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Description Toolbox for the manipulation, description and rendering of sequences, and more generally the mining of sequence data in the field of social sciences. Although the toolbox is primarily intended for analyzing state or event sequences that describe life courses such as family formation histories or professional careers, its features also apply to many other kinds of categorical sequence data. It accepts many different sequence representations as input and provides tools for converting sequences from one format to another. It offers several functions for describing and rendering sequences, for computing distances between sequences with different metrics (among which optimal matching), original dissimilarity-based analysis tools, and simple functions for extracting the most frequent subsequences and identifying the most discriminating ones among them. A user's guide can be found on the TraMineR web page.
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TraMineR-package

Trajectory Miner: a Toolbox for Exploring and Rendering Sequences

Description

(Version: 2.2-0) Toolbox for the manipulation, description and rendering of sequences, and more generally the mining of sequence data in the field of social sciences. Although the toolbox is primarily intended for analyzing state or event sequences that describe life courses such as family formation histories or professional careers, its features also apply to many other kinds of categorical sequence data. It accepts many different sequence representations as input and provides tools for converting sequences from one format to another. It offers several functions for describing and rendering sequences, for computing distances between sequences with different metrics (among which optimal matching), original dissimilarity-based analysis tools, and simple functions for extracting the most frequent subsequences and identifying the most discriminating ones among them. A user’s guide can be found on the TraMineR web page.

Details

TraMineR provides tools for both state sequences and event sequences. The first step when using the package is to define a state sequence object (with `seqdef`) if you want to explore state sequences, and an event sequence object (with `seqecreate`) if you are interested in event sequencing.

State sequences are defined from a series of variables giving the states at the successive positions, while event sequences are defined from (vertical) time stamped event data. The package, however, can handle many other different data organizations and provides tools to help converting state sequences into event sequences and vice versa.

Author(s)

Alexis Gabadinho, Matthias Studer, Nicolas S. Müller, Reto Bürgin, Pierre-Alexandre Fonta, and Gilbert Ritschard

References


Examples

```
## load the mvad data
library(TraMineR)
data(mvad)

## create a state sequence object from columns 17 to 86
mvad.seq <- seqdef(mvad[,17:86])

## distribution plot by sex (male)
seqdplot(mvad.seq, group=mvad$male, border=NA)

## compute the LCS pairwise distance matrix
## among the first 10 sequences
mvad.lcs <- seqdist(mvad.seq[1:10,], method="LCS")
```

---

**actcal**

*Example data set: Activity calendar from the Swiss Household Panel*

Description

This data set contains 2000 individual sequences of monthly activity statuses from January to December 2000.

Usage

```
data(actcal)
```

Format

A data frame with 2000 rows, 12 state variables, 1 id variable and 11 covariates.

Details

The data set is a subsample of the data collected by the Swiss Household Panel (SHP).
The state column (variable) names are `jan00`, `feb00`, etc... and correspond to columns 13 to 24.
There are four possible states:

- **A** = Full-time paid job (> 37 hours)
- **B** = Long part-time paid job (19-36 hours)
- **C** = Short part-time paid job (1-18 hours)
- **D** = Unemployed (no work)

The data set contains also the following covariates:

- `age00` (age in 2000)
- `educat00` (education level)
Source
Swiss Household Panel

References
https://forscenter.ch/projects/swiss-household-panel/

actcal.tse

Example data set: Activity calendar from the Swiss Household Panel (time stamped event format)

Description
This data set contains events defined from the state sequences in the actcal data set. It was created with the code shown in the examples section. It is provided to symplify example of event sequence mining.

Usage
data(actcal.tse)

Format
Time stamped events derived from state sequences in the actcal data set.

Source
Swiss Household Panel

See Also
seqformat, actcal
Examples

data(actcal)
actcal.seq <- seqdef(actcal[,13:24])

## Defining the transition matrix
transition <- seqetm(actcal.seq, method="transition")
transition

## Converting STS data to TSE
actcal.tse <- seqformat(actcal, 13:24, from = "STS", to = "TSE", tevent = transition)

## Defining the event sequence object
actcal.eseq <- seqecreate(id=actcal.tse$id, time=actcal.tse$time, event=actcal.tse$event)

alphabet

Get or set the alphabet of a state or event sequence object

Description

For state sequences, the function gets or sets the (short) labels associated to the states in the alphabet of a state sequence object (the list of all possible states). The get form also applies to event sequences, while the set form does not work with event sequences.

Usage

alphabet(seqdata, with.missing=FALSE)
alphabet(seqdata) <- value

Arguments

seqdata a state sequence object of class stslist as defined with the seqdef function or, for the get form only, an event sequence object as defined with seqecreate or a probabilistic suffix tree generated with the PST package.

value For state sequences only. Vector of characters of the same length as the vector returned by the alphabet function, i.e. one label for each state in the alphabet.

with.missing Logical. When seqdata is a state sequence object (stslist), should the returned alphabet include the nr symbol standing for missing states?
Details
A state sequence object—created with the `seqdef` function—stores sequences as a matrix where columns are factors. The levels of the factors include the alphabet plus the codes for missing values and void elements. The alphabet function retrieves or sets the “alphabet” attribute of the state sequence object. The state names composing the alphabet are preferably short labels, since they are used for printing sequences. Longer labels for describing more precisely each state in legend are stored in the “labels” attribute of the sequence object.

For an event sequence object—created with `seqecreate`—the get form of alphabet works as an alias for `levels`. The set form `alphabet <-` does not work and should not be used.

Value
For ‘alphabet’ a character vector containing the alphabet.
For ‘alphabet <-’ the updated state sequence object.

Author(s)
Alexis Gabadinho and Gilbert Ritschard

See Also
`seqdef`

Examples
```r
## Creating a sequence object with the columns 13 to 24
## in the 'actcal' example data set
data(actcal)
actcal.seq <- seqdef(actcal,13:24)

## Retrieving the alphabet
alphabet(actcal.seq)

## Setting the alphabet
alphabet(actcal.seq) <- c("FT", "PT", "LT", "NO")

## Event sequences
actcal.eseq <- seqecreate(actcal.seq)
alphabet(actcal.eseq)
```

bfspell
Example data set: First 20 biofam sequences in SPELL form

Description
First 20 sequences of the biofam data set in SPELL form. The data serve to illustrate the use of `seqformat` for converting SPELL data into STS (horizontal) form.
Usage
data(bfspell)

Format
A data set with two data frames: bfspell20 with one row per spell and bfpdata20 with one row per id. The bfspell20 data frame contains the spell data themselves (4 variables id, begin, end, states) and bfpdata20 the year when aged 15 (2 variables id, when15).

Details
The states are coded with the following short labels

P = "Parent"
L = "Left"
M = "Married"
LM = "Left+Marr"
C = "Child"
LC = "Left+Child"
LMC = "Left+Marr+Child"
D = "Divorced"

The data is a SPELL representation of biofam[1:20,10:25], corresponding to 20 family life sequences between ages 15 and 30.

See Also
biofam

---

**biofam**

*Example data set: Family life states from the Swiss Household Panel biographical survey*

**Description**

2000 16 year-long family life sequences built from the retrospective biographical survey carried out by the Swiss Household Panel (SHP) in 2002.

**Usage**
data(biofam)
data(bfspell)

**Format**
A data frame with 2000 rows, 16 state variables, 1 id variable and 7 covariates and 2 weights variables.
The biofam data set was constructed by Müller et al. (2007) from the data of the retrospective biographical survey carried out by the Swiss Household Panel (SHP) in 2002.

The data set contains (in columns 10 to 25) sequences of family life states from age 15 to 30 (sequence length is 16) and a series of covariates. The sequences are a sample of 2000 sequences of those created from the SHP biographical survey. It includes only individuals who were at least 30 years old at the time of the survey. The biofam data set describes family life courses of 2000 individuals born between 1909 and 1972.

The states numbered from 0 to 7 are defined from the combination of five basic states, namely Living with parents (Parent), Left home (Left), Married (Marr), Having Children (Child), Divorced:

0 = "Parent"
1 = "Left"
2 = "Married"
3 = "Left+Marr"
4 = "Child"
5 = "Left+Child"
6 = "Left+Marr+Child"
7 = "Divorced"

The covariates are:

- `sex`
- `birthyr` (birth year)
- `nat_1_02` (first nationality)
- `plingu02` (language of questionnaire)
- `p02r01` (religion)
- `p02r04` (religious participation)
- `cspfaj` (father’s social status)
- `cspmoj` (mother’s social status)

Two additional weights variables are inserted for illustrative purpose ONLY (since biofam is a subsample of the original data, these weights are not adapted to the actual data):

- `wp00tbgp` (weights inflating to the Swiss population)
- `wp00tbgs` (weights respecting sample size)

Source

Swiss Household Panel [https://forscenter.ch/projects/swiss-household-panel/](https://forscenter.ch/projects/swiss-household-panel/)


**References**


---

**cpal**

*Get or set the color palette of a sequence object*

---

**Description**

This function gets or sets the color palette of a sequence object, that is, the list of colors used to represent the states.

**Usage**

```r
cpal(seqdata)
cpal(seqdata) <- value
```

**Arguments**

- `seqdata` a state sequence object as defined by the `seqdef` function.
- `value` a vector containing the colors, of length equal to the number of states in the alphabet. The colors can be passed as character strings representing color names such as returned by the `colors` function, as hexadecimal values or as RGB vectors using the `rgb` function. Each color is attributed to the corresponding state in the alphabet, the order being the one returned by the `alphabet`.

**Details**

In the plot functions provided for visualizing sequence objects, a different color is associated to each state of the alphabet. The color palette is defined when creating the sequence object, either automatically using the `brewer.pal` function of the `RColorBrewer` package or by specifying a user defined color vector. The `cpal` function can be used to get or set the color palette of a previously defined sequence object.

**Value**

- For `cpal(seqdata)` a vector containing the colors.
- For `cpal(seqdata) <-` the updated sequence object.

**Author(s)**

Alexis Gabadinho

**See Also**

- `seqdef`
dissassoc

Analysis of discrepancy from dissimilarity measures

Description

Compute and test the share of discrepancy (defined from a dissimilarity matrix) explained by a categorical variable.

Usage

dissassoc(diss, group, weights=NULL, R=1000,
   weight.permutation="replicate", squared=FALSE)

Arguments

diss A dissimilarity matrix or a dist object (see dist)
group A categorical variable. For a numerical variable use dissmfacw.
weights optional numerical vector containing weights.
R Number of permutations for computing the p-value. If equal to 1, no permutation test is performed.
weight.permutation Weighted permutation method: "diss" (attach weights to the dissimilarity matrix), "replicate" (replicate case using weights), "rounded-replicate" (replicate case using rounded weights), "random-sampling" (random assignment of covariate profiles to the objects using distributions defined by the weights.)
squared Logical. If TRUE the dissimilarities diss are squared.
dissassoc

Details

The dissassoc function assesses the association between objects characterized by their dissimilarity matrix and a discrete covariate. It provides a generalization of the ANOVA principle to any kind of distance metric. The function returns a pseudo R-square that can be interpreted as a usual R-square. The statistical significance of the association is computed by means of permutation tests. The function performs also a test of discrepancy homogeneity (equality of within variances) using a generalization of the Levene statistic and Bartlett’s statistics. There are print and hist methods (the latter producing an histogram of the permuted values used for testing the significance).

If a numeric group variable is provided, it will be treated as categorical, i.e., each different value will be considered as a different category. To measure the ‘linear’ effect of a numerical variable, use dissfacw.

Value

An object of class dissassoc with the following components:

- groups: A data frame with the number of cases and the discrepancy of each group
- anova.table: The pseudo ANOVA table
- stat: The value of the statistics and their p-values
- perms: The permutation object, containing the values computed for each permutation

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

References


See Also
dissvar to compute the pseudo variance from dissimilarities and for a basic introduction to concepts of pseudo variance analysis.
disstree for an induction tree analyse of objects characterized by a dissimilarity matrix.
**disscenter** to compute the distance of each object to its group center from pairwise dissimilarities. **dissmfacw** to perform multi-factor analysis of variance from pairwise dissimilarities.

### Examples

```r
## Defining a state sequence object
data(mvad)
mvad.seq <- seqdef(mvad[, 17:86])

## Building dissimilarities (any dissimilarity measure can be used)
mvad.ham <- seqdist(mvad.seq, method="HAM")

## R=1 implies no permutation test
da <- dissassoc(mvad.ham, group=mvad$gcse5eq, R=10)
print(da)
hist(da)
```

---

**disscenter**  
*Compute distances to the center of a group*

### Description

Computes the dissimilarity between objects and their group center from their pairwise dissimilarity matrix.

### Usage

```r
disscenter(diss, group=NULL, medoids.index=NULL,
allcenter = FALSE, weights=NULL, squared=FALSE)
```

### Arguments

- **diss**: a dissimilarity matrix such as generated by `seqdist`, or a `dist` object (see `dist`)
- **group**: if NULL (default), the whole data set is considered. Otherwise a different center is considered for each distinct value of the group variable
- **medoids.index**: if NULL, returns the dissimilarity to the center. If set to "first", returns the index of the first encountered most central sequence. If group is set, an index is returned per group. When set to "all", indexes of all medoids (one list per group) are returned.
- **allcenter**: logical. If TRUE, returns a data.frame containing the dissimilarity between each object and its group center, each column corresponding to a group.
- **weights**: optional numerical vector containing weights.
- **squared**: Logical. If TRUE diss is squared.
Details

This function computes the dissimilarity between given objects and their group center. It is possible that the group center does not belong to the space formed by the objects (in the same way as the average of integer numbers is not necessarily an integer itself). This distance can also be understood as the contribution to the discrepancy (see `dissvar`). Note that when the dissimilarity measure does not respect the triangle inequality, the dissimilarity between a given object and its group center may be negative.

It can be shown that this dissimilarity is equal to (see Batagelj 1988):

$$d_{x\tilde{g}} = \frac{1}{n} \left( \sum_{i=1}^{n} d_{xi} - SS \right)$$

where $SS$ is the sum of squares (see `dissvar`).

Value

A vector with the dissimilarity to the group center for each object, or a list of medoid indexes.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

References


See Also

dissvar to compute the pseudo variance from dissimilarities and for a basic introduction to concepts of pseudo variance analysis

dissassoc to test association between objects represented by their dissimilarities and a covariate.

disstree for an induction tree analyse of objects characterized by a dissimilarity matrix.

dissmfacw to perform multi-factor analysis of variance from pairwise dissimilarities.
Examples

```r
## Defining a state sequence object
data(mvad)
mvad.seq <- seqdef(mvad[, 17:86])

## Building dissimilarities (any dissimilarity measure can be used)
mvad.ham <- seqdist(mvad.seq, method="HAM")

## Compute distance to center according to group gcse5eq
dc <- disscenter(mvad.ham, group=mvad$gcse5eq)

## Ploting distribution of dissimilarity to center
boxplot(dc~mvad$gcse5eq, col="cyan")

## Retrieving index of the first medoids, one per group
dc <- disscenter(mvad.ham, group=mvad$Grammar, medoids.index="first")
print(dc)

## Retrieving index of all medoids in each group
dc <- disscenter(mvad.ham, group=mvad$Grammar, medoids.index="all")
print(dc)
```

dissmfacw

`Multi-factor ANOVA from a dissimilarity matrix`

description

Perform a multi-factor analysis of variance from a dissimilarity matrix.

Usage

`dissmfacw(formula, data, R = 1000, gower = FALSE, squared = FALSE, weights = NULL)`

Arguments

- `formula`: A regression-like formula. The left hand side term should be a dissimilarity matrix or a `dist` object.
- `data`: A data frame from which the variables in `formula` should be taken.
- `R`: Number of permutations used to assess significance.
- `gower`: Logical: Is the dissimilarity matrix already a Gower matrix?
- `squared`: Logical: Should we square the provided dissimilarities?
- `weights`: Optional numerical vector of case weights.
Details

This method is, in some way, a generalization of `dissassoc` to account for several explanatory variables. The function computes the part of discrepancy explained by the list of covariates specified in the formula. It provides for each covariate the Type-II effect, i.e. the effect measured when removing the covariate from the full model with all variables included.

(The returned F values may slightly differ from those obtained with TraMineR versions older than 1.8-9. Since 1.8-9, the within sum of squares at the denominator is divided by $n - m$ instead of $n - m - 1$, where $n$ is the sample size and $m$ the total number of predictors and/or contrasts used to represent categorical factors.)

For a single factor `dissmfacw` is slower than `dissassoc`. Moreover, the latter performs also tests for homogeneity in within-group discrepancies (equality of variances) with a generalization of Levene’s and Bartlett’s statistics.

Part of the function is based on the Multivariate Matrix Regression with qr decomposition algorithm written in SciPy-Python by Ondrej Libiger and Matt Zapala (See Zapala and Schork, 2006, for a full reference.) The algorithm has been adapted for Type-II effects and extended to account for case weights.

Value

A `dissmultifactor` object with the following components:

- mfac: The part of variance explained by each variable (comparing full model to model without the specified variable) and its significance using permutation test
- call: Function call
- perms: Permutation values as a boot object

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

References


**See Also**

dissvar to compute a pseudo variance from dissimilarities and for a basic introduction to concepts of discrepancy analysis.
dissassoc to test association between objects represented by their dissimilarities and a covariate.
disstree for an induction tree analysis of objects characterized by a dissimilarity matrix.
disscenter to compute the distance of each object to its group center from pairwise dissimilarities.

**Examples**

```r
## Define the state sequence object
data(mvad)
mvad.seq <- seqdef(mvad[, 17:86])
## Here, we use only first 100 sequences
mvad.seq <- mvad.seq[1:100,]

## Compute dissimilarities (any dissimilarity measure can be used)
mvad.ham <- seqdist(mvad.seq, method="HAM")

## And now the multi-factor analysis
print(dissmfacw(mvad.ham ~ male + Grammar + funemp + gcse5eq + fmpr + livboth, data=mvad[1:100,], R=10))
```

---

**dissrep**

*Extracting sets of representative objects using a dissimilarity matrix*

**Description**

The function extracts a set of representative objects that exhibits the key features of the whole data set, the goal being to get easy sounded interpretation of the latter. The user can set either the desired coverage level (the proportion of objects having a representative in their neighborhood) or the desired number of representatives.

