ ca*cb*cc*cd, p394)
```

```
$ANOVA
Response : y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL            7 6.3559 0.90798
RESIDUALS        0 0.0000
CORRECTED TOTAL  7 6.3559

$`Type I`
            Df  Sum Sq Mean Sq F value Pr(>F)
```

```
ca           1 2.07061 2.07061
cb           1 0.59951 0.59951
ca:cb        1 0.00031 0.00031
cc           1 0.00551 0.00551
ca:cc        1 0.80011 0.80011
cb:cc        1 2.82031 2.82031
ca:cb:cc     1 0.05951 0.05951
cd           0
ca:cd        0
cb:cd        0
ca:cb:cd     0
cc:cd        0
ca:cc:cd     0
cb:cc:cd     0
ca:cb:cc:cd  0

$`Type II`
            Df Sum Sq Mean Sq F value Pr(>F)
ca           0
cb           0
ca:cb        0
cc           0
ca:cc        0
cb:cc        0
ca:cb:cc     0
cd           0
ca:cd        0
cb:cd        0
ca:cb:cd     0
cc:cd        0
ca:cc:cd     0
cb:cc:cd     0
ca:cb:cc:cd  0

$`Type III`
CAUTION: Singularity Exists !
            Df Sum Sq Mean Sq F value Pr(>F)
ca           0
cb           0
ca:cb        0
cc           0
ca:cc        0
cb:cc        0
ca:cb:cc     0
cd           0
ca:cd        0
cb:cd        0
ca:cb:cd     0
```

```
cc:cd        0
ca:cc:cd     0
cb:cc:cd     0
ca:cb:cc:cd  0

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.68875        Inf       0
ca           0.50875        Inf       0
cb           0.27375        Inf       0
ca:cb       -0.00625        Inf       0
cc          -0.02625        Inf       0
ca:cc       -0.31625        Inf       0
cb:cc        0.59375        Inf       0
ca:cb:cc    -0.08625        Inf       0
cd           0.00000
ca:cd        0.00000
cb:cd        0.00000
ca:cb:cd     0.00000
cc:cd        0.00000
ca:cc:cd     0.00000
cb:cc:cd     0.00000
ca:cb:cc:cd  0.00000
```

(51) MODEL

```
GLM(y ~ a*b*c*d, p394)
```

```
$ANOVA
Response : y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL            7 6.3559 0.90798
RESIDUALS        0 0.0000
CORRECTED TOTAL  7 6.3559

$`Type I`
        Df  Sum Sq Mean Sq F value Pr(>F)
a        1 2.07061 2.07061
b        1 0.59951 0.59951
a:b      1 0.00031 0.00031
c        1 0.00551 0.00551
a:c      1 0.80011 0.80011
b:c      1 2.82031 2.82031
a:b:c    1 0.05951 0.05951
d        0
a:d      0
b:d      0
```

```
a:b:d    0
c:d      0
a:c:d    0
b:c:d    0
a:b:c:d  0

$`Type II`
        Df Sum Sq Mean Sq F value Pr(>F)
a        0
b        0
a:b      0
c        0
a:c      0
b:c      0
a:b:c    0
d        0
a:d      0
b:d      0
a:b:d    0
c:d      0
a:c:d    0
b:c:d    0
a:b:c:d  0

$`Type III`
CAUTION: Singularity Exists !
        Df Sum Sq Mean Sq F value Pr(>F)
a        0
b        0
a:b      0
c        0
a:c      0
b:c      0
a:b:c    0
d        0
a:d      0
b:d      0
a:b:d    0
c:d      0
a:c:d    0
b:c:d    0
a:b:c:d  0

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)     3.63        Inf       0
a0             -0.20        Inf       0
a1              0.00
```

```
b0             -1.55        Inf       0
b1              0.00
a0:b0          -0.37        Inf       0
a0:b1           0.00
a1:b0           0.00
a1:b1           0.00
c0             -0.33        Inf       0
c1              0.00
a0:c0          -1.61        Inf       0
a0:c1           0.00
a1:c0           0.00
a1:c1           0.00
b0:c0           2.03        Inf       0
b0:c1           0.00
b1:c0           0.00
b1:c1           0.00
a0:b0:c0        0.69        Inf       0
a0:b0:c1        0.00
a0:b1:c0        0.00
a0:b1:c1        0.00
a1:b0:c0        0.00
a1:b0:c1        0.00
a1:b1:c0        0.00
a1:b1:c1        0.00
d0              0.00
d1              0.00
a0:d0           0.00
a0:d1           0.00
a1:d0           0.00
a1:d1           0.00
b0:d0           0.00
b0:d1           0.00
b1:d0           0.00
b1:d1           0.00
a0:b0:d0        0.00
a0:b0:d1        0.00
a0:b1:d0        0.00
a0:b1:d1        0.00
a1:b0:d0        0.00
a1:b0:d1        0.00
a1:b1:d0        0.00
a1:b1:d1        0.00
c0:d0           0.00
c0:d1           0.00
c1:d0           0.00
c1:d1           0.00
a0:c0:d0        0.00
a0:c0:d1        0.00
```

```
a0:c1:d0        0.00
a0:c1:d1        0.00
a1:c0:d0        0.00
a1:c0:d1        0.00
a1:c1:d0        0.00
a1:c1:d1        0.00
b0:c0:d0        0.00
b0:c0:d1        0.00
b0:c1:d0        0.00
b0:c1:d1        0.00
b1:c0:d0        0.00
b1:c0:d1        0.00
b1:c1:d0        0.00
b1:c1:d1        0.00
a0:b0:c0:d0     0.00
a0:b0:c0:d1     0.00
a0:b0:c1:d0     0.00
a0:b0:c1:d1     0.00
a0:b1:c0:d0     0.00
a0:b1:c0:d1     0.00
a0:b1:c1:d0     0.00
a0:b1:c1:d1     0.00
a1:b0:c0:d0     0.00
a1:b0:c0:d1     0.00
a1:b0:c1:d0     0.00
a1:b0:c1:d1     0.00
a1:b1:c0:d0     0.00
a1:b1:c0:d1     0.00
a1:b1:c1:d0     0.00
a1:b1:c1:d1     0.00
```

#### 5.8.3 p399

(52) MODEL

```
p399 = read.table("C:/G/Rt/SAS4lm/p399.txt", header=TRUE)
p399 = af(p399, c("blk", "trt"))
GLM(y ~ trt + blk, p399)
```

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value   Pr(>F)
MODEL            8 281.127  35.141  40.822 0.005606 **
RESIDUALS        3   2.583   0.861
CORRECTED TOTAL 11 283.710
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value   Pr(>F)
trt  3 102.26  34.086  39.596 0.006515 **
blk  5 178.87  35.774  41.558 0.005691 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df  Sum Sq Mean Sq F value   Pr(>F)
trt  3  59.018  19.673  22.853 0.014388 *
blk  5 178.871  35.774  41.558 0.005691 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value   Pr(>F)
trt  3  59.018  19.673  22.853 0.014388 *
blk  5 178.871  35.774  41.558 0.005691 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error  t value  Pr(>|t|)
(Intercept)  19.1375    1.03732  18.4489 0.0003475 ***
trt1         -6.8250    0.92781  -7.3560 0.0051925 **
trt2         -5.9750    0.92781  -6.4399 0.0075922 **
trt3         -2.7000    0.92781  -2.9101 0.0619928 .
trt4          0.0000    0.00000
blk1        -10.7875    1.03732 -10.3994 0.0018975 **
blk2         -9.9375    1.03732  -9.5799 0.0024133 **
blk3         -5.9750    1.03732  -5.7600 0.0103986 *
blk4         -4.2000    1.03732  -4.0489 0.0271308 *
blk5         -2.1750    1.13633  -1.9141 0.1515206
blk6          0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.8.4 p403

(53) MODEL

```
p403 = read.table("C:/G/Rt/SAS4lm/p403.txt", header=TRUE)
p403 = af(p403, c("PATIENT", "VISIT"))
GLM(HR ~ SEQUENCE + PATIENT %in% SEQUENCE + VISIT + DRUG + RESIDS + RESIDT,p403)
```

```
$ANOVA
Response : HR
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           29 6408.7  220.99   3.912 3.127e-05 ***
RESIDUALS       42 2372.6   56.49
CORRECTED TOTAL 71 8781.3
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
                 Df Sum Sq Mean Sq F value   Pr(>F)
SEQUENCE          5  508.9  101.79  1.8019 0.133346
SEQUENCE:PATIENT 18 4692.3  260.69  4.6147 2.21e-05 ***
VISIT             2  146.8   73.39  1.2991 0.283499
DRUG              2  668.8  334.39  5.9194 0.005435 **
RESIDS            1  391.0  391.02  6.9219 0.011854 *
RESIDT            1    0.8    0.84  0.0149 0.903511
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
                 Df Sum Sq Mean Sq F value   Pr(>F)
SEQUENCE          5  701.2 140.237  2.4825  0.04665 *
SEQUENCE:PATIENT 18 4692.3 260.685  4.6147 2.21e-05 ***
VISIT             2  146.8  73.389  1.2991  0.28350
DRUG              2  344.0 171.975  3.0443  0.05826 .
RESIDS            1  309.2 309.174  5.4731  0.02414 *
RESIDT            1    0.8   0.840  0.0149  0.90351
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
                 Df Sum Sq Mean Sq F value   Pr(>F)
SEQUENCE          5  701.2 140.237  2.4825  0.04665 *
SEQUENCE:PATIENT 18 4692.3 260.685  4.6147 2.21e-05 ***
VISIT             2  146.8  73.389  1.2991  0.28350
DRUG              2  344.0 171.975  3.0443  0.05826 .
RESIDS            1  309.2 309.174  5.4731  0.02414 *
RESIDT            1    0.8   0.840  0.0149  0.90351
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                   Estimate Std. Error t value  Pr(>|t|)
(Intercept)          69.333     4.7287 14.6622 < 2.2e-16 ***
SEQUENCEA            -4.458     6.2319 -0.7154 0.4783191
SEQUENCEB            12.667     6.1368  2.0641 0.0452254 *
SEQUENCEC             4.854     6.2319  0.7789 0.4403943
```

```
SEQUENCED             24.187     6.2319  3.8812 0.0003609 ***
SEQUENCEE             12.875     6.2319  2.0660 0.0450354 *
SEQUENCEF              0.000     0.0000
SEQUENCEA:PATIENT1     0.000     0.0000
SEQUENCEA:PATIENT10    0.000     0.0000
SEQUENCEA:PATIENT11    0.000     0.0000
SEQUENCEA:PATIENT12    0.000     0.0000
SEQUENCEA:PATIENT13    0.000     0.0000
SEQUENCEA:PATIENT14    0.000     0.0000
SEQUENCEA:PATIENT15   16.000     6.1368  2.6072 0.0125823 *
SEQUENCEA:PATIENT16    0.000     0.0000
SEQUENCEA:PATIENT17   29.333     6.1368  4.7799 2.168e-05 ***
SEQUENCEA:PATIENT18    0.000     0.0000
SEQUENCEA:PATIENT19    0.000     0.0000
SEQUENCEA:PATIENT2     0.000     0.0000
SEQUENCEA:PATIENT20    0.000     0.0000
SEQUENCEA:PATIENT21    0.000     0.0000
SEQUENCEA:PATIENT22    0.000     0.0000
SEQUENCEA:PATIENT23    0.000     0.0000
SEQUENCEA:PATIENT24    0.000     0.0000
SEQUENCEA:PATIENT3     0.000     0.0000
SEQUENCEA:PATIENT4     0.000     0.0000
SEQUENCEA:PATIENT5     0.000     0.0000
SEQUENCEA:PATIENT6     0.000     0.0000
SEQUENCEA:PATIENT7    25.333     6.1368  4.1281 0.0001697 ***
SEQUENCEA:PATIENT8     0.000     0.0000
SEQUENCEA:PATIENT9     0.000     0.0000
SEQUENCEB:PATIENT1    10.667     6.1368  1.7382 0.0895112 .
SEQUENCEB:PATIENT10    0.000     0.0000
SEQUENCEB:PATIENT11    0.000     0.0000
SEQUENCEB:PATIENT12    0.000     0.0000
SEQUENCEB:PATIENT13    0.000     0.0000
SEQUENCEB:PATIENT14    0.000     0.0000
SEQUENCEB:PATIENT15    0.000     0.0000
SEQUENCEB:PATIENT16    0.000     0.0000
SEQUENCEB:PATIENT17    0.000     0.0000
SEQUENCEB:PATIENT18    0.000     0.0000
SEQUENCEB:PATIENT19    0.000     0.0000
SEQUENCEB:PATIENT2     0.000     0.0000
SEQUENCEB:PATIENT20  -13.333     6.1368 -2.1727 0.0354954 *
SEQUENCEB:PATIENT21    0.000     0.0000
SEQUENCEB:PATIENT22    0.000     0.0000
SEQUENCEB:PATIENT23    0.000     0.0000
SEQUENCEB:PATIENT24    0.000     0.0000
SEQUENCEB:PATIENT3     4.000     6.1368  0.6518 0.5180764
SEQUENCEB:PATIENT4     0.000     0.0000
SEQUENCEB:PATIENT5     0.000     0.0000
SEQUENCEB:PATIENT6     0.000     0.0000
```

```
SEQUENCEB:PATIENT7     0.000     0.0000
SEQUENCEB:PATIENT8     0.000     0.0000
SEQUENCEB:PATIENT9     0.000     0.0000
SEQUENCEC:PATIENT1     0.000     0.0000
SEQUENCEC:PATIENT10    2.667     6.1368  0.4345 0.6661219
SEQUENCEC:PATIENT11    0.000     0.0000
SEQUENCEC:PATIENT12    0.000     0.0000
SEQUENCEC:PATIENT13    0.000     0.0000
SEQUENCEC:PATIENT14    0.000     0.0000
SEQUENCEC:PATIENT15    0.000     0.0000
SEQUENCEC:PATIENT16    0.000     0.0000
SEQUENCEC:PATIENT17    0.000     0.0000
SEQUENCEC:PATIENT18    0.000     0.0000
SEQUENCEC:PATIENT19    0.000     0.0000
SEQUENCEC:PATIENT2     0.000     0.0000
SEQUENCEC:PATIENT20    0.000     0.0000
SEQUENCEC:PATIENT21   22.667     6.1368  3.6936 0.0006327 ***
SEQUENCEC:PATIENT22   13.333     6.1368  2.1727 0.0354954 *
SEQUENCEC:PATIENT23    0.000     0.0000
SEQUENCEC:PATIENT24    0.000     0.0000
SEQUENCEC:PATIENT3     0.000     0.0000
SEQUENCEC:PATIENT4     0.000     0.0000
SEQUENCEC:PATIENT5     0.000     0.0000
SEQUENCEC:PATIENT6     0.000     0.0000
SEQUENCEC:PATIENT7     0.000     0.0000
SEQUENCEC:PATIENT8     0.000     0.0000
SEQUENCEC:PATIENT9     0.000     0.0000
SEQUENCED:PATIENT1     0.000     0.0000
SEQUENCED:PATIENT10    0.000     0.0000
SEQUENCED:PATIENT11    0.000     0.0000
SEQUENCED:PATIENT12    0.000     0.0000
SEQUENCED:PATIENT13   -6.667     6.1368 -1.0863 0.2835215
SEQUENCED:PATIENT14    0.000     0.0000
SEQUENCED:PATIENT15    0.000     0.0000
SEQUENCED:PATIENT16    0.000     0.0000
SEQUENCED:PATIENT17    0.000     0.0000
SEQUENCED:PATIENT18    0.000     0.0000
SEQUENCED:PATIENT19    0.000     0.0000
SEQUENCED:PATIENT2     0.000     0.0000
SEQUENCED:PATIENT20    0.000     0.0000
SEQUENCED:PATIENT21    0.000     0.0000
SEQUENCED:PATIENT22    0.000     0.0000
SEQUENCED:PATIENT23    0.000     0.0000
SEQUENCED:PATIENT24   -7.333     6.1368 -1.1950 0.2387989
SEQUENCED:PATIENT3     0.000     0.0000
SEQUENCED:PATIENT4    -1.333     6.1368 -0.2173 0.8290506
SEQUENCED:PATIENT5     0.000     0.0000
SEQUENCED:PATIENT6     0.000     0.0000
```

```
SEQUENCED:PATIENT7     0.000     0.0000
SEQUENCED:PATIENT8     0.000     0.0000
SEQUENCED:PATIENT9     0.000     0.0000
SEQUENCEE:PATIENT1     0.000     0.0000
SEQUENCEE:PATIENT10    0.000     0.0000
SEQUENCEE:PATIENT11    0.000     0.0000
SEQUENCEE:PATIENT12   12.000     6.1368  1.9554 0.0572081 .
SEQUENCEE:PATIENT13    0.000     0.0000
SEQUENCEE:PATIENT14    0.000     0.0000
SEQUENCEE:PATIENT15    0.000     0.0000
SEQUENCEE:PATIENT16   13.333     6.1368  2.1727 0.0354954 *
SEQUENCEE:PATIENT17    0.000     0.0000
SEQUENCEE:PATIENT18    0.000     0.0000
SEQUENCEE:PATIENT19   -0.667     6.1368 -0.1086 0.9140096
SEQUENCEE:PATIENT2     0.000     0.0000
SEQUENCEE:PATIENT20    0.000     0.0000
SEQUENCEE:PATIENT21    0.000     0.0000
SEQUENCEE:PATIENT22    0.000     0.0000
SEQUENCEE:PATIENT23    0.000     0.0000
SEQUENCEE:PATIENT24    0.000     0.0000
SEQUENCEE:PATIENT3     0.000     0.0000
SEQUENCEE:PATIENT4     0.000     0.0000
SEQUENCEE:PATIENT5     0.000     0.0000
SEQUENCEE:PATIENT6     0.000     0.0000
SEQUENCEE:PATIENT7     0.000     0.0000
SEQUENCEE:PATIENT8     0.000     0.0000
SEQUENCEE:PATIENT9     0.000     0.0000
SEQUENCEF:PATIENT1     0.000     0.0000
SEQUENCEF:PATIENT10    0.000     0.0000
SEQUENCEF:PATIENT11   10.667     6.1368  1.7382 0.0895112 .
SEQUENCEF:PATIENT12    0.000     0.0000
SEQUENCEF:PATIENT13    0.000     0.0000
SEQUENCEF:PATIENT14   16.667     6.1368  2.7159 0.0095552 **
SEQUENCEF:PATIENT15    0.000     0.0000
SEQUENCEF:PATIENT16    0.000     0.0000
SEQUENCEF:PATIENT17    0.000     0.0000
SEQUENCEF:PATIENT18   18.667     6.1368  3.0418 0.0040426 **
SEQUENCEF:PATIENT19    0.000     0.0000
SEQUENCEF:PATIENT2     0.000     0.0000
SEQUENCEF:PATIENT20    0.000     0.0000
SEQUENCEF:PATIENT21    0.000     0.0000
SEQUENCEF:PATIENT22    0.000     0.0000
SEQUENCEF:PATIENT23    0.000     0.0000
SEQUENCEF:PATIENT24    0.000     0.0000
SEQUENCEF:PATIENT3     0.000     0.0000
SEQUENCEF:PATIENT4     0.000     0.0000
SEQUENCEF:PATIENT5     0.000     0.0000
SEQUENCEF:PATIENT6     0.000     0.0000
```

```
SEQUENCEF:PATIENT7     0.000     0.0000
SEQUENCEF:PATIENT8     0.000     0.0000
SEQUENCEF:PATIENT9     0.000     0.0000
VISIT2                -2.583     2.1697 -1.1907 0.2404762
VISIT3                 0.750     2.1697  0.3457 0.7313138
VISIT4                 0.000     0.0000
DRUGplacebo           -5.938     2.4258 -2.4477 0.0186398 *
DRUGstandard          -3.625     2.4258 -1.4944 0.1425553
DRUGtest               0.000     0.0000
RESIDS                -4.396     1.8790 -2.3395 0.0241414 *
RESIDT                 0.229     1.8790  0.1220 0.9035106
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(54) MODEL

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(HR ~ SEQUENCE + PATIENT %in% SEQUENCE + VISIT + DRUG + RESIDS + RESIDT,
         p403), type=3, singular.ok=TRUE) # NOT OK
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: HR
                 Sum Sq Df F values   Pr(>F)
SEQUENCE            0.0  0
VISIT             146.8  2   1.2991  0.28350
DRUG              344.0  2   3.0443  0.05826 .
RESIDS            309.2  1   5.4731  0.02414 *
RESIDT              0.8  1   0.0149  0.90351
SEQUENCE:PATIENT 4692.3 18   4.6147 2.21e-05 ***
Residuals        2372.6 42
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.8.5 p409 11.5

(55) MODEL

```
p409 = read.table("C:/G/Rt/SAS4lm/p409.txt", header=TRUE)
GLM(TS ~ SOURCE*AMT, p409) # p410 Output 11.21
```

```
$ANOVA
```

```
Response : TS
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL            5 258.727  51.745  263.71 1.785e-09 ***
RESIDUALS        9   1.766   0.196
CORRECTED TOTAL 14 260.493
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
           Df  Sum Sq Mean Sq F value    Pr(>F)
SOURCE      2  98.001  49.001 249.720 1.306e-08 ***
AMT         1 138.245 138.245 704.534 7.392e-10 ***
SOURCE:AMT  2  22.481  11.240  57.284 7.595e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
           Df  Sum Sq Mean Sq F value    Pr(>F)
SOURCE      2  98.001  49.001 249.720 1.306e-08 ***
AMT         1 138.245 138.245 704.534 7.392e-10 ***
SOURCE:AMT  2  22.481  11.240  57.284 7.595e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
           Df  Sum Sq Mean Sq F value    Pr(>F)
SOURCE      2   0.070   0.035   0.179     0.839
AMT         1 138.245 138.245 704.534 7.392e-10 ***
SOURCE:AMT  2  22.481  11.240  57.284 7.595e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error  t value  Pr(>|t|)
(Intercept)     9.49    0.46459  20.4266 7.537e-09 ***
SOURCEA         0.33    0.65703   0.5023    0.6275
SOURCEB        -0.02    0.65703  -0.0304    0.9764
SOURCEC         0.00    0.00000
AMT             3.35    0.14008  23.9150 1.867e-09 ***
SOURCEA:AMT    -1.61    0.19810  -8.1271 1.951e-05 ***
SOURCEB:AMT    -2.00    0.19810 -10.0958 3.305e-06 ***
SOURCEC:AMT     0.00    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.8.6 p412

(56) MODEL

```
p412 = read.table("C:/G/Rt/SAS4lm/p412.txt", header=TRUE)
GLM(ts ~ source:amt, p412) # p413 Output 11.24
```

```
$ANOVA
Response : ts
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            3 393.01 131.002  903.34 < 2.2e-16 ***
RESIDUALS       16   2.32   0.145
CORRECTED TOTAL 19 395.33
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
           Df Sum Sq Mean Sq F value    Pr(>F)
source:amt  3 393.01     131  903.34 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
           Df Sum Sq Mean Sq F value    Pr(>F)
source:amt  3 393.01     131  903.34 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
           Df Sum Sq Mean Sq F value    Pr(>F)
source:amt  3 393.01     131  903.34 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   9.8824   0.136994  72.137 < 2.2e-16 ***
sourceA:amt   1.7230   0.063503  27.133 8.438e-15 ***
sourceB:amt   1.2375   0.063503  19.488 1.427e-12 ***
sourceC:amt   3.2430   0.063503  51.068 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.8.7 p414

(57) MODEL

```r
p414 = read.table("C:/G/Rt/SAS4lm/p414.txt", header=TRUE)
p414 = af(p414, c("lackofit"))
GLM(loglivcu ~ level + lackofit, p414) # p415 Output 11.26
```

```
$ANOVA
Response : loglivcu
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            3 5.2310 1.74365  155.47 5.018e-14 ***
RESIDUALS       20 0.2243 0.01122
CORRECTED TOTAL 23 5.4553
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
         Df Sum Sq Mean Sq F value    Pr(>F)
level     1 4.9859  4.9859 444.555 3.997e-15 ***
lackofit  2 0.2450  0.1225  10.924 0.0006216 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
         Df  Sum Sq Mean Sq F value    Pr(>F)
level     0
lackofit  2 0.24504 0.12252  10.924 0.0006216 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
         Df  Sum Sq Mean Sq F value    Pr(>F)
level     0
lackofit  2 0.24504 0.12252  10.924 0.0006216 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  1.41347   0.155886  9.0674 1.598e-08 ***
level        0.00210   0.000408  5.1443 4.937e-05 ***
lackofit0   -0.19544   0.161770 -1.2081  0.241091
lackofit150 -0.34501   0.105903 -3.2578  0.003939 **
lackofit300  0.00000   0.000000
lackofit450  0.00000   0.000000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 5.8.8 p417

(58) MODEL

```
p417 = read.table("C:/G/Rt/SAS4lm/p417.txt", header=TRUE)
p417 = af(p417, c("TRT", "POT", "PLANT"))
GLM(Y ~ TRT + POT %in% TRT, p417) # p418 Output 11.28
```

```
$ANOVA
Response : Y
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL            7 267.226  38.175  12.433 7.522e-05 ***
RESIDUALS       13  39.917   3.071
CORRECTED TOTAL 20 307.143
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
        Df  Sum Sq Mean Sq F value    Pr(>F)
TRT      2 236.921 118.460  38.580 3.412e-06 ***
TRT:POT  5  30.306   6.061   1.974    0.1499
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df  Sum Sq Mean Sq F value    Pr(>F)
TRT      2 236.921 118.460  38.580 3.412e-06 ***
TRT:POT  5  30.306   6.061   1.974    0.1499
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
        Df  Sum Sq Mean Sq F value    Pr(>F)
TRT      2 200.111 100.055  32.586 8.626e-06 ***
TRT:POT  5  30.306   6.061   1.974    0.1499
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  12.0000    0.78365 15.3130 1.070e-09 ***
TRT1          0.0000    1.91954  0.0000   1.00000
TRT2          8.2500    1.17547  7.0185 9.087e-06 ***
TRT3          0.0000    0.00000
TRT1:POT1     2.6667    2.02337  1.3179   0.21028
TRT1:POT2     6.0000    2.14611  2.7958   0.01515 *
TRT1:POT3     0.0000    0.00000
```

```
TRT2:POT1     0.2500    1.51753  0.1647   0.87168
TRT2:POT2     0.0000    0.00000
TRT2:POT3     0.0000    0.00000
TRT3:POT1     1.0000    1.27969  0.7814   0.44854
TRT3:POT2    -1.0000    1.91954 -0.5210   0.61115
TRT3:POT3     0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ TRT + POT %in% TRT, p417), type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y
          Sum Sq Df F values  Pr(>F)
TRT       22.310  1    7.266 0.01835 *
TRT:POT   30.306  5    1.974 0.14991
Residuals 39.917 13
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.8.9 p431

(59) MODEL

```
p431 = read.table("C:/G/Rt/SAS4lm/p431.txt", header=TRUE)
p431 = af(p431, c("line", "sire", "agedam", "steerno"))
GLM(avdlygn ~ line + line:sire + agedam + line:agedam + age + intlwt, p431)
```

```
$ANOVA
Response : avdlygn
                Df Sum Sq  Mean Sq F value   Pr(>F)
MODEL           16 2.5275 0.157966  3.1437 0.001091 **
RESIDUALS       48 2.4119 0.050248
CORRECTED TOTAL 64 4.9394
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
            Df  Sum Sq  Mean Sq F value  Pr(>F)
line         2 0.38009 0.190046  3.7821 0.02983 *
```

```
line:sire    6 0.92634 0.154391  3.0726 0.01260 *
agedam       2 0.11894 0.059471  1.1835 0.31497
line:agedam  4 0.64889 0.162222  3.2284 0.02000 *
age          1 0.18349 0.183487  3.6516 0.06200 .
intlwt       1 0.26970 0.269704  5.3674 0.02483 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
            Df  Sum Sq Mean Sq F value   Pr(>F)
line         2 0.05526 0.02763  0.5498 0.580636
line:sire    6 0.97389 0.16231  3.2303 0.009543 **
agedam       2 0.33106 0.16553  3.2943 0.045640 *
line:agedam  4 0.45343 0.11336  2.2560 0.076821 .
age          1 0.38128 0.38128  7.5878 0.008277 **
intlwt       1 0.26970 0.26970  5.3674 0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
            Df  Sum Sq Mean Sq F value   Pr(>F)
line         2 0.13620 0.06810  1.3553 0.267560
line:sire    6 0.97389 0.16231  3.2303 0.009543 **
agedam       2 0.13011 0.06505  1.2946 0.283392
line:agedam  4 0.45343 0.11336  2.2560 0.076821 .
age          1 0.38128 0.38128  7.5878 0.008277 **
intlwt       1 0.26970 0.26970  5.3674 0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)    2.99627    0.51285  5.8423 4.361e-07 ***
line1          0.07182    0.14551  0.4936  0.623826
line2          0.25247    0.13717  1.8406  0.071867 .
line3          0.00000    0.00000
line1:sire1    0.08573    0.13028  0.6580  0.513652
line1:sire2   -0.12171    0.13622 -0.8934  0.376079
line1:sire3    0.00000    0.00000
line1:sire4    0.00000    0.00000
line1:sire5    0.00000    0.00000
line1:sire6    0.00000    0.00000
line1:sire7    0.00000    0.00000
line1:sire8    0.00000    0.00000
line1:sire9    0.00000    0.00000
line2:sire1    0.00000    0.00000
line2:sire2    0.00000    0.00000
line2:sire3    0.00000    0.00000
```

```
line2:sire4   -0.24460    0.12669 -1.9307  0.059443 .
line2:sire5    0.00000    0.00000
line2:sire6    0.00000    0.00000
line2:sire7    0.00000    0.00000
line2:sire8    0.00000    0.00000
line2:sire9    0.00000    0.00000
line3:sire1    0.00000    0.00000
line3:sire2    0.00000    0.00000
line3:sire3    0.00000    0.00000
line3:sire4    0.00000    0.00000
line3:sire5    0.00000    0.00000
line3:sire6    0.10540    0.12909  0.8165  0.418267
line3:sire7   -0.01952    0.12038 -0.1622  0.871856
line3:sire8   -0.33024    0.12567 -2.6278  0.011504 *
line3:sire9    0.00000    0.00000
agedam3        0.37039    0.11456  3.2332  0.002216 **
agedam4        0.27546    0.10378  2.6544  0.010746 *
agedam5        0.00000    0.00000
line1:agedam3 -0.44894    0.19581 -2.2927  0.026291 *
line1:agedam4 -0.28283    0.16085 -1.7584  0.085062 .
line1:agedam5  0.00000    0.00000
line2:agedam3 -0.26078    0.19529 -1.3354  0.188050
line2:agedam4 -0.35026    0.17439 -2.0085  0.050232 .
line2:agedam5  0.00000    0.00000
line3:agedam3  0.00000    0.00000
line3:agedam4  0.00000    0.00000
line3:agedam5  0.00000    0.00000
age           -0.00853    0.00310 -2.7546  0.008277 **
intlwt         0.00203    0.00087  2.3168  0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# p433 Output 11.40
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(avdlygn ~ line + line:sire + agedam + line:agedam + age + intlwt, p431),
      type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: avdlygn
             Sum Sq Df F values   Pr(>F)
line        0.00000  0
```

```
agedam      0.13011  2   1.2946 0.283392
age         0.38128  1   7.5878 0.008277 **
intlwt      0.26970  1   5.3674 0.024830 *
line:sire   0.97389  6   3.2303 0.009543 **
line:agedam 0.45343  4   2.2560 0.076821 .
Residuals   2.41192 48
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(60) MODEL

```
GLM(avdlygn ~ sire + agedam, p431) # # p434 Output 11.41
```

```
$ANOVA
Response : avdlygn
                Df Sum Sq  Mean Sq F value  Pr(>F)
MODEL           10 1.4254 0.142538  2.1904 0.03237 *
RESIDUALS       54 3.5140 0.065074
CORRECTED TOTAL 64 4.9394
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df  Sum Sq  Mean Sq F value  Pr(>F)
sire    8 1.30644 0.163305  2.5095 0.02138 *
agedam  2 0.11894 0.059471  0.9139 0.40707
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df  Sum Sq  Mean Sq F value  Pr(>F)
sire    8 1.33017 0.166271  2.5551 0.01937 *
agedam  2 0.11894 0.059471  0.9139 0.40707
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
       Df  Sum Sq  Mean Sq F value  Pr(>F)
sire    8 1.33017 0.166271  2.5551 0.01937 *
agedam  2 0.11894 0.059471  0.9139 0.40707
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.46347   0.096216 25.6036  < 2e-16 ***
sire1       -0.00739   0.128186 -0.0576  0.95427
```

```
sire2       -0.21429   0.128606 -1.6662  0.10146
sire3       -0.02260   0.146050 -0.1548  0.87759
sire4       -0.02364   0.128186 -0.1844  0.85440
sire5        0.12311   0.132193  0.9313  0.35585
sire6       -0.05290   0.138320 -0.3824  0.70364
sire7       -0.14760   0.129061 -1.1436  0.25782
sire8       -0.40781   0.135054 -3.0196  0.00386 **
sire9        0.00000   0.000000
agedam3      0.11738   0.089117  1.3172  0.19334
agedam4      0.04830   0.077154  0.6260  0.53395
agedam5      0.00000   0.000000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### 5.8.10 p437 ABSORB option in SAS

(61) MODEL

```
GLM(avdlygn ~ line + sire + agedam + line:agedam + age + intlwt, p431)
```

```
$ANOVA
Response : avdlygn
               Df Sum Sq  Mean Sq F value   Pr(>F)
MODEL          16 2.5275 0.157966  3.1437 0.001091 **
RESIDUALS      48 2.4119 0.050248
CORRECTED TOTAL 64 4.9394
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
            Df  Sum Sq  Mean Sq F value  Pr(>F)
line         2 0.38009 0.190046  3.7821 0.02983 *
sire         6 0.92634 0.154391  3.0726 0.01260 *
agedam       2 0.11894 0.059471  1.1835 0.31497
line:agedam  4 0.64889 0.162222  3.2284 0.02000 *
age          1 0.18349 0.183487  3.6516 0.06200 .
intlwt       1 0.26970 0.269704  5.3674 0.02483 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
            Df  Sum Sq Mean Sq F value   Pr(>F)
line         0
sire         6 0.97389 0.16231  3.2303 0.009543 **
agedam       2 0.33106 0.16553  3.2943 0.045640 *
line:agedam  4 0.45343 0.11336  2.2560 0.076821 .
```

```
age          1 0.38128 0.38128  7.5878 0.008277 **
intlwt       1 0.26970 0.26970  5.3674 0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
            Df  Sum Sq Mean Sq F value   Pr(>F)
line         0
sire         6 0.97389 0.16231  3.2303 0.009543 **
agedam       2 0.13011 0.06505  1.2946 0.283392
line:agedam  4 0.45343 0.11336  2.2560 0.076821 .
age          1 0.38128 0.38128  7.5878 0.008277 **
intlwt       1 0.26970 0.26970  5.3674 0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)    2.99627    0.51285  5.8423 4.361e-07 ***
line1          0.07182    0.14551  0.4936  0.623826
line2          0.25247    0.13717  1.8406  0.071867 .
line3          0.00000    0.00000
sire1          0.08573    0.13028  0.6580  0.513652
sire2         -0.12171    0.13622 -0.8934  0.376079
sire3          0.00000    0.00000
sire4         -0.24460    0.12669 -1.9307  0.059443 .
sire5          0.00000    0.00000
sire6          0.10540    0.12909  0.8165  0.418267
sire7         -0.01952    0.12038 -0.1622  0.871856
sire8         -0.33024    0.12567 -2.6278  0.011504 *
sire9          0.00000    0.00000
agedam3        0.37039    0.11456  3.2332  0.002216 **
agedam4        0.27546    0.10378  2.6544  0.010746 *
agedam5        0.00000    0.00000
line1:agedam3 -0.44894    0.19581 -2.2927  0.026291 *
line1:agedam4 -0.28283    0.16085 -1.7584  0.085062 .
line1:agedam5  0.00000    0.00000
line2:agedam3 -0.26078    0.19529 -1.3354  0.188050
line2:agedam4 -0.35026    0.17439 -2.0085  0.050232 .
line2:agedam5  0.00000    0.00000
line3:agedam3  0.00000    0.00000
line3:agedam4  0.00000    0.00000
line3:agedam5  0.00000    0.00000
age           -0.00853    0.00310 -2.7546  0.008277 **
intlwt         0.00203    0.00087  2.3168  0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# p437 Output 11.43
```

# 6 Sahai - Unbalanced

## 6.1 Table 11.2

(62) MODEL

```
T11.2 = read.table("C:/G/Rt/ANOVA/T11.2.txt")
colnames(T11.2) = c("Group", "Y")
T11.2 = af(T11.2, "Group")
GLM(Y ~ Group, T11.2) # p115
```

```
$ANOVA
Response : Y
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL            4  80.401 20.1003  5.9884 0.0004103 ***
RESIDUALS       59 198.036  3.3565
CORRECTED TOTAL 63 278.438
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
Group  4 80.401    20.1  5.9884 0.0004103 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
Group  4 80.401    20.1  5.9884 0.0004103 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
Group  4 80.401    20.1  5.9884 0.0004103 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error  t value  Pr(>|t|)
(Intercept)   66.133    0.47304 139.8040 < 2.2e-16 ***
Group1        -2.952    0.72726  -4.0584 0.0001473 ***
Group2        -2.508    0.80208  -3.1273 0.0027390 **
Group3        -1.967    0.88498  -2.2223 0.0301120 *
Group4        -2.592    0.60301  -4.2979 6.547e-05 ***
Group5         0.000    0.00000
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 6.2 Table 12.6

(63) MODEL

```
T12.6 = read.table("C:/G/Rt/ANOVA/T12.6.txt")
colnames(T12.6) = c("Location", "Family", "Y")
T12.6 = af(T12.6, c("Location", "Family"))
GLM(Y ~ Location + Family, T12.6) # p184
```

```
$ANOVA
Response : Y
                Df Sum Sq  Mean Sq F value    Pr(>F)
MODEL            7 1.6144 0.230636  8.9562 7.223e-07 ***
RESIDUALS       45 1.1588 0.025752
CORRECTED TOTAL 52 2.7733
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
         Df  Sum Sq Mean Sq F value    Pr(>F)
Location  3 0.74036 0.24679  9.5833 5.219e-05 ***
Family    4 0.87410 0.21852  8.4859 3.436e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
         Df  Sum Sq Mean Sq F value    Pr(>F)
Location  3 0.83765 0.27921 10.8426 1.753e-05 ***
Family    4 0.87410 0.21852  8.4859 3.436e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
         Df  Sum Sq Mean Sq F value    Pr(>F)
Location  3 0.83765 0.27921 10.8426 1.753e-05 ***
Family    4 0.87410 0.21852  8.4859 3.436e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  0.42999   0.079313  5.4214 2.236e-06 ***
Location1    0.27409   0.066143  4.1438 0.0001487 ***
Location2    0.07118   0.065245  1.0910 0.2810986
```

```
Location3   -0.06869   0.061950 -1.1088 0.2734048
Location4    0.00000   0.000000
Family1      0.18733   0.077778  2.4085 0.0201753 *
Family2     -0.02753   0.079595 -0.3458 0.7310768
Family3      0.31264   0.079951  3.9103 0.0003080 ***
Family4      0.14331   0.093203  1.5376 0.1311397
Family5      0.00000   0.000000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 6.3 Table 13.6

(64) MODEL

```
T13.6 = read.table("C:/G/Rt/ANOVA/T13.6.txt")
colnames(T13.6) = c("Site", "Worker", "Y")
T13.6 = af(T13.6, c("Site", "Worker"))
GLM(Y ~ Site + Worker + Site:Worker, T13.6)
```

```
$ANOVA
Response : Y
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           11 2643.11 240.283  60.323 < 2.2e-16 ***
RESIDUALS       35  139.42   3.983
CORRECTED TOTAL 46 2782.52
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
            Df  Sum Sq Mean Sq F value    Pr(>F)
Site         2 1281.55  640.77 160.866 < 2.2e-16 ***
Worker       3  399.27  133.09  33.412 2.234e-10 ***
Site:Worker  6  962.29  160.38  40.264 2.720e-14 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
            Df  Sum Sq Mean Sq F value    Pr(>F)
Site         2 1322.24  661.12 165.973 < 2.2e-16 ***
Worker       3  399.27  133.09  33.412 2.234e-10 ***
Site:Worker  6  962.29  160.38  40.264 2.720e-14 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
            Df Sum Sq Mean Sq F value    Pr(>F)
Site         2 804.83  402.42 101.026 2.887e-15 ***
```

```
Worker       3 430.88  143.63  36.058 8.310e-11 ***
Site:Worker  6 962.29  160.38  40.264 2.720e-14 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)     78.560    0.89256 88.0168 < 2.2e-16 ***
Site1            6.340    1.26227  5.0227 1.498e-05 ***
Site2            2.460    1.26227  1.9489  0.059362 .
Site3            0.000    0.00000
Worker1          3.640    1.45754  2.4974  0.017365 *
Worker2          3.840    1.26227  3.0421  0.004433 **
Worker3         15.565    1.33883 11.6258 1.430e-13 ***
Worker4          0.000    0.00000
Site1:Worker1   -5.940    2.62762 -2.2606  0.030108 *
Site1:Worker2    9.720    1.78511  5.4450 4.165e-06 ***
Site1:Worker3   -9.690    1.89340 -5.1178 1.124e-05 ***
Site1:Worker4    0.000    0.00000
Site2:Worker1  -11.960    2.62762 -4.5517 6.165e-05 ***
Site2:Worker2  -12.960    1.84005 -7.0433 3.360e-08 ***
Site2:Worker3  -16.365    1.84005 -8.8938 1.660e-10 ***
Site2:Worker4    0.000    0.00000
Site3:Worker1    0.000    0.00000
Site3:Worker2    0.000    0.00000
Site3:Worker3    0.000    0.00000
Site3:Worker4    0.000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 6.4 Table 14.2

(65) MODEL

```
T14.2 = read.csv("C:/G/Rt/ANOVA/T14.2.csv")
T14.2 = T14.2[!is.na(T14.2$Y),]
T14.2 = af(T14.2, c("Day", "Machine", "Operator"))
GLM(Y ~ Day + Machine + Operator, T14.2)
```

```
$ANOVA
Response : Y
                 Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL             7  6345.4  906.48  8.1297 5.931e-08 ***
RESIDUALS       110 12265.3  111.50
CORRECTED TOTAL 117 18610.6
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
         Df Sum Sq Mean Sq F value    Pr(>F)
Day       2 3737.8 1868.90 16.7611 4.426e-07 ***
Machine   2 2440.7 1220.33 10.9445 4.625e-05 ***
Operator  3  166.9   55.63  0.4989    0.6838
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
         Df Sum Sq Mean Sq F value    Pr(>F)
Day       2 3795.1 1897.56 17.0181 3.636e-07 ***
Machine   2 2464.8 1232.39 11.0526 4.227e-05 ***
Operator  3  166.9   55.63  0.4989    0.6838
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
         Df Sum Sq Mean Sq F value    Pr(>F)
Day       2 3795.1 1897.56 17.0181 3.636e-07 ***
Machine   2 2464.8 1232.39 11.0526 4.227e-05 ***
Operator  3  166.9   55.63  0.4989    0.6838
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  194.520     2.8292 68.7541 < 2.2e-16 ***
Day1          -1.395     2.5210 -0.5535    0.5811
Day2         -12.591     2.4293 -5.1831 9.994e-07 ***
Day3           0.000     0.0000
Machine1      10.446     2.4410  4.2795 4.015e-05 ***
Machine2       1.301     2.3888  0.5447    0.5871
Machine3       0.000     0.0000
Operator1     -3.048     2.8546 -1.0677    0.2880
Operator2     -0.076     2.6570 -0.0287    0.9771
Operator3     -0.275     2.7474 -0.0999    0.9206
Operator4      0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 6.5 Table 15.3

(66) MODEL

```r
T15.3 = read.table("C:/G/Rt/ANOVA/T15.3.txt")
colnames(T15.3) = c("Dam", "Sire", "pH")
T15.3 = af(T15.3, c("Dam", "Sire"))
GLM(pH ~ Dam/Sire, T15.3) # p301
```

```
$ANOVA
Response : pH
                 Df  Sum Sq   Mean Sq F value  Pr(>F)
MODEL            36 0.25804 0.0071678  2.8977 7.2e-06 ***
RESIDUALS       123 0.30425 0.0024736
CORRECTED TOTAL 159 0.56229
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
         Df   Sum Sq   Mean Sq F value    Pr(>F)
Dam      14 0.178017 0.0127155  5.1405 1.563e-07 ***
Dam:Sire 22 0.080024 0.0036374  1.4705   0.09662 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
         Df   Sum Sq   Mean Sq F value    Pr(>F)
Dam      14 0.178017 0.0127155  5.1405 1.563e-07 ***
Dam:Sire 22 0.080024 0.0036374  1.4705   0.09662 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
         Df   Sum Sq   Mean Sq F value    Pr(>F)
Dam      14 0.179405 0.0128146  5.1805 1.347e-07 ***
Dam:Sire 22 0.080024 0.0036374  1.4705   0.09662 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error  t value  Pr(>|t|)
(Intercept)   7.4125   0.024868 298.0778 < 2.2e-16 ***
Dam1          0.0450   0.035168   1.2796 0.2031065
Dam10         0.0350   0.035168   0.9952 0.3215844
Dam11         0.0755   0.033363   2.2630 0.0253922 *
Dam12         0.0025   0.035168   0.0711 0.9434440
Dam13         0.0400   0.035168   1.1374 0.2575856
Dam14         0.0555   0.033363   1.6635 0.0987592 .
Dam15         0.0895   0.033363   2.6826 0.0083104 **
Dam2          0.0225   0.035168   0.6398 0.5235039
Dam3          0.0295   0.033363   0.8842 0.3783132
```

```
Dam4          -0.0275   0.035168  -0.7820 0.4357428
Dam5           0.1408   0.037986   3.7075 0.0003152 ***
Dam6           0.0475   0.033363   1.4237 0.1570616
Dam7           0.0315   0.033363   0.9441 0.3469459
Dam8           0.0455   0.033363   1.3638 0.1751317
Dam9           0.0000   0.000000
Dam1:Sire1     0.0475   0.035168   1.3507 0.1792866
Dam1:Sire2     0.0000   0.000000
Dam1:Sire3     0.0000   0.000000
Dam10:Sire1   -0.0695   0.033363  -2.0831 0.0393121 *
Dam10:Sire2    0.0000   0.000000
Dam10:Sire3    0.0000   0.000000
Dam11:Sire1    0.0460   0.031455   1.4624 0.1461852
Dam11:Sire2    0.0000   0.000000
Dam11:Sire3    0.0000   0.000000
Dam12:Sire1    0.0470   0.033363   1.4087 0.1614391
Dam12:Sire2    0.0000   0.000000
Dam12:Sire3    0.0000   0.000000
Dam13:Sire1   -0.0645   0.033363  -1.9333 0.0555032 .
Dam13:Sire2   -0.0358   0.037986  -0.9433 0.3473613
Dam13:Sire3    0.0000   0.000000
Dam14:Sire1    0.0245   0.033363   0.7343 0.4641417
Dam14:Sire2   -0.0180   0.033363  -0.5395 0.5905089
Dam14:Sire3    0.0000   0.000000
Dam15:Sire1   -0.0500   0.031455  -1.5896 0.1145028
Dam15:Sire2   -0.0580   0.031455  -1.8439 0.0676071 .
Dam15:Sire3    0.0000   0.000000
Dam2:Sire1    -0.0010   0.033363  -0.0300 0.9761373
Dam2:Sire2     0.0000   0.000000
Dam2:Sire3     0.0000   0.000000
Dam3:Sire1    -0.0045   0.033363  -0.1349 0.8929288
Dam3:Sire2    -0.0320   0.033363  -0.9591 0.3393736
Dam3:Sire3     0.0000   0.000000
Dam4:Sire1     0.0550   0.037986   1.4479 0.1501886
Dam4:Sire2     0.0000   0.000000
Dam4:Sire3     0.0000   0.000000
Dam5:Sire1    -0.0593   0.036322  -1.6336 0.1049091
Dam5:Sire2    -0.0608   0.037986  -1.6015 0.1118387
Dam5:Sire3     0.0000   0.000000
Dam6:Sire1    -0.0450   0.033363  -1.3488 0.1798857
Dam6:Sire2     0.0075   0.033363   0.2248 0.8225105
Dam6:Sire3     0.0000   0.000000
Dam7:Sire1    -0.0290   0.033363  -0.8692 0.3864232
Dam7:Sire2    -0.0340   0.031455  -1.0809 0.2818582
Dam7:Sire3     0.0000   0.000000
Dam8:Sire1     0.0520   0.036322   1.4317 0.1547783
Dam8:Sire2     0.0000   0.000000
Dam8:Sire3     0.0000   0.000000
```

```
Dam9:Sire1   -0.0225   0.035168  -0.6398 0.5235039
Dam9:Sire2    0.0000   0.000000
Dam9:Sire3    0.0000   0.000000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts = c("contr.sum", "contr.poly"))
Anova(lm(pH ~ Dam/Sire, T15.3), type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: pH
            Sum Sq  Df F values    Pr(>F)
Dam       0.081011   6   5.4584 4.898e-05 ***
Dam:Sire  0.080024  22   1.4705   0.09662 .
Residuals 0.304253 123
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 6.6 Table 16.3

(67) MODEL

```
T16.3 = read.csv("C:/G/Rt/ANOVA/T16.3.csv")
colnames(T16.3) = c("Plot", "Sample", "Subsample", "Residue")
T16.3 = af(T16.3, c("Plot", "Sample", "Subsample"))
GLM(Residue ~ Plot/Sample/Subsample, T16.3) # p344
```

```
$ANOVA
Response : Residue
                Df Sum Sq  Mean Sq F value    Pr(>F)
MODEL           54 3.1897 0.059069  5.8842 1.476e-05 ***
RESIDUALS       22 0.2208 0.010039
CORRECTED TOTAL 76 3.4106
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
                      Df  Sum Sq  Mean Sq F value    Pr(>F)
Plot                  10 1.84041 0.184041 18.3332 1.929e-08 ***
Plot:Sample           22 0.99175 0.045079  4.4906 0.0004209 ***
Plot:Sample:Subsample 22 0.35757 0.016253  1.6191 0.1330632
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
                      Df  Sum Sq  Mean Sq F value    Pr(>F)
Plot                  10 1.84041 0.184041 18.3332 1.929e-08 ***
Plot:Sample           22 0.99175 0.045079  4.4906 0.0004209 ***
Plot:Sample:Subsample 22 0.35757 0.016253  1.6191 0.1330632
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
                      Df  Sum Sq  Mean Sq F value    Pr(>F)
Plot                  10 1.78686 0.178686 17.7998 2.547e-08 ***
Plot:Sample           22 0.99175 0.045079  4.4906 0.0004209 ***
Plot:Sample:Subsample 22 0.35757 0.016253  1.6191 0.1330632
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                         Estimate Std. Error t value  Pr(>|t|)
(Intercept)                 0.920    0.10019  9.1823 5.568e-09 ***
Plot1                      -0.400    0.14169 -2.8230 0.0099043 **
Plot10                     -0.400    0.14169 -2.8230 0.0099043 **
Plot11                     -0.530    0.14169 -3.7404 0.0011335 **
Plot2                       0.160    0.14169  1.1292 0.2709797
Plot3                      -0.630    0.14169 -4.4462 0.0002029 ***
Plot4                      -0.820    0.14169 -5.7871 8.025e-06 ***
Plot5                       0.000    0.14169  0.0000 1.0000000
Plot6                      -0.510    0.14169 -3.5993 0.0015942 **
Plot7                      -0.480    0.14169 -3.3876 0.0026487 **
Plot8                      -0.560    0.14169 -3.9522 0.0006777 ***
Plot9                       0.000    0.00000
Plot1:Sample1              -0.060    0.12271 -0.4890 0.6297131
Plot1:Sample2               0.020    0.14169  0.1411 0.8890368
Plot1:Sample3               0.000    0.00000
Plot10:Sample1             -0.020    0.12271 -0.1630 0.8720183
Plot10:Sample2              0.000    0.14169  0.0000 1.0000000
Plot10:Sample3              0.000    0.00000
Plot11:Sample1              0.000    0.12271  0.0000 1.0000000
Plot11:Sample2              0.110    0.14169  0.7763 0.4458271
Plot11:Sample3              0.000    0.00000
Plot2:Sample1              -0.595    0.12271 -4.8488 7.603e-05 ***
Plot2:Sample2              -0.650    0.14169 -4.5873 0.0001437 ***
Plot2:Sample3               0.000    0.00000
Plot3:Sample1               0.095    0.12271  0.7742 0.4470663
Plot3:Sample2               0.090    0.14169  0.6352 0.5318688
Plot3:Sample3               0.000    0.00000
```

```
Plot4:Sample1                0.200    0.12271  1.6298 0.1173694
Plot4:Sample2                0.150    0.14169  1.0586 0.3012597
Plot4:Sample3                0.000    0.00000
Plot5:Sample1               -0.365    0.12271 -2.9745 0.0069960 **
Plot5:Sample2               -0.080    0.14169 -0.5646 0.5780606
Plot5:Sample3                0.000    0.00000
Plot6:Sample1                0.065    0.12271  0.5297 0.6016249
Plot6:Sample2               -0.150    0.14169 -1.0586 0.3012597
Plot6:Sample3                0.000    0.00000
Plot7:Sample1                0.115    0.12271  0.9372 0.3588500
Plot7:Sample2                0.060    0.14169  0.4234 0.6760804
Plot7:Sample3                0.000    0.00000
Plot8:Sample1                0.305    0.12271  2.4855 0.0210209 *
Plot8:Sample2                0.180    0.14169  1.2703 0.2172344
Plot8:Sample3                0.000    0.00000
Plot9:Sample1               -0.355    0.12271 -2.8930 0.0084403 **
Plot9:Sample2               -0.210    0.14169 -1.4821 0.1525064
Plot9:Sample3                0.000    0.00000
Plot1:Sample1:Subsample1     0.015    0.10019  0.1497 0.8823566
Plot1:Sample1:Subsample2     0.000    0.00000
Plot1:Sample2:Subsample1    -0.280    0.14169 -1.9761 0.0608176 .
Plot1:Sample2:Subsample2     0.000    0.00000
Plot1:Sample3:Subsample1     0.000    0.00000
Plot1:Sample3:Subsample2     0.000    0.00000
Plot10:Sample1:Subsample1    0.050    0.10019  0.4990 0.6227069
Plot10:Sample1:Subsample2    0.000    0.00000
Plot10:Sample2:Subsample1   -0.060    0.14169 -0.4234 0.6760804
Plot10:Sample2:Subsample2    0.000    0.00000
Plot10:Sample3:Subsample1    0.000    0.00000
Plot10:Sample3:Subsample2    0.000    0.00000
Plot11:Sample1:Subsample1   -0.090    0.10019 -0.8983 0.3787697
Plot11:Sample1:Subsample2    0.000    0.00000
Plot11:Sample2:Subsample1    0.030    0.14169  0.2117 0.8342720
Plot11:Sample2:Subsample2    0.000    0.00000
Plot11:Sample3:Subsample1    0.000    0.00000
Plot11:Sample3:Subsample2    0.000    0.00000
Plot2:Sample1:Subsample1     0.060    0.10019  0.5988 0.5553935
Plot2:Sample1:Subsample2     0.000    0.00000
Plot2:Sample2:Subsample1    -0.390    0.14169 -2.7524 0.0116232 *
Plot2:Sample2:Subsample2     0.000    0.00000
Plot2:Sample3:Subsample1     0.000    0.00000
Plot2:Sample3:Subsample2     0.000    0.00000
Plot3:Sample1:Subsample1    -0.085    0.10019 -0.8484 0.4053723
Plot3:Sample1:Subsample2     0.000    0.00000
Plot3:Sample2:Subsample1    -0.130    0.14169 -0.9175 0.3688465
Plot3:Sample2:Subsample2     0.000    0.00000
Plot3:Sample3:Subsample1     0.000    0.00000
Plot3:Sample3:Subsample2     0.000    0.00000
```

```
Plot4:Sample1:Subsample1    -0.090    0.10019 -0.8983 0.3787697
Plot4:Sample1:Subsample2     0.000    0.00000
Plot4:Sample2:Subsample1    -0.120    0.14169 -0.8469 0.4061732
Plot4:Sample2:Subsample2     0.000    0.00000
Plot4:Sample3:Subsample1     0.000    0.00000
Plot4:Sample3:Subsample2     0.000    0.00000
Plot5:Sample1:Subsample1     0.300    0.10019  2.9942 0.0066835 **
Plot5:Sample1:Subsample2     0.000    0.00000
Plot5:Sample2:Subsample1     0.110    0.14169  0.7763 0.4458271
Plot5:Sample2:Subsample2     0.000    0.00000
Plot5:Sample3:Subsample1     0.000    0.00000
Plot5:Sample3:Subsample2     0.000    0.00000
Plot6:Sample1:Subsample1     0.115    0.10019  1.1478 0.2633860
Plot6:Sample1:Subsample2     0.000    0.00000
Plot6:Sample2:Subsample1     0.070    0.14169  0.4940 0.6261876
Plot6:Sample2:Subsample2     0.000    0.00000
Plot6:Sample3:Subsample1     0.000    0.00000
Plot6:Sample3:Subsample2     0.000    0.00000
Plot7:Sample1:Subsample1     0.110    0.10019  1.0979 0.2841276
Plot7:Sample1:Subsample2     0.000    0.00000
Plot7:Sample2:Subsample1    -0.060    0.14169 -0.4234 0.6760804
Plot7:Sample2:Subsample2     0.000    0.00000
Plot7:Sample3:Subsample1     0.000    0.00000
Plot7:Sample3:Subsample2     0.000    0.00000
Plot8:Sample1:Subsample1     0.240    0.10019  2.3954 0.0255487 *
Plot8:Sample1:Subsample2     0.000    0.00000
Plot8:Sample2:Subsample1     0.100    0.14169  0.7057 0.4877535
Plot8:Sample2:Subsample2     0.000    0.00000
Plot8:Sample3:Subsample1     0.000    0.00000
Plot8:Sample3:Subsample2     0.000    0.00000
Plot9:Sample1:Subsample1     0.020    0.10019  0.1996 0.8436154
Plot9:Sample1:Subsample2     0.000    0.00000
Plot9:Sample2:Subsample1    -0.110    0.14169 -0.7763 0.4458271
Plot9:Sample2:Subsample2     0.000    0.00000
Plot9:Sample3:Subsample1     0.000    0.00000
Plot9:Sample3:Subsample2     0.000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts = c("contr.sum", "contr.poly"))
Anova(lm(Residue ~ Plot/Sample/Subsample, T16.3), type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)
```

