Package ‘chi2x3way’

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Type Package

Title Partitioning Chi-Squared and Tau Index for Three-Way Contingency Tables

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Description Provides two index partitions for three-way contingency tables:
partition of the association measure chi-squared and of the predictability index tau
under several representative hypotheses about the expected frequencies (hypothesized probabilities).

Depends R (> 3.3.0), methods, tools

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`chi2x3way` *Chi-square and Marcotorchino's index for three-way contingency tables*

Description

It performs
1) the computation of the Pearson's index and its partitioning for three-way contingency tables under two Scenarios. When the input parameter `scen==1` then the theoretical probabilities are prescribed by the analyst (by default they are set homogeneous). When the input parameter `scen==2` then the theoretical probabilities are estimated from the data.
2) the computation of the Marcotorchino's index and its partitioning for three-way contingency tables under the two Scenarios. When the input parameter `scen==1` then the theoretical probabilities are prescribed by the analyst (by default they are set homogeneous). When the input parameter `scen==2` then the theoretical probabilities are estimated from the data. In order to check the distribution of the Marcotorchino's index under the two Scenarios, it is possible to look at the results of a simulation study setting the input parameter `simulation=TRUE`.

Usage

```
chi2x3way(X,  indextype = "chi2", scen = 2, simulation = FALSE,
nboots = 1000, nran = 1000,
pi = rep(1/dim(X)[[1]],dim(X)[[1]]),
pj = rep(1/dim(X)[[2]],dim(X)[[2]]),pk = rep(1/dim(X)[[3]],dim(X)[[3]]), digits = 3)
```

Arguments

`X` The three-way contingency table.

`indextype` The input parameter for specifying what index should be considered. By default, the partition of the classical three-way Pearson index `indextype = "chi2"` is selected. The analyst can also partition Marcotorchino's index by defining the input parameter `indextype = "tauM"`.

`scen` The input parameter for specifying what scenario should be considered. By default, `scen = 1`, so that the probabilities are defined as being fixed and homogeneous among the categories (i.e. Scenario 1). When `scen = 2`, the expected frequencies are set to be equal to the observed marginal frequencies (i.e. Scenario 2).

`simulation` A flag parameter, `simulation`, is included for specifying whether simulations are included as part of the analysis. When `simulation = TRUE`, three-way contingency tables are randomly generated under the different scenarios specified by `scen`. Note that for investigating the index distributions, a randomly generated contingency table which consists of at least one cell frequency that is less than five is automatically discarded. When `simulation = TRUE`, the distribution of the terms from the partition of the classic C_M-statistic, associated with Marcotorchino's index, the revised C^S_M-statistic and Pearson's chi-squared index are graphically depicted and compared using QQ-plots. By default, `simulation = FALSE`.

`nboots` The input parameter for specifying the number of random three-way contingency tables to be generated when `simulation = TRUE`. By default, `nboots = 1000`.

`nran` The input parameter for specifying the total number of samples of each randomly generated contingency table when `simulation = TRUE`. By default, `nran = 1000`.

`pi` The input parameter `pi` specifies the probabilities assigned to the row categories. When `scen = 1`, they can be arbitrarily defined by the analyst. By default, the parameter is set to reflect homogeneous marginal (uniform) probabilities so that `pi = rep(1/dim(X)[[1]], dim(X)[[1]])`. When `scen = 2` the hypothesized probabilities cannot be prescribed by the analyst and are set equal to the observed row margins of the three-way table.

`pj` The input parameter `pj` specifies the probabilities assigned to the column categories. When `scen = 1`, they can be arbitrarily defined by the analyst. By default, the parameter is set to reflect homogeneous marginal (uniform) probabilities so that `pi = rep(1/dim(X)[[2]], dim(X)[[2]])`. When `scen = 2` the hypothesized probabilities cannot be prescribed by the analyst and are set equal to the observed column margins of the three-way table.

`pk` The input parameter `pk` specifies the probabilities assigned to the tube categories. When `scen = 1`, they can be arbitrarily defined by the analyst. By default, the parameter is set to reflect homogeneous marginal (uniform) probabilities so that `pi = rep(1/dim(X)[[3]], dim(X)[[3]])`. When `scen = 2` the hypothesized probabilities are set equal to the observed tube margins of the three-way table.

`digits` The minimum number of decimal places used for displaying the numerical summaries of the analysis is set by the parameter `digits`.

By default, `digits = 3`.

