Package 'rela'

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Title Item Analysis Package with Standard Errors

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Description Item analysis with alpha standard error and principal axis factoring for continuous variable scales (with plots).

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R topics documented:

`itemanal` *Item analysis function*

Description

This function enables the user to evaluate the functioning of two or more items as a coherent scale. Among the traditionally used Cronbach's Alpha the function also produces standardized estimates as well as Duhachek and Iacobucci's (2004) proposed standrad errors and respective confidence intervals for the reliability coefficients. Further, the function provides a bootstrap estimate of the convidance interval of both the regular and standardized alpha values. The function's output can be

used to produce three plots: A density plot of the alpha and standardized alpha bootstrap simulations, a line plot of the "if item deleted" alpha values by each item and a star plot for all of the items for their respective "if item deleted" scale values. These plots can be called by submitting the output object of the function to the plot() statement. Similarly, the output can be viewed in an abbreviated form by submitting the output object to the summary() function.

Usage

```
itemanal(object, SE.par = 1.96, boots = 1000)
```

Arguments

`object`	Numeric dataset (usually a coerced matrix from a prior data frame) containing all items of the scale. The dataset is arranged observations (rows) by measure items (columns).
`SE.par`	Confidence interval corresponding Z-score. By default set to the 95 % confidence interval Z-score of 1.96.
`boots`	Number of boot strap samples computed. By default 1,000 simulations are estimated.

Details

The function is sensitive to the how the dataset was compiled. Using the cbind function will often return a matirx that appears numeric but in reality functions as a numeric compiled list. If system error messages occur try transforming the dataset using as.matrix(data.frame(your.dataset)).

Value

Output consists of a list with the following values:

`Variables`	General information about the entered items such as item type, number of cases used in the analysis, minimum, maximum values and item sum.
`Tendency`	Contains the measures of central tendancy: The respective item mean, median, standard deviation (SD), standard error of the mean (SE.mean) , lower and upper values of a 95 % confidence interval of the mean and item variance.
`Skewness`	Skewness, standard error of the skew, lower and upper values of the skew.
`Kurtosis`	Kurtosis, standard error of kurtosis as well as its respective 95 % confidence interval values.
`Covariance`	The covariance matrix of all items in the dataset.
`Correlation`	The correlation matrix of all submitted items.
`Alpha`	The number of items in the scale as well as the covariance based Cronbach's alpha estimate.
`Conf.Alpha`	Standard error of Cronbach's alpha with the associated lower and upper bound confidence interval values.
`Bootstrap.Simmulations`	The regular (covariance based) alpha bootstrap simulated estimates.

`Alpha.Bootstrap`
: Bootstrap mean, standard error and confidence interval lower and upper limits.

`Std.Alpha`
: The number of items in the scale as well as the correlation based Cronbach's alpha estimate.

`Conf.Std.Alpha`
: Standard error of the standardized Cronbach's alpha with the associated lower and upper bound confidence interval values.

`Bootstrap.Std.Simmulations`
: The standardized (correlation based) alpha bootstrap simulated estimates.

`Alpha.Std.Bootstrap`
: Standardized bootstrap mean, standard error and confidence interval lower and upper limits.

`Scale.Stats`
: Changes in scale statistics upon deletion of any one item in the scale. Contains scale mean and variance.

`Alpha.Stats`
: Changes in the scale's reliability estimate alpha upon deletion of any one item. Contains, corrected total item correlation, squared multiple correlation, adjusted alpha statistic without given item.

`call`
: Submitted function call.

Note

Under the current version of this function/package missing data is deleted listwise. Consequently only full cases are used in determining scale reliability. Also, note that the legends for the plots are placed interactively. Furthermore, the default plot function for the itemanal() object uses a windows() statement to produce several plots. This prevents prior plots from being replaced at the same time allowing for numerous plots to be produced. However, this option may not be fully functional in MAC and Linux environemnts since the function calls on a windows metafile.

Author(s)

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References

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16(3)*, 297-334.

Duhachek, A. & Iacobucci, D. (2004). Alpha's standard error (ASE): An accurate and precise confidence interval estimate. *Journal of Applied Psychology, 89(5)*, 792-808.

Kim, J., & Mueller, C. W. (1978). *Introduction to factor analysis: What it is and how to do it*. SAGE Publications: Newbury Park, CA.

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Kaiser, H. F. & Cerny, B. A. (1979). Factor analysis of the image correlation matrix. *Educational and Psychological Measurement*, 39, 711-714.

Pett, M. A., Lackey, N. R., & Sullivan, J. J. (2003). *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*. SAGE Publications: Thousand Oaks, CA.

