

Package ‘stability’

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Type Package

Title Stability Analysis of Genotype by Environment Interaction (GEI)

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Description Functionalities to perform Stability Analysis of Genotype by Environment Interaction (GEI) to identify superior and stable genotypes under diverse environments. It performs Eberhart & Russel's ANOVA (1966) (<doi:10.2135/cropsci1966.0011183X000600010011x>), Finlay and Wilkinson (1963) Joint Linear Regression (<doi:10.1071/AR9630742>), Wricke (1962, 1964) Ecovalence, Shukla's stability variance parameter (1972) (<doi:10.1038/hdy.1972.87>) and Kang's (1991) (<doi:10.2134/agronj1991.00021962008300010037x>) simultaneous selection for high yielding and stable parameter.

Depends R (>= 3.1)

Imports dplyr, ggplot2, ggfortify, lme4, magrittr, matrixStats,
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URL <https://github.com/myaseen208/stability>,
<https://myaseen208.github.io/stability/>

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add_anova	<i>Additive ANOVA for Genotypes by Environment Interaction (GEI) model</i>
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Description

Additive ANOVA for Genotypes by Environment Interaction (GEI) model

Usage

```
add_anova(.data, .y, .rep, .gen, .env)
```

```
## Default S3 method:
```

```
add_anova(.data, .y, .rep, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor

Value

Additive ANOVA

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
YieldANOVA <-
  add_anova(
    .data = ge_data
    , .y   = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
  )
YieldANOVA
```

ammi

Additive Main Effects and Multiplicative Interaction (AMMI)

Description

Performs Additive Main Effects and Multiplicative Interaction (AMMI) Analysis for Genotypes by Environment Interaction (GEI)

Usage

```
ammi(.data, .y, .rep, .gen, .env)
```

```
## Default S3 method:
ammi(.data, .y, .rep, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor

Value

Stability Measures

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
Yield.ammi <-
  ammi(
    .data = ge_data
    , .y   = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
  )
Yield.ammi
```

ammi_biplot

Additive Main Effects and Multiplicative Interaction (AMMI) Biplot

Description

Plots Additive Main Effects and Multiplicative Interaction (AMMI) for Genotypes by Environment Interaction (GEI)

Usage

```
ammi_biplot(.data, .y, .rep, .gen, .env)

## Default S3 method:
ammi_biplot(.data, .y, .rep, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor

Value

Stability Measures

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
  ammi_biplot(
    .data = ge_data
    , .y = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
  )
```

er_anova

Eberhart & Russel's Model ANOVA

Description

ANOVA of Eberhart & Russel's Model

Usage

```
er_anova(.data, .y, .rep, .gen, .env)
```

```
## Default S3 method:
```

```
er_anova(.data, .y, .rep, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor

Value

Additive ANOVA

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
Yield.er_anova <-
  er_anova(
    .data = ge_data
    , .y = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
  )
Yield.er_anova
```

ge_data

Data for Genotypes by Environment Interaction (GEI)

Description

ge_data is used for performing Genotypes by Environment Interaction (GEI) Analysis.

Usage

```
data(ge_data)
```

Format

A data.frame 1320 obs. of 6 variables.

Details

- Gen Genotype
- Institute Institute
- Rep Replicate
- Block Block
- Env Environment
- Yield Yield Response

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
```

ge_effects

Genotype by Environment Interaction Effects

Description

Calculates Genotype by Environment Interaction Effects

Usage

```
ge_effects(.data, .y, .gen, .env)
```

```
## Default S3 method:
```

```
ge_effects(.data, .y, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.gen	Genotypes Factor
.env	Environment Factor

Value

Effects

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
Yield.Effects <-
  ge_effects(
    .data = ge_data
    , .y = Yield
    , .gen = Gen
    , .env = Env
  )
names(Yield.Effects)

Yield.Effects$ge_means
Yield.Effects$ge_effects
Yield.Effects$gge_effects
```

ge_means

Genotype by Environment Interaction Means and Ranks

Description

Calculates Genotype by Environment Interaction Means along with their Ranks

Usage

```
ge_means(.data, .y, .gen, .env)

