Package 'safuzzy'

July 10, 2026

Type Package

Title Stability Analysis with Fuzzy Logic

Version 0.1.1

Description It integrates 'fuzzy logic' into the analysis of genotype adaptability and stability. By classifying genotypes based on degrees of belonging, the package provides a detailed assessment of their behavior in different environmental groups.

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Encoding UTF-8

LazyData true

RoxygenNote 8.0.0

Date 2026-07-02

Imports dplyr, purrr, tidyr

Depends R (>= 3.5)

NeedsCompilation no

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Repository CRAN

Date/Publication 2026-07-10 20:30:08 UTC

Contents

annicchiarico *Annicchiarico (1992) method*

Description

Adaptability and Stability Analysis based on the interpretation of the Annicchiarico 1992 methodology, developed by Carneiro et al. 2019.

Usage

```
annicchiarico(data, env, gen, rep, var)
```

Arguments

data	Data file (data.frame) with variables.
env	Column with environment information.
gen	Coluna contendo informações de genótipo.
rep	Column containing genotype information.
var	Variable to be analyzed.

Value

A data frame containing the following estimates:

Gen Genotype.

Wg General recommendation index for environments.

Wd Recommendation index for unfavorable environments.

Wf Recommendation index for favorable environments.

GE Membership (%) to the general stability genotypes group.

PA Membership (%) to the poorly adapted genotypes group.

FAV Membership (%) to the favorable adapted genotypes group.

UNF Membership (%) to the unfavorable adapted genotypes group.

Author(s)

Douglas de Oliveira Maciel <douglasmaciel@discente.ufg.br>

References

Carneiro, A. R. T., Sanglard, D. A., Azevedo, A. M., Souza, T. L. P. O. D., Pereira, H. S., & Melo, L. C. (2019). Fuzzy logic in automation for interpretation of adaptability and stability in plant breeding studies. Scientia Agricola, 76(2), 123-129.

See Also

hybrid

lin_binns

Examples

```
data(ge_data)
annicchiarico(data = ge_data, env = environment, gen = genotype, rep = block, var = gy)
```

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cruz_torres_vencovsky *Cruz, Torres & Vencovsky (1989) method*

Description

Adaptability and Stability Analysis based on the interpretation of the Cruz, Torres & Vencovsky (1989), developed by Carneiro et al. 2019.

Usage

```
cruz_torres_vencovsky(data, env, gen, rep, var)
```

Arguments

data	Data file (data.frame) with variables.
env	Column with environment information.
gen	Coluna contendo informações de genótipo.
rep	Column containing genotype information.
var	Variable to be analyzed.

Value

A data frame containing the following estimates:

Gen Genotype.

B_0 Mean of the variable for each genotype.

B_1 Regression coefficient (B_1) for each genotype.

B1_B2 Regression coefficient ($B_1 + B_2$) for each genotype.

R2 Coefficient of determination (R^2) for each genotype.

MdAF Membership (%) to the average adaptability to favorable environments genotypes group.

Nda Membership (%) to the poorly adapted genotypes group.

MdAG Membership (%) to the general adaptability to favorable environments genotypes group.

MaxGF Membership (%) to the maximum adaptability to favorable environments genotypes group.

MaxDes Membership (%) to the maximum adaptability to unfavorable environments environments group.

BE Membership (%) to the low stability genotypes group.

BP Membership (%) to the low yield genotypes group.

Author(s)

Douglas de Oliveira Maciel <douglasmaciel@discente.ufg.br>

References

Carneiro, A. R. T., Sanglard, D. A., Azevedo, A. M., Souza, T. L. P. O. D., Pereira, H. S., & Melo, L. C. (2019). Fuzzy logic in automation for interpretation of adaptability and stability in plant breeding studies. Scientia Agricola, 76(2), 123-129.

See Also

hybrid

lin_binns

eberhart_russell

Examples

```
data(ge_data)

cruz_torres_vencovsky(data = ge_data, env = environment, gen = genotype, rep = block, var = gy)
```

---

eberhart_russell *Eberhart & Russel (1966) method*

Description

Adaptability and Stability Analysis based on the interpretation of the Eberhart & Russel 1966 methodology, developed by Carneiro et al. 2018.

Usage

```
eberhart_russell(data, env, gen, rep, var)
```

Arguments

data	Data file (data.frame) with variables.
env	Column with environment information.
gen	Coluna contendo informações de genótipo.
rep	Column containing genotype information.
var	Variable to be analyzed.

Value

A data frame containing the following estimates:

`Gen` Genotype.

`B_0` Mean of the variable for each genotype.

`B_1` Regression coefficient (B_1) for each genotype.

`R2` Coefficient of determination (R^2) for each genotype.

`GE` Membership (%) to the general stability genotypes group.

`PA` Membership (%) to the poorly adapted genotypes group.

`FAV` Membership (%) to the favorable adapted genotypes group.

`UNF` Membership (%) to the unfavorable adapted genotypes group.

