

Package ‘ExtMallows’

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Type Package

Title An Extended Mallows Model and Its Hierarchical Version for Ranked Data Aggregation

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Description For multiple full/partial ranking lists, R package 'ExtMallows' can (1) detect whether the input ranking lists are over-correlated, and (2) use the Mallows model or extended Mallows model to integrate the ranking lists, and (3) use hierarchical extended Mallows model for rank integration if there are groups of over-correlated ranking lists.

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corrRankings	<i>p value for measuring the correlation of pairwise rankings</i>
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Description

It calculates the p values that measure the correlation of pairwise rankings.

Usage

```
corrRankings(rankings)
```

Arguments

rankings	A n by m data frame, with each column representing a ranking list, which ranks the items from the most preferred to the least preferred. For missing items, use 0 to denote them.
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Value

pair.pvalue	a symmetric matrix of p values, with the (i,j)-th element denoting the p value of the i,j-th rankings.
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Note

Note that the input rankings should have at least 8 rankings. When constructing the samples of rescaled V distance for a given rank position, the number of samples should at least be 28 and the number of rankings that have items up to this position should account for at least 2/3 of the total number of rankings, otherwise the p value calculation stops at this position.

Author(s)

Han Li, Minxuan Xu, Jun S. Liu and Xiaodan Fan

References

An extended Mallows model for ranked data aggregation

Examples

```
data(simu3)
pvalue=corrRankings(rankings = simu3)

#threshold the p values

threshold=0.05
pvalue.trunc=ifelse(pvalue<=0.05, pvalue, 1)

#plot the p values
```

```
x=y=1:ncol(pvalue)
par(mfrow=c(1,2))
image(x, y, pvalue, xlab = NA, ylab = NA, sub = "rank coefficient")
image(x, y, pvalue.trunc, xlab = NA, ylab = NA, sub = "rank coefficient < 0.05")
```

EMM

*An extended Mallows model for aggregating multiple ranking lists***Description**

It uses the extended Mallows model to aggregate multiple full/partial ranking lists.

Usage

```
EMM(rankings, initial.method, it.max)
```

Arguments

<code>rankings</code>	A n by m matrix, with each column representing a ranking list, which ranks the items from the most preferred to the least preferred. For missing items, use 0 to denote them.
<code>initial.method</code>	the method for initializing the value of π_0 , with four options: mean, median, geometric and random (the mean of three randomly sampled ranking lists). By default, <code>initial.method="mean"</code> .
<code>it.max</code>	the maximum number of iterations. By default, <code>it.max=20</code> .

Value

<code>op.phi</code>	optimal value of ϕ
<code>op.omega</code>	optimal value of ω
<code>op.alpha</code>	optimal value of α
<code>op.pi0</code>	optimal value of π_0 , ranking the items from the most preferred to the least preferred
<code>max.logL</code>	maximum value of log-likelihood

Author(s)

Han Li, Minxuan Xu, Jun S. Liu and Xiaodan Fan

References

An extended Mallows model for ranked data aggregation

Examples

```
data(simu1)
res=EMM(rankings = simu1, initial.method = "mean", it.max = 20)
res$op.phi
res$op.omega
res$op.pi0
```

HEMM

A hierarchical extended Mallows model for aggregating multiple ranking lists

Description

It uses the hierarchical extended Mallows model to aggregate multiple full/partial ranking lists.

Usage

```
HEMM(rankings, num.kappa, is.kappa.ranker, initial.method, it.max)
```

Arguments

<code>rankings</code>	A n by m matrix, with each column representing a ranking list, which ranks the items from the most preferred to the least preferred. For missing items, use 0 to denote them.
<code>num.kappa</code>	the number of over-correlated ranking groups
<code>is.kappa.ranker</code>	a list of over-correlated ranking groups, with the k-th element denoting the column numbers of the rankings that belong to the k-th group
<code>initial.method</code>	the method for initializing the value of pi0, with four options: mean, median, geometric and random (the mean of three randomly sampled ranking lists). By default, <code>initial.method="mean"</code> .
<code>it.max</code>	the maximum number of iterations. By default, <code>it.max=20</code> .

Value

<code>op.phi</code>	optimal value of phi
<code>op.phi1</code>	optimal value of phi1, the phi value in over-correlated ranking groups
<code>op.omega</code>	optimal value of omega
<code>op.alpha</code>	optimal value of alpha
<code>op.pi0</code>	optimal value of pi0, ranking the items from the most preferred to the least preferred
<code>op.kappa</code>	optimal value of kappa, denoting the items from the most preferred to the least preferred
<code>max.logL</code>	maximum value of log-likelihood

Author(s)

Han Li, Minxuan Xu, Jun S. Liu and Xiaodan Fan

References

An extended Mallows model for ranked data aggregation

Examples

```
data(simu3)
res=HEMM(rankings = simu3, num.kappa = 2, is.kappa.ranker = list(1:5, 6:10),
  initial.method = "mean", it.max = 20)
res$op.phi
res$op.phi1
res$op.omega
res$op.pi0

data(NBARankings)
res=HEMM(rankings = NBARankings, num.kappa = 1, is.kappa.ranker = list(1:6),
  initial.method = "mean", it.max = 20)
res$op.omega
res$op.pi0
res$op.kappa
```

MM

The Mallows model for aggregating multiple ranking lists

Description

It uses the Mallows model to aggregate multiple full/partial ranking lists.