```
Response: Residue
                       Sum Sq Df F values  Pr(>F)
Plot                  0.00000  0
Plot:Sample           0.36613 11   3.3156 0.00805 **
Plot:Sample:Subsample 0.35758 22   1.6191 0.13306
Residuals             0.22085 22
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

# 7 Federer - Variations

## 7.1 Example 1.1

(68) MODEL

```
ex1.1 = read.table("C:/G/Rt/Split/Ex1.1-spex1.txt", header=TRUE)
ex1.1 = af(ex1.1, c("R", "A", "B"))
GLM(Y ~ R + A + R:A + B + A:B, ex1.1)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           27 4905.7 181.694   10.75 1.994e-10 ***
RESIDUALS       36  608.5  16.902
CORRECTED TOTAL 63 5514.2
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3  223.8   74.60  4.4138   0.00963 **
A    3  194.6   64.85  3.8370   0.01756 *
R:A  9  158.2   17.58  1.0402   0.42842
B    3 4107.4 1369.13 81.0030 4.441e-16 ***
A:B  9  221.7   24.64  1.4577   0.20117
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3  223.8   74.60  4.4138   0.00963 **
A    3  194.6   64.85  3.8370   0.01756 *
R:A  9  158.2   17.58  1.0402   0.42842
B    3 4107.4 1369.13 81.0030 4.441e-16 ***
A:B  9  221.7   24.64  1.4577   0.20117
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3  223.8   74.60  4.4138   0.00963 **
A    3  194.6   64.85  3.8370   0.01756 *
R:A  9  158.2   17.58  1.0402   0.42842
B    3 4107.4 1369.13 81.0030 4.441e-16 ***
A:B  9  221.7   24.64  1.4577   0.20117
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   66.700     2.7193 24.5282 < 2.2e-16 ***
R1             6.750     2.9071  2.3219  0.026009 *
R2            10.025     2.9071  3.4485  0.001453 **
R3             5.825     2.9071  2.0037  0.052669 .
R4             0.000     0.0000
A1             6.856     3.8457  1.7828  0.083048 .
A2            -4.212     3.8457 -1.0954  0.280625
A3             2.231     3.8457  0.5802  0.565398
A4             0.000     0.0000
R1:A1         -4.050     4.1112 -0.9851  0.331146
R1:A2         -3.375     4.1112 -0.8209  0.417093
R1:A3         -3.800     4.1112 -0.9243  0.361485
R1:A4          0.000     0.0000
R2:A1        -11.325     4.1112 -2.7547  0.009156 **
R2:A2         -5.150     4.1112 -1.2527  0.218403
R2:A3         -6.475     4.1112 -1.5750  0.124015
R2:A4          0.000     0.0000
R3:A1         -7.550     4.1112 -1.8364  0.074562 .
R3:A2         -5.625     4.1112 -1.3682  0.179727
R3:A3         -6.650     4.1112 -1.6175  0.114496
R3:A4          0.000     0.0000
R4:A1          0.000     0.0000
R4:A2          0.000     0.0000
R4:A3          0.000     0.0000
R4:A4          0.000     0.0000
B1            -1.800     2.9071 -0.6192  0.539698
B2           -17.100     2.9071 -5.8822 9.985e-07 ***
B3            -1.000     2.9071 -0.3440  0.732856
B4             0.000     0.0000
A1:B1          3.700     4.1112  0.9000  0.374115
A1:B2         -4.275     4.1112 -1.0398  0.305350
A1:B3         -0.250     4.1112 -0.0608  0.951848
A1:B4          0.000     0.0000
A2:B1          9.500     4.1112  2.3107  0.026687 *
A2:B2          3.850     4.1112  0.9365  0.355276
A2:B3          4.400     4.1112  1.0702  0.291635
A2:B4          0.000     0.0000
A3:B1         -1.225     4.1112 -0.2980  0.767443
A3:B2         -2.800     4.1112 -0.6811  0.500190
A3:B3          1.900     4.1112  0.4621  0.646755
A3:B4          0.000     0.0000
A4:B1          0.000     0.0000
A4:B2          0.000     0.0000
A4:B3          0.000     0.0000
```

```
A4:B4          0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.2 Example 1.2

(69) MODEL

```
ex1.2 = read.table("C:/G/Rt/Split/Ex1.2-spex2.txt", header=TRUE)
ex1.2 = af(ex1.2, c("R", "A", "B"))
GLM(Y ~ R + A + R:A + B + A:B, ex1.2)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           47  35573  756.88  31.243 < 2.2e-16 ***
RESIDUALS       48   1163   24.23
CORRECTED TOTAL 95  36736
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df  Sum Sq Mean Sq  F value    Pr(>F)
R    2    38.6    19.3   0.7963 0.4568480
A    7   763.2   109.0   4.5003 0.0006418 ***
R:A 14  1377.2    98.4   4.0608 0.0001343 ***
B    3 30774.3 10258.1 423.4386 < 2.2e-16 ***
A:B 21  2620.1   124.8   5.1502 1.327e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df  Sum Sq Mean Sq  F value    Pr(>F)
R    2    38.6    19.3   0.7963 0.4568480
A    7   763.2   109.0   4.5003 0.0006418 ***
R:A 14  1377.2    98.4   4.0608 0.0001343 ***
B    3 30774.3 10258.1 423.4386 < 2.2e-16 ***
A:B 21  2620.1   124.8   5.1502 1.327e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq  F value    Pr(>F)
R    2    38.6    19.3   0.7963 0.4568480
A    7   763.2   109.0   4.5003 0.0006418 ***
R:A 14  1377.2    98.4   4.0608 0.0001343 ***
B    3 30774.3 10258.1 423.4386 < 2.2e-16 ***
```

```
A:B 21  2620.1   124.8   5.1502 1.327e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   16.000     3.4804  4.5972 3.130e-05 ***
R1            -6.250     3.4804 -1.7958 0.0788230 .
R2            -5.750     3.4804 -1.6521 0.1050354
R3             0.000     0.0000
A0            -7.083     4.9220 -1.4391 0.1566037
A1            -4.000     4.9220 -0.8127 0.4204117
A2            -4.500     4.9220 -0.9143 0.3651450
A3            -6.333     4.9220 -1.2868 0.2043526
A4            -3.500     4.9220 -0.7111 0.4804644
A5            -1.667     4.9220 -0.3386 0.7363740
A6            -6.250     4.9220 -1.2698 0.2102707
A7             0.000     0.0000
R1:A0          5.250     4.9220  1.0666 0.2914665
R1:A1         15.000     4.9220  3.0476 0.0037444 **
R1:A2         -0.500     4.9220 -0.1016 0.9195088
R1:A3          7.250     4.9220  1.4730 0.1472813
R1:A4          5.000     4.9220  1.0159 0.3147916
R1:A5          8.000     4.9220  1.6254 0.1106329
R1:A6         10.500     4.9220  2.1333 0.0380399 *
R1:A7          0.000     0.0000
R2:A0          5.000     4.9220  1.0159 0.3147916
R2:A1         -5.000     4.9220 -1.0159 0.3147916
R2:A2         12.000     4.9220  2.4381 0.0185190 *
R2:A3          4.750     4.9220  0.9651 0.3393506
R2:A4          4.500     4.9220  0.9143 0.3651450
R2:A5         12.000     4.9220  2.4381 0.0185190 *
R2:A6          2.250     4.9220  0.4571 0.6496363
R2:A7          0.000     0.0000
R3:A0          0.000     0.0000
R3:A1          0.000     0.0000
R3:A2          0.000     0.0000
R3:A3          0.000     0.0000
R3:A4          0.000     0.0000
R3:A5          0.000     0.0000
R3:A6          0.000     0.0000
R3:A7          0.000     0.0000
B0            36.000     4.0188  8.9580 8.177e-12 ***
B1             7.667     4.0188  1.9077 0.0624200 .
B2            19.333     4.0188  4.8108 1.531e-05 ***
B3             0.000     0.0000
A0:B0         22.000     5.6834  3.8709 0.0003271 ***
A0:B1         -4.333     5.6834 -0.7625 0.4495188
```

```
A0:B2        -15.333     5.6834 -2.6979 0.0096001 **
A0:B3          0.000     0.0000
A1:B0         16.000     5.6834  2.8152 0.0070497 **
A1:B1         -0.667     5.6834 -0.1173 0.9071111
A1:B2        -16.333     5.6834 -2.8739 0.0060246 **
A1:B3          0.000     0.0000
A2:B0         17.667     5.6834  3.1085 0.0031582 **
A2:B1         -6.333     5.6834 -1.1144 0.2706743
A2:B2         -4.333     5.6834 -0.7625 0.4495188
A2:B3          0.000     0.0000
A3:B0          4.667     5.6834  0.8211 0.4156454
A3:B1         -7.333     5.6834 -1.2903 0.2031245
A3:B2        -15.000     5.6834 -2.6393 0.0111717 *
A3:B3          0.000     0.0000
A4:B0          1.667     5.6834  0.2933 0.7705935
A4:B1         -3.000     5.6834 -0.5279 0.6000325
A4:B2        -20.667     5.6834 -3.6363 0.0006736 ***
A4:B3          0.000     0.0000
A5:B0          5.000     5.6834  0.8798 0.3833746
A5:B1        -16.667     5.6834 -2.9325 0.0051395 **
A5:B2         -6.667     5.6834 -1.1730 0.2465806
A5:B3          0.000     0.0000
A6:B0          0.333     5.6834  0.0587 0.9534740
A6:B1         -3.000     5.6834 -0.5279 0.6000325
A6:B2         -7.333     5.6834 -1.2903 0.2031245
A6:B3          0.000     0.0000
A7:B0          0.000     0.0000
A7:B1          0.000     0.0000
A7:B2          0.000     0.0000
A7:B3          0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.3 Example 2.1

(70) MODEL

```
ex2.1 = read.table("C:/G/Rt/Split/sbex.txt", header=TRUE)
colnames(ex2.1) = c("Y", "R", "A", "B")
ex2.1 = af(ex2.1, c("R", "A", "B"))
GLM(Y ~ R + A + R:A + B + R:B + A:B, ex2.1)
```

```
$ANOVA
Response : Y
               Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL          41 274.750  6.7012  5.1475 0.0002305 ***
RESIDUALS      18  23.433  1.3019
```

```
CORRECTED TOTAL 59 298.183
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    1  2.817  2.8167  2.1636 0.1585807
A    9 77.683  8.6315  6.6302 0.0003456 ***
R:A  9 81.017  9.0019  6.9147 0.0002658 ***
B    2 35.433 17.7167 13.6088 0.0002510 ***
R:B  2 16.233  8.1167  6.2347 0.0087635 **
A:B 18 61.567  3.4204  2.6273 0.0236253 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    1  2.817  2.8167  2.1636 0.1585807
A    9 77.683  8.6315  6.6302 0.0003456 ***
R:A  9 81.017  9.0019  6.9147 0.0002658 ***
B    2 35.433 17.7167 13.6088 0.0002510 ***
R:B  2 16.233  8.1167  6.2347 0.0087635 **
A:B 18 61.567  3.4204  2.6273 0.0236253 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    1  2.817  2.8167  2.1636 0.1585807
A    9 77.683  8.6315  6.6302 0.0003456 ***
R:A  9 81.017  9.0019  6.9147 0.0002658 ***
B    2 35.433 17.7167 13.6088 0.0002510 ***
R:B  2 16.233  8.1167  6.2347 0.0087635 **
A:B 18 61.567  3.4204  2.6273 0.0236253 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   46.583    0.95462 48.7979 < 2.2e-16 ***
R1             0.833    1.02053  0.8166  0.424850
R2             0.000    0.00000
A0            -3.833    1.31750 -2.9096  0.009350 **
A1             2.667    1.31750  2.0240  0.058068 .
A2             1.000    1.31750  0.7590  0.457669
A3            -2.167    1.31750 -1.6445  0.117418
A4             1.000    1.31750  0.7590  0.457669
A5            -1.333    1.31750 -1.0120  0.324940
```

```
A6            1.500    1.31750  1.1385  0.269830
A7            4.500    1.31750  3.4156  0.003083 **
A8           -0.167    1.31750 -0.1265  0.900737
A9            0.000    0.00000
R1:A0         1.667    1.31750  1.2650  0.221996
R1:A1        -3.333    1.31750 -2.5300  0.020955 *
R1:A2        -4.000    1.31750 -3.0361  0.007105 **
R1:A3         0.333    1.31750  0.2530  0.803131
R1:A4         0.000    1.31750  0.0000  1.000000
R1:A5         2.667    1.31750  2.0240  0.058068 .
R1:A6        -4.000    1.31750 -3.0361  0.007105 **
R1:A7        -3.000    1.31750 -2.2770  0.035225 *
R1:A8        -2.667    1.31750 -2.0240  0.058068 .
R1:A9         0.000    0.00000
R2:A0         0.000    0.00000
R2:A1         0.000    0.00000
R2:A2         0.000    0.00000
R2:A3         0.000    0.00000
R2:A4         0.000    0.00000
R2:A5         0.000    0.00000
R2:A6         0.000    0.00000
R2:A7         0.000    0.00000
R2:A8         0.000    0.00000
R2:A9         0.000    0.00000
B1           -3.150    1.19668 -2.6323  0.016910 *
B2           -0.600    1.19668 -0.5014  0.622175
B3            0.000    0.00000
R1:B1         2.300    0.72162  3.1873  0.005103 **
R1:B2         0.200    0.72162  0.2772  0.784821
R1:B3         0.000    0.00000
R2:B1         0.000    0.00000
R2:B2         0.000    0.00000
R2:B3         0.000    0.00000
A0:B1         3.000    1.61360  1.8592  0.079426 .
A0:B2         0.500    1.61360  0.3099  0.760221
A0:B3         0.000    0.00000
A1:B1        -3.000    1.61360 -1.8592  0.079426 .
A1:B2        -4.000    1.61360 -2.4789  0.023305 *
A1:B3         0.000    0.00000
A2:B1         2.500    1.61360  1.5493  0.138705
A2:B2        -2.500    1.61360 -1.5493  0.138705
A2:B3         0.000    0.00000
A3:B1         2.000    1.61360  1.2395  0.231091
A3:B2        -0.500    1.61360 -0.3099  0.760221
A3:B3         0.000    0.00000
A4:B1        -2.000    1.61360 -1.2395  0.231091
A4:B2        -1.000    1.61360 -0.6197  0.543200
A4:B3         0.000    0.00000
```

```
A5:B1          1.000    1.61360  0.6197  0.543200
A5:B2          0.000    1.61360  0.0000  1.000000
A5:B3          0.000    0.00000
A6:B1         -1.000    1.61360 -0.6197  0.543200
A6:B2         -0.500    1.61360 -0.3099  0.760221
A6:B3          0.000    0.00000
A7:B1         -0.500    1.61360 -0.3099  0.760221
A7:B2         -2.000    1.61360 -1.2395  0.231091
A7:B3          0.000    0.00000
A8:B1          2.500    1.61360  1.5493  0.138705
A8:B2         -2.000    1.61360 -1.2395  0.231091
A8:B3          0.000    0.00000
A9:B1          0.000    0.00000
A9:B2          0.000    0.00000
A9:B3          0.000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.4 Example 2.2

(71) MODEL

```
ex2.2 = read.table("C:/G/Rt/Split/sbex2_2.txt", header=TRUE)
ex2.2 = af(ex2.2, c("Row", "Column", "R", "S"))
GLM(Y ~ Column + R + R:Column + S + S:Column + R:S, ex2.2)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL           51  10328  202.51  0.8112 0.7688
RESIDUALS       48  11982  249.63
CORRECTED TOTAL 99  22310

$`Type I`
         Df Sum Sq Mean Sq F value Pr(>F)
Column    4 1318.6  329.66  1.3206 0.2758
R         4 1159.8  289.94  1.1615 0.3396
Column:R 16 2808.6  175.54  0.7032 0.7766
S         3  351.9  117.29  0.4699 0.7047
Column:S 12 3863.3  321.94  1.2897 0.2555
R:S      12  826.0   68.83  0.2757 0.9906

$`Type II`
         Df Sum Sq Mean Sq F value Pr(>F)
Column    4 1318.6  329.66  1.3206 0.2758
R         4 1159.8  289.94  1.1615 0.3396
Column:R 16 2808.6  175.54  0.7032 0.7766
```

```
S         3  351.9  117.29  0.4699 0.7047
Column:S 12 3863.3  321.94  1.2897 0.2555
R:S      12  826.0   68.83  0.2757 0.9906

$`Type III`
         Df Sum Sq Mean Sq F value Pr(>F)
Column    4 1318.6  329.66  1.3206 0.2758
R         4 1159.8  289.94  1.1615 0.3396
Column:R 16 2808.6  175.54  0.7032 0.7766
S         3  351.9  117.29  0.4699 0.7047
Column:S 12 3863.3  321.94  1.2897 0.2555
R:S      12  826.0   68.83  0.2757 0.9906

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  1000.52     11.393 87.8167  < 2e-16 ***
Column1        12.04     14.132  0.8522  0.39836
Column2        10.64     14.132  0.7529  0.45520
Column3         0.98     14.132  0.0696  0.94478
Column4       -12.93     14.132 -0.9149  0.36480
Column5         0.00      0.000
R1            -13.81     14.132 -0.9774  0.33325
R2            -10.85     14.132 -0.7678  0.44636
R3             -2.17     14.132 -0.1533  0.87880
R4             -3.63     14.132 -0.2571  0.79819
R5              0.00      0.000
Column1:R1     16.78     15.800  1.0619  0.29360
Column1:R2      5.34     15.800  0.3383  0.73661
Column1:R3     -9.13     15.800 -0.5775  0.56627
Column1:R4     -6.31     15.800 -0.3994  0.69139
Column1:R5      0.00      0.000
Column2:R1     16.71     15.800  1.0578  0.29545
Column2:R2     -1.64     15.800 -0.1036  0.91789
Column2:R3      7.40     15.800  0.4687  0.64142
Column2:R4     11.71     15.800  0.7413  0.46212
Column2:R5      0.00      0.000
Column3:R1     12.12     15.800  0.7671  0.44678
Column3:R2      0.27     15.800  0.0169  0.98656
Column3:R3    -14.04     15.800 -0.8885  0.37872
Column3:R4      9.01     15.800  0.5703  0.57116
Column3:R5      0.00      0.000
Column4:R1      1.31     15.800  0.0832  0.93402
Column4:R2     -3.85     15.800 -0.2438  0.80840
Column4:R3      0.84     15.800  0.0532  0.95782
Column4:R4      9.65     15.800  0.6111  0.54402
Column4:R5      0.00      0.000
Column5:R1      0.00      0.000
Column5:R2      0.00      0.000
```

```
Column5:R3      0.00      0.000
Column5:R4      0.00      0.000
Column5:R5      0.00      0.000
S1              3.74     13.406  0.2789  0.78154
S2             12.15     13.406  0.9066  0.36916
S3              2.83     13.406  0.2110  0.83380
S4              0.00      0.000
Column1:S1    -15.16     14.132 -1.0730  0.28861
Column1:S2    -31.48     14.132 -2.2278  0.03062 *
Column1:S3      1.26     14.132  0.0889  0.92955
Column1:S4      0.00      0.000
Column2:S1    -22.54     14.132 -1.5947  0.11734
Column2:S2    -31.01     14.132 -2.1946  0.03306 *
Column2:S3     -3.56     14.132 -0.2518  0.80229
Column2:S4      0.00      0.000
Column3:S1     -1.71     14.132 -0.1207  0.90442
Column3:S2    -14.46     14.132 -1.0229  0.31146
Column3:S3     19.65     14.132  1.3902  0.17088
Column3:S4      0.00      0.000
Column4:S1      5.39     14.132  0.3816  0.70448
Column4:S2     -3.36     14.132 -0.2376  0.81319
Column4:S3     17.58     14.132  1.2443  0.21943
Column4:S4      0.00      0.000
Column5:S1      0.00      0.000
Column5:S2      0.00      0.000
Column5:S3      0.00      0.000
Column5:S4      0.00      0.000
R1:S1           3.84     14.132  0.2714  0.78721
R1:S2          -1.62     14.132 -0.1148  0.90910
R1:S3         -11.37     14.132 -0.8047  0.42495
R1:S4           0.00      0.000
R2:S1          12.02     14.132  0.8507  0.39915
R2:S2          10.32     14.132  0.7300  0.46894
R2:S3          -6.46     14.132 -0.4568  0.64984
R2:S4           0.00      0.000
R3:S1           9.62     14.132  0.6810  0.49913
R3:S2           2.19     14.132  0.1551  0.87738
R3:S3          -8.14     14.132 -0.5760  0.56730
R3:S4           0.00      0.000
R4:S1           4.15     14.132  0.2939  0.77006
R4:S2           3.09     14.132  0.2189  0.82762
R4:S3          -6.44     14.132 -0.4560  0.65045
R4:S4           0.00      0.000
R5:S1           0.00      0.000
R5:S2           0.00      0.000
R5:S3           0.00      0.000
R5:S4           0.00      0.000
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(72) MODEL

```
GLM(Y ~ Row + R + Row:R + S + Column:S + R:S + Column:R:S, ex2.2)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL           99  22310  225.36
RESIDUALS        0      0
CORRECTED TOTAL 99  22310

$`Type I`
           Df  Sum Sq Mean Sq F value Pr(>F)
Row         4   147.4   36.86
R           4  1159.8  289.94
Row:R      16  3979.8  248.74
S           3   351.9  117.29
S:Column   12  3863.3  321.94
R:S        12   826.0   68.83
R:S:Column 48 11982.3  249.63

$`Type II`
           Df  Sum Sq Mean Sq F value Pr(>F)
Row         0
R           4  1159.8  289.94
Row:R       0
S           3   351.9  117.29
S:Column   12  3863.3  321.94
R:S        12   826.0   68.83
R:S:Column 48 11982.3  249.63

$`Type III`
CAUTION: Singularity Exists !
           Df  Sum Sq Mean Sq F value Pr(>F)
Row         0
R           4  1159.8  289.94
Row:R       0
S           3   351.9  117.29
S:Column   12  3863.3  321.94
R:S        12   826.0   68.83
R:S:Column 48 11982.3  249.63

$Parameter
             Estimate Std. Error t value Pr(>|t|)
(Intercept)    1001.61        Inf       0
```

| | | | |
|---|---|---|---|
| Row1 | -5.98 | Inf | 0 |
| Row2 | 16.88 | Inf | 0 |
| Row3 | 19.34 | Inf | 0 |
| Row4 | -24.93 | Inf | 0 |
| Row5 | 0.00 | | |
| R1 | 9.12 | Inf | 0 |
| R2 | -18.93 | Inf | 0 |
| R3 | -2.75 | Inf | 0 |
| R4 | 3.02 | Inf | 0 |
| R5 | 0.00 | | |
| Row1:R1 | 3.72 | Inf | 0 |
| Row1:R2 | 14.16 | Inf | 0 |
| Row1:R3 | -24.63 | Inf | 0 |
| Row1:R4 | 3.52 | Inf | 0 |
| Row1:R5 | 0.00 | | |
| Row2:R1 | -61.81 | Inf | 0 |
| Row2:R2 | 12.43 | Inf | 0 |
| Row2:R3 | -0.94 | Inf | 0 |
| Row2:R4 | -20.79 | Inf | 0 |
| Row2:R5 | 0.00 | | |
| Row3:R1 | -56.60 | Inf | 0 |
| Row3:R2 | -12.11 | Inf | 0 |
| Row3:R3 | -30.06 | Inf | 0 |
| Row3:R4 | -4.44 | Inf | 0 |
| Row3:R5 | 0.00 | | |
| Row4:R1 | 46.95 | Inf | 0 |
| Row4:R2 | 26.04 | Inf | 0 |
| Row4:R3 | 43.63 | Inf | 0 |
| Row4:R4 | 12.51 | Inf | 0 |
| Row4:R5 | 0.00 | | |
| Row5:R1 | 0.00 | | |
| Row5:R2 | 0.00 | | |
| Row5:R3 | 0.00 | | |
| Row5:R4 | 0.00 | | |
| Row5:R5 | 0.00 | | |
| S1 | 24.26 | Inf | 0 |
| S2 | 21.85 | Inf | 0 |
| S3 | -7.81 | Inf | 0 |
| S4 | 0.00 | | |
| S1:Column1 | -47.84 | Inf | 0 |
| S1:Column2 | -58.48 | Inf | 0 |
| S1:Column3 | -40.38 | Inf | 0 |
| S1:Column4 | 10.08 | Inf | 0 |
| S1:Column5 | 0.00 | | |
| S2:Column1 | -40.43 | Inf | 0 |
| S2:Column2 | -13.68 | Inf | 0 |
| S2:Column3 | -58.94 | Inf | 0 |
| S2:Column4 | -15.74 | Inf | 0 |

| | | | |
|---|---|---|---|
| S2:Column5 | 0.00 | | |
| S3:Column1 | -0.39 | Inf | 0 |
| S3:Column2 | 33.69 | Inf | 0 |
| S3:Column3 | 5.46 | Inf | 0 |
| S3:Column4 | 49.36 | Inf | 0 |
| S3:Column5 | 0.00 | | |
| S4:Column1 | 0.00 | | |
| S4:Column2 | 0.00 | | |
| S4:Column3 | 0.00 | | |
| S4:Column4 | 0.00 | | |
| S4:Column5 | 0.00 | | |
| R1:S1 | -12.01 | Inf | 0 |
| R1:S2 | 17.28 | Inf | 0 |
| R1:S3 | 18.96 | Inf | 0 |
| R1:S4 | 0.00 | | |
| R2:S1 | -39.64 | Inf | 0 |
| R2:S2 | -21.90 | Inf | 0 |
| R2:S3 | -31.42 | Inf | 0 |
| R2:S4 | 0.00 | | |
| R3:S1 | -10.98 | Inf | 0 |
| R3:S2 | -21.39 | Inf | 0 |
| R3:S3 | 14.46 | Inf | 0 |
| R3:S4 | 0.00 | | |
| R4:S1 | -10.34 | Inf | 0 |
| R4:S2 | -8.49 | Inf | 0 |
| R4:S3 | 18.78 | Inf | 0 |
| R4:S4 | 0.00 | | |
| R5:S1 | 0.00 | | |
| R5:S2 | 0.00 | | |
| R5:S3 | 0.00 | | |
| R5:S4 | 0.00 | | |
| R1:S1:Column1 | 54.97 | Inf | 0 |
| R1:S1:Column2 | 5.27 | Inf | 0 |
| R1:S1:Column3 | 10.94 | Inf | 0 |
| R1:S1:Column4 | 8.05 | Inf | 0 |
| R1:S1:Column5 | 0.00 | | |
| R1:S2:Column1 | -24.43 | Inf | 0 |
| R1:S2:Column2 | -78.73 | Inf | 0 |
| R1:S2:Column3 | 15.88 | Inf | 0 |
| R1:S2:Column4 | -7.23 | Inf | 0 |
| R1:S2:Column5 | 0.00 | | |
| R1:S3:Column1 | -11.99 | Inf | 0 |
| R1:S3:Column2 | -72.89 | Inf | 0 |
| R1:S3:Column3 | -26.10 | Inf | 0 |
| R1:S3:Column4 | -40.68 | Inf | 0 |
| R1:S3:Column5 | 0.00 | | |
| R1:S4:Column1 | 0.00 | | |
| R1:S4:Column2 | 0.00 | | |

| | | | |
|---|---|---|---|
| R1:S4:Column3 | 0.00 | | |
| R1:S4:Column4 | 0.00 | | |
| R1:S4:Column5 | 0.00 | | |
| R2:S1:Column1 | 86.83 | Inf | 0 |
| R2:S1:Column2 | 87.33 | Inf | 0 |
| R2:S1:Column3 | 76.49 | Inf | 0 |
| R2:S1:Column4 | 7.66 | Inf | 0 |
| R2:S1:Column5 | 0.00 | | |
| R2:S2:Column1 | 67.97 | Inf | 0 |
| R2:S2:Column2 | 0.73 | Inf | 0 |
| R2:S2:Column3 | 71.73 | Inf | 0 |
| R2:S2:Column4 | 20.65 | Inf | 0 |
| R2:S2:Column5 | 0.00 | | |
| R2:S3:Column1 | 46.34 | Inf | 0 |
| R2:S3:Column2 | 13.83 | Inf | 0 |
| R2:S3:Column3 | 66.93 | Inf | 0 |
| R2:S3:Column4 | -2.28 | Inf | 0 |
| R2:S3:Column5 | 0.00 | | |
| R2:S4:Column1 | 0.00 | | |
| R2:S4:Column2 | 0.00 | | |
| R2:S4:Column3 | 0.00 | | |
| R2:S4:Column4 | 0.00 | | |
| R2:S4:Column5 | 0.00 | | |
| R3:S1:Column1 | 7.17 | Inf | 0 |
| R3:S1:Column2 | 52.01 | Inf | 0 |
| R3:S1:Column3 | 51.42 | Inf | 0 |
| R3:S1:Column4 | -7.58 | Inf | 0 |
| R3:S1:Column5 | 0.00 | | |
| R3:S2:Column1 | -5.38 | Inf | 0 |
| R3:S2:Column2 | 12.88 | Inf | 0 |
| R3:S2:Column3 | 83.94 | Inf | 0 |
| R3:S2:Column4 | 26.47 | Inf | 0 |
| R3:S2:Column5 | 0.00 | | |
| R3:S3:Column1 | -21.65 | Inf | 0 |
| R3:S3:Column2 | -75.11 | Inf | 0 |
| R3:S3:Column3 | 32.21 | Inf | 0 |
| R3:S3:Column4 | -48.45 | Inf | 0 |
| R3:S3:Column5 | 0.00 | | |
| R3:S4:Column1 | 0.00 | | |
| R3:S4:Column2 | 0.00 | | |
| R3:S4:Column3 | 0.00 | | |
| R3:S4:Column4 | 0.00 | | |
| R3:S4:Column5 | 0.00 | | |
| R4:S1:Column1 | 14.41 | Inf | 0 |
| R4:S1:Column2 | 35.11 | Inf | 0 |
| R4:S1:Column3 | 54.52 | Inf | 0 |
| R4:S1:Column4 | -31.57 | Inf | 0 |
| R4:S1:Column5 | 0.00 | | |

```
R4:S2:Column1     6.58        Inf       0
R4:S2:Column2   -21.55        Inf       0
R4:S2:Column3    50.87        Inf       0
R4:S2:Column4    22.02        Inf       0
R4:S2:Column5     0.00
R4:S3:Column1    -4.47        Inf       0
R4:S3:Column2   -52.07        Inf       0
R4:S3:Column3    -2.11        Inf       0
R4:S3:Column4   -67.47        Inf       0
R4:S3:Column5     0.00
R4:S4:Column1     0.00
R4:S4:Column2     0.00
R4:S4:Column3     0.00
R4:S4:Column4     0.00
R4:S4:Column5     0.00
R5:S1:Column1     0.00
R5:S1:Column2     0.00
R5:S1:Column3     0.00
R5:S1:Column4     0.00
R5:S1:Column5     0.00
R5:S2:Column1     0.00
R5:S2:Column2     0.00
R5:S2:Column3     0.00
R5:S2:Column4     0.00
R5:S2:Column5     0.00
R5:S3:Column1     0.00
R5:S3:Column2     0.00
R5:S3:Column3     0.00
R5:S3:Column4     0.00
R5:S3:Column5     0.00
R5:S4:Column1     0.00
R5:S4:Column2     0.00
R5:S4:Column3     0.00
R5:S4:Column4     0.00
R5:S4:Column5     0.00
```

(73) MODEL

```
GLM(Y ~ Row + R + S + R:S + Row:R + Column:S + Column:R:S, ex2.2)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL           99  22310  225.36
RESIDUALS        0      0
CORRECTED TOTAL 99  22310
```

```
$`Type I`
           Df  Sum Sq Mean Sq F value Pr(>F)
Row         4   147.4   36.86
R           4  1159.8  289.94
S           3   351.9  117.29
R:S        12   826.0   68.83
Row:R      16  3979.8  248.74
S:Column   12  3863.3  321.94
R:S:Column 48 11982.3  249.63

$`Type II`
           Df  Sum Sq Mean Sq F value Pr(>F)
Row         0
R           4  1159.8  289.94
S           3   351.9  117.29
R:S        12   826.0   68.83
Row:R       0
S:Column   12  3863.3  321.94
R:S:Column 48 11982.3  249.63

$`Type III`
CAUTION: Singularity Exists !
           Df  Sum Sq Mean Sq F value Pr(>F)
Row         0
R           4  1159.8  289.94
S           3   351.9  117.29
R:S        12   826.0   68.83
Row:R       0
S:Column   12  3863.3  321.94
R:S:Column 48 11982.3  249.63

$Parameter
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    1001.61        Inf       0
Row1             -5.98        Inf       0
Row2             16.88        Inf       0
Row3             19.34        Inf       0
Row4            -24.93        Inf       0
Row5              0.00
R1                9.12        Inf       0
R2              -18.93        Inf       0
R3               -2.75        Inf       0
R4                3.02        Inf       0
R5                0.00
S1               24.26        Inf       0
S2               21.85        Inf       0
S3               -7.81        Inf       0
S4                0.00
```

| | | | |
|---|---|---|---|
| R1:S1 | -12.01 | Inf | 0 |
| R1:S2 | 17.28 | Inf | 0 |
| R1:S3 | 18.96 | Inf | 0 |
| R1:S4 | 0.00 | | |
| R2:S1 | -39.64 | Inf | 0 |
| R2:S2 | -21.90 | Inf | 0 |
| R2:S3 | -31.42 | Inf | 0 |
| R2:S4 | 0.00 | | |
| R3:S1 | -10.98 | Inf | 0 |
| R3:S2 | -21.39 | Inf | 0 |
| R3:S3 | 14.46 | Inf | 0 |
| R3:S4 | 0.00 | | |
| R4:S1 | -10.34 | Inf | 0 |
| R4:S2 | -8.49 | Inf | 0 |
| R4:S3 | 18.78 | Inf | 0 |
| R4:S4 | 0.00 | | |
| R5:S1 | 0.00 | | |
| R5:S2 | 0.00 | | |
| R5:S3 | 0.00 | | |
| R5:S4 | 0.00 | | |
| Row1:R1 | 3.72 | Inf | 0 |
| Row1:R2 | 14.16 | Inf | 0 |
| Row1:R3 | -24.63 | Inf | 0 |
| Row1:R4 | 3.52 | Inf | 0 |
| Row1:R5 | 0.00 | | |
| Row2:R1 | -61.81 | Inf | 0 |
| Row2:R2 | 12.43 | Inf | 0 |
| Row2:R3 | -0.94 | Inf | 0 |
| Row2:R4 | -20.79 | Inf | 0 |
| Row2:R5 | 0.00 | | |
| Row3:R1 | -56.60 | Inf | 0 |
| Row3:R2 | -12.11 | Inf | 0 |
| Row3:R3 | -30.06 | Inf | 0 |
| Row3:R4 | -4.44 | Inf | 0 |
| Row3:R5 | 0.00 | | |
| Row4:R1 | 46.95 | Inf | 0 |
| Row4:R2 | 26.04 | Inf | 0 |
| Row4:R3 | 43.63 | Inf | 0 |
| Row4:R4 | 12.51 | Inf | 0 |
| Row4:R5 | 0.00 | | |
| Row5:R1 | 0.00 | | |
| Row5:R2 | 0.00 | | |
| Row5:R3 | 0.00 | | |
| Row5:R4 | 0.00 | | |
| Row5:R5 | 0.00 | | |
| S1:Column1 | -47.84 | Inf | 0 |
| S1:Column2 | -58.48 | Inf | 0 |
| S1:Column3 | -40.38 | Inf | 0 |

```
S1:Column4       10.08        Inf       0
S1:Column5        0.00
S2:Column1      -40.43        Inf       0
S2:Column2      -13.68        Inf       0
S2:Column3      -58.94        Inf       0
S2:Column4      -15.74        Inf       0
S2:Column5        0.00
S3:Column1       -0.39        Inf       0
S3:Column2       33.69        Inf       0
S3:Column3        5.46        Inf       0
S3:Column4       49.36        Inf       0
S3:Column5        0.00
S4:Column1        0.00
S4:Column2        0.00
S4:Column3        0.00
S4:Column4        0.00
S4:Column5        0.00
R1:S1:Column1    54.97        Inf       0
R1:S1:Column2     5.27        Inf       0
R1:S1:Column3    10.94        Inf       0
R1:S1:Column4     8.05        Inf       0
R1:S1:Column5     0.00
R1:S2:Column1   -24.43        Inf       0
R1:S2:Column2   -78.73        Inf       0
R1:S2:Column3    15.88        Inf       0
R1:S2:Column4    -7.23        Inf       0
R1:S2:Column5     0.00
R1:S3:Column1   -11.99        Inf       0
R1:S3:Column2   -72.89        Inf       0
R1:S3:Column3   -26.10        Inf       0
R1:S3:Column4   -40.68        Inf       0
R1:S3:Column5     0.00
R1:S4:Column1     0.00
R1:S4:Column2     0.00
R1:S4:Column3     0.00
R1:S4:Column4     0.00
R1:S4:Column5     0.00
R2:S1:Column1    86.83        Inf       0
R2:S1:Column2    87.33        Inf       0
R2:S1:Column3    76.49        Inf       0
R2:S1:Column4     7.66        Inf       0
R2:S1:Column5     0.00
R2:S2:Column1    67.97        Inf       0
R2:S2:Column2     0.73        Inf       0
R2:S2:Column3    71.73        Inf       0
R2:S2:Column4    20.65        Inf       0
R2:S2:Column5     0.00
R2:S3:Column1    46.34        Inf       0
```

```
R2:S3:Column2    13.83        Inf       0
R2:S3:Column3    66.93        Inf       0
R2:S3:Column4    -2.28        Inf       0
R2:S3:Column5     0.00
R2:S4:Column1     0.00
R2:S4:Column2     0.00
R2:S4:Column3     0.00
R2:S4:Column4     0.00
R2:S4:Column5     0.00
R3:S1:Column1     7.17        Inf       0
R3:S1:Column2    52.01        Inf       0
R3:S1:Column3    51.42        Inf       0
R3:S1:Column4    -7.58        Inf       0
R3:S1:Column5     0.00
R3:S2:Column1    -5.38        Inf       0
R3:S2:Column2    12.88        Inf       0
R3:S2:Column3    83.94        Inf       0
R3:S2:Column4    26.47        Inf       0
R3:S2:Column5     0.00
R3:S3:Column1   -21.65        Inf       0
R3:S3:Column2   -75.11        Inf       0
R3:S3:Column3    32.21        Inf       0
R3:S3:Column4   -48.45        Inf       0
R3:S3:Column5     0.00
R3:S4:Column1     0.00
R3:S4:Column2     0.00
R3:S4:Column3     0.00
R3:S4:Column4     0.00
R3:S4:Column5     0.00
R4:S1:Column1    14.41        Inf       0
R4:S1:Column2    35.11        Inf       0
R4:S1:Column3    54.52        Inf       0
R4:S1:Column4   -31.57        Inf       0
R4:S1:Column5     0.00
R4:S2:Column1     6.58        Inf       0
R4:S2:Column2   -21.55        Inf       0
R4:S2:Column3    50.87        Inf       0
R4:S2:Column4    22.02        Inf       0
R4:S2:Column5     0.00
R4:S3:Column1    -4.47        Inf       0
R4:S3:Column2   -52.07        Inf       0
R4:S3:Column3    -2.11        Inf       0
R4:S3:Column4   -67.47        Inf       0
R4:S3:Column5     0.00
R4:S4:Column1     0.00
R4:S4:Column2     0.00
R4:S4:Column3     0.00
R4:S4:Column4     0.00
```

```
R4:S4:Column5     0.00
R5:S1:Column1     0.00
R5:S1:Column2     0.00
R5:S1:Column3     0.00
R5:S1:Column4     0.00
R5:S1:Column5     0.00
R5:S2:Column1     0.00
R5:S2:Column2     0.00
R5:S2:Column3     0.00
R5:S2:Column4     0.00
R5:S2:Column5     0.00
R5:S3:Column1     0.00
R5:S3:Column2     0.00
R5:S3:Column3     0.00
R5:S3:Column4     0.00
R5:S3:Column5     0.00
R5:S4:Column1     0.00
R5:S4:Column2     0.00
R5:S4:Column3     0.00
R5:S4:Column4     0.00
R5:S4:Column5     0.00
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ Row + R + S + R:S + Row:R + Column:S + Column:R:S, ex2.2), type=3,
      singular.ok=TRUE) # Error
```

### 7.5 Example 3.1

(74) MODEL

```
ex3.1 = read.table("C:/G/Rt/Split/spedsite.txt", header=TRUE)
ex3.1 = af(ex3.1, c("Site", "A", "B", "C", "Block"))
GLM(Yield ~ Site + Site:Block + A + B + A:B + A:Site + B:Site + A:B:Site +
    A:B:Site:Block + C + A:C + B:C + A:B:C + C:Site + A:C:Site + B:C:Site +
    A:B:C:Site, ex3.1)
```

```
$ANOVA
Response : Yield
                 Df     Sum Sq  Mean Sq F value    Pr(>F)
MODEL           239 2724374186 11399055  23.682 < 2.2e-16 ***
RESIDUALS       240  115521933   481341
CORRECTED TOTAL 479 2839896119
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
```

```
               Df     Sum Sq   Mean Sq  F value  Pr(>F)
Site            3  621230991 207076997 430.2082 < 2e-16 ***
Site:Block      8 1305369943 163171243 338.9928 < 2e-16 ***
A               1    1333205   1333205   2.7698 0.09737 .
B               4   47928577  11982144  24.8932 < 2e-16 ***
A:B             4      14849      3712   0.0077 0.99988
Site:A          3      33010     11003   0.0229 0.99531
Site:B         12      37932      3161   0.0066 1.00000
Site:A:B       12      11494       958   0.0020 1.00000
Site:Block:A:B 72    8239680    114440   0.2378 1.00000
C               3  739890389 246630130 512.3809 < 2e-16 ***
A:C             3       3233      1078   0.0022 0.99985
B:C            12      34961      2913   0.0061 1.00000
A:B:C          12      11077       923   0.0019 1.00000
Site:C          9      25983      2887   0.0060 1.00000
Site:A:C        9      22227      2470   0.0051 1.00000
Site:B:C       36      88610      2461   0.0051 1.00000
Site:A:B:C     36      98025      2723   0.0057 1.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
               Df     Sum Sq   Mean Sq  F value  Pr(>F)
Site            3  621230991 207076997 430.2082 < 2e-16 ***
Site:Block      8 1305369943 163171243 338.9928 < 2e-16 ***
A               1    1333205   1333205   2.7698 0.09737 .
B               4   47928577  11982144  24.8932 < 2e-16 ***
A:B             4      14849      3712   0.0077 0.99988
Site:A          3      33010     11003   0.0229 0.99531
Site:B         12      37932      3161   0.0066 1.00000
Site:A:B       12      11494       958   0.0020 1.00000
Site:Block:A:B 72    8239680    114440   0.2378 1.00000
C               3  739890389 246630130 512.3809 < 2e-16 ***
A:C             3       3233      1078   0.0022 0.99985
B:C            12      34961      2913   0.0061 1.00000
A:B:C          12      11077       923   0.0019 1.00000
Site:C          9      25983      2887   0.0060 1.00000
Site:A:C        9      22227      2470   0.0051 1.00000
Site:B:C       36      88610      2461   0.0051 1.00000
Site:A:B:C     36      98025      2723   0.0057 1.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
               Df     Sum Sq   Mean Sq  F value  Pr(>F)
Site            3  621230991 207076997 430.2082 < 2e-16 ***
Site:Block      8 1305369943 163171243 338.9928 < 2e-16 ***
A               1    1333205   1333205   2.7698 0.09737 .
```

```
B                4   47928577  11982144  24.8932 < 2e-16 ***
A:B              4      14849      3712   0.0077 0.99988
Site:A           3      33010     11003   0.0229 0.99531
Site:B          12      37932      3161   0.0066 1.00000
Site:A:B        12      11494       958   0.0020 1.00000
Site:Block:A:B  72    8239680    114440   0.2378 1.00000
C                3  739890389 246630130 512.3809 < 2e-16 ***
A:C              3       3233      1078   0.0022 0.99985
B:C             12      34961      2913   0.0061 1.00000
A:B:C           12      11077       923   0.0019 1.00000
Site:C           9      25983      2887   0.0060 1.00000
Site:A:C         9      22227      2470   0.0051 1.00000
Site:B:C        36      88610      2461   0.0051 1.00000
Site:A:B:C      36      98025      2723   0.0057 1.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                     Estimate Std. Error t value  Pr(>|t|)
(Intercept)            6915.2     490.58 14.0958 < 2.2e-16 ***
Site1                   -54.7     693.79 -0.0788 0.9372617
Site2                  2003.4     693.79  2.8877 0.0042356 **
Site3                  2418.5     693.79  3.4859 0.0005830 ***
Site4                     0.0       0.00
Site1:BlockR1          4457.0     490.58  9.0851 < 2.2e-16 ***
Site1:BlockR2          2855.5     490.58  5.8206 1.868e-08 ***
Site1:BlockR3             0.0       0.00
Site2:BlockR1          4495.5     490.58  9.1636 < 2.2e-16 ***
Site2:BlockR2          2894.7     490.58  5.9006 1.226e-08 ***
Site2:BlockR3             0.0       0.00
Site3:BlockR1          4527.2     490.58  9.2283 < 2.2e-16 ***
Site3:BlockR2          2863.7     490.58  5.8375 1.710e-08 ***
Site3:BlockR3             0.0       0.00
Site4:BlockR1          4467.3     490.58  9.1060 < 2.2e-16 ***
Site4:BlockR2          2810.3     490.58  5.7284 3.022e-08 ***
Site4:BlockR3             0.0       0.00
AA1                     -91.2     693.79 -0.1315 0.8954707
AA2                       0.0       0.00
BB1                    -442.7     693.79 -0.6380 0.5240537
BB2                    -366.4     693.79 -0.5281 0.5978905
BB3                    -224.9     693.79 -0.3242 0.7460791
BB4                    -200.5     693.79 -0.2890 0.7728360
BB5                       0.0       0.00
AA1:BB1                  56.4     981.16  0.0575 0.9541950
AA1:BB2                  76.1     981.16  0.0775 0.9382554
AA1:BB3                  -3.7     981.16 -0.0037 0.9970214
AA1:BB4                 141.0     981.16  0.1437 0.8858525
AA1:BB5                   0.0       0.00
```

| | | | | |
|---|---|---|---|---|
| AA2:BB1 | 0.0 | 0.00 | | |
| AA2:BB2 | 0.0 | 0.00 | | |
| AA2:BB3 | 0.0 | 0.00 | | |
| AA2:BB4 | 0.0 | 0.00 | | |
| AA2:BB5 | 0.0 | 0.00 | | |
| Site1:AA1 | 70.5 | 981.16 | 0.0719 | 0.9427784 |
| Site1:AA2 | 0.0 | 0.00 | | |
| Site2:AA1 | -7.3 | 981.16 | -0.0074 | 0.9941105 |
| Site2:AA2 | 0.0 | 0.00 | | |
| Site3:AA1 | 64.6 | 981.16 | 0.0658 | 0.9475734 |
| Site3:AA2 | 0.0 | 0.00 | | |
| Site4:AA1 | 0.0 | 0.00 | | |
| Site4:AA2 | 0.0 | 0.00 | | |
| Site1:BB1 | 99.7 | 981.16 | 0.1016 | 0.9191748 |
| Site1:BB2 | 69.5 | 981.16 | 0.0708 | 0.9435887 |
| Site1:BB3 | 127.2 | 981.16 | 0.1297 | 0.8969180 |
| Site1:BB4 | 155.4 | 981.16 | 0.1584 | 0.8742746 |
| Site1:BB5 | 0.0 | 0.00 | | |
| Site2:BB1 | 21.7 | 981.16 | 0.0222 | 0.9823327 |
| Site2:BB2 | 4.6 | 981.16 | 0.0047 | 0.9962767 |
| Site2:BB3 | -3.7 | 981.16 | -0.0037 | 0.9970214 |
| Site2:BB4 | 66.5 | 981.16 | 0.0678 | 0.9460199 |
| Site2:BB5 | 0.0 | 0.00 | | |
| Site3:BB1 | 55.6 | 981.16 | 0.0567 | 0.9548708 |
| Site3:BB2 | 74.7 | 981.16 | 0.0762 | 0.9393354 |
| Site3:BB3 | 53.5 | 981.16 | 0.0545 | 0.9565606 |
| Site3:BB4 | 160.8 | 981.16 | 0.1639 | 0.8699313 |
| Site3:BB5 | 0.0 | 0.00 | | |
| Site4:BB1 | 0.0 | 0.00 | | |
| Site4:BB2 | 0.0 | 0.00 | | |
| Site4:BB3 | 0.0 | 0.00 | | |
| Site4:BB4 | 0.0 | 0.00 | | |
| Site4:BB5 | 0.0 | 0.00 | | |
| Site1:AA1:BB1 | -38.2 | 1387.58 | -0.0276 | 0.9780312 |
| Site1:AA1:BB2 | -103.7 | 1387.58 | -0.0747 | 0.9405072 |
| Site1:AA1:BB3 | -46.3 | 1387.58 | -0.0334 | 0.9733901 |
| Site1:AA1:BB4 | -172.2 | 1387.58 | -0.1241 | 0.9013579 |
| Site1:AA1:BB5 | 0.0 | 0.00 | | |
| Site1:AA2:BB1 | 0.0 | 0.00 | | |
| Site1:AA2:BB2 | 0.0 | 0.00 | | |
| Site1:AA2:BB3 | 0.0 | 0.00 | | |
| Site1:AA2:BB4 | 0.0 | 0.00 | | |
| Site1:AA2:BB5 | 0.0 | 0.00 | | |
| Site2:AA1:BB1 | -47.2 | 1387.58 | -0.0340 | 0.9729117 |
| Site2:AA1:BB2 | -26.1 | 1387.58 | -0.0188 | 0.9850180 |
| Site2:AA1:BB3 | 25.0 | 1387.58 | 0.0180 | 0.9856402 |
| Site2:AA1:BB4 | -109.2 | 1387.58 | -0.0787 | 0.9373572 |
| Site2:AA1:BB5 | 0.0 | 0.00 | | |

| | | | | |
|---|---|---|---|---|
| Site2:AA2:BB1 | 0.0 | 0.00 | | |
| Site2:AA2:BB2 | 0.0 | 0.00 | | |
| Site2:AA2:BB3 | 0.0 | 0.00 | | |
| Site2:AA2:BB4 | 0.0 | 0.00 | | |
| Site2:AA2:BB5 | 0.0 | 0.00 | | |
| Site3:AA1:BB1 | -48.0 | 1387.58 | -0.0346 | 0.9724333 |
| Site3:AA1:BB2 | -87.7 | 1387.58 | -0.0632 | 0.9496282 |
| Site3:AA1:BB3 | 1.3 | 1387.58 | 0.0010 | 0.9992341 |
| Site3:AA1:BB4 | -86.4 | 1387.58 | -0.0623 | 0.9503926 |
| Site3:AA1:BB5 | 0.0 | 0.00 | | |
| Site3:AA2:BB1 | 0.0 | 0.00 | | |
| Site3:AA2:BB2 | 0.0 | 0.00 | | |
| Site3:AA2:BB3 | 0.0 | 0.00 | | |
| Site3:AA2:BB4 | 0.0 | 0.00 | | |
| Site3:AA2:BB5 | 0.0 | 0.00 | | |
| Site4:AA1:BB1 | 0.0 | 0.00 | | |
| Site4:AA1:BB2 | 0.0 | 0.00 | | |
| Site4:AA1:BB3 | 0.0 | 0.00 | | |
| Site4:AA1:BB4 | 0.0 | 0.00 | | |
| Site4:AA1:BB5 | 0.0 | 0.00 | | |
| Site4:AA2:BB1 | 0.0 | 0.00 | | |
| Site4:AA2:BB2 | 0.0 | 0.00 | | |
| Site4:AA2:BB3 | 0.0 | 0.00 | | |
| Site4:AA2:BB4 | 0.0 | 0.00 | | |
| Site4:AA2:BB5 | 0.0 | 0.00 | | |
| Site1:BlockR1:AA1:BB1 | -928.2 | 693.79 | -1.3379 | 0.1821806 |
| Site1:BlockR1:AA1:BB2 | -733.2 | 693.79 | -1.0569 | 0.2916292 |
| Site1:BlockR1:AA1:BB3 | -514.0 | 693.79 | -0.7409 | 0.4595022 |
| Site1:BlockR1:AA1:BB4 | -350.2 | 693.79 | -0.5048 | 0.6141363 |
| Site1:BlockR1:AA1:BB5 | -106.7 | 693.79 | -0.1539 | 0.8778451 |
| Site1:BlockR1:AA2:BB1 | -900.7 | 693.79 | -1.2983 | 0.1954278 |
| Site1:BlockR1:AA2:BB2 | -683.7 | 693.79 | -0.9855 | 0.3253553 |
| Site1:BlockR1:AA2:BB3 | -415.7 | 693.79 | -0.5992 | 0.5495736 |
| Site1:BlockR1:AA2:BB4 | -216.5 | 693.79 | -0.3121 | 0.7552696 |
| Site1:BlockR1:AA2:BB5 | 0.0 | 0.00 | | |
| Site1:BlockR2:AA1:BB1 | -744.0 | 693.79 | -1.0724 | 0.2846291 |
| Site1:BlockR2:AA1:BB2 | -533.0 | 693.79 | -0.7682 | 0.4430960 |
| Site1:BlockR2:AA1:BB3 | -417.7 | 693.79 | -0.6021 | 0.5476564 |
| Site1:BlockR2:AA1:BB4 | -277.7 | 693.79 | -0.4003 | 0.6892633 |
| Site1:BlockR2:AA1:BB5 | -80.0 | 693.79 | -0.1153 | 0.9082966 |
| Site1:BlockR2:AA2:BB1 | -713.2 | 693.79 | -1.0281 | 0.3049602 |
| Site1:BlockR2:AA2:BB2 | -488.5 | 693.79 | -0.7041 | 0.4820495 |
| Site1:BlockR2:AA2:BB3 | -373.2 | 693.79 | -0.5380 | 0.5910833 |
| Site1:BlockR2:AA2:BB4 | -231.2 | 693.79 | -0.3333 | 0.7391874 |
| Site1:BlockR2:AA2:BB5 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA1:BB1 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA1:BB2 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA1:BB3 | 0.0 | 0.00 | | |