Examples

```
library(rela)

Belts <- Seatbelts[,1:7]
Belts.item <- itemanal(Belts)
summary(Belts.item)

Belts2 <- Belts[,-5]
Belts2 <- Belts2[,-5]
Belts.item2 <- itemanal(Belts2)
summary(Belts.item2)
```

---

paf *Principal Axis Factoring*

Description

This function performs a prinxipal axis factor analysis providing the user with a set of preliminary informative estimates regarding the dimensionality and scale functioning of the submitted items. The function does not allow for rotations and is by no means considered a full factor analysis tool, but rather a supplemental module. The function's output object can be submitted to the summary() function for an abbreviated version of the results. Further, the output object can be graphed, using plot(), producing four plots: a comparison of the reproduced correlation residuals, initial and final item communalities (with an interactively placed legend), measures of sampling adequacy, and an Eigenvalue scree plot.

Usage

```
paf(object, eigcrit=1, convcrit=.001)
```

Arguments

`object`	Numeric dataset (usually a coerced matrix from a prior data frame) containing all items of the scale. The dataset is arranged observations (rows) by measure items (columns).
`eigcrit`	Eigenvalue criterion cut-off to be used in the iterative estimation process. By default set to use all eigenvalues greater than 1.
`convcrit`	The convergence criterion determining the number of iterations by computing difference scores between prior and estimated communalities. By default set to be less than .001 for each compared cell.

Details

This function is intended as a companion to the itemanal() function in this package (rela). Its primiary goal is to provide the researcher with additional information when exploring the dimensionality and reliability of a scale. Moreover, the when called the function will produce four plots: A scree plot of the eigenvalues of the original correlation matrix, a plot of the measure of sampling adequacy values for each item, a comparative plot for the initial and final communalities, and a plot series for the correlation residuals for each individual item against all other items.

Value

Output consists of a list with the following values:

`Correlation`	Correlation matrix of the submitted dataset.
`Anti.Image.Cov`	The Anti Image Covariance Matrix.
`Anti.Image.Cor`	The Anti Image Correlation Matrix.
`KMO`	The Kaiser-Meyer-Olkin measure of sampling adequacy test.
`MSA`	Individual measures of sampling adequacy for each item.
`Bartlett`	Bartlett's Test of Sphericity for covariance matrices.
`Communalities`	Initial and final communality extractions.
`Iterations`	Number of iterations needed to meet convergence criterion.
`Eigenvalues`	All eigenvalues for extracted at each iteration.
`Communality.Iterations`	All estimated communalities for each iteration submited to the convergence test.
`Criterion.Differences`	Difference scores between estimated communalities.
`Factor.Loadings`	Final item factor loadings on extracted latent components.
`Reproduced.Cor`	Factor loading reproduced correlation matrix.
`Residuals`	Correlation residuals (observed minus reproduced correlations).
`RMS`	Root mean square errors (of the correlation residuals).
`call`	Submitted arguments to the paf() function.

Note

Under the current version of this function/package missing data is deleted listwise. Consequently only full cases are used in determining scale reliability. Furthermore, the default plot function for the itemanal() object uses a windows() statement to produce several plots. This prevents prior plots from being replaced at the same time allowing for numerous plots to be produced. However, this option may not be fully functional in MAC and Linux environemnts since the function calls on a windows metafile.

Author(s)

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References

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16(3)*, 297-334.

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Examples

```
library(rela)

Belts <- Seatbelts[,1:7]
summary(Belts)

paf.belt <- paf(Belts)
summary(paf.belt)

Belts2 <- Belts[,-5]
Belts2 <- Belts2[,-5]

paf.belt2 <- paf(Belts2)
summary(paf.belt2)
```

`rela` *Scale item analysis with standard errors and principal axis factoring*

Description

The package's functions analyze scale items as a collective measure providing information both on the item and scale level. Cronbach's reliability estimates are reported both in the original and standardized form along with respective standard errors and confidence interval lower and upper bounds. Further the principal axis factoring function (paf) included in the package allows to preliminarily screen the items if they load on the same single latent construct. Both functions' output can be viewed abbreviated using summary() as well as in graphical form using plot().

Details

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Type:	Package
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License:	Artistic
LazyLoad:	yes

The package contains two function (itemanal and paf) which report a list of scale item analytic statistics.

Author(s)

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References

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16(3)*, 297-334.

Duhachek, A. & Iacobucci, D. (2004). Alpha's standard error (ASE): An accurate and precise confidence interval estimate. *Journal of Applied Psychology, 89(5)*, 792-808.

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