Usage

```
MM(rankings, initial.method, it.max)
```

Arguments

<code>rankings</code>	A n by m matrix, with each column representing a ranking list, which ranks the items from the most preferred to the least preferred. For missing items, use 0 to denote them.
<code>initial.method</code>	the method for initializing the value of π_0 , with four options: mean, median, geometric and random (the mean of three randomly sampled ranking lists). By default, <code>initial.method="mean"</code> .
<code>it.max</code>	the maximum number of iterations. By default, <code>it.max=20</code> .

Value

op.phi	optimal value of phi
op.pi0	optimal value of pi0, ranking the items from the most preferred to the least preferred
max.logL	maximum value of log-likelihood

Author(s)

Han Li, Minxuan Xu, Jun S. Liu and Xiaodan Fan

References

Mallows, C. L. (1957). Non-null ranking models, *Biometrika* 44(1/2): 114-130.

Examples

```
data(simu1)
res=MM(rankings = simu1, initial.method = "mean", it.max = 20)
res$op.phi
res$op.pi0
```

NBArankings

A real example of rankings of NBA teams

Description

This example is about aggregating the multiple rankings of NBA teams and was studied by Deng et al. (2014). They collected 34 rankings, including 6 professional rankings and 28 amateur rankings, for the 30 NBA teams in the 2011-2012 season. For the missing items in the partial rankings, we use number 0 to denote them.

Usage

```
data("NBArankings")
```

Format

A data frame with 30 observations on the following 34 variables.

V1 a factor with levels 76ers Bobcats Bucks Bulls Cavaliers Celtics Clippers Grizzlies Hawks Heat Hornets Jazz Kings Knicks Lakers Magic Mavericks Nets Nuggets Pacers Pistons Raptors Rockets Spurs Suns Thunder Timberwolves TrailBlazers Warriors Wizards

V2 a factor with levels 76ers Bobcats Bucks Bulls Cavaliers Celtics Clippers Grizzlies Hawks Heat Hornets Jazz Kings Knicks Lakers Magic Mavericks Nets Nuggets Pacers Pistons Raptors Rockets Spurs Suns Thunder Timberwolves TrailBlazers Warriors Wizards

- V3 a factor with levels 76ers Bobcats Bucks Bulls Cavaliers Celtics Clippers Grizzlies Hawks Heat Hornets Jazz Kings Knicks Lakers Magic Mavericks Nets Nuggets Pacers Pistons Raptors Rockets Spurs Suns Thunder Timberwolves TrailBlazers Warriors Wizards
- V4 a factor with levels 76ers Bobcats Bucks Bulls Cavaliers Celtics Clippers Grizzlies Hawks Heat Hornets Jazz Kings Knicks Lakers Magic Mavericks Nets Nuggets Pacers Pistons Raptors Rockets Spurs Suns Thunder Timberwolves TrailBlazers Warriors Wizards
- V5 a factor with levels 76ers Bobcats Bucks Bulls Cavaliers Celtics Clippers Grizzlies Hawks Heat Hornets Jazz Kings Knicks Lakers Magic Mavericks Nets Nuggets Pacers Pistons Raptors Rockets Spurs Suns Thunder Timberwolves TrailBlazers Warriors Wizards
- V6 a factor with levels 76ers Bobcats Bucks Bulls Cavaliers Celtics Clippers Grizzlies Hawks Heat Hornets Jazz Kings Knicks Lakers Magic Mavericks Nets Nuggets Pacers Pistons Raptors Rockets Spurs Suns Thunder Timberwolves TrailBlazers Warriors Wizards
- V7 a factor with levels 0 Bulls Celtics Hawks Heat Lakers Pacers Spurs Thunder
- V8 a factor with levels 0 Bulls Celtics Clippers Heat Knicks Lakers Spurs Thunder
- V9 a factor with levels 0 Bulls Celtics Heat Knicks Lakers Mavericks Spurs Thunder
- V10 a factor with levels 0 Bulls Celtics Clippers Heat Lakers Mavericks Spurs Thunder
- V11 a factor with levels 0 Bulls Celtics Heat Knicks Lakers Nuggets Warriors Wizards
- V12 a factor with levels 0 Bulls Celtics Clippers Heat Lakers Mavericks Spurs Thunder
- V13 a factor with levels 0 Bulls Celtics Hornets Jazz Kings Lakers Magic Rockets
- V14 a factor with levels 0 76ers Celtics Heat Kings Lakers Rockets Spurs Suns
- V15 a factor with levels 0 Bulls Celtics Heat Lakers Mavericks Rockets Spurs Thunder
- V16 a factor with levels 0 Celtics Hawks Heat Lakers Mavericks Raptors Spurs Thunder
- V17 a factor with levels 0 76ers Celtics Heat Knicks Lakers Mavericks Nets Thunder
- V18 a factor with levels 0 76ers Bulls Cavaliers Celtics Heat Lakers Mavericks Thunder
- V19 a factor with levels 0 Bulls Heat Kings Lakers Rockets Spurs Suns Warriors
- V20 a factor with levels 0 Bucks Celtics Heat Lakers Magic Mavericks Rockets Suns
- V21 a factor with levels 0 Celtics Heat Kings Lakers Mavericks Spurs Suns Timberwolves
- V22 a factor with levels 0 Celtics Heat Kings Lakers Spurs Suns Thunder Timberwolves
- V23 a factor with levels 0 Bobcats Celtics Heat Lakers Mavericks Nuggets Spurs Suns
- V24 a factor with levels 0 76ers Heat Knicks Lakers Pistons Rockets Spurs Wizards
- V25 a factor with levels 0 76ers Celtics Hawks Heat Knicks Lakers Magic Thunder
- V26 a factor with levels 0 Bulls Cavaliers Celtics Hawks Heat Knicks Lakers Rockets
- V27 a factor with levels 0 76ers Clippers Lakers Magic Mavericks Pacers Raptors Warriors
- V28 a factor with levels 0 76ers Bulls Celtics Heat Lakers Pistons Rockets Wizards
- V29 a factor with levels 0 76ers Bulls Grizzlies Hawks Kings Knicks Nets Timberwolves
- V30 a factor with levels 0 76ers Bucks Bulls Knicks Raptors Rockets Thunder Timberwolves

