

The `ammistability` Package: A Brief Introduction

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Overview

The package `ammistability` (Ajay et al., 2019a) is a collection of functions for the computation of various stability parameters from the results of Additive Main Effects and Multiplicative Interaction (AMMI) analysis computed by the `AMMI` function of `agricolae` package.

The goal of this vignette is to introduce the users to these functions and give a primer in computation of various stability parameters/indices from a fitted AMMI model. This document assumes a basic knowledge of R programming language.



Installation

The package can be installed from CRAN as follows:

```
# Install from CRAN
install.packages('ammistability', dependencies=TRUE)
```

The development version can be installed from github as follows:

```
# Install development version from Github
devtools::install_github("ajaygp/ammistability")
```

Then the package can be loaded using the function

```
library(ammistability)
```

Version History

The current version of the package is 0.1.2. The previous versions are as follows.

Table 1. Version history of `ammistability` R package.

Version	Date
0.1.0	2018-08-13
0.1.1	2018-12-07

To know detailed history of changes use `news(package='ammistability')`.

AMMI model

The difference in response of genotypes to different environmental conditions is known as Genotype-Environment Interaction (GEI). Understanding the nature and structure of this interaction is critical for plant breeders to select for genotypes with wide or specific adaptability. One of the most popular techniques to achieve this is by fitting the Additive Main Effects and Multiplicative Interaction (AMMI) model to the results of multi environment trials (Gauch, 1988, 1992).

The AMMI equation is described as follows.

$$Y_{ij} = \mu + \alpha_i + \beta_j + \sum_{n=1}^N \lambda_n \gamma_{in} \delta_{jn} + \rho_{ij}$$

Where, Y_{ij} is the yield of the i th genotype in the j th environment, μ is the grand mean, α_i is the genotype deviation from the grand mean, β_j is the environment deviation, N is the total number of interaction principal components (IPCs), λ_n is the singular value for n th IPC and correspondingly λ_n^2 is its eigen value, γ_{in} is the eigenvector value for i th genotype, δ_{jn} is the eigenvector value for the j th environment and ρ_{ij} is the residual.

AMMI stability parameters

Although the AMMI model can aid in determining genotypes with wide or specific adaptability, it fails to rank genotypes according to their stability. Several measures have been developed over the years to indicate the stability of genotypes from the results of AMMI analysis (Table 1.).

The details about AMMI stability parameters/indices implemented in `ammistability` are described in Table 1.

Table 1 : AMMI stability parameters/indices implemented in `ammistability`.

AMMI stability parameter	function	Details	Reference
Sum across environments of GEI modelled by AMMI ($AMGE$)	<code>AMGE.AMMI</code>	$AMGE = \sum_{j=1}^E \sum_{n=1}^{N'} \lambda_n \gamma_{in} \delta_{jn}$	Sneller et al. (1997)
AMMI Stability Index (ASI)	<code>ASI.AMMI</code> and <code>MASI.AMMI</code>	$ASI = \sqrt{[PC_1^2 \times \theta_1^2] + [PC_2^2 \times \theta_2^2]}$	Jambhulkar et al. (2014); Jambhulkar et al. (2015); Jambhulkar et al. (2017)
AMMI Based Stability Parameter ($ASTAB$)	<code>ASTAB.AMMI</code>	$ASTAB = \sum_{n=1}^{N'} \lambda_n \gamma_{in}^2$	Rao and Prabhakaran (2005)
AMMI stability value (ASV) *	<code>agricolae::index.AMMI</code> and <code>MASV.AMMI</code>	Distance from the coordinate point to the origin in a two dimensional scattergram generated by plotting of IPC1 score against IPC2 score.	Purchase (1997); Purchase et al. (1999); Purchase et al. (2000)
		$ASV = \sqrt{\left(\frac{SSIPC_1}{SSIPC_2} \times PC_1\right)^2 + (PC_2)^2}$	
$AV_{(AMGE)}$	<code>AVAMGE.AMMI</code>	$AV_{(AMGE)} = \sum_{j=1}^E \sum_{n=1}^{N'} \lambda_n \gamma_{in} \delta_{jn} $	Zali et al. (2012)
Annicchiarico's D parameter (D_a)	<code>DA.AMMI</code>	The unsquared Euclidean distance from the origin of significant IPC axes in the AMMI model.	Annicchiarico (1997)
		$D_a = \sqrt{\sum_{n=1}^{N'} (\lambda_n \gamma_{in})^2}$	
Zhang's D parameter or AMMI statistic coefficient or AMMI distance or AMMI stability index (D_z)	<code>DZ.AMMI</code>	The distance of IPC point from origin in space.	Zhang et al. (1998)
		$D_z = \sqrt{\sum_{n=1}^{N'} \gamma_{in}^2}$	
Averages of the squared eigenvector values EV	<code>EV.AMMI</code>	$EV = \sum_{n=1}^{N'} \frac{\gamma_{in}^2}{N'}$	Zobel (1994)
Stability measure based on fitted AMMI model FA	<code>FA.AMMI</code>	$FA = \sum_{n=1}^{N'} \lambda_n^2 \gamma_{in}^2$	Raju (2002); Zali et al. (2012)

AMMI stability parameter	function	Details	Reference
FP	FA.AMMI	Equivalent to FA , when only the first IPC axis is considered for computation. $FP = \lambda_1^2 \gamma_{i1}^2$ As λ_1^2 will be same for all the genotypes, the absolute value of γ_{i1} alone is sufficient for comparison. So this is also equivalent to the comparison based on biplot with first IPC axis.	Raju (2002); Zali et al. (2012)
B	FA.AMMI	Equivalent to FA , when only the first two IPC axes are considered for computation. $B = \sum_{n=1}^2 \lambda_n^2 \gamma_{in}^2$ Stability comparisons based on this measure will be equivalent to the comparisons based on biplot with first two IPC axes.	Raju (2002); Zali et al. (2012)
$W_{(AMMI)}$	FA.AMMI	Equivalent to FA , when all the IPC axes in the AMMI model are considered for computation. $W_{(AMMI)} = \sum_{n=1}^N \lambda_n^2 \gamma_{in}^2$ Equivalent to Wricke's ecovalence.	Wricke (1962); Raju (2002); Zali et al. (2012)
Modified AMMI Stability Index ($MASI$)	MASI.AMMI	$MASI = \sqrt{\sum_{n=1}^{N'} PC_n^2 \times \theta_n^2}$	Ajay et al. (2018)
Modified AMMI stability value ($MASV$)	MASV.AMMI	$MASV = \sqrt{\sum_{n=1}^{N'-1} \left(\frac{SSIPC_n}{SSIPC_{n+1}} \times PC_n \right)^2 + (P_n)^2}$	Ajay et al. (2019b); Zali et al. (2012)
Sums of the absolute value of the IPC scores ($SIPC$)	SIPC.AMMI	$SIPC = \sum_{n=1}^{N'} \lambda_n^{0.5} \gamma_{in} $ $SIPC = \sum_{n=1}^{N'} PC_n $	Sneller et al. (1997)
Absolute value of the relative contribution of IPCs to the interaction (Za)	ZA.AMMI	$Za = \sum_{i=1}^{N'} \theta_n \gamma_{in} $	Zali et al. (2012)

Where, N is the total number of interaction principal components (IPCs); N' is the number of significant IPCAs (number of IPC that were retained in the AMMI model via F tests); λ_n is the singular value for n th IPC and correspondingly λ_n^2 is its eigen value; γ_{in} is the eigenvector value for i th genotype; δ_{jn} is the eigenvector value for the j th environment; $SSIPC_1, SSIPC_2, \dots, SSIPC_n$ are the sum of squares of the 1st, 2th, \dots , and n th IPC; PC_1, PC_2, \dots, PC_n are the scores of 1st, 2th,

..., and n th IPC; θ_n is the percentage sum of squares explained by n th principal component interaction effect; and E is the number of environments.

Examples

AMMI model from agricolae::AMMI

```
library(agricolae)
data(plrv)

# AMMI model
model <- with(plrv, AMMI(Locality, Genotype, Rep, Yield, console = FALSE))

# ANOVA
model$ANOVA
```

Analysis of Variance Table

Response: Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
ENV	5	122284	24456.9	257.0382	9.08e-12 ***
REP(ENV)	12	1142	95.1	2.5694	0.002889 **
GEN	27	17533	649.4	17.5359	< 2.2e-16 ***
ENV:GEN	135	23762	176.0	4.7531	< 2.2e-16 ***
Residuals	324	11998	37.0		

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

```
# IPC F test
model$analysis
```

	percent	acum	Df	Sum.Sq	Mean.Sq	F.value	Pr.F
PC1	56.3	56.3	31	13368.5954	431.24501	11.65	0.0000
PC2	27.1	83.3	29	6427.5799	221.64069	5.99	0.0000
PC3	9.4	92.7	27	2241.9398	83.03481	2.24	0.0005
PC4	4.3	97.1	25	1027.5785	41.10314	1.11	0.3286
PC5	2.9	100.0	23	696.1012	30.26527	0.82	0.7059

```
# Mean yield and IPC scores
model$biplot
```

	type	Yield	PC1	PC2	PC3	PC4	PC5
102.18	GEN	26.31947	-1.50828851	1.258765244	-0.19220309	0.48738861	-0.04364115
104.22	GEN	31.28887	0.32517729	-1.297024517	-0.63695749	-0.44159957	0.95312506
121.31	GEN	30.10174	0.95604605	1.143461054	-1.28777348	2.22246913	-1.30661916
141.28	GEN	39.75624	2.11153737	0.817810467	1.45527701	0.25257620	-0.25996142
157.26	GEN	36.95181	1.05139017	2.461179974	-1.97208942	-1.96538800	-0.59719268
163.9	GEN	21.41747	-2.12407441	-0.284381234	-0.21791137	-0.50743629	0.18563390
221.19	GEN	22.98480	-0.84981828	0.347983673	-0.82400783	-0.11451944	-0.57504816
233.11	GEN	28.66655	0.07554203	-1.046497338	1.04040485	0.22868362	0.65754266
235.6	GEN	38.63477	1.20102029	-2.816581184	0.80975361	1.02013062	-0.40273415
241.2	GEN	26.34039	-0.79948495	0.220768053	-0.98538801	0.30004421	0.07555258
255.7	GEN	30.58975	-1.49543817	-1.186549449	0.92552519	-0.32009239	-0.46344763
314.12	GEN	28.17335	1.39335380	-0.332786322	-0.73226877	0.05987348	0.54406154
317.6	GEN	35.32583	1.05170769	0.002555823	-0.81561907	0.58180433	0.39627052
319.20	GEN	38.75767	3.08338144	1.995946966	0.87971668	-1.11908943	0.29657050
320.16	GEN	26.34808	-1.55737097	0.732314249	-0.41432567	1.32097009	2.29506737
342.15	GEN	26.01336	-1.35880873	-0.741980068	0.87480105	-1.12013125	-0.10776433
346.2	GEN	23.84175	-2.48453928	-0.397045286	1.07091711	-0.90974484	-0.12738693
351.26	GEN	36.11581	1.22670345	1.537183139	1.79835728	-0.03516368	0.30191335
364.21	GEN	34.05974	0.27328985	-0.447941156	0.03139543	0.77920500	-0.95811256
402.7	GEN	27.47748	-0.12907269	-0.080086669	0.01934016	-0.36085862	-0.28473777
405.2	GEN	28.98663	-1.90936369	0.309047963	0.57682642	0.51163370	-0.34397623
406.12	GEN	32.68323	0.90781100	-1.733433781	-0.24223050	-0.38596144	-0.49796296
427.7	GEN	36.19020	0.42791957	-0.723190970	-0.85381724	-0.53089914	1.00677993
450.3	GEN	36.19602	1.38026196	1.279525147	0.16025163	0.61270137	-0.34325251
506.2	GEN	33.26623	-0.33054261	-0.302588536	-1.58471588	-0.04659416	0.87807441
Canchan	GEN	27.00126	1.47802905	0.380553178	1.67423900	0.07718375	0.49381313
Desiree	GEN	16.15569	-3.64968796	1.720025405	0.43761089	0.04648011	-0.86767477
Unica	GEN	39.10400	1.25331924	-2.817033826	-0.99510845	-0.64366599	-0.90489253
Ayac	ENV	23.70254	-2.29611851	0.966037760	1.95959116	2.75548057	1.67177210
Hyo-02	ENV	45.73082	3.85283195	-5.093371615	1.16967118	-0.08985538	0.01540152
LM-02	ENV	34.64462	-1.14575146	-0.881093222	-4.56547274	0.55159099	0.52350416

```
LM-03    ENV 53.83493  5.34625518  4.265275487 -0.14143931 -0.11714533 -0.40285728
SR-02    ENV 14.95128 -2.58678337  0.660309540  0.89096920 -3.25055305  1.37283488
SR-03    ENV 11.15328 -3.17043379  0.082842050  0.68668051  0.15048221 -3.18065538
```

```
# G*E matrix (deviations from mean)
array(model$genXenv, dim(model$genXenv), dimnames(model$genXenv))
```

GEN	ENV	Ayac	Hyo-02	LM-02	LM-03	SR-02	SR-03
102.18	5.5726162	-12.4918224	1.7425251	-2.7070438	2.91734869	4.9663762	
104.22	-2.8712076	7.1684102	3.9336218	-4.0358373	0.47881580	-4.6738028	
121.31	0.3255230	-3.8666836	4.3182811	10.4366135	-11.88343843	0.6697043	
141.28	-0.9451837	5.6454825	-9.7806639	14.6463104	-4.80337115	-4.7625741	
157.26	-10.3149711	-10.6241677	4.2336365	16.8683612	2.71710210	-2.8799609	
163.9	3.0874931	-6.9416721	3.4963790	-12.5533271	7.01688164	5.8942454	
221.19	-0.6041752	-6.0090018	4.0648518	-2.6974743	1.27671246	3.9690870	
233.11	2.5837535	6.8277609	-3.4440645	-4.4985717	0.19989490	-1.6687730	
235.6	-1.7541523	19.8225025	-2.2394463	-5.6643239	-8.11400542	-2.0505746	
241.2	1.0710975	-5.3831118	5.4253097	-3.2588271	0.46433086	1.6812008	
255.7	2.4443155	1.3860497	-1.8857757	-12.9626594	4.31373929	6.7043306	
314.12	-3.8812099	6.2098482	2.3577759	5.9071782	-3.92419060	-6.6694018	
317.6	-1.7450319	3.0388540	3.0448064	5.5211634	-4.79271565	-5.0670763	
319.20	-6.0155949	2.8477540	-9.7697504	24.8850017	-1.82949467	-10.1179157	
320.16	10.9481796	-10.2982108	4.9608280	-6.2233088	2.99984918	-2.3873373	
342.15	0.8508002	-0.3338618	-2.4575390	-10.3783871	7.29753151	5.0214562	
346.2	4.7000495	-6.2178087	-2.2612391	-14.9700672	9.90123888	8.8478267	
351.26	2.6002030	-0.9918665	-10.8315931	12.7429121	-0.02713985	-3.4925156	
364.21	-0.4533734	3.2864208	-0.1335527	-0.1592533	-4.82292664	2.2826853	
402.7	-1.2134573	-0.0387229	-0.2179557	-0.8774011	1.08032472	1.2672123	
405.2	6.6477681	-8.3071271	-0.6159895	-8.8927189	3.52179705	7.6462704	
406.12	-6.1296667	12.0703469	1.1195092	-2.2601009	-3.13776595	-1.6623226	
427.7	-3.1340922	4.3967072	4.2792028	-1.0194744	0.76266844	-5.2850119	
450.3	-0.5047010	-1.0720791	-3.2821761	12.8806007	-5.04562407	-2.9760204	
506.2	-1.2991912	-1.5682154	8.3142802	-3.1819279	0.60021498	-2.8651608	
Canchan	1.2929442	5.7152780	-9.3713622	9.0803035	-1.65332869	-5.0638348	
Desiree	9.5767845	-22.3280421	0.2396387	-11.8935722	9.62433886	14.7808522	
Unica	-10.8355195	18.0569790	4.7604622	-4.7341684	-5.13878822	-2.1089651	

AMGE.AMMI()

```
# With default n (N') and default ssi.method (farshadfar)
AMGE.AMMI(model)
```

