Package 'raincin'

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Title Ranking with Incomplete Information

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Description Various statistical and mathematical ranking and rating methods with incomplete information are included. This package is initially designed for the scoring system in a high school project showcase to rank student research projects, where each judge can only evaluate a set of projects in a limited time period. See Langville, A. N. and Meyer, C. D. (2012), Who is Number 1: The Science of Rating and Ranking, Princeton University Press <doi:10.1515/9781400841677>, and Gou, J. and Wu, S. (2020), A Judging System for Project Showcase: Rating and Ranking with Incomplete Information, Technical Report.

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Imports lme4, popdemo, stats

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R topics documented:

`colley` *Colley's Method for Rating and Ranking*

Description

Calculate ratings and provide rankings using Colley's method

Usage

```
colley(jpMat, method = "colley", ties.method = "average")
```

Arguments

`jpMat`	a Judge-Presenter matrix, or a User-Movie matrix
`method`	a character string specifying Colley's method, including "colley", "colleym", "colleynt" and "colleymnt"
`ties.method`	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Details

1. `colley`: Colley's method
2. `colleym`: Colleyized Massey method
3. `colleynt`: Colley's method, no ties
4. `colleymnt`: Colleyized Massey method, no ties

Value

A list of two vectors: a rating vector and a ranking vector

Author(s)

Jiangtao Gou

References

Colley, W. N. (2001). Colley's bias free college football ranking method: the Colley matrix explained.

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Langville, A. N. and Meyer, C. D. (2012). Who's Number 1?: The Science of Rating and Ranking. Princeton University Press.

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,
byrow=TRUE)
result <- colley(jpMat, method='colley')
print(result)
```

---

convertJudgePresenterMatrix

Judge-Presenter Matrix Converter

Description

Convert a judge-presenter matrix to a data frame with three variables/columns

Usage

```
convertJudgePresenterMatrix(jpMat)
```

Arguments

`jpMat`	a Judge-Presenter matrix, or a User-Movie matrix

Details

1. `score`: nonzero and non-NA scores
2. `row`: array indices
3. `col`: arry indices

Value

A data frame as a long table, where each row is an observation, including the score, the row number and the column number in the `jpMat` matrix

Author(s)

Jiangtao Gou

Fengqing Zhang

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,
byrow=TRUE)
result <- convertJudgePresenterMatrix(jpMat)
print(result)
```

`elo` *Elo's Method for Rating and Ranking*

Description

Calculate ratings and provide rankings using Elo's system

Usage

```
elo(
  jpMat,
  method = "elow",
  Kfactor = 32,
  xiparameter = 400,
  initScore = 2000,
  round = 100,
  ties.method = "average"
)
```

Arguments

`jpMat`	a Judge-Presenter matrix, or a User-Movie matrix
`method`	a character string specifying Elo's method, including "elo", "elow", "elos"
`Kfactor`	a parameter to properly balance the deviation between actual and expected scroes against prior ratings
`xiparameter`	a parameter affects the spread of the reatings in the logistic function
`initScore`	a parameter describe the average rating
`round`	a parameter indicates the number of iterations
`ties.method`	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Details

1. `elo`: Elo's system, using win-tie-loss, equivalent to `elow`
2. `elow`: Elo's system, using win-tie-loss
3. `elos`: Elo's system, using game scores (each pair has one pair of scores)

Author(s)

Jiangtao Gou

References

Elo, A. E. (1978). The Rating of Chessplayers, Past and Present. Arco Publishing Company, New York.

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Langville, A. N. and Meyer, C. D. (2012). Who's Number 1?: The Science of Rating and Ranking. Princeton University Press.