Value

`X` The three-way contingency table of dimension IxJxK.

`indexparts` The three-way index partition `indexparts`. When `indextype = "chi2"`, this output gives the chi-squared partition, while `indextype = "tauM"` returns the partition of Marcotorchino's index, tau_M and its related C_M-statistics. Further, it also returns the percentage of explained inertia, the degrees of freedom and the p-value of each term of the partition.

`simulaout` When the input parameter `simulation = TRUE`, the output includes the object `simulaout` which returns `nboot` number of randomly generated three-way contingency tables. The output also includes the row, column and tube hypothesized probabilities `pi`, `pj`, and `pk`, and their observed marginal frequencies defined by the object name `margI`, `margJ` and `margK`, respectively. Furthermore, the output includes the empirical distribution of each term of the partition of the C_M-statistic, chi-squared statistic and C^S_M-statistic based on the nboots randomly generated contingency tables.

When `simulation = FALSE`, then `simulaout = NULL`.

Note

This function recalls internally many other functions, depending on the setting of the input parameter `indexype`. It recalls one of the four functions which does a partition under two different Scenarios. These two Scenarios depend on the theoretical probabilities: 1) the theoretical probabilities can be prescribed by the analysy. By default, when `scen = 1`, they are set all equal (homogeneity margins); 2) when `scen = 2`, the theoretical probabilities are estimated from the data. After performing a partition, it gives the output object necessary for printing the results. The print function is `print.Chi2for3way` . This function belongs to the class `chi3class`.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons.
Carlier A Kroonenberg PM (1996) Biplots and decompositions in two-way and three-way correspondence analysis. Psychometrika, 61, 355-373.
Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.
Lombardo R Carlier A D'Ambra L (1996) Nonsymmetric correspondence analysis for three-way contingency tables. Methodologica, 4, 59-80.

Examples

```
##---- Should be DIRECTLY executable !! ----
##-- ==>  Define data, use random,
## The function is currently defined as
data(olive)
chi2x3way(olive, scen = 2, indextype = "tauM", simulation = FALSE, nboots = 100, nran = 1000,
pi = rep(1/dim(olive)[[1]],dim(olive)[[1]]), pj = rep(1/dim(olive)[[2]],dim(olive)[[2]]),
pk = rep(1/dim(olive)[[3]],dim(olive)[[3]]), digits = 3)
```

`chi3scen1` *Pearson's index for three-way contingency tables under Scenario 1 (prescribed probabilities)*

Description

It provides the Pearson's index, e.g. chi-square index, partitioning under the Scenario 1 when probabilities are homogeneous.

Usage

```
chi3scen1(X, pi=rep(1/dim(X)[[1]],dim(X)[[1]]), pj=rep(1/dim(X)[[2]],dim(X)[[2]]),
pk=rep(1/dim(X)[[3]],dim(X)[[3]]), digits = 3)
```

Arguments

`X`	The three-way contingency table.
`pi`	The input parameter for specifying the theoretical probabilities of rows categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pi = rep(1/dim(X)[[1]],dim(X)[[1]])`.
`pj`	The input parameter for specifying the theoretical probabilities of columns categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pj = rep(1/dim(X)[[2]],dim(X)[[2]])`.
`pk`	The input parameter for specifying the theoretical probabilities of tube categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pk = rep(1/dim(X)[[3]],dim(X)[[3]])`.
`digits`	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.

Value

Description of the output returned

`z`	The chi-square index partition under Scenario 1, we get seven terms of the chi-square partition, three main terms, two bivariate terms and a trivariate term. The output is in a matrix, the four rows of this matrix indicate the index, the percentage of the explained inertia, the degree of freedom, the p-value, respectively.

Note

This function belongs to the class `chi3class`.

Author(s)

Lombardo R and Takane Y

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons.
Carlier A Kroonenberg PM (1996) Biplots and decompositions in two-way and three-way correspondence analysis. Psychometrika, 61, 355-373.
Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.

Examples

```
##---- Should be DIRECTLY executable !! ----
data(olive)
chi3scen1(olive)
```

`chi3scen2` *Pearson's index for three-way contingency tables under Scenario 2*

Description

It provides the Pearson's index, e.g. chi-square index, partitioning under the Scenario 2 when probabilities are set equal to the observed margin frequencies

Usage

```
chi3scen2(X, digits = 3)
```

Arguments

`X`	The three-way contingency table.
`digits`	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.