## Default S3 method:
ge_means(.data, .y, .gen, .env)
```


Arguments

.data	data.frame
.y	Response Variable
.gen	Genotypes Factor
.env	Environment Factor

Value

Means and Ranks

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)

Yield.ge_means <-
  ge_means(
    .data = ge_data
    , .y = Yield
    , .gen = Gen
    , .env = Env
  )

Yield.ge_means$ge_means
Yield.ge_means$ge_ranks
Yield.ge_means$g_means
Yield.ge_means$e_means
```

gge_biplot

Genotype plus Genotypes by Environment (GGE) Interaction Biplot

Description

Plots Genotype plus Genotypes by Environment (GGE) Interaction Biplot for Genotypes by Environment Interaction (GEI)

Usage

```
gge_biplot(.data, .y, .rep, .gen, .env)

## Default S3 method:
gge_biplot(.data, .y, .rep, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor

Value

Stability Measures

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
gge_biplot(
  .data = ge_data
  , .y   = Yield
  , .rep = Rep
  , .gen = Gen
  , .env = Env
)
```

indiv_anova	<i>Individual ANOVA for Each Environment</i>
-------------	--

Description

Individual ANOVA for Each Environment

Usage

```
## Default S3 method:  
indiv_anova(.data, .y, .rep, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor

Value

Additive ANOVA

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)
3. Ghulam Murtaza (<gmurtaza208@gmail.com>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)  
Yield.indiv_anova <-  
  indiv_anova(  
    .data = ge_data  
    , .y   = Yield  
    , .rep = Rep  
    , .gen = Gen  
    , .env = Env  
  )
```

Yield.indiv_anova

stability

Stability Analysis of Genotype by Environment Interaction (GEI)

Description

The `stability` package provides functionalities to perform Stability Analysis of Genotype by Environment Interaction (GEI) to identify superior and stable genotypes under diverse environments. It performs Eberhart & Russel's ANOVA (1966), Finlay and Wilkinson (1963) Joint Linear Regression, Wricke (1962, 1964) Ecovalence, Shukla's stability variance parameter (1972) and Kang's (1991) simultaneous selection for high yielding and stable parameter.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

stab_asv

Additive Main Effects and Multiplicative Interacion Stability Value

Description

Additive ANOVA for Genotypes by Environment Interaction (GEI) model

Usage

```
stab_asv(.data, .y, .rep, .gen, .env)
```

```
## Default S3 method:
```

```
stab_asv(.data, .y, .rep, .gen, .env)
```

Arguments

<code>.data</code>	data.frame
<code>.y</code>	Response Variable
<code>.rep</code>	Replication Factor
<code>.gen</code>	Genotypes Factor
<code>.env</code>	Environment Factor

Value

Additive ANOVA

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
YieldASV <-
  stab_asv(
    .data = ge_data
    , .y   = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
  )
YieldASV
```

stab_dist

Stability Distance in AMMI

Description

Stability Distance of Genotypes in Additive ANOVA for Genotypes by Environment Interaction (GEI) model

Usage

```
stab_dist(.data, .y, .rep, .gen, .env, .m = 2)
```

```
## Default S3 method:
```

```
stab_dist(.data, .y, .rep, .gen, .env, .m = 2)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor
.m	No of PCs retained

Value

Stability Distance

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

Examples

```
data(ge_data)
YieldDist <-
  stab_dist(
    .data = ge_data
    , .y   = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
    , .m   = 2
  )
YieldDist
```

stab_fox

Stability Fox Function

Description

Performs a stability analysis based on the criteria of Fox et al. (1990), using the statistical "TOP third" only. In Fox function, a stratified ranking of the genotypes at each environment separately is done. The proportion of locations at which the genotype occurred in the top third are expressed in TOP output.