	AMGE	SSI	rAMGE	rY	means
102.18	-8.659740e-15	28.0	5.0	23	26.31947
104.22	1.110223e-15	28.0	15.0	13	31.28887
121.31	4.440892e-16	29.0	14.0	15	30.10174
141.28	1.021405e-14	27.5	26.5	1	39.75624
157.26	2.220446e-15	22.5	17.5	5	36.95181
163.9	-1.243450e-14	28.0	1.0	27	21.41747
221.19	-4.440892e-15	35.0	9.0	26	22.98480
233.11	2.275957e-15	36.0	19.0	17	28.66655
235.6	5.773160e-15	26.5	22.5	4	38.63477
241.2	-5.329071e-15	30.0	8.0	22	26.34039
255.7	-3.774758e-15	24.0	10.0	14	30.58975
314.12	5.773160e-15	40.5	22.5	18	28.17335
317.6	2.220446e-15	26.5	17.5	9	35.32583
319.20	1.731948e-14	31.0	28.0	3	38.75767
320.16	-6.217249e-15	27.0	6.0	21	26.34808
342.15	-2.442491e-15	35.0	11.0	24	26.01336
346.2	-1.110223e-14	28.0	3.0	25	23.84175
351.26	1.021405e-14	34.5	26.5	8	36.11581
364.21	1.415534e-15	26.0	16.0	10	34.05974
402.7	-3.885781e-16	31.0	12.0	19	27.47748
405.2	-1.088019e-14	20.0	4.0	16	28.98663
406.12	3.108624e-15	32.0	20.0	12	32.68323
427.7	1.110223e-16	20.0	13.0	7	36.19020
450.3	6.439294e-15	30.0	24.0	6	36.19602
506.2	-5.773160e-15	18.0	7.0	11	33.26623

```
Canchan 9.325873e-15 45.0 25.0 20 27.00126
Desiree -1.132427e-14 30.0 2.0 28 16.15569
Unica 5.329071e-15 23.0 21.0 2 39.10400
```

```
# With n = 4 and default ssi.method (farshadfar)
```

```
AMGE.AMMI(model, n = 4)
```

	AMGE	SSI	rAMGE	rY	means
102.18	-9.992007e-15	28	5	23	26.31947
104.22	2.886580e-15	31	18	13	31.28887
121.31	-3.996803e-15	25	10	15	30.10174
141.28	9.992007e-15	27	26	1	39.75624
157.26	8.881784e-15	29	24	5	36.95181
163.9	-1.065814e-14	29	2	27	21.41747
221.19	-4.718448e-15	35	9	26	22.98480
233.11	1.387779e-15	32	15	17	28.66655
235.6	3.108624e-15	23	19	4	38.63477
241.2	-6.550316e-15	29	7	22	26.34039
255.7	-3.774758e-15	25	11	14	30.58975
314.12	6.217249e-15	41	23	18	28.17335
317.6	0.000000e+00	22	13	9	35.32583
319.20	2.087219e-14	31	28	3	38.75767
320.16	-1.021405e-14	25	4	21	26.34808
342.15	2.053913e-15	41	17	24	26.01336
346.2	-7.993606e-15	31	6	25	23.84175
351.26	9.159340e-15	33	25	8	36.11581
364.21	-8.881784e-16	22	12	10	34.05974
402.7	2.983724e-16	33	14	19	27.47748
405.2	-1.326717e-14	17	1	16	28.98663
406.12	3.552714e-15	32	20	12	32.68323
427.7	1.887379e-15	23	16	7	36.19020
450.3	5.107026e-15	27	21	6	36.19602
506.2	-5.592748e-15	19	8	11	33.26623
Canchan	1.010303e-14	47	27	20	27.00126
Desiree	-1.043610e-14	31	3	28	16.15569
Unica	5.773160e-15	24	22	2	39.10400

```
# With default n (N') and ssi.method = "rao"
```

```
AMGE.AMMI(model, ssi.method = "rao")
```

	AMGE	SSI	rAMGE	rY	means
102.18	-8.659740e-15	0.5673198	5.0	23	26.31947
104.22	1.110223e-15	3.2887624	15.0	13	31.28887
121.31	4.440892e-16	6.6529106	14.0	15	30.10174
141.28	1.021405e-14	1.5428597	26.5	1	39.75624
157.26	2.220446e-15	2.3391212	17.5	5	36.95181
163.9	-1.243450e-14	0.4957785	1.0	27	21.41747
221.19	-4.440892e-15	0.1822906	9.0	26	22.98480
233.11	2.275957e-15	2.0413097	19.0	17	28.66655
235.6	5.773160e-15	1.6959735	22.5	4	38.63477
241.2	-5.329071e-15	0.3862254	8.0	22	26.34039
255.7	-3.774758e-15	0.3301705	10.0	14	30.58975
314.12	5.773160e-15	1.3548726	22.5	18	28.17335
317.6	2.220446e-15	2.2861050	17.5	9	35.32583
319.20	1.731948e-14	1.4091383	28.0	3	38.75767
320.16	-6.217249e-15	0.4539931	6.0	21	26.34808
342.15	-2.442491e-15	-0.1829870	11.0	24	26.01336
346.2	-1.110223e-14	0.5505176	3.0	25	23.84175
351.26	1.021405e-14	1.4241614	26.5	8	36.11581
364.21	1.415534e-15	2.8898091	16.0	10	34.05974
402.7	-3.885781e-16	-5.5857093	12.0	19	27.47748
405.2	-1.088019e-14	0.7136396	4.0	16	28.98663
406.12	3.108624e-15	1.8758598	20.0	12	32.68323
427.7	1.110223e-16	23.8657048	13.0	7	36.19020
450.3	6.439294e-15	1.5713258	24.0	6	36.19602
506.2	-5.773160e-15	0.6484020	7.0	11	33.26623
Canchan	9.325873e-15	1.1504601	25.0	20	27.00126
Desiree	-1.132427e-14	0.3043571	2.0	28	16.15569
Unica	5.329071e-15	1.7476282	21.0	2	39.10400


```
# Changing the ratio of weights for Rao's SSI
AMGE.AMMI(model, ssi.method = "rao", a = 0.43)
```

	AMGE	SSI	rAMGE	rY	means
102.18	-8.659740e-15	0.7330999	5.0	23	26.31947
104.22	1.110223e-15	1.9956774	15.0	13	31.28887
121.31	4.440892e-16	3.4201982	14.0	15	30.10174
141.28	1.021405e-14	1.4023070	26.5	1	39.75624
157.26	2.220446e-15	1.6925787	17.5	5	36.95181
163.9	-1.243450e-14	0.6112325	1.0	27	21.41747
221.19	-4.440892e-15	0.5055618	9.0	26	22.98480
233.11	2.275957e-15	1.4105366	19.0	17	28.66655
235.6	5.773160e-15	1.4473033	22.5	4	38.63477
241.2	-5.329071e-15	0.6556181	8.0	22	26.34039
255.7	-3.774758e-15	0.7104896	10.0	14	30.58975
314.12	5.773160e-15	1.1062024	22.5	18	28.17335
317.6	2.220446e-15	1.6395625	17.5	9	35.32583
319.20	1.731948e-14	1.3262482	28.0	3	38.75767
320.16	-6.217249e-15	0.6849012	6.0	21	26.34808
342.15	-2.442491e-15	0.4047789	11.0	24	26.01336
346.2	-1.110223e-14	0.6798261	3.0	25	23.84175
351.26	1.021405e-14	1.2836086	26.5	8	36.11581
364.21	1.415534e-15	1.8756248	16.0	10	34.05974
402.7	-3.885781e-16	-1.8911807	12.0	19	27.47748
405.2	-1.088019e-14	0.8455870	4.0	16	28.98663
406.12	3.108624e-15	1.4140438	20.0	12	32.68323
427.7	1.110223e-16	10.9348548	13.0	7	36.19020
450.3	6.439294e-15	1.3483801	24.0	6	36.19602
506.2	-5.773160e-15	0.8970722	7.0	11	33.26623
Canchan	9.325873e-15	0.9965214	25.0	20	27.00126
Desiree	-1.132427e-14	0.4311301	2.0	28	16.15569
Unica	5.329071e-15	1.4782355	21.0	2	39.10400

ASI.AMMI()

```
# With default ssi.method (farshadfar)
ASI.AMMI(model)
```

	ASI	SSI	rASI	rY	means
102.18	0.91512303	43	20	23	26.31947
104.22	0.39631322	19	6	13	31.28887
121.31	0.62108102	25	10	15	30.10174
141.28	1.20927797	26	25	1	39.75624
157.26	0.89176583	22	17	5	36.95181
163.9	1.19833464	51	24	27	21.41747
221.19	0.48765291	34	8	26	22.98480
233.11	0.28677206	21	4	17	28.66655
235.6	1.01971997	25	21	4	38.63477
241.2	0.45406877	29	7	22	26.34039
255.7	0.90124720	33	19	14	30.58975
314.12	0.78962523	30	12	18	28.17335
317.6	0.59211183	18	9	9	35.32583
319.20	1.81826161	30	27	3	38.75767
320.16	0.89897900	39	18	21	26.34808
342.15	0.79099371	37	13	24	26.01336
346.2	1.40292793	51	26	25	23.84175
351.26	0.80654291	22	14	8	36.11581
364.21	0.19598368	12	2	10	34.05974
402.7	0.07583976	20	1	19	27.47748
405.2	1.07822942	39	23	16	28.98663
406.12	0.69418710	23	11	12	32.68323
427.7	0.31056699	12	5	7	36.19020
450.3	0.85094150	22	16	6	36.19602
506.2	0.20336120	14	3	11	33.26623
Canchan	0.83849670	35	15	20	27.00126
Desiree	2.10698168	56	28	28	16.15569
Unica	1.03956820	24	22	2	39.10400

```
# With ssi.method = "rao"
ASI.AMMI(model, ssi.method = "rao")
```

	ASI	SSI	rASI	rY	means
102.18	0.91512303	1.3832387	20	23	26.31947
104.22	0.39631322	2.2326416	6	13	31.28887
121.31	0.62108102	1.7551519	10	15	30.10174
141.28	1.20927797	1.6936286	25	1	39.75624
157.26	0.89176583	1.7436656	17	5	36.95181
163.9	1.19833464	1.0993106	24	27	21.41747
221.19	0.48765291	1.7347850	8	26	22.98480
233.11	0.28677206	2.6102708	4	17	28.66655
235.6	1.01971997	1.7309273	21	4	38.63477
241.2	0.45406877	1.9170753	7	22	26.34039
255.7	0.90124720	1.5305578	19	14	30.58975
314.12	0.78962523	1.5271379	12	18	28.17335
317.6	0.59211183	1.9633384	9	9	35.32583
319.20	1.81826161	1.5279859	27	3	38.75767
320.16	0.89897900	1.3936010	18	21	26.34808
342.15	0.79099371	1.4556573	13	24	26.01336
346.2	1.40292793	1.1198795	26	25	23.84175
351.26	0.80654291	1.7733422	14	8	36.11581
364.21	0.19598368	3.5623227	2	10	34.05974
402.7	0.07583976	7.2317748	1	19	27.47748
405.2	1.07822942	1.3907733	23	16	28.98663
406.12	0.69418710	1.7578467	11	12	32.68323
427.7	0.31056699	2.7272047	5	7	36.19020
450.3	0.85094150	1.7448731	16	6	36.19602
506.2	0.20336120	3.4475042	3	11	33.26623
Canchan	0.83849670	1.4534532	15	20	27.00126
Desiree	2.10698168	0.7548219	28	28	16.15569
Unica	1.03956820	1.7372299	22	2	39.10400

```
# Changing the ratio of weights for Rao's SSI
ASI.AMMI(model, ssi.method = "rao", a = 0.43)
```

	ASI	SSI	rASI	rY	means
102.18	0.91512303	1.0839450	20	23	26.31947
104.22	0.39631322	1.5415455	6	13	31.28887
121.31	0.62108102	1.3141619	10	15	30.10174
141.28	1.20927797	1.4671376	25	1	39.75624
157.26	0.89176583	1.4365328	17	5	36.95181
163.9	1.19833464	0.8707513	24	27	21.41747
221.19	0.48765291	1.1731344	8	26	22.98480
233.11	0.28677206	1.6551898	4	17	28.66655
235.6	1.01971997	1.4623334	21	4	38.63477
241.2	0.45406877	1.3138836	7	22	26.34039
255.7	0.90124720	1.2266562	19	14	30.58975
314.12	0.78962523	1.1802765	12	18	28.17335
317.6	0.59211183	1.5007728	9	9	35.32583
319.20	1.81826161	1.3773527	27	3	38.75767
320.16	0.89897900	1.0889326	18	21	26.34808
342.15	0.79099371	1.1093959	13	24	26.01336
346.2	1.40292793	0.9246517	26	25	23.84175
351.26	0.80654291	1.4337564	14	8	36.11581
364.21	0.19598368	2.1648057	2	10	34.05974
402.7	0.07583976	3.6203374	1	19	27.47748
405.2	1.07822942	1.1367545	23	16	28.98663
406.12	0.69418710	1.3632981	11	12	32.68323
427.7	0.31056699	1.8452998	5	7	36.19020
450.3	0.85094150	1.4230055	16	6	36.19602
506.2	0.20336120	2.1006861	3	11	33.26623
Canchan	0.83849670	1.1268084	15	20	27.00126
Desiree	2.10698168	0.6248300	28	28	16.15569
Unica	1.03956820	1.4737642	22	2	39.10400

```
ASTAB.AMMI()
```

```
# With default n (N') and default ssi.method (farshadfar)
ASTAB.AMMI(model)
```

	ASTAB	SSI	rASTAB	rY	means
102.18	3.89636621	39	16	23	26.31947
104.22	2.19372771	21	8	13	31.28887
121.31	3.87988776	29	14	15	30.10174
141.28	7.24523520	23	22	1	39.75624
157.26	11.05196482	31	26	5	36.95181
163.9	4.64005014	46	19	27	21.41747
221.19	1.52227265	30	4	26	22.98480
233.11	2.18330553	24	7	17	28.66655
235.6	10.03128021	28	24	4	38.63477
241.2	1.65890425	27	5	22	26.34039
255.7	4.50083178	32	18	14	30.58975
314.12	2.58839912	27	9	18	28.17335
317.6	1.77133006	15	6	9	35.32583
319.20	14.26494686	30	27	3	38.75767
320.16	3.13335427	32	11	21	26.34808
342.15	3.16217247	36	12	24	26.01336
346.2	7.47744386	48	23	25	23.84175
351.26	7.10182225	29	21	8	36.11581
364.21	0.27632429	12	2	10	34.05974
402.7	0.02344768	20	1	19	27.47748
405.2	4.07390905	33	17	16	28.98663
406.12	3.88758910	27	15	12	32.68323
427.7	1.43512423	10	3	7	36.19020
450.3	3.56798827	19	13	6	36.19602
506.2	2.71214267	21	10	11	33.26623
Canchan	5.13246683	40	20	20	27.00126
Desiree	16.47021287	56	28	28	16.15569
Unica	10.49672952	27	25	2	39.10400

```
# With n = 4 and default ssi.method (farshadfar)
ASTAB.AMMI(model, n = 4)
```

	ASTAB	SSI	rASTAB	rY	means
102.18	4.1339139	36	13	23	26.31947
104.22	2.3887379	21	8	13	31.28887
121.31	8.8192568	38	23	15	30.10174
141.28	7.3090299	22	21	1	39.75624
157.26	14.9147148	31	26	5	36.95181
163.9	4.8975417	45	18	27	21.41747
221.19	1.5353874	29	3	26	22.98480
233.11	2.2356017	24	7	17	28.66655
235.6	11.0719467	29	25	4	38.63477
241.2	1.7489308	27	5	22	26.34039
255.7	4.6032909	30	16	14	30.58975
314.12	2.5919840	27	9	18	28.17335
317.6	2.1098263	15	6	9	35.32583
319.20	15.5173080	30	27	3	38.75767
320.16	4.8783163	38	17	21	26.34808
342.15	4.4168665	39	15	24	26.01336
346.2	8.3050795	47	22	25	23.84175
351.26	7.1030587	28	20	8	36.11581
364.21	0.8834847	12	2	10	34.05974
402.7	0.1536666	20	1	19	27.47748
405.2	4.3356781	30	14	16	28.98663
406.12	4.0365553	24	12	12	32.68323
427.7	1.7169781	11	4	7	36.19020
450.3	3.9433912	17	11	6	36.19602
506.2	2.7143137	21	10	11	33.26623
Canchan	5.1384242	39	19	20	27.00126
Desiree	16.4723733	56	28	28	16.15569
Unica	10.9110354	26	24	2	39.10400

```
# With default n (N') and ssi.method = "rao"
ASTAB.AMMI(model, ssi.method = "rao")
```