Value

`z`	The chi-square index partition under Scenario 2, we get five terms of the chi-square partition, three bivariate terms and a trivariate one. The output is in a matrix, the four rows of this matrix indicate the index, the percentage of the explained inertia, the degree of freedom, the p-value, respectively.

Note

This function belongs to the class `chi3class`.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons. Carlier A Kroonenberg PM (1996) Biplots and decompositions in two-way and three-way correspondence analysis. Psychometrika, 61, 355-373.
Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.

Examples

```
##---- Should be DIRECTLY executable !! ----
data(olive)
chi3scen2(olive)
```

---

happy — *Three-way contingency table by Davis (1977)*

Description

The data consists of 3 rows, 5 columns and 4 tubes. The rows represent the levels of Happiness, the columns are concerned with the number of siblings and the tubes with the Education.

Usage

```
data(olive)
```

Format

The format is: row names [1:6] "H1" "H2" "H3"
col names [1:3] "S1" "S2" "S3" "S4" "S5" tube names [1:2] "E1" "E2" "E3" "E4"

References

Davis JA (1977) Codebook for the 1977 General Social Survey. Chicago: National Opinion Research Centre.

Examples

```
data(happy)
dim(happy)
dimnames(happy)
```

`olive` *Agresti's data (1990), three-way contingency table*

Description

The data consists of 6 rows, 3 columns and 2 tubes. The rows represent the preference for black olives of Armed Forces personnel, the columns are concerned with the location and the tubes with the urbanization.

Usage

```
data(olive)
```

Format

The format is: row names [1:6] "A" "B" "C" "D" "E" "F"
col names [1:3] "NW" "NE" "SW" tube names [1:2] "urban" "rural"

References

Agresti A (1990) Categorical Data Analysis (pg. 335). John Wiley & Sons.

Examples

```
data(olive)
dim(olive)
dimnames(olive)
```

`print.chi2x3way` *Printing function of the results of the three-way index partition*

Description

This function prints the results of the three-way index partition.
The input parameter is the name of the output of the main function `Chi2for3way`.

Usage

```
## S3 method for class 'chi2x3way'
print(x, digits = 3, ...)
```

Arguments

`x`	The name of the output object, for example say `res`, used with the main function `Chi2for3way`.
`digits`	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.
`...`	Further arguments passed to or from other methods.

Value

The value of output returned depends on the kind of three-way-index and scenario considered itemXThe three-way contingency table.

`indexparts` The three-way index partition `indexparts`. When `indextype = "chi2"` this output gives the chi-squared partition while `indextype = "tauM"` returns the partition of Marcotorchino's index, of its numerator and its related C_M-statistics. Further, it also returns the percentage of explained inertia, the degrees of freedom and the p-value of each term of the partition.

`simulaout` When the input parameter `simulation = TRUE`, the output object `simulaout` includes the randomly generated three-way tables and their hypothesized probabilities `pi`, `pj`, `pk`. The output also includes the observed marginal frequencies `margI`, `margJ` and `margK` and the index partition of C_M, X^2 and C^S_M for each of the `nboot` tables.

Further, the output also gives the mean of the theoretical and observed distributions of the classical and revised C_M-statistics, the variance of the theoretical and observed distributions of the classical and revised C_M-statistics. When `simulation = FALSE`, then `simulaout = NULL`.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons.
Carlier A Kroonenberg PM (1996) Biplots and decompositions in two-way and three-way correspondence analysis. Psychometrika, 61, 355-373.
Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.
Lombardo R Carlier A D'Ambra L (1996) Nonsymmetric correspondence analysis for three-way contingency tables. Methodologica, 4, 59-80.

Examples

```
data(olive)
resolive<-chi2x3way(olive,scen=2,simulation=FALSE)
print.chi2x3way(resolive)
```

`QQplot` *QQ-plots of the simulated distribution of the Marcotorchino's index partition*

Description

It allows
the graphical representation of each term of the Marcotorchino's index partition under scenario 2 or 1.

Usage

```
QQplot(nsample=100, yobs, nameC, taudf)
```

Arguments

`nsample`	The number of random tables to generate. For each table, the terms of index partition are computed.
`yobs`	The term of the index partition, it represents the observed distribution of the C-statistic associated to the term of the partition.
`nameC`	The label of the term of the index partition.
`taudf`	The number of degree of freedom associated to the term of the index partition.