| | | | | |
|---|---|---|---|---|
| Site1:BlockR3:AA1:BB4 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA1:BB5 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA2:BB1 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA2:BB2 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA2:BB3 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA2:BB4 | 0.0 | 0.00 | | |
| Site1:BlockR3:AA2:BB5 | 0.0 | 0.00 | | |
| Site2:BlockR1:AA1:BB1 | -974.5 | 693.79 | -1.4046 | 0.1614307 |
| Site2:BlockR1:AA1:BB2 | -779.5 | 693.79 | -1.1235 | 0.2623297 |
| Site2:BlockR1:AA1:BB3 | -559.5 | 693.79 | -0.8064 | 0.4207860 |
| Site2:BlockR1:AA1:BB4 | -301.0 | 693.79 | -0.4339 | 0.6647869 |
| Site2:BlockR1:AA1:BB5 | -172.0 | 693.79 | -0.2479 | 0.8044126 |
| Site2:BlockR1:AA2:BB1 | -878.8 | 693.79 | -1.2666 | 0.2065270 |
| Site2:BlockR1:AA2:BB2 | -603.5 | 693.79 | -0.8699 | 0.3852446 |
| Site2:BlockR1:AA2:BB3 | -392.3 | 693.79 | -0.5654 | 0.5723471 |
| Site2:BlockR1:AA2:BB4 | -212.5 | 693.79 | -0.3063 | 0.7596497 |
| Site2:BlockR1:AA2:BB5 | 0.0 | 0.00 | | |
| Site2:BlockR2:AA1:BB1 | -725.0 | 693.79 | -1.0450 | 0.2970798 |
| Site2:BlockR2:AA1:BB2 | -572.5 | 693.79 | -0.8252 | 0.4100886 |
| Site2:BlockR2:AA1:BB3 | -427.2 | 693.79 | -0.6158 | 0.5385953 |
| Site2:BlockR2:AA1:BB4 | -278.0 | 693.79 | -0.4007 | 0.6889983 |
| Site2:BlockR2:AA1:BB5 | -144.5 | 693.79 | -0.2083 | 0.8351894 |
| Site2:BlockR2:AA2:BB1 | -629.5 | 693.79 | -0.9073 | 0.3651382 |
| Site2:BlockR2:AA2:BB2 | -530.0 | 693.79 | -0.7639 | 0.4456638 |
| Site2:BlockR2:AA2:BB3 | -304.0 | 693.79 | -0.4382 | 0.6616540 |
| Site2:BlockR2:AA2:BB4 | -204.5 | 693.79 | -0.2948 | 0.7684330 |
| Site2:BlockR2:AA2:BB5 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA1:BB1 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA1:BB2 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA1:BB3 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA1:BB4 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA1:BB5 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA2:BB1 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA2:BB2 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA2:BB3 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA2:BB4 | 0.0 | 0.00 | | |
| Site2:BlockR3:AA2:BB5 | 0.0 | 0.00 | | |
| Site3:BlockR1:AA1:BB1 | -1029.0 | 693.79 | -1.4832 | 0.1393432 |
| Site3:BlockR1:AA1:BB2 | -781.0 | 693.79 | -1.1257 | 0.2614150 |
| Site3:BlockR1:AA1:BB3 | -555.2 | 693.79 | -0.8003 | 0.4243187 |
| Site3:BlockR1:AA1:BB4 | -442.5 | 693.79 | -0.6378 | 0.5242099 |
| Site3:BlockR1:AA1:BB5 | -152.7 | 693.79 | -0.2202 | 0.8259273 |
| Site3:BlockR1:AA2:BB1 | -858.5 | 693.79 | -1.2374 | 0.2171441 |
| Site3:BlockR1:AA2:BB2 | -683.7 | 693.79 | -0.9855 | 0.3253553 |
| Site3:BlockR1:AA2:BB3 | -453.7 | 693.79 | -0.6540 | 0.5137261 |
| Site3:BlockR1:AA2:BB4 | -213.2 | 693.79 | -0.3074 | 0.7588278 |
| Site3:BlockR1:AA2:BB5 | 0.0 | 0.00 | | |
| Site3:BlockR2:AA1:BB1 | -756.0 | 693.79 | -1.0897 | 0.2769512 |

```
Site3:BlockR2:AA1:BB2   -566.0     693.79 -0.8158 0.4154169
Site3:BlockR2:AA1:BB3   -354.5     693.79 -0.5110 0.6098465
Site3:BlockR2:AA1:BB4   -266.2     693.79 -0.3838 0.7014939
Site3:BlockR2:AA1:BB5    -87.2     693.79 -0.1258 0.9000280
Site3:BlockR2:AA2:BB1   -619.2     693.79 -0.8926 0.3729847
Site3:BlockR2:AA2:BB2   -448.2     693.79 -0.6461 0.5188377
Site3:BlockR2:AA2:BB3   -261.0     693.79 -0.3762 0.7071037
Site3:BlockR2:AA2:BB4   -175.7     693.79 -0.2533 0.8002381
Site3:BlockR2:AA2:BB5      0.0       0.00
Site3:BlockR3:AA1:BB1      0.0       0.00
Site3:BlockR3:AA1:BB2      0.0       0.00
Site3:BlockR3:AA1:BB3      0.0       0.00
Site3:BlockR3:AA1:BB4      0.0       0.00
Site3:BlockR3:AA1:BB5      0.0       0.00
Site3:BlockR3:AA2:BB1      0.0       0.00
Site3:BlockR3:AA2:BB2      0.0       0.00
Site3:BlockR3:AA2:BB3      0.0       0.00
Site3:BlockR3:AA2:BB4      0.0       0.00
Site3:BlockR3:AA2:BB5      0.0       0.00
Site4:BlockR1:AA1:BB1   -920.0     693.79 -1.3261 0.1860824
Site4:BlockR1:AA1:BB2   -756.0     693.79 -1.0897 0.2769512
Site4:BlockR1:AA1:BB3   -550.5     693.79 -0.7935 0.4282876
Site4:BlockR1:AA1:BB4   -312.5     693.79 -0.4504 0.6528099
Site4:BlockR1:AA1:BB5    -94.0     693.79 -0.1355 0.8923395
Site4:BlockR1:AA2:BB1   -825.8     693.79 -1.1902 0.2351416
Site4:BlockR1:AA2:BB2   -603.3     693.79 -0.8695 0.3854412
Site4:BlockR1:AA2:BB3   -425.0     693.79 -0.6126 0.5407345
Site4:BlockR1:AA2:BB4   -154.8     693.79 -0.2231 0.8236856
Site4:BlockR1:AA2:BB5      0.0       0.00
Site4:BlockR2:AA1:BB1   -664.5     693.79 -0.9578 0.3391346
Site4:BlockR2:AA1:BB2   -552.3     693.79 -0.7960 0.4268228
Site4:BlockR2:AA1:BB3   -366.0     693.79 -0.5275 0.5983068
Site4:BlockR2:AA1:BB4   -213.3     693.79 -0.3074 0.7588278
Site4:BlockR2:AA1:BB5     -1.3     693.79 -0.0018 0.9985639
Site4:BlockR2:AA2:BB1   -547.3     693.79 -0.7888 0.4310156
Site4:BlockR2:AA2:BB2   -434.5     693.79 -0.6263 0.5317316
Site4:BlockR2:AA2:BB3   -320.3     693.79 -0.4616 0.6447888
Site4:BlockR2:AA2:BB4    -79.8     693.79 -0.1149 0.9085819
Site4:BlockR2:AA2:BB5      0.0       0.00
Site4:BlockR3:AA1:BB1      0.0       0.00
Site4:BlockR3:AA1:BB2      0.0       0.00
Site4:BlockR3:AA1:BB3      0.0       0.00
Site4:BlockR3:AA1:BB4      0.0       0.00
Site4:BlockR3:AA1:BB5      0.0       0.00
Site4:BlockR3:AA2:BB1      0.0       0.00
Site4:BlockR3:AA2:BB2      0.0       0.00
Site4:BlockR3:AA2:BB3      0.0       0.00
Site4:BlockR3:AA2:BB4      0.0       0.00
```

```
Site4:BlockR3:AA2:BB5      0.0       0.00
CC1                    -3320.7     566.48 -5.8620 1.503e-08 ***
CC2                    -2205.0     566.48 -3.8925 0.0001286 ***
CC3                    -1108.0     566.48 -1.9560 0.0516306 .
CC4                        0.0       0.00
AA1:CC1                   -1.7     801.12 -0.0021 0.9983418
AA1:CC2                  -17.0     801.12 -0.0212 0.9830875
AA1:CC3                   21.7     801.12  0.0270 0.9784459
AA1:CC4                    0.0       0.00
AA2:CC1                    0.0       0.00
AA2:CC2                    0.0       0.00
AA2:CC3                    0.0       0.00
AA2:CC4                    0.0       0.00
BB1:CC1                  -36.7     801.12 -0.0458 0.9635321
BB1:CC2                  -13.0     801.12 -0.0162 0.9870665
BB1:CC3                   13.3     801.12  0.0166 0.9867349
BB1:CC4                    0.0       0.00
BB2:CC1                  -28.0     801.12 -0.0350 0.9721477
BB2:CC2                   27.7     801.12  0.0345 0.9724791
BB2:CC3                   62.0     801.12  0.0774 0.9383762
BB2:CC4                    0.0       0.00
BB3:CC1                  -21.0     801.12 -0.0262 0.9791089
BB3:CC2                   20.3     801.12  0.0254 0.9797720
BB3:CC3                   36.3     801.12  0.0454 0.9638634
BB3:CC4                    0.0       0.00
BB4:CC1                   18.7     801.12  0.0233 0.9814297
BB4:CC2                   28.0     801.12  0.0350 0.9721477
BB4:CC3                   84.3     801.12  0.1053 0.9162497
BB4:CC4                    0.0       0.00
BB5:CC1                    0.0       0.00
BB5:CC2                    0.0       0.00
BB5:CC3                    0.0       0.00
BB5:CC4                    0.0       0.00
AA1:BB1:CC1               51.7    1132.95  0.0456 0.9636641
AA1:BB1:CC2                7.7    1132.95  0.0068 0.9946064
AA1:BB1:CC3              -16.0    1132.95 -0.0141 0.9887440
AA1:BB1:CC4                0.0       0.00
AA1:BB2:CC1               51.3    1132.95  0.0453 0.9638984
AA1:BB2:CC2              -52.3    1132.95 -0.0462 0.9631956
AA1:BB2:CC3              -88.3    1132.95 -0.0780 0.9379189
AA1:BB2:CC4                0.0       0.00
AA1:BB3:CC1               97.3    1132.95  0.0859 0.9316085
AA1:BB3:CC2               74.0    1132.95  0.0653 0.9479766
AA1:BB3:CC3              -26.7    1132.95 -0.0235 0.9812412
AA1:BB3:CC4                0.0       0.00
AA1:BB4:CC1              -78.0    1132.95 -0.0688 0.9451689
AA1:BB4:CC2              -27.7    1132.95 -0.0244 0.9805379
AA1:BB4:CC3              -67.3    1132.95 -0.0594 0.9526576
```

| | | | | |
|---|---|---|---|---|
| AA1:BB4:CC4 | 0.0 | 0.00 | | |
| AA1:BB5:CC1 | 0.0 | 0.00 | | |
| AA1:BB5:CC2 | 0.0 | 0.00 | | |
| AA1:BB5:CC3 | 0.0 | 0.00 | | |
| AA1:BB5:CC4 | 0.0 | 0.00 | | |
| AA2:BB1:CC1 | 0.0 | 0.00 | | |
| AA2:BB1:CC2 | 0.0 | 0.00 | | |
| AA2:BB1:CC3 | 0.0 | 0.00 | | |
| AA2:BB1:CC4 | 0.0 | 0.00 | | |
| AA2:BB2:CC1 | 0.0 | 0.00 | | |
| AA2:BB2:CC2 | 0.0 | 0.00 | | |
| AA2:BB2:CC3 | 0.0 | 0.00 | | |
| AA2:BB2:CC4 | 0.0 | 0.00 | | |
| AA2:BB3:CC1 | 0.0 | 0.00 | | |
| AA2:BB3:CC2 | 0.0 | 0.00 | | |
| AA2:BB3:CC3 | 0.0 | 0.00 | | |
| AA2:BB3:CC4 | 0.0 | 0.00 | | |
| AA2:BB4:CC1 | 0.0 | 0.00 | | |
| AA2:BB4:CC2 | 0.0 | 0.00 | | |
| AA2:BB4:CC3 | 0.0 | 0.00 | | |
| AA2:BB4:CC4 | 0.0 | 0.00 | | |
| AA2:BB5:CC1 | 0.0 | 0.00 | | |
| AA2:BB5:CC2 | 0.0 | 0.00 | | |
| AA2:BB5:CC3 | 0.0 | 0.00 | | |
| AA2:BB5:CC4 | 0.0 | 0.00 | | |
| Site1:CC1 | 31.3 | 801.12 | 0.0391 | 0.9688336 |
| Site1:CC2 | 26.7 | 801.12 | 0.0333 | 0.9734735 |
| Site1:CC3 | 26.7 | 801.12 | 0.0333 | 0.9734735 |
| Site1:CC4 | 0.0 | 0.00 | | |
| Site2:CC1 | -29.0 | 801.12 | -0.0362 | 0.9711534 |
| Site2:CC2 | -72.3 | 801.12 | -0.0903 | 0.9281316 |
| Site2:CC3 | -10.3 | 801.12 | -0.0129 | 0.9897194 |
| Site2:CC4 | 0.0 | 0.00 | | |
| Site3:CC1 | 1.7 | 801.12 | 0.0021 | 0.9983418 |
| Site3:CC2 | -7.0 | 801.12 | -0.0087 | 0.9930356 |
| Site3:CC3 | -15.7 | 801.12 | -0.0196 | 0.9844138 |
| Site3:CC4 | 0.0 | 0.00 | | |
| Site4:CC1 | 0.0 | 0.00 | | |
| Site4:CC2 | 0.0 | 0.00 | | |
| Site4:CC3 | 0.0 | 0.00 | | |
| Site4:CC4 | 0.0 | 0.00 | | |
| Site1:AA1:CC1 | -10.0 | 1132.95 | -0.0088 | 0.9929649 |
| Site1:AA1:CC2 | -15.0 | 1132.95 | -0.0132 | 0.9894475 |
| Site1:AA1:CC3 | -29.0 | 1132.95 | -0.0256 | 0.9796001 |
| Site1:AA1:CC4 | 0.0 | 0.00 | | |
| Site1:AA2:CC1 | 0.0 | 0.00 | | |
| Site1:AA2:CC2 | 0.0 | 0.00 | | |
| Site1:AA2:CC3 | 0.0 | 0.00 | | |

| | | | | |
|---|---|---|---|---|
| Site1:AA2:CC4 | 0.0 | 0.00 | | |
| Site2:AA1:CC1 | 62.0 | 1132.95 | 0.0547 | 0.9564036 |
| Site2:AA1:CC2 | 156.7 | 1132.95 | 0.1383 | 0.8901335 |
| Site2:AA1:CC3 | -20.7 | 1132.95 | -0.0182 | 0.9854614 |
| Site2:AA1:CC4 | 0.0 | 0.00 | | |
| Site2:AA2:CC1 | 0.0 | 0.00 | | |
| Site2:AA2:CC2 | 0.0 | 0.00 | | |
| Site2:AA2:CC3 | 0.0 | 0.00 | | |
| Site2:AA2:CC4 | 0.0 | 0.00 | | |
| Site3:AA1:CC1 | -48.0 | 1132.95 | -0.0424 | 0.9662412 |
| Site3:AA1:CC2 | 9.0 | 1132.95 | 0.0079 | 0.9936684 |
| Site3:AA1:CC3 | 48.7 | 1132.95 | 0.0430 | 0.9657726 |
| Site3:AA1:CC4 | 0.0 | 0.00 | | |
| Site3:AA2:CC1 | 0.0 | 0.00 | | |
| Site3:AA2:CC2 | 0.0 | 0.00 | | |
| Site3:AA2:CC3 | 0.0 | 0.00 | | |
| Site3:AA2:CC4 | 0.0 | 0.00 | | |
| Site4:AA1:CC1 | 0.0 | 0.00 | | |
| Site4:AA1:CC2 | 0.0 | 0.00 | | |
| Site4:AA1:CC3 | 0.0 | 0.00 | | |
| Site4:AA1:CC4 | 0.0 | 0.00 | | |
| Site4:AA2:CC1 | 0.0 | 0.00 | | |
| Site4:AA2:CC2 | 0.0 | 0.00 | | |
| Site4:AA2:CC3 | 0.0 | 0.00 | | |
| Site4:AA2:CC4 | 0.0 | 0.00 | | |
| Site1:BB1:CC1 | -6.0 | 1132.95 | -0.0053 | 0.9957789 |
| Site1:BB1:CC2 | -62.0 | 1132.95 | -0.0547 | 0.9564036 |
| Site1:BB1:CC3 | 6.3 | 1132.95 | 0.0056 | 0.9955444 |
| Site1:BB1:CC4 | 0.0 | 0.00 | | |
| Site1:BB2:CC1 | 61.0 | 1132.95 | 0.0538 | 0.9571061 |
| Site1:BB2:CC2 | -57.0 | 1132.95 | -0.0503 | 0.9599163 |
| Site1:BB2:CC3 | -38.0 | 1132.95 | -0.0335 | 0.9732713 |
| Site1:BB2:CC4 | 0.0 | 0.00 | | |
| Site1:BB3:CC1 | -85.7 | 1132.95 | -0.0756 | 0.9397894 |
| Site1:BB3:CC2 | -116.0 | 1132.95 | -0.1024 | 0.9185346 |
| Site1:BB3:CC3 | -108.3 | 1132.95 | -0.0956 | 0.9239018 |
| Site1:BB3:CC4 | 0.0 | 0.00 | | |
| Site1:BB4:CC1 | -74.7 | 1132.95 | -0.0659 | 0.9475086 |
| Site1:BB4:CC2 | -36.7 | 1132.95 | -0.0324 | 0.9742088 |
| Site1:BB4:CC3 | -138.3 | 1132.95 | -0.1221 | 0.9029220 |
| Site1:BB4:CC4 | 0.0 | 0.00 | | |
| Site1:BB5:CC1 | 0.0 | 0.00 | | |
| Site1:BB5:CC2 | 0.0 | 0.00 | | |
| Site1:BB5:CC3 | 0.0 | 0.00 | | |
| Site1:BB5:CC4 | 0.0 | 0.00 | | |
| Site2:BB1:CC1 | 59.3 | 1132.95 | 0.0524 | 0.9582769 |
| Site2:BB1:CC2 | 43.0 | 1132.95 | 0.0380 | 0.9697559 |
| Site2:BB1:CC3 | 18.7 | 1132.95 | 0.0165 | 0.9868682 |

| | | | | |
|---|---|---|---|---|
| Site2:BB1:CC4 | 0.0 | 0.00 | | |
| Site2:BB2:CC1 | 54.3 | 1132.95 | 0.0480 | 0.9617901 |
| Site2:BB2:CC2 | 95.3 | 1132.95 | 0.0841 | 0.9330104 |
| Site2:BB2:CC3 | -54.0 | 1132.95 | -0.0477 | 0.9620243 |
| Site2:BB2:CC4 | 0.0 | 0.00 | | |
| Site2:BB3:CC1 | -55.3 | 1132.95 | -0.0488 | 0.9610874 |
| Site2:BB3:CC2 | 81.3 | 1132.95 | 0.0718 | 0.9428297 |
| Site2:BB3:CC3 | -2.3 | 1132.95 | -0.0021 | 0.9983585 |
| Site2:BB3:CC4 | 0.0 | 0.00 | | |
| Site2:BB4:CC1 | -32.0 | 1132.95 | -0.0282 | 0.9774904 |
| Site2:BB4:CC2 | 13.0 | 1132.95 | 0.0115 | 0.9908544 |
| Site2:BB4:CC3 | -63.0 | 1132.95 | -0.0556 | 0.9557011 |
| Site2:BB4:CC4 | 0.0 | 0.00 | | |
| Site2:BB5:CC1 | 0.0 | 0.00 | | |
| Site2:BB5:CC2 | 0.0 | 0.00 | | |
| Site2:BB5:CC3 | 0.0 | 0.00 | | |
| Site2:BB5:CC4 | 0.0 | 0.00 | | |
| Site3:BB1:CC1 | 39.3 | 1132.95 | 0.0347 | 0.9723338 |
| Site3:BB1:CC2 | 19.0 | 1132.95 | 0.0168 | 0.9866337 |
| Site3:BB1:CC3 | 19.3 | 1132.95 | 0.0171 | 0.9863993 |
| Site3:BB1:CC4 | 0.0 | 0.00 | | |
| Site3:BB2:CC1 | 73.3 | 1132.95 | 0.0647 | 0.9484447 |
| Site3:BB2:CC2 | -66.0 | 1132.95 | -0.0583 | 0.9535940 |
| Site3:BB2:CC3 | -28.3 | 1132.95 | -0.0250 | 0.9800690 |
| Site3:BB2:CC4 | 0.0 | 0.00 | | |
| Site3:BB3:CC1 | 1.3 | 1132.95 | 0.0012 | 0.9990620 |
| Site3:BB3:CC2 | -49.0 | 1132.95 | -0.0432 | 0.9655383 |
| Site3:BB3:CC3 | 26.7 | 1132.95 | 0.0235 | 0.9812412 |
| Site3:BB3:CC4 | 0.0 | 0.00 | | |
| Site3:BB4:CC1 | -61.0 | 1132.95 | -0.0538 | 0.9571061 |
| Site3:BB4:CC2 | -65.7 | 1132.95 | -0.0580 | 0.9538281 |
| Site3:BB4:CC3 | -103.7 | 1132.95 | -0.0915 | 0.9271704 |
| Site3:BB4:CC4 | 0.0 | 0.00 | | |
| Site3:BB5:CC1 | 0.0 | 0.00 | | |
| Site3:BB5:CC2 | 0.0 | 0.00 | | |
| Site3:BB5:CC3 | 0.0 | 0.00 | | |
| Site3:BB5:CC4 | 0.0 | 0.00 | | |
| Site4:BB1:CC1 | 0.0 | 0.00 | | |
| Site4:BB1:CC2 | 0.0 | 0.00 | | |
| Site4:BB1:CC3 | 0.0 | 0.00 | | |
| Site4:BB1:CC4 | 0.0 | 0.00 | | |
| Site4:BB2:CC1 | 0.0 | 0.00 | | |
| Site4:BB2:CC2 | 0.0 | 0.00 | | |
| Site4:BB2:CC3 | 0.0 | 0.00 | | |
| Site4:BB2:CC4 | 0.0 | 0.00 | | |
| Site4:BB3:CC1 | 0.0 | 0.00 | | |
| Site4:BB3:CC2 | 0.0 | 0.00 | | |
| Site4:BB3:CC3 | 0.0 | 0.00 | | |

```
Site4:BB3:CC4              0.0       0.00
Site4:BB4:CC1              0.0       0.00
Site4:BB4:CC2              0.0       0.00
Site4:BB4:CC3              0.0       0.00
Site4:BB4:CC4              0.0       0.00
Site4:BB5:CC1              0.0       0.00
Site4:BB5:CC2              0.0       0.00
Site4:BB5:CC3              0.0       0.00
Site4:BB5:CC4              0.0       0.00
Site1:AA1:BB1:CC1        -66.7    1602.23 -0.0416 0.9668453
Site1:AA1:BB1:CC2        -16.3    1602.23 -0.0102 0.9918749
Site1:AA1:BB1:CC3        -86.0    1602.23 -0.0537 0.9572387
Site1:AA1:BB1:CC4          0.0       0.00
Site1:AA1:BB2:CC1        -31.0    1602.23 -0.0193 0.9845796
Site1:AA1:BB2:CC2         81.3    1602.23  0.0508 0.9595570
Site1:AA1:BB2:CC3         58.3    1602.23  0.0364 0.9709877
Site1:AA1:BB2:CC4          0.0       0.00
Site1:AA1:BB3:CC1       -103.3    1602.23 -0.0645 0.9486311
Site1:AA1:BB3:CC2         -3.7    1602.23 -0.0023 0.9981760
Site1:AA1:BB3:CC3         45.3    1602.23  0.0283 0.9774513
Site1:AA1:BB3:CC4          0.0       0.00
Site1:AA1:BB4:CC1        137.3    1602.23  0.0857 0.9317655
Site1:AA1:BB4:CC2         69.3    1602.23  0.0433 0.9655200
Site1:AA1:BB4:CC3        137.0    1602.23  0.0855 0.9319307
Site1:AA1:BB4:CC4          0.0       0.00
Site1:AA1:BB5:CC1          0.0       0.00
Site1:AA1:BB5:CC2          0.0       0.00
Site1:AA1:BB5:CC3          0.0       0.00
Site1:AA1:BB5:CC4          0.0       0.00
Site1:AA2:BB1:CC1          0.0       0.00
Site1:AA2:BB1:CC2          0.0       0.00
Site1:AA2:BB1:CC3          0.0       0.00
Site1:AA2:BB1:CC4          0.0       0.00
Site1:AA2:BB2:CC1          0.0       0.00
Site1:AA2:BB2:CC2          0.0       0.00
Site1:AA2:BB2:CC3          0.0       0.00
Site1:AA2:BB2:CC4          0.0       0.00
Site1:AA2:BB3:CC1          0.0       0.00
Site1:AA2:BB3:CC2          0.0       0.00
Site1:AA2:BB3:CC3          0.0       0.00
Site1:AA2:BB3:CC4          0.0       0.00
Site1:AA2:BB4:CC1          0.0       0.00
Site1:AA2:BB4:CC2          0.0       0.00
Site1:AA2:BB4:CC3          0.0       0.00
Site1:AA2:BB4:CC4          0.0       0.00
Site1:AA2:BB5:CC1          0.0       0.00
Site1:AA2:BB5:CC2          0.0       0.00
Site1:AA2:BB5:CC3          0.0       0.00
```

| | | | | |
|---|---|---|---|---|
| Site1:AA2:BB5:CC4 | 0.0 | 0.00 | | |
| Site2:AA1:BB1:CC1 | -130.0 | 1602.23 | -0.0811 | 0.9354009 |
| Site2:AA1:BB1:CC2 | -79.0 | 1602.23 | -0.0493 | 0.9607163 |
| Site2:AA1:BB1:CC3 | 17.7 | 1602.23 | 0.0110 | 0.9912116 |
| Site2:AA1:BB1:CC4 | 0.0 | 0.00 | | |
| Site2:AA1:BB2:CC1 | -128.0 | 1602.23 | -0.0799 | 0.9363925 |
| Site2:AA1:BB2:CC2 | -92.0 | 1602.23 | -0.0574 | 0.9542585 |
| Site2:AA1:BB2:CC3 | 160.3 | 1602.23 | 0.1001 | 0.9203734 |
| Site2:AA1:BB2:CC4 | 0.0 | 0.00 | | |
| Site2:AA1:BB3:CC1 | -49.0 | 1602.23 | -0.0306 | 0.9756281 |
| Site2:AA1:BB3:CC2 | -220.3 | 1602.23 | -0.1375 | 0.8907380 |
| Site2:AA1:BB3:CC3 | 51.3 | 1602.23 | 0.0320 | 0.9744679 |
| Site2:AA1:BB3:CC4 | 0.0 | 0.00 | | |
| Site2:AA1:BB4:CC1 | 60.7 | 1602.23 | 0.0379 | 0.9698278 |
| Site2:AA1:BB4:CC2 | -81.7 | 1602.23 | -0.0510 | 0.9593914 |
| Site2:AA1:BB4:CC3 | 37.7 | 1602.23 | 0.0235 | 0.9812639 |
| Site2:AA1:BB4:CC4 | 0.0 | 0.00 | | |
| Site2:AA1:BB5:CC1 | 0.0 | 0.00 | | |
| Site2:AA1:BB5:CC2 | 0.0 | 0.00 | | |
| Site2:AA1:BB5:CC3 | 0.0 | 0.00 | | |
| Site2:AA1:BB5:CC4 | 0.0 | 0.00 | | |
| Site2:AA2:BB1:CC1 | 0.0 | 0.00 | | |
| Site2:AA2:BB1:CC2 | 0.0 | 0.00 | | |
| Site2:AA2:BB1:CC3 | 0.0 | 0.00 | | |
| Site2:AA2:BB1:CC4 | 0.0 | 0.00 | | |
| Site2:AA2:BB2:CC1 | 0.0 | 0.00 | | |
| Site2:AA2:BB2:CC2 | 0.0 | 0.00 | | |
| Site2:AA2:BB2:CC3 | 0.0 | 0.00 | | |
| Site2:AA2:BB2:CC4 | 0.0 | 0.00 | | |
| Site2:AA2:BB3:CC1 | 0.0 | 0.00 | | |
| Site2:AA2:BB3:CC2 | 0.0 | 0.00 | | |
| Site2:AA2:BB3:CC3 | 0.0 | 0.00 | | |
| Site2:AA2:BB3:CC4 | 0.0 | 0.00 | | |
| Site2:AA2:BB4:CC1 | 0.0 | 0.00 | | |
| Site2:AA2:BB4:CC2 | 0.0 | 0.00 | | |
| Site2:AA2:BB4:CC3 | 0.0 | 0.00 | | |
| Site2:AA2:BB4:CC4 | 0.0 | 0.00 | | |
| Site2:AA2:BB5:CC1 | 0.0 | 0.00 | | |
| Site2:AA2:BB5:CC2 | 0.0 | 0.00 | | |
| Site2:AA2:BB5:CC3 | 0.0 | 0.00 | | |
| Site2:AA2:BB5:CC4 | 0.0 | 0.00 | | |
| Site3:AA1:BB1:CC1 | 60.7 | 1602.23 | 0.0379 | 0.9698278 |
| Site3:AA1:BB1:CC2 | -3.3 | 1602.23 | -0.0021 | 0.9983418 |
| Site3:AA1:BB1:CC3 | -8.3 | 1602.23 | -0.0052 | 0.9958545 |
| Site3:AA1:BB1:CC4 | 0.0 | 0.00 | | |
| Site3:AA1:BB2:CC1 | -47.3 | 1602.23 | -0.0295 | 0.9764568 |
| Site3:AA1:BB2:CC2 | 138.0 | 1602.23 | 0.0861 | 0.9314351 |
| Site3:AA1:BB2:CC3 | 44.3 | 1602.23 | 0.0277 | 0.9779486 |

| | | | | |
|---|---|---|---|---|
| Site3:AA1:BB2:CC4 | 0.0 | 0.00 | | |
| Site3:AA1:BB3:CC1 | -51.7 | 1602.23 | -0.0322 | 0.9743022 |
| Site3:AA1:BB3:CC2 | -49.0 | 1602.23 | -0.0306 | 0.9756281 |
| Site3:AA1:BB3:CC3 | -70.7 | 1602.23 | -0.0441 | 0.9648573 |
| Site3:AA1:BB3:CC4 | 0.0 | 0.00 | | |
| Site3:AA1:BB4:CC1 | 114.0 | 1602.23 | 0.0712 | 0.9433371 |
| Site3:AA1:BB4:CC2 | 45.0 | 1602.23 | 0.0281 | 0.9776171 |
| Site3:AA1:BB4:CC3 | 19.7 | 1602.23 | 0.0123 | 0.9902168 |
| Site3:AA1:BB4:CC4 | 0.0 | 0.00 | | |
| Site3:AA1:BB5:CC1 | 0.0 | 0.00 | | |
| Site3:AA1:BB5:CC2 | 0.0 | 0.00 | | |
| Site3:AA1:BB5:CC3 | 0.0 | 0.00 | | |
| Site3:AA1:BB5:CC4 | 0.0 | 0.00 | | |
| Site3:AA2:BB1:CC1 | 0.0 | 0.00 | | |
| Site3:AA2:BB1:CC2 | 0.0 | 0.00 | | |
| Site3:AA2:BB1:CC3 | 0.0 | 0.00 | | |
| Site3:AA2:BB1:CC4 | 0.0 | 0.00 | | |
| Site3:AA2:BB2:CC1 | 0.0 | 0.00 | | |
| Site3:AA2:BB2:CC2 | 0.0 | 0.00 | | |
| Site3:AA2:BB2:CC3 | 0.0 | 0.00 | | |
| Site3:AA2:BB2:CC4 | 0.0 | 0.00 | | |
| Site3:AA2:BB3:CC1 | 0.0 | 0.00 | | |
| Site3:AA2:BB3:CC2 | 0.0 | 0.00 | | |
| Site3:AA2:BB3:CC3 | 0.0 | 0.00 | | |
| Site3:AA2:BB3:CC4 | 0.0 | 0.00 | | |
| Site3:AA2:BB4:CC1 | 0.0 | 0.00 | | |
| Site3:AA2:BB4:CC2 | 0.0 | 0.00 | | |
| Site3:AA2:BB4:CC3 | 0.0 | 0.00 | | |
| Site3:AA2:BB4:CC4 | 0.0 | 0.00 | | |
| Site3:AA2:BB5:CC1 | 0.0 | 0.00 | | |
| Site3:AA2:BB5:CC2 | 0.0 | 0.00 | | |
| Site3:AA2:BB5:CC3 | 0.0 | 0.00 | | |
| Site3:AA2:BB5:CC4 | 0.0 | 0.00 | | |
| Site4:AA1:BB1:CC1 | 0.0 | 0.00 | | |
| Site4:AA1:BB1:CC2 | 0.0 | 0.00 | | |
| Site4:AA1:BB1:CC3 | 0.0 | 0.00 | | |
| Site4:AA1:BB1:CC4 | 0.0 | 0.00 | | |
| Site4:AA1:BB2:CC1 | 0.0 | 0.00 | | |
| Site4:AA1:BB2:CC2 | 0.0 | 0.00 | | |
| Site4:AA1:BB2:CC3 | 0.0 | 0.00 | | |
| Site4:AA1:BB2:CC4 | 0.0 | 0.00 | | |
| Site4:AA1:BB3:CC1 | 0.0 | 0.00 | | |
| Site4:AA1:BB3:CC2 | 0.0 | 0.00 | | |
| Site4:AA1:BB3:CC3 | 0.0 | 0.00 | | |
| Site4:AA1:BB3:CC4 | 0.0 | 0.00 | | |
| Site4:AA1:BB4:CC1 | 0.0 | 0.00 | | |
| Site4:AA1:BB4:CC2 | 0.0 | 0.00 | | |
| Site4:AA1:BB4:CC3 | 0.0 | 0.00 | | |

```
Site4:AA1:BB4:CC4          0.0       0.00
Site4:AA1:BB5:CC1          0.0       0.00
Site4:AA1:BB5:CC2          0.0       0.00
Site4:AA1:BB5:CC3          0.0       0.00
Site4:AA1:BB5:CC4          0.0       0.00
Site4:AA2:BB1:CC1          0.0       0.00
Site4:AA2:BB1:CC2          0.0       0.00
Site4:AA2:BB1:CC3          0.0       0.00
Site4:AA2:BB1:CC4          0.0       0.00
Site4:AA2:BB2:CC1          0.0       0.00
Site4:AA2:BB2:CC2          0.0       0.00
Site4:AA2:BB2:CC3          0.0       0.00
Site4:AA2:BB2:CC4          0.0       0.00
Site4:AA2:BB3:CC1          0.0       0.00
Site4:AA2:BB3:CC2          0.0       0.00
Site4:AA2:BB3:CC3          0.0       0.00
Site4:AA2:BB3:CC4          0.0       0.00
Site4:AA2:BB4:CC1          0.0       0.00
Site4:AA2:BB4:CC2          0.0       0.00
Site4:AA2:BB4:CC3          0.0       0.00
Site4:AA2:BB4:CC4          0.0       0.00
Site4:AA2:BB5:CC1          0.0       0.00
Site4:AA2:BB5:CC2          0.0       0.00
Site4:AA2:BB5:CC3          0.0       0.00
Site4:AA2:BB5:CC4          0.0       0.00
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(75) MODEL

```
ex3.1a = read.table("C:/G/Rt/Split/Ex3.1-example.txt", header=TRUE)
ex3.1a = af(ex3.1a, c("row", "P", "column", "R", "S"))
GLM(height ~ P + column + column:P + R + P:R + column:R + column:R:P + S +
   P:S + column:S + column:S:P + R:S + R:S:column + R:S:P + R:S:P:column, ex3.1a)
```

```
Warning in sqrt(diag(bVar)): NaNs produced

$ANOVA
Response : height
                 Df Sum Sq Mean Sq F value Pr(>F)
MODEL           199 7534.8  37.863
RESIDUALS         0    0.0
CORRECTED TOTAL 199 7534.8

$`Type I`
             Df Sum Sq Mean Sq F value Pr(>F)
P             1  253.1 253.125
```

```
column         4  109.4  27.358
P:column       4  208.0  51.988
R              4   90.6  22.657
P:R            4  504.9 126.237
column:R      16 3357.8 209.864
P:column:R    16 1442.6  90.163
S              3   16.4   5.458
P:S            3   14.3   4.765
column:S      12  265.4  22.121
P:column:S    12   96.5   8.044
R:S           12  195.1  16.254
column:R:S    48  365.5   7.615
P:R:S         12  100.3   8.361
P:column:R:S  48  514.7  10.723

$`Type II`
              Df Sum Sq Mean Sq F value Pr(>F)
P              1  253.1 253.125
column         4  109.4  27.357
P:column       4  208.0  51.988
R              4   90.6  22.657
P:R            4  505.0 126.238
column:R      16 3357.8 209.864
P:column:R    16 1442.6  90.163
S              3   16.4   5.458
P:S            3   14.3   4.765
column:S      12  265.4  22.121
P:column:S    12   96.5   8.044
R:S           12  195.0  16.254
column:R:S    48  365.5   7.615
P:R:S         12  100.3   8.361
P:column:R:S  48  514.7  10.723

$`Type III`
              Df Sum Sq Mean Sq F value Pr(>F)
P              1  253.1 253.125
column         4  109.4  27.358
P:column       4  208.0  51.988
R              4   90.6  22.657
P:R            4  505.0 126.238
column:R      16 3357.8 209.864
P:column:R    16 1442.6  90.163
S              3   16.4   5.458
P:S            3   14.3   4.765
column:S      12  265.4  22.121
P:column:S    12   96.5   8.044
R:S           12  195.0  16.254
column:R:S    48  365.5   7.615
```

```
P:R:S        12  100.3   8.361
P:column:R:S 48  514.7  10.723

$Parameter
                Estimate Std. Error t value Pr(>|t|)
(Intercept)           98
P1                    -2
P2                     0
column1              -10
column2              -20
column3                0
column4              -13
column5                0
P1:column1            12
P1:column2            12
P1:column3             1
P1:column4            13
P1:column5             0
P2:column1             0
P2:column2             0
P2:column3             0
P2:column4             0
P2:column5             0
R1                    -9
R2                     1
R3                   -15
R4                    -1
R5                     0
P1:R1                 12
P1:R2                  2
P1:R3                 -3
P1:R4                  3
P1:R5                  0
P2:R1                  0
P2:R2                  0
P2:R3                  0
P2:R4                  0
P2:R5                  0
column1:R1            19
column1:R2            10
column1:R3            28
column1:R4             1
column1:R5             0
column2:R1            21
column2:R2             7
column2:R3            33
column2:R4            20
column2:R5             0
```

```
column3:R1              7
column3:R2             -6
column3:R3             12
column3:R4             -5
column3:R5              0
column4:R1             23
column4:R2              1
column4:R3             13
column4:R4             14
column4:R5              0
column5:R1              0
column5:R2              0
column5:R3              0
column5:R4              0
column5:R5              0
P1:column1:R1         -40
P1:column1:R2         -12
P1:column1:R3          -5
P1:column1:R4          -2
P1:column1:R5           0
P1:column2:R1         -23
P1:column2:R2          -8
P1:column2:R3         -10
P1:column2:R4         -11
P1:column2:R5           0
P1:column3:R1          -9
P1:column3:R2           1
P1:column3:R3           8
P1:column3:R4          -6
P1:column3:R5           0
P1:column4:R1         -34
P1:column4:R2           0
P1:column4:R3           8
P1:column4:R4         -18
P1:column4:R5           0
P1:column5:R1           0
P1:column5:R2           0
P1:column5:R3           0
P1:column5:R4           0
P1:column5:R5           0
P2:column1:R1           0
P2:column1:R2           0
P2:column1:R3           0
P2:column1:R4           0
P2:column1:R5           0
P2:column2:R1           0
P2:column2:R2           0
P2:column2:R3           0
```

```
P2:column2:R4           0
P2:column2:R5           0
P2:column3:R1           0
P2:column3:R2           0
P2:column3:R3           0
P2:column3:R4           0
P2:column3:R5           0
P2:column4:R1           0
P2:column4:R2           0
P2:column4:R3           0
P2:column4:R4           0
P2:column4:R5           0
P2:column5:R1           0
P2:column5:R2           0
P2:column5:R3           0
P2:column5:R4           0
P2:column5:R5           0
S1                      1
S2                     -2
S3                     -5
S4                      0
P1:S1                   1
P1:S2                  -1
P1:S3                   7
P1:S4                   0
P2:S1                   0
P2:S2                   0
P2:S3                   0
P2:S4                   0
column1:S1              9
column1:S2              1
column1:S3             16
column1:S4              0
column2:S1             -2
column2:S2              4
column2:S3              6
column2:S4              0
column3:S1             -3
column3:S2             -8
column3:S3              5
column3:S4              0
column4:S1              2
column4:S2              6
column4:S3              7
column4:S4              0
column5:S1              0
column5:S2              0
column5:S3              0
```

```
column5:S4              0
P1:column1:S1         -12
P1:column1:S2           2
P1:column1:S3         -17
P1:column1:S4           0
P1:column2:S1           4
P1:column2:S2           9
P1:column2:S3           3
P1:column2:S4           0
P1:column3:S1           3
P1:column3:S2          14
P1:column3:S3          -5
P1:column3:S4           0
P1:column4:S1          -5
P1:column4:S2          -4
P1:column4:S3         -10
P1:column4:S4           0
P1:column5:S1           0
P1:column5:S2           0
P1:column5:S3           0
P1:column5:S4           0
P2:column1:S1           0
P2:column1:S2           0
P2:column1:S3           0
P2:column1:S4           0
P2:column2:S1           0
P2:column2:S2           0
P2:column2:S3           0
P2:column2:S4           0
P2:column3:S1           0
P2:column3:S2           0
P2:column3:S3           0
P2:column3:S4           0
P2:column4:S1           0
P2:column4:S2           0
P2:column4:S3           0
P2:column4:S4           0
P2:column5:S1           0
P2:column5:S2           0
P2:column5:S3           0
P2:column5:S4           0
R1:S1                   8
R1:S2                  11
R1:S3                  15
R1:S4                   0
R2:S1                  -1
R2:S2                  -1
R2:S3                   4
```

```
R2:S4                  0
R3:S1                 -4
R3:S2                  0
R3:S3                  4
R3:S4                  0
R4:S1                 -8
R4:S2                 -5
R4:S3                 -2
R4:S4                  0
R5:S1                  0
R5:S2                  0
R5:S3                  0
R5:S4                  0
column1:R1:S1        -17
column1:R1:S2         -9
column1:R1:S3        -27
column1:R1:S4          0
column1:R2:S1        -14
column1:R2:S2         -8
column1:R2:S3        -16
column1:R2:S4          0
column1:R3:S1         -7
column1:R3:S2          1
column1:R3:S3        -17
column1:R3:S4          0
column1:R4:S1        -10
column1:R4:S2          3
column1:R4:S3        -19
column1:R4:S4          0
column1:R5:S1          0
column1:R5:S2          0
column1:R5:S3          0
column1:R5:S4          0
column2:R1:S1          2
column2:R1:S2         -4
column2:R1:S3        -11
column2:R1:S4          0
column2:R2:S1          4
column2:R2:S2          1
column2:R2:S3         -4
column2:R2:S4          0
column2:R3:S1          6
column2:R3:S2          0
column2:R3:S3        -10
column2:R3:S4          0
column2:R4:S1         11
column2:R4:S2          3
column2:R4:S3        -11
```

```
column2:R4:S4           0
column2:R5:S1           0
column2:R5:S2           0
column2:R5:S3           0
column2:R5:S4           0
column3:R1:S1          -5
column3:R1:S2           1
column3:R1:S3         -17
column3:R1:S4           0
column3:R2:S1           1
column3:R2:S2          10
column3:R2:S3          -7
column3:R2:S4           0
column3:R3:S1           8
column3:R3:S2          11
column3:R3:S3           0
column3:R3:S4           0
column3:R4:S1          17
column3:R4:S2          22
column3:R4:S3           8
column3:R4:S4           0
column3:R5:S1           0
column3:R5:S2           0
column3:R5:S3           0
column3:R5:S4           0
column4:R1:S1         -13
column4:R1:S2         -15
column4:R1:S3         -18
column4:R1:S4           0
column4:R2:S1           1
column4:R2:S2           5
column4:R2:S3           6
column4:R2:S4           0
column4:R3:S1           4
column4:R3:S2           1
column4:R3:S3          -2
column4:R3:S4           0
column4:R4:S1          -4
column4:R4:S2           2
column4:R4:S3          -1
column4:R4:S4           0
column4:R5:S1           0
column4:R5:S2           0
column4:R5:S3           0
column4:R5:S4           0
column5:R1:S1           0
column5:R1:S2           0
column5:R1:S3           0
```

| | |
|---|---|
| column5:R1:S4 | 0 |
| column5:R2:S1 | 0 |
| column5:R2:S2 | 0 |
| column5:R2:S3 | 0 |
| column5:R2:S4 | 0 |
| column5:R3:S1 | 0 |
| column5:R3:S2 | 0 |
| column5:R3:S3 | 0 |
| column5:R3:S4 | 0 |
| column5:R4:S1 | 0 |
| column5:R4:S2 | 0 |
| column5:R4:S3 | 0 |
| column5:R4:S4 | 0 |
| column5:R5:S1 | 0 |
| column5:R5:S2 | 0 |
| column5:R5:S3 | 0 |
| column5:R5:S4 | 0 |
| P1:R1:S1 | -7 |
| P1:R1:S2 | 0 |
| P1:R1:S3 | -18 |
| P1:R1:S4 | 0 |
| P1:R2:S1 | -2 |
| P1:R2:S2 | 3 |
| P1:R2:S3 | -10 |
| P1:R2:S4 | 0 |
| P1:R3:S1 | 12 |
| P1:R3:S2 | 10 |
| P1:R3:S3 | -6 |
| P1:R3:S4 | 0 |
| P1:R4:S1 | 7 |
| P1:R4:S2 | 5 |
| P1:R4:S3 | 0 |
| P1:R4:S4 | 0 |
| P1:R5:S1 | 0 |
| P1:R5:S2 | 0 |
| P1:R5:S3 | 0 |
| P1:R5:S4 | 0 |
| P2:R1:S1 | 0 |
| P2:R1:S2 | 0 |
| P2:R1:S3 | 0 |
| P2:R1:S4 | 0 |
| P2:R2:S1 | 0 |
| P2:R2:S2 | 0 |
| P2:R2:S3 | 0 |
| P2:R2:S4 | 0 |
| P2:R3:S1 | 0 |
| P2:R3:S2 | 0 |
| P2:R3:S3 | 0 |

```
P2:R3:S4                0
P2:R4:S1                0
P2:R4:S2                0
P2:R4:S3                0
P2:R4:S4                0
P2:R5:S1                0
P2:R5:S2                0
P2:R5:S3                0
P2:R5:S4                0
P1:column1:R1:S1       17
P1:column1:R1:S2       -1
P1:column1:R1:S3       33
P1:column1:R1:S4        0
P1:column1:R2:S1       14
P1:column1:R2:S2        4
P1:column1:R2:S3       20
P1:column1:R2:S4        0
P1:column1:R3:S1       -2
P1:column1:R3:S2      -16
P1:column1:R3:S3       16
P1:column1:R3:S4        0
P1:column1:R4:S1        9
P1:column1:R4:S2      -14
P1:column1:R4:S3       19
P1:column1:R4:S4        0
P1:column1:R5:S1        0
P1:column1:R5:S2        0
P1:column1:R5:S3        0
P1:column1:R5:S4        0
P1:column2:R1:S1        2
P1:column2:R1:S2       -8
P1:column2:R1:S3       11
P1:column2:R1:S4        0
P1:column2:R2:S1       -5
P1:column2:R2:S2      -13
P1:column2:R2:S3       -1
P1:column2:R2:S4        0
P1:column2:R3:S1      -15
P1:column2:R3:S2      -14
P1:column2:R3:S3        6
P1:column2:R3:S4        0
P1:column2:R4:S1      -13
P1:column2:R4:S2      -12
P1:column2:R4:S3        1
P1:column2:R4:S4        0
P1:column2:R5:S1        0
P1:column2:R5:S2        0
P1:column2:R5:S3        0
```

```
P1:column2:R5:S4        0
P1:column3:R1:S1        3
P1:column3:R1:S2      -18
P1:column3:R1:S3       17
P1:column3:R1:S4        0
P1:column3:R2:S1      -10
P1:column3:R2:S2      -22
P1:column3:R2:S3       14
P1:column3:R2:S4        0
P1:column3:R3:S1      -19
P1:column3:R3:S2      -26
P1:column3:R3:S3        0
P1:column3:R3:S4        0
P1:column3:R4:S1      -19
P1:column3:R4:S2      -25
P1:column3:R4:S3       -8
P1:column3:R4:S4        0
P1:column3:R5:S1        0
P1:column3:R5:S2        0
P1:column3:R5:S3        0
P1:column3:R5:S4        0
P1:column4:R1:S1       12
P1:column4:R1:S2       14
P1:column4:R1:S3       30
P1:column4:R1:S4        0
P1:column4:R2:S1        5
P1:column4:R2:S2       -7
P1:column4:R2:S3        0
P1:column4:R2:S4        0
P1:column4:R3:S1      -15
P1:column4:R3:S2      -11
P1:column4:R3:S3        3
P1:column4:R3:S4        0
P1:column4:R4:S1        7
P1:column4:R4:S2        2
P1:column4:R4:S3        9
P1:column4:R4:S4        0
P1:column4:R5:S1        0
P1:column4:R5:S2        0
P1:column4:R5:S3        0
P1:column4:R5:S4        0
P1:column5:R1:S1        0
P1:column5:R1:S2        0
P1:column5:R1:S3        0
P1:column5:R1:S4        0
P1:column5:R2:S1        0
P1:column5:R2:S2        0
P1:column5:R2:S3        0
```

```
P1:column5:R2:S4        0
P1:column5:R3:S1        0
P1:column5:R3:S2        0
P1:column5:R3:S3        0
P1:column5:R3:S4        0
P1:column5:R4:S1        0
P1:column5:R4:S2        0
P1:column5:R4:S3        0
P1:column5:R4:S4        0
P1:column5:R5:S1        0
P1:column5:R5:S2        0
P1:column5:R5:S3        0
P1:column5:R5:S4        0
P2:column1:R1:S1        0
P2:column1:R1:S2        0
P2:column1:R1:S3        0
P2:column1:R1:S4        0
P2:column1:R2:S1        0
P2:column1:R2:S2        0
P2:column1:R2:S3        0
P2:column1:R2:S4        0
P2:column1:R3:S1        0
P2:column1:R3:S2        0
P2:column1:R3:S3        0
P2:column1:R3:S4        0
P2:column1:R4:S1        0
P2:column1:R4:S2        0
P2:column1:R4:S3        0
P2:column1:R4:S4        0
P2:column1:R5:S1        0
P2:column1:R5:S2        0
P2:column1:R5:S3        0
P2:column1:R5:S4        0
P2:column2:R1:S1        0
P2:column2:R1:S2        0
P2:column2:R1:S3        0
P2:column2:R1:S4        0
P2:column2:R2:S1        0
P2:column2:R2:S2        0
P2:column2:R2:S3        0
P2:column2:R2:S4        0
P2:column2:R3:S1        0
P2:column2:R3:S2        0
P2:column2:R3:S3        0
P2:column2:R3:S4        0
P2:column2:R4:S1        0
P2:column2:R4:S2        0
P2:column2:R4:S3        0
```

```
P2:column2:R4:S4        0
P2:column2:R5:S1        0
P2:column2:R5:S2        0
P2:column2:R5:S3        0
P2:column2:R5:S4        0
P2:column3:R1:S1        0
P2:column3:R1:S2        0
P2:column3:R1:S3        0
P2:column3:R1:S4        0
P2:column3:R2:S1        0
P2:column3:R2:S2        0
P2:column3:R2:S3        0
P2:column3:R2:S4        0
P2:column3:R3:S1        0
P2:column3:R3:S2        0
P2:column3:R3:S3        0
P2:column3:R3:S4        0
P2:column3:R4:S1        0
P2:column3:R4:S2        0
P2:column3:R4:S3        0
P2:column3:R4:S4        0
P2:column3:R5:S1        0
P2:column3:R5:S2        0
P2:column3:R5:S3        0
P2:column3:R5:S4        0
P2:column4:R1:S1        0
P2:column4:R1:S2        0
P2:column4:R1:S3        0
P2:column4:R1:S4        0
P2:column4:R2:S1        0
P2:column4:R2:S2        0
P2:column4:R2:S3        0
P2:column4:R2:S4        0
P2:column4:R3:S1        0
P2:column4:R3:S2        0
P2:column4:R3:S3        0
P2:column4:R3:S4        0
P2:column4:R4:S1        0
P2:column4:R4:S2        0
P2:column4:R4:S3        0
P2:column4:R4:S4        0
P2:column4:R5:S1        0
P2:column4:R5:S2        0
P2:column4:R5:S3        0
P2:column4:R5:S4        0
P2:column5:R1:S1        0
P2:column5:R1:S2        0
P2:column5:R1:S3        0
```

```
P2:column5:R1:S4        0
P2:column5:R2:S1        0
P2:column5:R2:S2        0
P2:column5:R2:S3        0
P2:column5:R2:S4        0
P2:column5:R3:S1        0
P2:column5:R3:S2        0
P2:column5:R3:S3        0
P2:column5:R3:S4        0
P2:column5:R4:S1        0
P2:column5:R4:S2        0
P2:column5:R4:S3        0
P2:column5:R4:S4        0
P2:column5:R5:S1        0
P2:column5:R5:S2        0
P2:column5:R5:S3        0
P2:column5:R5:S4        0
```

(76) MODEL

```
GLM(height ~ row + R + P + S + S:R + row:P + R:P + row:R:P + S:P + S:P:row +
    S:R:P + R:S:P:row, ex3.1a)
```

```
Warning in sqrt(diag(bVar)): NaNs produced

$ANOVA
Response : height
                 Df Sum Sq Mean Sq F value Pr(>F)
MODEL           199 7534.8  37.863
RESIDUALS         0    0.0
CORRECTED TOTAL 199 7534.8

$`Type I`
          Df  Sum Sq Mean Sq F value Pr(>F)
row        4 2017.03  504.26
R          4   90.63   22.66
P          1  253.12  253.12
S          3   16.38    5.46
R:S       12  195.05   16.25
row:P      4  167.25   41.81
R:P        4  504.95  126.24
row:R:P   32 2933.52   91.67
P:S        3   14.30    4.77
row:P:S   24  234.68    9.78
R:P:S     12  100.33    8.36
row:R:P:S 96 1007.52   10.49
```

```
$`Type II`
          Df  Sum Sq Mean Sq F value Pr(>F)
row        4 2017.03  504.26
R          4   90.63   22.66
P          1  253.12  253.12
S          3   16.38    5.46
R:S       12  195.05   16.25
row:P      4  167.25   41.81
R:P        4  504.95  126.24
row:R:P   32 2933.52   91.67
P:S        3   14.30    4.77
row:P:S   24  234.68    9.78
R:P:S     12  100.33    8.36
row:R:P:S 96 1007.52   10.49

$`Type III`
          Df  Sum Sq Mean Sq F value Pr(>F)
row        4 2017.03  504.26
R          4   90.63   22.66
P          1  253.12  253.12
S          3   16.38    5.46
R:S       12  195.05   16.25
row:P      4  167.25   41.81
R:P        4  504.95  126.24
row:R:P   32 2933.52   91.67
P:S        3   14.30    4.77
row:P:S   24  234.68    9.78
R:P:S     12  100.33    8.36
row:R:P:S 96 1007.52   10.49

$Parameter
             Estimate Std. Error t value Pr(>|t|)
(Intercept)        88
row1               10
row2               10
row3              -10
row4               -3
row5                0
R1                  2
R2                 11
R3                 -5
R4                  4
R5                  0
P1                 10
P2                  0
S1                 10
S2                 -1
S3                 11
```

```
S4                0
R1:S1            -1
R1:S2            10
R1:S3            -6
R1:S4             0
R2:S1           -10
R2:S2            -2
R2:S3           -12
R2:S4             0
R3:S1            -7
R3:S2             6
R3:S3            -7
R3:S4             0
R4:S1            -3
R4:S2             8
R4:S3            -5
R4:S4             0
R5:S1             0
R5:S2             0
R5:S3             0
R5:S4             0
row1:P1         -11
row1:P2           0
row2:P1         -12
row2:P2           0
row3:P1           0
row3:P2           0
row4:P1           1
row4:P2           0
row5:P1           0
row5:P2           0
R1:P1           -11
R1:P2             0
R2:P1           -10
R2:P2             0
R3:P1             6
R3:P2             0
R4:P1           -14
R4:P2             0
R5:P1             0
R5:P2             0
row1:R1:P1       11
row1:R1:P2      -11
row1:R2:P1        2
row1:R2:P2      -22
row1:R3:P1        5
row1:R3:P2        8
row1:R4:P1       12
```

```
row1:R4:P2          -5
row1:R5:P1           0
row1:R5:P2           0
row2:R1:P1          11
row2:R1:P2          -4
row2:R2:P1           2
row2:R2:P2         -10
row2:R3:P1          -4
row2:R3:P2           3
row2:R4:P1           8
row2:R4:P2          -4
row2:R5:P1           0
row2:R5:P2           0
row3:R1:P1           9
row3:R1:P2          19
row3:R2:P1           6
row3:R2:P2           4
row3:R3:P1         -11
row3:R3:P2          10
row3:R4:P1          21
row3:R4:P2           6
row3:R5:P1           0
row3:R5:P2           0
row4:R1:P1          -7
row4:R1:P2          11
row4:R2:P1          -7
row4:R2:P2         -10
row4:R3:P1           2
row4:R3:P2          15
row4:R4:P1          12
row4:R4:P2           8
row4:R5:P1           0
row4:R5:P2           0
row5:R1:P1           0
row5:R1:P2           0
row5:R2:P1           0
row5:R2:P2           0
row5:R3:P1           0
row5:R3:P2           0
row5:R4:P1           0
row5:R4:P2           0
row5:R5:P1           0
row5:R5:P2           0
P1:S1              -11
P1:S2                1
P1:S3              -10
P1:S4                0
P2:S1                0
```