	ASTAB	SSI	rASTAB	rY	means
102.18	3.89636621	0.9916073	16	23	26.31947
104.22	2.19372771	1.2572096	8	13	31.28887
121.31	3.87988776	1.1154972	14	15	30.10174
141.28	7.24523520	1.3680406	22	1	39.75624
157.26	11.05196482	1.2518822	26	5	36.95181
163.9	4.64005014	0.8103867	19	27	21.41747
221.19	1.52227265	1.0909958	4	26	22.98480
233.11	2.18330553	1.1728390	7	17	28.66655
235.6	10.03128021	1.3115430	24	4	38.63477
241.2	1.65890425	1.1722749	5	22	26.34039
255.7	4.50083178	1.1129205	18	14	30.58975
314.12	2.58839912	1.1194868	9	18	28.17335
317.6	1.77133006	1.4453573	6	9	35.32583
319.20	14.26494686	1.3001667	27	3	38.75767
320.16	3.13335427	1.0250358	11	21	26.34808
342.15	3.16217247	1.0126098	12	24	26.01336
346.2	7.47744386	0.8469106	23	25	23.84175
351.26	7.10182225	1.2507915	21	8	36.11581
364.21	0.27632429	2.9922101	2	10	34.05974
402.7	0.02344768	23.0708927	1	19	27.47748
405.2	4.07390905	1.0727560	17	16	28.98663
406.12	3.88758910	1.1994027	15	12	32.68323
427.7	1.43512423	1.5423074	3	7	36.19020
450.3	3.56798827	1.3259199	13	6	36.19602
506.2	2.71214267	1.2763780	10	11	33.26623
Canchan	5.13246683	0.9816986	20	20	27.00126
Desiree	16.47021287	0.5583351	28	28	16.15569
Unica	10.49672952	1.3245441	25	2	39.10400

```
# Changing the ratio of weights for Rao's SSI
ASTAB.AMMI(model, ssi.method = "rao", a = 0.43)
```

	ASTAB	SSI	rASTAB	rY	means
102.18	3.89636621	0.9155436	16	23	26.31947
104.22	2.19372771	1.1221097	8	13	31.28887
121.31	3.87988776	1.0391104	14	15	30.10174
141.28	7.24523520	1.3271348	22	1	39.75624
157.26	11.05196482	1.2250659	26	5	36.95181
163.9	4.64005014	0.7465140	19	27	21.41747
221.19	1.52227265	0.8963051	4	26	22.98480
233.11	2.18330553	1.0370941	7	17	28.66655
235.6	10.03128021	1.2819982	24	4	38.63477
241.2	1.65890425	0.9936194	5	22	26.34039
255.7	4.50083178	1.0470721	18	14	30.58975
314.12	2.58839912	1.0049865	9	18	28.17335
317.6	1.77133006	1.2780410	6	9	35.32583
319.20	14.26494686	1.2793904	27	3	38.75767
320.16	3.13335427	0.9304495	11	21	26.34808
342.15	3.16217247	0.9188855	12	24	26.01336
346.2	7.47744386	0.8072751	23	25	23.84175
351.26	7.10182225	1.2090596	21	8	36.11581
364.21	0.27632429	1.9196572	2	10	34.05974
402.7	0.02344768	10.4311581	1	19	27.47748
405.2	4.07390905	1.0000071	17	16	28.98663
406.12	3.88758910	1.1231672	15	12	32.68323
427.7	1.43512423	1.3357940	3	7	36.19020
450.3	3.56798827	1.2428556	13	6	36.19602
506.2	2.71214267	1.1671018	10	11	33.26623
Canchan	5.13246683	0.9239540	20	20	27.00126
Desiree	16.47021287	0.5403407	28	28	16.15569
Unica	10.49672952	1.2963093	25	2	39.10400

```
AVAMGE.AMMI()
```

```
# With default n (N') and default ssi.method (farshadfar)
AVAMGE.AMMI(model)
```

	AVAMGE	SSI	rAVAMGE	rY	means
--	--------	-----	---------	----	-------

```

102.18 30.229771 40      17 23 26.31947
104.22 21.584579 21      8 13 31.28887
121.31 27.893984 28     13 15 30.10174
141.28 40.486706 24     23  1 39.75624
157.26 44.055803 29     24  5 36.95181
163.9  39.056228 48     21 27 21.41747
221.19 17.905975 33      7 26 22.98480
233.11 16.242635 21      4 17 28.66655
235.6  39.840739 26     22  4 38.63477
241.2  17.101113 28      6 22 26.34039
255.7  29.306918 29     15 14 30.58975
314.12 28.760304 32     14 18 28.17335
317.6  22.700856 18      9  9 35.32583
319.20 55.232023 30     27  3 38.75767
320.16 30.717681 40     19 21 26.34808
342.15 25.538281 34     10 24 26.01336
346.2  46.236590 50     25 25 23.84175
351.26 30.105573 24     16  8 36.11581
364.21  6.742386 12      2 10 34.05974
402.7   2.202291 20      1 19 27.47748
405.2  35.890684 36     20 16 28.98663
406.12 27.272847 24     12 12 32.68323
427.7  16.756971 12      5  7 36.19020
450.3  25.628188 17     11  6 36.19602
506.2  15.760611 14      3 11 33.26623
Canchan 30.515224 38     18 20 27.00126
Desiree 69.096357 56     28 28 16.15569
Unica  47.204593 28     26  2 39.10400

```

```

# With n = 4 and default ssi.method (farshadfar)
AVAMGE.AMMI(model, n = 4)

```

```

      AVAMGE SSI rAVAMGE rY      means
102.18 30.431550 39      16 23 26.31947
104.22 21.176775 21      8 13 31.28887
121.31 34.844853 34     19 15 30.10174
141.28 40.382139 24     23  1 39.75624
157.26 49.421992 31     26  5 36.95181
163.9  38.846149 48     21 27 21.41747
221.19 17.858564 33      7 26 22.98480
233.11 17.449539 23      6 17 28.66655
235.6  39.657410 26     22  4 38.63477
241.2  17.225331 27      5 22 26.34039
255.7  29.585043 28     14 14 30.58975
314.12 28.801567 31     13 18 28.17335
317.6  23.101824 18      9  9 35.32583
319.20 55.695327 30     27  3 38.75767
320.16 31.566364 39     18 21 26.34808
342.15 26.310253 35     11 24 26.01336
346.2  46.863568 50     25 25 23.84175
351.26 29.920025 23     15  8 36.11581
364.21  9.635146 12      2 10 34.05974
402.7   3.665565 20      1 19 27.47748
405.2  35.538076 36     20 16 28.98663
406.12 26.916422 24     12 12 32.68323
427.7  16.266701 11      4  7 36.19020
450.3  25.622916 16     10  6 36.19602
506.2  15.709209 14      3 11 33.26623
Canchan 30.908627 37     17 20 27.00126
Desiree 69.115600 56     28 28 16.15569
Unica  46.610186 26     24  2 39.10400

```

```

# With default n (N') and ssi.method = "rao"
AVAMGE.AMMI(model, ssi.method = "rao")

```

```

      AVAMGE      SSI rAVAMGE rY      means
102.18 30.229771 1.4579240      17 23 26.31947
104.22 21.584579 1.8601746      8 13 31.28887
121.31 27.893984 1.6314700     13 15 30.10174

```

```

141.28 40.486706 1.7440938      23  1 39.75624
157.26 44.055803 1.6163747      24  5 36.95181
163.9  39.056228 1.1625489      21 27 21.41747
221.19 17.905975 1.7619814       7 26 22.98480
233.11 16.242635 2.0509293       4 17 28.66655
235.6  39.840739 1.7147885      22  4 38.63477
241.2  17.101113 1.9190480       6 22 26.34039
255.7  29.306918 1.6160450      15 14 30.58975
314.12 28.760304 1.5490150      14 18 28.17335
317.6  22.700856 1.9504975       9  9 35.32583
319.20 55.232023 1.5919808      27  3 38.75767
320.16 30.717681 1.4493304      19 21 26.34808
342.15 25.538281 1.5581219      10 24 26.01336
346.2  46.236590 1.1695027      25 25 23.84175
351.26 30.105573 1.7798138      16  8 36.11581
364.21  6.742386 3.7995961       2 10 34.05974
402.7   2.202291 9.1285592       1 19 27.47748
405.2  35.890684 1.4502899      20 16 28.98663
406.12 27.272847 1.7304443      12 12 32.68323
427.7  16.756971 2.2619806       5  7 36.19020
450.3  25.628188 1.8876432      11  6 36.19602
506.2  15.760611 2.2350438       3 11 33.26623
Canchan 30.515224 1.4745437      18 20 27.00126
Desiree 69.096357 0.7891628      28 28 16.15569
Unica   47.204593 1.6590963      26  2 39.10400

```

```

# Changing the ratio of weights for Rao's SSI
AVAMGE.AMMI(model, ssi.method = "rao", a = 0.43)

```

```

      AVAMGE      SSI rAVAMGE rY      means
102.18 30.229771 1.1160597      17 23 26.31947
104.22 21.584579 1.3813847       8 13 31.28887
121.31 27.893984 1.2609787      13 15 30.10174
141.28 40.486706 1.4888376      23  1 39.75624
157.26 44.055803 1.3817977      24  5 36.95181
163.9  39.056228 0.8979438      21 27 21.41747
221.19 17.905975 1.1848289       7 26 22.98480
233.11 16.242635 1.4146730       4 17 28.66655
235.6  39.840739 1.4553938      22  4 38.63477
241.2  17.101113 1.3147318       6 22 26.34039
255.7  29.306918 1.2634156      15 14 30.58975
314.12 28.760304 1.1896837      14 18 28.17335
317.6  22.700856 1.4952513       9  9 35.32583
319.20 55.232023 1.4048705      27  3 38.75767
320.16 30.717681 1.1128962      19 21 26.34808
342.15 25.538281 1.1534557      10 24 26.01336
346.2  46.236590 0.9459897      25 25 23.84175
351.26 30.105573 1.4365392      16  8 36.11581
364.21  6.742386 2.2668332       2 10 34.05974
402.7   2.202291 4.4359547       1 19 27.47748
405.2  35.890684 1.1623466      20 16 28.98663
406.12 27.272847 1.3515151      12 12 32.68323
427.7  16.756971 1.6452535       5  7 36.19020
450.3  25.628188 1.4843966      11  6 36.19602
506.2  15.760611 1.5793281       3 11 33.26623
Canchan 30.515224 1.1358773      18 20 27.00126
Desiree 69.096357 0.6395966      28 28 16.15569
Unica   47.204593 1.4401668      26  2 39.10400

```

DA.AMMI()

```

# With default n (N') and default ssi.method (farshadfar)
DA.AMMI(model)

```

```

      DA SSI rDA rY      means
102.18 15.040431 39  16 23 26.31947
104.22  9.798867 22   9 13 31.28887
121.31 12.917859 26  11 15 30.10174
141.28 19.659222 23  22  1 39.75624

```

```

157.26 21.459064 29 24 5 36.95181
163.9 17.499098 48 21 27 21.41747
221.19 8.507426 31 5 26 22.98480
233.11 8.981297 24 7 17 28.66655
235.6 21.941275 29 25 4 38.63477
241.2 8.453875 26 4 22 26.34039
255.7 15.423064 32 18 14 30.58975
314.12 12.222308 28 10 18 28.17335
317.6 9.592839 17 8 9 35.32583
319.20 28.986374 30 27 3 38.75767
320.16 13.835583 34 13 21 26.34808
342.15 13.025230 36 12 24 26.01336
346.2 21.230207 48 23 25 23.84175
351.26 17.269543 28 20 8 36.11581
364.21 3.781576 12 2 10 34.05974
402.7 1.191312 20 1 19 27.47748
405.2 16.027557 35 19 16 28.98663
406.12 13.989359 26 14 12 32.68323
427.7 7.507408 10 3 7 36.19020
450.3 14.270920 21 15 6 36.19602
506.2 8.954538 17 6 11 33.26623
Canchan 15.138085 37 17 20 27.00126
Desiree 32.114860 56 28 28 16.15569
Unica 22.343936 28 26 2 39.10400

```

```

# With n = 4 and default ssi.method (farshadfar)
DA.AMMI(model, n = 4)

```

```

      DA SSI rDA rY    means
102.18 15.185880 39 16 23 26.31947
104.22 9.981329 22 9 13 31.28887
121.31 16.071287 33 18 15 30.10174
141.28 19.689228 23 22 1 39.75624
157.26 23.064716 31 26 5 36.95181
163.9 17.634737 48 21 27 21.41747
221.19 8.521680 30 4 26 22.98480
233.11 9.035019 24 7 17 28.66655
235.6 22.375871 28 24 4 38.63477
241.2 8.551852 27 5 22 26.34039
255.7 15.484417 31 17 14 30.58975
314.12 12.225021 28 10 18 28.17335
317.6 9.913993 17 8 9 35.32583
319.20 29.383463 30 27 3 38.75767
320.16 14.957211 35 14 21 26.34808
342.15 13.888046 35 11 24 26.01336
346.2 21.587939 48 23 25 23.84175
351.26 17.270205 28 20 8 36.11581
364.21 5.053446 12 2 10 34.05974
402.7 1.956846 20 1 19 27.47748
405.2 16.177987 35 19 16 28.98663
406.12 14.087553 24 12 12 32.68323
427.7 7.847138 10 3 7 36.19020
450.3 14.512302 19 13 6 36.19602
506.2 8.956781 17 6 11 33.26623
Canchan 15.141726 35 15 20 27.00126
Desiree 32.115482 56 28 28 16.15569
Unica 22.514867 27 25 2 39.10400

```

```

# With default n (N') and ssi.method = "rao"
DA.AMMI(model, ssi.method = "rao")

```

```

      DA      SSI rDA rY    means
102.18 15.040431 1.4730947 16 23 26.31947
104.22 9.798867 1.9640618 9 13 31.28887
121.31 12.917859 1.6974593 11 15 30.10174
141.28 19.659222 1.7667347 22 1 39.75624
157.26 21.459064 1.6358359 24 5 36.95181
163.9 17.499098 1.2268624 21 27 21.41747
221.19 8.507426 1.8365835 5 26 22.98480

```

```

233.11  8.981297 1.9644804  7 17 28.66655
235.6   21.941275 1.6812376 25  4 38.63477
241.2   8.453875 1.9528811  4 22 26.34039
255.7   15.423064 1.5970737 18 14 30.58975
314.12  12.222308 1.6753281 10 18 28.17335
317.6   9.592839 2.1159612  8  9 35.32583
319.20  28.986374 1.5827930 27  3 38.75767
320.16  13.835583 1.5275780 13 21 26.34808
342.15  13.025230 1.5582533 12 24 26.01336
346.2   21.230207 1.2130205 23 25 23.84175
351.26  17.269543 1.7131362 20  8 36.11581
364.21  3.781576 3.5563052  2 10 34.05974
402.7   1.191312 8.6595018  1 19 27.47748
405.2   16.027557 1.5221857 19 16 28.98663
406.12  13.989359 1.7267910 14 12 32.68323
427.7   7.507408 2.4119665  3  7 36.19020
450.3   14.270920 1.8282838 15  6 36.19602
506.2   8.954538 2.1175331  6 11 33.26623
Canchan 15.138085 1.4913580 17 20 27.00126
Desiree 32.114860 0.8147588 28 28 16.15569
Unica   22.343936 1.6889406 26  2 39.10400

```

```

# Changing the ratio of weights for Rao's SSI
DA.AMMI(model, ssi.method = "rao", a = 0.43)

```

```

          DA      SSI rDA rY    means
102.18  15.040431 1.1225831 16 23 26.31947
104.22   9.798867 1.4260562  9 13 31.28887
121.31  12.917859 1.2893541 11 15 30.10174
141.28  19.659222 1.4985733 22  1 39.75624
157.26  21.459064 1.3901660 24  5 36.95181
163.9   17.499098 0.9255986 21 27 21.41747
221.19   8.507426 1.2169078  5 26 22.98480
233.11   8.981297 1.3775000  7 17 28.66655
235.6   21.941275 1.4409668 25  4 38.63477
241.2   8.453875 1.3292801  4 22 26.34039
255.7   15.423064 1.2552580 18 14 30.58975
314.12  12.222308 1.2439983 10 18 28.17335
317.6   9.592839 1.5664007  8  9 35.32583
319.20  28.986374 1.4009197 27  3 38.75767
320.16  13.835583 1.1465427 13 21 26.34808
342.15  13.025230 1.1535122 12 24 26.01336
346.2   21.230207 0.9647024 23 25 23.84175
351.26  17.269543 1.4078678 20  8 36.11581
364.21  3.781576 2.1622181  2 10 34.05974
402.7   1.191312 4.2342600  1 19 27.47748
405.2   16.027557 1.1932619 19 16 28.98663
406.12  13.989359 1.3499442 14 12 32.68323
427.7   7.507408 1.7097474  3  7 36.19020
450.3   14.270920 1.4588721 15  6 36.19602
506.2   8.954538 1.5287986  6 11 33.26623
Canchan 15.138085 1.1431075 17 20 27.00126
Desiree 32.114860 0.6506029 28 28 16.15569
Unica   22.343936 1.4529998 26  2 39.10400