Note

This function is called from the function tauMbootQQ and allows to depict graphically the three-way index distribution. A QQ-plot is produced for each term of the index partition.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons.
Carlier A Kroonenberg PM (1996) Biplots and decompositions in two-way and three-way correspondence analysis. Psychometrika, 61, 355-373.
Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.

r3dtable *Simulations for generating three-way contingency tables*

Description

It allows 1) the generation of `nboots=1000` randomly tables where the row, column, tube probabilities can be prescribed by the analyst. By default, they are uniform.

Usage

```
r3dtable(I = 3, J = 3, K = 3, pi=rep(1/I,I), pj=rep(1/J,J), pk=rep(1/K,K), nboots = 1000,
nran = 10000, digits = 3)
```

Arguments

`I`	The number `I` is set equal to the rows of the input table `X`.
`J`	The number `J` is set equal to the columns of the input table `X`.
`K`	The number `K` is set equal to the tubes of the input three-way table `X`.
`pi`	The prescribed row probabilities. By default, they are homogeneous.
`pj`	The prescribed column probabilities. By default, they are homogeneous.
`pk`	The prescribed tube probabilities. By default, they are homogeneous.
`nboots`	The number of the random three-way tables that you want to generate.
`nran`	The total number of individuals of each generated three-way table.
`digits`	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.

Value

`XB`	The `nboots=1000` randomly generated three-way tables.
`XB[[i]]$pi`	The row, prescribed probabilities of the i.th randomly generated three-way table.
`XB[[i]]$pj`	The column, prescribed probabilities of the i.th randomly generated three-way table.
`XB[[i]]$pk`	The tube, prescribed probabilities of the i.th randomly generated three-way table.
`margI`	The row observed margins of the randomly generated three-way table.
`margJ`	The column observed margins of the randomly generated three-way table.
`margK`	The tube observed margins of the randomly generated three-way table.

Note

This function allows the generation of random tables under the complete independence with different theoretical probabilities.

Author(s)

Lombardo R, Takane Y, Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons. Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.

Examples

```
r3dtable(I = 3, J = 3, K = 3, pi=rep(1/3,3), pj=rep(1/3,3), pk=rep(1/3,3),
nboots = 10, nran = 1000, digits = 3)
```

---

simula *Simulations of three-way contingency tables*

Description

Allows the generation of random contingency tables with prescribed theoretical probabilities

Usage

```
simula(I, J, K, nran = 1000, pi, pj, pk)
```

Arguments

`I`	The input parameter for specifying the number of rows.
`J`	The input parameter for specifying the number of columns.
`K`	The input parameter for specifying the number of tubes.
`nran`	The input parameter for specifying the number of individuals in each table.
`pi`	The input parameter for specifying the theoretical probability of rows.
`pj`	The input parameter for specifying the theoretical probability of columns.
`pk`	The input parameter for specifying the theoretical probability of tubes.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.

Examples

```
##---- Should be DIRECTLY executable !! ----
##-- ==>  Define data, use random,
##--or do  help(data=index)  for the standard data sets.
simula(4,3,2,pi=rep(1/4,4),pj=rep(1/3,3),pk=rep(1/2,2))
## The function is currently defined as
```

`tau3scen1` *Marcotorchino's index for three-way contingency tables under Scenario 1*

Description

It provides the partition of the Marcotorchino's index and its related \$C_M\$-statistic under the Scenario 1 when probabilities are homogeneous.

Usage

```
tau3scen1(X, pi=rep(1/dim(X)[[1]],dim(X)[[1]]), pj=rep(1/dim(X)[[2]],dim(X)[[2]]),
pk=rep(1/dim(X)[[3]],dim(X)[[3]]), digits = 3)
```

Arguments

`X`	The three-way contingency table.
`pi`	The input parameter for specifying the theoretical probabilities of rows categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pi = rep(1/dim(X)[[1]],dim(X)[[1]])`.
`pj`	The input parameter for specifying the theoretical probabilities of columns categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pj = rep(1/dim(X)[[2]],dim(X)[[2]])`.
`pk`	The input parameter for specifying the theoretical probabilities of tube categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pk = rep(1/dim(X)[[3]],dim(X)[[3]])`.
`digits`	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.

Value

Description of the output returned

z The partition of the Marcotorchino's index, of the C_M-statistic and its revised formula, under Scenario 1. We get seven terms partitioning the Marcotorchino's index and the related C_M-statistic: three main terms, two bivariate terms and a trivariate term. The output is in a matrix, the six rows of this matrix indicate the tau index numerator, the tau index, the percentage of explained inertia, the C_M-statistic, the degree of freedom, the p-value, respectively.

