Package ‘RankAggreg’

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Title Weighted rank aggregation
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Imports gtools
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Description This package performs aggregation of ordered lists based
on the ranks using several different algorithms: Borda count,
Cross-Entropy Monte Carlo algorithm, Genetic algorithm, and a
brute force algorithm (for small problems)
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Weighted Rank Aggregation via brute force algorithm

Description

Weighted rank aggregation of ordered lists is performed using the brute force approach, i.e. generating all possible ordered lists and finding the list with the minimum value of the objective function.

Usage

BruteAggreg(x, k, weights = NULL, distance = c("Spearman", "Kendall"),
importance=rep(1, nrow(x)))

Arguments

- **x**: a matrix of ordered lists to be combined (lists must be in rows)
- **k**: size of the top-k list
- **weights**: scores (weights) to be used in the aggregation process
- **distance**: distance which "measures" the similarity between the ordered lists
- **importance**: a vector of weights indicating the importance of each ordered list in x

Details

The function performs rank aggregation using the old-fashion brute force approach. This approach works for small problems only and should not be attempted if k is relatively large (k > 10). To generate all possible ordered lists, the permutation function from the gtools package is used. Both weighted and unweighted rank aggregation can be performed. Please refer to the documentation for RankAggreg function as the same constraints on x and index.weights apply to both functions.

Value

- **top.list**: Top-k aggregated list
- **optimal.value**: the minimum value of the objective function corresponding to the top-k list
- **distance**: distance used by the algorithm
- **method**: method used: BruteForce
- **importance**: importance vector used
- **lists**: original lists to be combined
- **weights**: scaled weights used in aggregation
- **sample**: objective function values
- **sample.size**: number of all possible solutions
- **summary**: contains minimum and median values of sample
Author(s)

Vasyl Pihur, Somnath Datta, Susmita Datta

References


See Also

RankAggreg

Examples

require(gtools)

# rank aggregation without weights

toplist <- BruteAggreg(x, 5)

# weighted rank aggregation
set.seed(100)
w <- matrix(rnorm(20), ncol=5)
w <- t(apply(w, 1, sort))

toplist <- BruteAggreg(x,5,w,"Spearman") # using the Spearman distance
toplist <- BruteAggreg(x,5,w,"Kendall") # using the Kendall distance
plot(toplist)

---

geneLists

**Ordered Gene Lists from 5 microarray studies**

Description

This dataset contains five lists of genes, each of size 25, from five independent microarray studies on prostate cancer. The lists are given in Table 4 in the manuscript by DeConde et al. Lists form the rows of the dataset with columns corresponding to the ranks of genes in each individual study.

Usage

data(geneLists)

Format

A matrix of size 5 by 25 containing 5 lists of genes.
**Source**


**Examples**

```r
data(geneLists)
topList <- RankAggreg(geneLists, 5, N=700, seed=100, convIn=3)
plot(topList)
```

---

**plot.raggr**

*Plot function for raggr object returned by RankAggreg or BruteAggreg*

**Description**

Plots individual ordered lists with the corresponding solution. Optionally, naive average rank aggregation can be added.

**Usage**

```r
## S3 method for class 'raggr'
plot(x, show.average = TRUE, show.legend = TRUE, colR="red", ...)
```

**Arguments**

- `x`: raggr object returned by RankAggreg
- `show.average`: boolean if average aggregation to be plotted
- `show.legend`: boolean if the legend is to be displayed
- `colR`: specifies the color for the resulting list
- `...`: additional plotting parameters

**Details**

The function plots individual lists and the solution using ranks only (weights are not used at any time). Optional average rank aggregation can be performed and visualized. Average rank aggregation is a simple aggregation procedure which computes the average ranks for each unique element across and orders them from the smallest to the largest value.

**Value**

Nothing is returned

**Author(s)**

Vasyl Pihur, Somnath Datta, Susmita Datta
References

See Also
RankAggreg, BruteAggreg

Examples
# rank aggregation without weights
x <- matrix(c("A", "B", "C", "D", "E",
  "B", "D", "A", "E", "C",
  "B", "A", "E", "C", "D",
  "A", "D", "B", "C", "E"), byrow=TRUE, ncol=5)

(CES <- RankAggreg(x, k=5, method="CE", distance="Spearman", rho=1, verbose=FALSE))
plot(CES)

RankAggreg

Description
Performs aggregation of ordered lists based on the ranks (optionally with additional weights) via the Cross-Entropy Monte Carlo algorithm or the Genetic Algorithm.

Usage
RankAggreg(x, k, weights=NULL, method=c("CE", "GA"),
  distance=c("Spearman", "Kendall"), seed=NULL, maxIter = 1000,
  convIn=ifelse(method=="CE", 7, 30), importance=rep(1,nrow(x)),
  rho=1, weight=.25, N=10*k^2, v1=NULL,
  popSize=100, CP=.4, MP=.01, verbose=TRUE, ...)