**Usage**

```r
dissrep(diss, criterion = "density", score = NULL, decreasing = TRUE,
coverage = 0.25, nrep = NULL, pradius = 0.10, dmax = NULL,
weights = NULL, trep, tsim)
```

**Arguments**

- `diss` A dissimilarity matrix or a `dist` object (see `dist`)
criterion
the representativeness criterion for sorting the candidate list. One of "freq" (frequency), "density" (neighborhood density) or "dist" (centrality). An optional vector containing the scores for sorting the candidate objects may also be provided. See below and details.

score
an optional vector containing the representativeness scores used for sorting the objects in the candidate list. The length of the vector must be equal to the number of rows/columns in the distance matrix, i.e. the number of objects.

decreasing
if a score vector is provided, indicates whether the objects in the candidate list must be sorted in ascending or decreasing order of this score. The first object in the candidate list is supposed to be the most representative.

coverage
controls the size of the representative set by setting the desired coverage level, i.e. the proportion of objects having a representative in their neighborhood. Neighborhood radius is defined by pradius.

nrep
number of representatives. If NULL (default), coverage argument is used to control the size of the representative set.

pradius
neighborhood radius as a percentage of the maximum (theoretical) distance dmax. Defaults to 0.1 (10%). Object y is redundant to object x when it is in the neighborhood of x, i.e., within a distance pradius*dmax from x.

dmax
maximum theoretical distance. Used to derive the neighborhood radius as pradius*dmax. If NULL, the value of dmax is derived from the dissimilarity matrix.

weights
vector of weights of length equal to the number of rows of the dissimilarity matrix. If NULL, equal weights are assigned.

trep
Deprecated. Use coverage instead.

tsim
Deprecated. Use pradius instead.

Details
The representative set is obtained by an heuristic. Representatives are selected by successively extracting from the sequences sorted by their representativeness score those which are not redundant with already retained representatives. The selection stops when either the desired coverage or the wanted number of representatives is reached. Objects are sorted either by the values provided as score argument, or by specifying one of the following as criterion argument: "freq" (sequence frequency), "density" (neighborhood density), "dist" (centrality).

The frequency criterion uses the frequencies as representativeness score. The frequency of an object in the data is computed as the number of other objects with whom the dissimilarity is equal to 0. The more frequent an object the more representative it is supposed to be. Hence, objects are sorted in decreasing frequency order. Indeed, this criterion is the neighborhood (see below) criterion with the neighborhood diameter set to 0.

The neighborhood density is the number—density—of sequences in the neighborhood of the object. This requires to set the neighborhood radius pradius. Objects are sorted in decreasing density order.

The centrality criterion is the sum of distances to all other objects. The smallest the sum, the most representative the sequence.

Use criterion="dist" and nrep=1 to get the medoid and criterion="density" and nrep=1 to get the densest object pattern.

For more details, see Gabadinho et al., 2011.
Value

An object of class `diss.rep`. This is a vector containing the indexes of the representative objects with the following additional attributes:

- **Scores**
  a vector with the representative score of each object given the chosen criterion.

- **Distances**
  a matrix with the distance of each object to its nearest representative.

- **Statistics**
  a data frame with quality measures for each representative: number of objects attributed to the representative, number of object in the representative’s neighborhood, mean distance to the representative.

- **Quality**
  overall quality measure.

Print and summary methods are available.

Author(s)

Alexis Gabadinho (with Gilbert Ritschard for the help page)

References


See Also

`seqrep`, `disscenter`

Examples

```r
## Defining a sequence object with the data in columns 10 to 25
## (family status from age 15 to 30) in the biofam data set
data(biofam)
biofam.seq <- seqdef(biofam, 10:25, labels=biofam.lab)

## Computing the distance matrix
costs <- seqsubm(biofam.seq, method="TRATE")
biofam.om <- seqdist(biofam.seq, method="OM", sm=costs)

## Representative set using the neighborhood density criterion
biofam.rep <- dissrep(biofam.om)
biofam.rep
summary(biofam.rep)
```

**disstree**  
*Dis similarity Tree*

**Description**

Tree structured discrepancy analysis of objects described by their pairwise dissimilarities.

**Usage**

```r
disstree(formula, data = NULL, weights = NULL, min.size = 0.05, 
          max.depth = 5, R = 1000, pval = 0.01, object = NULL, 
          weight.permutation = "replicate", squared = FALSE, first = NULL, 
          minSize, maxdepth)
```

**Arguments**

- `formula`: Formula with a dissimilarity matrix as left hand side and the candidate partitioning variables on the right side.
- `data`: Data frame where variables in formula will be searched for.
- `weights`: Optional numerical vector of weights.
- `min.size`: Minimum number of cases in a node, will be treated as a proportion if less than 1.
- `max.depth`: Maximum depth of the tree
- `R`: Number of permutations used to assess the significance of the split.
- `pval`: Maximum allowed p-value for a split
- `object`: An optional R object represented by the dissimilarity matrix. This object may be used by the print method or `disstree2dot` to render specific object type.
- `weight.permutation`: Weight permutation method: "diss" (attach weights to the dissimilarity matrix), "replicate" (replicate cases using weights), "rounded-replicate" (replicate case using rounded weights), "random-sampling" (random assignment of covariate profiles to the objects using distributions defined by the weights.)
- `squared`: Logical: Should the diss dissimilarities be squared?
- `first`: One of the variable in the right-hand side of the formula. This forces the first node of the tree to be split by this variable.
- `minSize`: Deprecated. Use `min.size` instead.
- `maxdepth`: Deprecated. Use `max.depth` instead.

**Details**

The procedure iteratively splits the data. At each step, the procedure selects the variable and split that explain the greatest part of the discrepancy, i.e., the split for which we get the highest pseudo R2. The significance of the retained split is assessed through a permutation test.

`seqtree` provides a simpler interface if you plan to use `disstree` for state sequence objects.
Value

An object of class `disstree` that contains the following components:

- **root**: A node object, root of the tree
- **info**: General information such as parameters used to build the tree
- **info$adjustment**: A `dissassoc` object providing global statistics for tree.
- **formula**: The formula used to generate the tree
- **data**: data used to build the tree
- **weights**: weights

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

References


See Also

- `seqtree` to generate a specific `disstree` objects for analyzing state sequences.
- `seqtreedisplay` to generate graphic representation of `seqtree` objects when analyzing state sequences.
- `disstreedisplay` is a more general interface to generate such representation for other type of objects.
- `dissvar` to compute discrepancy using dissimilarities and for a basic introduction to discrepancy analysis.
- `dissassoc` to test association between objects represented by their dissimilarities and a covariate.
- `dissmfacw` to perform multi-factor analysis of variance from pairwise dissimilarities.
- `disscenter` to compute the distance of each object to its group center from pairwise dissimilarities.
Examples

```r
data(mvad)

## Defining a state sequence object
mvad.seq <- seqdef(mvad[, 17:86])

## Computing dissimilarities (any dissimilarity measure can be used)
mvad.ham <- seqdist(mvad.seq, method="HAM")

## Grow the tree using using a low R value for illustration.
## For R=10, pval cannot be lower than 0.1
dt <- disstree(mvad.ham ~ male + Grammar + funemp + gcse5eq + fmpr + livboth,
               data=mvad, R = 10, pval = 0.1)
print(dt)

## Will only work if GraphViz is properly installed
## See seqtree for simpler way to plot a sequence tree.
## Not run:
disstreedisplay(dt, image.fun = seqdplot, image.data = mvad.seq,
                ## Additional parameters passed to seqdplot
                with.legend = FALSE, axes = FALSE, ylab = "")

## End(Not run)
## Second method, using a specific function
myplotfunction <- function(individuals, seqs, ...) {
  par(font.sub=2, mar=c(3,0,6,0), mgp=c(0,0,0))
  ## using mds to order sequence in seqiplot
  mds <- cmdscale(seqdist(seqs[individuals,], method="HAM"),k=1)
  seqiplot(seqs[individuals,], sortv=mds,...)
}

## If image.data is not set, index of individuals are sent to image.fun
## Not run:
disstreedisplay(dt, image.fun = myplotfunction, cex.main = 3,
                ## additional parameters passed to myplotfunction
                seqs = mvad.seq,
                ## additional parameters passed to seqiplot (through myplotfunction)
                with.legend = FALSE, axes = FALSE, idxs = 0, space = 0, ylab = "", border = NA)

## End(Not run)
```

---

**disstree2dot**  
*Graphical representation of a dissimilarity tree*

**Description**

Functions to generate a "dot" file and associated images files that can be used in GraphViz to get a graphical representation of the tree.
Usage

disstree2dot(tree, filename, digits = 3, image.fun = NULL, image.data = NULL, 
only.leaf = FALSE, device = "jpeg", image.format = "jpg", 
device.args = list(), use.title = TRUE, label.pos = "main", 
node.pos = "main", split.pos = "sub", cex.main = 1, 
legend.text = NULL, image.legend = NULL, image.quality = NULL, 
show.depth = FALSE, title.outer = FALSE, 
imagefunc, imagedata, imgLeafOnly, devicefunc, imageext, 
device.arg, label.loc, node.loc, split.loc, title.cex, legendtext, 
legendimage, qualityimage, showdepth, ...)

disstree2doptp(tree, filename, image.data = NULL, only.leaf = FALSE, 
image.fun = plot, cex.main = 3, with.quality = TRUE, 
cex.quality = cex.main, title.outer = FALSE, 
imagedata, imgLeafOnly, imagefunc, title.cex, withquality, 
quality.fontsize, ...)

seqtree2dot(tree, filename, seqdata = tree$info$object, only.leaf = FALSE, 
sortv = NULL, diss = NULL, cex.main = 3, with.legend = "auto", 
cex.legend = cex.main, with.quality = FALSE, 
cex.quality = cex.main, axes = FALSE, 
imgLeafOnly, dist.matrix, title.cex, 
withlegend, withquality, ...)

Arguments

tree The tree to be plotted.
filename A filename, without extension, that will be used to generate image and dot files.
digits Number of significant digits to plot.
image.fun A function to plot the individuals in a node, see details.
image.data a data.frame that will be passed to image.fun, see details.
only.leaf Logical: If TRUE, only terminal node will be plotted.
device A device function, "jpeg" by default.
image.format extension for image files.
device.args Argument passed to device.
use.title Logical: If TRUE, node information will be printed using title command, see details.
label.pos Location of the node label, see title for possible values.
node.pos Node content location, see title for possible values.
split.pos Split information location, see title for possible values.
cex.main cex applied to all calls to title (see use.title).
title.outer Logical: If TRUE, the title (see use.title) is printed in the outer margins.
legend.text An optional text appearing in a distinct node.
image.legend An optional image file appearing in a distinct node.
image.quality An optional image file appearing in a distinct node.
show.depth Logical. If TRUE, information about depth of the tree is added to the plot.
with.quality If TRUE, a node displaying fitting measures of the tree is added to the plot.
cex.quality Numeric. Size of the font of the fitting measures node.
seqdata A sequence object as defined by the seqdef function.
sortv The name of an optional variable used to sort the data before plotting, see seqplot.
diss The name of an optional dissimilarity matrix used to find representative sequences, seqrplot.
with.legend defines if and where the legend of the state colors is plotted. The default value "auto" sets the position of the legend automatically. Other possible value is "right". Obsolete value TRUE is equivalent to "auto".
cex.legend Size of the font of the legend.
axes If set to "all" (default value) x axes are drawn for each plot in the graphic. If set to "bottom" and group is used, axes are drawn only under the plots located at the bottom of the graphic area. If FALSE, no x axis is drawn.
imagefunc Deprecated. Use image.fun instead.
imagedata Deprecated. Use image.data instead.
imLeafOnly Deprecated. Use only.leaf instead.
devicefunc Deprecated. Use device instead.
imageext Deprecated. Use image.format instead.
device.arg Deprecated. Use device.args instead.
label.loc Deprecated. Use label.pos instead.
node.loc Deprecated. Use node.pos instead.
split.loc Deprecated. Use split.pos instead.
title.cex Deprecated. Use cex.main instead.
legendtext Deprecated. Use legend.text instead.
legendimage Deprecated. Use image.legend instead.
qualityimage Deprecated. Use image.quality instead.
showdepth Deprecated. Use show.depth instead.
withquality Deprecated. Use with.quality instead.
quality.fontsize Deprecated. Use cex.quality instead.
dist.matrix Deprecated. Use diss instead.
withlegend Deprecated. Use with.legend instead.
... other parameters that will be passed to image.fun or seqplot (for seqtrees2dot).
Details

These functions generate a "dot" file that can be used in GraphViz (http://www.graphviz.org). It also generates one image per node through a call to image.fun passing the selected lines of image.data if present or otherwise a list of indexes (of individuals belonging to a node). These functions are not intended to be used by end-user. See seqtreedisplay and disstreedisplay for a much simpler way to generate a graphical representation of a tree (seqtree or disstree).

seqtree2dot is a shortcut for sequences objects using the plot function seqplot. For each node, it calls seqplot with the corresponding subset of rows of seqdata and the provided seqplot's arguments. You should at least specify the type of the plot (e.g. type="d", see seqplot for more details).

If use.title is TRUE, image.fun should take care to leave enough space for the title.

disstree2dotp is a simplified interface of disstree2dot which automatically leaves enough space for the title and subtitles. These functions are intended to be generic.

Value

Nothing but generates a "dot" and several image files (one per node) in the current working directory (see getwd and setwd).

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

See Also

seqtree and seqtreedisplay, disstree and disstreedisplay.

disstreeleaf

| disstreeleaf | Terminal node membership |

Description

Return a factor with the terminal node membership of each case.

Usage

disstreeleaf(tree, label=FALSE)

Arguments

tree The tree, a disstree or DissTreeNode object.
label Logical. If TRUE, the returned leaf memberships are labelled with the corresponding classifications rules.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)
**dissvar**

**See Also**

`disstree` for examples

---

**dissvar**

*Disimilarity based discrepancy*

**Description**

Compute the discrepancy from the pairwise dissimilarities between objects. The discrepancy is a measure of dispersion of the set of objects.

**Usage**

\[ \text{dissvar}(\text{diss}, \text{weights}=\text{NULL}, \text{squared} = \text{FALSE}) \]

**Arguments**

- `diss`: A dissimilarity matrix or a `dist` object (see `dist`)
- `weights`: optional numerical vector containing weights.
- `squared`: Logical. If `TRUE` diss is squared.

**Details**

The discrepancy is an extension of the concept of variance to any kind of objects for which we can compute pairwise dissimilarities. The discrepancy $s^2$ is defined as:

\[
 s^2 = \frac{1}{2n^2} \sum_{i=1}^{n} \sum_{j=1}^{n} d_{ij}
\]

*Mathematical ground:* In the Euclidean case, the sum of squares can be expressed as:

\[
 SS = \sum_{i=1}^{n} (y_i - \bar{y})^2 = \frac{1}{2n} \sum_{i=1}^{n} \sum_{j=1}^{n} (y_i - y_j)^2
\]

The concept of discrepancy generalizes the equation by allowing to replace the $(y_i - y_j)^2$ term with any measure of dissimilarity $d_{ij}$.

**Value**

The discrepancy.

**Author(s)**

Matthias Studer (with Gilbert Ritschard for the help page)
References


See Also

dissassoc to test association between objects represented by their dissimilarities and a covariate.
disstree for an induction tree analyze of objects characterized by a dissimilarity matrix.
disscenter to compute the distance of each object to its group center from pairwise dissimilarities.
dissmfacw to perform multi-factor analysis of variance from pairwise dissimilarities.

Examples

```r
## Defining a state sequence object
data(mvad)
mvad.seq <- seqdef(mvad[, 17:86])

## Building dissimilarities (any dissimilarity measure can be used)
mvad.ham <- seqdist(mvad.seq, method="HAM")

## Pseudo variance of the sequences
print(dissvar(mvad.ham))
```

---

**Example data set with missing values and weights**

Description

Example data set used to demonstrate the handling of missing values and weights.

The state columns (variable) are named ‘P1’ to ‘P13’.

The alphabet is made of four possible states: A, B, C and D.

The data set contains also case weights (variable weights). The sum of the weights is 60.
Example data sets with weighted and unweighted sequence data

Usage

data(ex2)

Format

A data frame with 7 rows, 13 state variables, 1 weight variable.

Source

The brain of the TraMineR package team.

Description

Example data sets used to demonstrate the handling of weights. The 'ex2.weighted' data set contains 6 sequences with weights inflating to 100 sequences (sum of weights is 100). The second data frame 'ex2.unweighted' contains the corresponding 100 sequences. The sequences are, in both data frames, in the 'seq' column, and weights in the 'weight' column of 'ex2.weighted'. The alphabet is made of four possible states: A,B,C and D.

These data sets are mainly intended to test and illustrate the handling of weights in TraMineR's functions. Weighted results obtained with 'ex2.weighted' data set should be exactly the same as unweighted results obtained with the 'ex2.unweighted' data set.

Usage

data(ex2)

Format

The command data(ex2) generates two data frames:

- ex2.weighted: a data frame with 6 rows, 1 variable containing sequences as character strings, 1 weight variable.
- ex2.unweighted: a data frame with 100 rows, 1 variable containing sequences as character strings.

Source

The brain of the TraMineR package team.

Examples

data(ex2)

ex2w.seq <- seqdef(ex2.weighted, 1, weights=ex2.weighted$weight)
ex2u.seq <- seqdef(ex2.unweighted)
Example data set: sequences of family formation

Description

This data set contains 5 sequences of family formation histories, used by Elzinga (2008) to introduce several metrics for computing distances between sequences. These sequences don’t contain information about the duration spent in each state, they contain only distinct successive states.

Usage

data(famform)

Format

A data frame with 5 rows and 1 variable.

Details

The sequences are in ‘STS’ format and stored in character strings with states separated with ‘-’. This data set is used in TraMineR’s manual to crosscheck some results with those presented by Elzinga.

Source

Elzinga (2008)

References


Test if is a proper state sequence (stslist) object

Description

The function tests whether x is of class stslist and if its weights attribute has the expected length and names.

Usage

is.stslist(x)
Arguments

x          object to be tested.

Value

Logical: result of the test.