```

DZ.AMMI()

```

# With default n (N') and default ssi.method (farshadfar)
DZ.AMMI(model)

```

```

          DZ SSI rDZ rY    means
102.18  0.26393535 37 14 23 26.31947
104.22  0.22971564 21  8 13 31.28887
121.31  0.32031744 34 19 15 30.10174
141.28  0.39838535 23 22  1 39.75624
157.26  0.53822924 33 28  5 36.95181
163.9   0.26659011 42 15 27 21.41747
221.19  0.19563325 29  3 26 22.98480
233.11  0.25167755 27 10 17 28.66655

```



```

235.6  0.46581370  28  24  4  38.63477
241.2  0.21481887  28   6 22 26.34039
255.7  0.30862904  31 17 14 30.58975
314.12 0.22603261  25  7 18 28.17335
317.6  0.20224771  14  5  9 35.32583
319.20 0.50675112  29 26  3 38.75767
320.16 0.23280596  30  9 21 26.34808
342.15 0.25989774  36 12 24 26.01336
346.2  0.37125512  45 20 25 23.84175
351.26 0.43805896  31 23  8 36.11581
364.21 0.07409309  12  2 10 34.05974
402.7  0.02004533  20  1 19 27.47748
405.2  0.26238837  29 13 16 28.98663
406.12 0.28179394  28 16 12 32.68323
427.7  0.20176581  11  4  7 36.19020
450.3  0.25465368  17 11  6 36.19602
506.2  0.30899851  29 18 11 33.26623
Canchan 0.37201039  41 21 20 27.00126
Desiree 0.52005815  55 27 28 16.15569
Unica 0.48083049  27 25  2 39.10400

```

```

# With n = 4 and default ssi.method (farshadfar)
DZ.AMMI(model, n = 4)

```

```

      DZ SSI rDZ rY  means
102.18 0.28722309 33 10 23 26.31947
104.22 0.25160706 21  8 13 31.28887
121.31 0.60785568 42 27 15 30.10174
141.28 0.40268829 21 20  1 39.75624
157.26 0.70597721 33 28  5 36.95181
163.9  0.29151868 39 12 27 21.41747
221.19 0.19743603 29  3 26 22.98480
233.11 0.25722999 26  9 17 28.66655
235.6  0.52269682 29 25  4 38.63477
241.2  0.22585722 26  4 22 26.34039
255.7  0.31747123 30 16 14 30.58975
314.12 0.22646067 23  5 18 28.17335
317.6  0.24329787 16  7  9 35.32583
319.20 0.56961794 29 26  3 38.75767
320.16 0.38533472 40 19 21 26.34808
342.15 0.36788692 41 17 24 26.01336
346.2  0.42725798 46 21 25 23.84175
351.26 0.43813521 30 22  8 36.11581
364.21 0.19569373 12  2 10 34.05974
402.7  0.08624291 20  1 19 27.47748
405.2  0.28808268 27 11 16 28.98663
406.12 0.29573097 26 14 12 32.68323
427.7  0.23651352 13  6  7 36.19020
450.3  0.29177451 19 13  6 36.19602
506.2  0.30918827 26 15 11 33.26623
Canchan 0.37244277 38 18 20 27.00126
Desiree 0.52017037 52 24 28 16.15569
Unica 0.50357109 25 23  2 39.10400

```

```

# With default n (N') and ssi.method = "rao"
DZ.AMMI(model, ssi.method = "rao")

```

```

      DZ      SSI rDZ rY  means
102.18 0.26393535 1.5536988 14 23 26.31947
104.22 0.22971564 1.8193399  8 13 31.28887
121.31 0.32031744 1.5545939 19 15 30.10174
141.28 0.39838535 1.7570779 22  1 39.75624
157.26 0.53822924 1.5459114 28  5 36.95181
163.9  0.26659011 1.3869397 15 27 21.41747
221.19 0.19563325 1.6878048  3 26 22.98480
233.11 0.25167755 1.6641025 10 17 28.66655
235.6  0.46581370 1.6538090 24  4 38.63477
241.2  0.21481887 1.7134093  6 22 26.34039
255.7  0.30862904 1.5922105 17 14 30.58975

```

```

314.12 0.22603261 1.7307783 7 18 28.17335
317.6 0.20224771 2.0595024 5 9 35.32583
319.20 0.50675112 1.6259792 26 3 38.75767
320.16 0.23280596 1.6476346 9 21 26.34808
342.15 0.25989774 1.5545233 12 24 26.01336
346.2 0.37125512 1.2718506 20 25 23.84175
351.26 0.43805896 1.5966462 23 8 36.11581
364.21 0.07409309 3.5881882 2 10 34.05974
402.7 0.02004533 10.0539968 1 19 27.47748
405.2 0.26238837 1.6447637 13 16 28.98663
406.12 0.28179394 1.7171135 16 12 32.68323
427.7 0.20176581 2.0898536 4 7 36.19020
450.3 0.25465368 1.9010808 11 6 36.19602
506.2 0.30899851 1.6787677 18 11 33.26623
Canchan 0.37201039 1.3738642 21 20 27.00126
Desiree 0.52005815 0.8797586 27 28 16.15569
Unica 0.48083049 1.6568004 25 2 39.10400

```

```

# Changing the ratio of weights for Rao's SSI
DZ.AMMI(model, ssi.method = "rao", a = 0.43)

```

```

      DZ      SSI rDZ rY      means
102.18 0.26393535 1.1572429 14 23 26.31947
104.22 0.22971564 1.3638258 8 13 31.28887
121.31 0.32031744 1.2279220 19 15 30.10174
141.28 0.39838535 1.4944208 22 1 39.75624
157.26 0.53822924 1.3514985 28 5 36.95181
163.9 0.26659011 0.9944318 15 27 21.41747
221.19 0.19563325 1.1529329 3 26 22.98480
233.11 0.25167755 1.2483375 10 17 28.66655
235.6 0.46581370 1.4291726 24 4 38.63477
241.2 0.21481887 1.2263072 6 22 26.34039
255.7 0.30862904 1.2531668 17 14 30.58975
314.12 0.22603261 1.2678419 7 18 28.17335
317.6 0.20224771 1.5421234 5 9 35.32583
319.20 0.50675112 1.4194898 26 3 38.75767
320.16 0.23280596 1.1981670 9 21 26.34808
342.15 0.25989774 1.1519083 12 24 26.01336
346.2 0.37125512 0.9899993 20 25 23.84175
351.26 0.43805896 1.3577771 23 8 36.11581
364.21 0.07409309 2.1759278 2 10 34.05974
402.7 0.02004533 4.8338929 1 19 27.47748
405.2 0.26238837 1.2459704 13 16 28.98663
406.12 0.28179394 1.3457828 16 12 32.68323
427.7 0.20176581 1.5712389 4 7 36.19020
450.3 0.25465368 1.4901748 11 6 36.19602
506.2 0.30899851 1.3401295 18 11 33.26623
Canchan 0.37201039 1.0925852 21 20 27.00126
Desiree 0.52005815 0.6785528 27 28 16.15569
Unica 0.48083049 1.4391795 25 2 39.10400

```

```
EV.AMMI()
```

```

# With default n (N') and default ssi.method (farshadfar)
EV.AMMI(model)

```

```

      EV SSI rEV rY      means
102.18 0.0232206231 37 14 23 26.31947
104.22 0.0175897578 21 8 13 31.28887
121.31 0.0342010876 34 19 15 30.10174
141.28 0.0529036285 23 22 1 39.75624
157.26 0.0965635719 33 28 5 36.95181
163.9 0.0236900961 42 15 27 21.41747
221.19 0.0127574566 29 3 26 22.98480
233.11 0.0211138628 27 10 17 28.66655
235.6 0.0723274691 28 24 4 38.63477
241.2 0.0153823821 28 6 22 26.34039
255.7 0.0317506280 31 17 14 30.58975
314.12 0.0170302467 25 7 18 28.17335

```

```

317.6  0.0136347120  14   5   9 35.32583
319.20 0.0855988994  29  26   3 38.75767
320.16 0.0180662044  30   9  21 26.34808
342.15 0.0225156118  36  12  24 26.01336
346.2  0.0459434537  45  20  25 23.84175
351.26 0.0639652186  31  23   8 36.11581
364.21 0.0018299284  12   2  10 34.05974
402.7  0.0001339385  20   1  19 27.47748
405.2  0.0229492190  29  13  16 28.98663
406.12 0.0264692745  28  16  12 32.68323
427.7  0.0135698145  11   4   7 36.19020
450.3  0.0216161656  17  11   6 36.19602
506.2  0.0318266934  29  18  11 33.26623
Canchan 0.0461305761  41  21  20 27.00126
Desiree 0.0901534938  55  27  28 16.15569
Unica 0.0770659860  27  25   2 39.10400

```

```

# With n = 4 and default ssi.method (farshadfar)
EV.AMMI(model, n = 4)

```

```

      EV SSI rEV rY   means
102.18 0.020624276 33  10 23 26.31947
104.22 0.015826528 21   8 13 31.28887
121.31 0.092372131 42  27 15 30.10174
141.28 0.040539465 21  20   1 39.75624
157.26 0.124600955 33  28   5 36.95181
163.9  0.021245785 39  12 27 21.41747
221.19 0.009745247 29   3 26 22.98480
233.11 0.016541818 26   9 17 28.66655
235.6  0.068302992 29  25   4 38.63477
241.2  0.012752871 26   4 22 26.34039
255.7  0.025196996 30  16 14 30.58975
314.12 0.012821109 23   5 18 28.17335
317.6  0.014798464 16   7   9 35.32583
319.20 0.081116150 29  26   3 38.75767
320.16 0.037120712 40  19 21 26.34808
342.15 0.033835196 41  17 24 26.01336
346.2  0.045637346 46  21 25 23.84175
351.26 0.047990616 30  22   8 36.11581
364.21 0.009574009 12   2  10 34.05974
402.7  0.001859460 20   1  19 27.47748
405.2  0.020747907 27  11 16 28.98663
406.12 0.021864201 26  14 12 32.68323
427.7  0.013984661 13   6   7 36.19020
450.3  0.021283092 19  13   6 36.19602
506.2  0.023899346 26  15 11 33.26623
Canchan 0.034678404 38  18 20 27.00126
Desiree 0.067644303 52  24 28 16.15569
Unica 0.063395960 25  23   2 39.10400

```

```

# With default n (N') and ssi.method = "rao"
EV.AMMI(model, ssi.method = "rao")

```

```

      EV      SSI rEV rY   means
102.18 0.0232206231 0.9920136 14 23 26.31947
104.22 0.0175897578 1.1968926   8 13 31.28887
121.31 0.0342010876 1.0723629 19 15 30.10174
141.28 0.0529036285 1.3550266 22   1 39.75624
157.26 0.0965635719 1.2370234 28   5 36.95181
163.9  0.0236900961 0.8295284 15 27 21.41747
221.19 0.0127574566 0.9930645   3 26 22.98480
233.11 0.0211138628 1.0818975 10 17 28.66655
235.6  0.0723274691 1.3026828 24   4 38.63477
241.2  0.0153823821 1.0609011   6 22 26.34039
255.7  0.0317506280 1.0952885 17 14 30.58975
314.12 0.0170302467 1.1011148   7 18 28.17335
317.6  0.0136347120 1.3797760   5   9 35.32583
319.20 0.0855988994 1.3000274 26   3 38.75767
320.16 0.0180662044 1.0311353   9  21 26.34808

```

```

342.15 0.0225156118 0.9862240 12 24 26.01336
346.2 0.0459434537 0.8450255 20 25 23.84175
351.26 0.0639652186 1.2261684 23 8 36.11581
364.21 0.0018299284 2.8090292 2 10 34.05974
402.7 0.0001339385 24.1014741 1 19 27.47748
405.2 0.0229492190 1.0805609 13 16 28.98663
406.12 0.0264692745 1.1830798 16 12 32.68323
427.7 0.0135698145 1.4090495 4 7 36.19020
450.3 0.0216161656 1.3239797 11 6 36.19602
506.2 0.0318266934 1.1823230 18 11 33.26623
Canchan 0.0461305761 0.9477687 21 20 27.00126
Desiree 0.0901534938 0.5612418 27 28 16.15569
Unica 0.0770659860 1.3153400 25 2 39.10400

```

```

# Changing the ratio of weights for Rao's SSI
EV.AMMI(model, ssi.method = "rao", a = 0.43)

```

```

              EV          SSI rEV rY      means
102.18 0.0232206231 0.9157183 14 23 26.31947
104.22 0.0175897578 1.0961734 8 13 31.28887
121.31 0.0342010876 1.0205626 19 15 30.10174
141.28 0.0529036285 1.3215387 22 1 39.75624
157.26 0.0965635719 1.2186766 28 5 36.95181
163.9 0.0236900961 0.7547449 15 27 21.41747
221.19 0.0127574566 0.8541946 3 26 22.98480
233.11 0.0211138628 0.9979893 10 17 28.66655
235.6 0.0723274691 1.2781883 24 4 38.63477
241.2 0.0153823821 0.9457286 6 22 26.34039
255.7 0.0317506280 1.0394903 17 14 30.58975
314.12 0.0170302467 0.9970866 7 18 28.17335
317.6 0.0136347120 1.2498410 5 9 35.32583
319.20 0.0855988994 1.2793305 26 3 38.75767
320.16 0.0180662044 0.9330723 9 21 26.34808
342.15 0.0225156118 0.9075396 12 24 26.01336
346.2 0.0459434537 0.8064645 20 25 23.84175
351.26 0.0639652186 1.1984717 23 8 36.11581
364.21 0.0018299284 1.8408895 2 10 34.05974
402.7 0.0001339385 10.8743081 1 19 27.47748
405.2 0.0229492190 1.0033632 13 16 28.98663
406.12 0.0264692745 1.1161483 16 12 32.68323
427.7 0.0135698145 1.2784931 4 7 36.19020
450.3 0.0216161656 1.2420213 11 6 36.19602
506.2 0.0318266934 1.1266582 18 11 33.26623
Canchan 0.0461305761 0.9093641 21 20 27.00126
Desiree 0.0901534938 0.5415905 27 28 16.15569
Unica 0.0770659860 1.2923516 25 2 39.10400

```

FA.AMMI()

```

# With default n (N') and default ssi.method (farshadfar)
FA.AMMI(model)

```

```

              FA SSI rFA rY      means
102.18 226.214559 39 16 23 26.31947
104.22 96.017789 22 9 13 31.28887
121.31 166.871081 26 11 15 30.10174
141.28 386.485026 23 22 1 39.75624
157.26 460.491413 29 24 5 36.95181
163.9 306.218437 48 21 27 21.41747
221.19 72.376305 31 5 26 22.98480
233.11 80.663694 24 7 17 28.66655
235.6 481.419528 29 25 4 38.63477
241.2 71.468008 26 4 22 26.34039
255.7 237.870912 32 18 14 30.58975
314.12 149.384801 28 10 18 28.17335
317.6 92.022551 17 8 9 35.32583
319.20 840.209886 30 27 3 38.75767
320.16 191.423345 34 13 21 26.34808
342.15 169.656627 36 12 24 26.01336

```

```

346.2    450.721670  48  23  25  23.84175
351.26   298.237108  28  20   8  36.11581
364.21    14.300314  12   2  10  34.05974
402.7     1.419225  20   1  19  27.47748
405.2    256.882577  35  19  16  28.98663
406.12   195.702153  26  14  12  32.68323
427.7     56.361179  10   3   7  36.19020
450.3    203.659148  21  15   6  36.19602
506.2     80.183743  17   6  11  33.26623
Canchan  229.161607  37  17  20  27.00126
Desiree 1031.364210  56  28  28  16.15569
Unica    499.251489  28  26   2  39.10400