```
P2:S2                0
P2:S3                0
P2:S4                0
row1:P1:S1           3
row1:P1:S2           3
row1:P1:S3           1
row1:P1:S4           0
row1:P2:S1         -12
row1:P2:S2          -9
row1:P2:S3         -11
row1:P2:S4           0
row2:P1:S1           3
row2:P1:S2          -3
row2:P1:S3           1
row2:P1:S4           0
row2:P2:S1          -9
row2:P2:S2          -1
row2:P2:S3         -16
row2:P2:S4           0
row3:P1:S1           5
row3:P1:S2          10
row3:P1:S3          10
row3:P1:S4           0
row3:P2:S1         -11
row3:P2:S2           3
row3:P2:S3         -10
row3:P2:S4           0
row4:P1:S1           0
row4:P1:S2          -1
row4:P1:S3          -2
row4:P1:S4           0
row4:P2:S1          -7
row4:P2:S2           5
row4:P2:S3          -9
row4:P2:S4           0
row5:P1:S1           0
row5:P1:S2           0
row5:P1:S3           0
row5:P1:S4           0
row5:P2:S1           0
row5:P2:S2           0
row5:P2:S3           0
row5:P2:S4           0
R1:P1:S1            11
R1:P1:S2            -1
R1:P1:S3            13
R1:P1:S4             0
R1:P2:S1             0
```

```
R1:P2:S2             0
R1:P2:S3             0
R1:P2:S4             0
R2:P1:S1            10
R2:P1:S2             1
R2:P1:S3             7
R2:P1:S4             0
R2:P2:S1             0
R2:P2:S2             0
R2:P2:S3             0
R2:P2:S4             0
R3:P1:S1             4
R3:P1:S2            -7
R3:P1:S3             4
R3:P1:S4             0
R3:P2:S1             0
R3:P2:S2             0
R3:P2:S3             0
R3:P2:S4             0
R4:P1:S1             3
R4:P1:S2            -8
R4:P1:S3             4
R4:P1:S4             0
R4:P2:S1             0
R4:P2:S2             0
R4:P2:S3             0
R4:P2:S4             0
R5:P1:S1             0
R5:P1:S2             0
R5:P1:S3             0
R5:P1:S4             0
R5:P2:S1             0
R5:P2:S2             0
R5:P2:S3             0
R5:P2:S4             0
row1:R1:P1:S1       -9
row1:R1:P1:S2       -4
row1:R1:P1:S3      -10
row1:R1:P1:S4        0
row1:R1:P2:S1       12
row1:R1:P2:S2        9
row1:R1:P2:S3       16
row1:R1:P2:S4        0
row1:R2:P1:S1        0
row1:R2:P1:S2       -3
row1:R2:P1:S3        2
row1:R2:P1:S4        0
row1:R2:P2:S1       15
```

```
row1:R2:P2:S2       20
row1:R2:P2:S3       24
row1:R2:P2:S4        0
row1:R3:P1:S1       -1
row1:R3:P1:S2       -7
row1:R3:P1:S3       -1
row1:R3:P1:S4        0
row1:R3:P2:S1        8
row1:R3:P2:S2        4
row1:R3:P2:S3        5
row1:R3:P2:S4        0
row1:R4:P1:S1       -1
row1:R4:P1:S2       -2
row1:R4:P1:S3       -2
row1:R4:P1:S4        0
row1:R4:P2:S1        7
row1:R4:P2:S2        2
row1:R4:P2:S3       -7
row1:R4:P2:S4        0
row1:R5:P1:S1        0
row1:R5:P1:S2        0
row1:R5:P1:S3        0
row1:R5:P1:S4        0
row1:R5:P2:S1        0
row1:R5:P2:S2        0
row1:R5:P2:S3        0
row1:R5:P2:S4        0
row2:R1:P1:S1      -11
row2:R1:P1:S2       -9
row2:R1:P1:S3      -10
row2:R1:P1:S4        0
row2:R1:P2:S1        1
row2:R1:P2:S2       -6
row2:R1:P2:S3        9
row2:R1:P2:S4        0
row2:R2:P1:S1       -6
row2:R2:P1:S2        2
row2:R2:P1:S3        2
row2:R2:P1:S4        0
row2:R2:P2:S1        4
row2:R2:P2:S2       -6
row2:R2:P2:S3       16
row2:R2:P2:S4        0
row2:R3:P1:S1        4
row2:R3:P1:S2       10
row2:R3:P1:S3        6
row2:R3:P1:S4        0
row2:R3:P2:S1        7
```

```
row2:R3:P2:S2       -2
row2:R3:P2:S3        7
row2:R3:P2:S4        0
row2:R4:P1:S1       -1
row2:R4:P1:S2        6
row2:R4:P1:S3        4
row2:R4:P1:S4        0
row2:R4:P2:S1       -7
row2:R4:P2:S2       -5
row2:R4:P2:S3        9
row2:R4:P2:S4        0
row2:R5:P1:S1        0
row2:R5:P1:S2        0
row2:R5:P1:S3        0
row2:R5:P1:S4        0
row2:R5:P2:S1        0
row2:R5:P2:S2        0
row2:R5:P2:S3        0
row2:R5:P2:S4        0
row3:R1:P1:S1      -15
row3:R1:P1:S2      -10
row3:R1:P1:S3      -10
row3:R1:P1:S4        0
row3:R1:P2:S1        0
row3:R1:P2:S2      -12
row3:R1:P2:S3        4
row3:R1:P2:S4        0
row3:R2:P1:S1      -14
row3:R2:P1:S2      -16
row3:R2:P1:S3       -3
row3:R2:P1:S4        0
row3:R2:P2:S1        9
row3:R2:P2:S2       -1
row3:R2:P2:S3        8
row3:R2:P2:S4        0
row3:R3:P1:S1        9
row3:R3:P1:S2       -2
row3:R3:P1:S3       -8
row3:R3:P1:S4        0
row3:R3:P2:S1        5
row3:R3:P2:S2      -10
row3:R3:P2:S3        5
row3:R3:P2:S4        0
row3:R4:P1:S1       -7
row3:R4:P1:S2      -21
row3:R4:P1:S3      -11
row3:R4:P1:S4        0
row3:R4:P2:S1       -4
```

```
row3:R4:P2:S2      -13
row3:R4:P2:S3       -6
row3:R4:P2:S4        0
row3:R5:P1:S1        0
row3:R5:P1:S2        0
row3:R5:P1:S3        0
row3:R5:P1:S4        0
row3:R5:P2:S1        0
row3:R5:P2:S2        0
row3:R5:P2:S3        0
row3:R5:P2:S4        0
row4:R1:P1:S1       -9
row4:R1:P1:S2       -7
row4:R1:P1:S3       -2
row4:R1:P1:S4        0
row4:R1:P2:S1       -1
row4:R1:P2:S2      -13
row4:R1:P2:S3        3
row4:R1:P2:S4        0
row4:R2:P1:S1        1
row4:R2:P1:S2        2
row4:R2:P1:S3        6
row4:R2:P1:S4        0
row4:R2:P2:S1        9
row4:R2:P2:S2        0
row4:R2:P2:S3       11
row4:R2:P2:S4        0
row4:R3:P1:S1        3
row4:R3:P1:S2        0
row4:R3:P1:S3        4
row4:R3:P1:S4        0
row4:R3:P2:S1        6
row4:R3:P2:S2       -9
row4:R3:P2:S3        9
row4:R3:P2:S4        0
row4:R4:P1:S1        2
row4:R4:P1:S2       -2
row4:R4:P1:S3        2
row4:R4:P1:S4        0
row4:R4:P2:S1       -7
row4:R4:P2:S2      -19
row4:R4:P2:S3       -4
row4:R4:P2:S4        0
row4:R5:P1:S1        0
row4:R5:P1:S2        0
row4:R5:P1:S3        0
row4:R5:P1:S4        0
row4:R5:P2:S1        0
```

```
row4:R5:P2:S2        0
row4:R5:P2:S3        0
row4:R5:P2:S4        0
row5:R1:P1:S1        0
row5:R1:P1:S2        0
row5:R1:P1:S3        0
row5:R1:P1:S4        0
row5:R1:P2:S1        0
row5:R1:P2:S2        0
row5:R1:P2:S3        0
row5:R1:P2:S4        0
row5:R2:P1:S1        0
row5:R2:P1:S2        0
row5:R2:P1:S3        0
row5:R2:P1:S4        0
row5:R2:P2:S1        0
row5:R2:P2:S2        0
row5:R2:P2:S3        0
row5:R2:P2:S4        0
row5:R3:P1:S1        0
row5:R3:P1:S2        0
row5:R3:P1:S3        0
row5:R3:P1:S4        0
row5:R3:P2:S1        0
row5:R3:P2:S2        0
row5:R3:P2:S3        0
row5:R3:P2:S4        0
row5:R4:P1:S1        0
row5:R4:P1:S2        0
row5:R4:P1:S3        0
row5:R4:P1:S4        0
row5:R4:P2:S1        0
row5:R4:P2:S2        0
row5:R4:P2:S3        0
row5:R4:P2:S4        0
row5:R5:P1:S1        0
row5:R5:P1:S2        0
row5:R5:P1:S3        0
row5:R5:P1:S4        0
row5:R5:P2:S1        0
row5:R5:P2:S2        0
row5:R5:P2:S3        0
row5:R5:P2:S4        0
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(height ~ row + R + P + S + S:R + row:P + R:P + row:R:P + S:P +
         S:P:row + S:R:P + R:S:P:row, ex3.1a), type=3, singular.ok=TRUE)
```

```
          # Error
```

(77) MODEL

- p94 Appendix 3.1

```
ex3.1b = read.table("C:/G/Rt/Split/spexvar3.txt", header=TRUE)
ex3.1b = af(ex3.1b, c("rep", "var", "nit", "row", "col"))
GLM(yield ~ rep + var + rep:var + nit + var:nit, ex3.1b)
```

```
$ANOVA
Response : yield
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           26  44017 1692.97  9.5603 4.779e-11 ***
RESIDUALS       45   7969  177.08
CORRECTED TOTAL 71  51986
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      5 15875.3  3175.1 17.9297 9.525e-10 ***
var      2  1786.4   893.2  5.0438  0.010557 *
rep:var 10  6013.3   601.3  3.3957  0.002251 **
nit      3 20020.5  6673.5 37.6856 2.458e-12 ***
var:nit  6   321.7    53.6  0.3028  0.932199
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      5 15875.3  3175.1 17.9297 9.525e-10 ***
var      2  1786.4   893.2  5.0438  0.010557 *
rep:var 10  6013.3   601.3  3.3957  0.002251 **
nit      3 20020.5  6673.5 37.6856 2.458e-12 ***
var:nit  6   321.7    53.6  0.3028  0.932199
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      5 15875.3  3175.1 17.9297 9.525e-10 ***
var      2  1786.4   893.2  5.0438  0.010557 *
rep:var 10  6013.3   601.3  3.3957  0.002251 **
nit      3 20020.5  6673.5 37.6856 2.458e-12 ***
var:nit  6   321.8    53.6  0.3028  0.932199
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   85.875     8.1490 10.5381 9.814e-14 ***
rep1          20.750     9.4097  2.2052 0.0325933 *
rep2         -14.000     9.4097 -1.4878 0.1437694
rep3          12.250     9.4097  1.3019 0.1995913
rep4         -23.750     9.4097 -2.5240 0.0152008 *
rep5           9.500     9.4097  1.0096 0.3180846
rep6           0.000     0.0000
var1         -22.500    11.5244 -1.9524 0.0571318 .
var2         -20.125    11.5244 -1.7463 0.0875843 .
var3           0.000     0.0000
rep1:var1     32.750    13.3073  2.4611 0.0177533 *
rep1:var2     22.250    13.3073  1.6720 0.1014609
rep1:var3      0.000     0.0000
rep2:var1     16.000    13.3073  1.2024 0.2355164
rep2:var2     31.750    13.3073  2.3859 0.0213053 *
rep2:var3      0.000     0.0000
rep3:var1    -14.500    13.3073 -1.0896 0.2816769
rep3:var2     10.750    13.3073  0.8078 0.4234387
rep3:var3      0.000     0.0000
rep4:var1     26.250    13.3073  1.9726 0.0547034 .
rep4:var2     29.000    13.3073  2.1793 0.0345870 *
rep4:var3      0.000     0.0000
rep5:var1    -16.500    13.3073 -1.2399 0.2214304
rep5:var2    -13.000    13.3073 -0.9769 0.3338365
rep5:var3      0.000     0.0000
rep6:var1      0.000     0.0000
rep6:var2      0.000     0.0000
rep6:var3      0.000     0.0000
nit1          21.833     7.6830  2.8418 0.0067187 **
nit2          30.500     7.6830  3.9698 0.0002562 ***
nit3          40.167     7.6830  5.2280 4.290e-06 ***
nit4           0.000     0.0000
var1:nit1     -3.667    10.8653 -0.3375 0.7373358
var1:nit2      8.833    10.8653  0.8130 0.4205085
var1:nit3      6.833    10.8653  0.6289 0.5325868
var1:nit4      0.000     0.0000
var2:nit1     -3.333    10.8653 -0.3068 0.7604214
var2:nit2      4.167    10.8653  0.3835 0.7031679
var2:nit3      4.667    10.8653  0.4295 0.6696087
var2:nit4      0.000     0.0000
var3:nit1      0.000     0.0000
var3:nit2      0.000     0.0000
var3:nit3      0.000     0.0000
```

```
var3:nit4      0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(78) MODEL

```
GLM(yield ~ rep + var + rep:var + nit + var:nit + row + col, ex3.1b)
```

```
$ANOVA
Response : yield
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           37  48090  1299.7  11.341 6.734e-11 ***
RESIDUALS       34   3896   114.6
CORRECTED TOTAL 71  51986
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      5 15875.3  3175.1 27.7056 4.391e-11 ***
var      2  1786.4   893.2  7.7939 0.0016359 **
rep:var 10  6013.3   601.3  5.2472 0.0001207 ***
nit      3 20020.5  6673.5 58.2331 1.754e-13 ***
var:nit  6   321.8    53.6  0.4679 0.8271333
row      9   900.9   100.1  0.8734 0.5575581
col      2  3171.5  1585.7 13.8373 4.012e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      2  5942.5  2971.3 25.9273 1.449e-07 ***
var      2  2799.8  1399.9 12.2155 0.0001005 ***
rep:var  4   997.8   249.4  2.1767 0.0926008 .
nit      3 12559.3  4186.4 36.5308 9.683e-11 ***
var:nit  6   477.8    79.6  0.6949 0.6553307
row      9   945.0   105.0  0.9162 0.5230151
col      2  3171.5  1585.7 13.8373 4.012e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      2  5942.5  2971.3 25.9273 1.449e-07 ***
var      2  2799.8  1399.9 12.2155 0.0001005 ***
rep:var  4   997.8   249.4  2.1767 0.0926008 .
```

```
nit      3 11977.9  3992.6 34.8397 1.775e-10 ***
var:nit  6   477.8    79.6  0.6949 0.6553307
row      9   945.0   105.0  0.9162 0.5230151
col      2  3171.5  1585.7 13.8373 4.012e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   78.195     9.4953  8.2351 1.311e-09 ***
rep1          22.320    11.2116  1.9908 0.0545890 .
rep2          -9.827     9.9492 -0.9877 0.3302882
rep3          16.942    10.2780  1.6484 0.1084805
rep4         -24.656    10.6082 -2.3242 0.0262249 *
rep5          16.807    10.1264  1.6597 0.1061670
rep6           0.000     0.0000
var1         -23.629    12.0789 -1.9562 0.0586954 .
var2         -16.007    11.9933 -1.3346 0.1908629
var3           0.000     0.0000
rep1:var1     39.666    14.2816  2.7775 0.0088510 **
rep1:var2     24.703    14.1608  1.7445 0.0901108 .
rep1:var3      0.000     0.0000
rep2:var1     22.158    13.3805  1.6560 0.1069231
rep2:var2     35.142    13.4753  2.6079 0.0134358 *
rep2:var3      0.000     0.0000
rep3:var1    -15.615    15.0163 -1.0399 0.3057408
rep3:var2      5.214    14.8157  0.3519 0.7270537
rep3:var3      0.000     0.0000
rep4:var1     32.022    14.0835  2.2737 0.0294152 *
rep4:var2     32.597    14.2110  2.2938 0.0281056 *
rep4:var3      0.000     0.0000
rep5:var1    -15.951    13.7718 -1.1582 0.2548377
rep5:var2    -20.826    14.0023 -1.4873 0.1461435
rep5:var3      0.000     0.0000
rep6:var1      0.000     0.0000
rep6:var2      0.000     0.0000
rep6:var3      0.000     0.0000
nit1          20.904     6.8122  3.0686 0.0042045 **
nit2          25.790     7.9006  3.2643 0.0025052 **
nit3          43.888     8.4402  5.1999 9.452e-06 ***
nit4           0.000     0.0000
var1:nit1      1.136     9.7632  0.1164 0.9080219
var1:nit2     14.232    10.2550  1.3878 0.1742328
var1:nit3     -3.260    11.0914 -0.2939 0.7705879
var1:nit4      0.000     0.0000
var2:nit1     -1.428     9.1191 -0.1566 0.8764628
var2:nit2      5.784    11.0936  0.5214 0.6054692
var2:nit3     -6.461    11.3313 -0.5702 0.5722670
```

```
var2:nit4      0.000     0.0000
var3:nit1      0.000     0.0000
var3:nit2      0.000     0.0000
var3:nit3      0.000     0.0000
var3:nit4      0.000     0.0000
row1           1.613     9.9332  0.1624 0.8719639
row10        -13.706     8.4538 -1.6213 0.1141882
row11        -14.812     8.7800 -1.6870 0.1007506
row12          0.000     0.0000
row13          2.006     8.3976  0.2389 0.8126419
row14          0.000     0.0000
row15         -4.632     8.4677 -0.5470 0.5879538
row16          0.000     0.0000
row17         -0.198     8.7515 -0.0226 0.9820790
row18          0.000     0.0000
row2           0.000     0.0000
row3         -10.016     8.3602 -1.1980 0.2391928
row4           0.000     0.0000
row5          -7.727     8.5301 -0.9059 0.3713775
row6           0.000     0.0000
row7          -3.594     8.6347 -0.4162 0.6798797
row8           0.000     0.0000
row9           0.000     0.0000
col1          11.566     3.9157  2.9538 0.0056610 **
col2           0.000     0.0000
col3          16.517     4.1675  3.9633 0.0003597 ***
col4           0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(yield ~ rep + var + rep:var + nit + var:nit + row + col, ex3.1b),
      type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: yield
           Sum Sq Df F values    Pr(>F)
rep        5942.5  2  25.9273 1.449e-07 ***
var           0.0  0
nit       11977.9  3  34.8397 1.775e-10 ***
row         945.0  9   0.9162    0.5230
col        3171.5  2  13.8373 4.012e-05 ***
rep:var     997.8  4   2.1767    0.0926 .
```

```
var:nit     477.8  6   0.6949    0.6553
Residuals  3896.4 34
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.6 Example 4.1

(79) MODEL

```
ex4.1 = read.table("C:/G/Rt/Split/Ex4.1-example.txt", header=TRUE)
ex4.1 = af(ex4.1, c("row", "P", "column", "R", "S"))
GLM(height ~ P + column + column:P + R + P:R + column:R + column:R:P + S +
   P:S + column:S + column:S:P + R:S + R:S:column + R:S:P + R:S:P:column, ex4.1)
```

```
$ANOVA
Response : height
                 Df Sum Sq Mean Sq F value Pr(>F)
MODEL           199 1710.2  8.5937
RESIDUALS         0    0.0
CORRECTED TOTAL 199 1710.2

$`Type I`
             Df Sum Sq Mean Sq F value Pr(>F)
P             1  28.12 28.1250
column        4  34.33  8.5825
P:column      4  91.45 22.8625
R             4  31.03  7.7575
P:R           4  48.95 12.2375
column:R     16 467.92 29.2450
P:column:R   16 350.10 21.8813
S             3   3.78  1.2583
P:S           3   3.29  1.0983
column:S     12  74.55  6.2125
P:column:S   12  47.03  3.9192
R:S          12  36.65  3.0542
column:R:S   48 197.40  4.1125
P:R:S        12  26.33  2.1942
P:column:R:S 48 269.22  5.6087

$`Type II`
             Df Sum Sq Mean Sq F value Pr(>F)
P             1  28.12 28.1250
column        4  34.33  8.5825
P:column      4  91.45 22.8625
R             4  31.03  7.7575
P:R           4  48.95 12.2375
column:R     16 467.92 29.2450
```

```
P:column:R   16 350.10 21.8813
S             3   3.77  1.2583
P:S           3   3.30  1.0983
column:S     12  74.55  6.2125
P:column:S   12  47.03  3.9192
R:S          12  36.65  3.0542
column:R:S   48 197.40  4.1125
P:R:S        12  26.33  2.1942
P:column:R:S 48 269.22  5.6087

$`Type III`
             Df Sum Sq Mean Sq F value Pr(>F)
P             1  28.12 28.1250
column        4  34.33  8.5825
P:column      4  91.45 22.8625
R             4  31.03  7.7575
P:R           4  48.95 12.2375
column:R     16 467.92 29.2450
P:column:R   16 350.10 21.8813
S             3   3.77  1.2583
P:S           3   3.29  1.0983
column:S     12  74.55  6.2125
P:column:S   12  47.03  3.9192
R:S          12  36.65  3.0542
column:R:S   48 197.40  4.1125
P:R:S        12  26.33  2.1942
P:column:R:S 48 269.22  5.6087

$Parameter
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)             8        Inf       0
P1                     -2        Inf       0
P2                      0
column1                 0        Inf       0
column2                 0        Inf       0
column3                 0        Inf       0
column4                -3        Inf       0
column5                 0
P1:column1              2        Inf       0
P1:column2              2        Inf       0
P1:column3              1        Inf       0
P1:column4              3        Inf       0
P1:column5              0
P2:column1              0
P2:column2              0
P2:column3              0
P2:column4              0
P2:column5              0
```

```
R1                    1        Inf       0
R2                    1        Inf       0
R3                   -5        Inf       0
R4                   -1        Inf       0
R5                    0
P1:R1                 2        Inf       0
P1:R2                 2        Inf       0
P1:R3                 7        Inf       0
P1:R4                 3        Inf       0
P1:R5                 0
P2:R1                 0
P2:R2                 0
P2:R3                 0
P2:R4                 0
P2:R5                 0
column1:R1           -1        Inf       0
column1:R2            0        Inf       0
column1:R3            8        Inf       0
column1:R4            1        Inf       0
column1:R5            0
column2:R1           -9        Inf       0
column2:R2           -3        Inf       0
column2:R3            3        Inf       0
column2:R4            0        Inf       0
column2:R5            0
column3:R1           -3        Inf       0
column3:R2           -6        Inf       0
column3:R3            2        Inf       0
column3:R4           -5        Inf       0
column3:R5            0
column4:R1            3        Inf       0
column4:R2            1        Inf       0
column4:R3            3        Inf       0
column4:R4            4        Inf       0
column4:R5            0
column5:R1            0
column5:R2            0
column5:R3            0
column5:R4            0
column5:R5            0
P1:column1:R1       -10        Inf       0
P1:column1:R2        -2        Inf       0
P1:column1:R3        -5        Inf       0
P1:column1:R4        -2        Inf       0
P1:column1:R5         0
P1:column2:R1         7        Inf       0
P1:column2:R2        -8        Inf       0
P1:column2:R3       -10        Inf       0
```

| | | | |
|---|---|---|---|
| P1:column2:R4 | -1 | Inf | 0 |
| P1:column2:R5 | 0 | | |
| P1:column3:R1 | 1 | Inf | 0 |
| P1:column3:R2 | 1 | Inf | 0 |
| P1:column3:R3 | -2 | Inf | 0 |
| P1:column3:R4 | 4 | Inf | 0 |
| P1:column3:R5 | 0 | | |
| P1:column4:R1 | -4 | Inf | 0 |
| P1:column4:R2 | 0 | Inf | 0 |
| P1:column4:R3 | -2 | Inf | 0 |
| P1:column4:R4 | -8 | Inf | 0 |
| P1:column4:R5 | 0 | | |
| P1:column5:R1 | 0 | | |
| P1:column5:R2 | 0 | | |
| P1:column5:R3 | 0 | | |
| P1:column5:R4 | 0 | | |
| P1:column5:R5 | 0 | | |
| P2:column1:R1 | 0 | | |
| P2:column1:R2 | 0 | | |
| P2:column1:R3 | 0 | | |
| P2:column1:R4 | 0 | | |
| P2:column1:R5 | 0 | | |
| P2:column2:R1 | 0 | | |
| P2:column2:R2 | 0 | | |
| P2:column2:R3 | 0 | | |
| P2:column2:R4 | 0 | | |
| P2:column2:R5 | 0 | | |
| P2:column3:R1 | 0 | | |
| P2:column3:R2 | 0 | | |
| P2:column3:R3 | 0 | | |
| P2:column3:R4 | 0 | | |
| P2:column3:R5 | 0 | | |
| P2:column4:R1 | 0 | | |
| P2:column4:R2 | 0 | | |
| P2:column4:R3 | 0 | | |
| P2:column4:R4 | 0 | | |
| P2:column4:R5 | 0 | | |
| P2:column5:R1 | 0 | | |
| P2:column5:R2 | 0 | | |
| P2:column5:R3 | 0 | | |
| P2:column5:R4 | 0 | | |
| P2:column5:R5 | 0 | | |
| S1 | 1 | Inf | 0 |
| S2 | -2 | Inf | 0 |
| S3 | -5 | Inf | 0 |
| S4 | 0 | | |
| P1:S1 | 1 | Inf | 0 |
| P1:S2 | -1 | Inf | 0 |

```
P1:S3                    7        Inf       0
P1:S4                    0
P2:S1                    0
P2:S2                    0
P2:S3                    0
P2:S4                    0
column1:S1              -1        Inf       0
column1:S2               1        Inf       0
column1:S3               6        Inf       0
column1:S4               0
column2:S1              -2        Inf       0
column2:S2              -6        Inf       0
column2:S3               6        Inf       0
column2:S4               0
column3:S1              -3        Inf       0
column3:S2               2        Inf       0
column3:S3               5        Inf       0
column3:S4               0
column4:S1               2        Inf       0
column4:S2               6        Inf       0
column4:S3               7        Inf       0
column4:S4               0
column5:S1               0
column5:S2               0
column5:S3               0
column5:S4               0
P1:column1:S1           -2        Inf       0
P1:column1:S2            2        Inf       0
P1:column1:S3           -7        Inf       0
P1:column1:S4            0
P1:column2:S1           -6        Inf       0
P1:column2:S2            9        Inf       0
P1:column2:S3           -7        Inf       0
P1:column2:S4            0
P1:column3:S1            3        Inf       0
P1:column3:S2            4        Inf       0
P1:column3:S3           -5        Inf       0
P1:column3:S4            0
P1:column4:S1           -5        Inf       0
P1:column4:S2           -4        Inf       0
P1:column4:S3          -10        Inf       0
P1:column4:S4            0
P1:column5:S1            0
P1:column5:S2            0
P1:column5:S3            0
P1:column5:S4            0
P2:column1:S1            0
P2:column1:S2            0
```

```
P2:column1:S3           0
P2:column1:S4           0
P2:column2:S1           0
P2:column2:S2           0
P2:column2:S3           0
P2:column2:S4           0
P2:column3:S1           0
P2:column3:S2           0
P2:column3:S3           0
P2:column3:S4           0
P2:column4:S1           0
P2:column4:S2           0
P2:column4:S3           0
P2:column4:S4           0
P2:column5:S1           0
P2:column5:S2           0
P2:column5:S3           0
P2:column5:S4           0
R1:S1                  -2        Inf       0
R1:S2                   1        Inf       0
R1:S3                   5        Inf       0
R1:S4                   0
R2:S1                  -1        Inf       0
R2:S2                  -1        Inf       0
R2:S3                   4        Inf       0
R2:S4                   0
R3:S1                  -4        Inf       0
R3:S2                   0        Inf       0
R3:S3                   4        Inf       0
R3:S4                   0
R4:S1                  -8        Inf       0
R4:S2                  -5        Inf       0
R4:S3                  -2        Inf       0
R4:S4                   0
R5:S1                   0
R5:S2                   0
R5:S3                   0
R5:S4                   0
column1:R1:S1           3        Inf       0
column1:R1:S2           1        Inf       0
column1:R1:S3          -7        Inf       0
column1:R1:S4           0
column1:R2:S1          -4        Inf       0
column1:R2:S2           2        Inf       0
column1:R2:S3          -6        Inf       0
column1:R2:S4           0
column1:R3:S1           3        Inf       0
column1:R3:S2           1        Inf       0
```

| | | | |
|---|---|---|---|
| column1:R3:S3 | -7 | Inf | 0 |
| column1:R3:S4 | 0 | | |
| column1:R4:S1 | 0 | Inf | 0 |
| column1:R4:S2 | 3 | Inf | 0 |
| column1:R4:S3 | 1 | Inf | 0 |
| column1:R4:S4 | 0 | | |
| column1:R5:S1 | 0 | | |
| column1:R5:S2 | 0 | | |
| column1:R5:S3 | 0 | | |
| column1:R5:S4 | 0 | | |
| column2:R1:S1 | 12 | Inf | 0 |
| column2:R1:S2 | 16 | Inf | 0 |
| column2:R1:S3 | -1 | Inf | 0 |
| column2:R1:S4 | 0 | | |
| column2:R2:S1 | 4 | Inf | 0 |
| column2:R2:S2 | 11 | Inf | 0 |
| column2:R2:S3 | -4 | Inf | 0 |
| column2:R2:S4 | 0 | | |
| column2:R3:S1 | 6 | Inf | 0 |
| column2:R3:S2 | 10 | Inf | 0 |
| column2:R3:S3 | -10 | Inf | 0 |
| column2:R3:S4 | 0 | | |
| column2:R4:S1 | 11 | Inf | 0 |
| column2:R4:S2 | 13 | Inf | 0 |
| column2:R4:S3 | -1 | Inf | 0 |
| column2:R4:S4 | 0 | | |
| column2:R5:S1 | 0 | | |
| column2:R5:S2 | 0 | | |
| column2:R5:S3 | 0 | | |
| column2:R5:S4 | 0 | | |
| column3:R1:S1 | 5 | Inf | 0 |
| column3:R1:S2 | 1 | Inf | 0 |
| column3:R1:S3 | -7 | Inf | 0 |
| column3:R1:S4 | 0 | | |
| column3:R2:S1 | 1 | Inf | 0 |
| column3:R2:S2 | 0 | Inf | 0 |
| column3:R2:S3 | -7 | Inf | 0 |
| column3:R2:S4 | 0 | | |
| column3:R3:S1 | 8 | Inf | 0 |
| column3:R3:S2 | 1 | Inf | 0 |
| column3:R3:S3 | 0 | Inf | 0 |
| column3:R3:S4 | 0 | | |
| column3:R4:S1 | 17 | Inf | 0 |
| column3:R4:S2 | 12 | Inf | 0 |
| column3:R4:S3 | 8 | Inf | 0 |
| column3:R4:S4 | 0 | | |
| column3:R5:S1 | 0 | | |
| column3:R5:S2 | 0 | | |

```
column3:R5:S3           0
column3:R5:S4           0
column4:R1:S1          -3        Inf       0
column4:R1:S2          -5        Inf       0
column4:R1:S3          -8        Inf       0
column4:R1:S4           0
column4:R2:S1          -9        Inf       0
column4:R2:S2          -5        Inf       0
column4:R2:S3          -4        Inf       0
column4:R2:S4           0
column4:R3:S1           4        Inf       0
column4:R3:S2           1        Inf       0
column4:R3:S3          -2        Inf       0
column4:R3:S4           0
column4:R4:S1           6        Inf       0
column4:R4:S2           2        Inf       0
column4:R4:S3          -1        Inf       0
column4:R4:S4           0
column4:R5:S1           0
column4:R5:S2           0
column4:R5:S3           0
column4:R5:S4           0
column5:R1:S1           0
column5:R1:S2           0
column5:R1:S3           0
column5:R1:S4           0
column5:R2:S1           0
column5:R2:S2           0
column5:R2:S3           0
column5:R2:S4           0
column5:R3:S1           0
column5:R3:S2           0
column5:R3:S3           0
column5:R3:S4           0
column5:R4:S1           0
column5:R4:S2           0
column5:R4:S3           0
column5:R4:S4           0
column5:R5:S1           0
column5:R5:S2           0
column5:R5:S3           0
column5:R5:S4           0
P1:R1:S1                3        Inf       0
P1:R1:S2               10        Inf       0
P1:R1:S3               -8        Inf       0
P1:R1:S4                0
P1:R2:S1               -2        Inf       0
P1:R2:S2                3        Inf       0
```

```
P1:R2:S3              -10        Inf       0
P1:R2:S4                0
P1:R3:S1                2        Inf       0
P1:R3:S2                0        Inf       0
P1:R3:S3               -6        Inf       0
P1:R3:S4                0
P1:R4:S1                7        Inf       0
P1:R4:S2                5        Inf       0
P1:R4:S3                0        Inf       0
P1:R4:S4                0
P1:R5:S1                0
P1:R5:S2                0
P1:R5:S3                0
P1:R5:S4                0
P2:R1:S1                0
P2:R1:S2                0
P2:R1:S3                0
P2:R1:S4                0
P2:R2:S1                0
P2:R2:S2                0
P2:R2:S3                0
P2:R2:S4                0
P2:R3:S1                0
P2:R3:S2                0
P2:R3:S3                0
P2:R3:S4                0
P2:R4:S1                0
P2:R4:S2                0
P2:R4:S3                0
P2:R4:S4                0
P2:R5:S1                0
P2:R5:S2                0
P2:R5:S3                0
P2:R5:S4                0
P1:column1:R1:S1       -3        Inf       0
P1:column1:R1:S2      -11        Inf       0
P1:column1:R1:S3       13        Inf       0
P1:column1:R1:S4        0
P1:column1:R2:S1        4        Inf       0
P1:column1:R2:S2       -6        Inf       0
P1:column1:R2:S3       10        Inf       0
P1:column1:R2:S4        0
P1:column1:R3:S1       -2        Inf       0
P1:column1:R3:S2       -6        Inf       0
P1:column1:R3:S3        6        Inf       0
P1:column1:R3:S4        0
P1:column1:R4:S1       -1        Inf       0
P1:column1:R4:S2       -4        Inf       0
```

| | | | |
|---|---|---|---|
| P1:column1:R4:S3 | -1 | Inf | 0 |
| P1:column1:R4:S4 | 0 | | |
| P1:column1:R5:S1 | 0 | | |
| P1:column1:R5:S2 | 0 | | |
| P1:column1:R5:S3 | 0 | | |
| P1:column1:R5:S4 | 0 | | |
| P1:column2:R1:S1 | -8 | Inf | 0 |
| P1:column2:R1:S2 | -28 | Inf | 0 |
| P1:column2:R1:S3 | 1 | Inf | 0 |
| P1:column2:R1:S4 | 0 | | |
| P1:column2:R2:S1 | 5 | Inf | 0 |
| P1:column2:R2:S2 | -13 | Inf | 0 |
| P1:column2:R2:S3 | 9 | Inf | 0 |
| P1:column2:R2:S4 | 0 | | |
| P1:column2:R3:S1 | 5 | Inf | 0 |
| P1:column2:R3:S2 | -4 | Inf | 0 |
| P1:column2:R3:S3 | 16 | Inf | 0 |
| P1:column2:R3:S4 | 0 | | |
| P1:column2:R4:S1 | -3 | Inf | 0 |
| P1:column2:R4:S2 | -12 | Inf | 0 |
| P1:column2:R4:S3 | 1 | Inf | 0 |
| P1:column2:R4:S4 | 0 | | |
| P1:column2:R5:S1 | 0 | | |
| P1:column2:R5:S2 | 0 | | |
| P1:column2:R5:S3 | 0 | | |
| P1:column2:R5:S4 | 0 | | |
| P1:column3:R1:S1 | -7 | Inf | 0 |
| P1:column3:R1:S2 | -18 | Inf | 0 |
| P1:column3:R1:S3 | 7 | Inf | 0 |
| P1:column3:R1:S4 | 0 | | |
| P1:column3:R2:S1 | 0 | Inf | 0 |
| P1:column3:R2:S2 | -2 | Inf | 0 |
| P1:column3:R2:S3 | 14 | Inf | 0 |
| P1:column3:R2:S4 | 0 | | |
| P1:column3:R3:S1 | -9 | Inf | 0 |
| P1:column3:R3:S2 | -6 | Inf | 0 |
| P1:column3:R3:S3 | 0 | Inf | 0 |
| P1:column3:R3:S4 | 0 | | |
| P1:column3:R4:S1 | -19 | Inf | 0 |
| P1:column3:R4:S2 | -15 | Inf | 0 |
| P1:column3:R4:S3 | -8 | Inf | 0 |
| P1:column3:R4:S4 | 0 | | |
| P1:column3:R5:S1 | 0 | | |
| P1:column3:R5:S2 | 0 | | |
| P1:column3:R5:S3 | 0 | | |
| P1:column3:R5:S4 | 0 | | |
| P1:column4:R1:S1 | 2 | Inf | 0 |
| P1:column4:R1:S2 | -6 | Inf | 0 |

| | | | |
|---|---|---|---|
| P1:column4:R1:S3 | 10 | Inf | 0 |
| P1:column4:R1:S4 | 0 | | |
| P1:column4:R2:S1 | 15 | Inf | 0 |
| P1:column4:R2:S2 | 3 | Inf | 0 |
| P1:column4:R2:S3 | 10 | Inf | 0 |
| P1:column4:R2:S4 | 0 | | |
| P1:column4:R3:S1 | -5 | Inf | 0 |
| P1:column4:R3:S2 | -1 | Inf | 0 |
| P1:column4:R3:S3 | 3 | Inf | 0 |
| P1:column4:R3:S4 | 0 | | |
| P1:column4:R4:S1 | -3 | Inf | 0 |
| P1:column4:R4:S2 | 2 | Inf | 0 |
| P1:column4:R4:S3 | 9 | Inf | 0 |
| P1:column4:R4:S4 | 0 | | |
| P1:column4:R5:S1 | 0 | | |
| P1:column4:R5:S2 | 0 | | |
| P1:column4:R5:S3 | 0 | | |
| P1:column4:R5:S4 | 0 | | |
| P1:column5:R1:S1 | 0 | | |
| P1:column5:R1:S2 | 0 | | |
| P1:column5:R1:S3 | 0 | | |
| P1:column5:R1:S4 | 0 | | |
| P1:column5:R2:S1 | 0 | | |
| P1:column5:R2:S2 | 0 | | |
| P1:column5:R2:S3 | 0 | | |
| P1:column5:R2:S4 | 0 | | |
| P1:column5:R3:S1 | 0 | | |
| P1:column5:R3:S2 | 0 | | |
| P1:column5:R3:S3 | 0 | | |
| P1:column5:R3:S4 | 0 | | |
| P1:column5:R4:S1 | 0 | | |
| P1:column5:R4:S2 | 0 | | |
| P1:column5:R4:S3 | 0 | | |
| P1:column5:R4:S4 | 0 | | |
| P1:column5:R5:S1 | 0 | | |
| P1:column5:R5:S2 | 0 | | |
| P1:column5:R5:S3 | 0 | | |
| P1:column5:R5:S4 | 0 | | |
| P2:column1:R1:S1 | 0 | | |
| P2:column1:R1:S2 | 0 | | |
| P2:column1:R1:S3 | 0 | | |
| P2:column1:R1:S4 | 0 | | |
| P2:column1:R2:S1 | 0 | | |
| P2:column1:R2:S2 | 0 | | |
| P2:column1:R2:S3 | 0 | | |
| P2:column1:R2:S4 | 0 | | |
| P2:column1:R3:S1 | 0 | | |
| P2:column1:R3:S2 | 0 | | |

```
P2:column1:R3:S3        0
P2:column1:R3:S4        0
P2:column1:R4:S1        0
P2:column1:R4:S2        0
P2:column1:R4:S3        0
P2:column1:R4:S4        0
P2:column1:R5:S1        0
P2:column1:R5:S2        0
P2:column1:R5:S3        0
P2:column1:R5:S4        0
P2:column2:R1:S1        0
P2:column2:R1:S2        0
P2:column2:R1:S3        0
P2:column2:R1:S4        0
P2:column2:R2:S1        0
P2:column2:R2:S2        0
P2:column2:R2:S3        0
P2:column2:R2:S4        0
P2:column2:R3:S1        0
P2:column2:R3:S2        0
P2:column2:R3:S3        0
P2:column2:R3:S4        0
P2:column2:R4:S1        0
P2:column2:R4:S2        0
P2:column2:R4:S3        0
P2:column2:R4:S4        0
P2:column2:R5:S1        0
P2:column2:R5:S2        0
P2:column2:R5:S3        0
P2:column2:R5:S4        0
P2:column3:R1:S1        0
P2:column3:R1:S2        0
P2:column3:R1:S3        0
P2:column3:R1:S4        0
P2:column3:R2:S1        0
P2:column3:R2:S2        0
P2:column3:R2:S3        0
P2:column3:R2:S4        0
P2:column3:R3:S1        0
P2:column3:R3:S2        0
P2:column3:R3:S3        0
P2:column3:R3:S4        0
P2:column3:R4:S1        0
P2:column3:R4:S2        0
P2:column3:R4:S3        0
P2:column3:R4:S4        0
P2:column3:R5:S1        0
P2:column3:R5:S2        0
```

```
P2:column3:R5:S3        0
P2:column3:R5:S4        0
P2:column4:R1:S1        0
P2:column4:R1:S2        0
P2:column4:R1:S3        0
P2:column4:R1:S4        0
P2:column4:R2:S1        0
P2:column4:R2:S2        0
P2:column4:R2:S3        0
P2:column4:R2:S4        0
P2:column4:R3:S1        0
P2:column4:R3:S2        0
P2:column4:R3:S3        0
P2:column4:R3:S4        0
P2:column4:R4:S1        0
P2:column4:R4:S2        0
P2:column4:R4:S3        0
P2:column4:R4:S4        0
P2:column4:R5:S1        0
P2:column4:R5:S2        0
P2:column4:R5:S3        0
P2:column4:R5:S4        0
P2:column5:R1:S1        0
P2:column5:R1:S2        0
P2:column5:R1:S3        0
P2:column5:R1:S4        0
P2:column5:R2:S1        0
P2:column5:R2:S2        0
P2:column5:R2:S3        0
P2:column5:R2:S4        0
P2:column5:R3:S1        0
P2:column5:R3:S2        0
P2:column5:R3:S3        0
P2:column5:R3:S4        0
P2:column5:R4:S1        0
P2:column5:R4:S2        0
P2:column5:R4:S3        0
P2:column5:R4:S4        0
P2:column5:R5:S1        0
P2:column5:R5:S2        0
P2:column5:R5:S3        0
P2:column5:R5:S4        0
```

(80) MODEL

```
GLM(height ~ row + R + P + S + S:R + row:P + R:P + row:R:P + S:P + S:P:row +
    S:R:P + R:S:P:row, ex4.1)
```

```
Warning in sqrt(diag(bVar)): NaNs produced

$ANOVA
Response : height
                 Df Sum Sq Mean Sq F value Pr(>F)
MODEL           199 1710.2  8.5937
RESIDUALS         0    0.0
CORRECTED TOTAL 199 1710.2

$`Type I`
          Df Sum Sq Mean Sq F value Pr(>F)
row        4 309.43  77.357
R          4  31.03   7.758
P          1  28.12  28.125
S          3   3.78   1.258
R:S       12  36.65   3.054
row:P      4 130.25  32.563
R:P        4  48.95  12.238
row:R:P   32 504.12  15.754
P:S        3   3.29   1.098
row:P:S   24 171.28   7.137
R:P:S     12  26.33   2.194
row:R:P:S 96 416.92   4.343

$`Type II`
          Df Sum Sq Mean Sq F value Pr(>F)
row        4 309.43  77.357
R          4  31.03   7.758
P          1  28.12  28.125
S          3   3.78   1.258
R:S       12  36.65   3.054
row:P      4 130.25  32.563
R:P        4  48.95  12.237
row:R:P   32 504.12  15.754
P:S        3   3.30   1.098
row:P:S   24 171.28   7.137
R:P:S     12  26.33   2.194
row:R:P:S 96 416.92   4.343

$`Type III`
          Df Sum Sq Mean Sq F value Pr(>F)
row        4 309.43  77.358
R          4  31.03   7.757
P          1  28.13  28.125
S          3   3.78   1.258
R:S       12  36.65   3.054
row:P      4 130.25  32.563
R:P        4  48.95  12.237
```

```
row:R:P   32 504.12  15.754
P:S        3   3.30   1.098
row:P:S   24 171.28   7.137
R:P:S     12  26.33   2.194
row:R:P:S 96 416.92   4.343

$Parameter
              Estimate Std. Error t value Pr(>|t|)
(Intercept)          8
row1                 0
row2                 0
row3                 0
row4                -3
row5                 0
R1                  -8
R2                   1
R3                  -5
R4                  -6
R5                   0
P1                   0
P2                   0
S1                   0
S2                  -1
S3                   1
S4                   0
R1:S1                9
R1:S2               10
R1:S3                4
R1:S4                0
R2:S1                0
R2:S2               -2
R2:S3               -2
R2:S4                0
R3:S1                3
R3:S2                6
R3:S3                3
R3:S4                0
R4:S1                7
R4:S2                8
R4:S3                5
R4:S4                0
R5:S1                0
R5:S2                0
R5:S3                0
R5:S4                0
row1:P1             -1
row1:P2              0
row2:P1             -2
```

```
row2:P2              0
row3:P1              0
row3:P2              0
row4:P1              1
row4:P2              0
row5:P1              0
row5:P2              0
R1:P1                9
R1:P2                0
R2:P1                0
R2:P2                0
R3:P1                6
R3:P2                0
R4:P1                6
R4:P2                0
R5:P1                0
R5:P2                0
row1:R1:P1           1
row1:R1:P2           9
row1:R2:P1           2
row1:R2:P2          -2
row1:R3:P1           5
row1:R3:P2           8
row1:R4:P1           2
row1:R4:P2           5
row1:R5:P1           0
row1:R5:P2           0
row2:R1:P1           1
row2:R1:P2           6
row2:R2:P1           2
row2:R2:P2           0
row2:R3:P1          -4
row2:R3:P2           3
row2:R4:P1          -2
row2:R4:P2           6
row2:R5:P1           0
row2:R5:P2           0
row3:R1:P1          -1
row3:R1:P2           9
row3:R2:P1          -4
row3:R2:P2          -6
row3:R3:P1          -1
row3:R3:P2           0
row3:R4:P1           1
row3:R4:P2           6
row3:R5:P1           0
row3:R5:P2           0
row4:R1:P1          -7
```

```
row4:R1:P2          11
row4:R2:P1          -7
row4:R2:P2           0
row4:R3:P1           2
row4:R3:P2           5
row4:R4:P1           2
row4:R4:P2           8
row4:R5:P1           0
row4:R5:P2           0
row5:R1:P1           0
row5:R1:P2           0
row5:R2:P1           0
row5:R2:P2           0
row5:R3:P1           0
row5:R3:P2           0
row5:R4:P1           0
row5:R4:P2           0
row5:R5:P1           0
row5:R5:P2           0
P1:S1               -1
P1:S2                1
P1:S3                0
P1:S4                0
P2:S1                0
P2:S2                0
P2:S3                0
P2:S4                0
row1:P1:S1           3
row1:P1:S2           3
row1:P1:S3           1
row1:P1:S4           0
row1:P2:S1          -2
row1:P2:S2           1
row1:P2:S3          -1
row1:P2:S4           0
row2:P1:S1           3
row2:P1:S2          -3
row2:P1:S3           1
row2:P1:S4           0
row2:P2:S1           1
row2:P2:S2          -1
row2:P2:S3          -6
row2:P2:S4           0
row3:P1:S1          -5
row3:P1:S2           0
row3:P1:S3           0
row3:P1:S4           0
row3:P2:S1          -1
```

```
row3:P2:S2          -7
row3:P2:S3           0
row3:P2:S4           0
row4:P1:S1           0
row4:P1:S2          -1
row4:P1:S3          -2
row4:P1:S4           0
row4:P2:S1           3
row4:P2:S2           5
row4:P2:S3           1
row4:P2:S4           0
row5:P1:S1           0
row5:P1:S2           0
row5:P1:S3           0
row5:P1:S4           0
row5:P2:S1           0
row5:P2:S2           0
row5:P2:S3           0
row5:P2:S4           0
R1:P1:S1            -9
R1:P1:S2           -11
R1:P1:S3            -7
R1:P1:S4             0
R1:P2:S1             0
R1:P2:S2             0
R1:P2:S3             0
R1:P2:S4             0
R2:P1:S1             0
R2:P1:S2             1
R2:P1:S3            -3
R2:P1:S4             0
R2:P2:S1             0
R2:P2:S2             0
R2:P2:S3             0
R2:P2:S4             0
R3:P1:S1            -6
R3:P1:S2            -7
R3:P1:S3            -6
R3:P1:S4             0
R3:P2:S1             0
R3:P2:S2             0
R3:P2:S3             0
R3:P2:S4             0
R4:P1:S1            -7
R4:P1:S2            -8
R4:P1:S3            -6
R4:P1:S4             0
R4:P2:S1             0
```

```
R4:P2:S2             0
R4:P2:S3             0
R4:P2:S4             0
R5:P1:S1             0
R5:P1:S2             0
R5:P1:S3             0
R5:P1:S4             0
R5:P2:S1             0
R5:P2:S2             0
R5:P2:S3             0
R5:P2:S4             0
row1:R1:P1:S1        1
row1:R1:P1:S2        6
row1:R1:P1:S3        0
row1:R1:P1:S4        0
row1:R1:P2:S1       -8
row1:R1:P2:S2      -11
row1:R1:P2:S3       -4
row1:R1:P2:S4        0
row1:R2:P1:S1        0
row1:R2:P1:S2       -3
row1:R2:P1:S3        2
row1:R2:P1:S4        0
row1:R2:P2:S1       -5
row1:R2:P2:S2        0
row1:R2:P2:S3        4
row1:R2:P2:S4        0
row1:R3:P1:S1       -1
row1:R3:P1:S2       -7
row1:R3:P1:S3       -1
row1:R3:P1:S4        0
row1:R3:P2:S1       -2
row1:R3:P2:S2       -6
row1:R3:P2:S3       -5
row1:R3:P2:S4        0
row1:R4:P1:S1       -1
row1:R4:P1:S2       -2
row1:R4:P1:S3       -2
row1:R4:P1:S4        0
row1:R4:P2:S1       -3
row1:R4:P2:S2       -8
row1:R4:P2:S3       -7
row1:R4:P2:S4        0
row1:R5:P1:S1        0
row1:R5:P1:S2        0
row1:R5:P1:S3        0
row1:R5:P1:S4        0
row1:R5:P2:S1        0
```

```
row1:R5:P2:S2        0
row1:R5:P2:S3        0
row1:R5:P2:S4        0
row2:R1:P1:S1       -1
row2:R1:P1:S2        1
row2:R1:P1:S3        0
row2:R1:P1:S4        0
row2:R1:P2:S1       -9
row2:R1:P2:S2       -6
row2:R1:P2:S3       -1
row2:R1:P2:S4        0
row2:R2:P1:S1       -6
row2:R2:P1:S2        2
row2:R2:P1:S3        2
row2:R2:P1:S4        0
row2:R2:P2:S1       -6
row2:R2:P2:S2        4
row2:R2:P2:S3        6
row2:R2:P2:S4        0
row2:R3:P1:S1        4
row2:R3:P1:S2       10
row2:R3:P1:S3        6
row2:R3:P1:S4        0
row2:R3:P2:S1       -3
row2:R3:P2:S2       -2
row2:R3:P2:S3       -3
row2:R3:P2:S4        0
row2:R4:P1:S1       -1
row2:R4:P1:S2        6
row2:R4:P1:S3        4
row2:R4:P1:S4        0
row2:R4:P2:S1       -7
row2:R4:P2:S2       -5
row2:R4:P2:S3       -1
row2:R4:P2:S4        0
row2:R5:P1:S1        0
row2:R5:P1:S2        0
row2:R5:P1:S3        0
row2:R5:P1:S4        0
row2:R5:P2:S1        0
row2:R5:P2:S2        0
row2:R5:P2:S3        0
row2:R5:P2:S4        0
row3:R1:P1:S1        5
row3:R1:P1:S2        0
row3:R1:P1:S3        0
row3:R1:P1:S4        0
row3:R1:P2:S1      -10
```

```
row3:R1:P2:S2       -2
row3:R1:P2:S3       -6
row3:R1:P2:S4        0
row3:R2:P1:S1        6
row3:R2:P1:S2        4
row3:R2:P1:S3        7
row3:R2:P1:S4        0
row3:R2:P2:S1       -1
row3:R2:P2:S2        9
row3:R2:P2:S3       -2
row3:R2:P2:S4        0
row3:R3:P1:S1        9
row3:R3:P1:S2       -2
row3:R3:P1:S3        2
row3:R3:P1:S4        0
row3:R3:P2:S1       -5
row3:R3:P2:S2        0
row3:R3:P2:S3       -5
row3:R3:P2:S4        0
row3:R4:P1:S1        3
row3:R4:P1:S2       -1
row3:R4:P1:S3       -1
row3:R4:P1:S4        0
row3:R4:P2:S1      -14
row3:R4:P2:S2       -3
row3:R4:P2:S3       -6
row3:R4:P2:S4        0
row3:R5:P1:S1        0
row3:R5:P1:S2        0
row3:R5:P1:S3        0
row3:R5:P1:S4        0
row3:R5:P2:S1        0
row3:R5:P2:S2        0
row3:R5:P2:S3        0
row3:R5:P2:S4        0
row4:R1:P1:S1        1
row4:R1:P1:S2        3
row4:R1:P1:S3        8
row4:R1:P1:S4        0
row4:R1:P2:S1      -11
row4:R1:P2:S2      -13
row4:R1:P2:S3       -7
row4:R1:P2:S4        0
row4:R2:P1:S1        1
row4:R2:P1:S2        2
row4:R2:P1:S3        6
row4:R2:P1:S4        0
row4:R2:P2:S1       -1
```

```
row4:R2:P2:S2        0
row4:R2:P2:S3        1
row4:R2:P2:S4        0
row4:R3:P1:S1        3
row4:R3:P1:S2        0
row4:R3:P1:S3        4
row4:R3:P1:S4        0
row4:R3:P2:S1       -4
row4:R3:P2:S2       -9
row4:R3:P2:S3       -1
row4:R3:P2:S4        0
row4:R4:P1:S1        2
row4:R4:P1:S2       -2
row4:R4:P1:S3        2
row4:R4:P1:S4        0
row4:R4:P2:S1      -17
row4:R4:P2:S2      -19
row4:R4:P2:S3      -14
row4:R4:P2:S4        0
row4:R5:P1:S1        0
row4:R5:P1:S2        0
row4:R5:P1:S3        0
row4:R5:P1:S4        0
row4:R5:P2:S1        0
row4:R5:P2:S2        0
row4:R5:P2:S3        0
row4:R5:P2:S4        0
row5:R1:P1:S1        0
row5:R1:P1:S2        0
row5:R1:P1:S3        0
row5:R1:P1:S4        0
row5:R1:P2:S1        0
row5:R1:P2:S2        0
row5:R1:P2:S3        0
row5:R1:P2:S4        0
row5:R2:P1:S1        0
row5:R2:P1:S2        0
row5:R2:P1:S3        0
row5:R2:P1:S4        0
row5:R2:P2:S1        0
row5:R2:P2:S2        0
row5:R2:P2:S3        0
row5:R2:P2:S4        0
row5:R3:P1:S1        0
row5:R3:P1:S2        0
row5:R3:P1:S3        0
row5:R3:P1:S4        0
row5:R3:P2:S1        0
```

```
row5:R3:P2:S2        0
row5:R3:P2:S3        0
row5:R3:P2:S4        0
row5:R4:P1:S1        0
row5:R4:P1:S2        0
row5:R4:P1:S3        0
row5:R4:P1:S4        0
row5:R4:P2:S1        0
row5:R4:P2:S2        0
row5:R4:P2:S3        0
row5:R4:P2:S4        0
row5:R5:P1:S1        0
row5:R5:P1:S2        0
row5:R5:P1:S3        0
row5:R5:P1:S4        0
row5:R5:P2:S1        0
row5:R5:P2:S2        0
row5:R5:P2:S3        0
row5:R5:P2:S4        0
```

## 7.7 Example 5.1

(81) MODEL

```
ex5.1 = read.table("C:/G/Rt/Split/sbsp.txt", header=TRUE)
ex5.1 = af(ex5.1, c("R", "A", "C", "B", "Tx"))
GLM(Y ~ R + A + R*A + C + B + C*B + Tx + B*Tx, ex5.1)
```

```
$ANOVA
Response : Y
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           20 193.583  9.6792  9.4176 2.969e-05 ***
RESIDUALS       15  15.417  1.0278
CORRECTED TOTAL 35 209.000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  33.500 16.7500 16.2973 0.0001734 ***
A     1  16.000 16.0000 15.5676 0.0012951 **
R:A   2  32.167 16.0833 15.6486 0.0002133 ***
C     2   0.500  0.2500  0.2432 0.7871141
B     1   1.778  1.7778  1.7297 0.2081966
C:B   2   0.389  0.1944  0.1892 0.8295745
Tx    5 103.333 20.6667 20.1081  3.63e-06 ***
B:Tx  5   5.917  1.1833  1.1514 0.3770453
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  23.047 11.5236 11.2122 0.0010520 **
A     1  12.375 12.3751 12.0406 0.0034285 **
R:A   2  27.164 13.5819 13.2148 0.0004907 ***
C     2   0.500  0.2500  0.2432 0.7871141
B     1   1.778  1.7778  1.7297 0.2081966
C:B   2   0.389  0.1944  0.1892 0.8295745
Tx    5 103.333 20.6667 20.1081  3.63e-06 ***
B:Tx  5   5.917  1.1833  1.1514 0.3770453
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  22.451 11.2254 10.9220 0.0011828 **
A     1  15.001 15.0013 14.5958 0.0016719 **
R:A   2  27.164 13.5819 13.2148 0.0004907 ***
C     2   0.500  0.2500  0.2432 0.7871141
B     1   1.778  1.7778  1.7297 0.2081966
C:B   2   0.389  0.1944  0.1892 0.8295745
Tx    5 103.333 20.6667 20.1081  3.63e-06 ***
B:Tx  5   5.917  1.1833  1.1514 0.3770453
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   8.0833    0.86156  9.3822 1.149e-07 ***
R1           -0.5417    0.67056 -0.8078 0.4318411
R2           -0.1250    0.62082 -0.2013 0.8431323
R3            0.0000    0.00000
A1           -0.4167    0.67056 -0.6214 0.5436847
A2            0.0000    0.00000
R1:A1         0.4375    0.98160  0.4457 0.6621795
R1:A2         0.0000    0.00000
R2:A1        -3.7292    0.91382 -4.0808 0.0009837 ***
R2:A2         0.0000    0.00000
R3:A1         0.0000    0.00000
R3:A2         0.0000    0.00000
C1            0.5000    0.58531  0.8542 0.4064073
C2            0.3333    0.58531  0.5695 0.5774500
C3            0.0000    0.00000
B1            0.1250    1.03470  0.1208 0.9054464
B2            0.0000    0.00000
```