Usage

```
stab_fox(.data, .y, .rep, .gen, .env)
```

```
## Default S3 method:
```

```
stab_fox(.data, .y, .rep, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

1. Fox, P.N. and Skovmand, B. and Thompson, B.K. and Braun, H.J. and Cormier, R. (1990). Yield and adaptation of hexaploid spring triticale. *Euphytica*, **47**, 57-64.

Examples

```
data(ge_data)
YieldFox <-
  stab_fox(
    .data = ge_data
    , .y   = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
  )
YieldFox
```

stab_kang	<i>Stability Kang Function</i>
-----------	--------------------------------

Description

Performs a stability analysis based on the Kang (1988) criteria. Kang nonparametric stability (ranksum) uses both "trait single value" and stability variance (Shukla, 1972), and the genotype with the lowest ranksum is commonly the most favorable one.

Usage

```
stab_kang(.data, .y, .rep, .gen, .env)

## Default S3 method:
stab_kang(.data, .y, .rep, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

1. Kang, M.S. (1988). A rank-sum method for selecting high-yielding, stable corn genotypes. *Cereal Research Communications*, **16**, 1-2.
2. Shukla, G.K. (1972). Some aspects of partitioning genotype environmental components of variability. *Heredity*, **29**, 237-245.

Examples

```
data(ge_data)
YieldKang <-
  stab_kang(
    .data = ge_data
    , .y   = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
  )
YieldKang
```

stab_masv

Modified Additive Main Effects and Multiplicative Interacion Stability Value

Description

Additive ANOVA for Genotypes by Environment Interaction (GEI) model

Usage

```
stab_masv(.data, .y, .rep, .gen, .env, .m = 2)
```

```
## Default S3 method:
```

```
stab_masv(.data, .y, .rep, .gen, .env, .m = 2)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor
.m	No of PCs retained

Value

Additive ANOVA

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
YieldMASV <-
  stab_masv(
    .data = ge_data
    , .y = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
    , .m = 2
  )
YieldMASV
```

stab_measures

Stability Measures for Genotypes by Environment Interaction (GEI)

Description

Stability Measures for Genotypes by Environment Interaction (GEI)

Usage

```
stab_measures(.data, .y, .gen, .env)
```

```
## Default S3 method:
stab_measures(.data, .y, .gen, .env)
```

Arguments

.data	data.frame
.y	Response Variable
.gen	Genotypes Factor
.env	Environment Factor

Value

Stability Measures

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
Yield.StabMeasures <- stab_measures(
  .data = ge_data
  , .y = Yield
  , .gen = Gen
  , .env = Env
)
Yield.StabMeasures
```

stab_par

Stability Parameters for Genotypes by Environment Interaction (GEI)

Description

Stability Parameters for Genotypes by Environment Interaction (GEI)

Usage

```
stab_par(.data, .y, .rep, .gen, .env, alpha = 0.1, .envCov = NULL)

## Default S3 method:
stab_par(.data, .y, .rep, .gen, .env, alpha = 0.1,
  .envCov = NULL)
```

Arguments

.data	data.frame
.y	Response Variable
.rep	Replication Factor
.gen	Genotypes Factor
.env	Environment Factor
alpha	Level of Significance, default is 0.1
.envCov	Environmental Covariate, default is NULL

Value

Stability Parameters

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
Yield.StabPar <-
  stab_par(
    .data = ge_data
    , .y = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
    , alpha = 0.1
    , .envCov = NULL
  )

Yield.StabPar
```

`stab_reg`*Individual Regression for each Genotype*

Description

Individual Regression for each Genotype in Genotypes by Environment Interaction (GEI)

Usage

```
stab_reg(.data, .y, .rep, .gen, .env)
```

```
## Default S3 method:
```

```
stab_reg(.data, .y, .rep, .gen, .env)
```

Arguments

<code>.data</code>	data.frame
<code>.y</code>	Response Variable
<code>.rep</code>	Replication Factor
<code>.gen</code>	Genotypes Factor
<code>.env</code>	Environment Factor

Value

Additive ANOVA

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Kent M. Edkridge (<keskridge1@unl.edu>)

References

Singh, R. K. and Chaudhary, B. D. (2004) *Biometrical Methods in Quantitative Genetic Analysis*. New Delhi: Kalyani.

Examples

```
data(ge_data)
Yield.StabReg <-
  stab_reg(
    .data = ge_data
    , .y   = Yield
    , .rep = Rep
    , .gen = Gen
    , .env = Env
```

stab_reg

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)

Yield.StabReg

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