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,
byrow=TRUE)
result <- elo(jpMat,
method='elow',
Kfactor=32,
xiparameter=400,
initScore=2000,
round=10,
ties.method='average')
print(result)
```

`keener` *Keener's method for Rating and Ranking*

Description

Calculate ratings and provide rankings using Keener's method, without using Laplace's Rule of Succession, and using Laplace's Rule of Succession

Usage

```
keener(
  jpMat,
  method = "keener",
  irreducibility = 0.01,
  ties.method = "average"
)
```

Arguments

jpMat	a Judge-Presenter matrix, or a User-Movie matrix
method	a character string specifying Keener's method without applying a nonlinear skweing function, including "keener", "keenerwolrs"
irreducibility	a non-negative parameter, which is the ratio of the value of each element in the pertubation matrix to the average value in the normalized proportaion matrix.
ties.method	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Details

1. keener: Keener's method with Laplace's Rule of Succession
2. keenerwolrs: Keener's method without Laplace's Rule of Succession

1. hitsjp: HITS, using judge-presenter matrix, equivalent to offdefsc
2. offdefnt: Offense-Defense rating method, using judge-presenter matrix

Author(s)

Jiangtao Gou

References

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Keener, J. P. (1993). The Perron-Frobenius theorem and the ranking of football teams. SIAM Review 35, 80-93.

Langville, A. N. and Meyer, C. D. (2012). Who's Number 1?: The Science of Rating and Ranking. Princeton University Press.

Examples

```
library(popdemo)
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,
byrow=TRUE)
result <- keener(jpMat,
method = 'keener',
irreducibility = 0)
print(result)
```

`keenersk` *Keener's method applying a nonlinear skweing function for Rating and Ranking*

Description

Calculate ratings and provide rankings using Keener's method applying a nonlinear skweing function, without using Laplace's Rule of Succession, and using Laplace's Rule of Succession

Usage

```
keenersk(
  jpMat,
  method = "keenersk",
  irreducibility = 0.01,
  ties.method = "average"
)
```

Arguments

`jpMat`	a Judge-Presenter matrix, or a User-Movie matrix
`method`	a character string specifying Keener's method applying a nonlinear skweing function, including "keenersk", "keenerskwolrs"
`irreducibility`	a non-negative parameter, which is the ratio of the value of each element in the pertubation matrix to the average value in the normalized proportaion matrix.
`ties.method`	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Details

1. `keenersk`: Keener's method with Laplace's Rule of Succession, applying a nonlinear skweing function
2. `keenerskwolrs`: Keener's method without Laplace's Rule of Succession, applying a nonlinear skweing function

Author(s)

Jiangtao Gou

References

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Keener, J. P. (1993). The Perron-Frobenius theorem and the ranking of football teams. SIAM Review 35, 80-93.

Langville, A. N. and Meyer, C. D. (2012). Who's Number 1?: The Science of Rating and Ranking. Princeton University Press.

Examples

```
library(popdemo)
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,
byrow=TRUE)
result <- keenersk(jpMat,
method = 'keenersk',
irreducibility = 0)
print(result)
```

`markov` *Google's PageRank algorithm for Rating and Ranking*

Description

Calculate ratings and provide rankings using Google's PageRank algorithm

Usage

```
markov(
  jpMat,
  method = "markovvl",
  dampingFactor = 0.85,
  ties.method = "average"
)
```

Arguments

`jpMat`	a Judge-Presenter matrix, or a User-Movie matrix
`method`	a character string specifying Markov's method, including "markov", "markovvl", "markovlvpd", "markovwlvp".
`dampingFactor`	the PageRank theory holds that an imaginary surfer who is randomly clicking on links will eventually stop clicking. The probability, at any step, that the person will continue is a damping factor. Web 0.85, NFL 0.60, NCAA basketball 0.50
`ties.method`	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Details

1. `markov`: Markov's method, voting with losses, equivalent to `markovvl`
2. `markovvl`: Markov's method, voting with losses
3. `markovlvpd`: Markov's method, losers vote with point differentials
4. `markovwlvp`: Markov's method, winners and losers vote with points

Author(s)

Jiangtao Gou

References

Brin, S. and Page, L. (1998). The anatomy of a large-scale hypertextual web search engine. Computer Networks and ISDN Systems 30, 107-117. Proceedings of the Seventh International World Wide Web Conference.

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Langville, A. N. and Meyer, C. D. (2012). Who's Number 1?: The Science of Rating and Ranking. Princeton University Press.

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,
byrow=TRUE)
result <- markov(jpMat,
method='markovvl',
dampingFactor=0.85,
ties.method='average')
print(result)
```

