Package 'AMMIStbP'

July 12, 2018

Type Package

Title Additive Main Effects and Multiplicative Interaction Model Stability Parameters

Version 0.0.0.9000

Description Computes various stability parameters from AMMI analysis results such as 1. Modified AMMI Stability Value (MASV) 2. SIPC, 3. AMGE 4. Eigen value stability parameter (EV), 5. Zi 6. FA 7. Di

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Encoding UTF-8

Depends R (>= 3.0.1)

VignetteBuilder knitr

RoxygenNote 6.0.1

Imports agricolae, Rdpack

Suggests knitr, rmarkdown, pander

RdMacros Rdpack

URL http://github.com/ajaygpb/AMMIStbp

BugReports http://github.com/ajaygpb/AMMIStbp/issues

R topics documented:

AMGE.AMMI *Sum Across Environments of GEI Modelled by AMMI*

Description

AMGE.AMMI computes the Sum Across Environments of GEI Modelled by AMMI (AMGE) (Sneller et al., 1997) considering all significant interaction principal components (IPCs) in the AMMI model. Using AMGE, the Yield stability Index (YSI) is also calculated.

Usage

```
AMGE.AMMI(model, n, alpha = 0.05)
```

Arguments

model	The AMMI model (An object of class AMMI generated by AMMI.
n	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
alpha	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The Sum Across Environments of GEI Modelled by AMMI ($AMGE$) is computed as follows:

$$AMGE = \sum_{j=1}^{E} \sum_{n=1}^{N'} \lambda_n \gamma_{in} \delta_{jn}$$

Where, N' is the number of significant IPCs (number of IPC that were retained in the AMMI model via F tests); λ_n is the is the singular value for IPC n and correspondingly λ_n^2 is its eigen value; γ_{in} is the eigenvector value for ith genotype; and δ_{jn} is the eigenvector value for jth environment.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{AMGE} + R_Y$$

Where, R_{AMGE} is the SIPC rank of the genotype and R_Y is the mean yield rank of the genotype.

References

Sneller CH, Kilgore-Norquest L, Dombek D (1997). "Repeatability of Yield Stability Statistics in Soybean." *Crop Science*, **37**(2), 383–390. doi: 10.2135/cropsci1997.0011183X003700020013x.

ASI.AMMI *AMMI Stability Index*

Description

ASI.AMMI computes the AMMI Stability Index (ASI) (Jambhulkar et al., 2014; Jambhulkar et al., 2015; Jambhulkar et al., 2017) considering the first two interaction principal components (IPCs) in the AMMI model. Using ASI, the Yield stability Index (YSI) is also calculated.

Usage

```
ASI.AMMI(model, n, alpha = 0.05)
```

Arguments

model	The AMMI model (An object of class AMMI generated by AMMI.
n	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
alpha	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The AMMI Stability Index (ASI) is computed as follows:

$$ASI = \sqrt{[PC_1^2 \times \theta_1^2] + [PC_2^2 \times \theta_2^2]}$$

Where, PC_1 and PC_2 are the scores of 1st and 2nd IPCs respectively; and θ_1 and θ_2 are percentage sum of squares explained by the 1st and 2nd principal component interaction effect respectively.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{ASI} + R_Y$$

Where, R_{ASI} is the ASI rank of the genotype and R_Y is the mean yield rank of the genotype.

References

Jambhulkar NN, Bose LK, Singh ON (2014). "AMMI Stability Index for Stability Analysis." In Mohapatra T (ed.), *CRRI Newsletter, January-March 2014*, volume 35 number 1, 15. Central Rice Research Institute, Cuttack, Orissa. http://www.crri.nic.in/CRRI_newsletter/crnl_jan_mar_14_web.pdf.

Jambhulkar NN, Bose LK, Pande K, Singh ON (2015). "Genotype by environment interaction and stability analysis in rice genotypes." *Ecology, Environment and Conservation*, **21**(3), 1427–1430. http://www.envirobiotechjournals.com/article_abstract.php?aid=6346&iid=200&jid=3.

Jambhulkar N, Rath N, Bose L, Subudhi H, Biswajit M, Lipi D, Meher J, others (2017). "Stability analysis for grain yield in rice in demonstrations conducted during rabi season in India." *Oryza*, **54**(2), 236–240. doi: 10.5958/22495266.2017.00030.3.