Note

This function belongs to the class `chi3class`.

Author(s)

Lombardo R and Takane Y

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons.
Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.
Lombardo R Carlier A D'Ambra L (1996) Nonsymmetric correspondence analysis for three-way contingency tables. Methodologica, 4, 59-80.
Marcotorchino F (1985) Utilisation des comparaisons par paires en statistique des contingencies: Partie III. Etude du Centre Scientifique, IBM, France. No F 081

Examples

```
data(olive)
tau3scen1(olive)
```

`tau3scen1new` *Marcotorchino's index for three-way contingency tables under Scenario 1. Revised formulation.*

Description

It provides the partition of the Marcotorchino's index and of the C_M-statistic, revised formula, under the Scenario 1 when probabilities are set homogeneous.

Usage

```
tau3scen1new(X, pi=rep(1/dim(X)[[1]],dim(X)[[1]]), pj=rep(1/dim(X)[[2]],dim(X)[[2]]),
pk=rep(1/dim(X)[[3]],dim(X)[[3]]), digits = 3)
```

Arguments

`X`	The three-way contingency table.
`pi`	The input parameter for specifying the theoretical probabilities of rows categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pi = rep(1/dim(X)[[1]],dim(X)[[1]])`.
`pj`	The input parameter for specifying the theoretical probabilities of columns categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pj = rep(1/dim(X)[[2]],dim(X)[[2]])`.
`pk`	The input parameter for specifying the theoretical probabilities of tube categories. When `scen = 1`, they can be prescribed by the analyst. By default, they are set equal among the categories, homogeneous margins (uniform probabilities), that is `pk = rep(1/dim(X)[[3]],dim(X)[[3]])`.
`digits`	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.

Value

Description of of the output returned

`z`	The Marcotorchino's index partition under Scenario 1, we get seven terms partitioning the Marcotorchino's index and the revised C_M-statistic, three main terms, two bivariate terms and a trivariate term. The output is in a matrix, the six rows of this matrix indicate the tau index numerator, the tau index, the percentage of explained inertia, the revised C_M-statistic, the degree of freedom, the p-value, respectively.

Note

This function belongs to the class `chi3class`.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons. Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2015) Partitions of Pearson's chi-square statistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.
Lombardo R Carlier A D'Ambra L (1996) Nonsymmetric correspondence analysis for three-way contingency tables. Methodologica, 4, 59-80.
Marcotorchino F (1985) Utilisation des comparaisons par paires en statistique des contingencies: Partie III. Etude du Centre Scientifique, IBM, France. No F 081

Examples

```
data(olive)
tau3scen1new(olive)
```

`tau3scen2` *Marcortchino's index for three-way contingency tables under Scenario 2*

Description

It provides the Marcotorchino' index partitioning under Scenario 2 when probabilities are set equal to the observed marginal frequencies.

Usage

```
tau3scen2(X, digits = 3)
```

Arguments

X	The three-way contingency table.
digits	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.

Value

z	The Marcotorchino's index partition under Scenario 2, we get five terms of the tau index partition, three bivariate terms and a trivariate one. The output is in a matrix, , the six rows of this matrix indicate the tau index numerator, the tau index, the percentage of explained inertia, the C_M-statistic, the degree of freedom, the p-value, respectively.

Note

This function belongs to the class `chi3class`.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons. Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Lombardo R Carlier A D'Ambra L (1996) Nonsymmetric correspondence analysis for three-way contingency tables. Methodologica, 4, 59-80.
Loisel S and Takane Y (2015) Partitions of Pearson's chi-square statistic for frequency tables: A

comprehensive account. Computational Statistics, 31, 1429-1452.
Marcotorchino F (1985) Utilisation des comparaisons par paires en statistique des contingencies: Partie III. Etude du Centre Scientifique, IBM, France. No F 081

Examples

```
##---- Should be DIRECTLY executable !! ----
data(olive)
tau3scen2(olive)
```

`tau3scen2new` *Marcortchino's index for three-way contingency tables under Scenario 2. Revised formulation.*

Description

It provides the partition of the Marcotorchino' index as well of the C_M-statistic revised formula, under the Scenario 2, when probabilities are equal to the observed marginal frequencies. The constant in the computation of the C_M-statistic is different, it does not consider the denominator of the index and is equal to $(n-1)I$ where n is the total individual number and I the row category number.