V31 a factor with levels 0 76ers Heat Lakers Magic Mavericks Pacers Pistons Suns
V32 a factor with levels 0 76ers Bulls Celtics Heat Knicks Lakers Magic Pacers
V33 a factor with levels 0 Clippers Heat Knicks Lakers Mavericks Nets Nuggets Wizards
V34 a factor with levels 0 Bulls Hawks Heat Jazz Knicks Nets Rockets Timberwolves

References

Deng, K., Han, S., Li, K. J. and Liu, J. S. (2014). Bayesian aggregation of order-based rank data, *Journal of the American Statistical Association* 109(507): 1023-1039.

Examples

```
data(NBArankings)
dim(NBArankings)
```

simu1	<i>Simulation data 1</i>
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Description

This data set is simulated as described in the Simulation Study 1 of the reference. It is a 30 by 6 data frame, representing 6 independent top-30 partial rankings.

Usage

```
data("simu1")
```

Format

A data frame with 30 observations on the following 6 variables.

V1 a numeric vector
V2 a numeric vector
V3 a numeric vector
V4 a numeric vector
V5 a numeric vector
V6 a numeric vector

References

An extended Mallows model for ranked data aggregation

Examples

```
data(simu1)
dim(simu1)
```

`simu2`*Simulation data 2*

Description

This data set is simulated as described in the Simulation Study 2 of the reference. It is a 40 by 6 data frame, representing 6 independent top-40 partial rankings.

Usage

```
data("simu2")
```

Format

A data frame with 40 observations on the following 6 variables.

V1 a numeric vector

V2 a numeric vector

V3 a numeric vector

V4 a numeric vector

V5 a numeric vector

V6 a numeric vector

References

An extended Mallows model for ranked data aggregation

Examples

```
data(simu2)  
dim(simu2)
```

`simu3`*Simulation data 3*

Description

This data set is simulated as described in the Simulation Study 3 of the reference. It is a 100 by 20 data frame, representing 20 full rankings. The columns 1-5 and the columns 6-10 represent two highly correlated ranking groups, respectively.

Usage

```
data("simu3")
```

Format

A data frame with 100 observations on the following 20 variables.

V1 a numeric vector

V2 a numeric vector

V3 a numeric vector

V4 a numeric vector

V5 a numeric vector

V6 a numeric vector

V7 a numeric vector

V8 a numeric vector

V9 a numeric vector

V10 a numeric vector

V11 a numeric vector

V12 a numeric vector

V13 a numeric vector

V14 a numeric vector

V15 a numeric vector

V16 a numeric vector

V17 a numeric vector

V18 a numeric vector

V19 a numeric vector

V20 a numeric vector

References

An extended Mallows model for ranked data aggregation

Examples

```
data(simu3)
```

```
dim(simu3)
```

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