AVAMGE.AMMI *Sum Across Environments of Absolute Value of GEI Modelled by AMMI*

Description

AVAMGE.AMMI computes the Sum Across Environments of Absolute Value of GEI Modelled by AMMI (AVAMGE) (Zali et al., 2012) considering all significant interaction principal components (IPCs) in the AMMI model. Using AVAMGE, the Yield stability Index (YSI) is also calculated.

Usage

```
AVAMGE.AMMI(model, n, alpha = 0.05)
```

Arguments

model	The AMMI model (An object of class AMMI generated by AMMI.
n	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
alpha	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The Sum Across Environments of Absolute Value of GEI Modelled by AMMI ($AVAMGE$) is computed as follows:

$$AV_{(AMGE)} = \sum_{j=1}^{E} \sum_{n=1}^{N'} |\lambda_n \gamma_{in} \delta_{jn}|$$

Where, N' is the number of significant IPCs (number of IPC that were retained in the AMMI model via F tests); λ_n is the is the singular value for IPC n and correspondingly λ_n^2 is its eigen value; γ_{in} is the eigenvector value for ith genotype; and δ_{jn} is the eigenvector value for jth environment.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{AVAMGE} + R_Y$$

Where, R_{AVAMGE} is the SIPC rank of the genotype and R_Y is the mean yield rank of the genotype.

References

Zali H, Farshadfar E, Sabaghpour SH, Karimizadeh R (2012). "Evaluation of genotype * environment interaction in chickpea using measures of stability from AMMI model." *Annals of Biological Research*, **3**(7), 3126–3136. http://www.ijabbr.com/article_7777_620ea1a0c1fd04868f60bd23c6dda48b.pdf.

DA.AMMI *Annicchiarico's D Parameter*

Description

DA.AMMI computes the Annicchiarico's D Parameter values (D_a) (Annicchiarico, 1997) considering all significant interaction principal components (IPCs) in the AMMI model. It is the unsquared Euclidean distance from the origin of significant IPC axes in the AMMI model. Using D_a, the Yield stability Index (YSI) is also calculated.

Usage

```
DA.AMMI(model, n, alpha = 0.05)
```

Arguments

model	The AMMI model (An object of class AMMI generated by AMMI.
n	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
alpha	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The Annicchiarico's D Parameter value (D_a) is computed as follows:

$$D_a = \sqrt{\sum_{n=1}^{N'} (\lambda_n \gamma_{in})^2}$$

Where, N' is the number of significant IPCAs (number of IPC that were retained in the AMMI model via F tests); λ_n is the is the singular value for IPC n and correspondingly λ_n^2 is its eigen value; and γ_{in} is the eigenvector value for ith genotype.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{D_a} + R_Y$$

Where, R_{D_a} is the D_a rank of the genotype and R_Y is the mean yield rank of the genotype.

References

Annicchiarico P (1997). "Joint regression vs AMMI analysis of genotype-environment interactions for cereals in Italy." *Euphytica*, **94**(1), 53–62. doi: 10.1023/A:1002954824178, https://link.springer.com/article/10.1023/A:1002954824178.

DZ.AMMI *Zhang's D Parameter*

Description

DZ.AMMI computes the Zhang's D Parameter values or AMMI statistic coefficient or AMMI distance or AMMI stability index (D_Z) (Zhang, 1998) considering all significant interaction principal components (IPCs) in the AMMI model. It is the distance of IPC point from origin in space. Using D_Z, the Yield stability Index (YSI) is also calculated.

Usage

```
DZ.AMMI(model, n, alpha = 0.05)
```

Arguments

model	The AMMI model (An object of class AMMI generated by AMMI.
n	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
alpha	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The Zhang's D Parameter value (D_z) is computed as follows:

$$D_z = \sqrt{\sum_{n=1}^{N'} \gamma_{in}^2}$$

Where, N' is the number of significant IPCAs (number of IPC that were retained in the AMMI model via F tests); and γ_{in} is the eigenvector value for ith genotype.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{D_z} + R_Y$$

Where, R_{D_z} is the D_Z rank of the genotype and R_Y is the mean yield rank of the genotype.