Author(s)

Gilbert Ritschard

See Also

seqdef

Examples

## Creating a sequence object with the columns 13 to 24
## in the 'actcal' example data set
data(biofam)
biofam <- biofam[sample(nrow(biofam),300),]
biofam.lab <- c("Parent", "Left", "Married", "Left+Marr",
               "Child", "Left+Child", "Left+Marr+Child", "Divorced")
biofam.seq <- seqdef(biofam[,10:25], weights=biofam$wp00tbgs)

is.stslist(biofam.seq) #TRUE

attr(biofam.seq, "weights") <- NULL
is.stslist(biofam.seq) #TRUE

attr(biofam.seq, "weights") <- rep(1, nrow(biofam.seq))
is.stslist(biofam.seq) #FALSE

w <- rep(1, nrow(biofam.seq))
names(w) <- rownames(biofam.seq)
attr(biofam.seq, "weights") <- w
is.stslist(biofam.seq) #TRUE

mvad

Example data set: Transition from school to work

Description

The data comes from a study by McVicar and Anyadike-Danes on transition from school to work. The data consist of static background characteristics and a time series sequence of 72 monthly labour market activities for each of 712 individuals in a cohort survey. The individuals were followed up from July 1993 to June 1999. The monthly states are recorded in columns 15 (Jul. 93) to 86 (Jun. 99).
States are:

- employment (EM)
- FE (further education)
- HE (higher education)
- joblessness (JL)
- school (SC)
- training (TR)

The data set contains also ids (id) and sample weights (weight) as well as the following binary covariates:

- male
- catholic
- Belfast, N.Eastern, Southern, S.Eastern, Western (location of school, one of five Education and Library Board areas in Northern Ireland)
- Grammar (type of secondary education, 1=grammar school)
- funemp (father’s employment status at time of survey, 1=father unemployed)
- gcse5eq (qualifications gained by the end of compulsory education, 1=5+ GCSEs at grades A-C, or equivalent)
- fmpr (SOC code of father’s current or most recent job, 1=SOC1 (professional, managerial or related))
- livboth (living arrangements at time of first sweep of survey (June 1995), 1=living with both parents)

Usage

```
data(mvad)
```

Format

A data frame containing 712 rows, 72 state variables, 1 id variable and 13 covariates.

Source

McVicar and Anyadike-Danes (2002)

References

Description

Plot method for the sliding values returned by `seqdiff`. Plots a statistic (the Pseudo R2 by default) along the position axis.

Usage

```r
## S3 method for class 'seqdiff'
plot(x, stat = "Pseudo R2", type = "l", ylab = stat,
     xlab = "", legend.pos = "top", ylim = NULL, xaxis = TRUE, col = NULL,
     xtstep = NULL, tick.last = NULL, legendposition, xaxt, ...)
```

Arguments

- `x`: an object produced by `seqdiff`
- `stat`: character. Name of the statistic to be plotted. Can be any of the statistics returned by `seqdiff` or "discrepancy". See details.
- `type`: the line type, see `lines`
- `ylab`: character: y-axis label.
- `xlab`: character: x-axis label.
- `legend.pos`: character: position of the line legend, see `legend`
- `ylim`: numeric: if not NULL, range of the y-axis.
- `xaxis`: logical: if TRUE an x-axis is plotted.
- `col`: list of colors to use for each line.
- `xtstep`: integer: optional step between tick-marks and labels on the x-axis. If unspecified, the `xtstep` attribute of the sequence object `x` is used. (see `seqdef`)
- `tick.last`: logical. Should a tick mark be enforced at the last position on the x-axis? If unspecified, the `tick.last` attribute of the `x` object is used.
- `legendposition`: Deprecated. Use `legend.pos` instead.
- `xaxt`: Deprecated. Use `xaxis` instead.
- `...`: Additional parameters passed to `lines`

Details

The function plots the sliding values of the requested statistic.

You can plot the evolution of two statistics by providing for instance `stat=c("Pseudo R2", "Levene")`. Use `stat="discrepancy"` to plot the within-discrepancies.

For "discrepancy", a separate line is drawn for the whole set of sequences and for each group. Those two values cannot be paired with another statistic.
Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

See Also

seqdiff

plot.stslist

Plot method for state sequence objects

Description

This is the plot method for state sequence objects of class stslist created by the seqdef function. It produces a sequence index plot.

Usage

## S3 method for class 'stslist'
plot(x, idxs = NULL, weighted = TRUE, sortv = NULL, 
     cpal = NULL, missing.color = NULL, ylab = NULL, 
     yaxis = TRUE, xaxis = TRUE, ytlab = NULL, ylas = 0, 
     xlab = NULL, xtstep = NULL, tick.last = NULL, cex.axis = 1, 
     tlim, cex.plot, ...)

Arguments

x

A state sequence object created with the seqdef function.

idxs

Indexes of the sequences to be plotted (default value is 1:10), for instance 20:50 to plot sequences 20 to 50, c(2, 8, 12, 25) to plot sequences 2, 8, 12 and 25 in seqdata. If set to 0, all sequences in seqdata are plotted.

weighted

Logical: Should the bar representing each sequence be proportional to its weight? Ignored when no weights are assigned to sequences (see seqdef.)

sortv

A sorting variable or a sort method (one of "from.start" or "from.end"). See details.

cpal

Color palette for the states. A vector of colors of length equal to the number of states in the alphabet. If NULL (default), the cpal attribute of the seqdata sequence object is used (see seqdef).

missing.color

Color for representing missing values inside the sequences. If NULL (default) the color is taken from the "missing.color" attribute of the x sequence object.

ylab

String. An optional label for the y axis. If set to NA, no label is drawn.

yaxis

Logical. Should the y axis be plotted? When set as TRUE, sequence indexes are displayed.

xaxis

Logical. Should the x (time) axis be plotted? Default is TRUE.
The labels of the plotted sequences to display on the y axis. Default is the indexes of the sequences as defined by the `idxs` argument. Can be set to "id" for displaying the row names (id) of the sequences instead of their indexes; row names can be assigned to the sequence object with the id argument of the `seqdef` function or afterwards with `rownames`. Otherwise `ytlab` can be set to a vector of length equal to the number of sequences to be plotted.

Sets the orientation of the sequence labels appearing on the y axis. Accepted values are the same as for the `las` standard option:
0: always parallel to the axis (default),
1: always horizontal,
2: always perpendicular to the axis,
3: always vertical.

Optional labels for the x axis ticks labels. If unspecified, the column names of the seqdata sequence object are used (see `seqdef`).

Optional interval at which the tick-marks and labels of the x-axis are displayed. For example, with `xtstep=3` a tick-mark is drawn at position 1, 4, 7, etc... The display of the corresponding labels depends on the available space and is dealt with automatically. If unspecified, the `xtstep` attribute of the x object is used.

Logical. Should a tick mark be enforced at the last position on the x-axis? If unspecified, the `tick.last` attribute of the x object is used.

Axis annotation magnification. See `par`.

Deprecated. Use `idxs` instead.

Deprecated. Use `cex.axis` instead.

Arguments to be passed to the plot function or other graphical parameters.

Details

This is the default plot method for state sequence objects (produced by the `seqdef` function), i.e., for objects of class `stslist`. It produces a sequence index plot, where individual sequences are rendered with stacked bars depicting the states over time.

This method is called by the generic `seqplot` function (if `type="i"`). The latter produces more sophisticated plots, allowing grouping and automatic display of the state color legend. The `seqiplot` function is a shortcut for calling `seqplot` with `type="i"`.

When a `sortv` variable is provided to `seqiplot` or `seqIplot`, its values define the order in which the sequences are plotted. With `sortv = "from.start"`, sequence are sorted by the elements of the alphabet at the successive positions starting from the beginning of the sequences. The "from.end" method proceeds similarly, but backward from the last position.

The interest of sequence index plots has for instance been stressed by Scherer (2001) and Brzinsky-Fay et al. (2006). Notice that such index plots for thousands of sequences result in very heavy graphic files if they are stored in PDF or POSTSCRIPT format. To reduce the size, we suggest saving the figures in bitmap format by using for instance `png` instead of `postscript` or `pdf`.

Author(s)

Gilbert Ritschard
plot.stslist.freq

Plot method for sequence frequency tables

Description

Plot method for output produced by the seqtab function, i.e objects of class stslist.freq.

Usage

## S3 method for class 'stslist.freq'
plot(x, cpal = NULL, missing.color = NULL, pbarw = TRUE,
     ylab = NULL, yaxis = TRUE, xaxis = TRUE,
     xtlab = NULL, xtstep = NULL, tick.last = NULL, cex.axis = 1,
     cex.plot, ...)

Arguments

x an object of class stslist.freq as produced by the seqtab function.
plot.stslist.freq

alternative color palette to be used for the states. If user specified, a vector of colors with number of elements equal to the number of states in the alphabet. By default, the ‘cpal’ attribute of the x object is used.

missing.color alternative color for representing missing values inside the sequences. By default, this color is taken from the missing.color attribute of the x object.

pbarw if pbarw=TRUE (default), the width of the bars are proportional to the sequence frequency in the dataset.

ylab an optional label for the y axis. If set to NA, no label is drawn.

yaxis if TRUE or "cum", the y axis is plotted with a label showing the cumulated percentage frequency of the displayed sequences. If "pct", the percentage value for each sequence is displayed.

xaxis if TRUE (default) the x-axis is plotted.

xtlab optional labels for the ticks of the x-axis. If unspecified, the names attribute of the x object is used.

xtstep optional interval at which the tick-marks and labels of the x-axis are displayed. For example, with xtstep=3 a tick-mark is drawn at position 1, 4, 7, etc... The display of the corresponding labels depends on the available space and is dealt with automatically. If unspecified, the xtstep attribute of the x object is used.

tick.last Logical. Should a tick mark be enforced at the last position on the x-axis? If unspecified, the tick.last attribute of the x object is used.

cex.axis Axis annotation magnification. See par.

... further graphical parameters. For example border=NA to remove the bars borders, space=0 to remove space between sequences. For more details about the graphical parameter arguments, see barplot and par.

cex.plot Deprecated. Use cex.axis instead.

Details

This is the plot method for the output produced by the seqtab function, i.e. objects of class stslist.freq. It produces a plot showing the sequences sorted bottom up according to their frequency in the data set.

This method is called by the generic seqplot function (if type="f") that produces more sophisticated plots, allowing grouping and automatic display of the state color legend. The seqfplot function is a shortcut for calling seqplot with type="f".

Author(s)

Alexis Gabadinho

Examples

## Loading the 'actcal' example data set
data(actcal)

## Defining a sequence object with data in columns 13 to 24
## (activity status from january to december 2000)
actcal.lab <- c("> 37 hours", "19-36 hours", "1-18 hours", "no work")
actcal.seq <- seqdef(actcal, 13:24, labels=actcal.lab)

## 10 most frequent sequences in the data
actcal.freq <- seqtab(actcal.seq)

## Plotting the object
plot(actcal.freq, main="Sequence frequencies - actcal data set")

## Plotting all the distinct sequences without borders
## and space between sequences
actcal.freq2 <- seqtab(actcal.seq, idxs=0)
plot(actcal.freq2, main="Sequence frequencies - actcal data set",
     border=NA, space=0)

---

### plot.stslist.meant

**Plot method for objects produced by the seqmeant function**

**Description**

This is the plot method for objects of class `stslist.meant` produced by the `seqmeant` function.

**Usage**

```
## S3 method for class 'stslist.meant'
plot(x, cpal = NULL, ylab = NULL, yaxis = TRUE,
     xaxis = TRUE, cex.axis = 1, ylim = NULL, cex.plot, ...)
```

**Arguments**

- `x`: an object of class `stslist.meant` as produced by the `seqmeant` function.
- `cpal`: alternative color palette to use for the states. If user specified, a vector of colors with number of elements equal to the number of states in the alphabet. By default, the `cpal` attribute of the `seqdata` sequence object is used (see `seqdef`).
- `ylab`: an optional label for the y axis. If set to NA, no label is drawn.
- `yaxis`: controls whether the y axis is plotted. Default is TRUE.
- `xaxis`: if TRUE (default) the xaxis is plotted.
- `cex.axis`: Axis annotation magnification. See `par`.
- `ylim`: an optional vector setting the limits for the y axis. If NULL (default), limits are set to (0, max. sequence length).
- `cex.plot`: Deprecated. Use `cex.axis` instead.
- `...`: further graphical parameters. For more details about the graphical parameter arguments, see `barplot` and `par`.
Details

This is the plot method for the output produced by the `seqmeant` function, i.e., objects of class `stslist.meant`. It produces a plot showing the mean times spent in each state of the alphabet.

When the "se" attribute of `x` is TRUE, i.e., when `x` contains also the standard errors of the mean times, error bars are automatically displayed on the plot. See the `serr` argument of `seqmeant`.

This method is called by the generic `seqplot` function (if `type="mt"`) that produces more sophisticated plots, allowing grouping and automatic display of the states legend. The `seqmtplot` function is a shortcut for calling `seqplot` with `type="mt"`.

Examples

```r
## Loading the mvad data set and creating a sequence object
data(mvad)
mvad.labels <- c("employment", "further education", "higher education", "joblessness", "school", "training")
mvad.scodes <- c("EM", "FE", "HE", "JL", "SC", "TR")
mvad.seq <- seqdef(mvad, 15:86, states=mvad.scodes, labels=mvad.labels)

## Computing the mean times
mvad.meant <- seqmeant(mvad.seq)

## Plotting
plot(mvad.meant, main="Mean durations in each state of the alphabet")

## Changing the y axis limits
plot(mvad.meant, main="Mean durations in each state of the alphabet", ylim=c(0,40))

## Displaying error bars
mvad.meant.e <- seqmeant(mvad.seq, serr=TRUE)
plot(mvad.meant.e, main="Mean durations in each state of the alphabet", ylim=c(0,40))
```

Description

Plot method for output produced by the seqmodst function, i.e objects of class `stslist.modst`.

Usage

```r
## S3 method for class 'stslist.modst'
plot(x, cpal = NULL, ylab = NULL, xaxis = TRUE, xtlab = NULL, xtstep = NULL, tick.last = NULL, cex.axis = 1, cex.plot, ...)
```
Arguments

- **x**: an object of class `stslist.modst` as produced by the `seqmodst` function.
- **cpal**: alternative color palette to use for the states. If user specified, a vector of colors with number of elements equal to the number of states in the alphabet. By default, the 'cpal' attribute of the `x` object is used.
- **ylab**: an optional label for the y axis. If set to NA, no label is drawn.
- **yaxis**: if TRUE (default) the y axis is plotted.
- **xaxis**: if TRUE (default) the x axis is plotted.
- **xtlab**: optional labels for the x axis ticks. If unspecified, the names attribute of the `x` object is used.
- **xtstep**: optional interval at which the tick-marks and labels of the x-axis are displayed. For example, with `xtstep=3` a tick-mark is drawn at position 1, 4, 7, etc... The display of the corresponding labels depends on the available space and is dealt with automatically. If unspecified, the `xtstep` attribute of the `x` object is used.
- **tick.last**: logical. Should a tick mark be enforced at the last position on the x-axis? If unspecified, the `tick.last` attribute of the `x` object is used.
- **cex.axis**: Axis annotation magnification. See `par`.
- **cex.plot**: Deprecated. Use `cex.axis` instead.
- **...**: further graphical parameters. For more details about the graphical parameter arguments, see `barplot` and `par`.

Details

This is the plot method for the output produced by the `seqmodst` function, i.e. objects of class `stslist.modst`. It produces a plot showing the sequence of modal states with bar width proportional to the state frequencies.

This method is called by the generic `seqplot` function (if `type="ms"`) that produces more sophisticated plots, allowing grouping and automatic display of the states legend. The `seqmsplot` function is a shortcut for calling `seqplot` with `type="ms"`.

Examples

```r
## Defining a sequence object with the data in columns 10 to 25
## (family status from age 15 to 30) in the biofam data set
data(biofam)
biofam.seq <- seqdef(biofam, 10:25, labels=biofam.lab)

## Modal state sequence
biofam.modst <- seqmodst(biofam.seq)
plot(biofam.modst)
```
plot.stslist.rep  

Plot method for representative sequence sets

Description

This is the plot method for output produced by the seqrep function, i.e., for objects of class stslist.rep. It produces a representative sequence plot.

Usage

## S3 method for class 'stslist.rep'
plot(x, cpal = NULL, missing.color = NULL, pbarw = TRUE, dmax = NULL, stats = TRUE, ylab = NULL, xaxis = TRUE, xtlab = NULL, xtstep = NULL, tick.last = NULL, cex.with.axis = 1, cex.plot, ...)

Arguments

- **x**: an object of class stslist.rep as produced by the seqrep function.
- **cpal**: alternative color palette to use for the states. If user specified, a vector of colors with number of elements equal to the number of states in the alphabet. By default, the 'cpal' attribute of the x object is used.
- **missing.color**: alternative color for representing missing values inside the sequences. By default, this color is taken from the "missing.color" attribute of the sequence object being plotted.
- **pbarw**: when TRUE, the bar heights are set proportional to the number of represented sequences.
- **dmax**: maximal theoretical distance, used for the x axis limits.
- **stats**: if TRUE (default), mean discrepancy in each subset defined by all sequences attributed to one representative sequence and the mean distance to this representative sequence are displayed.
- **ylab**: an optional label for the y axis. If set to NA, no label is drawn.
- **xaxis**: controls whether a x axis is plotted.
- **xtlab**: optional labels for the x axis ticks labels. If unspecified, the column names of the object being plotted.
- **xtstep**: optional interval at which the tick-marks and labels of the x-axis are displayed. For example, with xtstep=3 a tick-mark is drawn at position 1, 4, 7, etc... The display of the corresponding labels depends on the available space and is dealt with automatically. If unspecified, the xtstep attribute of the x object is used.
- **tick.last**: Logical. Should a tick mark be enforced at the last position on the x-axis? If unspecified, the tick.last attribute of the x object is used.
- **cex.with.axis**: Axis annotation and plotting text and symbols magnification. See par.
- **cex.plot**: Deprecated. Use cex.with.axis instead.
- **...**: further graphical parameters. For more details about the graphical parameter arguments, see barplot and par.
Details

This is the plot method for the output produced by the `seqrep` function, i.e. objects of class `stslist.rep`. It produces a plot where the representative sequences are displayed as horizontal bars with width proportional to the number of sequences assigned to them. Sequences are plotted bottom-up according to their representativeness score.

Above the plot, two parallel series of symbols associated to each representative are displayed horizontally on a scale ranging from 0 to the maximal theoretical distance $D_{\text{max}}$. The location of the symbol associated to the representative $r_i$ indicates on axis $A$ the (pseudo) variance ($V_i$) within the subset of sequences assigned to $r_i$ and on the axis $B$ the mean distance $MD_i$ to the representative.

This method is called by the generic `seqplot` function (if type="r") that produces more sophisticated plots with group splits and automatic display of the color legend. The `seqrplot` function is a shortcut for calling `seqplot` with type="r".

Author(s)

Alexis Gabadinho (with Gilbert Ritschar for the help page)

Examples

```r
## Loading the mvad data set and creating a sequence object
data(mvad)
mvad.labels <- c("employment", "further education", "higher education", "joblessness", "school", "training")
mvad.scodes <- c("EM","FE","HE","JL","SC","TR")

## First 36 months trajectories
mvad.seq <- seqdef(mvad, 15:50, states=mvad.scodes, labels=mvad.labels)

## Computing Hamming distances
##
dist.ham <- seqdist(mvad.seq, method="HAM")

## Extracting a representative set using the sequence frequency
## as a representativeness criterion
mvad.rep <- seqrep(mvad.seq, diss=dist.ham)

## Plotting the representative set
plot(mvad.rep)
```

---

**plot.stslist.statd**  
*Plot method for objects produced by the seqstatd function*

Description

This is the plot method for output produced by the `seqstatd` function, i.e for objects of class `stslist.statd`. 