`massey` *Massey's method for Rating and Ranking*

Description

Calculate ratings and provide rankings using Massey's method, Masseyized Colley method, Massey's method–no ties, Masseyized Colley method–no ties

Usage

```
massey(jpMat, method = "massey", ties.method = "average")
```

Arguments

`jpMat`	a Judge-Presenter matrix, or a User-Movie matrix
`method`	a character string specifying Massey's method, including "massey", "masseyc", "masseynt" and "masseycnt"
`ties.method`	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Details

1. `massey`: Massey's method
2. `masseyc`: Masseyized Colley method
3. `masseynt`: Massey's method, no ties
4. `masseycnt`: Masseyized Colley method, no ties

Author(s)

Jiangtao Gou

References

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Langville, A. N. and Meyer, C. D. (2012). Who's Number 1?: The Science of Rating and Ranking. Princeton University Press.

Massey, K. (1997). Statistical models applied to the rating of sports teams. Bachelor's Thesis, Blue eld College.

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,
byrow=TRUE)
result <- massey(jpMat, method='massey')
print(result)
```

---

matchMeanSD *Transform Data to Desired Mean and Standard Deviation*

Description

Transform Data to Desired Mean and Standard Deviation

Usage

```
matchMeanSD(data, mean = 0, sd = 1)
```

Arguments

data	a vector includeing data to be transformed
mean	a value of desired mean
sd	a value of desirred SD

Value

a vector of transformed vector

Author(s)

Jiangtao Gou

Fengqing Zhang

Examples

```
orig_data <- c(1,3,5,10)
trans_data <- matchMeanSD(data=orig_data, mean=100, sd=15)
print(trans_data)
```

---

mixedeff *Mixed Effects Models for Rating and Ranking*

Description

Calculate ratings and provide rankings using Mixed Effects Modeling

Usage

```
mixedeff(jpMat, REML = FALSE, ties.method = "average")
```

Arguments

jpMat	a Judge-Presenter matrix, or a User-Movie matrix
REML	a logical value for lme4::lmer
ties.method	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Author(s)

Jiangtao Gou

Fengqing Zhang

References

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Examples

```
jpMat <- c(1,3,5,2,6,4,3,8,7)
attr(jpMat, "dim") <- c(3,3)
mixedeff(jpMat)
```

naive *Simple Linear Models for Rating and Ranking*

Description

Calculate ratings and provide rankings using Simple Linear regression

Usage

```
naive(jpMat, stats = FALSE, ties.method = "average")
```

Arguments

jpMat	a Judge-Presenter matrix, or a User-Movie matrix
stats	a logical value to indicate whether a linear model should be fitted and the test statistics should be reported
ties.method	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Author(s)

Jiangtao Gou

Shuyi Wu

References

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,
byrow=TRUE)
result <- naive(jpMat)
print(result)
```

`offdefnt` *Kleinberg's HITS algorithm for Rating and Ranking with Rectangular Matrix*

Description

Calculate ratings and provide rankings using Kleinberg's HITS algorithm, using a rectangular matrix for score matrix (judege-presenter)

Usage

```
offdefnt(
  jpMat,
  method = "hitsjp",
  totalsupporteps = 0,
  numiter = 100,
  ties.method = "average"
)
```

Arguments

`jpMat`	a Judge-Presenter matrix, or a User-Movie matrix
`method`	a character string specifying the HITS algorithm, including "hitsjp".
`totalsupporteps`	a small number to guarantee the total support property
`numiter`	a number of iterations
`ties.method`	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Details

movie i is good and deserves a high rating mi if it gets high ratings from good (discriminating) users. Similarly, user j is good and serves a high rating hj when his or her ratings match the true ratings of the movies.