```
C1:B1        -0.5000    0.82776 -0.6040 0.5548431
C1:B2         0.0000    0.00000
C2:B1        -0.1667    0.82776 -0.2013 0.8431323
C2:B2         0.0000    0.00000
C3:B1         0.0000    0.00000
C3:B2         0.0000    0.00000
Tx1          -5.4792    0.89008 -6.1558 1.839e-05 ***
Tx2          -2.7083    0.85323 -3.1742 0.0062873 **
Tx3          -1.2292    0.89008 -1.3810 0.1875206
Tx4          -0.9167    0.89008 -1.0299 0.3193930
Tx5          -2.2917    0.89008 -2.5747 0.0211374 *
Tx6           0.0000    0.00000
B1:Tx1        1.6250    1.34112  1.2117 0.2443809
B1:Tx2       -0.2500    1.24164 -0.2013 0.8431323
B1:Tx3        1.1250    1.34112  0.8388 0.4147227
B1:Tx4        1.5000    1.34112  1.1185 0.2809609
B1:Tx5       -0.7500    1.34112 -0.5592 0.5842567
B1:Tx6        0.0000    0.00000
B2:Tx1        0.0000    0.00000
B2:Tx2        0.0000    0.00000
B2:Tx3        0.0000    0.00000
B2:Tx4        0.0000    0.00000
B2:Tx5        0.0000    0.00000
B2:Tx6        0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(82) MODEL

```
GLM(Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx, ex5.1)
```

```
$ANOVA
Response : Y
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           20 194.188  9.7094  9.8323 2.254e-05 ***
RESIDUALS       15  14.813  0.9875
CORRECTED TOTAL 35 209.000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  33.500 16.7500 16.9620 0.0001410 ***
A     1  16.000 16.0000 16.2025 0.0011013 **
R:A   2  32.167 16.0833 16.2869 0.0001739 ***
C     2   0.500  0.2500  0.2532 0.7795913
B     1   1.778  1.7778  1.8003 0.1996385
```

```
C:B   2   0.389  0.1944  0.1969 0.8233570
Tx    5 103.333 20.6667 20.9283 2.813e-06 ***
A:Tx  5   6.521  1.3042  1.3207 0.3078554
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  33.500 16.7500 16.9620 0.0001410 ***
A     1  16.000 16.0000 16.2025 0.0011013 **
R:A   2  32.167 16.0833 16.2869 0.0001739 ***
C     2   0.807  0.4037  0.4088 0.6716130
B     1   1.757  1.7574  1.7797 0.2020905
C:B   2   0.030  0.0150  0.0152 0.9849064
Tx    5 103.333 20.6667 20.9283 2.813e-06 ***
A:Tx  5   6.521  1.3042  1.3207 0.3078554
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  33.500 16.7500 16.9620 0.0001410 ***
A     1  16.000 16.0000 16.2025 0.0011013 **
R:A   2  32.167 16.0833 16.2869 0.0001739 ***
C     2   0.780  0.3902  0.3952 0.6803789
B     1   1.776  1.7756  1.7980 0.1999029
C:B   2   0.030  0.0150  0.0152 0.9849064
Tx    5 103.333 20.6667 20.9283 2.813e-06 ***
A:Tx  5   6.521  1.3042  1.3207 0.3078554
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   7.7083    0.84451  9.1276 1.638e-07 ***
R1           -0.3333    0.57373 -0.5810  0.569873
R2           -0.1667    0.57373 -0.2905  0.775414
R3            0.0000    0.00000
A1            0.2292    1.01422  0.2260  0.824288
A2            0.0000    0.00000
R1:A1        -0.3333    0.81138 -0.4108  0.687010
R1:A2         0.0000    0.00000
R2:A1        -4.1667    0.81138 -5.1353  0.000122 ***
R2:A2         0.0000    0.00000
R3:A1         0.0000    0.00000
R3:A2         0.0000    0.00000
C1            0.0625    0.65729  0.0951  0.925504
C2            0.4375    0.60853  0.7189  0.483227
```

```
C3            0.0000    0.00000
B1            0.5938    0.65729  0.9033  0.380630
B2            0.0000    0.00000
C1:B1        -0.0625    0.89574 -0.0698  0.945294
C1:B2         0.0000    0.00000
C2:B1        -0.1563    0.89574 -0.1744  0.863854
C2:B2         0.0000    0.00000
C3:B1         0.0000    0.00000
C3:B2         0.0000    0.00000
Tx1          -4.8854    0.87247 -5.5995 5.070e-05 ***
Tx2          -2.5208    0.83635 -3.0141  0.008719 **
Tx3          -0.8854    0.87247 -1.0148  0.326271
Tx4           0.7083    0.87247  0.8119  0.429560
Tx5          -3.2292    0.87247 -3.7012  0.002134 **
Tx6           0.0000    0.00000
A1:Tx1        0.4375    1.31458  0.3328  0.743887
A1:Tx2       -0.6250    1.21707 -0.5135  0.615061
A1:Tx3        0.4375    1.31458  0.3328  0.743887
A1:Tx4       -1.7500    1.31458 -1.3312  0.202996
A1:Tx5        1.1250    1.31458  0.8558  0.405580
A1:Tx6        0.0000    0.00000
A2:Tx1        0.0000    0.00000
A2:Tx2        0.0000    0.00000
A2:Tx3        0.0000    0.00000
A2:Tx4        0.0000    0.00000
A2:Tx5        0.0000    0.00000
A2:Tx6        0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(83) MODEL

```
GLM(Y ~ R + A + A:R + C + B + B:C + Tx + A:Tx + B:Tx, ex5.1)
```

```
$ANOVA
Response : Y
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL           24 196.238  8.1766  7.0476 0.0008758 ***
RESIDUALS       11  12.762  1.1602
CORRECTED TOTAL 35 209.000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  33.500 16.7500 14.4373 0.0008391 ***
A     1  16.000 16.0000 13.7908 0.0034197 **
```

```
R:A   2  32.167 16.0833 13.8626 0.0009856 ***
C     2   0.500  0.2500  0.2155 0.8094766
B     1   1.778  1.7778  1.5323 0.2415358
C:B   2   0.389  0.1944  0.1676 0.8478141
Tx    5 103.333 20.6667 17.8131 6.055e-05 ***
A:Tx  5   6.521  1.3042  1.1241 0.4027183
B:Tx  4   2.050  0.5126  0.4418 0.7761730
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  23.116 11.5581  9.9622  0.003396 **
A     1  12.375 12.3751 10.6664  0.007519 **
R:A   2  27.426 13.7132 11.8197  0.001820 **
C     2   0.970  0.4850  0.4180  0.668392
B     1   1.757  1.7574  1.5148  0.244080
C:B   2   0.085  0.0424  0.0366  0.964202
Tx    5 103.333 20.6667 17.8131 6.055e-05 ***
A:Tx  4   2.655  0.6636  0.5720  0.688652
B:Tx  4   2.050  0.5126  0.4418  0.776173
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  22.186 11.0928  9.5611  0.003924 **
A     0
R:A   2  27.426 13.7132 11.8197  0.001820 **
C     2   1.010  0.5049  0.4352  0.657839
B     1   1.792  1.7922  1.5448  0.239751
C:B   2   0.085  0.0424  0.0366  0.964202
Tx    5 103.333 20.6667 17.8131 6.055e-05 ***
A:Tx  4   2.655  0.6636  0.5720  0.688652
B:Tx  4   2.050  0.5126  0.4418  0.776173
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   7.9545    0.98427  8.0817  5.93e-06 ***
R1           -0.6318    0.73222 -0.8629 0.4066247
R2           -0.1636    0.66557 -0.2459 0.8103184
R3            0.0000    0.00000
A1            0.2273    1.10928  0.2049 0.8414057
A2            0.0000    0.00000
R1:A1         0.4636    1.09010  0.4253 0.6788082
```

```
R1:A2         0.0000    0.00000
R2:A1        -3.7682    0.98951 -3.8081 0.0029022 **
R2:A2         0.0000    0.00000
R3:A1         0.0000    0.00000
R3:A2         0.0000    0.00000
C1            0.2682    0.73222  0.3663 0.7211200
C2            0.4364    0.66557  0.6556 0.5255407
C3            0.0000    0.00000
B1           -0.2409    1.17470 -0.2051 0.8412545
B2            0.0000    0.00000
C1:B1        -0.2318    0.98951 -0.2343 0.8190745
C1:B2         0.0000    0.00000
C2:B1         0.0318    0.98951  0.0322 0.9749241
C2:B2         0.0000    0.00000
C3:B1         0.0000    0.00000
C3:B2         0.0000    0.00000
Tx1          -5.3485    1.04397 -5.1232 0.0003318 ***
Tx2          -2.5152    1.00973 -2.4909 0.0299872 *
Tx3          -1.1667    1.04397 -1.1175 0.2875828
Tx4           0.2424    1.22954  0.1972 0.8472929
Tx5          -2.6167    1.17171 -2.2332 0.0472599 *
Tx6           0.0000    0.00000
A1:Tx1       -0.4182    1.59983 -0.2614 0.7986202
A1:Tx2       -0.6182    1.42305 -0.4344 0.6723913
A1:Tx3       -0.2000    1.59983 -0.1250 0.9027684
A1:Tx4       -2.0091    1.51170 -1.3290 0.2107461
A1:Tx5       -0.1000    1.98612 -0.0503 0.9607465
A1:Tx6        0.0000    0.00000
A2:Tx1        0.0000    0.00000
A2:Tx2        0.0000    0.00000
A2:Tx3        0.0000    0.00000
A2:Tx4        0.0000    0.00000
A2:Tx5        0.0000    0.00000
A2:Tx6        0.0000    0.00000
B1:Tx1        1.7818    1.59983  1.1138 0.2891291
B1:Tx2       -0.0182    1.42305 -0.0128 0.9900347
B1:Tx3        1.2000    1.59983  0.7501 0.4689466
B1:Tx4        1.1909    1.51170  0.7878 0.4474596
B1:Tx5        0.0000    0.00000
B1:Tx6        0.0000    0.00000
B2:Tx1        0.0000    0.00000
B2:Tx2        0.0000    0.00000
B2:Tx3        0.0000    0.00000
B2:Tx4        0.0000    0.00000
B2:Tx5        0.0000    0.00000
B2:Tx6        0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ R + A + A:R + C + B + B:C + Tx + A:Tx + B:Tx, ex5.1),
      type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y
           Sum Sq Df F values    Pr(>F)
R          22.186  2   9.5611  0.003924 **
A           0.000  0
C           1.010  2   0.4352  0.657839
B           0.000  0
Tx        103.333  5  17.8131 6.055e-05 ***
R:A        27.426  2  11.8197  0.001820 **
C:B         0.085  2   0.0366  0.964202
A:Tx        2.655  4   0.5720  0.688652
B:Tx        2.050  4   0.4418  0.776173
Residuals  12.762 11
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(84) MODEL

```
GLM(Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx + B:Tx + A:B:Tx, ex5.1)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value   Pr(>F)
MODEL           28  204.2  7.2929  10.635 0.001719 **
RESIDUALS        7    4.8  0.6857
CORRECTED TOTAL 35  209.0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
       Df  Sum Sq Mean Sq F value    Pr(>F)
R       2  33.500 16.7500 24.4271 0.0006969 ***
A       1  16.000 16.0000 23.3333 0.0018985 **
R:A     2  32.167 16.0833 23.4549 0.0007889 ***
C       2   0.500  0.2500  0.3646 0.7069339
B       1   1.778  1.7778  2.5926 0.1513998
C:B     2   0.389  0.1944  0.2836 0.7613494
Tx      5 103.333 20.6667 30.1389 0.0001357 ***
```

```
A:Tx    5   6.521  1.3042  1.9019 0.2123307
B:Tx    4   2.050  0.5126  0.7475 0.5896365
A:B:Tx  4   7.962  1.9905  2.9029 0.1038803
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df  Sum Sq Mean Sq F value    Pr(>F)
R       2  31.838 15.9191 23.2153 0.0008139 ***
A       1  12.375 12.3751 18.0470 0.0038017 **
R:A     1   2.017  2.0174  2.9420 0.1300172
C       2   0.500  0.2500  0.3645 0.7069558
B       1   1.757  1.7574  2.5629 0.1534298
C:B     1   0.644  0.6445  0.9399 0.3646045
Tx      5 103.333 20.6667 30.1389 0.0001357 ***
A:Tx    4   2.655  0.6636  0.9678 0.4812226
B:Tx    4   2.050  0.5126  0.7475 0.5896365
A:B:Tx  4   7.962  1.9905  2.9029 0.1038803
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
       Df  Sum Sq Mean Sq F value    Pr(>F)
R       1  11.643 11.6429 16.9793 0.0044562 **
A       0
R:A     1   2.017  2.0174  2.9420 0.1300172
C       1   0.002  0.0017  0.0025 0.9614825
B       1   1.769  1.7694  2.5804 0.1522328
C:B     1   0.644  0.6445  0.9399 0.3646045
Tx      5 103.815 20.7630 30.2793 0.0001336 ***
A:Tx    4   2.951  0.7378  1.0760 0.4358837
B:Tx    4   3.553  0.8882  1.2954 0.3579988
A:B:Tx  4   7.962  1.9905  2.9029 0.1038803
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   8.5833    0.86189  9.9587 2.199e-05 ***
R1           -1.2833    0.79282 -1.6187 0.1495477
R2           -0.0500    0.55549 -0.0900 0.9308004
R3            0.0000    0.00000
A1           -0.5833    0.98561 -0.5918 0.5725621
A2            0.0000    0.00000
R1:A1         1.7250    1.00570  1.7152 0.1300172
R1:A2         0.0000    0.00000
R2:A1        -3.4083    1.01136 -3.3700 0.0119197 *
```

```
R2:A2         0.0000    0.00000
R3:A1         0.0000    0.00000
R3:A2         0.0000    0.00000
C1           -0.3833    0.79282 -0.4835 0.6434958
C2            0.5500    0.55549  0.9901 0.3551012
C3            0.0000    0.00000
B1           -0.4417    0.94112 -0.4693 0.6531236
B2            0.0000    0.00000
C1:B1         0.2833    0.96806  0.2927 0.7782513
C1:B2         0.0000    0.00000
C2:B1        -0.6917    0.82462 -0.8388 0.4293080
C2:B2         0.0000    0.00000
C3:B1         0.0000    0.00000
C3:B2         0.0000    0.00000
Tx1          -5.8333    0.95618 -6.1006 0.0004908 ***
Tx2          -2.2500    0.92582 -2.4303 0.0454020 *
Tx3          -1.8333    0.95618 -1.9173 0.0967067 .
Tx4           2.0833    1.37321  1.5171 0.1730222
Tx5          -2.6167    0.90079 -2.9048 0.0228276 *
Tx6           0.0000    0.00000
A1:Tx1       -0.2250    1.75173 -0.1284 0.9014099
A1:Tx2       -1.3000    1.69706 -0.7660 0.4686960
A1:Tx3        0.6750    1.75173  0.3853 0.7114327
A1:Tx4       -4.8500    1.70713 -2.8410 0.0250077 *
A1:Tx5       -0.1000    1.52690 -0.0655 0.9496134
A1:Tx6        0.0000    0.00000
A2:Tx1        0.0000    0.00000
A2:Tx2        0.0000    0.00000
A2:Tx3        0.0000    0.00000
A2:Tx4        0.0000    0.00000
A2:Tx5        0.0000    0.00000
A2:Tx6        0.0000    0.00000
B1:Tx1        1.9750    1.75173  1.1275 0.2967084
B1:Tx2       -0.7000    1.69706 -0.4125 0.6923283
B1:Tx3        2.0750    1.75173  1.1845 0.2748540
B1:Tx4       -1.6500    1.70713 -0.9665 0.3659742
B1:Tx5        0.0000    0.00000
B1:Tx6        0.0000    0.00000
B2:Tx1        0.0000    0.00000
B2:Tx2        0.0000    0.00000
B2:Tx3        0.0000    0.00000
B2:Tx4        0.0000    0.00000
B2:Tx5        0.0000    0.00000
B2:Tx6        0.0000    0.00000
A1:B1:Tx1     0.8750    2.32379  0.3765 0.7176693
A1:B1:Tx2     1.2500    2.37847  0.5255 0.6154343
A1:B1:Tx3    -0.6250    2.32379 -0.2690 0.7957174
A1:B1:Tx4     6.0000    2.02837  2.9580 0.0211639 *
```

```
A1:B1:Tx5     0.0000    0.00000
A1:B1:Tx6     0.0000    0.00000
A1:B2:Tx1     0.0000    0.00000
A1:B2:Tx2     0.0000    0.00000
A1:B2:Tx3     0.0000    0.00000
A1:B2:Tx4     0.0000    0.00000
A1:B2:Tx5     0.0000    0.00000
A1:B2:Tx6     0.0000    0.00000
A2:B1:Tx1     0.0000    0.00000
A2:B1:Tx2     0.0000    0.00000
A2:B1:Tx3     0.0000    0.00000
A2:B1:Tx4     0.0000    0.00000
A2:B1:Tx5     0.0000    0.00000
A2:B1:Tx6     0.0000    0.00000
A2:B2:Tx1     0.0000    0.00000
A2:B2:Tx2     0.0000    0.00000
A2:B2:Tx3     0.0000    0.00000
A2:B2:Tx4     0.0000    0.00000
A2:B2:Tx5     0.0000    0.00000
A2:B2:Tx6     0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx + B:Tx + A:B:Tx, ex5.1),
      type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y
          Sum Sq Df F values   Pr(>F)
R         11.643  1  16.9793 0.004456 **
A          0.000  0
C          0.002  1   0.0025 0.961483
B          0.000  0
Tx        89.178  3  43.3503 6.87e-05 ***
R:A        2.017  1   2.9420 0.130017
C:B        0.644  1   0.9399 0.364604
A:Tx       0.543  3   0.2640 0.849381
B:Tx       3.384  3   1.6451 0.264128
A:B:Tx     7.962  4   2.9029 0.103880
Residuals  4.800  7
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 7.8 Example 7.1

(85) MODEL

```
ex7.1 = read.table("C:/G/Rt/Split/asped.txt", header=TRUE)
ex7.1 = af(ex7.1, c("R", "G", "F"))
GLM(Y ~ R + G + R:G + F + F:G, ex7.1)
```

```
$ANOVA
Response : Y
                 Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            95 577.83  6.0824  5.3082 1.068e-05 ***
RESIDUALS        24  27.50  1.1458
CORRECTED TOTAL 119 605.33
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3  84.76 28.2528 24.6570 1.655e-07 ***
G   27 343.48 12.7216 11.1025 4.286e-08 ***
R:G  9  11.75  1.3056  1.1394    0.3749
F    2  59.85 29.9250 26.1164 9.481e-07 ***
G:F 54  77.98  1.4441  1.2603    0.2718
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3   5.75  1.9167  1.6727    0.1994
G   27 343.48 12.7216 11.1025 4.286e-08 ***
R:G  9  11.75  1.3056  1.1394    0.3749
F    2  59.85 29.9250 26.1164 9.481e-07 ***
G:F 54  77.98  1.4441  1.2603    0.2718
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3   5.75  1.9167  1.6727    0.1994
G   27 343.48 12.7216 11.1025 4.286e-08 ***
R:G  9  11.75  1.3056  1.1394    0.3749
F    2  50.51 25.2525 22.0385 3.686e-06 ***
G:F 54  77.98  1.4441  1.2603    0.2718
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   4.0000    1.38193  2.8945 0.007962 **
R1            0.3333    0.87401  0.3814 0.706273
R2            0.0000    0.87401  0.0000 1.000000
R3           -0.3333    0.87401 -0.3814 0.706273
R4            0.0000    0.00000
G1            2.6667    1.74801  1.5255 0.140196
G10           1.0000    1.51383  0.6606 0.515174
G11           4.0000    1.51383  2.6423 0.014268 *
G12           3.0000    1.51383  1.9817 0.059074 .
G13           5.3333    1.74801  3.0511 0.005495 **
G14           4.3333    1.74801  2.4790 0.020593 *
G15           2.3333    1.74801  1.3348 0.194452
G16           5.3333    1.74801  3.0511 0.005495 **
G17           4.3333    1.74801  2.4790 0.020593 *
G18           4.3333    1.74801  2.4790 0.020593 *
G19           5.0000    1.74801  2.8604 0.008625 **
G2            0.6667    1.74801  0.3814 0.706273
G20           4.0000    1.74801  2.2883 0.031224 *
G21           4.0000    1.74801  2.2883 0.031224 *
G22           5.0000    1.74801  2.8604 0.008625 **
G23           5.0000    1.74801  2.8604 0.008625 **
G24           5.0000    1.74801  2.8604 0.008625 **
G25           2.9167    1.57564  1.8511 0.076500 .
G26           1.6667    1.57564  1.0578 0.300691
G27           5.0833    1.57564  3.2262 0.003604 **
G28           4.0000    1.31101  3.0511 0.005495 **
G3            1.6667    1.74801  0.9535 0.349861
G4           -0.3333    1.74801 -0.1907 0.850370
G5            3.6667    1.74801  2.0976 0.046650 *
G6            2.6667    1.74801  1.5255 0.140196
G7           -1.0000    1.51383 -0.6606 0.515174
G8            1.0000    1.51383  0.6606 0.515174
G9            0.0000    0.00000
R1:G1         0.0000    0.00000
R1:G10        0.0000    0.00000
R1:G11        0.0000    0.00000
R1:G12        0.0000    0.00000
R1:G13        0.0000    0.00000
R1:G14        0.0000    0.00000
R1:G15        0.0000    0.00000
R1:G16        0.0000    0.00000
R1:G17        0.0000    0.00000
R1:G18        0.0000    0.00000
R1:G19        0.0000    0.00000
R1:G2         0.0000    0.00000
R1:G20        0.0000    0.00000
```

```
R1:G21        0.0000    0.00000
R1:G22        0.0000    0.00000
R1:G23        0.0000    0.00000
R1:G24        0.0000    0.00000
R1:G25       -1.3333    1.23603 -1.0787 0.291435
R1:G26       -1.3333    1.23603 -1.0787 0.291435
R1:G27       -0.6667    1.23603 -0.5394 0.594608
R1:G28        0.0000    0.00000
R1:G3         0.0000    0.00000
R1:G4         0.0000    0.00000
R1:G5         0.0000    0.00000
R1:G6         0.0000    0.00000
R1:G7         0.0000    0.00000
R1:G8         0.0000    0.00000
R1:G9         0.0000    0.00000
R2:G1         0.0000    0.00000
R2:G10        0.0000    0.00000
R2:G11        0.0000    0.00000
R2:G12        0.0000    0.00000
R2:G13        0.0000    0.00000
R2:G14        0.0000    0.00000
R2:G15        0.0000    0.00000
R2:G16        0.0000    0.00000
R2:G17        0.0000    0.00000
R2:G18        0.0000    0.00000
R2:G19        0.0000    0.00000
R2:G2         0.0000    0.00000
R2:G20        0.0000    0.00000
R2:G21        0.0000    0.00000
R2:G22        0.0000    0.00000
R2:G23        0.0000    0.00000
R2:G24        0.0000    0.00000
R2:G25       -0.6667    1.23603 -0.5394 0.594608
R2:G26       -1.3333    1.23603 -1.0787 0.291435
R2:G27       -1.0000    1.23603 -0.8090 0.426440
R2:G28        0.0000    0.00000
R2:G3         0.0000    0.00000
R2:G4         0.0000    0.00000
R2:G5         0.0000    0.00000
R2:G6         0.0000    0.00000
R2:G7         0.0000    0.00000
R2:G8         0.0000    0.00000
R2:G9         0.0000    0.00000
R3:G1         0.0000    0.00000
R3:G10        0.0000    0.00000
R3:G11        0.0000    0.00000
R3:G12        0.0000    0.00000
R3:G13        0.0000    0.00000
```

| | | | | |
|---|---|---|---|---|
| R3:G14 | 0.0000 | 0.00000 | | |
| R3:G15 | 0.0000 | 0.00000 | | |
| R3:G16 | 0.0000 | 0.00000 | | |
| R3:G17 | 0.0000 | 0.00000 | | |
| R3:G18 | 0.0000 | 0.00000 | | |
| R3:G19 | 0.0000 | 0.00000 | | |
| R3:G2 | 0.0000 | 0.00000 | | |
| R3:G20 | 0.0000 | 0.00000 | | |
| R3:G21 | 0.0000 | 0.00000 | | |
| R3:G22 | 0.0000 | 0.00000 | | |
| R3:G23 | 0.0000 | 0.00000 | | |
| R3:G24 | 0.0000 | 0.00000 | | |
| R3:G25 | 1.3333 | 1.23603 | 1.0787 | 0.291435 |
| R3:G26 | 1.0000 | 1.23603 | 0.8090 | 0.426440 |
| R3:G27 | -0.6667 | 1.23603 | -0.5394 | 0.594608 |
| R3:G28 | 0.0000 | 0.00000 | | |
| R3:G3 | 0.0000 | 0.00000 | | |
| R3:G4 | 0.0000 | 0.00000 | | |
| R3:G5 | 0.0000 | 0.00000 | | |
| R3:G6 | 0.0000 | 0.00000 | | |
| R3:G7 | 0.0000 | 0.00000 | | |
| R3:G8 | 0.0000 | 0.00000 | | |
| R3:G9 | 0.0000 | 0.00000 | | |
| R4:G1 | 0.0000 | 0.00000 | | |
| R4:G10 | 0.0000 | 0.00000 | | |
| R4:G11 | 0.0000 | 0.00000 | | |
| R4:G12 | 0.0000 | 0.00000 | | |
| R4:G13 | 0.0000 | 0.00000 | | |
| R4:G14 | 0.0000 | 0.00000 | | |
| R4:G15 | 0.0000 | 0.00000 | | |
| R4:G16 | 0.0000 | 0.00000 | | |
| R4:G17 | 0.0000 | 0.00000 | | |
| R4:G18 | 0.0000 | 0.00000 | | |
| R4:G19 | 0.0000 | 0.00000 | | |
| R4:G2 | 0.0000 | 0.00000 | | |
| R4:G20 | 0.0000 | 0.00000 | | |
| R4:G21 | 0.0000 | 0.00000 | | |
| R4:G22 | 0.0000 | 0.00000 | | |
| R4:G23 | 0.0000 | 0.00000 | | |
| R4:G24 | 0.0000 | 0.00000 | | |
| R4:G25 | 0.0000 | 0.00000 | | |
| R4:G26 | 0.0000 | 0.00000 | | |
| R4:G27 | 0.0000 | 0.00000 | | |
| R4:G28 | 0.0000 | 0.00000 | | |
| R4:G3 | 0.0000 | 0.00000 | | |
| R4:G4 | 0.0000 | 0.00000 | | |
| R4:G5 | 0.0000 | 0.00000 | | |
| R4:G6 | 0.0000 | 0.00000 | | |

```
R4:G7         0.0000    0.00000
R4:G8         0.0000    0.00000
R4:G9         0.0000    0.00000
F1           -1.0000    1.51383 -0.6606 0.515174
F2            0.0000    1.51383  0.0000 1.000000
F3            0.0000    0.00000
G1:F1        -4.0000    2.14087 -1.8684 0.073962 .
G1:F2        -2.0000    2.14087 -0.9342 0.359506
G1:F3         0.0000    0.00000
G10:F1        0.0000    2.14087  0.0000 1.000000
G10:F2       -1.0000    2.14087 -0.4671 0.644642
G10:F3        0.0000    0.00000
G11:F1        1.0000    2.14087  0.4671 0.644642
G11:F2        0.0000    2.14087  0.0000 1.000000
G11:F3        0.0000    0.00000
G12:F1       -3.0000    2.14087 -1.4013 0.173924
G12:F2       -2.0000    2.14087 -0.9342 0.359506
G12:F3        0.0000    0.00000
G13:F1       -1.0000    2.14087 -0.4671 0.644642
G13:F2       -2.0000    2.14087 -0.9342 0.359506
G13:F3        0.0000    0.00000
G14:F1       -2.0000    2.14087 -0.9342 0.359506
G14:F2       -2.0000    2.14087 -0.9342 0.359506
G14:F3        0.0000    0.00000
G15:F1       -2.0000    2.14087 -0.9342 0.359506
G15:F2       -1.0000    2.14087 -0.4671 0.644642
G15:F3        0.0000    0.00000
G16:F1       -1.0000    2.14087 -0.4671 0.644642
G16:F2       -2.0000    2.14087 -0.9342 0.359506
G16:F3        0.0000    0.00000
G17:F1       -1.0000    2.14087 -0.4671 0.644642
G17:F2        0.0000    2.14087  0.0000 1.000000
G17:F3        0.0000    0.00000
G18:F1       -2.0000    2.14087 -0.9342 0.359506
G18:F2       -1.0000    2.14087 -0.4671 0.644642
G18:F3        0.0000    0.00000
G19:F1       -3.0000    2.14087 -1.4013 0.173924
G19:F2       -1.0000    2.14087 -0.4671 0.644642
G19:F3        0.0000    0.00000
G2:F1        -1.0000    2.14087 -0.4671 0.644642
G2:F2         1.0000    2.14087  0.4671 0.644642
G2:F3         0.0000    0.00000
G20:F1       -1.0000    2.14087 -0.4671 0.644642
G20:F2       -2.0000    2.14087 -0.9342 0.359506
G20:F3        0.0000    0.00000
G21:F1        0.0000    2.14087  0.0000 1.000000
G21:F2       -4.0000    2.14087 -1.8684 0.073962 .
G21:F3        0.0000    0.00000
```

```
G22:F1        0.0000    2.14087  0.0000 1.000000
G22:F2       -2.0000    2.14087 -0.9342 0.359506
G22:F3        0.0000    0.00000
G23:F1        1.0000    2.14087  0.4671 0.644642
G23:F2       -1.0000    2.14087 -0.4671 0.644642
G23:F3        0.0000    0.00000
G24:F1        1.0000    2.14087  0.4671 0.644642
G24:F2       -1.0000    2.14087 -0.4671 0.644642
G24:F3        0.0000    0.00000
G25:F1       -2.5000    1.69251 -1.4771 0.152652
G25:F2       -2.2500    1.69251 -1.3294 0.196219
G25:F3        0.0000    0.00000
G26:F1       -1.7500    1.69251 -1.0340 0.311458
G26:F2       -2.2500    1.69251 -1.3294 0.196219
G26:F3        0.0000    0.00000
G27:F1        1.0000    1.69251  0.5908 0.560152
G27:F2       -0.2500    1.69251 -0.1477 0.883806
G27:F3        0.0000    0.00000
G28:F1        1.0000    1.69251  0.5908 0.560152
G28:F2        0.0000    1.69251  0.0000 1.000000
G28:F3        0.0000    0.00000
G3:F1        -1.0000    2.14087 -0.4671 0.644642
G3:F2         1.0000    2.14087  0.4671 0.644642
G3:F3         0.0000    0.00000
G4:F1         2.0000    2.14087  0.9342 0.359506
G4:F2         4.0000    2.14087  1.8684 0.073962 .
G4:F3         0.0000    0.00000
G5:F1        -1.0000    2.14087 -0.4671 0.644642
G5:F2         0.0000    2.14087  0.0000 1.000000
G5:F3         0.0000    0.00000
G6:F1         1.0000    2.14087  0.4671 0.644642
G6:F2         1.0000    2.14087  0.4671 0.644642
G6:F3         0.0000    0.00000
G7:F1        -1.0000    2.14087 -0.4671 0.644642
G7:F2        -1.0000    2.14087 -0.4671 0.644642
G7:F3         0.0000    0.00000
G8:F1        -2.0000    2.14087 -0.9342 0.359506
G8:F2        -2.0000    2.14087 -0.9342 0.359506
G8:F3         0.0000    0.00000
G9:F1         0.0000    0.00000
G9:F2         0.0000    0.00000
G9:F3         0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ R + G + R:G + F + F:G, ex7.1), type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison


Anova Table (Type III tests)

Response: Y
           Sum Sq Df F values    Pr(>F)
R           0.000  0
G         202.417  3  58.8848 3.258e-11 ***
F          50.505  2  22.0385 3.686e-06 ***
R:G        11.750  9   1.1394    0.3749
G:F        77.983 54   1.2603    0.2718
Residuals  27.500 24
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.9 Example 7.2

(86) MODEL

```
ex7.2 = read.table("C:/G/Rt/Split/aspedt.txt", header=TRUE)
ex7.2 = af(ex7.2, c("R", "T", "G"))
GLM(Y ~ R + T + R:T + G + G:T, ex7.2)
```

```
$ANOVA
Response : Y
                 Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            99 538.70  5.4415  5.1892 1.286e-05 ***
RESIDUALS        24  25.17  1.0486
CORRECTED TOTAL 123 563.87
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df  Sum Sq Mean Sq F value    Pr(>F)
R    3  73.255 24.4183 23.2863 2.752e-07 ***
T    3  32.000 10.6667 10.1722 0.0001645 ***
R:T  9  28.402  3.1558  3.0095 0.0149568 *
G   21 309.908 14.7575 14.0734 7.158e-09 ***
T:G 63  95.140  1.5102  1.4401 0.1617931
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df  Sum Sq Mean Sq F value    Pr(>F)
R    3   4.229  1.4097  1.3444 0.2834998
```

```
T    3  32.000 10.6667 10.1722 0.0001645 ***
R:T  9  10.854  1.2060  1.1501 0.3684706
G   21 309.908 14.7575 14.0734 7.158e-09 ***
T:G 63  95.140  1.5102  1.4401 0.1617931
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df  Sum Sq Mean Sq F value    Pr(>F)
R    3   4.229  1.4097  1.3444  0.283500
T    3  22.668  7.5559  7.2056  0.001299 **
R:T  9  10.854  1.2060  1.1501  0.368471
G   21 309.908 14.7575 14.0734 7.158e-09 ***
T:G 63  95.140  1.5102  1.4401  0.161793
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   7.3333    1.32200  5.5471 1.048e-05 ***
R1           -0.6667    0.83611 -0.7973 0.4330680
R2           -0.3333    0.83611 -0.3987 0.6936589
R3           -1.3333    0.83611 -1.5947 0.1238666
R4            0.0000    0.00000
T1           -3.3333    1.86959 -1.7829 0.0872539 .
T2           -2.0000    1.86959 -1.0698 0.2953720
T3           -0.3333    1.86959 -0.1783 0.8599900
T4            0.0000    0.00000
R1:T1        -0.6667    1.18243 -0.5638 0.5781149
R1:T2         0.3333    1.18243  0.2819 0.7804333
R1:T3         1.6667    1.18243  1.4095 0.1715077
R1:T4         0.0000    0.00000
R2:T1         0.3333    1.18243  0.2819 0.7804333
R2:T2         0.0000    1.18243  0.0000 1.0000000
R2:T3        -0.6667    1.18243 -0.5638 0.5781149
R2:T4         0.0000    0.00000
R3:T1         1.0000    1.18243  0.8457 0.4060656
R3:T2         0.3333    1.18243  0.2819 0.7804333
R3:T3         0.6667    1.18243  0.5638 0.5781149
R3:T4         0.0000    0.00000
R4:T1         0.0000    0.00000
R4:T2         0.0000    0.00000
R4:T3         0.0000    0.00000
R4:T4         0.0000    0.00000
G1           -3.6667    1.67221 -2.1927 0.0382606 *
G10           0.0000    1.44818  0.0000 1.0000000
G11           0.0000    1.67221  0.0000 1.0000000
G12           0.0000    1.67221  0.0000 1.0000000
```

```
G13          -2.0000    1.67221 -1.1960 0.2433719
G14          -4.0000    1.67221 -2.3920 0.0249405 *
G15           1.0000    1.67221  0.5980 0.5554350
G16          -1.3333    1.67221 -0.7973 0.4330680
G17          -1.3333    1.67221 -0.7973 0.4330680
G18          -0.3333    1.67221 -0.1993 0.8436786
G19           0.6667    1.67221  0.3987 0.6936589
G2           -2.6667    1.67221 -1.5947 0.1238666
G20          -1.2500    1.25416 -0.9967 0.3288617
G21          -2.5000    1.25416 -1.9934 0.0577070 .
G22          -0.2500    1.25416 -0.1993 0.8436786
G3           -1.6667    1.67221 -0.9967 0.3288617
G4           -4.6667    1.67221 -2.7907 0.0101456 *
G5           -2.6667    1.67221 -1.5947 0.1238666
G6           -2.0000    1.44818 -1.3810 0.1799904
G7           -3.0000    1.44818 -2.0716 0.0492199 *
G8           -2.0000    1.44818 -1.3810 0.1799904
G9            0.0000    0.00000
T1:G1         9.0000    2.36487  3.8057 0.0008596 ***
T1:G10        5.0000    2.04803  2.4414 0.0223806 *
T1:G11        5.3333    2.36487  2.2552 0.0335125 *
T1:G12        5.3333    2.36487  2.2552 0.0335125 *
T1:G13       -0.6667    2.36487 -0.2819 0.7804333
T1:G14        2.3333    2.36487  0.9867 0.3336497
T1:G15        4.3333    2.36487  1.8324 0.0793324 .
T1:G16        6.3333    2.36487  2.6781 0.0131499 *
T1:G17        6.3333    2.36487  2.6781 0.0131499 *
T1:G18        5.3333    2.36487  2.2552 0.0335125 *
T1:G19        4.3333    2.36487  1.8324 0.0793324 .
T1:G2         7.0000    2.36487  2.9600 0.0068231 **
T1:G20        4.6667    1.77365  2.6311 0.0146356 *
T1:G21        4.6667    1.77365  2.6311 0.0146356 *
T1:G22        3.6667    1.77365  2.0673 0.0496526 *
T1:G3         5.0000    2.36487  2.1143 0.0450700 *
T1:G4         7.0000    2.36487  2.9600 0.0068231 **
T1:G5         9.0000    2.36487  3.8057 0.0008596 ***
T1:G6         1.0000    2.04803  0.4883 0.6297879
T1:G7         2.0000    2.04803  0.9765 0.3385352
T1:G8         2.0000    2.04803  0.9765 0.3385352
T1:G9         0.0000    0.00000
T2:G1         7.6667    2.36487  3.2419 0.0034696 **
T2:G10        2.0000    2.04803  0.9765 0.3385352
T2:G11        4.6667    2.36487  1.9733 0.0600798 .
T2:G12        2.6667    2.36487  1.1276 0.2706286
T2:G13       -0.3333    2.36487 -0.1410 0.8890840
T2:G14        0.6667    2.36487  0.2819 0.7804333
T2:G15        3.6667    2.36487  1.5505 0.1341152
T2:G16        4.0000    2.36487  1.6914 0.1037018
```

```
T2:G17        5.0000    2.36487  2.1143 0.0450700 *
T2:G18        2.0000    2.36487  0.8457 0.4060656
T2:G19        0.0000    2.36487  0.0000 1.0000000
T2:G2         5.6667    2.36487  2.3962 0.0247152 *
T2:G20        4.8333    1.77365  2.7251 0.0118067 *
T2:G21        2.5833    1.77365  1.4565 0.1582118
T2:G22        3.5833    1.77365  2.0203 0.0546461 .
T2:G3         1.6667    2.36487  0.7048 0.4877422
T2:G4         4.6667    2.36487  1.9733 0.0600798 .
T2:G5         5.6667    2.36487  2.3962 0.0247152 *
T2:G6         0.0000    2.04803  0.0000 1.0000000
T2:G7         0.0000    2.04803  0.0000 1.0000000
T2:G8        -1.0000    2.04803 -0.4883 0.6297879
T2:G9         0.0000    0.00000
T3:G1         0.6667    2.36487  0.2819 0.7804333
T3:G10        1.0000    2.04803  0.4883 0.6297879
T3:G11        0.6667    2.36487  0.2819 0.7804333
T3:G12        0.6667    2.36487  0.2819 0.7804333
T3:G13       -1.3333    2.36487 -0.5638 0.5781149
T3:G14       -0.3333    2.36487 -0.1410 0.8890840
T3:G15        0.6667    2.36487  0.2819 0.7804333
T3:G16        1.3333    2.36487  0.5638 0.5781149
T3:G17        1.3333    2.36487  0.5638 0.5781149
T3:G18        2.3333    2.36487  0.9867 0.3336497
T3:G19        1.3333    2.36487  0.5638 0.5781149
T3:G2         0.6667    2.36487  0.2819 0.7804333
T3:G20        0.9167    1.77365  0.5168 0.6100085
T3:G21        0.6667    1.77365  0.3759 0.7103135
T3:G22        0.4167    1.77365  0.2349 0.8162632
T3:G3         0.6667    2.36487  0.2819 0.7804333
T3:G4         0.6667    2.36487  0.2819 0.7804333
T3:G5         0.6667    2.36487  0.2819 0.7804333
T3:G6        -1.0000    2.04803 -0.4883 0.6297879
T3:G7         0.0000    2.04803  0.0000 1.0000000
T3:G8        -1.0000    2.04803 -0.4883 0.6297879
T3:G9         0.0000    0.00000
T4:G1         0.0000    0.00000
T4:G10        0.0000    0.00000
T4:G11        0.0000    0.00000
T4:G12        0.0000    0.00000
T4:G13        0.0000    0.00000
T4:G14        0.0000    0.00000
T4:G15        0.0000    0.00000
T4:G16        0.0000    0.00000
T4:G17        0.0000    0.00000
T4:G18        0.0000    0.00000
T4:G19        0.0000    0.00000
T4:G2         0.0000    0.00000
```

```
T4:G20        0.0000    0.00000
T4:G21        0.0000    0.00000
T4:G22        0.0000    0.00000
T4:G3         0.0000    0.00000
T4:G4         0.0000    0.00000
T4:G5         0.0000    0.00000
T4:G6         0.0000    0.00000
T4:G7         0.0000    0.00000
T4:G8         0.0000    0.00000
T4:G9         0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.10 Example 7.3

(87) MODEL

```
ex7.3 = read.table("C:/G/Rt/Split/assped.txt", header=TRUE)
ex7.3 = af(ex7.3, c("R", "T", "G", "F"))
f7.3 = Y ~ R + T + R:T + G + G:T + R:T:G + F + F:T + F:G + F:G:T
GLM(f7.3, ex7.3)
```

```
$ANOVA
Response : Y
                 Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           155 656.12  4.2330  13.446 3.997e-14 ***
RESIDUALS        36  11.33  0.3148
CORRECTED TOTAL 191 667.45
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
      Df Sum Sq Mean Sq  F value    Pr(>F)
R      3  27.06   9.019  28.6489 1.203e-09 ***
T      1  10.55  10.547  33.5018 1.334e-06 ***
R:T    3   2.97   0.991   3.1489  0.036705 *
G     22 389.01  17.682  56.1668 < 2.2e-16 ***
T:G   22  18.42   0.837   2.6601  0.004445 **
R:T:G 12   8.78   0.731   2.3235  0.025315 *
F      2 164.28  82.141 260.9173 < 2.2e-16 ***
T:F    2   0.84   0.422   1.3401  0.274574
G:F   44  23.47   0.533   1.6943  0.053191 .
T:G:F 44  10.74   0.244   0.7753  0.790640
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
```

```
      Df Sum Sq Mean Sq  F value    Pr(>F)
R      3  12.49   4.162  13.2206 5.655e-06 ***
T      1  10.55  10.547  33.5018 1.334e-06 ***
R:T    3   1.15   0.384   1.2206  0.316281
G     22 389.01  17.682  56.1668 < 2.2e-16 ***
T:G   22  18.42   0.837   2.6601  0.004445 **
R:T:G 12   8.78   0.731   2.3235  0.025315 *
F      2 164.28  82.141 260.9173 < 2.2e-16 ***
T:F    2   0.84   0.422   1.3401  0.274574
G:F   44  23.47   0.533   1.6943  0.053191 .
T:G:F 44  10.74   0.244   0.7753  0.790640
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
      Df Sum Sq Mean Sq  F value    Pr(>F)
R      3  12.49   4.162  13.2206 5.655e-06 ***
T      1  11.16  11.158  35.4430 8.021e-07 ***
R:T    3   1.15   0.384   1.2206  0.316281
G     22 389.01  17.682  56.1668 < 2.2e-16 ***
T:G   22  18.42   0.837   2.6601  0.004445 **
R:T:G 12   8.78   0.731   2.3235  0.025315 *
F      2 120.56  60.282 191.4828 < 2.2e-16 ***
T:F    2   0.82   0.411   1.3060  0.283432
G:F   44  23.47   0.533   1.6943  0.053191 .
T:G:F 44  10.74   0.244   0.7753  0.790640
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)  10.0000    0.72436 13.8054 4.441e-16 ***
R1           -1.0000    0.45812 -2.1828 0.0356525 *
R2           -1.0000    0.45812 -2.1828 0.0356525 *
R3            0.0000    0.45812  0.0000 1.0000000
R4            0.0000    0.00000
T1           -0.6667    1.02439 -0.6508 0.5193136
T2            0.0000    0.00000
R1:T1         0.3333    0.64788  0.5145 0.6100498
R1:T2         0.0000    0.00000
R2:T1         0.6667    0.64788  1.0290 0.3103479
R2:T2         0.0000    0.00000
R3:T1         0.0000    0.64788  0.0000 1.0000000
R3:T2         0.0000    0.00000
R4:T1         0.0000    0.00000
R4:T2         0.0000    0.00000
G1           -4.0000    0.91625 -4.3656 0.0001024 ***
G10          -2.0000    0.79349 -2.5205 0.0162919 *
```

```
G11          -4.0000    0.91625 -4.3656 0.0001024 ***
G12          -1.0000    0.91625 -1.0914 0.2823433
G13          -1.0000    0.91625 -1.0914 0.2823433
G14          -2.0000    0.91625 -2.1828 0.0356525 *
G15          -3.0000    0.91625 -3.2742 0.0023455 **
G16          -6.0000    0.91625 -6.5485 1.294e-07 ***
G17          -4.0000    0.91625 -4.3656 0.0001024 ***
G18          -3.0000    0.91625 -3.2742 0.0023455 **
G19          -3.0000    0.91625 -3.2742 0.0023455 **
G2           -1.0000    0.91625 -1.0914 0.2823433
G20          -2.0000    0.91625 -2.1828 0.0356525 *
G21          -3.0000    0.82589 -3.6324 0.0008677 ***
G22          -1.3333    0.82589 -1.6144 0.1151698
G23          -1.0000    0.68718 -1.4552 0.1542753
G3            0.0000    0.91625  0.0000 1.0000000
G4            0.0000    0.91625  0.0000 1.0000000
G5            0.0000    0.91625  0.0000 1.0000000
G6           -2.0000    0.79349 -2.5205 0.0162919 *
G7           -2.0000    0.79349 -2.5205 0.0162919 *
G8           -1.0000    0.79349 -1.2603 0.2156865
G9            0.0000    0.00000
T1:G1         1.3333    1.29577  1.0290 0.3103479
T1:G10       -1.0000    1.12217 -0.8911 0.3787754
T1:G11        0.6667    1.29577  0.5145 0.6100498
T1:G12       -0.3333    1.29577 -0.2572 0.7984521
T1:G13       -1.3333    1.29577 -1.0290 0.3103479
T1:G14        1.6667    1.29577  1.2862 0.2065706
T1:G15       -2.3333    1.29577 -1.8007 0.0801274 .
T1:G16        1.6667    1.29577  1.2862 0.2065706
T1:G17       -0.3333    1.29577 -0.2572 0.7984521
T1:G18       -0.3333    1.29577 -0.2572 0.7984521
T1:G19        0.6667    1.29577  0.5145 0.6100498
T1:G2        -0.6667    1.29577 -0.5145 0.6100498
T1:G20       -0.3333    1.29577 -0.2572 0.7984521
T1:G21        1.5833    1.16799  1.3556 0.1836683
T1:G22       -0.5833    1.16799 -0.4994 0.6205124
T1:G23        0.4167    0.97183  0.4287 0.6706625
T1:G3         0.3333    1.29577  0.2572 0.7984521
T1:G4         0.3333    1.29577  0.2572 0.7984521
T1:G5         0.3333    1.29577  0.2572 0.7984521
T1:G6        -1.0000    1.12217 -0.8911 0.3787754
T1:G7         1.0000    1.12217  0.8911 0.3787754
T1:G8         1.0000    1.12217  0.8911 0.3787754
T1:G9         0.0000    0.00000
T2:G1         0.0000    0.00000
T2:G10        0.0000    0.00000
T2:G11        0.0000    0.00000
T2:G12        0.0000    0.00000
```

```
T2:G13        0.0000    0.00000
T2:G14        0.0000    0.00000
T2:G15        0.0000    0.00000
T2:G16        0.0000    0.00000
T2:G17        0.0000    0.00000
T2:G18        0.0000    0.00000
T2:G19        0.0000    0.00000
T2:G2         0.0000    0.00000
T2:G20        0.0000    0.00000
T2:G21        0.0000    0.00000
T2:G22        0.0000    0.00000
T2:G23        0.0000    0.00000
T2:G3         0.0000    0.00000
T2:G4         0.0000    0.00000
T2:G5         0.0000    0.00000
T2:G6         0.0000    0.00000
T2:G7         0.0000    0.00000
T2:G8         0.0000    0.00000
T2:G9         0.0000    0.00000
R1:T1:G1      0.0000    0.00000
R1:T1:G10     0.0000    0.00000
R1:T1:G11     0.0000    0.00000
R1:T1:G12     0.0000    0.00000
R1:T1:G13     0.0000    0.00000
R1:T1:G14     0.0000    0.00000
R1:T1:G15     0.0000    0.00000
R1:T1:G16     0.0000    0.00000
R1:T1:G17     0.0000    0.00000
R1:T1:G18     0.0000    0.00000
R1:T1:G19     0.0000    0.00000
R1:T1:G2      0.0000    0.00000
R1:T1:G20     0.0000    0.00000
R1:T1:G21    -1.0000    0.64788 -1.5435 0.1314585
R1:T1:G22     0.0000    0.64788  0.0000 1.0000000
R1:T1:G23     0.0000    0.00000
R1:T1:G3      0.0000    0.00000
R1:T1:G4      0.0000    0.00000
R1:T1:G5      0.0000    0.00000
R1:T1:G6      0.0000    0.00000
R1:T1:G7      0.0000    0.00000
R1:T1:G8      0.0000    0.00000
R1:T1:G9      0.0000    0.00000
R1:T2:G1      0.0000    0.00000
R1:T2:G10     0.0000    0.00000
R1:T2:G11     0.0000    0.00000
R1:T2:G12     0.0000    0.00000
R1:T2:G13     0.0000    0.00000
R1:T2:G14     0.0000    0.00000
```

```
R1:T2:G15     0.0000    0.00000
R1:T2:G16     0.0000    0.00000
R1:T2:G17     0.0000    0.00000
R1:T2:G18     0.0000    0.00000
R1:T2:G19     0.0000    0.00000
R1:T2:G2      0.0000    0.00000
R1:T2:G20     0.0000    0.00000
R1:T2:G21     0.6667    0.64788  1.0290 0.3103479
R1:T2:G22     0.0000    0.64788  0.0000 1.0000000
R1:T2:G23     0.0000    0.00000
R1:T2:G3      0.0000    0.00000
R1:T2:G4      0.0000    0.00000
R1:T2:G5      0.0000    0.00000
R1:T2:G6      0.0000    0.00000
R1:T2:G7      0.0000    0.00000
R1:T2:G8      0.0000    0.00000
R1:T2:G9      0.0000    0.00000
R2:T1:G1      0.0000    0.00000
R2:T1:G10     0.0000    0.00000
R2:T1:G11     0.0000    0.00000
R2:T1:G12     0.0000    0.00000
R2:T1:G13     0.0000    0.00000
R2:T1:G14     0.0000    0.00000
R2:T1:G15     0.0000    0.00000
R2:T1:G16     0.0000    0.00000
R2:T1:G17     0.0000    0.00000
R2:T1:G18     0.0000    0.00000
R2:T1:G19     0.0000    0.00000
R2:T1:G2      0.0000    0.00000
R2:T1:G20     0.0000    0.00000
R2:T1:G21    -1.0000    0.64788 -1.5435 0.1314585
R2:T1:G22    -0.3333    0.64788 -0.5145 0.6100498
R2:T1:G23     0.0000    0.00000
R2:T1:G3      0.0000    0.00000
R2:T1:G4      0.0000    0.00000
R2:T1:G5      0.0000    0.00000
R2:T1:G6      0.0000    0.00000
R2:T1:G7      0.0000    0.00000
R2:T1:G8      0.0000    0.00000
R2:T1:G9      0.0000    0.00000
R2:T2:G1      0.0000    0.00000
R2:T2:G10     0.0000    0.00000
R2:T2:G11     0.0000    0.00000
R2:T2:G12     0.0000    0.00000
R2:T2:G13     0.0000    0.00000
R2:T2:G14     0.0000    0.00000
R2:T2:G15     0.0000    0.00000
R2:T2:G16     0.0000    0.00000
```

```
R2:T2:G17     0.0000    0.00000
R2:T2:G18     0.0000    0.00000
R2:T2:G19     0.0000    0.00000
R2:T2:G2      0.0000    0.00000
R2:T2:G20     0.0000    0.00000
R2:T2:G21    -1.0000    0.64788 -1.5435 0.1314585
R2:T2:G22     0.3333    0.64788  0.5145 0.6100498
R2:T2:G23     0.0000    0.00000
R2:T2:G3      0.0000    0.00000
R2:T2:G4      0.0000    0.00000
R2:T2:G5      0.0000    0.00000
R2:T2:G6      0.0000    0.00000
R2:T2:G7      0.0000    0.00000
R2:T2:G8      0.0000    0.00000
R2:T2:G9      0.0000    0.00000
R3:T1:G1      0.0000    0.00000
R3:T1:G10     0.0000    0.00000
R3:T1:G11     0.0000    0.00000
R3:T1:G12     0.0000    0.00000
R3:T1:G13     0.0000    0.00000
R3:T1:G14     0.0000    0.00000
R3:T1:G15     0.0000    0.00000
R3:T1:G16     0.0000    0.00000
R3:T1:G17     0.0000    0.00000
R3:T1:G18     0.0000    0.00000
R3:T1:G19     0.0000    0.00000
R3:T1:G2      0.0000    0.00000
R3:T1:G20     0.0000    0.00000
R3:T1:G21    -1.6667    0.64788 -2.5725 0.0143678 *
R3:T1:G22     0.6667    0.64788  1.0290 0.3103479
R3:T1:G23     0.0000    0.00000
R3:T1:G3      0.0000    0.00000
R3:T1:G4      0.0000    0.00000
R3:T1:G5      0.0000    0.00000
R3:T1:G6      0.0000    0.00000
R3:T1:G7      0.0000    0.00000
R3:T1:G8      0.0000    0.00000
R3:T1:G9      0.0000    0.00000
R3:T2:G1      0.0000    0.00000
R3:T2:G10     0.0000    0.00000
R3:T2:G11     0.0000    0.00000
R3:T2:G12     0.0000    0.00000
R3:T2:G13     0.0000    0.00000
R3:T2:G14     0.0000    0.00000
R3:T2:G15     0.0000    0.00000
R3:T2:G16     0.0000    0.00000
R3:T2:G17     0.0000    0.00000
R3:T2:G18     0.0000    0.00000
```

```
R3:T2:G19     0.0000    0.00000
R3:T2:G2      0.0000    0.00000
R3:T2:G20     0.0000    0.00000
R3:T2:G21    -0.6667    0.64788 -1.0290 0.3103479
R3:T2:G22     0.0000    0.64788  0.0000 1.0000000
R3:T2:G23     0.0000    0.00000
R3:T2:G3      0.0000    0.00000
R3:T2:G4      0.0000    0.00000
R3:T2:G5      0.0000    0.00000
R3:T2:G6      0.0000    0.00000
R3:T2:G7      0.0000    0.00000
R3:T2:G8      0.0000    0.00000
R3:T2:G9      0.0000    0.00000
R4:T1:G1      0.0000    0.00000
R4:T1:G10     0.0000    0.00000
R4:T1:G11     0.0000    0.00000
R4:T1:G12     0.0000    0.00000
R4:T1:G13     0.0000    0.00000
R4:T1:G14     0.0000    0.00000
R4:T1:G15     0.0000    0.00000
R4:T1:G16     0.0000    0.00000
R4:T1:G17     0.0000    0.00000
R4:T1:G18     0.0000    0.00000
R4:T1:G19     0.0000    0.00000
R4:T1:G2      0.0000    0.00000
R4:T1:G20     0.0000    0.00000
R4:T1:G21     0.0000    0.00000
R4:T1:G22     0.0000    0.00000
R4:T1:G23     0.0000    0.00000
R4:T1:G3      0.0000    0.00000
R4:T1:G4      0.0000    0.00000
R4:T1:G5      0.0000    0.00000
R4:T1:G6      0.0000    0.00000
R4:T1:G7      0.0000    0.00000
R4:T1:G8      0.0000    0.00000
R4:T1:G9      0.0000    0.00000
R4:T2:G1      0.0000    0.00000
R4:T2:G10     0.0000    0.00000
R4:T2:G11     0.0000    0.00000
R4:T2:G12     0.0000    0.00000
R4:T2:G13     0.0000    0.00000
R4:T2:G14     0.0000    0.00000
R4:T2:G15     0.0000    0.00000
R4:T2:G16     0.0000    0.00000
R4:T2:G17     0.0000    0.00000
R4:T2:G18     0.0000    0.00000
R4:T2:G19     0.0000    0.00000
R4:T2:G2      0.0000    0.00000
```