Author(s)

Douglas de Oliveira Maciel <douglasmaciel@discente.ufg.br>

References

Carneiro, V. Q., Prado, A. L. D., Cruz, C. D., Carneiro, P. C. S., Nascimento, M., & Carneiro, J. E. D. S. (2018). Fuzzy control systems for decision-making in cultivars recommendation. Acta Scientiarum. Agronomy, 40, e39314.

See Also

`hybrid`

`lin_binns`

Examples

```
data(ge_data)

eberhart_russell(data = ge_data, env = environment, gen = genotype, rep = block, var = gy)
```

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ge_data *Rice Lines Adaptability and Stability Data Using Fuzzy Logic*

Description

A real dataset containing the grain yield and plant heigth performance of upland rice lines evaluated across multiple environments. This dataset is used to demonstrate the application of the fuzzy logic methodology for adaptability and stability analysis implemented in the `safuzzy` package.

Usage

```
ge_data
```

Format

A data frame (or tibble) with columns representing the experimental factors:

`genotype` Factor representing the evaluated upland rice lines/genotypes.

`environment` Factor representing the test environments (combinations of locations and crop years).

`block` Factor representing the local control.

`gy` Numeric variable containing the grain yield performance (e.g., kg/ha).

`ph` Numeric variable containing the plant heigth performance (e.g., cm).

Details

The data consists of phenotypic evaluations of elite lines and commercial cultivars of upland rice. The analysis provides membership degrees that assist breeders in selecting stable and high-yielding genotypes for target environments.

Source

Data obtained from the breeding trials conducted and published by Maciel et al. (2025).

References

Maciel, D. D. O., Guimarães, P. H. R., & Melo, P. G. S. (2025). Harnessing fuzzy logic for adaptive and stable selection of upland rice lines. *Crop Breeding and Applied Biotechnology*, 25(2), e527425213. doi:10.1590/198470332025v25n2a28

Examples

```
data(ge_data)
head(ge_data)
```

`hybrid` *Hybrid method*

Description

Stability and Adaptability Analysis based on the interpretation of the Eberhart & Russel 1966 methodology, associated with the modified Lins & Bins (1988) methodology, developed by Carneiro et al. (2020).

Usage

```
hybrid(data, env, gen, rep, var)
```

Arguments

data	Data file (data.frame) with variables.
env	Column with environment information.
gen	Coluna contendo informações de genótipo.
rep	Column containing genotype information.
var	Variable to be analyzed.

Value

Um data frame contendo as seguintes estimativas:

Gen Genotype.

PIF Performance index in favorable environments.

PID Performance index in unfavorable environments.

B_1 Regression coefficient (B_1) for each genotype.

R2 Standardized coefficient of determination (R^2) for each genotype.

GE Membership (%) to the general stability genotypes group.

PA Membership (%) to the poorly adapted genotypes group.

FAV Membership (%) to the favorable adapted genotypes group.

UNF Membership (%) to the unfavorable adapted genotypes group.

Author(s)

Douglas de Oliveira Maciel <douglasmaciel@discente.ufg.br>

References

Carneiro, A. R. T., Sanglard, D. A., Azevedo, A. M., Souza, T. L. P. O. D., Pereira, H. S., Melo, L. C., & Carneiro, P. C. S. (2020). Fuzzy logic applied to different adaptability and stability methods in common bean. Pesquisa agropecuária brasileira, 55, e01609.

See Also

eberhart_russell

lin_binns

annicchiarico

Examples

```
data(ge_data)

hybrid(data = ge_data, env = environment, gen = genotype, rep = block, var = gy)
```

`lin_binns` *Modified method of Lin & Binns (1988)*

Description

Stability and Adaptability Analysis based on the interpretation of the modified Lins and Bins (1988) methodology.

Usage

```
lin_binns(data, env, gen, rep, var)
```

Arguments

`data`	Data file (data.frame) with variables.
`env`	Column with environment information.
`gen`	Coluna contendo informações de genótipo.
`rep`	Column containing genotype information.
`var`	Variable to be analyzed.

Value

A data frame containing the following estimates:

`Gen` Genotype.

`PIF` Performance index in favorable environments.

`PID` Performance index in unfavorable environments.

`GE` Membership (%) to the general stability genotypes group.

`PA` Membership (%) to the poorly adapted genotypes group.

`FAV` Membership (%) to the favorable adapted genotypes group.

`UNF` Membership (%) to the unfavorable adapted genotypes group.

Author(s)

Douglas de Oliveira Maciel <douglasmaciel@discente.ufg.br>

References

Carneiro, P. C. S. (1998). Novas metodologias de análise da adaptabilidade e estabilidade de comportamento (Doctoral dissertation, Universidade Federal de Viçosa.).

See Also

`eberhart_russell`

`hybrid`

Examples

```
data(ge_data)

lin_binns(data = ge_data, env = environment, gen = genotype, rep = block, var = gy)
```

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