References

Zhang Z, Lu C, Xiang Z (1998). "Analysis of variety stability based on AMMI model." *Acta Agronomica Sinica*, **24**(3), 304–309. http://zwxb.chinacrops.org/EN/Y1998/V24/I03/304.

EV.AMMI *Averages of the Squared Eigenvector Values*

Description

EV.AMMI computes the Sums of the Averages of the Squared Eigenvector Values (EV) (Zobel, 1994) considering all significant interaction principal components (IPCs) in the AMMI model. Using EV, the Yield stability Index (YSI) is also calculated.

Usage

```
EV.AMMI(model, n, alpha = 0.05)
```

Arguments

model	The AMMI model (An object of class AMMI generated by AMMI.
n	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
alpha	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The Averages of the Squared Eigenvector Values (EV) is computed as follows:

$$EV = \sum_{n=1}^{N'} \frac{\gamma_{in}^2}{N'}$$

Where, N' is the number of significant IPCs (number of IPC that were retained in the AMMI model via F tests); and γ_{in} is the eigenvector value for ith genotype.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{EV} + R_Y$$

Where, R_{EV} is the EV rank of the genotype and R_Y is the mean yield rank of the genotype.

References

Zobel R (1994). "Stress resistance and root systems." In *Proceedings of the Workshop on Adaptation of Plants to Soil Stress. 1-4 August, 1993. INTSORMIL Publication 94-2*, 80–99. Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.

MASV.AMMI *Modified AMMI Stability Value*

Description

MASV.AMMI computes the Modified AMMI Stability Value (MASV) (Zali et al., 2012; Please see **Note**) from a modified formula of AMMI Stability Value (ASV) (Purchase et al. 1997). This formula calculates AMMI stability value considering all significant interaction principal components (IPCs) in the AMMI model. Using MASV, the Yield stability Index (YSI) is also calculated.

Usage

```
MASV.AMMI(model, n, alpha = 0.05)
```

Arguments

model	The AMMI model (An object of class AMMI generated by AMMI.
n	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
alpha	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The Modified AMMI Stability Value ($MASV$) is computed as follows:

$$MASV = \sqrt{\sum_{n=1}^{N'-1} \left(\frac{SSIPC_n}{SSIPC_{n+1}} \times PC_n \right)^2 + (PC_{N'})^2}$$

Where, $SSIPC_1$, $SSIPC_2$, $\cdots$, $SSIPC_n$ are the sum of squares of the 1st, 2nd, ..., and nth IPC; and PC_1, PC_2, $\cdots$, PC_n are the scores of 1st, 2nd, ..., and nth IPC.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{MASV} + R_Y$$

Where, R_{MASV} is the MASV rank of the genotype and R_Y is the mean yield rank of the genotype.

Note

In Zali et al., (2012), the formula for both AMMI stability value (ASV) was found to be erroneus, when compared with the original publications (Purchase 1997; Purchase et al., 1999; Purchase et al., 2000).

ASV (Zali et al., 2012)

$$ASV = \sqrt{\left(\frac{SSIPC_1}{SSIPC_2} \right) \times (PC_1)^2 + (PC_2)^2}$$

ASV (Purchase 1997; Purchase et al., 1999; Purchase et al., 2000)

$$ASV = \sqrt{\left(\frac{SSIPC_1}{SSIPC_2} \times PC_1\right)^2 + (PC_2)^2}$$

The authors believe that the proposed Modified AMMI stability value (MASV) in Zali et al., (2012) is also erroneous and have implemented the corrected one in `MASV.AMMI`.

MASV (Zali et al., 2012)

$$MASV = \sqrt{\sum_{n=1}^{N'-1}\left(\frac{SSIPC_n}{SSIPC_{n+1}}\right) \times (PC_n)^2 + (PC_{N'})^2}$$

References

Purchase J (1997). *Parametric Analysis to Describe Genotype * Environment Interaction and Yield Stability in Winter Wheat*. PhD thesis, University of the Orange Free State. http://hdl.handle.net/11660/1966.

Purchase J, Hatting H, Van Deventer C (1999). "The use of the AMMI model and AMMI stability value to describe genotype x environment interaction and yield stability in winter wheat (*Triticum aestivum* L.)." In *Proceedings of the Tenth Regional Wheat Workshop for Eastern, Central and Southern Africa, 14-18 September 1998*. University of Stellenbosch, South Africa.