---
## S3 method for class 'stslist.statd'
plot(x, type = "d", cpal = NULL, ylab = NULL, 
     yaxis = TRUE, xaxis = TRUE, xtlab = NULL, xtstep = NULL, tick.last = NULL, 
     cex.axis = 1, space = 0, xlab = NULL, cex.plot, ...)

### Arguments

- **x**: an object of class `stslist.statd` as produced by the `seqstatd` function.
- **type**: if "d" (default), a state distribution plot is produced. If "Ht" an entropy index plot is produced.
- **cpal**: alternative color palette to be used for the states. If user specified, a vector of colors with number of elements equal to the number of states in the alphabet. By default, the ‘cpal’ attribute of the x object is used.
- **ylab**: an optional label for the y axis. If set to NA, no label is drawn.
- **yaxis**: if TRUE or "cum", the y axis is plotted with a label showing the cumulated percentage frequency of the displayed sequences. If "pct", the percentage value for each sequence is displayed.
- **xaxis**: if TRUE (default) the x-axis is plotted.
- **xtlab**: optional labels for the ticks of the x-axis. If unspecified, the names attribute of the input x object is used.
- **xtstep**: optional interval at which the tick-marks and labels of the x-axis are displayed. For example, with xtstep=3 a tick-mark is drawn at position 1, 4, 7, etc... The display of the corresponding labels depends on the available space and is dealt with automatically. If unspecified, the xtstep attribute of the x object is used.
- **tick.last**: Logical. Should a tick mark be enforced at the last position on the x-axis? If unspecified, the tick.last attribute of the x object is used.
- **cex.axis**: Axis annotation magnification. See `par`.
- **space**: the space between the stacked bars. Default is 0, i.e. no space.
- **xlab**: Optional title for the x axis. See `title`.
- **cex.plot**: Deprecated. Use cex.axis instead.
- **...**: further graphical parameters such as border=NA to remove the borders of the bars. For more details about the graphical parameter arguments, see `barplot` and `par`.

### Details

This is the plot method for the output produced by the `seqstatd` function, i.e. for objects of class `stslist.statd`. If type="d" it produces a state distribution plot presenting the sequence of the transversal state frequencies at each successive (time) position, as computed by the `seqstatd` function. With type="Ht", the series of entropies of the transversal state distributions is plotted.

This method is called by the generic `seqplot` function (if type="d" or type="Ht") that produces more sophisticated plots, allowing grouping and automatic display of the state color legend. The `seqdplot` and `seqHtplot` functions are shortcuts for calling `seqplot` with type="d" or type="Ht" respectively.
Value

The plotted values, i.e. for type="d" the cross-sectional distributions, and for type="Ht" the cross-sectional entropies.

Examples

```r
## Defining a sequence object with the data in columns 10 to 25
## (family status from age 15 to 30) in the biofam data set
data(biofam)
biofam.seq <- seqdef(biofam, 10:25, labels=biofam.lab)

## State distribution
biofam.statd <- seqstatd(biofam.seq)

## State distribution plot (default type="d" option)
plot(biofam.statd)

## Entropy index plot
plot(biofam.statd, type="Ht")
```

plot.subseqelist

Plot frequencies of subsequences

Description

Plot frequencies of subsequences.

Usage

```r
## S3 method for class 'subseqelist'
plot(x, freq=NULL,cex=1,...)
```

Arguments

- `x` The subsequences to plot (a subseqelist object)
- `freq` The frequencies to plot, support if NULL
- `cex` Plotting text and symbols magnification. See `par`.
- `...` arguments passed to `barplot`

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)
See Also  
\textit{seqefsub}

Examples

```r
## loading data
data(actcal.tse)

## creating sequences
actcal.eseq <- seqecreate(actcal.tse)

## Looking for frequent subsequences
fsubseq <- seqefsub(actcal.eseq,pmin.support=0.01)

## Frequence of first ten subsequences
plot(fsubseq[1:10], cex=2)
plot(fsubseq[1:10])
```

---

\textbf{plot.subseqelistchisq}  \textit{Plot discriminant subsequences}

Description

Plot the result of \textit{seqecmpgroup}

Usage

```r
## S3 method for class 'subseqelistchisq'
plot(x, ylim = "uniform", rows = NA, cols = NA,
     resid.levels = c(0.05,0.01),
     cpal = brewer.pal(1 + 2 * length(resid.levels), "RdBu"), vlegend = NULL,
     cex.legend = 1, ptype = "freq", legend.title = NULL, residlevels, legendcol,
     legend.cex, ...)  
```

Arguments

- \texttt{x}  The subsequences to plot (a subseqelist object).
- \texttt{ylim} if "uniform" all axes have same limits.
- \texttt{rows} Number of graphic rows.
- \texttt{cols} Number of graphic columns.
- \texttt{resid.levels} Significance levels used to colorize the Pearson residual.
- \texttt{cpal} Color palette used to color the results.
- \texttt{vlegend} When \texttt{TRUE} the legend is printed vertically, when \texttt{FALSE} it is printed horizontally.
  If \texttt{NULL} (default) the best position will be chosen.
- \texttt{cex.legend} Scale parameters for text legend.
print.stslist

Description

This is the print method for state sequence objects of class stslist created by the seqdef function.

Usage

```r
## S3 method for class 'stslist'
print(x, format='STS', extended=FALSE, ...)
```

Arguments

- `x` A state sequence (stslist) object.
- `format` String: print format. One of "STS" (default) or "SPS".
- `extended` Logical: should the output be printed in extended matrix form?
- `...` Additional print arguments.

Author(s)

Gilbert Ritschard

See Also

`seqdef`, `plot.stslist`
Examples

## Defining a sequence object with the data in columns 10 to 25
## (family status from age 15 to 30) in the biofam data set
data(biofam)
biofam <- biofam[500:600,,] ## using a subsample only
biofam.lab <- c("Parent", "Left", "Married", "Left+Marr", 
                 "Child", "Left+Child", "Left+Marr+Child", "Divorced")
biofam.seq <- seqdef(biofam, 10:25, states=biofam.shortlab, 
                     labels=biofam.lab)

## Print of first 5 sequences
print(biofam.seq[1:5,])
print(biofam.seq[1:5,,] extended=TRUE)
print(biofam.seq[1:5,,] format="SPS")
print(biofam.seq[1:5,,] format="SPS", SPS.out = list(xfix = "", sdsep = "/"))

read.tda.mdist  

Read a distance matrix produced by TDA.

Description

This function reads a distance matrix produced by TDA into an R object. When computing OM
distances in TDA, the output is a 'half' matrix stored in a text file as a vector.

Usage

read.tda.mdist(file)

Arguments

file the path to the file containing TDA output.

Value

a R matrix containing the distances.
Description

The function provides details about a pairwise alignment.

Usage

seqalign(seqdata, indices, indel=1, sm, with.missing = FALSE)

## S3 method for class 'seqalign'
plot(x, cpal = NULL, missing.color = NULL, ylab = NULL,
     yaxis = TRUE, xaxis = TRUE, ytlab = NULL, ylas = 0, xtlab = NULL,
     cex.axis = 1, cex.plot, ...)

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

Arguments

seqdata a state sequence object defined with the seqdef function.
indices a vector of length 2 giving the indexes of the two sequences
indel indel cost (see seqdist)
sm matrix of substitution costs or a method for computing the costs (see seqdist)
with.missing logical: Should the missing state be considered as an element of the alphabet?
x an object of class seqalign
cpal color palette
missing.color color for missing elements
ylab y label
yaxis yaxis
xaxis xaxis
ytlab ytlab
ylas ylas
xtlab xtlab
cex.axis Axis annotation magnification. See par.
digits number of digits for printed output
cex.plot Deprecated. Use cex.axis instead.
... additional arguments passed to other functions

Details

There are print and plot methods for seqalign objects.
Value

Object of class seqalign

Author(s)

Alexis Gabadinho (plot.seqalign) and Matthias Studer (seqalign) (with Gilbert Ritschard for the help page)

See Also

seqdist

Examples

data(biofam)
biofam.seq <- seqdef(biofam, 10:25)
costs <- seqsubm(biofam.seq, method="TRATE")
sa <- seqalign(biofam.seq, 1:2, indel=1, sm=costs)
print(sa)
plot(sa)
sa <- seqalign(biofam.seq, c(1,5), indel=0.5, sm=costs)
print(sa)
plot(sa)
Examples

```r
data(mvad)
mvad.shortlab <- c("EM", "FE", "HE", "JL", "SC", "TR")
mvad.seq <- seqdef(mvad, states=mvad.shortlab, 15:86)

## Comparing sequences 1 and 2 in mvad.seq
seqcomp(mvad.seq[1,], mvad.seq[2,])

## Comparing sequences 176 and 211 in mvad.seq
seqcomp(mvad.seq[176,], mvad.seq[211,])
```

---

**seqconc**

*Concatenate vectors of states or events into a character string*

**Description**

Concatenate vectors of states or events into a character string. In the string, each state is separated by 'sep'. The void elements in the input sequences are eliminated.

**Usage**

```r
seqconc(data, var=NULL, sep="-", vname="Sequence", void=NA)
```

**Arguments**

- `data` A dataframe or matrix containing sequence data.
- `var` List of the columns containing the sequences. Default is `NULL` in which case all columns are retained. Whether the sequences are in the compressed (character strings) or extended format is automatically detected by counting the number of columns.
- `sep` Character used as separator. By default, "-".
- `vname` an optional name for the variable containing the sequences. By default, "Sequence".
- `void` the code used for void elements appearing in the sequences (see Gabadinho et al. (2009) for more details on missing values and void elements in sequences). Default is NA.

**Value**

A vector of character strings, one for each row in the input data.

**Author(s)**

Alexis Gabadinho
seqcost

References


See Also

`seqdecomp`.

Examples

```r
data(actcal)
actcal.string <- seqconc(actcal, 13:24)
head(actcal.string)
```

Description

The function `seqcost` proposes different ways to generate substitution costs (supposed to reflect state dissimilarities) and possibly indel costs. Proposed methods are: "CONSTANT" (same cost for all substitutions), "TRATE" (derived from the observed transition rates), "FUTURE" (Chi-squared distance between conditional state distributions lag positions ahead), "FEATURES" (Gower distance between state features), "INDELS" (based on estimated indel costs). The substitution-cost matrix is intended to serve as `sm` argument in the `seqdist` function that computes distances between sequences. `seqsubm` is an alias that returns only the substitution cost matrix, i.e., no indel.

Usage

```r
seqcost(seqdata, method, cval = NULL, with.missing = FALSE, miss.cost = NULL, time.varying = FALSE, weighted = TRUE, transition = "both", lag = 1, miss.cost.fixed = NULL, state.features = NULL, feature.weights = NULL, feature.type = list(), proximities = FALSE)
```

```r
seqsubm(...)
```

Arguments

- `seqdata` A sequence object as returned by the `seqdef` function.
- `method` String. How to generate the costs. One of "CONSTANT" (same cost for all substitutions), "TRATE" (derived from the observed transition rates), "FUTURE" (Chi-squared distance between conditional state distributions lag positions ahead), "FEATURES" (Gower distance between state features), "INDELS" (based on estimated indel costs).
seqcost

**cval**  
Scalar. For method "CONSTANT", the single substitution cost.  
For method "TRATE", a base value from which transition probabilities are subtracted.  
If NULL, cval=2 is used, unless transition is "both" and time.varying is TRUE, in which case cval=4.

**with.missing**  
Logical. Should an additional entry be added in the matrix for the missing states? If TRUE, the ‘missing’ state is also added to the alphabet. Set as TRUE if you want to use the costs for distances between sequences containing non deleted (non void) missing values. Forced as FALSE when there are no non-void missing values in seqdata. See Gabadinho et al. (2010) for more details on the options for handling missing values when creating the state sequence object with seqdef.

**miss.cost**  
Scalar or vector. Cost for substituting the missing state. Default is cval.

**miss.cost.fixed**  
Logical. Should the substitution cost for missing be set as the miss.cost value. When NULL (default) it will be set as FALSE when method = "INDELS" or "INDELSLOG", and TRUE otherwise.

**time.varying**  
Logical. If TRUE return an array with a distinct matrix for each time unit. Time is the third dimension (subscript) of the returned array.

**weighted**  
Logical. Should weights in seqdata be used when applicable?

**transition**  
String. Only used if method="TRATE" and time.varying=TRUE. On which transition are rates based? Should be one of "previous" (from previous state), "next" (to next state) or "both".

**lag**  
Integer. For methods TRATE and FUTURE only. Time ahead to which transition rates are computed (default is lag=1).

**state.features**  
Data frame with features values for each state.

**feature.weights**  
Vector of feature weights with length equal to the number of columns of state.features.

**feature.type**  
List of feature types. See daisy for details.

**proximities**  
Logical: should state proximities be returned instead of substitution costs?

...  
Arguments passed to seqcost

**Details**

The substitution-cost matrix has dimension \( nS \times nS \), where \( nS \) is the number of states in the alphabet of the sequence object. The element \((i, j)\) of the matrix is the cost of substituting state \( i \) with state \( j \). It defines the dissimilarity between the states \( i \) and \( j \).

With method CONSTANT, the substitution costs are all set equal to the cval value, the default value being 2.

With method TRATE (transition rates), the transition probabilities between all pairs of states is first computed (using the seqtrate function). Then, the substitution cost between states \( i \) and \( j \) is obtained with the formula

\[
SC(i, j) = cval - P(i|j) - P(j|i)
\]
where $P(i|j)$ is the probability of transition from state $j$ to $i$ Lag positions ahead.

With method FUTURE, the cost between $i$ and $j$ is the Chi-squared distance between the vector ($d(alphabet|i)$) of probabilities of transition from states $i$ and $j$ to all the states in the alphabet Lag positions ahead:

$$SC(i, j) = \text{ChiDist}(d(alphabet|i), d(alphabet|j))$$

With method FEATURES, each state is characterized by the variables state.features, and the cost between $i$ and $j$ is computed as the Gower distance between their vectors of state.features values.

With methods INDELS and INDELSLOG, values of indels are first derived from the state relative frequencies $f_i$. For INDELS, $\text{indel}_i = 1/f_i$ is used, and for INDELSLOG, $\text{indel}_i = \log[2/(1 + f_i)]$. Substitution costs are then set as $SC(i, j) = \text{indel}_i + \text{indel}_j$.

For all methods but INDELS and INDELSLOG, the indel is set as $\max(sm)/2$ when time_varying=FALSE and as 1 otherwise.

Value

For seqcost, a list of two elements, indel and sm or prox:

- **indel**  The indel cost. Either a scalar or a vector of size $ns$.
- **sm**  The substitution-cost matrix when proximities = FALSE (default).
- **prox**  The state proximity matrix when proximities = TRUE.

$s_m$ and prox are a matrix of size $ns \times ns$, where $ns$ is the number of states in the alphabet of the sequence object.

For seqsubm, only one element, the matrix $sm$.

Author(s)

Gilbert Ritschard and Matthias Studer (and Alexis Gabadinho for first version of seqsubm)

References


See Also

seqtrate, seqdef, seqdist.

Examples

## Defining a sequence object with columns 10 to 25
## of a subset of the 'biofam' example data set.
data(biofam)
biofam.seq <- seqdef(biofam[501:600,10:25])

## Indel and substitution costs based on log of inverse state frequencies
lifcost <- seqcost(biofam.seq, method="INDELSLOG")
## Here lifcost$indel is a vector
biofam.om <- seqdist(biofam.seq, method="OM", indel=lifcost$indel, sm=lifcost$sm)

## Optimal matching using transition rates based substitution-cost matrix
## and the associated indel cost
## Here trcost$indel is a scalar
trcost <- seqcost(biofam.seq, method="TRATE")
biofam.om <- seqdist(biofam.seq, method="OM", indel=trcost$indel, sm=trcost$sm)

## Using costs based on FUTURE with a forward lag of 4
fucost <- seqcost(biofam.seq, method="FUTURE", lag=4)
biofam.om <- seqdist(biofam.seq, method="OM", indel=fucost$indel, sm=fucost$sm)

## Optimal matching using a unique substitution cost of 2
## and an insertion/deletion cost of 3
ccost <- seqsubm(biofam.seq, method="CONSTANT", cval=2)
biofam.om.c2 <- seqdist(biofam.seq, method="OM", indel=3, sm=ccost)

## Displaying the distance matrix for the first 10 sequences
biofam.om.c2[1:10,1:10]

## Example with weights and missings
##
## data(ex1)
ex1.seq <- seqdef(ex1[,1:13], weights=ex1$weights)

## Unweighted
subm <- seqcost(ex1.seq, method="INDELSLOG", with.missing=TRUE, weighted=FALSE)
ex1.om <- seqdist(ex1.seq, method="OM", indel=subm$indel, sm=subm$sm, with.missing=TRUE)

## Weighted
subm.w <- seqcost(ex1.seq, method="INDELSLOG", with.missing=TRUE, weighted=TRUE)
ex1.omw <- seqdist(ex1.seq, method="OM", indel=subm.w$indel, sm=subm.w$sm, with.missing=TRUE)
ex1.om == ex1.omw
seqdecomp

Convert a character string into a vector of states or events

Description

For the moment, each character in the string will be considered to be one state or event = this function will not give accurate results if the character string representing the sequence contains events or states coded with more than one character.

Usage

seqdecomp(data, var=NULL, sep='-', miss="NA", vnames=NULL)

Arguments

data: a dataframe or matrix containing sequence data.
var: the list of columns containing the sequences. Default is NULL, i.e., all the columns. Whether the sequences are in the compressed (character strings) or extended format is automatically detected by counting the number of columns.
sep: the between states/events separator used in the input data set. Default is '-'.
miss: the symbol for missing values (if any) used in the input data set. Default is NA.
vnames: optional names for the column/variables of the output data set. Default is NULL.

See Also

seqconc.

Examples

## Converts 'seq' into a vector of states of length 10
seq <- "A-A-A-A-B-B-B-C-C-C"
seqdecomp(seq)

seqdef

Create a state sequence object

Description

Create a state sequence object with attributes such as alphabet, color palette and state labels. Most TraMineR functions for state sequences require such a state sequence object as input argument. There are specific methods for plotting, summarizing and printing state sequence objects.
Usage

seqdef(data, var=NULL, informat="STS", stsep=NULL,
alphabet=NULL, states=NULL, id=NULL, weights=NULL, start=1,
left=NA, right="DEL", gaps=NA, missing=NA, void="%", nr="*",
cnames=NULL, xtstep=1, tick.last=FALSE, cpal=NULL,
missing.color="darkgrey", labels=NULL, ...)