Usage

```
tau3scen2new(X, digits = 3)
```

Arguments

`X`	The three-way contingency table.
`digits`	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.

Value

`z`	The Marcotorchino's index partition under Scenario 2, we get five terms of the chi-square partition, three bivariate terms and a trivariate one. The output is in a matrix, the six rows of this matrix indicate the tau index numerator, the tau index, the percentage of explained inertia, the revised C_M-statistic, the degree of freedom, the p-value, respectively.

Note

This function belongs to the class `chi3class`.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons. Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Lombardo R Carlier A D'Ambra L (1996). Nonsymmetric correspondence analysis for three-way contingency tables. Methodologica, 4, 59-80.
Loisel S and Takane Y (2015) Partitions of Pearson's chi-square statistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.
Marcotorchino F (1985) Utilisation des comparaisons par paires en statistique des contingencies: Partie III. Etude du Centre Scientifique, IBM, France. No F 081

Examples

```
##---- Should be DIRECTLY executable !! ----
data(olive)
tau3scen2new(olive)
```

---

tauMbootQQ *Simulations for observing the Marcotorchino's index distribution*

Description

It allows 1) the generation of `nboots=1000` randomly tables where the row, column, tube probabilities are set equal to the observed margins of the three-way table considered for the partition under Scenario 2. While under Scenario 1, the row, column, tube probabilities are prescribed by the analyst. By default, they are homogeneous.

Usage

```
tauMbootQQ(rows = 3, cols = 3, tubs = 3, nboots = 1000, nran = 10000, digits = 3,
scen=2, pi, pj, pk)
```

Arguments

`rows`	The number of `rows` is set equal to the rows of the input table `X`.
`cols`	The number of `cols` is set equal to the columns of the input table `X`.
`tubs`	The number of `tubs` is set equal to the tubes of the input three-way table `X`.
`nboots`	The number of three-way tables randomly generated.
`nran`	The total number of individuals of each generated three-way table.
`digits`	The minimum number of decimal places, `digits`, used for displaying the numerical summaries of the analysis. By default, `digits = 3`.
`scen`	The input parameter for specifying the Scenario under which the theoretical probabilities are computed. Under Scenario 1 the probabilities are prescribed by the analyst, by default they are set homogeneous.

pi	The prescribed row probabilities. By default they are equal to the row margins of the input three-way table X.
pj	The prescribed column probabilities. By default they are equal to the column margins of the input three-way table X.
pk	The prescribed tube probabilities. By default they are equal to the tube margins of the input three-way table X.

Value

XG	The nboots=1000 randomly generated three-way tables.
margI	The row observed margins of the randomly generated three-way table.
margJ	The column observed margins of the randomly generated three-way table.
margK	The tube observed margins of the randomly generated three-way table.
ytau	The table of the terms of the Marcotorchino's index and of the C_M-statistic partition, associated to each of the randomly generated three-way table.
ytauNew	The table of the new expression of the terms of the C_M-statistic partition, associated to each of the randomly generated three-way table.
ychi	The table of the terms of the chi-square index partition associated to each of the randomly generated three-way table.
chidf	The table of the degree of freedom related to each terms of the chi-square index partition of the randomly generated three-way table.
cont	The number of the randomly generated three-way table whose margin products is less than 5.

Note

This function allows the generation of random tables under different theoretical probabilities. It allow to depict graphically the three-way index distribution. From calling the function QQplot, a QQ-plot is produced for each term of the partition of three indices: the Pearson's index, the classic C_M-statistic and of the revised C_M-statistic.

Author(s)

Lombardo R, Takane Y and Beh EJ

References

Beh EJ and Lombardo R (2014) Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons.
Carlier A Kroonenberg PM (1996) Biplots and decompositions in two-way and three-way correspondence analysis. Psychometrika, 61, 355-373.
Lancaster H O (1951) Complex contingency tables treated by the partition of the chi-square. Journal of Royal Statistical Society, Series B, 13, 242-249.
Loisel S and Takane Y (2016) Partitions of Pearson's chi-square ststistic for frequency tables: A comprehensive account. Computational Statistics, 31, 1429-1452.

Examples

```
tauMbootQQ(rows = 3, cols = 3, tubs = 3, nboots = 10, nran = 1000, digits = 3,
pi=rep(1/3,3), pj=rep(1/3,3), pk=rep(1/3,3))
```

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