```

```

# With n = 4 and default ssi.method (farshadfar)
FA.AMMI(model, n = 4)

```

```

          FA SSI rFA rY    means
102.18   230.610963  39  16  23  26.31947
104.22    99.626933  22   9  13  31.28887
121.31   258.286270  33  18  15  30.10174
141.28   387.665704  23  22   1  39.75624
157.26   531.981114  31  26   5  36.95181
163.9    310.983953  48  21  27  21.41747
221.19    72.619025  30   4  26  22.98480
233.11    81.631564  24   7  17  28.66655
235.6    500.679624  28  24   4  38.63477
241.2     73.134171  27   5  22  26.34039
255.7    239.767170  31  17  14  30.58975
314.12   149.451148  28  10  18  28.17335
317.6     98.287259  17   8   9  35.32583
319.20   863.387913  30  27   3  38.75767
320.16   223.718164  35  14  21  26.34808
342.15   192.877830  35  11  24  26.01336
346.2    466.039106  48  23  25  23.84175
351.26   298.259992  28  20   8  36.11581
364.21    25.537314  12   2  10  34.05974
402.7     3.829248  20   1  19  27.47748
405.2    261.727258  35  19  16  28.98663
406.12   198.459140  24  12  12  32.68323
427.7     61.577580  10   3   7  36.19020
450.3    210.606905  19  13   6  36.19602
506.2     80.223923  17   6  11  33.26623
Canchan  229.271862  35  15  20  27.00126
Desiree 1031.404193  56  28  28  16.15569
Unica    506.919240  27  25   2  39.10400

```

```

# With default n (N') and ssi.method = "rao"
FA.AMMI(model, ssi.method = "rao")

```

```

          FA          SSI rFA rY    means
102.18   226.214559  0.9902913  16  23  26.31947
104.22    96.017789  1.3314840   9  13  31.28887
121.31   166.871081  1.1606028  11  15  30.10174
141.28   386.485026  1.3736129  22   1  39.75624
157.26   460.491413  1.2697440  24   5  36.95181
163.9    306.218437  0.7959379  21  27  21.41747
221.19    72.376305  1.1624072   5  26  22.98480
233.11    80.663694  1.3052353   7  17  28.66655
235.6    481.419528  1.3217963  25   4  38.63477
241.2     71.468008  1.2770668   4  22  26.34039
255.7    237.870912  1.1230515  18  14  30.58975
314.12   149.384801  1.1186933  10  18  28.17335
317.6     92.022551  1.4766266   8   9  35.32583
319.20   840.209886  1.2992910  27   3  38.75767
320.16   191.423345  1.0152386  13  21  26.34808
342.15   169.656627  1.0243579  12  24  26.01336
346.2    450.721670  0.8436895  23  25  23.84175
351.26   298.237108  1.2777984  20   8  36.11581
364.21    14.300314  3.2006702   2  10  34.05974

```

```

402.7      1.419225 21.9563817   1 19 27.47748
405.2     256.882577 1.0614812  19 16 28.98663
406.12    195.702153 1.2183859  14 12 32.68323
427.7      56.361179 1.7103246   3  7 36.19020
450.3     203.659148 1.3269556  15  6 36.19602
506.2      80.183743 1.4574286   6 11 33.26623
Canchan   229.161607 1.0108222  17 20 27.00126
Desiree   1031.364210 0.5557465  28 28 16.15569
Unica     499.251489 1.3348781  26  2 39.10400

```

```

# Changing the ratio of weights for Rao's SSI
FA.AMMI(model, ssi.method = "rao", a = 0.43)

```

```

          FA      SSI rFA rY    means
102.18    226.214559 0.9149776 16 23 26.31947
104.22     96.017789 1.1540477  9 13 31.28887
121.31    166.871081 1.0585058 11 15 30.10174
141.28    386.485026 1.3295309 22  1 39.75624
157.26    460.491413 1.2327465 24  5 36.95181
163.9     306.218437 0.7403010 21 27 21.41747
221.19     72.376305 0.9270120  5 26 22.98480
233.11     80.663694 1.0940246  7 17 28.66655
235.6     481.419528 1.2864071 25  4 38.63477
241.2      71.468008 1.0386799  4 22 26.34039
255.7     237.870912 1.0514284 18 14 30.58975
314.12    149.384801 1.0046453 10 18 28.17335
317.6      92.022551 1.2914868  8  9 35.32583
319.20    840.209886 1.2790139 27  3 38.75767
320.16    191.423345 0.9262367 13 21 26.34808
342.15    169.656627 0.9239372 12 24 26.01336
346.2     450.721670 0.8058900 23 25 23.84175
351.26    298.237108 1.2206726 20  8 36.11581
364.21     14.300314 2.0092951  2 10 34.05974
402.7      1.419225 9.9519184   1 19 27.47748
405.2     256.882577 0.9951589 19 16 28.98663
406.12    195.702153 1.1313300 14 12 32.68323
427.7      56.361179 1.4080414   3  7 36.19020
450.3     203.659148 1.2433009 15  6 36.19602
506.2      80.183743 1.2449536   6 11 33.26623
Canchan   229.161607 0.9364771 17 20 27.00126
Desiree   1031.364210 0.5392276 28 28 16.15569
Unica     499.251489 1.3007530 26  2 39.10400

```

MASV.AMMI()

```

# With default n (N') and default ssi.method (farshadfar)
MASV.AMMI(model)

```

```

          MASV SSI rMASV rY    means
102.18    4.7855876 42    19 23 26.31947
104.22    3.8328358 25    12 13 31.28887
121.31    4.0446758 29    14 15 30.10174
141.28    5.1867706 21    20  1 39.75624
157.26    7.6459224 29    24  5 36.95181
163.9     4.4977055 43    16 27 21.41747
221.19    2.1905344 31     5 26 22.98480
233.11    3.1794345 26     9 17 28.66655
235.6     8.4913020 29    25  4 38.63477
241.2     2.0338659 26     4 22 26.34039
255.7     4.7013868 32    18 14 30.58975
314.12    3.1376678 26     8 18 28.17335
317.6     2.3345492 15     6  9 35.32583
319.20    8.6398087 30    27  3 38.75767
320.16    3.8822326 34    13 21 26.34808
342.15    3.6438425 34    10 24 26.01336
346.2     5.3987165 47    22 25 23.84175
351.26    5.4005468 31    23  8 36.11581
364.21    1.4047546 12     2 10 34.05974
402.7     0.3537818 20     1 19 27.47748

```

```

405.2  4.1095727  31  15 16 28.98663
406.12 5.3218165  33  21 12 32.68323
427.7  2.4124676  14   7  7 36.19020
450.3  4.6608954  23  17  6 36.19602
506.2  1.9330143  14   3 11 33.26623
Canchan 3.6665608  31  11 20 27.00126
Desiree 9.0626072  56  28 28 16.15569
Unica  8.5447632  28  26  2 39.10400

```

```

# With n = 4 and default ssi.method (farshadfar)
MASV.AMMI(model, n = 4)

```

```

      MASV SSI rMASV rY    means
102.18 4.8247593  39   16 23 26.31947
104.22 4.0510711  23   10 13 31.28887
121.31 5.2473236  34   19 15 30.10174
141.28 5.9101338  23   22  1 39.75624
157.26 8.7719153  30   25  5 36.95181
163.9  4.5459209  41   14 27 21.41747
221.19 2.7137861  29    3 26 22.98480
233.11 3.7724279  26    9 17 28.66655
235.6  8.6953084  28   24  4 38.63477
241.2  2.8067193  26    4 22 26.34039
255.7  5.0424601  32   18 14 30.58975
314.12 3.4445298  25    7 18 28.17335
317.6  2.8792321  14    5  9 35.32583
319.20 8.8774217  30   27  3 38.75767
320.16 4.1787768  33   12 21 26.34808
342.15 4.1725070  35   11 24 26.01336
346.2  5.8554350  46   21 25 23.84175
351.26 6.4286626  31   23  8 36.11581
364.21 1.6075453  12    2 10 34.05974
402.7  0.5067415  20    1 19 27.47748
405.2  4.2896919  29   13 16 28.98663
406.12 5.3564283  32   20 12 32.68323
427.7  2.9737174  13    6  7 36.19020
450.3  4.7112537  21   15  6 36.19602
506.2  3.6306466  19    8 11 33.26623
Canchan 4.8979104  37   17 20 27.00126
Desiree 9.1023670  56   28 28 16.15569
Unica  8.7835476  28   26  2 39.10400

```

```

# With default n (N') and ssi.method = "rao"
MASV.AMMI(model, ssi.method = "rao")

```

```

      MASV      SSI rMASV rY    means
102.18 4.7855876 1.4296717   19 23 26.31947
104.22 3.8328358 1.7337655   12 13 31.28887
121.31 4.0446758 1.6576851   14 15 30.10174
141.28 5.1867706 1.8235808   20  1 39.75624
157.26 7.6459224 1.5625443   24  5 36.95181
163.9  4.4977055 1.3064192   16 27 21.41747
221.19 2.1905344 1.9979910    5 26 22.98480
233.11 3.1794345 1.7949089    9 17 28.66655
235.6  8.4913020 1.5818054   25  4 38.63477
241.2  2.0338659 2.2035784    4 22 26.34039
255.7  4.7013868 1.5791422   18 14 30.58975
314.12 3.1376678 1.7902786    8 18 28.17335
317.6  2.3345492 2.3233562    6  9 35.32583
319.20 8.6398087 1.5802761   27  3 38.75767
320.16 3.8822326 1.5635888   13 21 26.34808
342.15 3.6438425 1.5987650   10 24 26.01336
346.2  5.3987165 1.2839782   22 25 23.84175
351.26 5.4005468 1.6840095   23  8 36.11581
364.21 1.4047546 3.0575043    2 10 34.05974
402.7  0.3537818 8.6266993    1 19 27.47748
405.2  4.1095727 1.6106479   15 16 28.98663
406.12 5.3218165 1.5795802   21 12 32.68323
427.7  2.4124676 2.3137009    7  7 36.19020

```

```

450.3  4.6608954 1.7669921 17 6 36.19602
506.2  1.9330143 2.4995588 3 11 33.26623
Canchan 3.6665608 1.6263253 11 20 27.00126
Desiree 9.0626072 0.8285565 28 28 16.15569
Unica 8.5447632 1.5950896 26 2 39.10400

```

```

# Changing the ratio of weights for Rao's SSI
MASV.AMMI(model, ssi.method = "rao", a = 0.43)

```

	MASV	SSI	rMASV	rY	means
102.18	4.7855876	1.1039112	19	23	26.31947
104.22	3.8328358	1.3270288	12	13	31.28887
121.31	4.0446758	1.2722512	14	15	30.10174
141.28	5.1867706	1.5230171	20	1	39.75624
157.26	7.6459224	1.3586506	24	5	36.95181
163.9	4.4977055	0.9598080	16	27	21.41747
221.19	2.1905344	1.2863130	5	26	22.98480
233.11	3.1794345	1.3045842	9	17	28.66655
235.6	8.4913020	1.3982110	25	4	38.63477
241.2	2.0338659	1.4370799	4	22	26.34039
255.7	4.7013868	1.2475474	18	14	30.58975
314.12	3.1376678	1.2934270	8	18	28.17335
317.6	2.3345492	1.6555805	6	9	35.32583
319.20	8.6398087	1.3998375	27	3	38.75767
320.16	3.8822326	1.1620273	13	21	26.34808
342.15	3.6438425	1.1709323	10	24	26.01336
346.2	5.3987165	0.9952142	22	25	23.84175
351.26	5.4005468	1.3953434	23	8	36.11581
364.21	1.4047546	1.9477337	2	10	34.05974
402.7	0.3537818	4.2201550	1	19	27.47748
405.2	4.1095727	1.2313006	15	16	28.98663
406.12	5.3218165	1.2866435	21	12	32.68323
427.7	2.4124676	1.6674932	7	7	36.19020
450.3	4.6608954	1.4325166	17	6	36.19602
506.2	1.9330143	1.6930696	3	11	33.26623
Canchan	3.6665608	1.2011435	11	20	27.00126
Desiree	9.0626072	0.6565359	28	28	16.15569
Unica	8.5447632	1.4126439	26	2	39.10400

SIPC.AMMI()

```

# With default n (N') and default ssi.method (farshadfar)
SIPC.AMMI(model)

```

	SIPC	SSI	rSIPC	rY	means
102.18	2.9592568	39	16	23	26.31947
104.22	2.2591593	22	9	13	31.28887
121.31	3.3872806	33	18	15	30.10174
141.28	4.3846248	23	22	1	39.75624
157.26	5.4846596	31	26	5	36.95181
163.9	2.6263670	38	11	27	21.41747
221.19	2.0218098	32	6	26	22.98480
233.11	2.1624442	24	7	17	28.66655
235.6	4.8273551	28	24	4	38.63477
241.2	2.0056410	27	5	22	26.34039
255.7	3.6075128	34	20	14	30.58975
314.12	2.4584089	28	10	18	28.17335
317.6	1.8698826	12	3	9	35.32583
319.20	5.9590451	31	28	3	38.75767
320.16	2.7040109	33	12	21	26.34808
342.15	2.9755899	41	17	24	26.01336
346.2	3.9525017	46	21	25	23.84175
351.26	4.5622439	31	23	8	36.11581
364.21	0.7526264	12	2	10	34.05974
402.7	0.2284995	20	1	19	27.47748
405.2	2.7952381	29	13	16	28.98663
406.12	2.8834753	27	15	12	32.68323
427.7	2.0049278	11	4	7	36.19020
450.3	2.8200387	20	14	6	36.19602


```

506.2  2.2178470  19    8 11 33.26623
Canchan 3.5328212  39   19 20 27.00126
Desiree 5.8073242  55   27 28 16.15569
Unica   5.0654615  27   25  2 39.10400

# With n = 4 and default ssi.method (farshadfar)
SIPC.AMMI(model, n = 4)

```

	SIPC	SSI	rSIPC	rY	means
102.18	3.4466455	38	15	23	26.31947
104.22	2.7007589	23	10	13	31.28887
121.31	5.6097497	38	23	15	30.10174
141.28	4.6372010	22	21	1	39.75624
157.26	7.4500476	33	28	5	36.95181
163.9	3.1338033	38	11	27	21.41747
221.19	2.1363292	29	3	26	22.98480
233.11	2.3911278	23	6	17	28.66655
235.6	5.8474857	29	25	4	38.63477
241.2	2.3056852	27	5	22	26.34039
255.7	3.9276052	31	17	14	30.58975
314.12	2.5182824	26	8	18	28.17335
317.6	2.4516869	16	7	9	35.32583
319.20	7.0781345	30	27	3	38.75767
320.16	4.0249810	39	18	21	26.34808
342.15	4.0957211	43	19	24	26.01336
346.2	4.8622465	47	22	25	23.84175
351.26	4.5974075	28	20	8	36.11581
364.21	1.5318314	12	2	10	34.05974
402.7	0.5893581	20	1	19	27.47748
405.2	3.3068718	29	13	16	28.98663
406.12	3.2694367	24	12	12	32.68323
427.7	2.5358269	16	9	7	36.19020
450.3	3.4327401	20	14	6	36.19602
506.2	2.2644412	15	4	11	33.26623
Canchan	3.6100050	36	16	20	27.00126
Desiree	5.8538044	54	26	28	16.15569
Unica	5.7091275	26	24	2	39.10400

```

# With default n (N') and ssi.method = "rao"
SIPC.AMMI(model, ssi.method = "rao")

```

	SIPC	SSI	rSIPC	rY	means
102.18	2.9592568	1.5124653	16	23	26.31947
104.22	2.2591593	1.8772594	9	13	31.28887
121.31	3.3872806	1.5531093	18	15	30.10174
141.28	4.3846248	1.7378762	22	1	39.75624
157.26	5.4846596	1.5578664	26	5	36.95181
163.9	2.6263670	1.4355650	11	27	21.41747
221.19	2.0218098	1.7071153	6	26	22.98480
233.11	2.1624442	1.8300896	7	17	28.66655
235.6	4.8273551	1.6608098	24	4	38.63477
241.2	2.0056410	1.8242469	5	22	26.34039
255.7	3.6075128	1.5341245	20	14	30.58975
314.12	2.4584089	1.7062126	10	18	28.17335
317.6	1.8698826	2.1873134	3	9	35.32583
319.20	5.9590451	1.5886436	28	3	38.75767
320.16	2.7040109	1.5751613	12	21	26.34808
342.15	2.9755899	1.4988930	17	24	26.01336
346.2	3.9525017	1.2672546	21	25	23.84175
351.26	4.5622439	1.6019853	23	8	36.11581
364.21	0.7526264	3.6831976	2	10	34.05974
402.7	0.2284995	9.3696848	1	19	27.47748
405.2	2.7952381	1.6378227	13	16	28.98663
406.12	2.8834753	1.7371554	15	12	32.68323
427.7	2.0049278	2.1457493	4	7	36.19020
450.3	2.8200387	1.8667975	14	6	36.19602
506.2	2.2178470	1.9576974	8	11	33.26623
Canchan	3.5328212	1.4284673	19	20	27.00126
Desiree	5.8073242	0.8601813	27	28	16.15569

```
Unica 5.0654615 1.6572552 25 2 39.10400
# Changing the ratio of weights for Rao's SSI
SIPC.AMMI(model, ssi.method = "rao", a = 0.43)
```