Arguments

data a data frame or matrix containing the sequence data.

var the list of columns containing the sequences. Default is NULL, i.e. all the columns. The function detects automatically whether the sequences are in the compressed (successive states in a character string) or extended format.

informat format of the original data. Default is "STS". Other available formats are: "SPS" and "SPELL", in which case the seqformat function is called to convert the data into the "STS" format (see TraMineR user's manual (Gabadinho et al., 2010) for a description of these formats). A better solution is nonetheless to convert first your data with seqformat, so as to have better control over the conversion process and visualize the intermediate "STS" formatted data.

stsep the character used as separator in the original data if input format is successive states in a character string. If NULL (default value), the seqfcheck function is called for detecting automatically a separator among "-" and ":". Other separators must be specified explicitly.

alphabet optional vector containing the alphabet (the list of all possible states). Use this option if some states in the alphabet don't appear in the data or if you want to reorder the states. The specified vector MUST contain AT LEAST all the states appearing in the data. It may possibly contain additional states not appearing in the data. If NULL, the alphabet is set to the distinct states appearing in the data as returned by the seqstatl function. See details.

states an optional vector containing the short state labels. Must have a length equal to the size of the alphabet and the labels must be ordered conformably with alphanumeric ordered values returned by the seqstatl function, or, when alphabet is set, with the thus newly defined alphabet.

id optional argument for setting the rownames of the sequence object. If NULL (default), the rownames are taken from the input data. If set to "auto", sequences are numbered from 1 to the number of sequences. A vector of rownames of length equal to the number of sequences may be specified as well.

weights optional numerical vector containing weights, which are accounted for by plotting and statistical functions when applicable.

start starting time. For instance, if sequences begin at age 15, you can specify 15. At this stage, used only for labelling column names.

left the behavior for missing values appearing before the first (leftmost) valid state in each sequence. See Gabadinho et al. (2010) for more details on the options for handling missing values when defining sequence objects. By default, left missing values are treated as 'real' missing values and converted to the internal
missing value code defined by the nr option. Other options are "DEL" to delete the positions containing missing values or a state code (belonging to the alphabet or not) to replace the missing values.

**right**
the behavior for missing values appearing after the last (rightmost) valid state in each sequence. Same options as for the left argument.

**gaps**
the behavior for missing values appearing inside the sequences, i.e. after the first (leftmost) valid state and before the last (rightmost) valid state of each sequence. Same options as for the left argument.

**missing**
the code used for missing values in the input data. When specified, all cells containing this value will be replaced by NA's, the internal R code for missing values. If 'missing' is not specified, cells containing NA's are considered as missing values.

**void**
the internal code used by TraMineR for representing void elements in the sequences. Default is "%". Must be different from left, gaps, and right.

**nr**
the internal code used by TraMineR for representing real missing elements in the sequences. Default is "*".

**cnames**
optional names for the columns composing the sequence data. Those names will be used by default in the graphics as axis labels. If NULL (default), names are taken from the original column names in the data.

**xtstep**
step between displayed tick-marks and labels on the time x-axis of state sequence plots. If not overridden by the user, plotting functions retrieve this parameter from the xtstep attribute of the sequence object. For example, with xtstep=3 a tick-mark is displayed at positions 1, 4, 7, etc... Default value is 1; i.e., a tick mark is displayed at each position. The display of the corresponding labels depends on the available space and is dealt with automatically.

**tick.last**
Logical. Should a tick mark be enforced at the last position on the time x-axis?

**cpal**
an optional color palette for representing the states in the graphics. If NULL (default), a color palette is created by calling the brewer.pal function of the RColorBrewer package. If number of states is less or equal than 8, the "Accent" palette is used. If number of states is between 8 and 12, the "Set3" palette is used. If the number of states in the data is greater than 12, colors are set using hcl.colors with the "Set 3" palette (See hcl.colors). To specify your own palette use e.g. the colors function, or the RColorBrewer or colorspace packages.

**missing.color**
alternative color for representing missing values inside the sequences. Defaults to "darkgrey".

**labels**
optional state labels used for the color legend of TraMineR’s graphics. If NULL (default), the state names in the alphabet are used as state labels as well.

... options passed to the seqformat function for handling input data that is not in STS format or print format.

**Details**
Applying subscripts to sequence objects (eg. seq[,1:5] or seq[1:10,]) returns a state sequence object with some attributes preserved (alphabet, missing) and some others (start, column names,
weights) adapted to the selected column or row subset. When the number of columns selected is 1, the returned object is a factor.

For reordering the states use the alphabet argument. This may for instance be useful to compare data from different sources with different codings of similar states. Using alphabet permits to order the states conformably in all sequence objects. Otherwise, the default state order is the alphanumeric order returned by the seqstatl function which may differ when you have different original codings.

**Value**

An object of class stslist. There are print, plot, rbind, summary, and subsetting [,] methods for such objects. State sequence objects are required as argument to other functions such as plotting functions (seqdplot, seqiplot or seqfplot), functions to compute distances (seqdist), etc...

**Author(s)**

Alexis Gabadinho and Gilbert Ritschard

**References**


**See Also**

plot.stslist plot method for state sequence objects,
print.stslist print method for state sequence objects,
is.stslist to test whether an object is a proper stslist object,
seqplot for high level plots of state sequence objects,
seqcreate to create an event sequence object,
seqformat for converting between various longitudinal data formats.

**Examples**

```r
## Creating a sequence object with the columns 13 to 24
## in the 'actcal' example data set
data(actcal)
actcal.seq <- seqdef(actcal,13:24,
labels=c("> 37 hours", "19-36 hours", "1-18 hours", "no work"))

## Displaying the first 10 rows of the sequence object
actcal.seq[1:10,]

## Displaying the first 10 rows of the sequence object
## in SPS format
print(actcal.seq[1:10,], format="SPS")
```
### Plotting the first 10 sequences

```r
plot(actcal.seq)
```

### Re-ordering the alphabet

```r
actcal.seq <- seqdef(actcal,13:24,alphabet=c("B","A","D","C"))
alphabet(actcal.seq)
```

### Adding a state not appearing in the data to the alphabet

```r
actcal.seq <- seqdef(actcal,13:24,alphabet=c("A","B","C","D","E"))
alphabet(actcal.seq)
```

### Adding a state not appearing in the data to the alphabet and changing the states labels

```r
actcal.seq <- seqdef(actcal,13:24,
  alphabet=c("A","B","C","D","E"),
  states=c("FT","PT","LT","NO","TR"))
alphabet(actcal.seq)
```

### rbind and summary

```r
seq1 <- actcal.seq[1:10,]
seq2 <- actcal.seq[20:25,]
seq <- rbind(seq1,seq2)
summary(seq)
```

### Example with missing values

```r
data(ex1)
```

### With right="DEL" default value

```r
seqdef(ex1,1:13)
```

### Eliminating 'left' missing values

```r
seqdef(ex1,1:13, left="DEL")
```

### Eliminating 'left' missing values and gaps

```r
seqdef(ex1,1:13, left="DEL", gaps="DEL")
```

### Example with weights

```r
ex1.seq <- seqdef(ex1, 1:13, weights=ex1$weights)
```

### Weighted sequence frequencies

```r
seqtab(ex1.seq)
```
seqdiff

Position-wise discrepancy analysis between groups of sequences

Description

The function analyses how the differences between groups of sequences evolve along the positions. It runs a sequence of discrepancy analyses on sliding windows.

Usage

```r
seqdiff(seqdata, group, cmprange = c(0, 1),
        seqdist.args = list(method = "LCS", norm = TRUE), with.missing = FALSE,
        weighted = TRUE, squared = FALSE, seqdist_arg)
```

Arguments

- `seqdata`: a state sequence object created with the `seqdef` function.
- `group`: The group variable.
- `cmprange`: The time range of the sliding window on which subsequences are compared.
- `seqdist.args`: List of arguments passed to `seqdist` for computing the distances.
- `with.missing`: Logical. If `TRUE`, missing values are considered as an additional state. If `FALSE` subsequences with missing values are removed from the analysis.
- `weighted`: Logical. If `TRUE`, `seqdiff` uses the weights specified in `seqdata`.
- `squared`: Logical. If `TRUE` the dissimilarities are squared for computing the discrepancy.
- `seqdist_arg`: Deprecated. Use `seqdist.args` instead.

Details

The function analyses how the part of discrepancy explained by the group variable evolves along the position axis. It runs successively discrepancy analyses within a sliding time-window of range `cmprange`). At each position, the method uses `seqdist` to compute a distance matrix over the time-window and then derives the explained discrepancy on that window with `dissassoc`.

There are print and plot methods for the returned value.

Value

A `seqdiff` object, with the following items:

- `stat`: A data.frame with three statistics (PseudoF, PseudoR² and PseudoT) for each time stamp of the sequence, see `dissassoc`.
- `discrepancy`: A data.frame with, at each time stamp, the discrepancy within each group defined by the group variable and for the whole population.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)
References


See Also
dissassoc to analyse the association of the group variable with the whole sequence

Examples

```r
## Define a state sequence object
data(mvad)
## First 12 months of first 200 trajectories
mvad.seq <- seqdef(mvad[1:200, 17:28])

## Position-wise discrepancy analysis
mvad.diff <- seqdiff(mvad.seq, group=mvad$gcseq[1:200])
print(mvad.diff)
plot(mvad.diff, stat=c("Pseudo R2", "Levene"), xtstep=6)
plot(mvad.diff, stat="discrepancy")
```

seqdim

### Dimension of a set of sequences

**Description**

Returns the number of sequences (rows) and the maximum length of a set of sequences.

**Usage**

```r
seqdim(seqdata)
```

**Arguments**

- `seqdata`: a set of sequences.

**Details**

The function will first search for separators '-' or ':' in the sequences in order to detect whether they are in the compressed or extended format.

**Value**

A vector with the number of sequences and the maximum sequence length.
seqdist

Distances (dissimilarities) between sequences

Description

Computes pairwise dissimilarities between sequences or dissimilarity from a reference sequence. Several dissimilarity measures can be chosen, including optimal matching (OM) and many of its variants, distance based on the count of common attributes, and distances between sequence state distributions.

Usage

```r
seqdist(seqdata, method, refseq = NULL, norm = "none", indel = "auto", sm = NULL, with.missing = FALSE, full.matrix = TRUE, kweights = rep(1.0, ncol(seqdata)), tpow = 1.0, expcost = 0.5, context, link = "mean", h = 0.5, nu, transindel = "constant", otto, previous = FALSE, add.column = TRUE, breaks = NULL, step = 1, overlap = FALSE, weighted = TRUE, global.pdotj = NULL, prox = NULL)
```

Arguments

- **seqdata**: State sequence object of class `stslist`. The sequence data to use. Use `seqdef` to create such an object.
- **method**: String. The dissimilarity measure to use. It can be "OM", "OMloc", "OMslen", "OMspell", "OMstran", "HAM", "DHD", "CHI2", "EUCLID", "LCS", "LCP", "RLCP", "NMS", "NMSMST", "SVRspell", or "TWED". See the Details section.
- **refseq**: NULL, Integer, or State Sequence Object. Default: NULL. The baseline sequence to compute the distances from. When an integer, the index of a sequence in `seqdata` or 0 for the most frequent sequence. When a state sequence object, it must contain a single sequence and have the same alphabet as `seqdata`.
- **norm**: String. Default: "none". The normalization to use when `method` is one of "OM", "OMloc", "OMslen", "OMspell", "OMstran", "TWED", "HAM", "DHD", "LCS", "LCP", "RLCP", "CHI2", "EUCLID". It can be "none", "auto", or, except for "CHI2" and "EUCLID", "maxlength", "gmean", "maxdist", or "YujiBo". "auto" is equivalent to "maxlength" when `method` is one of "OM", "HAM", or "DHD", to "gmean" when `method` is one of "LCS", "LCP", or "RLCP", to YujiBo when `method` is one of "OMloc", "OMslen", "OMspell", "OMstran", "TWED". See the Details section.
**indel**  Double, Vector of Doubles, or String. Default: "auto". Insertion/deletion cost(s). Applies when method is one of "OM", "OMslen", "OMspell", or "OMstran". The single state-independent insertion/deletion cost when a double. The state-dependent insertion/deletion costs when a vector of doubles. The vector should contain an indel cost by state in the order of the alphabet. When "auto", the indel is set as max(sm)/2 when sm is a matrix and is computed by means of seqcost when sm is a string specifying a cost method.

**sm**  NULL, Matrix, Array, or String. Substitution costs. Default: NULL. The substitution-cost matrix when a matrix and method is one of "OM", "OMloc", "OMslen", "OMspell", "OMstran", "HAM", or "TWED". The series of the substitution-cost matrices when an array and method = "DHD". They are grouped in a 3-dimensional array with the third index referring to the position in the sequence. One of the strings "CONSTANT", "INDELS", "INDELSLOG", or "TRATE". Designates a seqcost method to be used to build sm. For "DHD", only "TRATE" applies. In this latter case, the outcome is the same as with sm=NULL. sm is mandatory when method is one of "OM", "OMloc", "OMslen", "OMspell", "OMstran", or "TWED". sm is autogenerated when method is one of "HAM" or "DHD" and sm = NULL. See the Details section. Note: With method = "NMS" or method = "SVRspell", use prox instead.

**with.missing**  Logical. Default: FALSE. Should the non-deleted missing value be added to the alphabet as an additional state? If FALSE and seqdata or refseq contains such gaps, an error is raised.

**full.matrix**  Logical. Default: TRUE. When refseq = NULL, if TRUE, the full distance matrix is returned, if FALSE, an object of class dist is returned, that is, a vector containing only values from the upper triangle of the distance matrix. Objects of class dist are smaller and can be passed directly as arguments to most clustering functions.

**kweights**  Vector of Doubles. Default: vector of 1.0. The weights applied to subsequences when method is one of "NMS", "NMSMST", or "SVRspell". It contains at position k the weight applied to the subsequences of length k. It must be positive. Its length must be equal to the number of columns of seqdata.

**tpow**  Double. Default: 1.0. The exponential weight of spell length when method = "OMslen", "NMSMST", or "SVRspell".

**expcost**  Double. Default: 0.5. The cost of spell length transformation when method = "OMloc" or method = "OMspell". It must be positive. The exact interpretation is distance-dependent.

**context**  Double. Default: 1-2*expcost. The cost of local insertion when method = "OMloc". It must be positive.

**link**  String. Default: "mean". The function used to compute substitution costs when method = "OMslen". One of "mean" (arithmetic average) or "gmean" (geometric mean as in the original proposition of Halpin 2010).

**h**  Double. Default: 0.5. It must be greater than or equal to 0. The exponential weight of spell length when method = "OMslen".
The seqdist function returns a matrix of distances between sequences or a vector of distances from the reference sequence when refseq is set. The available metrics (see method option) include:

- **Edit distances**: optimal matching ("OM"), localized OM ("OMloc"), spell-length-sensitive OM ("OMslen"), OM of spell sequences ("OMspell"), OM of transition sequences ("OMstran"), Hamming ("HAM"), dynamic Hamming ("DHD"), and the time warp edit distance ("TWED").

- **Metrics based on counts of common attributes**: distance based on the longest common subsequence ("LCS"), on the longest common prefix ("LCP"), on the longest common suffix ("RLCP"), on the number of matching subsequences ("NMS"), on the number of matching subsequences weighted by the minimum shared time ("NMSMST") and, the subsequence vectorial representation distance ("SVRspell").

Details

The seqdist function returns a matrix of distances between sequences or a vector of distances from the reference sequence when refseq is set. The available metrics (see method option) include:

- **Edit distances**: optimal matching ("OM"), localized OM ("OMloc"), spell-length-sensitive OM ("OMslen"), OM of spell sequences ("OMspell"), OM of transition sequences ("OMstran"), Hamming ("HAM"), dynamic Hamming ("DHD"), and the time warp edit distance ("TWED").

- **Metrics based on counts of common attributes**: distance based on the longest common subsequence ("LCS"), on the longest common prefix ("LCP"), on the longest common suffix ("RLCP"), on the number of matching subsequences ("NMS"), on the number of matching subsequences weighted by the minimum shared time ("NMSMST") and, the subsequence vectorial representation distance ("SVRspell").
Distances between state distributions: Euclidean ("EUCLID"), Chi-squared ("CHI2").

See Studer and Ritschard (2014, 2016) for a description and the comparison of the above dissimilarity measures except "TWED" for which we refer to Marteau (2009) and Halpin (2014).

Each method can be controlled with the following parameters:

<table>
<thead>
<tr>
<th>method</th>
<th>parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>OM</td>
<td>sm, indel, norm</td>
</tr>
<tr>
<td>OMloc</td>
<td>sm, expcost, context, norm</td>
</tr>
<tr>
<td>OMslen</td>
<td>sm, indel, link, h, norm</td>
</tr>
<tr>
<td>OMspell</td>
<td>sm, indel, norm, tpow, expcost, norm</td>
</tr>
<tr>
<td>OMstran</td>
<td>sm, indel, transindel, otto, previous, add.column, norm</td>
</tr>
<tr>
<td>HAM, DHD</td>
<td>sm, norm</td>
</tr>
<tr>
<td>CHI2</td>
<td>breaks, step, overlap, norm, weighted, global.pdotj, norm</td>
</tr>
<tr>
<td>EUCLID</td>
<td>breaks, step, overlap, norm</td>
</tr>
<tr>
<td>LCS, LCP, RLCP</td>
<td>norm</td>
</tr>
<tr>
<td>NMS</td>
<td>prox, kweights</td>
</tr>
<tr>
<td>NMSMST</td>
<td>kweights, tpow</td>
</tr>
<tr>
<td>SVRspell</td>
<td>prox, kweights, tpow</td>
</tr>
<tr>
<td>TWED</td>
<td>sm, (indel), h, nu, norm</td>
</tr>
</tbody>
</table>

"LCS" is "OM" with a substitution cost of 2 (sm = "CONSTANT", cval = 2) and an indel of 1.0. "HAM" is "OM" without indels. "DHD" is "HAM" with specific substitution costs at each position.

"HAM" and "DHD" apply only to sequences of equal length.

For "TWED", the (single) indel serves only for empty sequences. The distance to an empty sequence is set as n*indel, where n is the length of the non empty sequence. By default (indel="auto"), indel is set as 2 * max(sm) + nu + lambda.

When sm = NULL, the substitution-cost matrix is automatically created for "HAM" with a single substitution cost of 1 and for "DHD" with the costs derived from the transition rates at the successive positions.

Some distances can optionally be normalized by means of the norm argument. Let d be the distance, m the maximum possible of the distance given the lengths p and q of the two sequences, and k the length of the longer sequence. Normalization "maxlength" is d/k (Abbott’s normalization), "gmean" is 1 - (m - d)/(p * q) 5 (Elzinga’s normalization), "maxdist" is d/m, and "YujianBo" is 2 * d/(m + d). For more details, see Gabadinho et al. (2009, 2011). Actually, to avoid negative outcomes, the length p, q, and k are set as (max) indel times the corresponding length. For some distances, m is only a possibly non-reachable upper bound.