Arguments
x a matrix of ordered lists to be combined (lists must be in rows)
k size of the top-k list
weights a matrix of scores (weights) to be used in the aggregation process. Weights in each row must be ordered either in decreasing or increasing order and must correspond to the elements in x
method method to be used to perform rank aggregation: Cross Entropy Monte Carlo (CE) or Genetic Algorithm (GA)
distance distance to be used which "measures" the similarity of ordered lists
seed a random seed specified for reproducability; default: NULL
maxIter: the maximum number of iterations allowed; default: 1000
convIn: stopping criteria for both CE and GA algorithms. If the best solution does not change in convIn iterations, the algorithm converged; default: 7 for CE, 30 for GA
importance: vector of weights indicating the importance of each list in x; default: a vector of 1's (equal weights are given to all lists)
rho: (rho*N) is the "quantile" of candidate lists sorted by the function values. Used only by the Cross-Entropy algorithm
weight: a learning factor used in the probability update procedure of the CE algorithm
N: a number of samples to be generated by the MCMC; default: 10nk, where n is the number of unique elements in x. Used only by the Cross-Entropy algorithm
v1: optional, can be used to specify the initial probability matrix; if v1=NULL, the initial probability matrix is set to 1/n, where n is the number of unique elements in x
popSize: population size in each generation of Genetic Algorithm; default: 100
CP: Cross-over probability for the GA; the default value is .4
MP: Mutation probability for the GA. This value should be small and the number of mutations in the population of size popSize and the number of features k is computed as popSize*k*MP.
verbose: boolean, if console output is to be displayed at each iteration
...: additional arguments can be passed to the internal procedures:
- p: penalty for the Kendall’s tau distance; default: 0

Details
The function performs rank aggregation via the Cross-Entropy Monte Carlo algorithm or the Genetic Algorithm. Both approaches can and should be used when k is relatively large (k > 10). If k is small, one can enumerate all possible candidate lists and find the minimum directly using the BruteAggreg function available in this package.

The Cross-Entropy Monte Carlo algorithm is an iterative procedure for solving difficult combinatorial problems in which it is computationally not feasible to find the solution directly. In the context of rank aggregation, the algorithm searches for the "super"-list which is as close as possible to the ordered lists in x. We use either the Spearman footrule distance or the Kendall’s tau to measure the "closeness" of any two ordered lists (or modified by us the weighted versions of these distances). Please refer to the paper in the references for further details.

The Genetic Algorithm requires setting CP and MP parameters which effect the rate of "evolution" in the population. If both CP and MP are small, the algorithms is very conservative and may take a long time to search the solution space of all ordered candidate lists. On the other hand, setting CP and MP (especially MP) large will introduce a large number of mutations in the population which can result in a local optima.

The convergence criteria used by both algorithms is the repetition of the same minimum value of the objective function in convIn consecutive iterations.
## Value

- **top.list**: Top-k aggregated list
- **optimal.value**: the minimum value of the objective function corresponding to the top-k list
- **sample.size**: the number of samples generated by the MCMC at each iteration
- **num.iter**: the number of iterations until convergence
- **method**: which algorithm was used
- **distance**: which distance was used
- **importance**: an importance vector used
- **lists**: the original ordered lists
- **weights**: scaled weights if specified
- **sample**: objective function scores from the last iteration
- **summary**: matrix containing minimum and median objective function scores for each iteration

## Author(s)

Vasyl Pihur, Somnath Datta, Susmita Datta

## References


## See Also

- `BruteAggreg`, `plot`

## Examples

```r
# rank aggregation without weights

(CESnoweights <- RankAggreg(x, 5, method="CE", distance="Spearman", N=100, convIn=5, rho=.1))

# weighted rank aggregation
set.seed(100)
w <- matrix(rnorm(20), ncol=5)
w <- t(apply(w, 1, sort))

# using the Cross-Entropy Monte-Carlo algorithm
(CES <- RankAggreg(x, 5, w, "CE", "Spearman", rho=.1, N=100, convIn=5))
plot(CES)

(CEK <- RankAggreg(x, 5, w, "CE", "Kendall", rho=.1, N=100, convIn=5))
```
# using the Genetic algorithm
(GAS <- RankAggreg(x, 5, w, "GA", "Spearman"))
plot(GAS)
(GAK <- RankAggreg(x, 5, w, "GA", "Kendall"))

# more complex example (to get a better solution, increase maxIter)
data(geneLists)
topGenes <- RankAggreg(geneLists, 25, method="GA", maxIter=100)
plot(topGenes)
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