	SIPC	SSI	rSIPC	rY	means
102.18	2.9592568	1.1395125	16	23	26.31947
104.22	2.2591593	1.3887312	9	13	31.28887
121.31	3.3872806	1.2272836	18	15	30.10174
141.28	4.3846248	1.4861641	22	1	39.75624
157.26	5.4846596	1.3566391	26	5	36.95181
163.9	2.6263670	1.0153407	11	27	21.41747
221.19	2.0218098	1.1612364	6	26	22.98480
233.11	2.1624442	1.3197119	7	17	28.66655
235.6	4.8273551	1.4321829	24	4	38.63477
241.2	2.0056410	1.2739673	5	22	26.34039
255.7	3.6075128	1.2281898	20	14	30.58975
314.12	2.4584089	1.2572786	10	18	28.17335
317.6	1.8698826	1.5970821	3	9	35.32583
319.20	5.9590451	1.4034355	28	3	38.75767
320.16	2.7040109	1.1670035	12	21	26.34808
342.15	2.9755899	1.1279873	17	24	26.01336
346.2	3.9525017	0.9880230	21	25	23.84175
351.26	4.5622439	1.3600729	23	8	36.11581
364.21	0.7526264	2.2167818	2	10	34.05974
402.7	0.2284995	4.5396387	1	19	27.47748
405.2	2.7952381	1.2429858	13	16	28.98663
406.12	2.8834753	1.3544008	15	12	32.68323
427.7	2.0049278	1.5952740	4	7	36.19020
450.3	2.8200387	1.4754330	14	6	36.19602
506.2	2.2178470	1.4600692	8	11	33.26623
Canchan	3.5328212	1.1160645	19	20	27.00126
Desiree	5.8073242	0.6701345	27	28	16.15569
Unica	5.0654615	1.4393751	25	2	39.10400

ZA.AMMI()

```
# With default n (N') and default ssi.method (farshadfar)
ZA.AMMI(model)
```

	Za	SSI	rZa	rY	means
102.18	0.15752787	41	18	23	26.31947
104.22	0.08552245	20	7	13	31.28887
121.31	0.13457796	26	11	15	30.10174
141.28	0.20424009	23	22	1	39.75624
157.26	0.20593889	28	23	5	36.95181
163.9	0.16161024	46	19	27	21.41747
221.19	0.08723440	34	8	26	22.98480
233.11	0.06559491	21	4	17	28.66655
235.6	0.20950908	29	25	4	38.63477
241.2	0.08160010	28	6	22	26.34039
255.7	0.16694984	34	20	14	30.58975
314.12	0.12243347	28	10	18	28.17335
317.6	0.08723605	18	9	9	35.32583
319.20	0.30778801	30	27	3	38.75767
320.16	0.14393358	35	14	21	26.34808
342.15	0.13891478	37	13	24	26.01336
346.2	0.20627243	49	24	25	23.84175
351.26	0.17809076	29	21	8	36.11581
364.21	0.03723882	12	2	10	34.05974
402.7	0.01243185	20	1	19	27.47748
405.2	0.15425031	33	17	16	28.98663
406.12	0.13595705	24	12	12	32.68323
427.7	0.07364374	12	5	7	36.19020
450.3	0.14895835	22	16	6	36.19602
506.2	0.06332050	14	3	11	33.26623
Canchan	0.14710608	35	15	20	27.00126
Desiree	0.32787182	56	28	28	16.15569
Unica	0.21646330	28	26	2	39.10400

```
# With n = 4 and default ssi.method (farshadfar)
ZA.AMMI(model, n = 4)
```

	Za	SSI	rZa	rY	means
102.18	0.16239946	41	18	23	26.31947
104.22	0.08993636	21	8	13	31.28887
121.31	0.15679216	30	15	15	30.10174
141.28	0.20676466	23	22	1	39.75624
157.26	0.22558350	31	26	5	36.95181
163.9	0.16668221	46	19	27	21.41747
221.19	0.08837906	33	7	26	22.98480
233.11	0.06788066	21	4	17	28.66655
235.6	0.21970557	28	24	4	38.63477
241.2	0.08459913	28	6	22	26.34039
255.7	0.17014926	34	20	14	30.58975
314.12	0.12303192	28	10	18	28.17335
317.6	0.09305134	18	9	9	35.32583
319.20	0.31897363	30	27	3	38.75767
320.16	0.15713705	37	16	21	26.34808
342.15	0.15011080	37	13	24	26.01336
346.2	0.21536559	48	23	25	23.84175
351.26	0.17844223	29	21	8	36.11581
364.21	0.04502719	12	2	10	34.05974
402.7	0.01603874	20	1	19	27.47748
405.2	0.15936424	33	17	16	28.98663
406.12	0.13981485	23	11	12	32.68323
427.7	0.07895023	12	5	7	36.19020
450.3	0.15508247	20	14	6	36.19602
506.2	0.06378622	14	3	11	33.26623
Canchan	0.14787755	32	12	20	27.00126
Desiree	0.32833640	56	28	28	16.15569
Unica	0.22289692	27	25	2	39.10400

```
# With default n (N') and ssi.method = "rao"
ZA.AMMI(model, ssi.method = "rao")
```

	Za	SSI	rZa	rY	means
102.18	0.15752787	1.4309653	18	23	26.31947
104.22	0.08552245	2.0752658	7	13	31.28887
121.31	0.13457796	1.6519700	11	15	30.10174
141.28	0.20424009	1.7380721	22	1	39.75624
157.26	0.20593889	1.6429878	23	5	36.95181
163.9	0.16161024	1.2566633	19	27	21.41747
221.19	0.08723440	1.7838011	8	26	22.98480
233.11	0.06559491	2.3102920	4	17	28.66655
235.6	0.20950908	1.6903953	25	4	38.63477
241.2	0.08160010	1.9646329	6	22	26.34039
255.7	0.16694984	1.5378736	20	14	30.58975
314.12	0.12243347	1.6556010	10	18	28.17335
317.6	0.08723605	2.1861684	9	9	35.32583
319.20	0.30778801	1.5568815	27	3	38.75767
320.16	0.14393358	1.4859985	14	21	26.34808
342.15	0.13891478	1.4977340	13	24	26.01336
346.2	0.20627243	1.2148178	24	25	23.84175
351.26	0.17809076	1.6842433	21	8	36.11581
364.21	0.03723882	3.5336141	2	10	34.05974
402.7	0.01243185	8.1540882	1	19	27.47748
405.2	0.15425031	1.5301007	17	16	28.98663
406.12	0.13595705	1.7293399	12	12	32.68323
427.7	0.07364374	2.4052596	5	7	36.19020
450.3	0.14895835	1.7859494	16	6	36.19602
506.2	0.06332050	2.5096775	3	11	33.26623
Canchan	0.14710608	1.4937760	15	20	27.00126
Desiree	0.32787182	0.8019725	28	28	16.15569
Unica	0.21646330	1.6918583	26	2	39.10400

```
# Changing the ratio of weights for Rao's SSI
ZA.AMMI(model, ssi.method = "rao", a = 0.43)
```

	Za	SSI	rZa	rY	means
102.18	0.15752787	1.1044675	18	23	26.31947
104.22	0.08552245	1.4738739	7	13	31.28887
121.31	0.13457796	1.2697937	11	15	30.10174
141.28	0.20424009	1.4862483	22	1	39.75624
157.26	0.20593889	1.3932413	23	5	36.95181
163.9	0.16161024	0.9384129	19	27	21.41747
221.19	0.08723440	1.1942113	8	26	22.98480
233.11	0.06559491	1.5261989	4	17	28.66655
235.6	0.20950908	1.4449047	25	4	38.63477
241.2	0.08160010	1.3343333	6	22	26.34039
255.7	0.16694984	1.2298019	20	14	30.58975
314.12	0.12243347	1.2355156	10	18	28.17335
317.6	0.08723605	1.5965898	9	9	35.32583
319.20	0.30778801	1.3897778	27	3	38.75767
320.16	0.14393358	1.1286635	14	21	26.34808
342.15	0.13891478	1.1274889	13	24	26.01336
346.2	0.20627243	0.9654752	24	25	23.84175
351.26	0.17809076	1.3954439	21	8	36.11581
364.21	0.03723882	2.1524610	2	10	34.05974
402.7	0.01243185	4.0169322	1	19	27.47748
405.2	0.15425031	1.1966653	17	16	28.98663
406.12	0.13595705	1.3510402	12	12	32.68323
427.7	0.07364374	1.7068634	5	7	36.19020
450.3	0.14895835	1.4406683	16	6	36.19602
506.2	0.06332050	1.6974207	3	11	33.26623
Canchan	0.14710608	1.1441472	15	20	27.00126
Desiree	0.32787182	0.6451047	28	28	16.15569
Unica	0.21646330	1.4542544	26	2	39.10400

Simultaneous selection indices for yield and stability

The most stable genotype need not necessarily be the highest yielding genotype. Hence, simultaneous selection indices (SSIs) have been proposed for the selection of stable as well as high yielding genotypes.

A family of simultaneous selection indices (I_i) were proposed by Rao and Prabhakaran (2005) similar to those proposed by Bajpai and Prabhakaran (2000) by incorporating the AMMI Based Stability Parameter ($ASTAB$) and Yield as components. These indices consist of yield component, measured as the ratio of the average performance of the i th genotype to the overall mean performance of the genotypes under test and a stability component, measured as the ratio of stability information ($\frac{1}{ASTAB}$) of the i th genotype to the mean stability information of the genotypes under test.

$$I_i = \frac{\bar{Y}_i}{\bar{Y}_{..}} + \alpha \frac{\frac{1}{ASTAB_i}}{\frac{1}{T} \sum_{i=1}^T \frac{1}{ASTAB_i}}$$

Where $ASTAB_i$ is the stability measure of the i th genotype under AMMI procedure; \bar{Y}_i is mean performance of i th genotype; $\bar{Y}_{..}$ is the overall mean; T is the number of genotypes under test and α is the ratio of the weights given to the stability components (w_2) and yield (w_1) with a restriction that $w_1 + w_2 = 1$. The weights can be specified as required (Table 2).

Table 2 : α and corresponding weights (w_1 and w_2)

α	w_1	w_2
1.00	0.5	0.5
0.67	0.6	0.4
0.43	0.7	0.3
0.25	0.8	0.2

In **ammistability**, the above expression has been implemented for all the stability parameters (SP) including $ASTAB$.

$$I_i = \frac{\bar{Y}_i}{\bar{Y}_{..}} + \alpha \frac{\frac{1}{SP_i}}{\frac{1}{T} \sum_{i=1}^T \frac{1}{SP_i}}$$

Genotype stability index (GSI) (Farshadfar, 2008) or Yield stability index (YSI) (Farshadfar et al., 2011; Jambhulkar et al.,

2017) is a simultaneous selection index for yield and yield stability which is computed by summation of the ranks of the stability index/parameter and the ranks of the mean yields. *YSI* is computed for all the stability parameters/indices implemented in this package.

$$GSI = YSI = R_{SP} + R_Y$$

Where, R_{SP} is the stability parameter/index rank of the genotype and R_Y is the mean yield rank of the genotype.

The function `SSI` implements both these indices in `ammistability`. Further, for each of the stability parameter functions, the simultaneous selection index is also computed by either of these functions as specified by the argument `ssi.method`.

Examples

SSI()

```
library(agricolae)
data(plrv)
model <- with(plrv, AMMI(Localty, Genotype, Rep, Yield, console=FALSE))

yield <- aggregate(model$means$Yield, by= list(model$means$GEN),
                    FUN=mean, na.rm=TRUE)[,2]
stab <- DZ.AMMI(model)$DZ
genotypes <- rownames(DZ.AMMI(model))

# With default ssi.method (farshadfar)
SSI(y = yield, sp = stab, gen = genotypes)
```

	SP	SSI	rSP	rY	means
102.18	0.26393535	37	14	23	26.31947
104.22	0.22971564	21	8	13	31.28887
121.31	0.32031744	34	19	15	30.10174
141.28	0.39838535	23	22	1	39.75624
157.26	0.53822924	33	28	5	36.95181
163.9	0.26659011	42	15	27	21.41747
221.19	0.19563325	29	3	26	22.98480
233.11	0.25167755	27	10	17	28.66655
235.6	0.46581370	28	24	4	38.63477
241.2	0.21481887	28	6	22	26.34039
255.7	0.30862904	31	17	14	30.58975
314.12	0.22603261	25	7	18	28.17335
317.6	0.20224771	14	5	9	35.32583
319.20	0.50675112	29	26	3	38.75767
320.16	0.23280596	30	9	21	26.34808
342.15	0.25989774	36	12	24	26.01336
346.2	0.37125512	45	20	25	23.84175
351.26	0.43805896	31	23	8	36.11581
364.21	0.07409309	12	2	10	34.05974
402.7	0.02004533	20	1	19	27.47748
405.2	0.26238837	29	13	16	28.98663
406.12	0.28179394	28	16	12	32.68323
427.7	0.20176581	11	4	7	36.19020
450.3	0.25465368	17	11	6	36.19602
506.2	0.30899851	29	18	11	33.26623
Canchan	0.37201039	41	21	20	27.00126
Desiree	0.52005815	55	27	28	16.15569
Unica	0.48083049	27	25	2	39.10400

```
# With ssi.method = "rao"
SSI(y = yield, sp = stab, gen = genotypes, method = "rao")
```

	SP	SSI	rSP	rY	means
102.18	0.26393535	1.5536988	14	23	26.31947
104.22	0.22971564	1.8193399	8	13	31.28887
121.31	0.32031744	1.5545939	19	15	30.10174
141.28	0.39838535	1.7570779	22	1	39.75624
157.26	0.53822924	1.5459114	28	5	36.95181
163.9	0.26659011	1.3869397	15	27	21.41747
221.19	0.19563325	1.6878048	3	26	22.98480
233.11	0.25167755	1.6641025	10	17	28.66655

```

235.6  0.46581370  1.6538090  24  4  38.63477
241.2  0.21481887  1.7134093  6  22  26.34039
255.7  0.30862904  1.5922105  17  14  30.58975
314.12 0.22603261  1.7307783  7  18  28.17335
317.6  0.20224771  2.0595024  5  9  35.32583
319.20 0.50675112  1.6259792  26  3  38.75767
320.16 0.23280596  1.6476346  9  21  26.34808
342.15 0.25989774  1.5545233  12  24  26.01336
346.2  0.37125512  1.2718506  20  25  23.84175
351.26 0.43805896  1.5966462  23  8  36.11581
364.21 0.07409309  3.5881882  2  10  34.05974
402.7  0.02004533  10.0539968  1  19  27.47748
405.2  0.26238837  1.6447637  13  16  28.98663
406.12 0.28179394  1.7171135  16  12  32.68323
427.7  0.20176581  2.0898536  4  7  36.19020
450.3  0.25465368  1.9010808  11  6  36.19602
506.2  0.30899851  1.6787677  18  11  33.26623
Canchan 0.37201039  1.3738642  21  20  27.00126
Desiree 0.52005815  0.8797586  27  28  16.15569
Unica 0.48083049  1.6568004  25  2  39.10400

# Changing the ratio of weights for Rao's SSI
SSI(y = yield, sp = stab, gen = genotypes, method = "rao", a = 0.43)

```

```

          SP      SSI rSP rY    means
102.18 0.26393535 1.1572429 14 23 26.31947
104.22 0.22971564 1.3638258 8 13 31.28887
121.31 0.32031744 1.2279220 19 15 30.10174
141.28 0.39838535 1.4944208 22 1 39.75624
157.26 0.53822924 1.3514985 28 5 36.95181
163.9 0.26659011 0.9944318 15 27 21.41747
221.19 0.19563325 1.1529329 3 26 22.98480
233.11 0.25167755 1.2483375 10 17 28.66655
235.6 0.46581370 1.4291726 24 4 38.63477
241.2 0.21481887 1.2263072 6 22 26.34039
255.7 0.30862904 1.2531668 17 14 30.58975
314.12 0.22603261 1.2678419 7 18 28.17335
317.6 0.20224771 1.5421234 5 9 35.32583
319.20 0.50675112 1.4194898 26 3 38.75767
320.16 0.23280596 1.1981670 9 21 26.34808
342.15 0.25989774 1.1519083 12 24 26.01336
346.2 0.37125512 0.9899993 20 25 23.84175
351.26 0.43805896 1.3577771 23 8 36.11581
364.21 0.07409309 2.1759278 2 10 34.05974
402.7 0.02004533 4.8338929 1 19 27.47748
405.2 0.26238837 1.2459704 13 16 28.98663
406.12 0.28179394 1.3457828 16 12 32.68323
427.7 0.20176581 1.5712389 4 7 36.19020
450.3 0.25465368 1.4901748 11 6 36.19602
506.2 0.30899851 1.3401295 18 11 33.26623
Canchan 0.37201039 1.0925852 21 20 27.00126
Desiree 0.52005815 0.6785528 27 28 16.15569
Unica 0.48083049 1.4391795 25 2 39.10400

```

Wrapper function

A function `ammistability` has also been implemented which is a wrapper around all the available functions in the package to compute simultaneously multiple AMMI stability parameters along with the corresponding SSIs. Correlation among the computed values as well as visualization of the differences in genotype ranks for the computed parameters is also generated.