```
R4:T2:G20     0.0000    0.00000
R4:T2:G21     0.0000    0.00000
R4:T2:G22     0.0000    0.00000
R4:T2:G23     0.0000    0.00000
R4:T2:G3      0.0000    0.00000
R4:T2:G4      0.0000    0.00000
R4:T2:G5      0.0000    0.00000
R4:T2:G6      0.0000    0.00000
R4:T2:G7      0.0000    0.00000
R4:T2:G8      0.0000    0.00000
R4:T2:G9      0.0000    0.00000
F1           -2.0000    0.79349 -2.5205 0.0162919 *
F2           -2.0000    0.79349 -2.5205 0.0162919 *
F3            0.0000    0.00000
T1:F1         0.0000    1.12217  0.0000 1.0000000
T1:F2         1.0000    1.12217  0.8911 0.3787754
T1:F3         0.0000    0.00000
T2:F1         0.0000    0.00000
T2:F2         0.0000    0.00000
T2:F3         0.0000    0.00000
G1:F1         0.0000    1.12217  0.0000 1.0000000
G1:F2         1.0000    1.12217  0.8911 0.3787754
G1:F3         0.0000    0.00000
G10:F1       -1.0000    1.12217 -0.8911 0.3787754
G10:F2        0.0000    1.12217  0.0000 1.0000000
G10:F3        0.0000    0.00000
G11:F1        1.0000    1.12217  0.8911 0.3787754
G11:F2        1.0000    1.12217  0.8911 0.3787754
G11:F3        0.0000    0.00000
G12:F1        1.0000    1.12217  0.8911 0.3787754
G12:F2        1.0000    1.12217  0.8911 0.3787754
G12:F3        0.0000    0.00000
G13:F1        0.0000    1.12217  0.0000 1.0000000
G13:F2        0.0000    1.12217  0.0000 1.0000000
G13:F3        0.0000    0.00000
G14:F1        1.0000    1.12217  0.8911 0.3787754
G14:F2        2.0000    1.12217  1.7823 0.0831422 .
G14:F3        0.0000    0.00000
G15:F1       -1.0000    1.12217 -0.8911 0.3787754
G15:F2        0.0000    1.12217  0.0000 1.0000000
G15:F3        0.0000    0.00000
G16:F1        0.0000    1.12217  0.0000 1.0000000
G16:F2        0.0000    1.12217  0.0000 1.0000000
G16:F3        0.0000    0.00000
G17:F1       -1.0000    1.12217 -0.8911 0.3787754
G17:F2        1.0000    1.12217  0.8911 0.3787754
G17:F3        0.0000    0.00000
G18:F1       -1.0000    1.12217 -0.8911 0.3787754
```

```
G18:F2        1.0000    1.12217  0.8911 0.3787754
G18:F3        0.0000    0.00000
G19:F1        0.0000    1.12217  0.0000 1.0000000
G19:F2        2.0000    1.12217  1.7823 0.0831422 .
G19:F3        0.0000    0.00000
G2:F1        -2.0000    1.12217 -1.7823 0.0831422 .
G2:F2         0.0000    1.12217  0.0000 1.0000000
G2:F3         0.0000    0.00000
G20:F1        0.0000    1.12217  0.0000 1.0000000
G20:F2        1.0000    1.12217  0.8911 0.3787754
G20:F3        0.0000    0.00000
G21:F1       -1.2500    0.88715 -1.4090 0.1674134
G21:F2        1.2500    0.88715  1.4090 0.1674134
G21:F3        0.0000    0.00000
G22:F1        0.0000    0.88715  0.0000 1.0000000
G22:F2        1.0000    0.88715  1.1272 0.2671137
G22:F3        0.0000    0.00000
G23:F1        0.0000    0.88715  0.0000 1.0000000
G23:F2        1.0000    0.88715  1.1272 0.2671137
G23:F3        0.0000    0.00000
G3:F1         0.0000    1.12217  0.0000 1.0000000
G3:F2         1.0000    1.12217  0.8911 0.3787754
G3:F3         0.0000    0.00000
G4:F1         2.0000    1.12217  1.7823 0.0831422 .
G4:F2         1.0000    1.12217  0.8911 0.3787754
G4:F3         0.0000    0.00000
G5:F1         0.0000    1.12217  0.0000 1.0000000
G5:F2         2.0000    1.12217  1.7823 0.0831422 .
G5:F3         0.0000    0.00000
G6:F1         0.0000    1.12217  0.0000 1.0000000
G6:F2         1.0000    1.12217  0.8911 0.3787754
G6:F3         0.0000    0.00000
G7:F1         1.0000    1.12217  0.8911 0.3787754
G7:F2         2.0000    1.12217  1.7823 0.0831422 .
G7:F3         0.0000    0.00000
G8:F1         1.0000    1.12217  0.8911 0.3787754
G8:F2         3.0000    1.12217  2.6734 0.0112153 *
G8:F3         0.0000    0.00000
G9:F1         0.0000    0.00000
G9:F2         0.0000    0.00000
G9:F3         0.0000    0.00000
T1:G1:F1     -2.0000    1.58698 -1.2603 0.2156865
T1:G1:F2     -2.0000    1.58698 -1.2603 0.2156865
T1:G1:F3      0.0000    0.00000
T1:G10:F1     0.0000    1.58698  0.0000 1.0000000
T1:G10:F2     0.0000    1.58698  0.0000 1.0000000
T1:G10:F3     0.0000    0.00000
T1:G11:F1    -1.0000    1.58698 -0.6301 0.5325917
```

```
T1:G11:F2    -1.0000    1.58698 -0.6301 0.5325917
T1:G11:F3     0.0000    0.00000
T1:G12:F1     0.0000    1.58698  0.0000 1.0000000
T1:G12:F2     0.0000    1.58698  0.0000 1.0000000
T1:G12:F3     0.0000    0.00000
T1:G13:F1     1.0000    1.58698  0.6301 0.5325917
T1:G13:F2     1.0000    1.58698  0.6301 0.5325917
T1:G13:F3     0.0000    0.00000
T1:G14:F1    -1.0000    1.58698 -0.6301 0.5325917
T1:G14:F2    -3.0000    1.58698 -1.8904 0.0667786 .
T1:G14:F3     0.0000    0.00000
T1:G15:F1     1.0000    1.58698  0.6301 0.5325917
T1:G15:F2     0.0000    1.58698  0.0000 1.0000000
T1:G15:F3     0.0000    0.00000
T1:G16:F1    -2.0000    1.58698 -1.2603 0.2156865
T1:G16:F2    -1.0000    1.58698 -0.6301 0.5325917
T1:G16:F3     0.0000    0.00000
T1:G17:F1     0.0000    1.58698  0.0000 1.0000000
T1:G17:F2    -1.0000    1.58698 -0.6301 0.5325917
T1:G17:F3     0.0000    0.00000
T1:G18:F1     0.0000    1.58698  0.0000 1.0000000
T1:G18:F2    -2.0000    1.58698 -1.2603 0.2156865
T1:G18:F3     0.0000    0.00000
T1:G19:F1    -1.0000    1.58698 -0.6301 0.5325917
T1:G19:F2    -3.0000    1.58698 -1.8904 0.0667786 .
T1:G19:F3     0.0000    0.00000
T1:G2:F1      0.0000    1.58698  0.0000 1.0000000
T1:G2:F2     -1.0000    1.58698 -0.6301 0.5325917
T1:G2:F3      0.0000    0.00000
T1:G20:F1     0.0000    1.58698  0.0000 1.0000000
T1:G20:F2    -2.0000    1.58698 -1.2603 0.2156865
T1:G20:F3     0.0000    0.00000
T1:G21:F1     0.0000    1.25462  0.0000 1.0000000
T1:G21:F2    -1.7500    1.25462 -1.3948 0.1716105
T1:G21:F3     0.0000    0.00000
T1:G22:F1    -0.2500    1.25462 -0.1993 0.8431780
T1:G22:F2    -1.0000    1.25462 -0.7971 0.4306457
T1:G22:F3     0.0000    0.00000
T1:G23:F1    -0.2500    1.25462 -0.1993 0.8431780
T1:G23:F2    -1.0000    1.25462 -0.7971 0.4306457
T1:G23:F3     0.0000    0.00000
T1:G3:F1      0.0000    1.58698  0.0000 1.0000000
T1:G3:F2     -2.0000    1.58698 -1.2603 0.2156865
T1:G3:F3      0.0000    0.00000
T1:G4:F1     -1.0000    1.58698 -0.6301 0.5325917
T1:G4:F2     -1.0000    1.58698 -0.6301 0.5325917
T1:G4:F3      0.0000    0.00000
T1:G5:F1      1.0000    1.58698  0.6301 0.5325917
```

```
T1:G5:F2     -2.0000    1.58698 -1.2603 0.2156865
T1:G5:F3      0.0000    0.00000
T1:G6:F1      0.0000    1.58698  0.0000 1.0000000
T1:G6:F2     -1.0000    1.58698 -0.6301 0.5325917
T1:G6:F3      0.0000    0.00000
T1:G7:F1     -1.0000    1.58698 -0.6301 0.5325917
T1:G7:F2     -2.0000    1.58698 -1.2603 0.2156865
T1:G7:F3      0.0000    0.00000
T1:G8:F1     -1.0000    1.58698 -0.6301 0.5325917
T1:G8:F2     -3.0000    1.58698 -1.8904 0.0667786 .
T1:G8:F3      0.0000    0.00000
T1:G9:F1      0.0000    0.00000
T1:G9:F2      0.0000    0.00000
T1:G9:F3      0.0000    0.00000
T2:G1:F1      0.0000    0.00000
T2:G1:F2      0.0000    0.00000
T2:G1:F3      0.0000    0.00000
T2:G10:F1     0.0000    0.00000
T2:G10:F2     0.0000    0.00000
T2:G10:F3     0.0000    0.00000
T2:G11:F1     0.0000    0.00000
T2:G11:F2     0.0000    0.00000
T2:G11:F3     0.0000    0.00000
T2:G12:F1     0.0000    0.00000
T2:G12:F2     0.0000    0.00000
T2:G12:F3     0.0000    0.00000
T2:G13:F1     0.0000    0.00000
T2:G13:F2     0.0000    0.00000
T2:G13:F3     0.0000    0.00000
T2:G14:F1     0.0000    0.00000
T2:G14:F2     0.0000    0.00000
T2:G14:F3     0.0000    0.00000
T2:G15:F1     0.0000    0.00000
T2:G15:F2     0.0000    0.00000
T2:G15:F3     0.0000    0.00000
T2:G16:F1     0.0000    0.00000
T2:G16:F2     0.0000    0.00000
T2:G16:F3     0.0000    0.00000
T2:G17:F1     0.0000    0.00000
T2:G17:F2     0.0000    0.00000
T2:G17:F3     0.0000    0.00000
T2:G18:F1     0.0000    0.00000
T2:G18:F2     0.0000    0.00000
T2:G18:F3     0.0000    0.00000
T2:G19:F1     0.0000    0.00000
T2:G19:F2     0.0000    0.00000
T2:G19:F3     0.0000    0.00000
T2:G2:F1      0.0000    0.00000
```

```
T2:G2:F2      0.0000    0.00000
T2:G2:F3      0.0000    0.00000
T2:G20:F1     0.0000    0.00000
T2:G20:F2     0.0000    0.00000
T2:G20:F3     0.0000    0.00000
T2:G21:F1     0.0000    0.00000
T2:G21:F2     0.0000    0.00000
T2:G21:F3     0.0000    0.00000
T2:G22:F1     0.0000    0.00000
T2:G22:F2     0.0000    0.00000
T2:G22:F3     0.0000    0.00000
T2:G23:F1     0.0000    0.00000
T2:G23:F2     0.0000    0.00000
T2:G23:F3     0.0000    0.00000
T2:G3:F1      0.0000    0.00000
T2:G3:F2      0.0000    0.00000
T2:G3:F3      0.0000    0.00000
T2:G4:F1      0.0000    0.00000
T2:G4:F2      0.0000    0.00000
T2:G4:F3      0.0000    0.00000
T2:G5:F1      0.0000    0.00000
T2:G5:F2      0.0000    0.00000
T2:G5:F3      0.0000    0.00000
T2:G6:F1      0.0000    0.00000
T2:G6:F2      0.0000    0.00000
T2:G6:F3      0.0000    0.00000
T2:G7:F1      0.0000    0.00000
T2:G7:F2      0.0000    0.00000
T2:G7:F3      0.0000    0.00000
T2:G8:F1      0.0000    0.00000
T2:G8:F2      0.0000    0.00000
T2:G8:F3      0.0000    0.00000
T2:G9:F1      0.0000    0.00000
T2:G9:F2      0.0000    0.00000
T2:G9:F3      0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(f7.3, ex7.3), type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y
```

```
           Sum Sq Df F values    Pr(>F)
R           0.000  0
T           0.000  0
G          73.444  2 116.6471 < 2.2e-16 ***
F         120.563  2 191.4828 < 2.2e-16 ***
R:T         0.000  0
T:G         5.778  2   9.1765 0.0006018 ***
T:F         0.822  2   1.3060 0.2834316
G:F        23.469 44   1.6943 0.0531910 .
R:T:G       8.778 12   2.3235 0.0253153 *
T:G:F      10.740 44   0.7753 0.7906401
Residuals  11.333 36
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.11 Example 8.1

(88) MODEL

```
ex8.1 = read.table("C:/G/Rt/Split/asbed.txt", header=TRUE)
ex8.1 = af(ex8.1, c("R", "A", "B"))
f8.1 = Y ~ R + A + R:A + B + B:R + A:B + A:B:R
GLM(f8.1, ex8.1)
```

```
$ANOVA
Response : Y
                 Df Sum Sq Mean Sq F value Pr(>F)
MODEL           104 3951.8  37.999
RESIDUALS         0    0.0
CORRECTED TOTAL 104 3951.8

$`Type I`
      Df  Sum Sq Mean Sq F value Pr(>F)
R      2 1787.68  893.84
A     12  601.24   50.10
R:A    6   24.93    4.16
B      8  156.87   19.61
R:B    4  319.87   79.97
A:B   60 1012.26   16.87
R:A:B 12   49.00    4.08

$`Type II`
      Df  Sum Sq Mean Sq F value Pr(>F)
R      2  372.22 186.111
A     12  601.24  50.103
R:A    6   50.00   8.333
B      8  156.87  19.609
```

```
R:B    4   87.44  21.861
A:B   60 1012.26  16.871
R:A:B 12   49.00   4.083

$`Type III`
      Df  Sum Sq Mean Sq F value Pr(>F)
R      2  372.22 186.111
A     12  572.31  47.692
R:A    6   50.00   8.333
B      8  185.85  23.231
R:B    4   87.44  21.861
A:B   60 1012.26  16.871
R:A:B 12   49.00   4.083

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)       34        Inf       0
R1               -10        Inf       0
R2               -10        Inf       0
R3                 0
A1               -19        Inf       0
A10              -24        Inf       0
A11              -20        Inf       0
A12              -19        Inf       0
A13              -20        Inf       0
A2               -20        Inf       0
A3               -19        Inf       0
A4               -16        Inf       0
A5               -16        Inf       0
A6               -12        Inf       0
A7               -20        Inf       0
A8                11        Inf       0
A9                 0
R1:A1              0
R1:A10             5        Inf       0
R1:A11             0        Inf       0
R1:A12             0        Inf       0
R1:A13             0
R1:A2              0
R1:A3              0
R1:A4              0
R1:A5              0
R1:A6              0
R1:A7              0
R1:A8              0
R1:A9              0
R2:A1              0
R2:A10             5        Inf       0
```

| | | | |
|---|---|---|---|
| R2:A11 | 0 | Inf | 0 |
| R2:A12 | 0 | Inf | 0 |
| R2:A13 | 0 | | |
| R2:A2 | 0 | | |
| R2:A3 | 0 | | |
| R2:A4 | 0 | | |
| R2:A5 | 0 | | |
| R2:A6 | 0 | | |
| R2:A7 | 0 | | |
| R2:A8 | 0 | | |
| R2:A9 | 0 | | |
| R3:A1 | 0 | | |
| R3:A10 | 0 | | |
| R3:A11 | 0 | | |
| R3:A12 | 0 | | |
| R3:A13 | 0 | | |
| R3:A2 | 0 | | |
| R3:A3 | 0 | | |
| R3:A4 | 0 | | |
| R3:A5 | 0 | | |
| R3:A6 | 0 | | |
| R3:A7 | 0 | | |
| R3:A8 | 0 | | |
| R3:A9 | 0 | | |
| B1 | 4 | Inf | 0 |
| B2 | -3 | Inf | 0 |
| B3 | -3 | Inf | 0 |
| B4 | -5 | Inf | 0 |
| B5 | -15 | Inf | 0 |
| B6 | -17 | Inf | 0 |
| B7 | -21 | Inf | 0 |
| B8 | -9 | Inf | 0 |
| B9 | 0 | | |
| R1:B1 | 0 | | |
| R1:B2 | 0 | | |
| R1:B3 | 0 | | |
| R1:B4 | 0 | | |
| R1:B5 | 0 | | |
| R1:B6 | 0 | | |
| R1:B7 | 0 | Inf | 0 |
| R1:B8 | 0 | Inf | 0 |
| R1:B9 | 0 | | |
| R2:B1 | 0 | | |
| R2:B2 | 0 | | |
| R2:B3 | 0 | | |
| R2:B4 | 0 | | |
| R2:B5 | 0 | | |
| R2:B6 | 0 | | |

| | | | |
|---|---|---|---|
| R2:B7 | 10 | Inf | 0 |
| R2:B8 | 0 | Inf | 0 |
| R2:B9 | 0 | | |
| R3:B1 | 0 | | |
| R3:B2 | 0 | | |
| R3:B3 | 0 | | |
| R3:B4 | 0 | | |
| R3:B5 | 0 | | |
| R3:B6 | 0 | | |
| R3:B7 | 0 | | |
| R3:B8 | 0 | | |
| R3:B9 | 0 | | |
| A1:B1 | 0 | Inf | 0 |
| A1:B2 | 0 | Inf | 0 |
| A1:B3 | 0 | | |
| A1:B4 | 0 | | |
| A1:B5 | 0 | | |
| A1:B6 | 0 | | |
| A1:B7 | 24 | Inf | 0 |
| A1:B8 | 11 | Inf | 0 |
| A1:B9 | 0 | | |
| A10:B1 | 0 | Inf | 0 |
| A10:B2 | -1 | Inf | 0 |
| A10:B3 | 7 | Inf | 0 |
| A10:B4 | 11 | Inf | 0 |
| A10:B5 | 20 | Inf | 0 |
| A10:B6 | 16 | Inf | 0 |
| A10:B7 | 22 | Inf | 0 |
| A10:B8 | 9 | Inf | 0 |
| A10:B9 | 0 | | |
| A11:B1 | 1 | Inf | 0 |
| A11:B2 | 6 | Inf | 0 |
| A11:B3 | 8 | Inf | 0 |
| A11:B4 | 8 | Inf | 0 |
| A11:B5 | 10 | Inf | 0 |
| A11:B6 | 20 | Inf | 0 |
| A11:B7 | 20 | Inf | 0 |
| A11:B8 | 10 | Inf | 0 |
| A11:B9 | 0 | | |
| A12:B1 | 0 | Inf | 0 |
| A12:B2 | 0 | Inf | 0 |
| A12:B3 | 7 | Inf | 0 |
| A12:B4 | 12 | Inf | 0 |
| A12:B5 | 9 | Inf | 0 |
| A12:B6 | 14 | Inf | 0 |
| A12:B7 | 14 | Inf | 0 |
| A12:B8 | 11 | Inf | 0 |
| A12:B9 | 0 | | |

| | | | |
|---|---|---|---|
| A13:B1 | 1 | Inf | 0 |
| A13:B2 | 6 | Inf | 0 |
| A13:B3 | 8 | Inf | 0 |
| A13:B4 | 8 | Inf | 0 |
| A13:B5 | 10 | Inf | 0 |
| A13:B6 | 20 | Inf | 0 |
| A13:B7 | 20 | Inf | 0 |
| A13:B8 | 10 | Inf | 0 |
| A13:B9 | 0 | | |
| A2:B1 | 1 | Inf | 0 |
| A2:B2 | 6 | Inf | 0 |
| A2:B3 | 0 | | |
| A2:B4 | 0 | | |
| A2:B5 | 0 | | |
| A2:B6 | 0 | | |
| A2:B7 | 20 | Inf | 0 |
| A2:B8 | 10 | Inf | 0 |
| A2:B9 | 0 | | |
| A3:B1 | 0 | | |
| A3:B2 | 0 | | |
| A3:B3 | 0 | | |
| A3:B4 | 0 | | |
| A3:B5 | 0 | | |
| A3:B6 | 0 | | |
| A3:B7 | 24 | Inf | 0 |
| A3:B8 | 11 | Inf | 0 |
| A3:B9 | 0 | | |
| A4:B1 | 0 | | |
| A4:B2 | 0 | | |
| A4:B3 | 4 | Inf | 0 |
| A4:B4 | 4 | Inf | 0 |
| A4:B5 | 0 | | |
| A4:B6 | 0 | | |
| A4:B7 | 16 | Inf | 0 |
| A4:B8 | 9 | Inf | 0 |
| A4:B9 | 0 | | |
| A5:B1 | 0 | | |
| A5:B2 | 0 | | |
| A5:B3 | 4 | Inf | 0 |
| A5:B4 | 9 | Inf | 0 |
| A5:B5 | 0 | | |
| A5:B6 | 0 | | |
| A5:B7 | 11 | Inf | 0 |
| A5:B8 | 8 | Inf | 0 |
| A5:B9 | 0 | | |
| A6:B1 | 0 | | |
| A6:B2 | 0 | | |
| A6:B3 | 0 | | |

| | | | |
|---|---|---|---|
| A6:B4 | 0 | | |
| A6:B5 | 0 | | |
| A6:B6 | 0 | | |
| A6:B7 | 12 | Inf | 0 |
| A6:B8 | 6 | Inf | 0 |
| A6:B9 | 0 | | |
| A7:B1 | 0 | | |
| A7:B2 | 0 | | |
| A7:B3 | 0 | | |
| A7:B4 | 0 | | |
| A7:B5 | 20 | Inf | 0 |
| A7:B6 | 20 | Inf | 0 |
| A7:B7 | 20 | Inf | 0 |
| A7:B8 | 10 | Inf | 0 |
| A7:B9 | 0 | | |
| A8:B1 | 0 | | |
| A8:B2 | 0 | | |
| A8:B3 | 0 | | |
| A8:B4 | 0 | | |
| A8:B5 | -11 | Inf | 0 |
| A8:B6 | -16 | Inf | 0 |
| A8:B7 | -6 | Inf | 0 |
| A8:B8 | -19 | Inf | 0 |
| A8:B9 | 0 | | |
| A9:B1 | 0 | | |
| A9:B2 | 0 | | |
| A9:B3 | 0 | | |
| A9:B4 | 0 | | |
| A9:B5 | 0 | | |
| A9:B6 | 0 | | |
| A9:B7 | 0 | | |
| A9:B8 | 0 | | |
| A9:B9 | 0 | | |
| R1:A1:B1 | 0 | | |
| R1:A1:B2 | 0 | | |
| R1:A1:B3 | 0 | | |
| R1:A1:B4 | 0 | | |
| R1:A1:B5 | 0 | | |
| R1:A1:B6 | 0 | | |
| R1:A1:B7 | 0 | | |
| R1:A1:B8 | 0 | | |
| R1:A1:B9 | 0 | | |
| R1:A10:B1 | 0 | | |
| R1:A10:B2 | 0 | | |
| R1:A10:B3 | 0 | | |
| R1:A10:B4 | 0 | | |
| R1:A10:B5 | 0 | | |
| R1:A10:B6 | 0 | | |

| | | | |
|---|---|---|---|
| R1:A10:B7 | 3 | Inf | 0 |
| R1:A10:B8 | 2 | Inf | 0 |
| R1:A10:B9 | 0 | | |
| R1:A11:B1 | 0 | | |
| R1:A11:B2 | 0 | | |
| R1:A11:B3 | 0 | | |
| R1:A11:B4 | 0 | | |
| R1:A11:B5 | 0 | | |
| R1:A11:B6 | 0 | | |
| R1:A11:B7 | 0 | Inf | 0 |
| R1:A11:B8 | 0 | Inf | 0 |
| R1:A11:B9 | 0 | | |
| R1:A12:B1 | 0 | | |
| R1:A12:B2 | 0 | | |
| R1:A12:B3 | 0 | | |
| R1:A12:B4 | 0 | | |
| R1:A12:B5 | 0 | | |
| R1:A12:B6 | 0 | | |
| R1:A12:B7 | 10 | Inf | 0 |
| R1:A12:B8 | 0 | Inf | 0 |
| R1:A12:B9 | 0 | | |
| R1:A13:B1 | 0 | | |
| R1:A13:B2 | 0 | | |
| R1:A13:B3 | 0 | | |
| R1:A13:B4 | 0 | | |
| R1:A13:B5 | 0 | | |
| R1:A13:B6 | 0 | | |
| R1:A13:B7 | 0 | | |
| R1:A13:B8 | 0 | | |
| R1:A13:B9 | 0 | | |
| R1:A2:B1 | 0 | | |
| R1:A2:B2 | 0 | | |
| R1:A2:B3 | 0 | | |
| R1:A2:B4 | 0 | | |
| R1:A2:B5 | 0 | | |
| R1:A2:B6 | 0 | | |
| R1:A2:B7 | 0 | | |
| R1:A2:B8 | 0 | | |
| R1:A2:B9 | 0 | | |
| R1:A3:B1 | 0 | | |
| R1:A3:B2 | 0 | | |
| R1:A3:B3 | 0 | | |
| R1:A3:B4 | 0 | | |
| R1:A3:B5 | 0 | | |
| R1:A3:B6 | 0 | | |
| R1:A3:B7 | 0 | | |
| R1:A3:B8 | 0 | | |
| R1:A3:B9 | 0 | | |

| | |
|---|---|
| R1:A4:B1 | 0 |
| R1:A4:B2 | 0 |
| R1:A4:B3 | 0 |
| R1:A4:B4 | 0 |
| R1:A4:B5 | 0 |
| R1:A4:B6 | 0 |
| R1:A4:B7 | 0 |
| R1:A4:B8 | 0 |
| R1:A4:B9 | 0 |
| R1:A5:B1 | 0 |
| R1:A5:B2 | 0 |
| R1:A5:B3 | 0 |
| R1:A5:B4 | 0 |
| R1:A5:B5 | 0 |
| R1:A5:B6 | 0 |
| R1:A5:B7 | 0 |
| R1:A5:B8 | 0 |
| R1:A5:B9 | 0 |
| R1:A6:B1 | 0 |
| R1:A6:B2 | 0 |
| R1:A6:B3 | 0 |
| R1:A6:B4 | 0 |
| R1:A6:B5 | 0 |
| R1:A6:B6 | 0 |
| R1:A6:B7 | 0 |
| R1:A6:B8 | 0 |
| R1:A6:B9 | 0 |
| R1:A7:B1 | 0 |
| R1:A7:B2 | 0 |
| R1:A7:B3 | 0 |
| R1:A7:B4 | 0 |
| R1:A7:B5 | 0 |
| R1:A7:B6 | 0 |
| R1:A7:B7 | 0 |
| R1:A7:B8 | 0 |
| R1:A7:B9 | 0 |
| R1:A8:B1 | 0 |
| R1:A8:B2 | 0 |
| R1:A8:B3 | 0 |
| R1:A8:B4 | 0 |
| R1:A8:B5 | 0 |
| R1:A8:B6 | 0 |
| R1:A8:B7 | 0 |
| R1:A8:B8 | 0 |
| R1:A8:B9 | 0 |
| R1:A9:B1 | 0 |
| R1:A9:B2 | 0 |
| R1:A9:B3 | 0 |

| | | | |
|---|---|---|---|
| R1:A9:B4 | 0 | | |
| R1:A9:B5 | 0 | | |
| R1:A9:B6 | 0 | | |
| R1:A9:B7 | 0 | | |
| R1:A9:B8 | 0 | | |
| R1:A9:B9 | 0 | | |
| R2:A1:B1 | 0 | | |
| R2:A1:B2 | 0 | | |
| R2:A1:B3 | 0 | | |
| R2:A1:B4 | 0 | | |
| R2:A1:B5 | 0 | | |
| R2:A1:B6 | 0 | | |
| R2:A1:B7 | 0 | | |
| R2:A1:B8 | 0 | | |
| R2:A1:B9 | 0 | | |
| R2:A10:B1 | 0 | | |
| R2:A10:B2 | 0 | | |
| R2:A10:B3 | 0 | | |
| R2:A10:B4 | 0 | | |
| R2:A10:B5 | 0 | | |
| R2:A10:B6 | 0 | | |
| R2:A10:B7 | -7 | Inf | 0 |
| R2:A10:B8 | 2 | Inf | 0 |
| R2:A10:B9 | 0 | | |
| R2:A11:B1 | 0 | | |
| R2:A11:B2 | 0 | | |
| R2:A11:B3 | 0 | | |
| R2:A11:B4 | 0 | | |
| R2:A11:B5 | 0 | | |
| R2:A11:B6 | 0 | | |
| R2:A11:B7 | 0 | Inf | 0 |
| R2:A11:B8 | 0 | Inf | 0 |
| R2:A11:B9 | 0 | | |
| R2:A12:B1 | 0 | | |
| R2:A12:B2 | 0 | | |
| R2:A12:B3 | 0 | | |
| R2:A12:B4 | 0 | | |
| R2:A12:B5 | 0 | | |
| R2:A12:B6 | 0 | | |
| R2:A12:B7 | 0 | Inf | 0 |
| R2:A12:B8 | 0 | Inf | 0 |
| R2:A12:B9 | 0 | | |
| R2:A13:B1 | 0 | | |
| R2:A13:B2 | 0 | | |
| R2:A13:B3 | 0 | | |
| R2:A13:B4 | 0 | | |
| R2:A13:B5 | 0 | | |
| R2:A13:B6 | 0 | | |

| | |
|---|---|
| R2:A13:B7 | 0 |
| R2:A13:B8 | 0 |
| R2:A13:B9 | 0 |
| R2:A2:B1 | 0 |
| R2:A2:B2 | 0 |
| R2:A2:B3 | 0 |
| R2:A2:B4 | 0 |
| R2:A2:B5 | 0 |
| R2:A2:B6 | 0 |
| R2:A2:B7 | 0 |
| R2:A2:B8 | 0 |
| R2:A2:B9 | 0 |
| R2:A3:B1 | 0 |
| R2:A3:B2 | 0 |
| R2:A3:B3 | 0 |
| R2:A3:B4 | 0 |
| R2:A3:B5 | 0 |
| R2:A3:B6 | 0 |
| R2:A3:B7 | 0 |
| R2:A3:B8 | 0 |
| R2:A3:B9 | 0 |
| R2:A4:B1 | 0 |
| R2:A4:B2 | 0 |
| R2:A4:B3 | 0 |
| R2:A4:B4 | 0 |
| R2:A4:B5 | 0 |
| R2:A4:B6 | 0 |
| R2:A4:B7 | 0 |
| R2:A4:B8 | 0 |
| R2:A4:B9 | 0 |
| R2:A5:B1 | 0 |
| R2:A5:B2 | 0 |
| R2:A5:B3 | 0 |
| R2:A5:B4 | 0 |
| R2:A5:B5 | 0 |
| R2:A5:B6 | 0 |
| R2:A5:B7 | 0 |
| R2:A5:B8 | 0 |
| R2:A5:B9 | 0 |
| R2:A6:B1 | 0 |
| R2:A6:B2 | 0 |
| R2:A6:B3 | 0 |
| R2:A6:B4 | 0 |
| R2:A6:B5 | 0 |
| R2:A6:B6 | 0 |
| R2:A6:B7 | 0 |
| R2:A6:B8 | 0 |
| R2:A6:B9 | 0 |

| | |
|---|---|
| R2:A7:B1 | 0 |
| R2:A7:B2 | 0 |
| R2:A7:B3 | 0 |
| R2:A7:B4 | 0 |
| R2:A7:B5 | 0 |
| R2:A7:B6 | 0 |
| R2:A7:B7 | 0 |
| R2:A7:B8 | 0 |
| R2:A7:B9 | 0 |
| R2:A8:B1 | 0 |
| R2:A8:B2 | 0 |
| R2:A8:B3 | 0 |
| R2:A8:B4 | 0 |
| R2:A8:B5 | 0 |
| R2:A8:B6 | 0 |
| R2:A8:B7 | 0 |
| R2:A8:B8 | 0 |
| R2:A8:B9 | 0 |
| R2:A9:B1 | 0 |
| R2:A9:B2 | 0 |
| R2:A9:B3 | 0 |
| R2:A9:B4 | 0 |
| R2:A9:B5 | 0 |
| R2:A9:B6 | 0 |
| R2:A9:B7 | 0 |
| R2:A9:B8 | 0 |
| R2:A9:B9 | 0 |
| R3:A1:B1 | 0 |
| R3:A1:B2 | 0 |
| R3:A1:B3 | 0 |
| R3:A1:B4 | 0 |
| R3:A1:B5 | 0 |
| R3:A1:B6 | 0 |
| R3:A1:B7 | 0 |
| R3:A1:B8 | 0 |
| R3:A1:B9 | 0 |
| R3:A10:B1 | 0 |
| R3:A10:B2 | 0 |
| R3:A10:B3 | 0 |
| R3:A10:B4 | 0 |
| R3:A10:B5 | 0 |
| R3:A10:B6 | 0 |
| R3:A10:B7 | 0 |
| R3:A10:B8 | 0 |
| R3:A10:B9 | 0 |
| R3:A11:B1 | 0 |
| R3:A11:B2 | 0 |
| R3:A11:B3 | 0 |

| | |
|---|---|
| R3:A11:B4 | 0 |
| R3:A11:B5 | 0 |
| R3:A11:B6 | 0 |
| R3:A11:B7 | 0 |
| R3:A11:B8 | 0 |
| R3:A11:B9 | 0 |
| R3:A12:B1 | 0 |
| R3:A12:B2 | 0 |
| R3:A12:B3 | 0 |
| R3:A12:B4 | 0 |
| R3:A12:B5 | 0 |
| R3:A12:B6 | 0 |
| R3:A12:B7 | 0 |
| R3:A12:B8 | 0 |
| R3:A12:B9 | 0 |
| R3:A13:B1 | 0 |
| R3:A13:B2 | 0 |
| R3:A13:B3 | 0 |
| R3:A13:B4 | 0 |
| R3:A13:B5 | 0 |
| R3:A13:B6 | 0 |
| R3:A13:B7 | 0 |
| R3:A13:B8 | 0 |
| R3:A13:B9 | 0 |
| R3:A2:B1 | 0 |
| R3:A2:B2 | 0 |
| R3:A2:B3 | 0 |
| R3:A2:B4 | 0 |
| R3:A2:B5 | 0 |
| R3:A2:B6 | 0 |
| R3:A2:B7 | 0 |
| R3:A2:B8 | 0 |
| R3:A2:B9 | 0 |
| R3:A3:B1 | 0 |
| R3:A3:B2 | 0 |
| R3:A3:B3 | 0 |
| R3:A3:B4 | 0 |
| R3:A3:B5 | 0 |
| R3:A3:B6 | 0 |
| R3:A3:B7 | 0 |
| R3:A3:B8 | 0 |
| R3:A3:B9 | 0 |
| R3:A4:B1 | 0 |
| R3:A4:B2 | 0 |
| R3:A4:B3 | 0 |
| R3:A4:B4 | 0 |
| R3:A4:B5 | 0 |
| R3:A4:B6 | 0 |

| | |
|---|---|
| R3:A4:B7 | 0 |
| R3:A4:B8 | 0 |
| R3:A4:B9 | 0 |
| R3:A5:B1 | 0 |
| R3:A5:B2 | 0 |
| R3:A5:B3 | 0 |
| R3:A5:B4 | 0 |
| R3:A5:B5 | 0 |
| R3:A5:B6 | 0 |
| R3:A5:B7 | 0 |
| R3:A5:B8 | 0 |
| R3:A5:B9 | 0 |
| R3:A6:B1 | 0 |
| R3:A6:B2 | 0 |
| R3:A6:B3 | 0 |
| R3:A6:B4 | 0 |
| R3:A6:B5 | 0 |
| R3:A6:B6 | 0 |
| R3:A6:B7 | 0 |
| R3:A6:B8 | 0 |
| R3:A6:B9 | 0 |
| R3:A7:B1 | 0 |
| R3:A7:B2 | 0 |
| R3:A7:B3 | 0 |
| R3:A7:B4 | 0 |
| R3:A7:B5 | 0 |
| R3:A7:B6 | 0 |
| R3:A7:B7 | 0 |
| R3:A7:B8 | 0 |
| R3:A7:B9 | 0 |
| R3:A8:B1 | 0 |
| R3:A8:B2 | 0 |
| R3:A8:B3 | 0 |
| R3:A8:B4 | 0 |
| R3:A8:B5 | 0 |
| R3:A8:B6 | 0 |
| R3:A8:B7 | 0 |
| R3:A8:B8 | 0 |
| R3:A8:B9 | 0 |
| R3:A9:B1 | 0 |
| R3:A9:B2 | 0 |
| R3:A9:B3 | 0 |
| R3:A9:B4 | 0 |
| R3:A9:B5 | 0 |
| R3:A9:B6 | 0 |
| R3:A9:B7 | 0 |
| R3:A9:B8 | 0 |
| R3:A9:B9 | 0 |

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(f8.1, ex8.1), type="III", singular.ok=TRUE)
```

### 7.12 Example 9.1

(89) MODEL

```
ex9.1 = read.table("C:/G/Rt/Split/Ex9.1-spex1.txt", header=TRUE)
ex9.1 = af(ex9.1, c("R", "A", "B"))
f9.1 = Y ~ R + A + R:A + B + A:B
GLM(f9.1, ex9.1)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           27 4920.8 182.251  10.594 5.927e-10 ***
RESIDUALS       34  584.9  17.203
CORRECTED TOTAL 61 5505.6
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3  218.7   72.89  4.2369   0.01199 *
A    3  194.9   64.96  3.7760   0.01930 *
R:A  9  186.9   20.76  1.2070   0.32287
B    3 4087.4 1362.47 79.2018 1.998e-15 ***
A:B  9  233.0   25.88  1.5047   0.18602
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3  157.8   52.61  3.0583   0.04134 *
A    3  227.2   75.73  4.4020   0.01014 *
R:A  9   94.5   10.50  0.6106   0.77932
B    3 4087.4 1362.47 79.2018 1.998e-15 ***
A:B  9  233.0   25.88  1.5047   0.18602
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value    Pr(>F)
R    3  171.0   57.01  3.3138   0.03143 *
A    3  209.7   69.92  4.0643   0.01431 *
R:A  9   94.5   10.50  0.6106   0.77932
```

```
B    3 4089.9 1363.29 79.2493 1.998e-15 ***
A:B  9  233.0   25.88  1.5047   0.18602
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   70.167     4.1476 16.9175 < 2.2e-16 ***
R1             4.417     3.7862  1.1665   0.25152
R2             7.692     3.7862  2.0315   0.05008 .
R3             3.492     3.7862  0.9222   0.36292
R4             0.000     0.0000
A1             3.390     4.9728  0.6816   0.50009
A2            -7.679     4.9728 -1.5442   0.13179
A3            -1.235     4.9728 -0.2484   0.80529
A4             0.000     0.0000
R1:A1         -1.717     4.7892 -0.3584   0.72223
R1:A2         -1.042     4.7892 -0.2175   0.82912
R1:A3         -1.467     4.7892 -0.3062   0.76129
R1:A4          0.000     0.0000
R2:A1         -8.992     4.7892 -1.8775   0.06905 .
R2:A2         -2.817     4.7892 -0.5881   0.56033
R2:A3         -4.142     4.7892 -0.8648   0.39322
R2:A4          0.000     0.0000
R3:A1         -5.217     4.7892 -1.0893   0.28370
R3:A2         -3.292     4.7892 -0.6873   0.49655
R3:A3         -4.317     4.7892 -0.9013   0.37375
R3:A4          0.000     0.0000
R4:A1          0.000     0.0000
R4:A2          0.000     0.0000
R4:A3          0.000     0.0000
R4:A4          0.000     0.0000
B1            -3.517     3.2790 -1.0725   0.29105
B2           -18.817     3.2790 -5.7386 1.882e-06 ***
B3            -2.100     3.3865 -0.6201   0.53932
B4             0.000     0.0000
A1:B1          5.417     4.3992  1.2313   0.22666
A1:B2         -2.558     4.3992 -0.5815   0.56471
A1:B3          0.850     4.4799  0.1897   0.85064
A1:B4          0.000     0.0000
A2:B1         11.217     4.3992  2.5497   0.01546 *
A2:B2          5.567     4.3992  1.2654   0.21434
A2:B3          5.500     4.4799  1.2277   0.22799
A2:B4          0.000     0.0000
A3:B1          0.492     4.3992  0.1118   0.91167
A3:B2         -1.083     4.3992 -0.2463   0.80696
A3:B3          3.000     4.4799  0.6697   0.50760
A3:B4          0.000     0.0000
```

```
A4:B1          0.000     0.0000
A4:B2          0.000     0.0000
A4:B3          0.000     0.0000
A4:B4          0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.13 Example 9.2

(90) MODEL

```
ex9.2 = read.table("C:/G/Rt/Split/Ex9.2-sbex.txt", header=TRUE)
ex9.2 = af(ex9.2, c("rep", "hyb", "gen"))
f9.2 = yield ~ rep + hyb + rep:hyb + gen + gen:rep + gen:hyb
GLM(f9.2, ex9.2)
```

```
$ANOVA
Response : yield
                Df  Sum Sq Mean Sq F value   Pr(>F)
MODEL           40 247.813  6.1953  4.4606 0.001119 **
RESIDUALS       16  22.222  1.3889
CORRECTED TOTAL 56 270.035
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
        Df Sum Sq Mean Sq F value    Pr(>F)
rep      1  0.239  0.2388  0.1719 0.6839085
hyb      9 66.796  7.4218  5.3437 0.0018370 **
rep:hyb  8 67.000  8.3750  6.0300 0.0011569 **
gen      2 36.351 18.1754 13.0863 0.0004293 ***
rep:gen  2 16.923  8.4616  6.0924 0.0107858 *
hyb:gen 18 60.504  3.3613  2.4201 0.0408545 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df Sum Sq Mean Sq F value    Pr(>F)
rep      1  0.167  0.1667  0.1200 0.7335481
hyb      9 66.796  7.4218  5.3437 0.0018370 **
rep:hyb  8 67.000  8.3750  6.0300 0.0011569 **
gen      2 36.351 18.1754 13.0863 0.0004293 ***
rep:gen  2 12.111  6.0556  4.3600 0.0308015 *
hyb:gen 18 60.504  3.3613  2.4201 0.0408545 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
        Df Sum Sq Mean Sq F value    Pr(>F)
rep      1  0.167  0.1667  0.1200 0.7335481
hyb      9 66.796  7.4218  5.3437 0.0018370 **
rep:hyb  8 67.000  8.3750  6.0300 0.0011569 **
gen      2 30.671 15.3356 11.0416 0.0009707 ***
rep:gen  2 12.111  6.0556  4.3600 0.0308015 *
hyb:gen 18 60.504  3.3613  2.4201 0.0408545 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   46.556    0.98862 47.0915 < 2.2e-16 ***
rep1           0.889    1.06381  0.8356  0.415699
rep2           0.000    0.00000
hyb0          -2.444    1.53826 -1.5891  0.131602
hyb1           2.667    1.36083  1.9596  0.067702 .
hyb2           1.000    1.36083  0.7348  0.473067
hyb3          -2.167    1.36083 -1.5922  0.130908
hyb4           1.000    1.36083  0.7348  0.473067
hyb5          -1.333    1.36083 -0.9798  0.341771
hyb6           1.500    1.36083  1.1023  0.286649
hyb7           4.500    1.36083  3.3068  0.004455 **
hyb8          -0.167    1.36083 -0.1225  0.904048
hyb9           0.000    0.00000
rep1:hyb0      0.000    0.00000
rep1:hyb1     -3.333    1.36083 -2.4495  0.026199 *
rep1:hyb2     -4.000    1.36083 -2.9394  0.009621 **
rep1:hyb3      0.333    1.36083  0.2449  0.809610
rep1:hyb4      0.000    1.36083  0.0000  1.000000
rep1:hyb5      2.667    1.36083  1.9596  0.067702 .
rep1:hyb6     -4.000    1.36083 -2.9394  0.009621 **
rep1:hyb7     -3.000    1.36083 -2.2045  0.042471 *
rep1:hyb8     -2.667    1.36083 -1.9596  0.067702 .
rep1:hyb9      0.000    0.00000
rep2:hyb0      0.000    0.00000
rep2:hyb1      0.000    0.00000
rep2:hyb2      0.000    0.00000
rep2:hyb3      0.000    0.00000
rep2:hyb4      0.000    0.00000
rep2:hyb5      0.000    0.00000
rep2:hyb6      0.000    0.00000
rep2:hyb7      0.000    0.00000
rep2:hyb8      0.000    0.00000
rep2:hyb9      0.000    0.00000
gen1          -3.056    1.24226 -2.4597  0.025671 *
gen2          -0.611    1.24226 -0.4919  0.629446
```

```
gen3           0.000    0.00000
rep1:gen1      2.111    0.78567  2.6870  0.016197 *
rep1:gen2      0.222    0.78567  0.2828  0.780924
rep1:gen3      0.000    0.00000
rep2:gen1      0.000    0.00000
rep2:gen2      0.000    0.00000
rep2:gen3      0.000    0.00000
hyb0:gen1      3.944    2.07870  1.8976  0.075951 .
hyb0:gen2      0.389    2.07870  0.1871  0.853947
hyb0:gen3      0.000    0.00000
hyb1:gen1     -3.000    1.66667 -1.8000  0.090743 .
hyb1:gen2     -4.000    1.66667 -2.4000  0.028919 *
hyb1:gen3      0.000    0.00000
hyb2:gen1      2.500    1.66667  1.5000  0.153088
hyb2:gen2     -2.500    1.66667 -1.5000  0.153088
hyb2:gen3      0.000    0.00000
hyb3:gen1      2.000    1.66667  1.2000  0.247607
hyb3:gen2     -0.500    1.66667 -0.3000  0.768040
hyb3:gen3      0.000    0.00000
hyb4:gen1     -2.000    1.66667 -1.2000  0.247607
hyb4:gen2     -1.000    1.66667 -0.6000  0.556909
hyb4:gen3      0.000    0.00000
hyb5:gen1      1.000    1.66667  0.6000  0.556909
hyb5:gen2      0.000    1.66667  0.0000  1.000000
hyb5:gen3      0.000    0.00000
hyb6:gen1     -1.000    1.66667 -0.6000  0.556909
hyb6:gen2     -0.500    1.66667 -0.3000  0.768040
hyb6:gen3      0.000    0.00000
hyb7:gen1     -0.500    1.66667 -0.3000  0.768040
hyb7:gen2     -2.000    1.66667 -1.2000  0.247607
hyb7:gen3      0.000    0.00000
hyb8:gen1      2.500    1.66667  1.5000  0.153088
hyb8:gen2     -2.000    1.66667 -1.2000  0.247607
hyb8:gen3      0.000    0.00000
hyb9:gen1      0.000    0.00000
hyb9:gen2      0.000    0.00000
hyb9:gen3      0.000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(f9.2, ex9.2), type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)
```

```
Response: yield
          Sum Sq Df F values    Pr(>F)
rep        0.000  0
hyb       66.704  8   6.0033 0.0011847 **
gen       30.671  2  11.0416 0.0009707 ***
rep:hyb   67.000  8   6.0300 0.0011569 **
rep:gen   12.111  2   4.3600 0.0308015 *
hyb:gen   60.504 18   2.4201 0.0408545 *
Residuals 22.222 16
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.14 Example 10.1

(91) MODEL

```
ex10.1 = read.table("C:/G/Rt/Split/Ex10.1-new.txt", header=TRUE)
ex10.1 = af(ex10.1, c("Site", "Block", "A", "B", "C"))
f10.1 = Yield ~ Site + Site + Site:Block + A + A:Site + B + B:Site + A:B +
        A:B:Site + A:B:Site:Block + C + A:C + B:C + A:B:C + C:Site + A:C:Site +
        B:C:Site + A:B:C:Site
GLM(f10.1, ex10.1)
```

```
$ANOVA
Response : Yield
                 Df     Sum Sq Mean Sq F value    Pr(>F)
MODEL           239 1639561484 6860090    2162 < 2.2e-16 ***
RESIDUALS       240     761522    3173
CORRECTED TOTAL 479 1640323006
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
               Df     Sum Sq   Mean Sq    F value  Pr(>F)
Site            3     552717    184239 5.8064e+01 < 2e-16 ***
Site:Block      8    7062320    882790 2.7822e+02 < 2e-16 ***
A               4 1387680917 346920229 1.0933e+05 < 2e-16 ***
Site:A         12      34068      2839 8.9470e-01 0.55301
B               1  100939695 100939695 3.1812e+04 < 2e-16 ***
Site:B          3       1618       539 1.6990e-01 0.91662
A:B             4   31444008   7861002 2.4775e+03 < 2e-16 ***
Site:A:B       12      33737      2811 8.8600e-01 0.56185
Site:Block:A:B 72     186911      2596 8.1810e-01 0.84155
C               3   19356264   6452088 2.0334e+03 < 2e-16 ***
A:C            12   26075792   2172983 6.8483e+02 < 2e-16 ***
B:C             3   23901387   7967129 2.5109e+03 < 2e-16 ***
```

```
A:B:C          12   41996729   3499727 1.1030e+03 < 2e-16 ***
Site:C          9      47625      5292 1.6677e+00 0.09747 .
Site:A:C       36     104110      2892 9.1140e-01 0.61768
Site:B:C        9      61111      6790 2.1400e+00 0.02701 *
Site:A:B:C     36      82475      2291 7.2200e-01 0.87941
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
               Df     Sum Sq   Mean Sq    F value  Pr(>F)
Site            3     552717    184239 5.8064e+01 < 2e-16 ***
Site:Block      8    7062320    882790 2.7822e+02 < 2e-16 ***
A               4 1387680917 346920229 1.0933e+05 < 2e-16 ***
Site:A         12      34068      2839 8.9470e-01 0.55301
B               1  100939695 100939695 3.1812e+04 < 2e-16 ***
Site:B          3       1618       539 1.6990e-01 0.91662
A:B             4   31444008   7861002 2.4775e+03 < 2e-16 ***
Site:A:B       12      33737      2811 8.8600e-01 0.56185
Site:Block:A:B 72     186911      2596 8.1810e-01 0.84155
C               3   19356264   6452088 2.0334e+03 < 2e-16 ***
A:C            12   26075792   2172983 6.8483e+02 < 2e-16 ***
B:C             3   23901388   7967129 2.5109e+03 < 2e-16 ***
A:B:C          12   41996729   3499727 1.1030e+03 < 2e-16 ***
Site:C          9      47625      5292 1.6677e+00 0.09747 .
Site:A:C       36     104110      2892 9.1140e-01 0.61768
Site:B:C        9      61111      6790 2.1400e+00 0.02701 *
Site:A:B:C     36      82475      2291 7.2200e-01 0.87941
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
               Df     Sum Sq   Mean Sq    F value  Pr(>F)
Site            3     552717    184239 5.8064e+01 < 2e-16 ***
Site:Block      8    7062320    882790 2.7822e+02 < 2e-16 ***
A               4 1387680917 346920229 1.0933e+05 < 2e-16 ***
Site:A         12      34068      2839 8.9470e-01 0.55301
B               1  100939695 100939695 3.1812e+04 < 2e-16 ***
Site:B          3       1618       539 1.6990e-01 0.91662
A:B             4   31444008   7861002 2.4775e+03 < 2e-16 ***
Site:A:B       12      33737      2811 8.8600e-01 0.56185
Site:Block:A:B 72     186911      2596 8.1810e-01 0.84155
C               3   19356264   6452088 2.0334e+03 < 2e-16 ***
A:C            12   26075792   2172983 6.8483e+02 < 2e-16 ***
B:C             3   23901388   7967129 2.5109e+03 < 2e-16 ***
A:B:C          12   41996729   3499727 1.1030e+03 < 2e-16 ***
Site:C          9      47625      5292 1.6677e+00 0.09747 .
Site:A:C       36     104110      2892 9.1140e-01 0.61768
Site:B:C        9      61111      6790 2.1400e+00 0.02701 *
```

```
Site:A:B:C     36      82475      2291 7.2200e-01 0.87941
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                     Estimate Std. Error   t value  Pr(>|t|)
(Intercept)           13608.3     39.831  341.6522 < 2.2e-16 ***
Site1                  -433.3     56.329   -7.6928 3.713e-13 ***
Site2                  -108.3     56.329   -1.9232  0.055637 .
Site3                  -116.7     56.329   -2.0711  0.039414 *
Site4                     0.0      0.000
Site1:BlockR1           175.0     39.831    4.3936 1.674e-05 ***
Site1:BlockR2           300.0     39.831    7.5318 1.013e-12 ***
Site1:BlockR3             0.0      0.000
Site2:BlockR1          -225.0     39.831   -5.6489 4.554e-08 ***
Site2:BlockR2          -375.0     39.831   -9.4148 < 2.2e-16 ***
Site2:BlockR3             0.0      0.000
Site3:BlockR1          -100.0     39.831   -2.5106  0.012711 *
Site3:BlockR2           -75.0     39.831   -1.8830  0.060916 .
Site3:BlockR3             0.0      0.000
Site4:BlockR1          -250.0     39.831   -6.2765 1.605e-09 ***
Site4:BlockR2          -275.0     39.831   -6.9042 4.483e-11 ***
Site4:BlockR3             0.0      0.000
AA1                   -5705.0     56.329 -101.2791 < 2.2e-16 ***
AA2                   -5020.2     56.329  -89.1230 < 2.2e-16 ***
AA3                   -3336.7     56.329  -59.2363 < 2.2e-16 ***
AA4                   -1241.7     56.329  -22.0429 < 2.2e-16 ***
AA5                       0.0      0.000
Site1:AA1                -2.4     79.662   -0.0303  0.975824
Site1:AA2                25.0     79.662    0.3138  0.753926
Site1:AA3               111.2     79.662    1.3965  0.163846
Site1:AA4               -16.7     79.662   -0.2092  0.834456
Site1:AA5                 0.0      0.000
Site2:AA1                91.2     79.662    1.1444  0.253590
Site2:AA2               132.4     79.662    1.6622  0.097771 .
Site2:AA3                30.7     79.662    0.3850  0.700608
Site2:AA4               -50.0     79.662   -0.6277  0.530828
Site2:AA5                 0.0      0.000
Site3:AA1                39.2     79.662    0.4917  0.623408
Site3:AA2                25.8     79.662    0.3243  0.746003
Site3:AA3               -38.3     79.662   -0.4802  0.631555
Site3:AA4               -41.7     79.662   -0.5230  0.601426
Site3:AA5                 0.0      0.000
Site4:AA1                 0.0      0.000
Site4:AA2                 0.0      0.000
Site4:AA3                 0.0      0.000
Site4:AA4                 0.0      0.000
Site4:AA5                 0.0      0.000
```