When norm="auto", "gmean" is applied to "LCS", "LCP" and "RLCP" distances, "maxlength" is applied to "OM", "HAM" and "DHD", and the normalization "YujianBo" of Yujian and Bo (2007) that preserves the triangle inequality is used in the other cases.

The square of the "CHI2" and "EUCLID" distances are normalized by the number of intervals and the maximal distance on each interval. Note that for 'CHI2' the maximal distance on each interval depends on the state distribution on the interval.

When sequences contain gaps and the left = NA, gaps = NA, or right = NA option was passed to seqdef (i.e. when there are non deleted missing values), the with.missing argument should be
set as \texttt{TRUE}. If left as \texttt{FALSE} the function stops when it encounters a gap. This is to make the user aware that there are gaps in the sequences. For methods that need an \texttt{sm} value, \texttt{seqdist} expects a substitution-cost matrix with a row and a column entry for the missing state (symbol defined with the \texttt{nr} option of \texttt{seqdef}). Substitution-cost matrices returned by \texttt{seqcost} (and so \texttt{seqsubm}) include these additional entries when the function is called with \texttt{with.missing = TRUE}. More details on how to compute distances with sequences containing gaps can be found in \textit{Gabadinho et al. (2009)}. 

\textbf{Value}

When \texttt{refseq} is \texttt{NULL} (default), the whole matrix of pairwise distances between sequences or, if \texttt{full.matrix = FALSE}, the corresponding \texttt{dist} object of pairwise distances between sequences is returned. Otherwise, a vector with distances between the sequences in the state sequence object and the reference sequence specified with \texttt{refseq} is returned.

\textbf{Author(s)}

Matthias Studer, Pierre-Alexandre Fonta, Alexis Gabadinho, Nicolas S. Müller, Gilbert Ritschard.

\textbf{References}


See also all references in \textit{Studer and Ritschard (2014, 2016)}

\textbf{See Also}

\texttt{seqcost}, \texttt{seqsubm}, \texttt{seqdef}, and for multichannel distances \texttt{seqdistmc}. 
Examples

## Examples without missings

## Defining a sequence object with columns 10 to 25
## of a subset of the 'biofam' data set
data(biofam)
biofam.seq <- seqdef(biofam[501:600, 10:25])

## OM distances using the vector of indels and substitution
## costs derived from the estimated state frequencies
costs <- seqcost(biofam.seq, method = "INDELSLOG")
biofam.om <- seqdist(biofam.seq, method = "OM",
                   indel = costs$indel, sm = costs$sm)

## OM between sequences of transitions
biofam.omstran <- seqdist(biofam.seq, method = "OMstran",
                          indel = costs$indel, sm = costs$sm,
                          otto=.3, transindel="subcost")

## Normalized LCP distances
biofam.lcp.n <- seqdist(biofam.seq, method = "LCP",
                        norm = "auto")

## Normalized LCS distances to the most frequent sequence
biofam.dref1 <- seqdist(biofam.seq, method = "LCS",
                        refseq = 0, norm = "auto")

## LCS distances to an external sequence
ref <- seqdef(as.matrix("(0,5)-(3,5)-(4,6)"), informat = "SPS",
              alphabet = alphabet(biofam.seq))
biofam.dref2 <- seqdist(biofam.seq, method = "LCS",
                        refseq = ref)

## Chi-squared distance over the full observed timeframe
biofam.chi.full <- seqdist(biofam.seq, method = "CHI2",
                           step = max(seqlength(biofam.seq)))

## Chi-squared distance over successive overlapping
## intervals of length 4
biofam.chi.ostep <- seqdist(biofam.seq, method = "CHI2",
                            step = 4, overlap = TRUE)

## Examples with missings

## Ignore empty row 7
data(ex1)
ex1.seq <- seqdef(ex1[1:6, 1:13])
## seqdistmc

### Multichannel distances between sequences

**Description**

Compute multichannel pairwise optimal matching (OM) distances between sequences by deriving the substitution costs from the costs of the single channels. Works with OM and its following variants: distance based on longest common subsequence (LCS), Hamming distance (HAM), and Dynamic Hamming distance (DHD).

**Usage**

```r
seqdistmc(channels, method, norm="none", indel=1, sm=NULL, with.missing=FALSE, full.matrix=TRUE, link="sum", cval=2, miss.cost=2, cweight=NULL)
```

**Arguments**

- `channels` A list of state sequence objects defined with the `seqdef` function, each state sequence object corresponding to a "channel".
- `method` The method to use for calculating the distance.
- `norm` The normalization method.
- `indel` The indel cost.
- `sm` The substitution matrix.
- `with.missing` Whether to include missing values.
- `full.matrix` Whether to return the full matrix.
- `link` The link function.
- `cval` The cvalue.
- `miss.cost` The cost for missing values.
- `cweight` The cweight.
method: a character string indicating the metric to be used. One of "OM" (Optimal Matching), "LCS" (Longest Common Subsequence), "HAM" (Hamming distance), "DHD" (Dynamic Hamming distance).

norm: String. Default: "none". The normalization method to use. See seqdist.

indel: A vector with an insertion/deletion cost for each channel (OM method).

sm: A list with a substitution-cost matrix for each channel (OM, HAM and DHD method) or a list of method names for generating the substitution-costs (see seqsubm).

with.missing: Must be set to TRUE when sequences contain non deleted gaps (missing values) or when channels are of different length. See details.

full.matrix: If TRUE (default), the full distance matrix is returned. If FALSE, an object of class dist is returned.

link: One of "sum" or "mean". Method to compute the "link" between channels. Default is to sum the substitution costs.

cval: Substitution cost for "CONSTANT" matrix, see seqsubm.

miss.cost: Missing values substitution cost, see seqsubm.

cweight: A vector of channel weights. Default is 1 (same weight for each channel).

Details
The seqdistmc function returns a matrix of multichannel distances between sequences. The available metrics (see 'method' option) are optimal matching ("OM"), longest common subsequence ("LCS"), Hamming distance ("HAM") and Dynamic Hamming Distance ("DHD"). See seqdist for more information about distances between sequences.

The seqdistmc function computes a multichannel distance in two steps following the strategy proposed by Pollock (2007). First it builds a new sequence object derived from the combination of the sequences of each channel. Second, it derives the substitution cost matrix by summing (or averaging) the costs of substitution across channels. It then calls seqdist to compute the distance matrix.

Normalization may be useful when dealing with sequences that are not all of the same length. For details on the applied normalization, see seqdist.

Value
A matrix of pairwise distances between multichannel sequences is returned.

Author(s)
Matthias Studer (with Gilbert Ritschard for the help page)

References
See Also

seqsubm, seqdef, seqdist.

Examples

data(biofam)

## Building one channel per type of event left, children or married
bf <- as.matrix(biofam[, 10:25])
children <- bf==4 | bf==5 | bf==6
married <- bf == 2 | bf== 3 | bf==6
left <- bf==1 | bf==3 | bf==5 | bf==6

## Building sequence objects
child.seq <- seqdef(children)
marr.seq <- seqdef(married)
left.seq <- seqdef(left)

## Using transition rates to compute substitution costs on each channel
mcdist <- seqdistmc(channels=list(child.seq, marr.seq, left.seq),
method="OM", sm =list("TRATE", "TRATE", "TRATE"))

## Using a weight of 2 for children channel and specifying substitution-cost
smatrix <- list()
smatrix[[1]] <- seqsubm(child.seq, method="CONSTANT")
smatrix[[2]] <- seqsubm(marr.seq, method="CONSTANT")
smatrix[[3]] <- seqsubm(left.seq, method="TRATE")
mcdist2 <- seqdistmc(channels=list(child.seq, marr.seq, left.seq),
method="OM", sm =smatrix, cweight=c(2,1,1))

seqdss

Extract distinct states sequence from a sequence object

Description

Extract distinct states sequence from a sequence object.

Usage

seqdss(seqdata, with.missing=FALSE)

Arguments

seqdata a sequence object as defined by the seqdef function.
with.missing if set to TRUE, missing statuses (gaps in sequences) also appear in the DSS. See seqdef on options for handling missing values when creating sequence objects.
Details


If called with the \{with.missing=TRUE\} argument, a missing state in a sequence is considered as the occurrence of an additional symbol of the alphabet, and two or more consecutive missing states are considered as two or more occurrences of the same state. Hence the DSS of A-A-**-**-B-B-C-C-D is A-**-B-C-D.

Value

a sequence object containing the distinct state sequence (DSS) for each sequence in the object given as argument.

Author(s)

Alexis Gabadinho

See Also

seqdur.

Examples

```r
## Creating a sequence object with the columns 13 to 24
## in the 'actcal' example data set
data(actcal)
actcal.seq <- seqdef(actcal,13:24)

## Retrieving the DSS
actcal.dss <- seqdss(actcal.seq)

## Displaying the DSS for the first 10 sequences
actcal.dss[1:10,]

## Example with with.missing argument
data(ex1)
ex1.seq <- seqdef(ex1, 1:13)

seqdss(ex1.seq)
seqdss(ex1.seq, with.missing=TRUE)
```

---

**seqdur**

Extract state durations from a sequence object.
Description


Usage

seqdur(seqdata, with.missing=FALSE)

Arguments

seqdata a sequence object as defined by the seqdef function.
with.missing if set to TRUE, durations are also computed for missing statuses (gaps in sequences). See seqdef on options for handling missing values when creating sequence objects.

Value

a matrix containing the states durations for each distinct state in each sequence.

Author(s)

Alexis Gabadinho

See Also

seqdss.

Examples

## Creating a sequence object with the columns 13 to 24
## in the 'actcal' example data set
data(actcal)
actcal.seq <- seqdef(actcal,13:24)

## Retrieving the DSS
actcal.dur <- seqdur(actcal.seq)

## Displaying the durations for the first 10 sequences
actcal.dur[1:10,]
seqeapplysub  

Checking for the presence of given event subsequences

Description
Checks occurrences of the subsequences subseq among the event sequences and returns the result according to the selected method.

Usage
seqeapplysub(subseq, method = NULL, constraint = NULL, rules=FALSE)

Arguments
- subseq: list of subsequences (an event subsequence object) such as created by seqefsub
- method: type of result, should be one of "count", "presence" or "age"
- constraint: Time constraints overriding those used to compute subseq. See seqeconstraint
- rules: If set to TRUE, instead of checking occurrences of the subsequences among the event sequences, check the occurrence of the subsequences inside the subsequences (internally used by seqerules)

Details
There are three methods implemented: "count" counts the number of occurrence of each given subsequence in each event sequence; "presence" returns 1 if the subsequence is present, 0 otherwise; "age" returns the age of appearance of each subsequence in each event sequence. In case of multiple possibilities, the age of the first occurrence is returned. When the subsequence is not in the sequence, -1 is returned.

Value
The return value is a matrix where each row corresponds to a sequence (row names are set accordingly) and each column corresponds to a subsequence (col names are set accordingly). The cells of the matrix contain the requested values (count, presence-absence indicator or age).

Author(s)
Matthias Studer and Reto Bürgin (alternative counting methods) (with Gilbert Ritschard for the help page)

References
See Also

`seqecreate` for more information on event sequence object and *Gabadinho et al. (2009)* on how to use the event sequence analysis module.

Examples

```r
## Loading data
data(actcal.tse)

## Creating the event sequence object
actcal.eseq <- seqecreate(actcal.tse)

## Printing sequences
actcal.eseq[1:10]

## Looking for frequent subsequences
fsubseq <- seqefsub(actcal.eseq,pmin.support=0.01)

## Counting the number of occurrences of each subsequence
msubcount <- seqeapplysub(fsubseq,method="count")
## First lines...
msubcount[1:10,1:10]

## Presence-absence of each subsequence
msubpres <- seqeapplysub(fsubseq,method="presence")
## First lines...
msubpres[1:10,1:10]

## Age at first appearance of each subsequence
msubage <- seqeapplysub(fsubseq,method="age")
## First lines...
msubage[1:10,1:10]
```

---

**seqecmpgroup**

*Identifying discriminating subsequences*

**Description**

Identify and sort the most discriminating subsequences by their discriminating power.

**Usage**

```r
seqecmpgroup(subseq, group, method="chisq", pvalue.limit=NULL, weighted = TRUE)
```
Arguments

subseq A subseqelist object (list of subsequences) such as produced by seqefsub

group Group membership, i.e., a variable or factor defining the groups which we want to discriminate

method The discrimination method; one of "bonferroni" or "chisq"

pvalue.limit Can be used to filter the results. Only subsequences with a p-value lower than this parameter are selected. If NULL all subsequences are returned (regardless of their p-values).

weighted Logical. If TRUE, seqecmpgroup uses the weights specified in subseq, (see seqefsub).

Details

The following discrimination test functions are implemented: chisq, the Pearson Independence Chi-squared test, and bonferroni, the Pearson Independence Chi-squared test with Bonferroni correction.

Value

An objet of type subseqelistchisq (subtype of subseqelist) with the following elements

subseq Sorted list of found discriminating subsequences

eseq The event sequence object on which the tests were computed

constraint Time constraints used for searching the subsequences (see seqeconstraint)

labels Levels (value labels) of the target group variable

type Type of test used

data A data frame with columns support, index (original rank of the subsequence, i.e., its position in the inputted subseq) and a pair of frequency and Pearson residual columns for each group

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

References


See Also

See also plot.subseqelistchisq to plot the results
Examples

```r
data(actcal.tse)
actcal.eseq <- seqecreate(actcal.tse)

## Searching for frequent subsequences, that is, appearing at least 20 times
fsubseq <- seqefsub(actcal.eseq, pmin.support=0.01)

## Searching for subsequences discriminating the most men and women
data(actcal)
discr <- seqecmpgroup(fsubseq, group=actcal$sex, method="bonferroni")

## Printing the six most discriminating subsequences
print(discr[1:6])

## Plotting the six most discriminating subsequences
plot(discr[1:6])
```

seqeconstraint

### Setting time constraints and the counting method

**Description**

Function used to set time constraints and the counting method in methods (seqe...) for event sequences such as seqefsub for searching frequent subsequences or seqeapplysub for checking occurrences of subsequences.

**Usage**

```r
seqeconstraint(max.gap = -1, window.size = -1, age.min = -1, age.max = -1,
               age.max.end = -1, count.method = 1, maxGap, windowSize, ageMin, ageMax,
               ageMaxEnd, countMethod)
```

**Arguments**

- `max.gap`: The maximum time gap between two events.
- `window.size`: The maximum time span accepted for subsequences.
- `age.min`: Minimal start time position allowed for subsequences. Ignored when equal to -1 (default).
- `age.max`: Maximal start time position allowed for subsequences. Ignored when equal to -1 (default).
- `age.max.end`: Maximal end time position allowed for subsequences. Ignored when equal to -1 (default).
- `count.method`: By default, subsequences are counted only one time by sequence ('COBJ' method). Alternative counting methods are 'CDIST_O', 'CWIN', 'CMINWIN' or 'CDIST' respectively. See details.
- `maxGap`: Deprecated. Use `max.gap` instead.
- `windowSize`: Deprecated. Use `window.size` instead.
ageMin
Deprecated. Use age.min instead.
ageMax
Deprecated. Use age.max instead.
ageMaxEnd
Deprecated. Use age.max.end instead.
countMethod
Deprecated. Use count.method instead.

Details

max.gap, window.size, age.min, age.max and age.max.end. If so, two events should not be separated by more than max.gap and the whole subsequence should not exceed a window.size time span. The other parameters specify the start and end age of the subsequence, it should start between age.min and age.max and finish before age.max.end. Parameters age.min, age.max and age.max.end are interpreted as the number of positions (time units) from the beginning of the sequence.

There are 5 options for the count.method argument. (1) By default, the count is the number of sequences that contain the subsequence ("COBJ" method). Alternatives are (2) "CDIST_0" (counts all distinct occurrences in each sequence including possibly overlapping occurrences, i.e., occurrences sharing a same event occurrence), (3) "CWIN" (number of slidden windows of length window.size that contain an occurrence of the subsequence), (4) "CMINWIN" (number of minimal windows of occurrence) and (5) "CDIST" (distinct occurrences without event occurrences overlap). See references.

Value

A constraint object containing one item per constraint type.

Author(s)

Matthias Studer, Nicolas S. Müller and Reto Bürgin (alternative counting methods) (with Gilbert Ritschard for the help page)

References


See Also

seqefsub, seqeapplysub
seqecontain 

*Check if sequence contains events*

**Description**

Check if an event sequence or subsequence contains given events

**Usage**

```r
seqecontain(eseq, event.list, unknown.exclude = FALSE, 
            seq, eventList, exclude)
```

**Arguments**

- `eseq` A event sequence object (`seqelist`) or a an event subsequence object (`subseqelist`)
- `event.list` A list of events
- `unknown.exclude` if TRUE the search is exclusive and returns FALSE for any subsequence containing an event that is not in event.list
- `seq` Deprecated. Use `eseq` instead.
- `eventList` Deprecated. Use `event.list` instead.
- `exclude` Deprecated. Use `unknown.exclude` instead.

**Details**

Checks, for each provided event sequence, if it contains one of the events in `event.list`. If `unknown.exclude` is TRUE, `seqecontain` looks if all events of the subsequence are in `event.list`.

**Value**

A logical vector.

**Author(s)**

Matthias Studer (with Gilbert Ritschard for the help page)

**See Also**

- `seqecreate` for creating event sequence objects and `seqefsub` for creating event subsequence objects.
Examples

```r
data(actcal.tse)
actcal.eseq <- seqecreate(actcal.tse)

# Searching for frequent subsequences, that is appearing at least 20 times
fsubseq <- seqefsub(actcal.eseq,min.support=20)

# looking for subsequence with FullTime
seqecontain(fsubseq,c("FullTime"))
```

---

**seqecreate**  
*Create event sequence objects.*

**Description**

Create an event sequence object either from time stamped events or from a state sequence object.

**Usage**

```r
seqecreate(data = NULL, id = NULL, timestamp = NULL, event = NULL, end.event = NULL, tevent = "transition", use.labels = TRUE, weighted = TRUE, endEvent)
```

**Arguments**

- **data**  
  A state sequence object (see `seqdef`) or a data frame

- **id**  
  The sequence 'id' (integer) column when data are provided in TSE format (ignored if data argument is provided).

- **timestamp**  
  The event 'timestamp' (double) column when data are provided in TSE format, i.e., the time at which events occur (ignored if data argument is provided).

- **event**  
  The 'event' column when data are provided in TSE format, i.e., the events occurring at the specified time stamps (ignored if data argument is provided).