1. `hitsjp`: HITS, using judge-presenter matrix, equivalent to `offdefsc`
2. `offdefnt`: Offense-Defense rating method, using judge-presenter matrix

Author(s)

Jiangtao Gou

References

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Kleinberg, J. M. (1999). Authoritative sources in a hyperlinked environment. Journal of the ACM 46, 604-632.

Langville, A. N. and Meyer, C. D. (2012). Who's Number 1?: The Science of Rating and Ranking. Princeton University Press.

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),nrow=6,byrow=TRUE)
method <- 'hitsjp'
totalsupporteps <- 0.01
numiter <- 10
ties.method <-'average'
result <- offdefnt(jpMat, method, totalsupporteps, numiter, ties.method)
print(result)
```

`offdefsc` *Kleinberg's HITS algorithm for Rating and Ranking with Square Matrix*

Description

Calculate ratings and provide rankings using Kleinberg's HITS algorithm, using a square matrix for score matrix (presenter-presenter)

Usage

```
offdefsc(
  jpMat,
  method = "hitspp",
  totalsupporteps = 0,
  totalsupporttype = 1,
  numiter = 100,
  ties.method = "average"
)
```

Arguments

`jpMat`	a Judge-Presenter matrix, or a User-Movie matrix
`method`	a character string specifying the HITS algorithm, including "hitspp".
`totalsupporteps`	a small number to guarantee the total support property
`totalsupporttype`	an indicater: 1 stands for matrix ee^T and 2 stands for matrix ee^T - I

numiter	a number of iterations
ties.method	a character string specifying how ties are treated, including "average", "first", "last", "random", "max", "min", from base::rank

Details

Large offense score means strong offense, and large defense score means weak defense

1. hitspp: HITS, using presenter-presenter matrix, equivalent to offdefsc
2. offdefsc: Offense-Defense rating method, using presenter-presenter matrix

Author(s)

Jiangtao Gou

References

Gou, J. and Wu, S. (2020). A Judging System for Project Showcase: Rating and Ranking with Incomplete Information. Technical Report.

Kleinberg, J. M. (1999). Authoritative sources in a hyperlinked environment. Journal of the ACM 46, 604-632.

Langville, A. N. and Meyer, C. D. (2012). Who's Number 1?: The Science of Rating and Ranking. Princeton University Press.

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),nrow=6,byrow=TRUE)
 method <- 'hitspp'
totalsupporteps <- 0.01
totalsupporttype <- 1
numiter <- 10
ties.method <-'average'
result <- offdefsc(jpMat, method, totalsupporteps, totalsupporttype, numiter, ties.method)
print(result)
```

---

readJudgePresenterMatrix

Transform a Judge-Presenter Matrix Converter

Description

Convert a judge-presenter matrix to a set of square matrices

Usage

```
readJudgePresenterMatrix(jpMat)
```

Arguments

jpMat	a Judge-Presenter matrix, or a User-Movie matrix

Value

A list, including numGame

1. numGame: Number of times teams i and j faced eath other
2. numWin: Number of wins teams i plays against j
3. numTie: Number of ties teams i plays against j
4. numLoss: Number of losses teams i plays against j
5. numPt: Number of points teams i accumulates against j

Author(s)

Jiangtao Gou

Shuyi Wu

Examples

```
jpMat <- matrix(data=c(5,4,3,0, 5,5,3,1, 0,0,0,5, 0,0,2,0, 4,0,0,3, 1,0,0,4),
nrow=6,byrow=TRUE)
result <- readJudgePresenterMatrix(jpMat)
print(result)
```

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