Examples

```

ammistability()

library(agricolae)
data(plrv)

# AMMI model
model <- with(plrv, AMMI(Locality, Genotype, Rep, Yield, console = FALSE))

```

```
ammistability(model, AMGE = TRUE, ASI = FALSE, ASV = TRUE, ASTAB = FALSE,
              AVAMGE = FALSE, DA = FALSE, DZ = FALSE, EV = TRUE,
              FA = FALSE, MASI = FALSE, MASV = TRUE, SIPC = TRUE,
              ZA = FALSE)
```

```
$Details
```

```
$Details$`Stability parameters estimated`
```

```
[1] "AMGE" "ASV" "EV" "MASV" "SIPC"
```

```
$Details$`SSI method`
```

```
[1] "Farshadfar (2008)"
```

```
$`Stability Parameters`
```

	genotype	means	AMGE	ASV	EV	MASV	SIPC
1	102.18	26.31947	-8.659740e-15	3.3801820	0.0232206231	4.7855876	2.9592568
2	104.22	31.28887	1.110223e-15	1.4627695	0.0175897578	3.8328358	2.2591593
3	121.31	30.10174	4.440892e-16	2.2937918	0.0342010876	4.0446758	3.3872806
4	141.28	39.75624	1.021405e-14	4.4672401	0.0529036285	5.1867706	4.3846248
5	157.26	36.95181	2.220446e-15	3.2923168	0.0965635719	7.6459224	5.4846596
6	163.9	21.41747	-1.243450e-14	4.4269636	0.0236900961	4.4977055	2.6263670
7	221.19	22.98480	-4.440892e-15	1.8014494	0.0127574566	2.1905344	2.0218098
8	233.11	28.66655	2.275957e-15	1.0582263	0.0211138628	3.1794345	2.1624442
9	235.6	38.63477	5.773160e-15	3.7647078	0.0723274691	8.4913020	4.8273551
10	241.2	26.34039	-5.329071e-15	1.6774241	0.0153823821	2.0338659	2.0056410
11	255.7	30.58975	-3.774758e-15	3.3289736	0.0317506280	4.7013868	3.6075128
12	314.12	28.17335	5.773160e-15	2.9170536	0.0170302467	3.1376678	2.4584089
13	317.6	35.32583	2.220446e-15	2.1874274	0.0136347120	2.3345492	1.8698826
14	319.20	38.75767	1.731948e-14	6.7164864	0.0855988994	8.6398087	5.9590451
15	320.16	26.34808	-6.217249e-15	3.3208950	0.0180662044	3.8822326	2.7040109
16	342.15	26.01336	-2.442491e-15	2.9219360	0.0225156118	3.6438425	2.9755899
17	346.2	23.84175	-1.110223e-14	5.1827747	0.0459434537	5.3987165	3.9525017
18	351.26	36.11581	1.021405e-14	2.9786832	0.0639652186	5.4005468	4.5622439
19	364.21	34.05974	1.415534e-15	0.7236998	0.0018299284	1.4047546	0.7526264
20	402.7	27.47748	-3.885781e-16	0.2801470	0.0001339385	0.3537818	0.2284995
21	405.2	28.98663	-1.088019e-14	3.9832546	0.0229492190	4.1095727	2.7952381
22	406.12	32.68323	3.108624e-15	2.5631734	0.0264692745	5.3218165	2.8834753
23	427.7	36.19020	1.110223e-16	1.1467970	0.0135698145	2.4124676	2.0049278
24	450.3	36.19602	6.439294e-15	3.1430174	0.0216161656	4.6608954	2.8200387
25	506.2	33.26623	-5.773160e-15	0.7511331	0.0318266934	1.9330143	2.2178470
26	Canchan	27.00126	9.325873e-15	3.0975884	0.0461305761	3.6665608	3.5328212
27	Desiree	16.15569	-1.132427e-14	7.7833445	0.0901534938	9.0626072	5.8073242
28	Unica	39.10400	5.329071e-15	3.8380782	0.0770659860	8.5447632	5.0654615

```
$`Simultaneous Selection Indices`
```

	genotype	means	AMGE_SSI	ASV_SSI	EV_SSI	MASV_SSI	SIPC_SSI
1	102.18	26.31947	28.0	43	37	42	39
2	104.22	31.28887	28.0	19	21	25	22
3	121.31	30.10174	29.0	25	34	29	33
4	141.28	39.75624	27.5	26	23	21	23
5	157.26	36.95181	22.5	22	33	29	31
6	163.9	21.41747	28.0	51	42	43	38
7	221.19	22.98480	35.0	34	29	31	32
8	233.11	28.66655	36.0	21	27	26	24
9	235.6	38.63477	26.5	25	28	29	28
10	241.2	26.34039	30.0	29	28	26	27
11	255.7	30.58975	24.0	33	31	32	34
12	314.12	28.17335	40.5	30	25	26	28
13	317.6	35.32583	26.5	18	14	15	12
14	319.20	38.75767	31.0	30	29	30	31
15	320.16	26.34808	27.0	39	30	34	33
16	342.15	26.01336	35.0	37	36	34	41
17	346.2	23.84175	28.0	51	45	47	46
18	351.26	36.11581	34.5	22	31	31	31
19	364.21	34.05974	26.0	12	12	12	12
20	402.7	27.47748	31.0	20	20	20	20
21	405.2	28.98663	20.0	39	29	31	29

22	406.12	32.68323	32.0	23	28	33	27
23	427.7	36.19020	20.0	12	11	14	11
24	450.3	36.19602	30.0	22	17	23	20
25	506.2	33.26623	18.0	14	29	14	19
26	Canchan	27.00126	45.0	35	41	31	39
27	Desiree	16.15569	30.0	56	55	56	55
28	Unica	39.10400	23.0	24	27	28	27

\$`SP Correlation`

	AMGE	ASV	EV	MASV	SIPC
AMGE	1.00**	<NA>	<NA>	<NA>	<NA>
ASV	-0.03	1.00**	<NA>	<NA>	<NA>
EV	0.31	0.70**	1.00**	<NA>	<NA>
MASV	0.21	0.81**	0.90**	1.00**	<NA>
SIPC	0.28	0.81**	0.96**	0.94**	1.00**

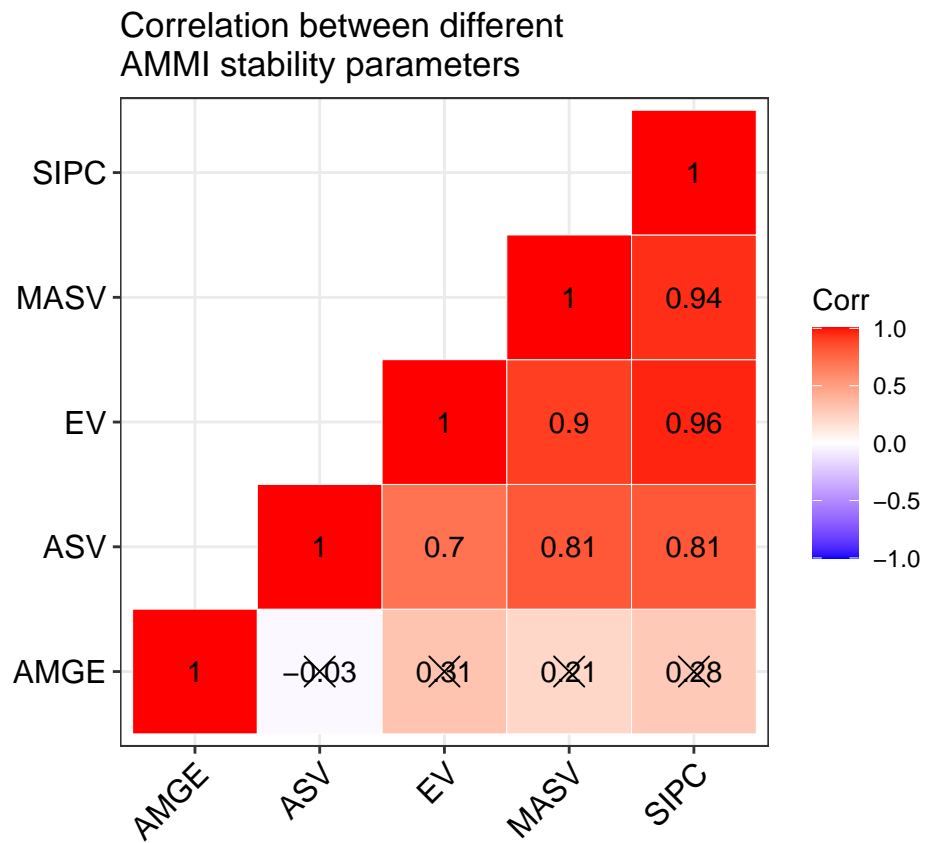
\$`SSI Correlation`

	AMGE	ASV	EV	MASV	SIPC
AMGE	1.00**	<NA>	<NA>	<NA>	<NA>
ASV	0.20	1.00**	<NA>	<NA>	<NA>
EV	0.24	0.84**	1.00**	<NA>	<NA>
MASV	0.23	0.92**	0.90**	1.00**	<NA>
SIPC	0.32	0.89**	0.96**	0.95**	1.00**

\$`SP and SSI Correlation`

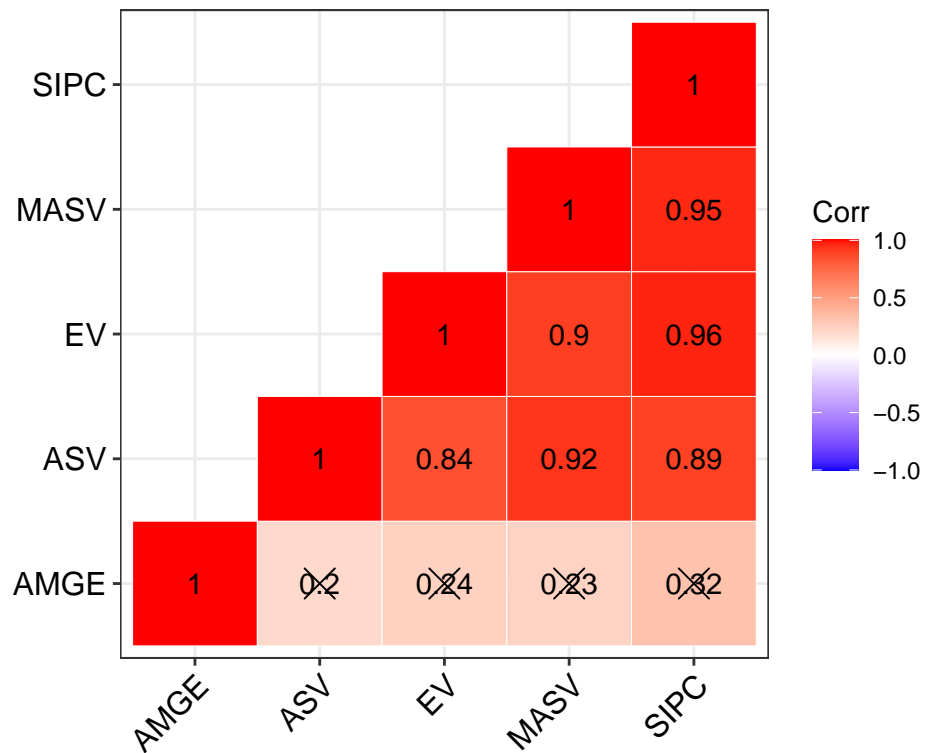
	AMGE	ASV	EV	MASV	SIPC	AMGE_SSI	ASV_SSI	EV_SSI	MASV_SSI	SIPC_SSI
AMGE	1.00**	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>
ASV	-0.03	1.00**	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>
EV	0.31	0.70**	1.00**	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>
MASV	0.21	0.81**	0.90**	1.00**	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>
SIPC	0.28	0.81**	0.96**	0.94**	1.00**	<NA>	<NA>	<NA>	<NA>	<NA>
AMGE_SSI	0.34	0.03	-0.08	-0.10	-0.03	1.00**	<NA>	<NA>	<NA>	<NA>
ASV_SSI	-0.56**	0.71**	0.21	0.35	0.34	0.20	1.00**	<NA>	<NA>	<NA>
EV_SSI	-0.42*	0.64**	0.48**	0.47*	0.53**	0.24	0.84**	1.00**	<NA>	<NA>
MASV_SSI	-0.46*	0.73**	0.40*	0.54**	0.51**	0.23	0.92**	0.90**	1.00**	<NA>
SIPC_SSI	-0.38*	0.70**	0.45*	0.50**	0.54**	0.32	0.89**	0.96**	0.95**	1.00**

\$`SP Correlogram`



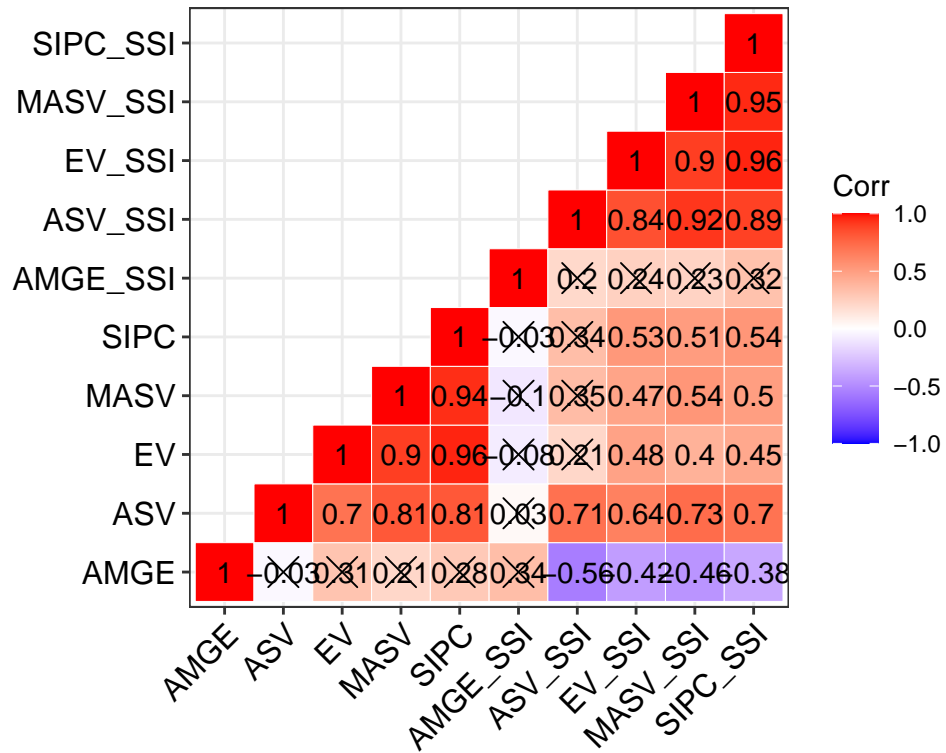
\$`SSI Correlogram`

Correlation between simultaneous selection indices
from different AMMI stability parameters