```
BB1                -1300.0     56.329  -23.0785 < 2.2e-16 ***
BB2                    0.0      0.000
Site1:BB1            -16.7     79.662   -0.2092  0.834456
Site1:BB2              0.0      0.000
Site2:BB1            100.0     79.662    1.2553  0.210589
Site2:BB2              0.0      0.000
Site3:BB1              0.0     79.662    0.0000  1.000000
Site3:BB2              0.0      0.000
Site4:BB1              0.0      0.000
Site4:BB2              0.0      0.000
AA1:BB1             1438.0     79.662   18.0513 < 2.2e-16 ***
AA1:BB2                0.0      0.000
AA2:BB1             1746.3     79.662   21.9218 < 2.2e-16 ***
AA2:BB2                0.0      0.000
AA3:BB1             2470.3     79.662   31.0102 < 2.2e-16 ***
AA3:BB2                0.0      0.000
AA4:BB1              -68.1     79.662   -0.8547  0.393595
AA4:BB2                0.0      0.000
AA5:BB1                0.0      0.000
AA5:BB2                0.0      0.000
Site1:AA1:BB1         54.5    112.659    0.4838  0.628997
Site1:AA1:BB2          0.0      0.000
Site1:AA2:BB1        -20.4    112.659   -0.1812  0.856344
Site1:AA2:BB2          0.0      0.000
Site1:AA3:BB1       -141.2    112.659   -1.2530  0.211409
Site1:AA3:BB2          0.0      0.000
Site1:AA4:BB1         45.6    112.659    0.4046  0.686122
Site1:AA4:BB2          0.0      0.000
Site1:AA5:BB1          0.0      0.000
Site1:AA5:BB2          0.0      0.000
Site2:AA1:BB1        -90.0    112.659   -0.7989  0.425155
Site2:AA1:BB2          0.0      0.000
Site2:AA2:BB1       -140.2    112.659   -1.2442  0.214651
Site2:AA2:BB2          0.0      0.000
Site2:AA3:BB1        -60.0    112.659   -0.5326  0.594816
Site2:AA3:BB2          0.0      0.000
Site2:AA4:BB1          3.5    112.659    0.0311  0.975242
Site2:AA4:BB2          0.0      0.000
Site2:AA5:BB1          0.0      0.000
Site2:AA5:BB2          0.0      0.000
Site3:AA1:BB1         12.4    112.659    0.1102  0.912331
Site3:AA1:BB2          0.0      0.000
Site3:AA2:BB1         39.4    112.659    0.3499  0.726739
Site3:AA2:BB2          0.0      0.000
Site3:AA3:BB1         49.8    112.659    0.4423  0.658643
Site3:AA3:BB2          0.0      0.000
Site3:AA4:BB1         32.7    112.659    0.2900  0.772097
Site3:AA4:BB2          0.0      0.000
```

| | | | | | |
|---|---|---|---|---|---|
| Site3:AA5:BB1 | 0.0 | 0.000 | | | |
| Site3:AA5:BB2 | 0.0 | 0.000 | | | |
| Site4:AA1:BB1 | 0.0 | 0.000 | | | |
| Site4:AA1:BB2 | 0.0 | 0.000 | | | |
| Site4:AA2:BB1 | 0.0 | 0.000 | | | |
| Site4:AA2:BB2 | 0.0 | 0.000 | | | |
| Site4:AA3:BB1 | 0.0 | 0.000 | | | |
| Site4:AA3:BB2 | 0.0 | 0.000 | | | |
| Site4:AA4:BB1 | 0.0 | 0.000 | | | |
| Site4:AA4:BB2 | 0.0 | 0.000 | | | |
| Site4:AA5:BB1 | 0.0 | 0.000 | | | |
| Site4:AA5:BB2 | 0.0 | 0.000 | | | |
| Site1:BlockR1:AA1:BB1 | 15.5 | 56.329 | 0.2752 | 0.783425 | |
| Site1:BlockR1:AA1:BB2 | -3.5 | 56.329 | -0.0621 | 0.950507 | |
| Site1:BlockR1:AA2:BB1 | 70.2 | 56.329 | 1.2471 | 0.213567 | |
| Site1:BlockR1:AA2:BB2 | 50.0 | 56.329 | 0.8876 | 0.375626 | |
| Site1:BlockR1:AA3:BB1 | 10.0 | 56.329 | 0.1775 | 0.859244 | |
| Site1:BlockR1:AA3:BB2 | -62.3 | 56.329 | -1.1051 | 0.270221 | |
| Site1:BlockR1:AA4:BB1 | 50.5 | 56.329 | 0.8965 | 0.370878 | |
| Site1:BlockR1:AA4:BB2 | 0.0 | 56.329 | 0.0000 | 1.000000 | |
| Site1:BlockR1:AA5:BB1 | 50.0 | 56.329 | 0.8876 | 0.375626 | |
| Site1:BlockR1:AA5:BB2 | 0.0 | 0.000 | | | |
| Site1:BlockR2:AA1:BB1 | 17.2 | 56.329 | 0.3062 | 0.759692 | |
| Site1:BlockR2:AA1:BB2 | 53.7 | 56.329 | 0.9542 | 0.340939 | |
| Site1:BlockR2:AA2:BB1 | 61.7 | 56.329 | 1.0962 | 0.274077 | |
| Site1:BlockR2:AA2:BB2 | 77.7 | 56.329 | 1.3803 | 0.168787 | |
| Site1:BlockR2:AA3:BB1 | 29.0 | 56.329 | 0.5148 | 0.607147 | |
| Site1:BlockR2:AA3:BB2 | -112.3 | 56.329 | -1.9927 | 0.047423 | * |
| Site1:BlockR2:AA4:BB1 | 42.0 | 56.329 | 0.7456 | 0.456631 | |
| Site1:BlockR2:AA4:BB2 | 75.0 | 56.329 | 1.3315 | 0.184303 | |
| Site1:BlockR2:AA5:BB1 | 0.0 | 56.329 | 0.0000 | 1.000000 | |
| Site1:BlockR2:AA5:BB2 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA1:BB1 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA1:BB2 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA2:BB1 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA2:BB2 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA3:BB1 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA3:BB2 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA4:BB1 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA4:BB2 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA5:BB1 | 0.0 | 0.000 | | | |
| Site1:BlockR3:AA5:BB2 | 0.0 | 0.000 | | | |
| Site2:BlockR1:AA1:BB1 | 35.7 | 56.329 | 0.6347 | 0.526255 | |
| Site2:BlockR1:AA1:BB2 | -32.3 | 56.329 | -0.5725 | 0.567503 | |
| Site2:BlockR1:AA2:BB1 | 68.5 | 56.329 | 1.2161 | 0.225157 | |
| Site2:BlockR1:AA2:BB2 | -37.5 | 56.329 | -0.6657 | 0.506225 | |
| Site2:BlockR1:AA3:BB1 | -11.0 | 56.329 | -0.1953 | 0.845339 | |
| Site2:BlockR1:AA3:BB2 | -30.3 | 56.329 | -0.5370 | 0.591752 | |

| | | | | |
|---|---|---|---|---|
| Site2:BlockR1:AA4:BB1 | 46.2 | 56.329 | 0.8211 | 0.412426 |
| Site2:BlockR1:AA4:BB2 | 25.0 | 56.329 | 0.4438 | 0.657574 |
| Site2:BlockR1:AA5:BB1 | 50.0 | 56.329 | 0.8876 | 0.375626 |
| Site2:BlockR1:AA5:BB2 | 0.0 | 0.000 | | |
| Site2:BlockR2:AA1:BB1 | 56.7 | 56.329 | 1.0075 | 0.314726 |
| Site2:BlockR2:AA1:BB2 | -22.3 | 56.329 | -0.3950 | 0.693196 |
| Site2:BlockR2:AA2:BB1 | 32.5 | 56.329 | 0.5770 | 0.564505 |
| Site2:BlockR2:AA2:BB2 | -60.0 | 56.329 | -1.0652 | 0.287873 |
| Site2:BlockR2:AA3:BB1 | -1.8 | 56.329 | -0.0311 | 0.975242 |
| Site2:BlockR2:AA3:BB2 | -42.5 | 56.329 | -0.7545 | 0.451295 |
| Site2:BlockR2:AA4:BB1 | 22.5 | 56.329 | 0.3994 | 0.689927 |
| Site2:BlockR2:AA4:BB2 | 50.0 | 56.329 | 0.8876 | 0.375626 |
| Site2:BlockR2:AA5:BB1 | 50.0 | 56.329 | 0.8876 | 0.375626 |
| Site2:BlockR2:AA5:BB2 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA1:BB1 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA1:BB2 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA2:BB1 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA2:BB2 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA3:BB1 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA3:BB2 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA4:BB1 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA4:BB2 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA5:BB1 | 0.0 | 0.000 | | |
| Site2:BlockR3:AA5:BB2 | 0.0 | 0.000 | | |
| Site3:BlockR1:AA1:BB1 | 17.2 | 56.329 | 0.3062 | 0.759692 |
| Site3:BlockR1:AA1:BB2 | -3.8 | 56.329 | -0.0666 | 0.946977 |
| Site3:BlockR1:AA2:BB1 | 4.2 | 56.329 | 0.0754 | 0.939920 |
| Site3:BlockR1:AA2:BB2 | -1.5 | 56.329 | -0.0266 | 0.978778 |
| Site3:BlockR1:AA3:BB1 | -13.0 | 56.329 | -0.2308 | 0.817678 |
| Site3:BlockR1:AA3:BB2 | 50.0 | 56.329 | 0.8876 | 0.375626 |
| Site3:BlockR1:AA4:BB1 | -18.0 | 56.329 | -0.3195 | 0.749589 |
| Site3:BlockR1:AA4:BB2 | 25.0 | 56.329 | 0.4438 | 0.657574 |
| Site3:BlockR1:AA5:BB1 | 0.0 | 56.329 | 0.0000 | 1.000000 |
| Site3:BlockR1:AA5:BB2 | 0.0 | 0.000 | | |
| Site3:BlockR2:AA1:BB1 | 21.0 | 56.329 | 0.3728 | 0.709621 |
| Site3:BlockR2:AA1:BB2 | 15.2 | 56.329 | 0.2707 | 0.786832 |
| Site3:BlockR2:AA2:BB1 | -5.3 | 56.329 | -0.0932 | 0.925821 |
| Site3:BlockR2:AA2:BB2 | 15.7 | 56.329 | 0.2796 | 0.780021 |
| Site3:BlockR2:AA3:BB1 | -22.5 | 56.329 | -0.3994 | 0.689927 |
| Site3:BlockR2:AA3:BB2 | 75.0 | 56.329 | 1.3315 | 0.184303 |
| Site3:BlockR2:AA4:BB1 | -25.8 | 56.329 | -0.4571 | 0.647990 |
| Site3:BlockR2:AA4:BB2 | 25.0 | 56.329 | 0.4438 | 0.657574 |
| Site3:BlockR2:AA5:BB1 | 0.0 | 56.329 | 0.0000 | 1.000000 |
| Site3:BlockR2:AA5:BB2 | 0.0 | 0.000 | | |
| Site3:BlockR3:AA1:BB1 | 0.0 | 0.000 | | |
| Site3:BlockR3:AA1:BB2 | 0.0 | 0.000 | | |
| Site3:BlockR3:AA2:BB1 | 0.0 | 0.000 | | |
| Site3:BlockR3:AA2:BB2 | 0.0 | 0.000 | | |

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Site3:BlockR3:AA3:BB1      0.0      0.000
Site3:BlockR3:AA3:BB2      0.0      0.000
Site3:BlockR3:AA4:BB1      0.0      0.000
Site3:BlockR3:AA4:BB2      0.0      0.000
Site3:BlockR3:AA5:BB1      0.0      0.000
Site3:BlockR3:AA5:BB2      0.0      0.000
Site4:BlockR1:AA1:BB1     38.7     56.329    0.6879  0.492169
Site4:BlockR1:AA1:BB2      6.5     56.329    0.1154  0.908230
Site4:BlockR1:AA2:BB1     17.5     56.329    0.3107  0.756319
Site4:BlockR1:AA2:BB2    -13.0     56.329   -0.2308  0.817678
Site4:BlockR1:AA3:BB1     61.5     56.329    1.0918  0.276020
Site4:BlockR1:AA3:BB2    -32.3     56.329   -0.5725  0.567503
Site4:BlockR1:AA4:BB1     33.0     56.329    0.5858  0.558534
Site4:BlockR1:AA4:BB2     25.0     56.329    0.4438  0.657574
Site4:BlockR1:AA5:BB1     75.0     56.329    1.3315  0.184303
Site4:BlockR1:AA5:BB2      0.0      0.000
Site4:BlockR2:AA1:BB1    -69.8     56.329   -1.2383  0.216833
Site4:BlockR2:AA1:BB2    -36.5     56.329   -0.6480  0.517622
Site4:BlockR2:AA2:BB1    -53.8     56.329   -0.9542  0.340939
Site4:BlockR2:AA2:BB2    -14.3     56.329   -0.2530  0.800503
Site4:BlockR2:AA3:BB1    -62.3     56.329   -1.1051  0.270221
Site4:BlockR2:AA3:BB2   -104.5     56.329   -1.8552  0.064800 .
Site4:BlockR2:AA4:BB1     -3.8     56.329   -0.0666  0.946977
Site4:BlockR2:AA4:BB2      0.0     56.329    0.0000  1.000000
Site4:BlockR2:AA5:BB1     25.0     56.329    0.4438  0.657574
Site4:BlockR2:AA5:BB2      0.0      0.000
Site4:BlockR3:AA1:BB1      0.0      0.000
Site4:BlockR3:AA1:BB2      0.0      0.000
Site4:BlockR3:AA2:BB1      0.0      0.000
Site4:BlockR3:AA2:BB2      0.0      0.000
Site4:BlockR3:AA3:BB1      0.0      0.000
Site4:BlockR3:AA3:BB2      0.0      0.000
Site4:BlockR3:AA4:BB1      0.0      0.000
Site4:BlockR3:AA4:BB2      0.0      0.000
Site4:BlockR3:AA5:BB1      0.0      0.000
Site4:BlockR3:AA5:BB2      0.0      0.000
CC1                    -1066.7     45.993  -23.1920 < 2.2e-16 ***
CC2                     -733.3     45.993  -15.9445 < 2.2e-16 ***
CC3                     -533.3     45.993  -11.5960 < 2.2e-16 ***
CC4                        0.0      0.000
AA1:CC1                 1551.3     65.044   23.8506 < 2.2e-16 ***
AA1:CC2                  137.7     65.044    2.1165  0.035330 *
AA1:CC3                  201.0     65.044    3.0902  0.002236 **
AA1:CC4                    0.0      0.000
AA2:CC1                 1877.7     65.044   28.8678 < 2.2e-16 ***
AA2:CC2                 1858.7     65.044   28.5757 < 2.2e-16 ***
AA2:CC3                 1936.7     65.044   29.7749 < 2.2e-16 ***
AA2:CC4                    0.0      0.000
```

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AA3:CC1                1915.7     65.044   29.4520 < 2.2e-16 ***
AA3:CC2                1315.7     65.044   20.2274 < 2.2e-16 ***
AA3:CC3                 815.7     65.044   12.5403 < 2.2e-16 ***
AA3:CC4                   0.0      0.000
AA4:CC1                 -66.7     65.044   -1.0250  0.306418
AA4:CC2                1200.0     65.044   18.4491 < 2.2e-16 ***
AA4:CC3                 833.3     65.044   12.8119 < 2.2e-16 ***
AA4:CC4                   0.0      0.000
AA5:CC1                   0.0      0.000
AA5:CC2                   0.0      0.000
AA5:CC3                   0.0      0.000
AA5:CC4                   0.0      0.000
BB1:CC1                 733.3     65.044   11.2745 < 2.2e-16 ***
BB1:CC2                 166.7     65.044    2.5624  0.011007 *
BB1:CC3                 200.0     65.044    3.0749  0.002350 **
BB1:CC4                   0.0      0.000
BB2:CC1                   0.0      0.000
BB2:CC2                   0.0      0.000
BB2:CC3                   0.0      0.000
BB2:CC4                   0.0      0.000
AA1:BB1:CC1           -2102.0     91.986  -22.8514 < 2.2e-16 ***
AA1:BB1:CC2            -122.3     91.986   -1.3299  0.184808
AA1:BB1:CC3            -116.7     91.986   -1.2683  0.205915
AA1:BB1:CC4               0.0      0.000
AA1:BB2:CC1               0.0      0.000
AA1:BB2:CC2               0.0      0.000
AA1:BB2:CC3               0.0      0.000
AA1:BB2:CC4               0.0      0.000
AA2:BB1:CC1           -2365.3     91.986  -25.7142 < 2.2e-16 ***
AA2:BB1:CC2           -1887.7     91.986  -20.5213 < 2.2e-16 ***
AA2:BB1:CC3           -1849.3     91.986  -20.1046 < 2.2e-16 ***
AA2:BB1:CC4               0.0      0.000
AA2:BB2:CC1               0.0      0.000
AA2:BB2:CC2               0.0      0.000
AA2:BB2:CC3               0.0      0.000
AA2:BB2:CC4               0.0      0.000
AA3:BB1:CC1           -4088.7     91.986  -44.4490 < 2.2e-16 ***
AA3:BB1:CC2           -2939.3     91.986  -31.9543 < 2.2e-16 ***
AA3:BB1:CC3           -2384.3     91.986  -25.9207 < 2.2e-16 ***
AA3:BB1:CC4               0.0      0.000
AA3:BB2:CC1               0.0      0.000
AA3:BB2:CC2               0.0      0.000
AA3:BB2:CC3               0.0      0.000
AA3:BB2:CC4               0.0      0.000
AA4:BB1:CC1            -561.0     91.986   -6.0988 4.243e-09 ***
AA4:BB1:CC2           -1233.3     91.986  -13.4079 < 2.2e-16 ***
AA4:BB1:CC3            -833.3     91.986   -9.0594 < 2.2e-16 ***
AA4:BB1:CC4               0.0      0.000
```

| | | | | | |
|---|---|---|---|---|---|
| AA4:BB2:CC1 | 0.0 | 0.000 | | | |
| AA4:BB2:CC2 | 0.0 | 0.000 | | | |
| AA4:BB2:CC3 | 0.0 | 0.000 | | | |
| AA4:BB2:CC4 | 0.0 | 0.000 | | | |
| AA5:BB1:CC1 | 0.0 | 0.000 | | | |
| AA5:BB1:CC2 | 0.0 | 0.000 | | | |
| AA5:BB1:CC3 | 0.0 | 0.000 | | | |
| AA5:BB1:CC4 | 0.0 | 0.000 | | | |
| AA5:BB2:CC1 | 0.0 | 0.000 | | | |
| AA5:BB2:CC2 | 0.0 | 0.000 | | | |
| AA5:BB2:CC3 | 0.0 | 0.000 | | | |
| AA5:BB2:CC4 | 0.0 | 0.000 | | | |
| Site1:CC1 | 100.0 | 65.044 | 1.5374 | 0.125506 | |
| Site1:CC2 | 33.3 | 65.044 | 0.5125 | 0.608789 | |
| Site1:CC3 | 0.0 | 65.044 | 0.0000 | 1.000000 | |
| Site1:CC4 | 0.0 | 0.000 | | | |
| Site2:CC1 | 133.3 | 65.044 | 2.0499 | 0.041461 | * |
| Site2:CC2 | 133.3 | 65.044 | 2.0499 | 0.041461 | * |
| Site2:CC3 | 66.7 | 65.044 | 1.0250 | 0.306418 | |
| Site2:CC4 | 0.0 | 0.000 | | | |
| Site3:CC1 | 66.7 | 65.044 | 1.0250 | 0.306418 | |
| Site3:CC2 | 0.0 | 65.044 | 0.0000 | 1.000000 | |
| Site3:CC3 | 0.0 | 65.044 | 0.0000 | 1.000000 | |
| Site3:CC4 | 0.0 | 0.000 | | | |
| Site4:CC1 | 0.0 | 0.000 | | | |
| Site4:CC2 | 0.0 | 0.000 | | | |
| Site4:CC3 | 0.0 | 0.000 | | | |
| Site4:CC4 | 0.0 | 0.000 | | | |
| Site1:AA1:CC1 | -136.7 | 91.986 | -1.4857 | 0.138660 | |
| Site1:AA1:CC2 | -33.7 | 91.986 | -0.3660 | 0.714688 | |
| Site1:AA1:CC3 | 39.0 | 91.986 | 0.4240 | 0.671961 | |
| Site1:AA1:CC4 | 0.0 | 0.000 | | | |
| Site1:AA2:CC1 | -173.3 | 91.986 | -1.8844 | 0.060726 | . |
| Site1:AA2:CC2 | -174.3 | 91.986 | -1.8952 | 0.059265 | . |
| Site1:AA2:CC3 | 0.7 | 91.986 | 0.0072 | 0.994223 | |
| Site1:AA2:CC4 | 0.0 | 0.000 | | | |
| Site1:AA3:CC1 | -198.7 | 91.986 | -2.1598 | 0.031782 | * |
| Site1:AA3:CC2 | -132.0 | 91.986 | -1.4350 | 0.152587 | |
| Site1:AA3:CC3 | -65.3 | 91.986 | -0.7103 | 0.478235 | |
| Site1:AA3:CC4 | 0.0 | 0.000 | | | |
| Site1:AA4:CC1 | -33.3 | 91.986 | -0.3624 | 0.717390 | |
| Site1:AA4:CC2 | 0.0 | 91.986 | 0.0000 | 1.000000 | |
| Site1:AA4:CC3 | 0.0 | 91.986 | 0.0000 | 1.000000 | |
| Site1:AA4:CC4 | 0.0 | 0.000 | | | |
| Site1:AA5:CC1 | 0.0 | 0.000 | | | |
| Site1:AA5:CC2 | 0.0 | 0.000 | | | |
| Site1:AA5:CC3 | 0.0 | 0.000 | | | |
| Site1:AA5:CC4 | 0.0 | 0.000 | | | |

| | | | | | |
|---|---|---|---|---|---|
| Site2:AA1:CC1 | -180.3 | 91.986 | -1.9605 | 0.051100 | . |
| Site2:AA1:CC2 | -81.3 | 91.986 | -0.8842 | 0.377475 | |
| Site2:AA1:CC3 | -47.0 | 91.986 | -0.5109 | 0.609856 | |
| Site2:AA1:CC4 | 0.0 | 0.000 | | | |
| Site2:AA2:CC1 | -196.7 | 91.986 | -2.1380 | 0.033526 | * |
| Site2:AA2:CC2 | -179.3 | 91.986 | -1.9496 | 0.052391 | . |
| Site2:AA2:CC3 | -124.7 | 91.986 | -1.3553 | 0.176601 | |
| Site2:AA2:CC4 | 0.0 | 0.000 | | | |
| Site2:AA3:CC1 | -85.3 | 91.986 | -0.9277 | 0.354505 | |
| Site2:AA3:CC2 | -85.3 | 91.986 | -0.9277 | 0.354505 | |
| Site2:AA3:CC3 | -52.0 | 91.986 | -0.5653 | 0.572394 | |
| Site2:AA3:CC4 | 0.0 | 0.000 | | | |
| Site2:AA4:CC1 | -33.3 | 91.986 | -0.3624 | 0.717390 | |
| Site2:AA4:CC2 | 0.0 | 91.986 | 0.0000 | 1.000000 | |
| Site2:AA4:CC3 | 33.3 | 91.986 | 0.3624 | 0.717390 | |
| Site2:AA4:CC4 | 0.0 | 0.000 | | | |
| Site2:AA5:CC1 | 0.0 | 0.000 | | | |
| Site2:AA5:CC2 | 0.0 | 0.000 | | | |
| Site2:AA5:CC3 | 0.0 | 0.000 | | | |
| Site2:AA5:CC4 | 0.0 | 0.000 | | | |
| Site3:AA1:CC1 | -138.7 | 91.986 | -1.5075 | 0.133002 | |
| Site3:AA1:CC2 | -83.0 | 91.986 | -0.9023 | 0.367794 | |
| Site3:AA1:CC3 | -104.0 | 91.986 | -1.1306 | 0.259347 | |
| Site3:AA1:CC4 | 0.0 | 0.000 | | | |
| Site3:AA2:CC1 | -61.7 | 91.986 | -0.6704 | 0.503251 | |
| Site3:AA2:CC2 | -71.7 | 91.986 | -0.7791 | 0.436684 | |
| Site3:AA2:CC3 | -68.0 | 91.986 | -0.7392 | 0.460480 | |
| Site3:AA2:CC4 | 0.0 | 0.000 | | | |
| Site3:AA3:CC1 | -115.7 | 91.986 | -1.2574 | 0.209816 | |
| Site3:AA3:CC2 | -15.7 | 91.986 | -0.1703 | 0.864905 | |
| Site3:AA3:CC3 | -15.7 | 91.986 | -0.1703 | 0.864905 | |
| Site3:AA3:CC4 | 0.0 | 0.000 | | | |
| Site3:AA4:CC1 | 33.3 | 91.986 | 0.3624 | 0.717390 | |
| Site3:AA4:CC2 | 0.0 | 91.986 | 0.0000 | 1.000000 | |
| Site3:AA4:CC3 | 33.3 | 91.986 | 0.3624 | 0.717390 | |
| Site3:AA4:CC4 | 0.0 | 0.000 | | | |
| Site3:AA5:CC1 | 0.0 | 0.000 | | | |
| Site3:AA5:CC2 | 0.0 | 0.000 | | | |
| Site3:AA5:CC3 | 0.0 | 0.000 | | | |
| Site3:AA5:CC4 | 0.0 | 0.000 | | | |
| Site4:AA1:CC1 | 0.0 | 0.000 | | | |
| Site4:AA1:CC2 | 0.0 | 0.000 | | | |
| Site4:AA1:CC3 | 0.0 | 0.000 | | | |
| Site4:AA1:CC4 | 0.0 | 0.000 | | | |
| Site4:AA2:CC1 | 0.0 | 0.000 | | | |
| Site4:AA2:CC2 | 0.0 | 0.000 | | | |
| Site4:AA2:CC3 | 0.0 | 0.000 | | | |
| Site4:AA2:CC4 | 0.0 | 0.000 | | | |

| | | | | | |
|---|---|---|---|---|---|
| Site4:AA3:CC1 | 0.0 | 0.000 | | | |
| Site4:AA3:CC2 | 0.0 | 0.000 | | | |
| Site4:AA3:CC3 | 0.0 | 0.000 | | | |
| Site4:AA3:CC4 | 0.0 | 0.000 | | | |
| Site4:AA4:CC1 | 0.0 | 0.000 | | | |
| Site4:AA4:CC2 | 0.0 | 0.000 | | | |
| Site4:AA4:CC3 | 0.0 | 0.000 | | | |
| Site4:AA4:CC4 | 0.0 | 0.000 | | | |
| Site4:AA5:CC1 | 0.0 | 0.000 | | | |
| Site4:AA5:CC2 | 0.0 | 0.000 | | | |
| Site4:AA5:CC3 | 0.0 | 0.000 | | | |
| Site4:AA5:CC4 | 0.0 | 0.000 | | | |
| Site1:BB1:CC1 | 0.0 | 91.986 | 0.0000 | 1.000000 | |
| Site1:BB1:CC2 | 33.3 | 91.986 | 0.3624 | 0.717390 | |
| Site1:BB1:CC3 | 33.3 | 91.986 | 0.3624 | 0.717390 | |
| Site1:BB1:CC4 | 0.0 | 0.000 | | | |
| Site1:BB2:CC1 | 0.0 | 0.000 | | | |
| Site1:BB2:CC2 | 0.0 | 0.000 | | | |
| Site1:BB2:CC3 | 0.0 | 0.000 | | | |
| Site1:BB2:CC4 | 0.0 | 0.000 | | | |
| Site2:BB1:CC1 | -166.7 | 91.986 | -1.8119 | 0.071255 | . |
| Site2:BB1:CC2 | -200.0 | 91.986 | -2.1743 | 0.030664 | * |
| Site2:BB1:CC3 | -233.3 | 91.986 | -2.5366 | 0.011827 | * |
| Site2:BB1:CC4 | 0.0 | 0.000 | | | |
| Site2:BB2:CC1 | 0.0 | 0.000 | | | |
| Site2:BB2:CC2 | 0.0 | 0.000 | | | |
| Site2:BB2:CC3 | 0.0 | 0.000 | | | |
| Site2:BB2:CC4 | 0.0 | 0.000 | | | |
| Site3:BB1:CC1 | 33.3 | 91.986 | 0.3624 | 0.717390 | |
| Site3:BB1:CC2 | 33.3 | 91.986 | 0.3624 | 0.717390 | |
| Site3:BB1:CC3 | -66.7 | 91.986 | -0.7248 | 0.469311 | |
| Site3:BB1:CC4 | 0.0 | 0.000 | | | |
| Site3:BB2:CC1 | 0.0 | 0.000 | | | |
| Site3:BB2:CC2 | 0.0 | 0.000 | | | |
| Site3:BB2:CC3 | 0.0 | 0.000 | | | |
| Site3:BB2:CC4 | 0.0 | 0.000 | | | |
| Site4:BB1:CC1 | 0.0 | 0.000 | | | |
| Site4:BB1:CC2 | 0.0 | 0.000 | | | |
| Site4:BB1:CC3 | 0.0 | 0.000 | | | |
| Site4:BB1:CC4 | 0.0 | 0.000 | | | |
| Site4:BB2:CC1 | 0.0 | 0.000 | | | |
| Site4:BB2:CC2 | 0.0 | 0.000 | | | |
| Site4:BB2:CC3 | 0.0 | 0.000 | | | |
| Site4:BB2:CC4 | 0.0 | 0.000 | | | |
| Site1:AA1:BB1:CC1 | 76.3 | 130.087 | 0.5868 | 0.557899 | |
| Site1:AA1:BB1:CC2 | -48.0 | 130.087 | -0.3690 | 0.712466 | |
| Site1:AA1:BB1:CC3 | -105.3 | 130.087 | -0.8097 | 0.418908 | |
| Site1:AA1:BB1:CC4 | 0.0 | 0.000 | | | |

| | | | | | |
|---|---|---|---|---|---|
| Site1:AA1:BB2:CC1 | 0.0 | 0.000 | | | |
| Site1:AA1:BB2:CC2 | 0.0 | 0.000 | | | |
| Site1:AA1:BB2:CC3 | 0.0 | 0.000 | | | |
| Site1:AA1:BB2:CC4 | 0.0 | 0.000 | | | |
| Site1:AA2:BB1:CC1 | 12.3 | 130.087 | 0.0948 | 0.924546 | |
| Site1:AA2:BB1:CC2 | 120.0 | 130.087 | 0.9225 | 0.357217 | |
| Site1:AA2:BB1:CC3 | -23.7 | 130.087 | -0.1819 | 0.855792 | |
| Site1:AA2:BB1:CC4 | 0.0 | 0.000 | | | |
| Site1:AA2:BB2:CC1 | 0.0 | 0.000 | | | |
| Site1:AA2:BB2:CC2 | 0.0 | 0.000 | | | |
| Site1:AA2:BB2:CC3 | 0.0 | 0.000 | | | |
| Site1:AA2:BB2:CC4 | 0.0 | 0.000 | | | |
| Site1:AA3:BB1:CC1 | 202.7 | 130.087 | 1.5579 | 0.120568 | |
| Site1:AA3:BB1:CC2 | 100.3 | 130.087 | 0.7713 | 0.441302 | |
| Site1:AA3:BB1:CC3 | 29.7 | 130.087 | 0.2281 | 0.819800 | |
| Site1:AA3:BB1:CC4 | 0.0 | 0.000 | | | |
| Site1:AA3:BB2:CC1 | 0.0 | 0.000 | | | |
| Site1:AA3:BB2:CC2 | 0.0 | 0.000 | | | |
| Site1:AA3:BB2:CC3 | 0.0 | 0.000 | | | |
| Site1:AA3:BB2:CC4 | 0.0 | 0.000 | | | |
| Site1:AA4:BB1:CC1 | -13.7 | 130.087 | -0.1051 | 0.916418 | |
| Site1:AA4:BB1:CC2 | -70.0 | 130.087 | -0.5381 | 0.591007 | |
| Site1:AA4:BB1:CC3 | -66.7 | 130.087 | -0.5125 | 0.608789 | |
| Site1:AA4:BB1:CC4 | 0.0 | 0.000 | | | |
| Site1:AA4:BB2:CC1 | 0.0 | 0.000 | | | |
| Site1:AA4:BB2:CC2 | 0.0 | 0.000 | | | |
| Site1:AA4:BB2:CC3 | 0.0 | 0.000 | | | |
| Site1:AA4:BB2:CC4 | 0.0 | 0.000 | | | |
| Site1:AA5:BB1:CC1 | 0.0 | 0.000 | | | |
| Site1:AA5:BB1:CC2 | 0.0 | 0.000 | | | |
| Site1:AA5:BB1:CC3 | 0.0 | 0.000 | | | |
| Site1:AA5:BB1:CC4 | 0.0 | 0.000 | | | |
| Site1:AA5:BB2:CC1 | 0.0 | 0.000 | | | |
| Site1:AA5:BB2:CC2 | 0.0 | 0.000 | | | |
| Site1:AA5:BB2:CC3 | 0.0 | 0.000 | | | |
| Site1:AA5:BB2:CC4 | 0.0 | 0.000 | | | |
| Site2:AA1:BB1:CC1 | 215.3 | 130.087 | 1.6553 | 0.099171 | . |
| Site2:AA1:BB1:CC2 | 92.7 | 130.087 | 0.7123 | 0.476945 | |
| Site2:AA1:BB1:CC3 | 122.0 | 130.087 | 0.9378 | 0.349274 | |
| Site2:AA1:BB1:CC4 | 0.0 | 0.000 | | | |
| Site2:AA1:BB2:CC1 | 0.0 | 0.000 | | | |
| Site2:AA1:BB2:CC2 | 0.0 | 0.000 | | | |
| Site2:AA1:BB2:CC3 | 0.0 | 0.000 | | | |
| Site2:AA1:BB2:CC4 | 0.0 | 0.000 | | | |
| Site2:AA2:BB1:CC1 | 143.0 | 130.087 | 1.0993 | 0.272755 | |
| Site2:AA2:BB1:CC2 | 186.0 | 130.087 | 1.4298 | 0.154072 | |
| Site2:AA2:BB1:CC3 | 288.7 | 130.087 | 2.2190 | 0.027421 | * |
| Site2:AA2:BB1:CC4 | 0.0 | 0.000 | | | |

| | | | | |
|---|---|---|---|---|
| Site2:AA2:BB2:CC1 | 0.0 | 0.000 | | |
| Site2:AA2:BB2:CC2 | 0.0 | 0.000 | | |
| Site2:AA2:BB2:CC3 | 0.0 | 0.000 | | |
| Site2:AA2:BB2:CC4 | 0.0 | 0.000 | | |
| Site2:AA3:BB1:CC1 | 195.7 | 130.087 | 1.5041 | 0.133866 |
| Site2:AA3:BB1:CC2 | 143.0 | 130.087 | 1.0993 | 0.272755 |
| Site2:AA3:BB1:CC3 | 203.3 | 130.087 | 1.5631 | 0.119358 |
| Site2:AA3:BB1:CC4 | 0.0 | 0.000 | | |
| Site2:AA3:BB2:CC1 | 0.0 | 0.000 | | |
| Site2:AA3:BB2:CC2 | 0.0 | 0.000 | | |
| Site2:AA3:BB2:CC3 | 0.0 | 0.000 | | |
| Site2:AA3:BB2:CC4 | 0.0 | 0.000 | | |
| Site2:AA4:BB1:CC1 | 136.3 | 130.087 | 1.0480 | 0.295686 |
| Site2:AA4:BB1:CC2 | 59.0 | 130.087 | 0.4535 | 0.650569 |
| Site2:AA4:BB1:CC3 | 66.7 | 130.087 | 0.5125 | 0.608789 |
| Site2:AA4:BB1:CC4 | 0.0 | 0.000 | | |
| Site2:AA4:BB2:CC1 | 0.0 | 0.000 | | |
| Site2:AA4:BB2:CC2 | 0.0 | 0.000 | | |
| Site2:AA4:BB2:CC3 | 0.0 | 0.000 | | |
| Site2:AA4:BB2:CC4 | 0.0 | 0.000 | | |
| Site2:AA5:BB1:CC1 | 0.0 | 0.000 | | |
| Site2:AA5:BB1:CC2 | 0.0 | 0.000 | | |
| Site2:AA5:BB1:CC3 | 0.0 | 0.000 | | |
| Site2:AA5:BB1:CC4 | 0.0 | 0.000 | | |
| Site2:AA5:BB2:CC1 | 0.0 | 0.000 | | |
| Site2:AA5:BB2:CC2 | 0.0 | 0.000 | | |
| Site2:AA5:BB2:CC3 | 0.0 | 0.000 | | |
| Site2:AA5:BB2:CC4 | 0.0 | 0.000 | | |
| Site3:AA1:BB1:CC1 | 42.0 | 130.087 | 0.3229 | 0.747082 |
| Site3:AA1:BB1:CC2 | -74.0 | 130.087 | -0.5688 | 0.569991 |
| Site3:AA1:BB1:CC3 | 96.3 | 130.087 | 0.7405 | 0.459703 |
| Site3:AA1:BB1:CC4 | 0.0 | 0.000 | | |
| Site3:AA1:BB2:CC1 | 0.0 | 0.000 | | |
| Site3:AA1:BB2:CC2 | 0.0 | 0.000 | | |
| Site3:AA1:BB2:CC3 | 0.0 | 0.000 | | |
| Site3:AA1:BB2:CC4 | 0.0 | 0.000 | | |
| Site3:AA2:BB1:CC1 | -113.3 | 130.087 | -0.8712 | 0.384510 |
| Site3:AA2:BB1:CC2 | 9.0 | 130.087 | 0.0692 | 0.944901 |
| Site3:AA2:BB1:CC3 | 83.7 | 130.087 | 0.6432 | 0.520736 |
| Site3:AA2:BB1:CC4 | 0.0 | 0.000 | | |
| Site3:AA2:BB2:CC1 | 0.0 | 0.000 | | |
| Site3:AA2:BB2:CC2 | 0.0 | 0.000 | | |
| Site3:AA2:BB2:CC3 | 0.0 | 0.000 | | |
| Site3:AA2:BB2:CC4 | 0.0 | 0.000 | | |
| Site3:AA3:BB1:CC1 | 36.3 | 130.087 | 0.2793 | 0.780255 |
| Site3:AA3:BB1:CC2 | -46.7 | 130.087 | -0.3587 | 0.720110 |
| Site3:AA3:BB1:CC3 | 82.0 | 130.087 | 0.6303 | 0.529068 |
| Site3:AA3:BB1:CC4 | 0.0 | 0.000 | | |

| | | | | |
|---|---|---|---|---|
| Site3:AA3:BB2:CC1 | 0.0 | 0.000 | | |
| Site3:AA3:BB2:CC2 | 0.0 | 0.000 | | |
| Site3:AA3:BB2:CC3 | 0.0 | 0.000 | | |
| Site3:AA3:BB2:CC4 | 0.0 | 0.000 | | |
| Site3:AA4:BB1:CC1 | -89.0 | 130.087 | -0.6842 | 0.494537 |
| Site3:AA4:BB1:CC2 | -100.0 | 130.087 | -0.7687 | 0.442819 |
| Site3:AA4:BB1:CC3 | 33.3 | 130.087 | 0.2562 | 0.797986 |
| Site3:AA4:BB1:CC4 | 0.0 | 0.000 | | |
| Site3:AA4:BB2:CC1 | 0.0 | 0.000 | | |
| Site3:AA4:BB2:CC2 | 0.0 | 0.000 | | |
| Site3:AA4:BB2:CC3 | 0.0 | 0.000 | | |
| Site3:AA4:BB2:CC4 | 0.0 | 0.000 | | |
| Site3:AA5:BB1:CC1 | 0.0 | 0.000 | | |
| Site3:AA5:BB1:CC2 | 0.0 | 0.000 | | |
| Site3:AA5:BB1:CC3 | 0.0 | 0.000 | | |
| Site3:AA5:BB1:CC4 | 0.0 | 0.000 | | |
| Site3:AA5:BB2:CC1 | 0.0 | 0.000 | | |
| Site3:AA5:BB2:CC2 | 0.0 | 0.000 | | |
| Site3:AA5:BB2:CC3 | 0.0 | 0.000 | | |
| Site3:AA5:BB2:CC4 | 0.0 | 0.000 | | |
| Site4:AA1:BB1:CC1 | 0.0 | 0.000 | | |
| Site4:AA1:BB1:CC2 | 0.0 | 0.000 | | |
| Site4:AA1:BB1:CC3 | 0.0 | 0.000 | | |
| Site4:AA1:BB1:CC4 | 0.0 | 0.000 | | |
| Site4:AA1:BB2:CC1 | 0.0 | 0.000 | | |
| Site4:AA1:BB2:CC2 | 0.0 | 0.000 | | |
| Site4:AA1:BB2:CC3 | 0.0 | 0.000 | | |
| Site4:AA1:BB2:CC4 | 0.0 | 0.000 | | |
| Site4:AA2:BB1:CC1 | 0.0 | 0.000 | | |
| Site4:AA2:BB1:CC2 | 0.0 | 0.000 | | |
| Site4:AA2:BB1:CC3 | 0.0 | 0.000 | | |
| Site4:AA2:BB1:CC4 | 0.0 | 0.000 | | |
| Site4:AA2:BB2:CC1 | 0.0 | 0.000 | | |
| Site4:AA2:BB2:CC2 | 0.0 | 0.000 | | |
| Site4:AA2:BB2:CC3 | 0.0 | 0.000 | | |
| Site4:AA2:BB2:CC4 | 0.0 | 0.000 | | |
| Site4:AA3:BB1:CC1 | 0.0 | 0.000 | | |
| Site4:AA3:BB1:CC2 | 0.0 | 0.000 | | |
| Site4:AA3:BB1:CC3 | 0.0 | 0.000 | | |
| Site4:AA3:BB1:CC4 | 0.0 | 0.000 | | |
| Site4:AA3:BB2:CC1 | 0.0 | 0.000 | | |
| Site4:AA3:BB2:CC2 | 0.0 | 0.000 | | |
| Site4:AA3:BB2:CC3 | 0.0 | 0.000 | | |
| Site4:AA3:BB2:CC4 | 0.0 | 0.000 | | |
| Site4:AA4:BB1:CC1 | 0.0 | 0.000 | | |
| Site4:AA4:BB1:CC2 | 0.0 | 0.000 | | |
| Site4:AA4:BB1:CC3 | 0.0 | 0.000 | | |
| Site4:AA4:BB1:CC4 | 0.0 | 0.000 | | |

```
Site4:AA4:BB2:CC1          0.0      0.000
Site4:AA4:BB2:CC2          0.0      0.000
Site4:AA4:BB2:CC3          0.0      0.000
Site4:AA4:BB2:CC4          0.0      0.000
Site4:AA5:BB1:CC1          0.0      0.000
Site4:AA5:BB1:CC2          0.0      0.000
Site4:AA5:BB1:CC3          0.0      0.000
Site4:AA5:BB1:CC4          0.0      0.000
Site4:AA5:BB2:CC1          0.0      0.000
Site4:AA5:BB2:CC2          0.0      0.000
Site4:AA5:BB2:CC3          0.0      0.000
Site4:AA5:BB2:CC4          0.0      0.000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(f10.1, ex10.1), type=3, singular.ok=TRUE) # NOT OK for Site:Block
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Yield
                   Sum Sq  Df   F values  Pr(>F)
Site               552717   3 5.8064e+01 < 2e-16 ***
A              1387680917   4 1.0933e+05 < 2e-16 ***
B               100939695   1 3.1812e+04 < 2e-16 ***
C                19356264   3 2.0334e+03 < 2e-16 ***
Site:Block              0   0
Site:A              34068  12 8.9470e-01 0.55301
Site:B               1618   3 1.6990e-01 0.91662
A:B              31444008   4 2.4775e+03 < 2e-16 ***
A:C              26075792  12 6.8483e+02 < 2e-16 ***
B:C              23901388   3 2.5109e+03 < 2e-16 ***
Site:C              47625   9 1.6677e+00 0.09747 .
Site:A:B            33737  12 8.8600e-01 0.56185
A:B:C            41996729  12 1.1030e+03 < 2e-16 ***
Site:A:C           104110  36 9.1140e-01 0.61768
Site:B:C            61111   9 2.1400e+00 0.02701 *
Site:Block:A:B     186911  72 8.1810e-01 0.84155
Site:A:B:C          82475  36 7.2200e-01 0.87941
Residuals          761522 240
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 7.15 Example 10.2

(92) MODEL

```
ex10.2 = read.table("C:/G/Rt/Split/Ex10.2-spbsite.txt", header=TRUE)
ex10.2 = af(ex10.2, c("Site", "Block", "A", "B"))
GLM(Yield ~ Site + Site:Block + A + A:Site + A:Site:Block + B + B:Site +
            B:Site:Block + A:B + A:B:Site, ex10.2)
```

```
$ANOVA
Response : Yield
                 Df     Sum Sq  Mean Sq F value    Pr(>F)
MODEL           227 6370995084 28066058   10814 < 2.2e-16 ***
RESIDUALS       252     654049     2595
CORRECTED TOTAL 479 6371649132
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
             Df     Sum Sq   Mean Sq    F value    Pr(>F)
Site          2  523573968 261786984 1.0086e+05 < 2.2e-16 ***
Site:Block    9 3756646710 417405190 1.6082e+05 < 2.2e-16 ***
A             4   29288163   7322041 2.8211e+03 < 2.2e-16 ***
Site:A        8     247899     30987 1.1939e+01 1.998e-14 ***
Site:Block:A 36    1783391     49539 1.9087e+01 < 2.2e-16 ***
B             7 1937592291 276798899 1.0665e+05 < 2.2e-16 ***
Site:B       14   15903698   1135978 4.3768e+02 < 2.2e-16 ***
Site:Block:B 63  105727288   1678211 6.4660e+02 < 2.2e-16 ***
A:B          28      91141      3255 1.2541e+00    0.1838
Site:A:B     56     140534      2510 9.6690e-01    0.5461
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
             Df     Sum Sq   Mean Sq    F value    Pr(>F)
Site          2  523573968 261786984 1.0086e+05 < 2.2e-16 ***
Site:Block    9 3756646710 417405190 1.6082e+05 < 2.2e-16 ***
A             4   29288163   7322041 2.8211e+03 < 2.2e-16 ***
Site:A        8     247899     30987 1.1939e+01 1.998e-14 ***
Site:Block:A 36    1783391     49539 1.9087e+01 < 2.2e-16 ***
B             7 1937592291 276798899 1.0665e+05 < 2.2e-16 ***
Site:B       14   15903698   1135978 4.3768e+02 < 2.2e-16 ***
Site:Block:B 63  105727288   1678211 6.4660e+02 < 2.2e-16 ***
A:B          28      91141      3255 1.2541e+00    0.1838
Site:A:B     56     140534      2510 9.6690e-01    0.5461
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
             Df     Sum Sq   Mean Sq    F value    Pr(>F)
Site          2  523573968 261786984 1.0086e+05 < 2.2e-16 ***
Site:Block    9 3756646710 417405190 1.6082e+05 < 2.2e-16 ***
A             4   29288163   7322041 2.8211e+03 < 2.2e-16 ***
Site:A        8     247899     30987 1.1939e+01 1.998e-14 ***
Site:Block:A 36    1783391     49539 1.9087e+01 < 2.2e-16 ***
B             7 1937592291 276798899 1.0665e+05 < 2.2e-16 ***
Site:B       14   15903698   1135978 4.3768e+02 < 2.2e-16 ***
Site:Block:B 63  105727288   1678211 6.4660e+02 < 2.2e-16 ***
A:B          28      91141      3255 1.2541e+00    0.1838
Site:A:B     56     140534      2510 9.6690e-01    0.5461
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                 Estimate Std. Error   t value  Pr(>|t|)
(Intercept)       13975.4     35.112  398.0266 < 2.2e-16 ***
Site1             -3964.6     49.655  -79.8426 < 2.2e-16 ***
Site2             -6027.2     49.655 -121.3814 < 2.2e-16 ***
Site3                 0.0      0.000
Site1:BlockR1      5969.7     39.462  151.2767 < 2.2e-16 ***
Site1:BlockR2      3993.2     39.462  101.1914 < 2.2e-16 ***
Site1:BlockR3      7976.0     39.462  202.1185 < 2.2e-16 ***
Site1:BlockR4         0.0      0.000
Site2:BlockR1      1983.1     39.462   50.2533 < 2.2e-16 ***
Site2:BlockR2      8050.7     39.462  204.0115 < 2.2e-16 ***
Site2:BlockR3      9979.6     39.462  252.8913 < 2.2e-16 ***
Site2:BlockR4         0.0      0.000
Site3:BlockR1     -1977.8     39.462  -50.1183 < 2.2e-16 ***
Site3:BlockR2      4028.8     39.462  102.0941 < 2.2e-16 ***
Site3:BlockR3      6011.4     39.462  152.3335 < 2.2e-16 ***
Site3:BlockR4         0.0      0.000
AA1                -558.7     42.242  -13.2267 < 2.2e-16 ***
AA2                -438.8     42.242  -10.3889 < 2.2e-16 ***
AA3                -240.1     42.242   -5.6838 3.632e-08 ***
AA4                -153.3     42.242   -3.6279 0.0003458 ***
AA5                   0.0      0.000
Site1:AA1           -38.1     59.739   -0.6377 0.5242659
Site1:AA2             0.8     59.739    0.0131 0.9895761
Site1:AA3           -98.2     59.739   -1.6436 0.1015027
Site1:AA4           -21.4     59.739   -0.3583 0.7203955
Site1:AA5             0.0      0.000
Site2:AA1           413.1     59.739    6.9145 3.844e-11 ***
Site2:AA2           368.4     59.739    6.1670 2.752e-09 ***
Site2:AA3           138.4     59.739    2.3163 0.0213427 *
Site2:AA4           164.4     59.739    2.7516 0.0063618 **
```

```
Site2:AA5              0.0      0.000
Site3:AA1              0.0      0.000
Site3:AA2              0.0      0.000
Site3:AA3              0.0      0.000
Site3:AA4              0.0      0.000
Site3:AA5              0.0      0.000
Site1:BlockR1:AA1   -190.6     36.024   -5.2916 2.635e-07 ***
Site1:BlockR1:AA2   -131.1     36.024   -3.6400 0.0003308 ***
Site1:BlockR1:AA3    -76.1     36.024   -2.1132 0.0355682 *
Site1:BlockR1:AA4    -52.6     36.024   -1.4608 0.1453053
Site1:BlockR1:AA5      0.0      0.000
Site1:BlockR2:AA1   -188.1     36.024   -5.2222 3.702e-07 ***
Site1:BlockR2:AA2   -148.4     36.024   -4.1188 5.168e-05 ***
Site1:BlockR2:AA3    -43.6     36.024   -1.2110 0.2270282
Site1:BlockR2:AA4    -33.0     36.024   -0.9161 0.3605109
Site1:BlockR2:AA5      0.0      0.000
Site1:BlockR3:AA1   -234.0     36.024   -6.4957 4.379e-10 ***
Site1:BlockR3:AA2   -133.3     36.024   -3.6989 0.0002658 ***
Site1:BlockR3:AA3    -82.1     36.024   -2.2797 0.0234592 *
Site1:BlockR3:AA4    -87.8     36.024   -2.4359 0.0155490 *
Site1:BlockR3:AA5      0.0      0.000
Site1:BlockR4:AA1      0.0      0.000
Site1:BlockR4:AA2      0.0      0.000
Site1:BlockR4:AA3      0.0      0.000
Site1:BlockR4:AA4      0.0      0.000
Site1:BlockR4:AA5      0.0      0.000
Site2:BlockR1:AA1   -382.5     36.024  -10.6180 < 2.2e-16 ***
Site2:BlockR1:AA2   -261.9     36.024   -7.2695 4.528e-12 ***
Site2:BlockR1:AA3   -171.6     36.024   -4.7642 3.204e-06 ***
Site2:BlockR1:AA4    -74.5     36.024   -2.0681 0.0396533 *
Site2:BlockR1:AA5      0.0      0.000
Site2:BlockR2:AA1   -634.4     36.024  -17.6099 < 2.2e-16 ***
Site2:BlockR2:AA2   -508.7     36.024  -14.1226 < 2.2e-16 ***
Site2:BlockR2:AA3   -288.9     36.024   -8.0190 3.997e-14 ***
Site2:BlockR2:AA4   -183.6     36.024   -5.0973 6.768e-07 ***
Site2:BlockR2:AA5      0.0      0.000
Site2:BlockR3:AA1   -607.5     36.024  -16.8638 < 2.2e-16 ***
Site2:BlockR3:AA2   -466.6     36.024  -12.9532 < 2.2e-16 ***
Site2:BlockR3:AA3   -249.6     36.024   -6.9294 3.517e-11 ***
Site2:BlockR3:AA4   -166.4     36.024   -4.6185 6.169e-06 ***
Site2:BlockR3:AA5      0.0      0.000
Site2:BlockR4:AA1      0.0      0.000
Site2:BlockR4:AA2      0.0      0.000
Site2:BlockR4:AA3      0.0      0.000
Site2:BlockR4:AA4      0.0      0.000
Site2:BlockR4:AA5      0.0      0.000
Site3:BlockR1:AA1     11.6     36.024    0.3227 0.7471876
Site3:BlockR1:AA2    -27.1     36.024   -0.7530 0.4521683
```

```
Site3:BlockR1:AA3     -8.9     36.024   -0.2464 0.8056004
Site3:BlockR1:AA4     51.3     36.024    1.4227 0.1560685
Site3:BlockR1:AA5      0.0      0.000
Site3:BlockR2:AA1   -237.6     36.024   -6.5963 2.463e-10 ***
Site3:BlockR2:AA2   -200.2     36.024   -5.5588 6.907e-08 ***
Site3:BlockR2:AA3   -142.0     36.024   -3.9418 0.0001048 ***
Site3:BlockR2:AA4    -55.4     36.024   -1.5372 0.1255045
Site3:BlockR2:AA5      0.0      0.000
Site3:BlockR3:AA1   -207.1     36.024   -5.7497 2.578e-08 ***
Site3:BlockR3:AA2   -232.2     36.024   -6.4471 5.769e-10 ***
Site3:BlockR3:AA3   -127.7     36.024   -3.5463 0.0004657 ***
Site3:BlockR3:AA4    -66.9     36.024   -1.8564 0.0645621 .
Site3:BlockR3:AA5      0.0      0.000
Site3:BlockR4:AA1      0.0      0.000
Site3:BlockR4:AA2      0.0      0.000
Site3:BlockR4:AA3      0.0      0.000
Site3:BlockR4:AA4      0.0      0.000
Site3:BlockR4:AA5      0.0      0.000
BB1                -5364.0     45.567 -117.7159 < 2.2e-16 ***
BB2                -4564.7     45.567 -100.1746 < 2.2e-16 ***
BB3                -3808.6     45.567  -83.5815 < 2.2e-16 ***
BB4                -3070.7     45.567  -67.3877 < 2.2e-16 ***
BB5                -2308.1     45.567  -50.6519 < 2.2e-16 ***
BB6                -1561.6     45.567  -34.2694 < 2.2e-16 ***
BB7                 -704.7     45.567  -15.4641 < 2.2e-16 ***
BB8                    0.0      0.000
Site1:BB1            -87.2     64.441   -1.3539 0.1769672
Site1:BB2            -63.8     64.441   -0.9900 0.3231006
Site1:BB3            -48.9     64.441   -0.7588 0.4486638
Site1:BB4            -16.6     64.441   -0.2576 0.7969270
Site1:BB5             17.3     64.441    0.2677 0.7891606
Site1:BB6             16.3     64.441    0.2529 0.8005184
Site1:BB7           -127.0     64.441   -1.9716 0.0497538 *
Site1:BB8              0.0      0.000
Site2:BB1           3583.2     64.441   55.6033 < 2.2e-16 ***
Site2:BB2           3099.2     64.441   48.0926 < 2.2e-16 ***
Site2:BB3           2577.7     64.441   39.9999 < 2.2e-16 ***
Site2:BB4           2111.0     64.441   32.7585 < 2.2e-16 ***
Site2:BB5           1589.0     64.441   24.6581 < 2.2e-16 ***
Site2:BB6           1116.0     64.441   17.3173 < 2.2e-16 ***
Site2:BB7            555.1     64.441    8.6133 8.882e-16 ***
Site2:BB8              0.0      0.000
Site3:BB1              0.0      0.000
Site3:BB2              0.0      0.000
Site3:BB3              0.0      0.000
Site3:BB4              0.0      0.000
Site3:BB5              0.0      0.000
Site3:BB6              0.0      0.000
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Site3:BB7              0.0      0.000
Site3:BB8              0.0      0.000
Site1:BlockR1:BB1  -1733.0     45.567  -38.0320 < 2.2e-16 ***
Site1:BlockR1:BB2  -1498.6     45.567  -32.8879 < 2.2e-16 ***
Site1:BlockR1:BB3  -1281.4     45.567  -28.1213 < 2.2e-16 ***
Site1:BlockR1:BB4   -984.4     45.567  -21.6034 < 2.2e-16 ***
Site1:BlockR1:BB5   -743.6     45.567  -16.3189 < 2.2e-16 ***
Site1:BlockR1:BB6   -499.4     45.567  -10.9597 < 2.2e-16 ***
Site1:BlockR1:BB7   -196.2     45.567   -4.3058 2.385e-05 ***
Site1:BlockR1:BB8      0.0      0.000
Site1:BlockR2:BB1  -1721.2     45.567  -37.7730 < 2.2e-16 ***
Site1:BlockR2:BB2  -1606.0     45.567  -35.2449 < 2.2e-16 ***
Site1:BlockR2:BB3  -1267.6     45.567  -27.8184 < 2.2e-16 ***
Site1:BlockR2:BB4  -1005.4     45.567  -22.0642 < 2.2e-16 ***
Site1:BlockR2:BB5   -800.4     45.567  -17.5654 < 2.2e-16 ***
Site1:BlockR2:BB6   -486.4     45.567  -10.6744 < 2.2e-16 ***
Site1:BlockR2:BB7   -233.8     45.567   -5.1309 5.761e-07 ***
Site1:BlockR2:BB8      0.0      0.000
Site1:BlockR3:BB1  -1709.0     45.567  -37.5053 < 2.2e-16 ***
Site1:BlockR3:BB2  -1522.6     45.567  -33.4146 < 2.2e-16 ***
Site1:BlockR3:BB3  -1220.2     45.567  -26.7782 < 2.2e-16 ***
Site1:BlockR3:BB4   -965.2     45.567  -21.1820 < 2.2e-16 ***
Site1:BlockR3:BB5   -767.8     45.567  -16.8499 < 2.2e-16 ***
Site1:BlockR3:BB6   -476.2     45.567  -10.4506 < 2.2e-16 ***
Site1:BlockR3:BB7   -220.2     45.567   -4.8325 2.345e-06 ***
Site1:BlockR3:BB8      0.0      0.000
Site1:BlockR4:BB1      0.0      0.000
Site1:BlockR4:BB2      0.0      0.000
Site1:BlockR4:BB3      0.0      0.000
Site1:BlockR4:BB4      0.0      0.000
Site1:BlockR4:BB5      0.0      0.000
Site1:BlockR4:BB6      0.0      0.000
Site1:BlockR4:BB7      0.0      0.000
Site1:BlockR4:BB8      0.0      0.000
Site2:BlockR1:BB1  -3519.6     45.567  -77.2402 < 2.2e-16 ***
Site2:BlockR1:BB2  -3097.8     45.567  -67.9835 < 2.2e-16 ***
Site2:BlockR1:BB3  -2563.0     45.567  -56.2469 < 2.2e-16 ***
Site2:BlockR1:BB4  -2044.0     45.567  -44.8571 < 2.2e-16 ***
Site2:BlockR1:BB5  -1539.6     45.567  -33.7877 < 2.2e-16 ***
Site2:BlockR1:BB6  -1052.8     45.567  -23.1045 < 2.2e-16 ***
Site2:BlockR1:BB7   -552.0     45.567  -12.1141 < 2.2e-16 ***
Site2:BlockR1:BB8      0.0      0.000
Site2:BlockR2:BB1  -5360.8     45.567 -117.6467 < 2.2e-16 ***
Site2:BlockR2:BB2  -4648.0     45.567 -102.0038 < 2.2e-16 ***
Site2:BlockR2:BB3  -3890.2     45.567  -85.3733 < 2.2e-16 ***
Site2:BlockR2:BB4  -3094.2     45.567  -67.9045 < 2.2e-16 ***
Site2:BlockR2:BB5  -2335.6     45.567  -51.2565 < 2.2e-16 ***
Site2:BlockR2:BB6  -1556.2     45.567  -34.1520 < 2.2e-16 ***
```