- **end.event**  
  If specified this event indicates the end of observation time (total length of event sequences) when it is not followed by any other valid event. The event is ignored when occurring in between two valid events.

- **tevent**  
  Either a transition matrix or a method to generate events from state sequences (see `seqtm`). Used only when data is a state sequence object.

- **use.labels**  
  If TRUE, transitions names are built from long state labels rather than from the short state names of the alphabet.

- **weighted**  
  If TRUE and data is a state sequence object, use the weights specified in data (see `seqdef`)

- **endEvent**  
  Deprecated. Use `end.event` instead.
Details

There are several ways to create an event sequence object. The first one is by providing the events in TSE format (see seqformat), i.e. by providing three paired lists: id, timestamp and event, such that each triplet (id, timestamp, event) defines the event that occurs at time timestamp for case id. Several events at the same time for a same id are allowed. The lists can be provided with the arguments id, timestamp and event. An alternative is by providing a data frame as data argument in which case the function takes the required information from the "id", "timestamp" and "event" columns of that data frame. In any case with TSE format, listed events should be grouped by id and an error will be thrown otherwise. Such grouping can be achieved by ordering the data according to the id column using the order function (e.g., data[order(data$id),]).

The other way is to pass a state sequence object (as data argument) and to perform an automatic state-to-event conversion. The simplest way to make a conversion is by means of a predefined method (see seqetm), such as "transition" (one distinct event per possible transition), "state" (a new event for each entering in a new state) and "period" (a pair of events, one start-state event and one end-state event for each found transition). For a more customized conversion, you can specify a transition matrix in the same way as in seqformat. Function seqetm can help you in creating your transition matrix.

Event sequence objects as created by seqecreate are required by most other 'seqe' methods, such as seqefsub or seqeapplysub for example.

Value

An object of class seqelist. There are print, and plot methods for such objects.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

References


See Also

    seqformat for converting between sequence formats, seqeweight for retrieving or assigning weights, seqefsub for searching frequent subsequences, seqecmpgroup to search for discriminant subsequences, seqeapplysub for counting subsequence occurrences, seqelength for information about length (observation time) of event sequences, seqdef to create a state sequence object.

Examples

    ##Starting with states sequences
    ##Loading data
data(biofam)
## Creating state sequences
bioFam.seq <- seqdef(biofam,10:25, informat='STS')
## Creating event sequences from biofam
biofam.eseq <- seqecreate(biofam.seq)

## Loading data
data(actcal.tse)
## Creating sequences
actcal.eseq <- seqecreate(id=actcal.tse$id, timestamp=actcal.tse$time,
event=actcal.tse$event)
## printing sequences
actcal.eseq[1:10]
## Example with missings
data(ex1) ## STS data with missing values
## Creating the state sequence object with by default
## the left missings and gaps coded as '*' and
## end missings coded as void ('%')
seqx1 <- seqdef(ex1[,1:13])
## and without ignoring right missings (coded as '*')
seqx1b <- seqdef(ex1[,1:13], right=NA)
## Compare the outcome
seqecreate(seqx1)
seqecreate(seqx1, tevent='state')
seqecreate(seqx1, tevent='state', end.event=attr(seqx1,'void'))
seqecreate(seqx1b, tevent='state')

seqefsub

Searching for frequent subsequences

Description

Returns the list of subsequences with minimal support sorted in decreasing order of support. Various
time constraints can be set to restrict the search to specific time periods or subsequence durations.
The function permits also to get information on specified subsequences.

Usage

seqefsub(eseq, str.subseq = NULL, min.support = NULL,
   pmin.support = NULL, constraint = seqeconstraint(), max.k = -1,
   weighted = TRUE, seq, strsubseq, minSupport, pMinSupport, maxK)
Arguments

eseq  A list of event sequences
str.subseq  A list of specific subsequences to look for. See details.
min.support  The minimum support (in number of sequences)
pmin.support  The minimum support (in percentage, corresponding count will be rounded)
constraint  A time constraint object as returned by seqeconstraint
max.k  The maximum number of events allowed in a subsequence
weighted  Logical. Should seqefsub use the weights specified in eseq (see seqeweight).
seq  Deprecated. Use eseq instead.
strsubseq  Deprecated. Use str.subseq instead.
minSupport  Deprecated. Use min.support instead.
pMinSupport  Deprecated. Use pmin.support instead.
maxK  Deprecated. Use max.k instead.

details

There are two usages of this function. The first is for searching subsequences satisfying a support condition. By default, the support is counted per sequence and not per occurrence, i.e. when a sequence contains several occurrences of a same subsequence it is counted only once. Use the count.method argument of seqeconstraint to change that. The minimal required support can be set with pmin.support as a proportion (between 0 and 1) in which case the support will be rounded, or through min.support as a number of sequences. Time constraints can also be imposed with the constraint argument, which must be the outcome of a call to the seqeconstraint function.

The second possibility is for searching sequences that contain specified subsequences. This is done by passing the list of subsequences with the str.subseq argument. The subsequences must contain only events from the alphabet of events of eseq and must be in the same format as that used to display subsequences (see str.seqelist). Each transition (group of events) should be enclosed in parentheses () and separated with commas, and the succession of transitions should be denoted by a '-' indicating a time gap. For instance "(FullTime)-(PartTime, Children)" stands for the subsequence "FullTime" followed by the transition defined by the two simultaneously occurring events "PartTime" and "Children".

To get information such as the number of occurrences of the subsequences returned by seqefsub or the sequences that contain each subsequence use the function seq eapplysub.

Subsets of the returned subseqelist can be accessed with the [] operator (see example). There are print and plot methods for subseqelist.

Value

A subseqelist object with at least the following attributes:

eseq  The list of sequences in which the subsequences were searched (a seqelist event sequence object).
subseq  A list of subsequences (a seqelist event sequence object).
data  A data frame containing details (support, frequency, ...) about the subsequences
constraint  The constraint object used when searching the subsequences.
type  The type of search: 'frequent' or 'user'
Author(s)

Matthias Studer and Reto Bürgin (alternative counting methods) (with Gilbert Ritschard for the help page)

References


See Also

See plot.subseqelist to plot the result. See seqecreate for creating event sequences. See seqeapplysub to count the number of occurrences of frequent subsequences in each sequence. See is.seqelist about seqelist.

Examples

data(actcal.tse)
actcal.eseq <- seqecreate(actcal.tse)

## Searching for subsequences appearing at least 20 times
fsubseq <- seqefsub(actcal.eseq, min.support=20)
## The same using a percentage
fsubseq <- seqefsub(actcal.eseq, pmin.support=0.01)
## Getting a string representation of subsequences
## First ten most frequent subsequences
fsubseq[1:10]

## Using time constraints
## Looking for subsequences starting in Summer (between June and September)
fsubseq <- seqefsub(actcal.eseq, min.support=10,
                     constraint=seqeconstraint(age.min=6, age.max=9))
fsubseq[1:10]

##Looking for subsequences occurring in Summer (between June and September)
fsubseq <- seqefsub(actcal.eseq, min.support = 10,
                     constraint=seqeconstraint(age.min=6, age.max=9, age.max.end=9))
fsubseq[1:10]

##Looking for subsequence enclosed in a 6 month period
## and with a maximum gap of 2 month
fsubseq <- seqefsub(actcal.eseq, min.support=10,
                     constraint=seqeconstraint(max.gap=2, window.size=6))
fsubseq[1:10]
seqeid

Retrieve unique ids from an event sequence object.

Description

Retrieve the unique ids from an event sequence object or from a list of event sequence object.

Usage

seqeid(eseq, s)

Arguments

eseq An event sequence object (as created with seqecreate) or a list of event sequence objects
s Deprecated. Use eseq instead.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

Examples

data(actcal.tse)
actcal.eseq <- seqecreate(actcal.tse)
sid <- seqid(actcal.eseq)
length(sid)
head(sid)

seqlength

Lengths of event sequences

Description

The length of an event sequence is its time span, i.e., the total time of observation. This information is useful to perform for instance a survival analysis. The function seqlength retrieves the lengths of the provided sequences, while seqlength <- sets the length of the sequences.

Usage

seqlength(eseq, s)
seqlength(eseq, s) <- value
seqetm

Arguments

eseq  An event sequence object (seqelist).
value A list of sequence lengths.
s  Deprecated. Use eseq instead.

Value

A numeric vector with the lengths of the sequences.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

Examples

data(actcal.tse)
actcal.eseq <- seqecreate(actcal.tse)
## Since end.event is not specified, contains no sequence lengths
## We set them manually as 12 for all sequences
sl <- numeric()
sl[1:2000] <- 12
seqelength(actcal.eseq) <- sl
actcal.eseq[1:10]
## Retrieve lengths
slen <- seqelength(actcal.eseq)
summary(slen)

seqetm

Create a transition-definition matrix

Description

This function automatically creates a transition-definition matrix from a state sequence object to transform the state sequences into time stamped event sequences (in TSE format).

Usage

seqetm(seqdata, method = "transition", use.labels = TRUE, sep = ">",
bp = "", ep = "end", seq)

Arguments

seqdata  State sequence object from which transition events will be determined
method  The method to use. One of "transition", "period" or "state".
use.labels  If TRUE, transition names are built from state labels rather than from the alphabet.
sep  Separator to be used between the from-state and to-state that define the transition ("transition" method).
bp Prefix for beginning of period event names ("period" method)
ep Prefix for end of period event names ("period" method)
seq Deprecated. Use seqdata instead.

Details

Warning!!!: State labels should not contain commas ",", which are reserved for separating multiple events of a same transition!

One of three methods can be selected with the method argument:

"transition" generates a single (from-state > to-state) event for each found transition and a distinct start-state event for each different sequence start;

"period" generates a pair of events (end-state-event, start-state-event) for each found transition, a start-state event for the beginning of the sequence and an end-state event for the end of the sequence; names used for end-state and start-state names can be controlled with the bp and ep arguments;

"state" generates only the to-state event of each found transition (useful for analysing state sequences with methods for event sequences);

Value

The transition-definition matrix.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

See Also

seqformat for converting to TSE format, seqecreate for creating an event sequence object, seqdef for creating a state sequence object.

Examples

```r
## Creating a state sequence object from columns 13 to 24
## in the 'actcal' example data set
data(actcal)
actcal.seq <- seqdef(actcal, 13:24,
  labels = c("FullTime", "PartTime", "LowPartTime", "NoWork"))

## Creating a transition matrix, one event per transition
seqetm(actcal.seq, method = "transition")

## Creating a transition matrix, single to-state events
seqetm(actcal.seq, method = "state")

## Creating a transition matrix, two events per transition
seqetm(actcal.seq, method = "period")

## changing the prefix of period start event.
seqetm(actcal.seq, method = "period", bp="begin")
```
seqeweight

Setting or retrieving weights of an event sequence object.

Description

Event sequence objects can be weighted. Weights are used by other functions such as seqefsub or seqecmpgroup to compute weighted statistics.

Usage

seqeweight(eseq, s)
seqeweight(eseq, s) <- value

Arguments

eseq An event sequence object (seqelist).
value Numerical vector containing weights
s Deprecated. Use eseq instead.

Value

seqeweight returns a numerical vector containing the weights associated to each event sequence.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

Examples

## Starting with states sequences
## Loading data
data(biofam)
## Creating state sequences
biofam.seq <- seqdef(biofam, 10:25, informat='STS')

## Creating event sequences from biofam
biofam.eseq <- seqecreate(biofam.seq, weighted=FALSE)

## Using the weights
seqeweight(biofam.eseq) <- biofam$wp00tbgs

## Now seqefsub accounts for weights unless weighted is set to FALSE
fsubseq <- seqefsub(biofam.eseq, pmin.support=0.01)

## Searching for weighted subsequences which best
## discriminate the birth cohort
discr <- seqecmpgroup(fsubseq, group=biofam$birthyr>=1940)
plot(discr[1:15])
seqfind

Indexes of state sequence(s) x in state sequence object y

Description

Finds the row indexes of state sequence(s) x in the state sequence object y.

Usage

seqfind(x, y)

Arguments

x a state sequence object containing one or more sequences (seqdef).
y a state sequence object.

Value

row index(es) of sequence(s) x in the set of sequences y.

Author(s)

Alexis Gabadinho (with Gilbert Ritschard for the help page)

See Also

.

Examples

data(mvad)
mvad.shortlab <- c("EM", "FE", "HE", "JL", "SC", "TR")
mvad.seq <- seqdef(mvad, states=mvad.shortlab, 15:86)

## Finding occurrences of sequence 176 in mvad.seq
seqfind(mvad.seq[176,],mvad.seq)

## Finding occurrences of sequence 1 to 8 in mvad.seq
seqfind(mvad.seq[1:8,],mvad.seq)
seqformat

Conversion between sequence formats

Description

Convert a sequence data set from one format to another.

Usage

seqformat(data, var = NULL, from, to, compress = FALSE, nrep = NULL, tevent, stsep = NULL, covar = NULL, SPS.in = list(xfix = "()", sdsep = ","), SPS.out = list(xfix = "()", sdsep = ","), id = 1, begin = 2, end = 3, status = 4, process = TRUE, pdata = NULL, pvar = NULL, limit = 100, overwrite = TRUE, fillblanks = NULL, tmin = NULL, tmax = NULL, missing = "*", with.missing = TRUE, right="DEL", compressed, nr)

Arguments

data  Data Frame, Matrix, or State Sequence Object. The data to use.
A data frame or a matrix with sequence data in one or more columns when from = "STS" or from = "SPS". If sequence data are in a single column, they are assumed to be in the compressed form (see stsep).
A data frame with sequence data in one or more columns when from = "SPELL". If sequence data has not four columns ordered as individual ID, spell start time, spell end time, and spell state status, use var or id / begin / end / status.
A state sequence object when from = "STS" or from is not specified.
var  NULL, List of Integers or Strings. Default: NULL. The indexes or the names of the columns with the sequence data in data. If NULL, all columns are considered.
from  String. The format of the input sequence data. It can be "STS", "SPS", or "SPELL". It is not needed if data is a state sequence object.
to  String. The format of the output data. It can be "STS", "DSS", "SPS", "SRS", "SPELL", or "TSE".
compress  Logical. Default: FALSE. When to = "STS", to = "DSS", or to = "SPS", should the sequences (row vector of states) be concatenated into strings? See seqconc.
nrep  Integer. The number of shifted replications when to = "SRS".
tevent  Matrix. The transition-definition matrix when to = "TSE". It should be of size d x d where d is the number of distinct states appearing in the sequences. The cell (i, j) lists the events associated with a transition from state i to state j. It can be created with seqetm.
stsep  NULL, Character. Default: NULL. The separator between states in the compressed form (strings) when from = "STS" or from = "SPS". If NULL, seqfcheck is called for detecting automatically a separator among ",", "\n", and ":". Other separators must be specified explicitly. See seqdecomp.
covar  List of Integers or Strings. The indexes or the names of additional columns in
data to include as covariates in the output when to = "SRS". The covariates are
replicated across the shifted replicated rows.

SPS.in  List. Default: list(xfix = "()", sdsep = ","). The specifications for the
state-duration couples in the input data when from = "SPS". The first specifi-
cation, xfix, specifies the prefix/suffix character. Use a two-character string if
the prefix and the suffix differ. Use xfix = "" when no prefix/suffix are present.
The second specification, sdsep, specifies the state/duration separator.

SPS.out List. Default: list(xfix = "()", sdsep = ","). The specifications for the
state-duration couples in the output data when to = "SPS". See SPS.in above.

id  NULL, Integer, String, List of Integers or Strings. Default: 1.
When from = "SPELL", the index or the name of the column containing the in-
dividual IDs in data (after var filtering).
When to = "TSE", the index or the name of the column containing the individ-
ual IDs in data (after var filtering) or the unique individual IDs. If id is not
manually specified, id is set as NULL for backward compatibility with TraMineR
1.8-13 behaviour. If id is manually or automatically set as NULL, the original in-
dividual IDs are ignored and replaced by the indexes of the sequences in the
input data.
When from = "SPELL" and to = "TSE", the index or the name of the column
containing the individual IDs in data (after var filtering). The TSE output will
use the original individual IDs.

begin  Integer or String. Default: 2. The index or the name of the column containing
the spell start times in data (after var filtering) when from = "SPELL". Start
times should be positive integers.

end  Integer or String. Default: 3. The index or the name of the column containing
the spell end times in data (after var filtering) when from = "SPELL". End times
should be positive integers.

status  Integer or String. Default: 4. The index or the name of the column containing
the spell statuses in data (after var filtering) when from = "SPELL".

process  Logical. Default: TRUE. When from = "SPELL", if TRUE, create sequences on a
process time axis, if FALSE, create sequences on a calendar time axis.
This process argument as well as the associated pdata and pvar arguments
are intended for data containing spell data with calendar begin and end times.
When those times are ages, use process = FALSE with pdata=NULL to use those
ages as process times. Option process = TRUE does currently not work for age
times.

pdata  NULL, "auto", or Data Frame. Default: NULL.
If NULL, the start and end times of each spell are supposed to be, if process =
TRUE, ages, if process = FALSE, years when from = "SPELL".
If "auto", ages are computed using the start time of the first spell of each indi-
vidual as her/his birthdate when from = "SPELL" and process = TRUE. For from
= "SPELL" and process = FALSE, "auto" is equivalent to NULL.
A data frame containing the ID and the birth time of the individuals when from
= "SPELL" or to = "SPELL". Use pvar to specify the column names. The ID is
used to match the birth time of each individual with the sequence data. The birth
time should be integer. It is the start time from which the positions on the time
axis are computed. It also serves to compute tmin and to guess tmax when the
latter are NULL, from = "SPELL", and process = FALSE.

**pvar**  
List of Integers or Strings. The indexes or names of the columns of the data
frame `pdata` that contain the ID and the birth time of the individuals in that
order.

**limit**  
Integer. Default: 100. The maximum age of age sequences when `from` = "SPELL"
and `process` = TRUE. Age sequences will be considered to start at 1 and to end
at limit.

**overwrite**  
Logical. Default: TRUE. When `from` = "SPELL", if TRUE, the most recent episode
overwrites the older one when they overlap each other, if FALSE, in case of over-
lap, the most recent episode starts after the end of the previous one.

**fillblanks**  
Character. The value to fill gaps between episodes when `from` = "SPELL".

**tmin**  
NULL or Integer. Default: NULL. The start time of the axis when `from` = "SPELL"
and `process` = FALSE. If NULL, the value is the minimum of the spell start times
(see `begin`) or the minimum of the birth time of the individuals (see `pdata` when it is a data frame and `process` = FALSE).