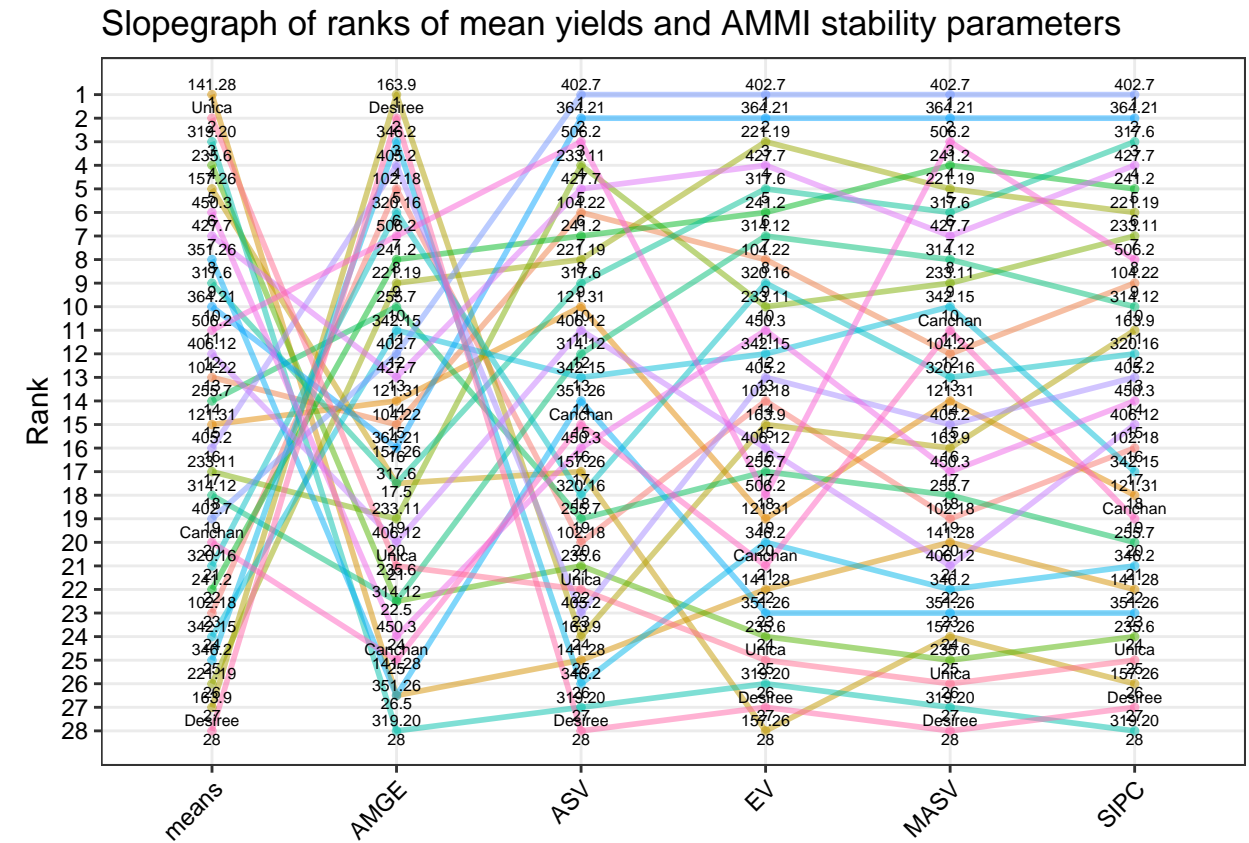


\$`SP and SSI Correlogram`

Correlation between different AMMI stability parameters and corresponding simultaneous selection indices

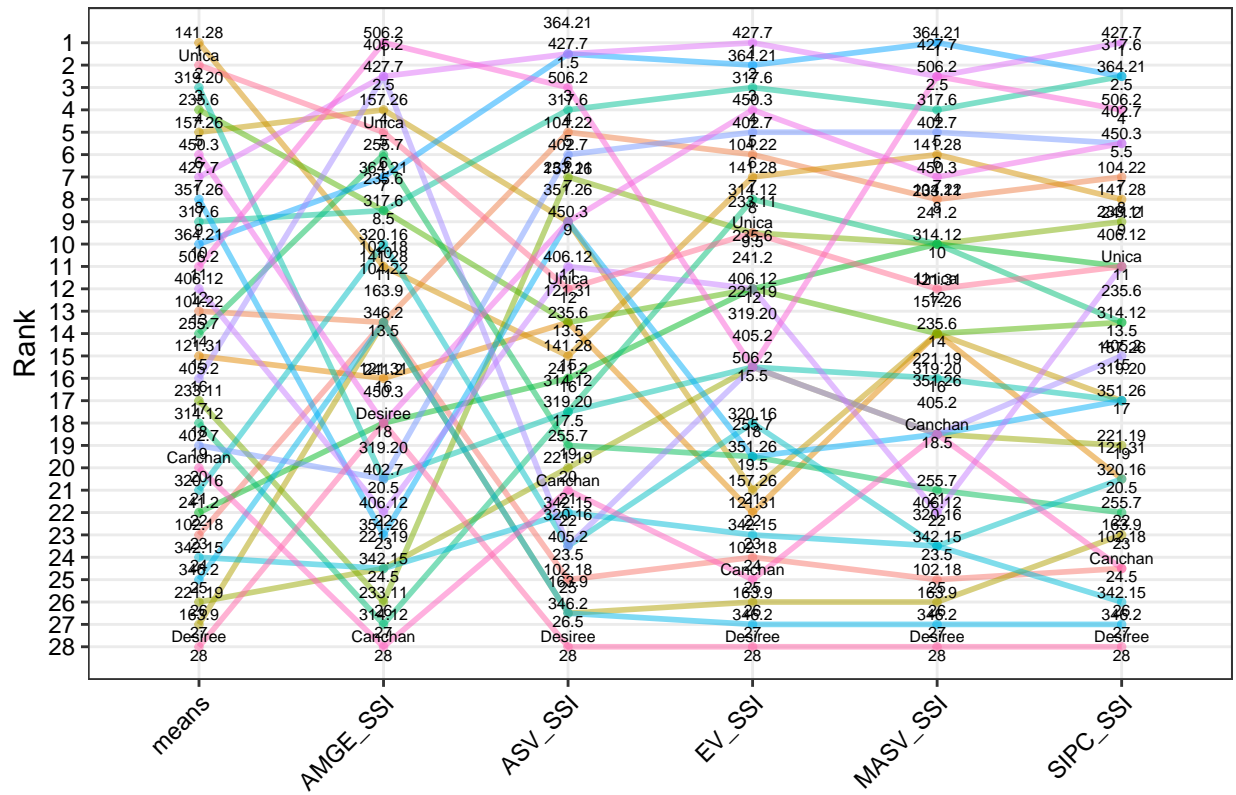


\$`SP Slopegraph`

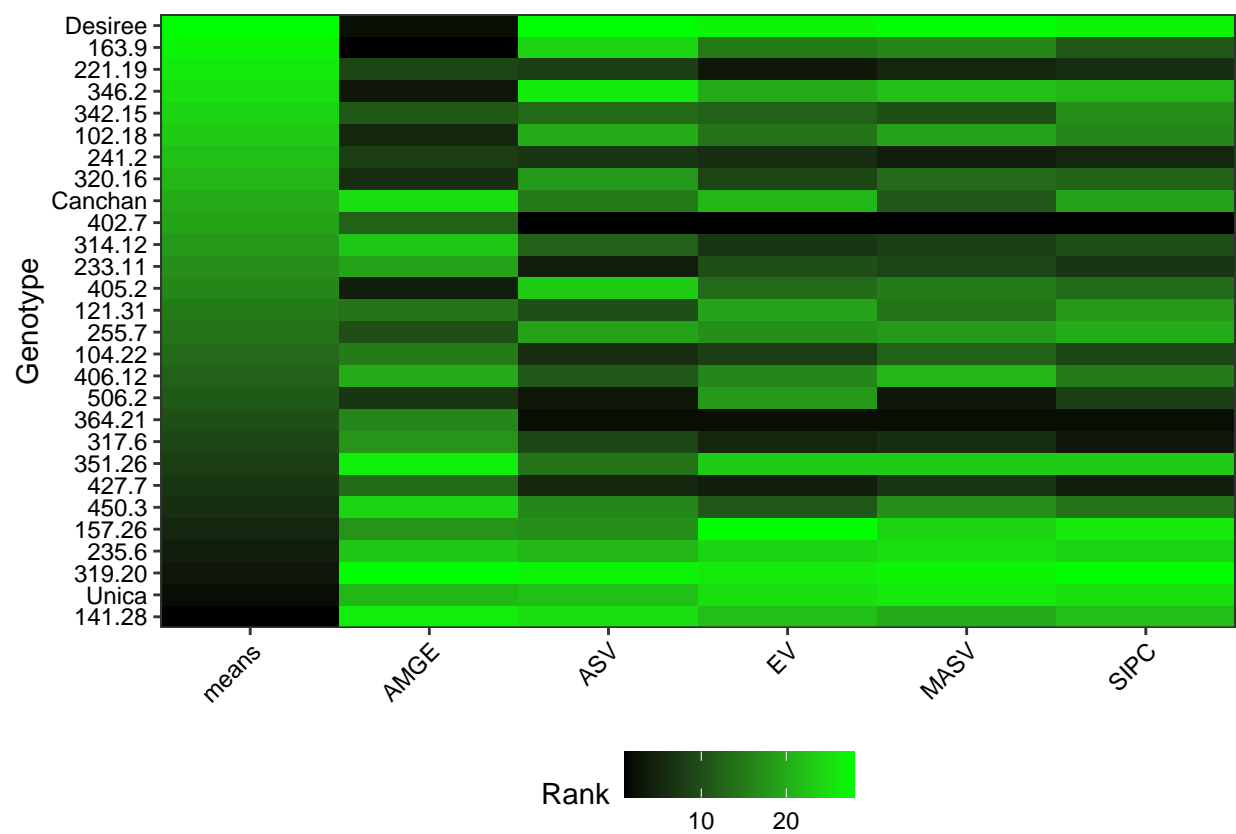


\$`SSI Slopegraph`

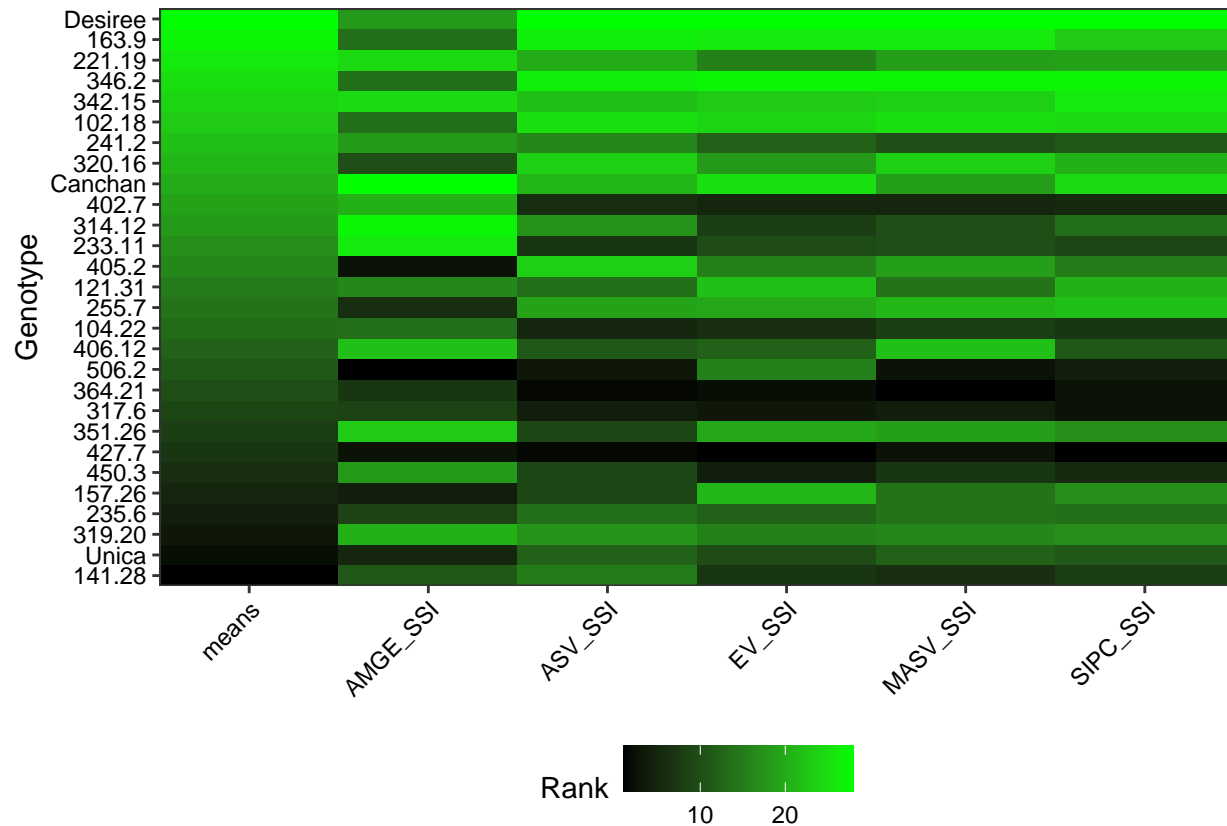
Slopegraph of ranks of mean yields and simultaneous selection indices



\$ SP Heatmap`



\$`SSI Heatmap`



Citing *ammistability*

To cite the R package '*ammistability*' in publications use:

Ajay, B. C., Aravind, J., and Abdul Fiyaz, R. (2019). *ammistability*: R package for ranking genotypes based on stability parameters derived from AMMI model. *Indian Journal of Genetics and Plant Breeding (The)*, 79(2), 460-466.

<http://www.isgpb.org/article/ammistability-r-package-for-ranking-genotypes-based-on-stability-parameters-derived-from-ammi-model>

Ajay, B. C., Aravind, J., and Abdul Fiyaz, R. (2021). *ammistability*: Additive Main Effects and Multiplicative Interaction Model Stability Parameters. R package version 0.1.2.9000, <https://ajaygpb.github.io/ammistability/>, <https://CRAN.R-project.org/package=ammistability>.

This free and open-source software implements academic research by the authors and co-workers. If you use it, please support the project by citing the package.

To see these entries in BibTeX format, use '`print(<citation>, bibtex=TRUE)`', '`toBibtex(.)`', or set '`options(citation.bibtex.max=999)`'.

Session Info

```
sessionInfo()
```

R Under development (unstable) (2021-02-02 r79929)

Platform: x86_64-w64-mingw32/x64 (64-bit)

Running under: Windows 10 x64 (build 19041)

Matrix products: default

locale:

```
[1] LC_COLLATE=English_India.1252 LC_CTYPE=English_India.1252 LC_MONETARY=English_India.1252
[4] LC_NUMERIC=C LC_TIME=English_India.1252
```

attached base packages:

[1] stats graphics grDevices utils datasets methods base

other attached packages:

[1] agricolae_1.3-3 readxl_1.3.1 ammistability_0.1.2.9000

loaded via a namespace (and not attached):

[1] Rcpp_1.0.6 lattice_0.20-41 assertthat_0.2.1 digest_0.6.27 mime_0.9 R6_2.5.0
 [7] cellranger_1.1.0 plyr_1.8.6 AlgDesign_1.2.0 ggcorrplot_0.1.3 labelled_2.7.0 evaluate_0.14
 [13] httr_1.4.2 ggplot2_3.3.3 highr_0.8 pillar_1.4.7 Rdpack_2.1 rlang_0.4.10
 [19] curl_4.3 rstudioapi_0.13 miniUI_0.1.1.1 combinat_0.0-8 rmarkdown_2.6 mathjaxr_1.2-0
 [25] labeling_0.4.2 stringr_1.4.0 questionr_0.7.4 pander_0.6.3 RCurl_1.98-1.2 munsell_0.5.0
 [31] shiny_1.6.0 compiler_4.1.0 httpuv_1.5.5 xfun_0.21 pkgconfig_2.0.3 htmltools_0.5.1.1
 [37] tidyselect_1.1.0 tibble_3.0.6 XML_3.99-0.5 crayon_1.4.1 dplyr_1.0.4 later_1.1.0.1
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 [73] haven_2.3.1

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