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Site2:BlockR2:BB7   -830.8     45.567  -18.2325 < 2.2e-16 ***
Site2:BlockR2:BB8      0.0      0.000
Site2:BlockR3:BB1  -5309.4     45.567 -116.5187 < 2.2e-16 ***
Site2:BlockR3:BB2  -4604.2     45.567 -101.0426 < 2.2e-16 ***
Site2:BlockR3:BB3  -3827.2     45.567  -83.9907 < 2.2e-16 ***
Site2:BlockR3:BB4  -3058.2     45.567  -67.1145 < 2.2e-16 ***
Site2:BlockR3:BB5  -2281.6     45.567  -50.0714 < 2.2e-16 ***
Site2:BlockR3:BB6  -1466.6     45.567  -32.1856 < 2.2e-16 ***
Site2:BlockR3:BB7   -795.8     45.567  -17.4644 < 2.2e-16 ***
Site2:BlockR3:BB8      0.0      0.000
Site2:BlockR4:BB1      0.0      0.000
Site2:BlockR4:BB2      0.0      0.000
Site2:BlockR4:BB3      0.0      0.000
Site2:BlockR4:BB4      0.0      0.000
Site2:BlockR4:BB5      0.0      0.000
Site2:BlockR4:BB6      0.0      0.000
Site2:BlockR4:BB7      0.0      0.000
Site2:BlockR4:BB8      0.0      0.000
Site3:BlockR1:BB1     -7.4     45.567   -0.1624 0.8711222
Site3:BlockR1:BB2     26.4     45.567    0.5794 0.5628587
Site3:BlockR1:BB3    -48.4     45.567   -1.0622 0.2891736
Site3:BlockR1:BB4    -67.6     45.567   -1.4835 0.1391827
Site3:BlockR1:BB5    -35.0     45.567   -0.7681 0.4431463
Site3:BlockR1:BB6     -8.2     45.567   -0.1800 0.8573324
Site3:BlockR1:BB7    -66.6     45.567   -1.4616 0.1451004
Site3:BlockR1:BB8      0.0      0.000
Site3:BlockR2:BB1  -1771.4     45.567  -38.8747 < 2.2e-16 ***
Site3:BlockR2:BB2  -1533.8     45.567  -33.6604 < 2.2e-16 ***
Site3:BlockR2:BB3  -1295.8     45.567  -28.4373 < 2.2e-16 ***
Site3:BlockR2:BB4  -1082.6     45.567  -23.7585 < 2.2e-16 ***
Site3:BlockR2:BB5   -796.0     45.567  -17.4688 < 2.2e-16 ***
Site3:BlockR2:BB6   -482.0     45.567  -10.5778 < 2.2e-16 ***
Site3:BlockR2:BB7   -304.2     45.567   -6.6759 1.556e-10 ***
Site3:BlockR2:BB8      0.0      0.000
Site3:BlockR3:BB1  -1772.4     45.567  -38.8966 < 2.2e-16 ***
Site3:BlockR3:BB2  -1509.0     45.567  -33.1161 < 2.2e-16 ***
Site3:BlockR3:BB3  -1281.6     45.567  -28.1257 < 2.2e-16 ***
Site3:BlockR3:BB4  -1013.2     45.567  -22.2354 < 2.2e-16 ***
Site3:BlockR3:BB5   -751.8     45.567  -16.4988 < 2.2e-16 ***
Site3:BlockR3:BB6   -462.6     45.567  -10.1521 < 2.2e-16 ***
Site3:BlockR3:BB7   -248.6     45.567   -5.4557 1.165e-07 ***
Site3:BlockR3:BB8      0.0      0.000
Site3:BlockR4:BB1      0.0      0.000
Site3:BlockR4:BB2      0.0      0.000
Site3:BlockR4:BB3      0.0      0.000
Site3:BlockR4:BB4      0.0      0.000
Site3:BlockR4:BB5      0.0      0.000
Site3:BlockR4:BB6      0.0      0.000
```

| | | | | | |
|---|---|---|---|---|---|
| Site3:BlockR4:BB7 | 0.0 | 0.000 | | | |
| Site3:BlockR4:BB8 | 0.0 | 0.000 | | | |
| AA1:BB1 | -61.5 | 50.945 | -1.2072 | 0.2284965 | |
| AA1:BB2 | -140.0 | 50.945 | -2.7480 | 0.0064285 | ** |
| AA1:BB3 | -57.7 | 50.945 | -1.1336 | 0.2580534 | |
| AA1:BB4 | -29.2 | 50.945 | -0.5741 | 0.5663822 | |
| AA1:BB5 | -66.7 | 50.945 | -1.3102 | 0.1913120 | |
| AA1:BB6 | -41.5 | 50.945 | -0.8146 | 0.4160716 | |
| AA1:BB7 | -40.5 | 50.945 | -0.7950 | 0.4273795 | |
| AA1:BB8 | 0.0 | 0.000 | | | |
| AA2:BB1 | -32.5 | 50.945 | -0.6379 | 0.5240931 | |
| AA2:BB2 | -62.7 | 50.945 | -1.2317 | 0.2192050 | |
| AA2:BB3 | -59.0 | 50.945 | -1.1581 | 0.2479183 | |
| AA2:BB4 | 51.8 | 50.945 | 1.0158 | 0.3107018 | |
| AA2:BB5 | 3.8 | 50.945 | 0.0736 | 0.9413805 | |
| AA2:BB6 | 8.3 | 50.945 | 0.1619 | 0.8714843 | |
| AA2:BB7 | 6.3 | 50.945 | 0.1227 | 0.9024579 | |
| AA2:BB8 | 0.0 | 0.000 | | | |
| AA3:BB1 | -90.0 | 50.945 | -1.7666 | 0.0785061 | . |
| AA3:BB2 | -122.7 | 50.945 | -2.4094 | 0.0166946 | * |
| AA3:BB3 | -110.0 | 50.945 | -2.1592 | 0.0317805 | * |
| AA3:BB4 | -63.0 | 50.945 | -1.2366 | 0.2173799 | |
| AA3:BB5 | -36.7 | 50.945 | -0.7214 | 0.4713562 | |
| AA3:BB6 | -11.5 | 50.945 | -0.2257 | 0.8215928 | |
| AA3:BB7 | -104.2 | 50.945 | -2.0463 | 0.0417637 | * |
| AA3:BB8 | 0.0 | 0.000 | | | |
| AA4:BB1 | -66.2 | 50.945 | -1.3004 | 0.1946476 | |
| AA4:BB2 | -60.2 | 50.945 | -1.1826 | 0.2380667 | |
| AA4:BB3 | -7.5 | 50.945 | -0.1472 | 0.8830788 | |
| AA4:BB4 | 3.8 | 50.945 | 0.0736 | 0.9413805 | |
| AA4:BB5 | 12.0 | 50.945 | 0.2355 | 0.8139760 | |
| AA4:BB6 | 14.5 | 50.945 | 0.2846 | 0.7761701 | |
| AA4:BB7 | -37.2 | 50.945 | -0.7312 | 0.4653514 | |
| AA4:BB8 | 0.0 | 0.000 | | | |
| AA5:BB1 | 0.0 | 0.000 | | | |
| AA5:BB2 | 0.0 | 0.000 | | | |
| AA5:BB3 | 0.0 | 0.000 | | | |
| AA5:BB4 | 0.0 | 0.000 | | | |
| AA5:BB5 | 0.0 | 0.000 | | | |
| AA5:BB6 | 0.0 | 0.000 | | | |
| AA5:BB7 | 0.0 | 0.000 | | | |
| AA5:BB8 | 0.0 | 0.000 | | | |
| Site1:AA1:BB1 | 67.2 | 72.048 | 0.9334 | 0.3515017 | |
| Site1:AA1:BB2 | 118.7 | 72.048 | 1.6482 | 0.1005547 | |
| Site1:AA1:BB3 | 49.7 | 72.048 | 0.6905 | 0.4905056 | |
| Site1:AA1:BB4 | -13.0 | 72.048 | -0.1804 | 0.8569552 | |
| Site1:AA1:BB5 | 77.7 | 72.048 | 1.0791 | 0.2815539 | |
| Site1:AA1:BB6 | 10.5 | 72.048 | 0.1457 | 0.8842456 | |

| | | | | | |
|---|---|---|---|---|---|
| Site1:AA1:BB7 | 48.7 | 72.048 | 0.6766 | 0.4992577 | |
| Site1:AA1:BB8 | 0.0 | 0.000 | | | |
| Site1:AA2:BB1 | 47.5 | 72.048 | 0.6593 | 0.5103141 | |
| Site1:AA2:BB2 | 75.5 | 72.048 | 1.0479 | 0.2956805 | |
| Site1:AA2:BB3 | 35.2 | 72.048 | 0.4893 | 0.6250835 | |
| Site1:AA2:BB4 | -56.8 | 72.048 | -0.7877 | 0.4316280 | |
| Site1:AA2:BB5 | -52.5 | 72.048 | -0.7287 | 0.4668712 | |
| Site1:AA2:BB6 | -57.3 | 72.048 | -0.7946 | 0.4275862 | |
| Site1:AA2:BB7 | -7.0 | 72.048 | -0.0972 | 0.9226782 | |
| Site1:AA2:BB8 | 0.0 | 0.000 | | | |
| Site1:AA3:BB1 | 172.0 | 72.048 | 2.3873 | 0.0177101 | * |
| Site1:AA3:BB2 | 116.0 | 72.048 | 1.6100 | 0.1086397 | |
| Site1:AA3:BB3 | 123.2 | 72.048 | 1.7107 | 0.0883720 | . |
| Site1:AA3:BB4 | 21.0 | 72.048 | 0.2915 | 0.7709287 | |
| Site1:AA3:BB5 | 64.7 | 72.048 | 0.8987 | 0.3696645 | |
| Site1:AA3:BB6 | -24.3 | 72.048 | -0.3366 | 0.7367115 | |
| Site1:AA3:BB7 | 182.7 | 72.048 | 2.5365 | 0.0118006 | * |
| Site1:AA3:BB8 | 0.0 | 0.000 | | | |
| Site1:AA4:BB1 | 104.5 | 72.048 | 1.4504 | 0.1481824 | |
| Site1:AA4:BB2 | 95.7 | 72.048 | 1.3290 | 0.1850560 | |
| Site1:AA4:BB3 | 73.2 | 72.048 | 1.0167 | 0.3102767 | |
| Site1:AA4:BB4 | 9.7 | 72.048 | 0.1353 | 0.8924613 | |
| Site1:AA4:BB5 | -17.3 | 72.048 | -0.2394 | 0.8109707 | |
| Site1:AA4:BB6 | -30.5 | 72.048 | -0.4233 | 0.6724148 | |
| Site1:AA4:BB7 | 141.7 | 72.048 | 1.9674 | 0.0502283 | . |
| Site1:AA4:BB8 | 0.0 | 0.000 | | | |
| Site1:AA5:BB1 | 0.0 | 0.000 | | | |
| Site1:AA5:BB2 | 0.0 | 0.000 | | | |
| Site1:AA5:BB3 | 0.0 | 0.000 | | | |
| Site1:AA5:BB4 | 0.0 | 0.000 | | | |
| Site1:AA5:BB5 | 0.0 | 0.000 | | | |
| Site1:AA5:BB6 | 0.0 | 0.000 | | | |
| Site1:AA5:BB7 | 0.0 | 0.000 | | | |
| Site1:AA5:BB8 | 0.0 | 0.000 | | | |
| Site2:AA1:BB1 | -11.8 | 72.048 | -0.1631 | 0.8705810 | |
| Site2:AA1:BB2 | 106.7 | 72.048 | 1.4817 | 0.1396805 | |
| Site2:AA1:BB3 | 8.7 | 72.048 | 0.1214 | 0.9034334 | |
| Site2:AA1:BB4 | -57.5 | 72.048 | -0.7981 | 0.4255737 | |
| Site2:AA1:BB5 | 17.5 | 72.048 | 0.2429 | 0.8082844 | |
| Site2:AA1:BB6 | -26.3 | 72.048 | -0.3643 | 0.7159080 | |
| Site2:AA1:BB7 | -30.0 | 72.048 | -0.4164 | 0.6774782 | |
| Site2:AA1:BB8 | 0.0 | 0.000 | | | |
| Site2:AA2:BB1 | -89.5 | 72.048 | -1.2422 | 0.2153051 | |
| Site2:AA2:BB2 | -74.3 | 72.048 | -1.0306 | 0.3037314 | |
| Site2:AA2:BB3 | -32.3 | 72.048 | -0.4476 | 0.6548116 | |
| Site2:AA2:BB4 | -151.8 | 72.048 | -2.1062 | 0.0361722 | * |
| Site2:AA2:BB5 | -127.5 | 72.048 | -1.7697 | 0.0779927 | . |
| Site2:AA2:BB6 | -163.5 | 72.048 | -2.2693 | 0.0240938 | * |

| | | | | | |
|---|---|---|---|---|---|
| Site2:AA2:BB7 | -127.5 | 72.048 | -1.7697 | 0.0779927 | . |
| Site2:AA2:BB8 | 0.0 | 0.000 | | | |
| Site2:AA3:BB1 | 57.7 | 72.048 | 0.8016 | 0.4235667 | |
| Site2:AA3:BB2 | 82.0 | 72.048 | 1.1381 | 0.2561446 | |
| Site2:AA3:BB3 | 95.2 | 72.048 | 1.3220 | 0.1873529 | |
| Site2:AA3:BB4 | -32.0 | 72.048 | -0.4442 | 0.6573149 | |
| Site2:AA3:BB5 | 60.2 | 72.048 | 0.8363 | 0.4038052 | |
| Site2:AA3:BB6 | -45.0 | 72.048 | -0.6246 | 0.5328074 | |
| Site2:AA3:BB7 | 69.7 | 72.048 | 0.9681 | 0.3339179 | |
| Site2:AA3:BB8 | 0.0 | 0.000 | | | |
| Site2:AA4:BB1 | -22.3 | 72.048 | -0.3088 | 0.7577110 | |
| Site2:AA4:BB2 | -49.3 | 72.048 | -0.6836 | 0.4948713 | |
| Site2:AA4:BB3 | -4.0 | 72.048 | -0.0555 | 0.9557691 | |
| Site2:AA4:BB4 | -57.8 | 72.048 | -0.8016 | 0.4235667 | |
| Site2:AA4:BB5 | -81.3 | 72.048 | -1.1277 | 0.2605082 | |
| Site2:AA4:BB6 | -111.0 | 72.048 | -1.5406 | 0.1246574 | |
| Site2:AA4:BB7 | -65.5 | 72.048 | -0.9091 | 0.3641550 | |
| Site2:AA4:BB8 | 0.0 | 0.000 | | | |
| Site2:AA5:BB1 | 0.0 | 0.000 | | | |
| Site2:AA5:BB2 | 0.0 | 0.000 | | | |
| Site2:AA5:BB3 | 0.0 | 0.000 | | | |
| Site2:AA5:BB4 | 0.0 | 0.000 | | | |
| Site2:AA5:BB5 | 0.0 | 0.000 | | | |
| Site2:AA5:BB6 | 0.0 | 0.000 | | | |
| Site2:AA5:BB7 | 0.0 | 0.000 | | | |
| Site2:AA5:BB8 | 0.0 | 0.000 | | | |
| Site3:AA1:BB1 | 0.0 | 0.000 | | | |
| Site3:AA1:BB2 | 0.0 | 0.000 | | | |
| Site3:AA1:BB3 | 0.0 | 0.000 | | | |
| Site3:AA1:BB4 | 0.0 | 0.000 | | | |
| Site3:AA1:BB5 | 0.0 | 0.000 | | | |
| Site3:AA1:BB6 | 0.0 | 0.000 | | | |
| Site3:AA1:BB7 | 0.0 | 0.000 | | | |
| Site3:AA1:BB8 | 0.0 | 0.000 | | | |
| Site3:AA2:BB1 | 0.0 | 0.000 | | | |
| Site3:AA2:BB2 | 0.0 | 0.000 | | | |
| Site3:AA2:BB3 | 0.0 | 0.000 | | | |
| Site3:AA2:BB4 | 0.0 | 0.000 | | | |
| Site3:AA2:BB5 | 0.0 | 0.000 | | | |
| Site3:AA2:BB6 | 0.0 | 0.000 | | | |
| Site3:AA2:BB7 | 0.0 | 0.000 | | | |
| Site3:AA2:BB8 | 0.0 | 0.000 | | | |
| Site3:AA3:BB1 | 0.0 | 0.000 | | | |
| Site3:AA3:BB2 | 0.0 | 0.000 | | | |
| Site3:AA3:BB3 | 0.0 | 0.000 | | | |
| Site3:AA3:BB4 | 0.0 | 0.000 | | | |
| Site3:AA3:BB5 | 0.0 | 0.000 | | | |
| Site3:AA3:BB6 | 0.0 | 0.000 | | | |

```
Site3:AA3:BB7          0.0      0.000
Site3:AA3:BB8          0.0      0.000
Site3:AA4:BB1          0.0      0.000
Site3:AA4:BB2          0.0      0.000
Site3:AA4:BB3          0.0      0.000
Site3:AA4:BB4          0.0      0.000
Site3:AA4:BB5          0.0      0.000
Site3:AA4:BB6          0.0      0.000
Site3:AA4:BB7          0.0      0.000
Site3:AA4:BB8          0.0      0.000
Site3:AA5:BB1          0.0      0.000
Site3:AA5:BB2          0.0      0.000
Site3:AA5:BB3          0.0      0.000
Site3:AA5:BB4          0.0      0.000
Site3:AA5:BB5          0.0      0.000
Site3:AA5:BB6          0.0      0.000
Site3:AA5:BB7          0.0      0.000
Site3:AA5:BB8          0.0      0.000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.16 Example 11.1

(93) MODEL

```
ex11.1 = read.table("C:/G/Rt/Split/Ex11.1-cov.txt", header=TRUE)
ex11.1 = af(ex11.1, c("R", "T", "S"))
GLM(Y ~ R + T + R:T + S + S:T, ex11.1)
```

```
$ANOVA
Response : Y
               Df Sum Sq Mean Sq F value  Pr(>F)
MODEL          11    328 29.8182  3.1948 0.02875 *
RESIDUALS      12    112  9.3333
CORRECTED TOTAL 23    440
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value  Pr(>F)
R    2     48      24  2.5714 0.11765
T    1     24      24  2.5714 0.13479
R:T  2     16       8  0.8571 0.44880
S    3    156      52  5.5714 0.01251 *
T:S  3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
    Df Sum Sq Mean Sq F value  Pr(>F)
R    2     48      24  2.5714 0.11765
T    1     24      24  2.5714 0.13479
R:T  2     16       8  0.8571 0.44880
S    3    156      52  5.5714 0.01251 *
T:S  3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value  Pr(>F)
R    2     48      24  2.5714 0.11765
T    1     24      24  2.5714 0.13479
R:T  2     16       8  0.8571 0.44880
S    3    156      52  5.5714 0.01251 *
T:S  3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)       17     2.1602  7.8695 4.448e-06 ***
R1                -5     2.1602 -2.3146 0.0391521 *
R2                -1     2.1602 -0.4629 0.6517110
R3                 0     0.0000
T1               -10     3.0551 -3.2733 0.0066627 **
T2                 0     0.0000
R1:T1              4     3.0551  1.3093 0.2149461
R1:T2              0     0.0000
R2:T1              2     3.0551  0.6547 0.5250404
R2:T2              0     0.0000
R3:T1              0     0.0000
R3:T2              0     0.0000
S1                -8     2.4944 -3.2071 0.0075321 **
S2                -9     2.4944 -3.6080 0.0035926 **
S3               -11     2.4944 -4.4098 0.0008506 ***
S4                 0     0.0000
T1:S1              6     3.5277  1.7008 0.1147185
T1:S2             10     3.5277  2.8347 0.0150430 *
T1:S3              8     3.5277  2.2678 0.0426079 *
T1:S4              0     0.0000
T2:S1              0     0.0000
T2:S2              0     0.0000
T2:S3              0     0.0000
T2:S4              0     0.0000
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(94) MODEL

```
GLM(Z ~ R + T + R:T + S + S:T, ex11.1)
```

```
$ANOVA
Response : Z
                Df Sum Sq Mean Sq F value  Pr(>F)
MODEL           11     46  4.1818  2.5091 0.06452 .
RESIDUALS       12     20  1.6667
CORRECTED TOTAL 23     66
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value Pr(>F)
R    2      9     4.5     2.7 0.1076
T    1      6     6.0     3.6 0.0821 .
R:T  2      1     0.5     0.3 0.7462
S    3      9     3.0     1.8 0.2008
T:S  3     21     7.0     4.2 0.0301 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value Pr(>F)
R    2      9     4.5     2.7 0.1076
T    1      6     6.0     3.6 0.0821 .
R:T  2      1     0.5     0.3 0.7462
S    3      9     3.0     1.8 0.2008
T:S  3     21     7.0     4.2 0.0301 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value Pr(>F)
R    2      9     4.5     2.7 0.1076
T    1      6     6.0     3.6 0.0821 .
R:T  2      1     0.5     0.3 0.7462
S    3      9     3.0     1.8 0.2008
T:S  3     21     7.0     4.2 0.0301 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
```

```
(Intercept)      6.0    0.91287  6.5727 2.641e-05 ***
R1              -2.0    0.91287 -2.1909  0.048930 *
R2              -1.0    0.91287 -1.0954  0.294821
R3               0.0    0.00000
T1              -3.5    1.29099 -2.7111  0.018917 *
T2               0.0    0.00000
R1:T1            1.0    1.29099  0.7746  0.453571
R1:T2            0.0    0.00000
R2:T1            0.5    1.29099  0.3873  0.705317
R2:T2            0.0    0.00000
R3:T1            0.0    0.00000
R3:T2            0.0    0.00000
S1              -2.0    1.05409 -1.8974  0.082097 .
S2              -4.0    1.05409 -3.7947  0.002554 **
S3              -2.0    1.05409 -1.8974  0.082097 .
S4               0.0    0.00000
T1:S1            2.0    1.49071  1.3416  0.204550
T1:S2            5.0    1.49071  3.3541  0.005736 **
T1:S3            1.0    1.49071  0.6708  0.515039
T1:S4            0.0    0.00000
T2:S1            0.0    0.00000
T2:S2            0.0    0.00000
T2:S3            0.0    0.00000
T2:S4            0.0    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(95) MODEL

```
GLM(Y ~ R + T + R:T + S + S:T + Z, ex11.1)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value  Pr(>F)
MODEL           12 342.45 28.5375   3.218 0.03116 *
RESIDUALS       11  97.55  8.8682
CORRECTED TOTAL 23 440.00
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
    Df Sum Sq Mean Sq F value  Pr(>F)
R    2  48.00   24.00  2.7063 0.11071
T    1  24.00   24.00  2.7063 0.12820
R:T  2  16.00    8.00  0.9021 0.43373
S    3 156.00   52.00  5.8637 0.01211 *
T:S  3  84.00   28.00  3.1574 0.06828 .
```

```
Z    1  14.45   14.45  1.6294 0.22807
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
    Df Sum Sq Mean Sq F value  Pr(>F)
R    2 18.300  9.1500  1.0318 0.38844
T    1  2.679  2.6786  0.3020 0.59359
R:T  2  9.450  4.7250  0.5328 0.60137
S    3 79.196 26.3985  2.9768 0.07822 .
T:S  3 37.474 12.4915  1.4086 0.29234
Z    1 14.450 14.4500  1.6294 0.22807
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
    Df Sum Sq Mean Sq F value  Pr(>F)
R    2 20.209 10.1043  1.1394 0.35505
T    1  6.104  6.1038  0.6883 0.42439
R:T  2  9.450  4.7250  0.5328 0.60137
S    3 84.243 28.0810  3.1665 0.06782 .
T:S  3 37.474 12.4915  1.4086 0.29234
Z    1 14.450 14.4500  1.6294 0.22807
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   11.900     4.5163  2.6349 0.023203 *
R1            -3.300     2.4915 -1.3245 0.212200
R2            -0.150     2.2085 -0.0679 0.947069
R3             0.000     0.0000
T1            -7.025     3.7815 -1.8577 0.090160 .
T2             0.000     0.0000
R1:T1          3.150     3.0515  1.0323 0.324102
R1:T2          0.000     0.0000
R2:T1          1.575     2.9965  0.5256 0.609590
R2:T2          0.000     0.0000
R3:T1          0.000     0.0000
R3:T2          0.000     0.0000
S1            -6.300     2.7723 -2.2725 0.044116 *
S2            -5.600     3.6065 -1.5528 0.148760
S3            -9.300     2.7723 -3.3546 0.006425 **
S4             0.000     0.0000
T1:S1          4.300     3.6875  1.1661 0.268238
T1:S2          5.750     4.7864  1.2013 0.254853
T1:S3          7.150     3.5025  2.0414 0.065946 .
T1:S4          0.000     0.0000
```

```
T2:S1          0.000     0.0000
T2:S2          0.000     0.0000
T2:S3          0.000     0.0000
T2:S4          0.000     0.0000
Z              0.850     0.6659  1.2765 0.228074
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.17 Example 11.2

(96) MODEL

```
ex11.2a = read.table("C:/G/Rt/Split/Ex11.2-sp3.txt", header=TRUE)
ex11.2a = af(ex11.2a, "A")
ex11.2a$MY = (ex11.2a$Y1 + ex11.2a$Y2)/sqrt(2)
ex11.2a$Z = 2*ex11.2a$Z/sqrt(2)
GLM(MY ~ Z + A, ex11.2a)
```

```
$ANOVA
Response : MY
               Df  Sum Sq Mean Sq F value  Pr(>F)
MODEL           2 234.639  117.32  9.5696 0.01953 *
RESIDUALS       5  61.298   12.26
CORRECTED TOTAL 7 295.937
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
  Df  Sum Sq Mean Sq F value  Pr(>F)
Z  1 190.148 190.148 15.5101 0.01098 *
A  1  44.492  44.492  3.6291 0.11512
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
  Df  Sum Sq Mean Sq F value Pr(>F)
Z  1 166.577 166.577 13.5874 0.0142 *
A  1  44.492  44.492  3.6291 0.1151
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
  Df  Sum Sq Mean Sq F value Pr(>F)
Z  1 166.577 166.577 13.5874 0.0142 *
A  1  44.492  44.492  3.6291 0.1151
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  15.3934    2.70222  5.6966 0.002326 **
Z             1.0219    0.27724  3.6861 0.014203 *
A1           -4.7497    2.49325 -1.9050 0.115119
A2            0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(97) MODEL

```
ex11.2b = read.table("C:/G/Rt/Split/Ex11.2-two.txt", header=TRUE)
ex11.2b = af(ex11.2b, c("sub", "A", "B"))
GLM(Y ~ A + A:sub + B + A:B, ex11.2b)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL            9 382.06  42.451  39.954 0.0001135 ***
RESIDUALS        6   6.38   1.062
CORRECTED TOTAL 15 388.44
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
      Df  Sum Sq Mean Sq F value    Pr(>F)
A      1  68.062  68.062 64.0588 0.0002029 ***
A:sub  6 227.875  37.979 35.7451 0.0001934 ***
B      1  85.562  85.562 80.5294 0.0001070 ***
A:B    1   0.562   0.562  0.5294 0.4942562
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df  Sum Sq Mean Sq F value    Pr(>F)
A      1  68.062  68.062 64.0588 0.0002029 ***
A:sub  6 227.875  37.979 35.7451 0.0001934 ***
B      1  85.562  85.562 80.5294 0.0001070 ***
A:B    1   0.562   0.562  0.5294 0.4942562
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
      Df  Sum Sq Mean Sq F value    Pr(>F)
A      1  68.062  68.062 64.0588 0.0002029 ***
A:sub  6 227.875  37.979 35.7451 0.0001934 ***
```

```
B      1  85.562  85.562 80.5294 0.0001070 ***
A:B    1   0.562   0.562  0.5294 0.4942562
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value  Pr(>|t|)
(Intercept)   10.000    0.81490 12.2714 1.784e-05 ***
A1            -3.125    1.15244 -2.7116 0.0350301 *
A2             0.000    0.00000
A1:sub1        0.000    1.03078  0.0000 1.0000000
A1:sub2        4.500    1.03078  4.3656 0.0047414 **
A1:sub3        8.000    1.03078  7.7611 0.0002406 ***
A1:sub4        0.000    0.00000
A1:sub5        0.000    0.00000
A1:sub6        0.000    0.00000
A1:sub7        0.000    0.00000
A1:sub8        0.000    0.00000
A2:sub1        0.000    0.00000
A2:sub2        0.000    0.00000
A2:sub3        0.000    0.00000
A2:sub4        0.000    0.00000
A2:sub5        0.000    1.03078  0.0000 1.0000000
A2:sub6       10.000    1.03078  9.7014 6.883e-05 ***
A2:sub7        5.000    1.03078  4.8507 0.0028496 **
A2:sub8        0.000    0.00000
B1             5.000    0.72887  6.8599 0.0004725 ***
B2             0.000    0.00000
A1:B1         -0.750    1.03078 -0.7276 0.4942562
A1:B2          0.000    0.00000
A2:B1          0.000    0.00000
A2:B2          0.000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(98) MODEL

```
ex11.2c = read.table("C:/G/Rt/Split/Ex11.2-spcov2.txt", header=TRUE)
ex11.2c = af(ex11.2c, c("block", "whole", "split"))
GLM(Y ~ block + whole + block:whole + split + split:whole, ex11.2c)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value  Pr(>F)
MODEL           11    328 29.8182  3.1948 0.02875 *
RESIDUALS       12    112  9.3333
CORRECTED TOTAL 23    440
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
            Df Sum Sq Mean Sq F value  Pr(>F)
block        2     48      24  2.5714 0.11765
whole        1     24      24  2.5714 0.13479
block:whole  2     16       8  0.8571 0.44880
split        3    156      52  5.5714 0.01251 *
whole:split  3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
            Df Sum Sq Mean Sq F value  Pr(>F)
block        2     48      24  2.5714 0.11765
whole        1     24      24  2.5714 0.13479
block:whole  2     16       8  0.8571 0.44880
split        3    156      52  5.5714 0.01251 *
whole:split  3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
            Df Sum Sq Mean Sq F value  Pr(>F)
block        2     48      24  2.5714 0.11765
whole        1     24      24  2.5714 0.13479
block:whole  2     16       8  0.8571 0.44880
split        3    156      52  5.5714 0.01251 *
whole:split  3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)         17     2.1602  7.8695 4.448e-06 ***
block1              -5     2.1602 -2.3146 0.0391521 *
block2              -1     2.1602 -0.4629 0.6517110
block3               0     0.0000
whole1             -10     3.0551 -3.2733 0.0066627 **
whole2               0     0.0000
block1:whole1        4     3.0551  1.3093 0.2149461
block1:whole2        0     0.0000
block2:whole1        2     3.0551  0.6547 0.5250404
block2:whole2        0     0.0000
block3:whole1        0     0.0000
block3:whole2        0     0.0000
split1              -8     2.4944 -3.2071 0.0075321 **
```

```
split2              -9     2.4944 -3.6080 0.0035926 **
split3             -11     2.4944 -4.4098 0.0008506 ***
split4               0     0.0000
whole1:split1        6     3.5277  1.7008 0.1147185
whole1:split2       10     3.5277  2.8347 0.0150430 *
whole1:split3        8     3.5277  2.2678 0.0426079 *
whole1:split4        0     0.0000
whole2:split1        0     0.0000
whole2:split2        0     0.0000
whole2:split3        0     0.0000
whole2:split4        0     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(99) MODEL

```
GLM(Z ~ block + whole + block:whole + split + split:whole, ex11.2c)
```

```
$ANOVA
Response : Z
                Df Sum Sq Mean Sq    F value    Pr(>F)
MODEL           11     38  3.4545 3.5903e+15 < 2.2e-16 ***
RESIDUALS       12      0  0.0000
CORRECTED TOTAL 23     38
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
            Df Sum Sq Mean Sq    F value Pr(>F)
block        2 36.000 18.0000 1.8707e+16 <2e-16 ***
whole        1  0.667  0.6667 6.9286e+14 <2e-16 ***
block:whole  2  1.333  0.6667 6.9286e+14 <2e-16 ***
split        3  0.000  0.0000 0.0000e+00      1
whole:split  3  0.000  0.0000 0.0000e+00      1
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
            Df Sum Sq Mean Sq    F value Pr(>F)
block        2 36.000 18.0000 1.8707e+16 <2e-16 ***
whole        1  0.667  0.6667 6.9286e+14 <2e-16 ***
block:whole  2  1.333  0.6667 6.9286e+14 <2e-16 ***
split        3  0.000  0.0000 0.0000e+00      1
whole:split  3  0.000  0.0000 0.0000e+00      1
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
            Df Sum Sq Mean Sq    F value Pr(>F)
block        2 36.000 18.0000 1.8707e+16 <2e-16 ***
whole        1  0.667  0.6667 6.9286e+14 <2e-16 ***
block:whole  2  1.333  0.6667 6.9286e+14 <2e-16 ***
split        3  0.000  0.0000 0.0000e+00      1
whole:split  3  0.000  0.0000 0.0000e+00      1
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error    t value Pr(>|t|)
(Intercept)          5 2.1934e-08  227957476   <2e-16 ***
block1              -3 2.1934e-08 -136774486   <2e-16 ***
block2              -1 2.1934e-08  -45591495   <2e-16 ***
block3               0 0.0000e+00
whole1               0 3.1019e-08          0        1
whole2               0 0.0000e+00
block1:whole1        0 3.1019e-08          0        1
block1:whole2        0 0.0000e+00
block2:whole1       -1 3.1019e-08  -32238055   <2e-16 ***
block2:whole2        0 0.0000e+00
block3:whole1        0 0.0000e+00
block3:whole2        0 0.0000e+00
split1               0 2.5327e-08          0        1
split2               0 2.5327e-08          0        1
split3               0 2.5327e-08          0        1
split4               0 0.0000e+00
whole1:split1        0 3.5818e-08          0        1
whole1:split2        0 3.5818e-08          0        1
whole1:split3        0 3.5818e-08          0        1
whole1:split4        0 0.0000e+00
whole2:split1        0 0.0000e+00
whole2:split2        0 0.0000e+00
whole2:split3        0 0.0000e+00
whole2:split4        0 0.0000e+00
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(100) MODEL

```
GLM(Y ~ block + whole + block:whole + split + split:whole + Z, ex11.2c)
```

```
$ANOVA
Response : Y
               Df Sum Sq Mean Sq F value  Pr(>F)
MODEL          11    328 29.8182  3.1948 0.02875 *
```

```
RESIDUALS       12    112  9.3333
CORRECTED TOTAL 23    440
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
            Df Sum Sq Mean Sq F value  Pr(>F)
block        2     48      24  2.5714 0.11765
whole        1     24      24  2.5714 0.13479
block:whole  2     16       8  0.8571 0.44880
split        3    156      52  5.5714 0.01251 *
whole:split  3     84      28  3.0000 0.07277 .
Z            0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
            Df  Sum Sq Mean Sq F value  Pr(>F)
block        2  13.286   6.643  0.7117 0.51039
whole        1  16.000  16.000  1.7143 0.21495
block:whole  1  16.000  16.000  1.7143 0.21495
split        3 156.000  52.000  5.5714 0.01251 *
whole:split  3  84.000  28.000  3.0000 0.07277 .
Z            0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
            Df  Sum Sq Mean Sq F value  Pr(>F)
block        2  13.286   6.643  0.7117 0.51039
whole        1  16.000  16.000  1.7143 0.21495
block:whole  1  16.000  16.000  1.7143 0.21495
split        3 156.000  52.000  5.5714 0.01251 *
whole:split  3  84.000  28.000  3.0000 0.07277 .
Z            0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)         17     2.1602  7.8695 4.448e-06 ***
block1              -5     2.1602 -2.3146 0.0391521 *
block2              -1     2.1602 -0.4629 0.6517110
block3               0     0.0000
whole1             -10     3.0551 -3.2733 0.0066627 **
whole2               0     0.0000
block1:whole1        4     3.0551  1.3093 0.2149461
```

```
block1:whole2        0     0.0000
block2:whole1        2     3.0551  0.6547 0.5250404
block2:whole2        0     0.0000
block3:whole1        0     0.0000
block3:whole2        0     0.0000
split1              -8     2.4944 -3.2071 0.0075321 **
split2              -9     2.4944 -3.6080 0.0035926 **
split3             -11     2.4944 -4.4098 0.0008506 ***
split4               0     0.0000
whole1:split1        6     3.5277  1.7008 0.1147185
whole1:split2       10     3.5277  2.8347 0.0150430 *
whole1:split3        8     3.5277  2.2678 0.0426079 *
whole1:split4        0     0.0000
whole2:split1        0     0.0000
whole2:split2        0     0.0000
whole2:split3        0     0.0000
whole2:split4        0     0.0000
Z                    0     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 7.18 Example 11.3

(101) MODEL

```
ex11.3 = read.table("C:/G/Rt/Split/Ex11.3-sbcov.txt", header=TRUE)
ex11.3 = af(ex11.3, c("block", "A", "B"))
GLM(Y ~ block + A + block:A + B + block:B + A:B, ex11.3)
```

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL           17 16.833  0.9902  1.9804 0.2038
RESIDUALS        6  3.000  0.5000
CORRECTED TOTAL 23 19.833

$`Type I`
        Df Sum Sq Mean Sq F value  Pr(>F)
block    3 4.5000  1.5000  3.0000 0.11696
A        1 1.5000  1.5000  3.0000 0.13397
block:A  3 0.5000  0.1667  0.3333 0.80220
B        2 8.3333  4.1667  8.3333 0.01855 *
block:B  6 1.0000  0.1667  0.3333 0.89648
A:B      2 1.0000  0.5000  1.0000 0.42188
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
        Df Sum Sq Mean Sq F value  Pr(>F)
block    3 4.5000  1.5000  3.0000 0.11696
A        1 1.5000  1.5000  3.0000 0.13397
block:A  3 0.5000  0.1667  0.3333 0.80220
B        2 8.3333  4.1667  8.3333 0.01855 *
block:B  6 1.0000  0.1667  0.3333 0.89648
A:B      2 1.0000  0.5000  1.0000 0.42188
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
        Df Sum Sq Mean Sq F value  Pr(>F)
block    3 4.5000  1.5000  3.0000 0.11696
A        1 1.5000  1.5000  3.0000 0.13397
block:A  3 0.5000  0.1667  0.3333 0.80220
B        2 8.3333  4.1667  8.3333 0.01855 *
block:B  6 1.0000  0.1667  0.3333 0.89648
A:B      2 1.0000  0.5000  1.0000 0.42188
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   4.5000    0.61237  7.3485 0.000325 ***
block1       -1.3333    0.81650 -1.6330 0.153590
block2       -0.3333    0.81650 -0.4082 0.697261
block3       -0.3333    0.81650 -0.4082 0.697261
block4        0.0000    0.00000
A1           -1.0000    0.70711 -1.4142 0.207031
A2            0.0000    0.00000
block1:A1     0.6667    0.81650  0.8165 0.445416
block1:A2     0.0000    0.00000
block2:A1     0.6667    0.81650  0.8165 0.445416
block2:A2     0.0000    0.00000
block3:A1     0.6667    0.81650  0.8165 0.445416
block3:A2     0.0000    0.00000
block4:A1     0.0000    0.00000
block4:A2     0.0000    0.00000
B1           -0.7500    0.79057 -0.9487 0.379410
B2           -1.7500    0.79057 -2.2136 0.068802 .
B3            0.0000    0.00000
block1:B1    -0.5000    1.00000 -0.5000 0.634880
block1:B2     0.5000    1.00000  0.5000 0.634880
block1:B3     0.0000    0.00000
block2:B1    -0.5000    1.00000 -0.5000 0.634880
block2:B2     0.5000    1.00000  0.5000 0.634880
block2:B3     0.0000    0.00000
```

```
block3:B1     0.0000    1.00000  0.0000 1.000000
block3:B2     0.0000    1.00000  0.0000 1.000000
block3:B3     0.0000    0.00000
block4:B1     0.0000    0.00000
block4:B2     0.0000    0.00000
block4:B3     0.0000    0.00000
A1:B1        -0.5000    0.70711 -0.7071 0.506021
A1:B2         0.5000    0.70711  0.7071 0.506021
A1:B3         0.0000    0.00000
A2:B1         0.0000    0.00000
A2:B2         0.0000    0.00000
A2:B3         0.0000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(102) MODEL

```
GLM(Z ~ block + A + block:A + B + block:B + A:B, ex11.3)
```

```
$ANOVA
Response : Z
                Df Sum Sq Mean Sq F value  Pr(>F)
MODEL           17 31.167 1.83333     3.3 0.07324 .
RESIDUALS        6  3.333 0.55556
CORRECTED TOTAL 23 34.500
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
        Df  Sum Sq Mean Sq F value  Pr(>F)
block    3  6.8333  2.2778     4.1 0.06689 .
A        1  6.0000  6.0000    10.8 0.01669 *
block:A  3  1.6667  0.5556     1.0 0.45472
B        2 13.0000  6.5000    11.7 0.00850 **
block:B  6  3.6667  0.6111     1.1 0.45542
A:B      2  0.0000  0.0000     0.0 1.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df  Sum Sq Mean Sq F value  Pr(>F)
block    3  6.8333  2.2778     4.1 0.06689 .
A        1  6.0000  6.0000    10.8 0.01669 *
block:A  3  1.6667  0.5556     1.0 0.45472
B        2 13.0000  6.5000    11.7 0.00850 **
block:B  6  3.6667  0.6111     1.1 0.45542
A:B      2  0.0000  0.0000     0.0 1.00000
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
        Df  Sum Sq Mean Sq F value  Pr(>F)
block    3  6.8333  2.2778     4.1 0.06689 .
A        1  6.0000  6.0000    10.8 0.01669 *
block:A  3  1.6667  0.5556     1.0 0.45472
B        2 13.0000  6.5000    11.7 0.00850 **
block:B  6  3.6667  0.6111     1.1 0.45542
A:B      2  0.0000  0.0000     0.0 1.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.83333    0.64550  4.3894 0.004621 **
block1       0.00000    0.86066  0.0000 1.000000
block2       1.83333    0.86066  2.1301 0.077194 .
block3      -0.16667    0.86066 -0.1936 0.852840
block4       0.00000    0.00000
A1          -1.66667    0.74536 -2.2361 0.066707 .
A2           0.00000    0.00000
block1:A1    1.00000    0.86066  1.1619 0.289403
block1:A2    0.00000    0.00000
block2:A1    0.33333    0.86066  0.3873 0.711901
block2:A2    0.00000    0.00000
block3:A1    1.33333    0.86066  1.5492 0.172308
block3:A2    0.00000    0.00000
block4:A1    0.00000    0.00000
block4:A2    0.00000    0.00000
B1          -0.50000    0.83333 -0.6000 0.570456
B2          -1.00000    0.83333 -1.2000 0.275367
B3           0.00000    0.00000
block1:B1   -2.00000    1.05409 -1.8974 0.106558
block1:B2    0.00000    1.05409  0.0000 1.000000
block1:B3    0.00000    0.00000
block2:B1   -2.00000    1.05409 -1.8974 0.106558
block2:B2   -0.50000    1.05409 -0.4743 0.652027
block2:B3    0.00000    0.00000
block3:B1   -1.00000    1.05409 -0.9487 0.379410
block3:B2   -0.50000    1.05409 -0.4743 0.652027
block3:B3    0.00000    0.00000
block4:B1    0.00000    0.00000
block4:B2    0.00000    0.00000
block4:B3    0.00000    0.00000
A1:B1        0.00000    0.74536  0.0000 1.000000
A1:B2        0.00000    0.74536  0.0000 1.000000
```

```
A1:B3        0.00000    0.00000
A2:B1        0.00000    0.00000
A2:B2        0.00000    0.00000
A2:B3        0.00000    0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(103) MODEL

```
GLM(Y ~ block + A + block:A + B + block:B + A:B + Z, ex11.3)
```

```
$ANOVA
Response : Y
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL           18 17.8417 0.99120  2.4884 0.1589
RESIDUALS        5  1.9917 0.39833
CORRECTED TOTAL 23 19.8333

$`Type I`
        Df Sum Sq Mean Sq F value  Pr(>F)
block    3 4.5000  1.5000  3.7657 0.09378 .
A        1 1.5000  1.5000  3.7657 0.10999
block:A  3 0.5000  0.1667  0.4184 0.74788
B        2 8.3333  4.1667 10.4603 0.01634 *
block:B  6 1.0000  0.1667  0.4184 0.84059
A:B      2 1.0000  0.5000  1.2552 0.36163
Z        1 1.0083  1.0083  2.5314 0.17248
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df Sum Sq Mean Sq F value Pr(>F)
block    3 3.6203 1.20678  3.0296 0.1319
A        1 0.0000 0.00000  0.0000 1.0000
block:A  3 0.2583 0.08611  0.2162 0.8813
B        2 1.0317 0.51587  1.2951 0.3522
block:B  6 0.4210 0.07017  0.1762 0.9717
A:B      2 1.0000 0.50000  1.2552 0.3616
Z        1 1.0083 1.00833  2.5314 0.1725

$`Type III`
        Df Sum Sq Mean Sq F value Pr(>F)
block    3 3.6613 1.22045  3.0639 0.1297
A        1 0.0054 0.00536  0.0134 0.9122
block:A  3 0.2583 0.08611  0.2162 0.8813
B        2 0.7685 0.38427  0.9647 0.4423
block:B  6 0.4210 0.07017  0.1762 0.9717
```

```
A:B      2 1.0000 0.50000  1.2552 0.3616
Z        1 1.0083 1.00833  2.5314 0.1725

$Parameter
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.94167    1.12164  2.6227  0.04695 *
block1      -1.33333    0.72877 -1.8296  0.12684
block2      -1.34167    0.96580 -1.3892  0.22347
block3      -0.24167    0.73105 -0.3306  0.75437
block4       0.00000    0.00000
A1          -0.08333    0.85456 -0.0975  0.92611
A2           0.00000    0.00000
block1:A1    0.11667    0.80660  0.1446  0.89065
block1:A2    0.00000    0.00000
block2:A1    0.48333    0.73783  0.6551  0.54135
block2:A2    0.00000    0.00000
block3:A1   -0.06667    0.86230 -0.0773  0.94137
block3:A2    0.00000    0.00000
block4:A1    0.00000    0.00000
block4:A2    0.00000    0.00000
B1          -0.47500    0.72649 -0.6538  0.54210
B2          -1.20000    0.78576 -1.5272  0.18725
B3           0.00000    0.00000
block1:B1    0.60000    1.12901  0.5314  0.61787
block1:B2    0.50000    0.89256  0.5602  0.59952
block1:B3    0.00000    0.00000
block2:B1    0.60000    1.12901  0.5314  0.61787
block2:B2    0.77500    0.90914  0.8525  0.43289
block2:B3    0.00000    0.00000
block3:B1    0.55000    0.95717  0.5746  0.59044
block3:B2    0.27500    0.90914  0.3025  0.77446
block3:B3    0.00000    0.00000
block4:B1    0.00000    0.00000
block4:B2    0.00000    0.00000
block4:B3    0.00000    0.00000
A1:B1       -0.50000    0.63114 -0.7922  0.46414
A1:B2        0.50000    0.63114  0.7922  0.46414
A1:B3        0.00000    0.00000
A2:B1        0.00000    0.00000
A2:B2        0.00000    0.00000
A2:B3        0.00000    0.00000
Z            0.55000    0.34569  1.5910  0.17248
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

# 8 Searle - Linear Models 2e

## 8.1 7.2 (p390, 59%)

(104) MODEL

```
weight = c(8,13,9,12,7,11,6,12,12,14,9,7,14,16,10,14,11,13)
treatment = c("ta","ta","ta","ta","ta","ta","tb","tb","tb","tb","tc","tc","tc",
              "tc","tc","tc","tc","tc")
variety = c("va","va","va","vc","vd","vd","va","va","vb","vb","vb","vb","vc",
            "vc","vd","vd","vd","vd")
d1 = data.frame(weight, treatment, variety)
GLM(weight ~ treatment*variety, d1)
```

```
$ANOVA
Response : weight
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL            7     82  11.714  2.0918   0.14
RESIDUALS       10     56   5.600
CORRECTED TOTAL 17    138

$`Type I`
                  Df Sum Sq Mean Sq F value  Pr(>F)
treatment          2 10.500   5.250  0.9375 0.42348
variety            3 36.786  12.262  2.1896 0.15232
treatment:variety  2 34.714  17.357  3.0995 0.08965 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
                  Df Sum Sq Mean Sq F value  Pr(>F)
treatment          2  9.486  4.7429  0.8469 0.45731
variety            3 36.786 12.2619  2.1896 0.15232
treatment:variety  2 34.714 17.3571  3.0995 0.08965 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
                  Df Sum Sq Mean Sq F value  Pr(>F)
treatment          2 12.471  6.2353  1.1134 0.36595
variety            3 34.872 11.6240  2.0757 0.16719
treatment:variety  2 34.714 17.3571  3.0995 0.08965 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                     Estimate Std. Error t value  Pr(>|t|)
```

```
(Intercept)                 12     1.1832 10.1419 1.397e-06 ***
treatmentta                 -3     2.0494 -1.4639   0.17395
treatmenttb                  5     2.3664  2.1129   0.06075 .
treatmenttc                  0     0.0000
varietyva                   -8     3.1305 -2.5555   0.02859 *
varietyvb                   -4     2.0494 -1.9518   0.07951 .
varietyvc                    3     2.0494  1.4639   0.17395
varietyvd                    0     0.0000
treatmentta:varietyva        9     3.8035  2.3662   0.03953 *
treatmentta:varietyvb        0     0.0000
treatmentta:varietyvc        0     3.5496  0.0000   1.00000
treatmentta:varietyvd        0     0.0000
treatmenttb:varietyva        0     0.0000
treatmenttb:varietyvb        0     0.0000
treatmenttb:varietyvc        0     0.0000
treatmenttb:varietyvd        0     0.0000
treatmenttc:varietyva        0     0.0000
treatmenttc:varietyvb        0     0.0000
treatmenttc:varietyvc        0     0.0000
treatmenttc:varietyvd        0     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts = c("contr.sum", "contr.poly"))
Anova(lm(weight ~ treatment*variety, d1), type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: weight
                  Sum Sq Df F values  Pr(>F)
treatment          0.000  0
variety            0.000  0
treatment:variety 34.714  2   3.0995 0.08965 .
Residuals         56.000 10
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 8.2 7.2 (p393, 60%)

(105) MODEL

```
percent = c(31,33,44,36,38,26,37,59,42,42,34,42,28,39,36,32,38,42,36,22,42,46,
            26,37,43)
refinery = c(rep("g",9),rep("n",8),rep("s",8))
process = as.factor(c(1,1,1,1,1,1,2,2,2,1,1,1,1,2,2,2,2,1,1,1,2,2,2,2,2))
source0 = c("t","t","t","t","o","m","t","t","o","m","i","i","i","t","o","m","m",
            "t","o","i","o","o","m","i","i")
d2 = data.frame(percent, refinery, process, source=source0)
GLM(percent ~ refinery*source, d2)
```

```
$ANOVA
Response : percent
                Df  Sum Sq Mean Sq F value Pr(>F)
MODEL           10  442.56  44.256  0.6361 0.7616
RESIDUALS       14  974.00  69.571
CORRECTED TOTAL 24 1416.56

$`Type I`
                Df  Sum Sq Mean Sq F value Pr(>F)
refinery         2  20.963  10.481  0.1507 0.8615
source           3 266.124  88.708  1.2751 0.3212
refinery:source  5 155.474  31.095  0.4469 0.8086

$`Type II`
                Df  Sum Sq Mean Sq F value Pr(>F)
refinery         2  25.535  12.767  0.1835 0.8343
source           3 266.124  88.708  1.2751 0.3212
refinery:source  5 155.474  31.095  0.4469 0.8086

$`Type III`
                Df  Sum Sq Mean Sq F value Pr(>F)
refinery         2  10.766   5.383  0.0774 0.9259
source           3 282.633  94.211  1.3542 0.2972
refinery:source  5 155.474  31.095  0.4469 0.8086

$Parameter
                  Estimate Std. Error t value  Pr(>|t|)
(Intercept)         42.000     8.3409  5.0354 0.0001822 ***
refineryg           -2.000     9.0093 -0.2220 0.8275243
refineryn           -3.000    11.7959 -0.2543 0.8029412
refinerys            0.000     0.0000
sourcei             -8.000     9.6313 -0.8306 0.4201255
sourcem            -16.000    11.7959 -1.3564 0.1964425
sourceo             -0.667     9.6313 -0.0692 0.9457944
sourcet              0.000     0.0000
refineryg:sourcei    0.000     0.0000
refineryg:sourcem    2.000    14.8428  0.1347 0.8947314
refineryg:sourceo    0.667    11.7959  0.0565 0.9557287
```

```
refineryg:sourcet    0.000     0.0000
refineryn:sourcei    3.667    13.6207  0.2692 0.7917042
refineryn:sourcem   14.333    15.2284  0.9412 0.3625491
refineryn:sourceo   -2.333    15.2284 -0.1532 0.8804095
refineryn:sourcet    0.000     0.0000
refinerys:sourcei    0.000     0.0000
refinerys:sourcem    0.000     0.0000
refinerys:sourceo    0.000     0.0000
refinerys:sourcet    0.000     0.0000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(percent ~ refinery*source, d2), type=3, singular.ok=TRUE)
```

```
Note: model has aliased coefficients
      sums of squares computed by model comparison

Anova Table (Type III tests)

Response: percent
                Sum Sq Df F values Pr(>F)
refinery          2.52  1   0.0362 0.8518
source          268.19  2   1.9275 0.1822
refinery:source 155.47  5   0.4469 0.8086
Residuals       974.00 14
```

# 9 Summary

| Package | Total | Pass | Fail |
|---|---|---|---|
| sasLM_0.1.2 | 105 | 103 (98%) | 2 (2%) |
| car_3.0-6 | 105 | <= 91 (< 87%) | >= 14 (> 13%) |

Definition of Pass: Practically identical to SAS output

Different results does not mean that one of them must be wrong.

Both of them can be right when singularity or aliased coefficients exist.

Type III sum of square(SS) depends on software implementation. Therefore, it could be different among software.

All of the failed cases with sasLM_0.1.2 had singularity and aliased coefficients.

All other cases having singularity or aliased coefficients still showed identical results.

## 10 Sesssion Information

```
R version 3.6.3 (2020-02-29)
Platform: x86_64-w64-mingw32/x64 (64-bit)
Running under: Windows 10 x64 (build 17763)

Matrix products: default

locale:
[1] LC_COLLATE=Korean_Korea.949 LC_CTYPE=Korean_Korea.949
LC_MONETARY=Korean_Korea.949 LC_NUMERIC=C
[5] LC_TIME=Korean_Korea.949

attached base packages:
[1] stats graphics grDevices utils datasets methods base

other attached packages:
[1] knitr_1.28 rmarkdown_1.15 car_3.0-7 carData_3.0-3 sasLM_0.1.2

loaded via a namespace (and not attached):
[1] Rcpp_1.0.2 magrittr_1.5 hms_0.5.3 rlang_0.4.5 stringr_1.4.0 tools_3.6.3
[7] data.table_1.12.8 xfun_0.12 rio_0.5.16 htmltools_0.3.6 yaml_2.2.0
digest_0.6.20
[13] abind_1.4-5 readxl_1.3.1 tibble_2.1.3 crayon_1.3.4 zip_2.0.4 vctrs_0.2.4
[19] curl_4.3 evaluate_0.14 haven_2.2.0 openxlsx_4.1.4 stringi_1.4.3
compiler_3.6.3
[25] pillar_1.4.3 cellranger_1.1.0 forcats_0.5.0 foreign_0.8-76 pkgconfig_2.0.3
```