Purchase JL, Hatting H, Deventer CSv (2000). "Genotype * environment interaction of winter wheat (*Triticum aestivum* L.) in South Africa: II. Stability analysis of yield performance." *South African Journal of Plant and Soil*, **17**(3), 101–107. doi: 10.1080/02571862.2000.10634878.

Zali H, Farshadfar E, Sabaghpour SH, Karimizadeh R (2012). "Evaluation of genotype * environment interaction in chickpea using measures of stability from AMMI model." *Annals of Biological Research*, **3**(7), 3126–3136. http://www.ijabbr.com/article_7777_620ea1a0c1fd04868f60bd23c6dda48b.pdf.

`SIPC.AMMI` *Sums of the Absolute Value of the IPC Scores*

Description

`SIPC.AMMI` computes the Sums of the Absolute Value of the IPC Scores (ASI) (Sneller et al., 1997) considering all significant interaction principal components (IPCs) in the AMMI model. Using SIPC, the Yield stability Index (YSI) is also calculated.

Usage

```
SIPC.AMMI(model, n, alpha = 0.05)
```

Arguments

`model`	The AMMI model (An object of class `AMMI` generated by `AMMI`.
`n`	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
`alpha`	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The Sums of the Absolute Value of the IPC Scores ($SIPC$) is computed as follows:

$$SIPC = \sum_{n=1}^{N'} \left|\lambda_n^{0.5}\gamma_{in}\right|$$

OR

$$SIPC = \sum_{n=1}^{N'} |PC_n|$$

Where, N' is the number of significant IPCs (number of IPC that were retained in the AMMI model via F tests); λ_n is the is the singular value for IPC n and correspondingly λ_n^2 is its eigen value; γ_{in} is the eigenvector value for ith genotype; and PC_1, PC_2, $\cdots$, PC_n are the scores of 1th, 2th, ..., and nth IPC.

The closer the SIPC scores are to zero, the more stable the genotypes are across test environments.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{SIPC} + R_Y$$

Where, R_{SIPC} is the SIPC rank of the genotype and R_Y is the mean yield rank of the genotype.

References

Sneller CH, Kilgore-Norquest L, Dombek D (1997). "Repeatability of Yield Stability Statistics in Soybean." *Crop Science*, **37**(2), 383–390. doi: 10.2135/cropsci1997.0011183X003700020013x.

`ZA.AMMI` *Absolute value of the Relative Contribution of IPCs to the Interaction*

Description

`ZA.AMMI` computes the Absolute value of the Relative Contribution of IPCs to the Interaction (Za) (Zali, 2012) considering all significant interaction principal components (IPCs) in the AMMI model. Using Za, the Yield stability Index (YSI) is also calculated.

Usage

```
ZA.AMMI(model, n, alpha = 0.05)
```

Arguments

`model`	The AMMI model (An object of class `AMMI` generated by `AMMI`.
`n`	The number of principal components to be considered for computation. The default value is the number of significant IPCs.
`alpha`	Type I error probability (Significance level) to be considered to identify the number of significant IPCs.

Details

The Absolute value of the Relative Contribution of IPCs to the Interaction (D_{Za}) is computed as follows:

$$Za = \sum_{i=1}^{N'} |\theta_n \gamma_{in}|$$

Where, N' is the number of significant IPCAs (number of IPC that were retained in the AMMI model via F tests); and γ_{in} is the eigenvector value for ith genotype; and θ_n is the percentage sum of squares explained by nth principal component interaction effect.

The Yield Stability Index (YSI) is computed as follows:

$$YSI = R_{Za} + R_Y$$

Where, R_{Za} is the Za rank of the genotype and R_Y is the mean yield rank of the genotype.

References

Zali H, Farshadfar E, Sabaghpour SH, Karimizadeh R (2012). "Evaluation of genotype * environment interaction in chickpea using measures of stability from AMMI model." *Annals of Biological Research*, **3**(7), 3126–3136. http://www.ijabbr.com/article_7777_620ea1a0c1fd04868f60bd23c6dda48b.pdf.

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