**tmax**  
NULL or Integer. Default: NULL. The end time of the axis when `from` = "SPELL"
and `process` = FALSE. If NULL, the value is the maximum of the spell end times
(see `end`) or the sum of the maximum of the spell end times and of the maxi-
mum of the birth time of the individuals (see `pdata` when it is a data frame and `process` = FALSE).

**missing**  
String. Default: ".". The code for missing states in data. It will be replaced
by NA in the output data. Ignored when data is a state sequence object (see `seqdef`), in which case the attribute `nr` is used as missing value code.

**with.missing**  
Logical. Default: TRUE. When `to` = "SPELL", should the spells of missing states
be included?

**right**  
One of "DEL" or NA. Default: "DEL". When `to` = "SPELL" and `with.missing` = TRUE,
set `right`=NA to include the end spells of missing states.

**compressed**  
Deprecated. Use `compress` instead.

**nr**  
Deprecated. Use `missing` instead.

**Details**

The `seqformat` function is used to convert data from one format to another. The input data is first
converted into the STS format and then converted to the output format. Depending on input and
output formats, some information can be lost in the conversion process. The output is a matrix or a
data frame, NOT a sequence `stslist` object. To process, print or plot the sequences with TraMineR
functions, you will have to first transform the data frame into a `stslist` state sequence object with
`seqdef`. See Gabadinho et al. (2009) and Ritschard et al. (2009) for more details on longitudinal
data formats and converting between them.

When data are in "SPELL" format (`from` = "SPELL"), the begin and end times are expected to be
positions in the sequences. Therefore they should be strictly positive integers. With `process`=TRUE,
the outcome sequences will be aligned on ages (process duration since birth), while with `process`=FALSE
they will be aligned on dates (position on the calendar time). If TRUE, values in the begin and end columns of data are assumed to be integer dates when pdata is not NULL, and ages otherwise. If FALSE, begin and end values are assumed to be dates when pdata is NULL and ages otherwise.

Value

A data frame for SRS, TSE, and SPELL, a matrix otherwise.

Author(s)

Alexis Gabadinho, Pierre-Alexandre Fonta, Nicolas S. Müller, Matthias Studer, and Gilbert Ritschard.

References


See Also

seqdef

Examples

```r
## Examples with raw STS sequences as input

## Loading a data frame with sequence data in the columns 13 to 24
data(actcal)

## Converting to SPS format
actcal.SPS.A <- seqformat(actcal, 13:24, from = "STS", to = "SPS")
head(actcal.SPS.A)

## Converting to compressed SPS format with no
## prefix/suffix and with "/" as state/duration separator
actcal.SPS.B <- seqformat(actcal, 13:24, from = "STS", to = "SPS",
  compress = TRUE, SPS.out = list(xfix = "", sdsep = "/"))
head(actcal.SPS.B)

## Converting to compressed DSS format
actcal.DSS <- seqformat(actcal, 13:24, from = "STS", to = "DSS",
  compress = TRUE)
head(actcal.DSS)
```

```r
## Examples with raw STS sequences as input

## Loading a data frame with sequence data in the columns 13 to 24
data(actcal)

## Converting to SPS format
actcal.SPS.A <- seqformat(actcal, 13:24, from = "STS", to = "SPS")
head(actcal.SPS.A)

## Converting to compressed SPS format with no
## prefix/suffix and with "/" as state/duration separator
actcal.SPS.B <- seqformat(actcal, 13:24, from = "STS", to = "SPS",
  compress = TRUE, SPS.out = list(xfix = "", sdsep = "/"))
head(actcal.SPS.B)

## Converting to compressed DSS format
actcal.DSS <- seqformat(actcal, 13:24, from = "STS", to = "DSS",
  compress = TRUE)
head(actcal.DSS)
```
## Examples with a state sequence object as input

### Loading a data frame with sequence data in the columns 10 to 25

```r
data(biofam)
```

### Limiting the number of considered cases to the first 20

```r
biofam <- biofam[1:20,]
```

### Creating a state sequence object

```r
biofam.labs <- c("Parent", "Left", "Married", "Left/Married", "Child", "Left/Child", "Left/Married/Child", "Divorced")
biofam.seq <- seqdef(biofam, 10:25, alphabet = 0:7,
states = biofam.short.labs, labels = biofam.labs)
```

### Converting to SPELL format

```r
bf.spell <- seqformat(biofam.seq, from = "STS", to = "SPELL",
pdata = biofam, pvar = c("idhous", "birthyr"))
head(bf.spell)
```

## Examples with SPELL sequences as input

### Loading two data frames: bfspell20 and bfpdata20

```r
data(bfspell)
```

### Converting to STS format with alignment on calendar years

```r
bf.sts.y <- seqformat(bfspell20, from = "SPELL", to = "STS",
id = "id", begin = "begin", end = "end", status = "states",
process = FALSE)
head(bf.sts.y)
```

### Converting to STS format with alignment on ages

```r
bf.sts.a <- seqformat(bfspell20, from = "SPELL", to = "STS",
id = "id", begin = "begin", end = "end", status = "states",
process = TRUE, pdata = bfpdata20, pvar = c("id", "when15"),
limit = 16)
names(bf.sts.a) <- paste0("a", 15:30)
head(bf.sts.a)
```

## Examples for TSE and SPELL output

### in presence of missing values

```r
data(ex1)## STS data with missing values
```
## creating the state sequence object with by default
## the end missings coded as void ('%')
sqex1 <- seqdef(ex1[,1:13])
as.matrix(sqex1)

## Creating state-event transition matrices
ttrans <- seqetm(sqex1, method='transition')
tstate <- seqetm(sqex1, method='state')

## Converting into time stamped events
seqformat(sqex1, from = "STS", to = "TSE", tevent = ttrans)
seqformat(sqex1, from = "STS", to = "TSE", tevent = tstate)

## Converting into vertical spell data
seqformat(sqex1, from = "STS", to = "SPELL", with.missing=TRUE)
seqformat(sqex1, from = "STS", to = "SPELL", with.missing=TRUE, right=NA)
seqformat(sqex1, from = "STS", to = "SPELL", with.missing=FALSE)

---

### seqfpos

**Search for the first occurrence of a given element in a sequence**

**Description**

Returns a vector containing the position of the first occurrence of the given element in each of the sequences in the data set.

**Usage**

seqfpos(seqdata, state)

**Arguments**

- **seqdata**: a sequence object (see `seqdef` function).
- **state**: the state element to search in the sequences

**Details**

The state to search for has to be passed as a character string, and must be one of the state returned by the `alphabet` function. If the state is not contained in a sequence, NA is returned for this sequence.

**Author(s)**

Alexis Gabadinho
Examples

```r
data(biofam)
biofam.seq <- seqdef(biofam,10:25)

## Searching for the first occurrence of state 1
## in each of the 5 first sequence of the biofam data set.
seqfpos(biofam.seq[1:5,],"1")
```

---

### seqgen

**Random sequences generation**

**Description**

Generates random sequences.

**Usage**

```r
seqgen(n, length, alphabet, p)
```

**Arguments**

- `n`: number of sequences to generate
- `length`: sequences length
- `alphabet`: the alphabet from which the sequences are generated
- `p`: an optional vector of probabilities for the states in the alphabet. Must be of the same length as the alphabet. If not specified, equal probabilities are used.

**Details**

Each sequence is generated by choosing a set of random numbers (with min=1 and max=length of the alphabet) using the `runif` function. When the probability distribution is not specified, the uniform probability distribution giving same probability to each state is used to generate the sequences.

**Value**

a sequence object.

**Author(s)**

Alexis Gabadinho (with Gilbert Ritschard for the help page)

**Examples**

```r
seq <- seqgen(1000,10,1:4,c(0.2,0.1,0.3,0.4))
seqstatd(seqdef(seq))
```
seqici  Complexity index of individual sequences

Description
Computes the complexity index, a composite measure of sequence complexity. The index uses the number of transitions in the sequence as a measure of the complexity induced by the state ordering and the longitudinal entropy as a measure of the complexity induced by the state distribution in the sequence.

Usage
seqici(seqdata, with.missing=FALSE, silent=TRUE)

Arguments
- seqdata: a sequence object as returned by the seqdef function.
- with.missing: if set to TRUE, missing status (gaps in sequences) is handled as an additional state when computing the state distribution and the number of transitions in the sequence.
- silent: logical: should messages about running operations be displayed?

Details
The complexity index $C(s)$ of a sequence $s$ is

$$C(s) = \sqrt{\frac{q(s)}{q_{max}} \frac{h(s)}{h_{max}}}$$

where $q(s)$ is the number of transitions in the sequence, $q_{max}$ the maximum number of transitions, $h(s)$ the within entropy, and $h_{max}$ the theoretical maximum entropy which is $h_{max} = -\log 1/|A|$ with $|A|$ the size of the alphabet.

The index $C(s)$ is the geometric mean of its two normalized components and is, therefore, itself normalized. The minimum value of 0 can only be reached by a sequence made of one distinct state, thus containing 0 transitions and having an entropy of 0. The maximum 1 of $C(s)$ is reached when the two following conditions are fulfilled: i) Each of the states in the alphabet is present in the sequence, and the total durations are uniform, i.e. each state occurs $\ell/|A|$ times, and ii) the number of transitions in the sequence is $\ell - 1$, meaning that the length $\ell_d$ of the DSS is equal to the length of the sequence $\ell$.

Value
a single-column matrix of length equal to the number of sequences in seqdata containing the complexity index value of each sequence.
Within sequence entropies

Description
Computes normalized or non-normalized within sequence entropies

Usage
seqient(seqdata, norm=TRUE, base=exp(1), with.missing=FALSE, silent=TRUE)
Arguments

seqdata a sequence object as returned by the seqdef function.
norm logical: should the entropy be normalized? TRUE by default. (see details)
base real positive value: base of the logarithm used in the entropy formula (see details). Default is exp(1), i.e., the natural logarithm is used.
with.missing logical: if TRUE, the missing state (gap in sequences) is handled as an additional state when computing the state distribution in the sequence.
silent logical: should messages about running operations be displayed?

Details

The seqient function returns the Shannon entropy of each sequence in seqdata. The entropy of a sequence is computed using the formula

\[ h(\pi_1, \ldots, \pi_s) = - \sum_{i=1}^{s} \pi_i \log \pi_i \]

where \( s \) is the size of the alphabet and \( \pi_i \) the proportion of occurrences of the \( i \)th state in the considered sequence. The base of the log is controlled with the base argument. By default the natural logarithm, i.e. the logarithm in base \( e \), is used. The entropy can be interpreted as the ‘uncertainty’ of predicting the states in a given sequence. If all states in the sequence are the same, the entropy is equal to 0. For example, the maximum entropy for a sequence of length 12 with an alphabet of 4 states is 1.386294 and is attained when each of the four states appears 3 times.

Normalization can be requested with the norm=TRUE option, in which case the returned value is the entropy divided by the entropy of the alphabet. The latter is an upper bound for the entropy of sequences made from this alphabet. It is exactly the maximal entropy when the sequence length is a multiple of the alphabet size. The value of the normalized entropy is independent of the chosen logarithm base.

Value

a single-column matrix with an entropy value for each sequence in seqdata; the column length is equal to the number of sequences.

Author(s)

Alexis Gabadinho

References


seqindic

See Also

seqindic, seqici, seqST, and seqstat for the entropy of the cross-sectional state distributions by positions in the sequence.

Examples

data(actcal)
actcal.seq <- seqdef(actcal,13:24)

## Summarize and plots an histogram
## of the within sequence entropy
actcal.ient <- seqient(actcal.seq)
summary(actcal.ient)
hist(actcal.ient)

## Examples using with.missing argument
data(ex1)
ex1.seq <- seqdef(ex1, 1:13, weights=ex1$weights)

seqient(ex1.seq)
seqient(ex1.seq, with.missing=TRUE)

seqindic

Sequence indicators

Description

Table of per sequence values of selected indicators.

Usage

seqindic(seqdata, indic=c("visited","trans","entr","cplx"), with.missing=FALSE,
ipo.args=list(), integr.args=list(), prec.args=list(), w=1)

Arguments

seqdata  a state sequence object (class stslist) as returned by seqdef.
indic     vector of character strings. List of selected indicators among "lgth" (sequence length), "nonm" (number of non-missing elements), "dlgth", (number of successive distinct states), "visited" (number of visited states), "trans" (number of state changes), "transp" (number of state changes as a proportion of maximum possible transitions), "entr" (longitudinal normalized entropy), "volat" (objective volatility), "cplx" (complexity index), "turbn" (normalized turbulence), "turb" (turbulence), "integr" (integrative potential), "ppos" (proportion of positive states), "vpos" volatility of positive-negative state sequences, "inpos" (potential to integrate a positive state), "prec" (precarity index). Setting indic="all" selects all indicators but "integr", "ppos", "vpos", "inpos", and "prec" that require an additional argument list.
seqindic

with.missing logical: should non-void missing values be treated as a regular state? If FALSE (default) missing values are ignored.

ipos.args list: when any of "ppos", "vpos", or "inpos" is requested, the arguments passed to seqipos together with seqdata and with.missing. See seqipos

integr.args list: when "integr" requested, the arguments passed to seqintegration together with seqdata and with.missing. See seqintegration

prec.args list: when "prec" requested, the arguments passed to seqprecarity together with seqdata and with.missing. See seqprecarity

w real in range [0,1]: when volat weight coefficient passed to seqivolatility. Default is 1.

Details

The number of visited states is the number of different elements in the sequence, e.g. 2 for aababba.

The sequence length, number of transitions, longitudinal entropy, complexity, turbulence, proportion of positive states, and precarity are computed respectively with functions seqlength, seqtransn, seqient, seqici, seqST, seqipos, and seqprecarity. See corresponding help pages for details.

The with.missing argument applies to all indicators but the length. lgth returns the length obtained with with.missing=TRUE, and nonm the length obtained with with.missing=FALSE.

Value

A data frame with the selected indicators. Names are:
Lght: Length of the sequence
NonM: Number of non missing elements
Dlgth: Length of the sequence of distinct successive states (DSS)
Visited: Number of visited states
Trans: Number of state changes
Transp: Number of state changes as a proportion of maximum number of transitions
Entr: Longitudinal entropy
Volat: Objective volatility
Cplx: Complexity
Turbn: Normalized turbulence
Turb: Turbulence
Integr: Integrative capacity
Ppos: Proportion of positive states
Vpos: Volatility of positive-negative state sequences
Inpos: Potential to integrate a positive state
Prec: Precarity

Author(s)

Gilbert Ritschard

See Also

seqlength, seqtransn, seqient, seqici, seqST, seqipos, and seqprecarity
Examples

```r
data(ex1)
sx <- seqdef(ex1[,1:13], right="DEL")
print(sx, format='
quotesingle.Var
SPS
quotesingle.Var')
seqindic(sx, indic=c("lgth","nomm","visited","turbn","cplx"))
seqindic(sx, indic=c("lgth","nomm","visited","turbn","cplx"), with.missing=TRUE)
seqindic(sx, indic=c("lgth","dlght","ppos","inpos","prec"), with.missing=TRUE,
      ipos.args=list(pos.states=c("A","B")),
      prec.args=list(state.order=c("A","B","C"), state.equiv=list(c("C","D"))))
seqindic(sx, indic=c("volat","integr"), integr.args=list(state="D"))
```

seqintegration  Integrative potential

Description

Returns Brzinsky-Fay’s index of integrative potential for each sequence, either a table with the index for each state or a vector with the index for the selected state.

Usage

```r
seqintegration(seqdata, state=NULL, pow=1, with.missing=FALSE)
```

Arguments

- `seqdata` a state sequence object (stslist) as returned by `seqdef`
- `state` character string. The state for which to compute the integration index (see Details). When `NULL` the index is computed for each state.
- `pow` real. Exponent applied to the position in the sequence. Higher value increase the importance of recency (see Details). Default is 1.
- `with.missing` logical: should non-void missing values be treated as a regular state? If `FALSE` (default) missing values are ignored.

Details

The index of integrative potential measures the capacity to integrate the selected state within the sequence, i.e. the tendency in to reach the selected state and end up in it. The index is defined as the sum of the position numbers occupied by the selected state in the sequence over the sum of all position numbers. Formally, for a sequence \( s \) of length \( L \), and numbering the positions \( i \) from 1 to \( L \), the index is

\[
integration = \frac{\sum_{(i | s_i = \text{state})} i^{\text{pow}}}{\sum_{i} i^{\text{pow}}}
\]

where \( \text{state} \) is the selected state.
The exponent \textit{pow} permits to control the focus given on the latest positions in the sequence. The higher \textit{pow}, the higher the importance of the last positions relative to the first ones. When \textit{with.missing} = FALSE, the index is adjusted by subtracting the sum of the positions numbers of the missings from the denominator. To compute the index for the missing state, \textit{with.missing} should be set as TRUE.

**Value**

When \text{state} = \text{NULL}, a numeric matrix with a row for each sequence and a column by state and a single column when a state is provided.

**Author(s)**

Gilbert Ritschard

**References**

Brzinsky-Fay, C. Unused Resources: Sequence and Trajectory Indicators. International Symposium on Sequence Analysis and Related Methods, Monte Verita, TI, Switzerland, October 10-12, 2018

**See Also**

\texttt{seqipos}, \texttt{seqivolatility}, \texttt{seqindic}

**Examples**

```r
data(ex1)
sx <- seqdef(ex1[,1:13], right="DEL")

seqintegration(sx)
seqintegration(sx, with.missing=TRUE)
seqintegration(sx, state="B")
seqintegration(sx, state="B", pow=1.5)
```

**seqipos**

\textit{Proportion of positive spells or states per sequence}

**Description**

Indicators for the underlaying binary sequences of positive and negative states. Possible indicators are the proportion of positive states within each sequence, i.e. of positive spells if computed on the sequences of distinct successive states (DSS), objective volatility of the binary sequences, and capacity to integrate a positive state.

**Usage**

\texttt{seqipos(seqdata, dss=NULL, pos.states=NULL, neg.states=NULL, index="share", pow=1, w=.5, with.missing=FALSE)}
sequpos

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>seqdata</td>
<td>a state sequence object (stslist) as returned by seqdef.</td>
</tr>
<tr>
<td>dss</td>
<td>logical. Should the proportion be computed inside the DSS sequences? Defaults to TRUE when index=&quot;share&quot; and to FALSE otherwise.</td>
</tr>
<tr>
<td>pos.states</td>
<td>vector of positive states.</td>
</tr>
<tr>
<td>neg.states</td>
<td>vector of negative states.</td>
</tr>
<tr>
<td>index</td>
<td>character string. One of &quot;share&quot; (proportion of positive states or spells), &quot;volatility&quot; (objective volatility), or &quot;integration&quot; (capacity to integrate a positive state). See Details. Default is &quot;share&quot;.</td>
</tr>
<tr>
<td>pow</td>
<td>real. Exponent passed to seqintegration. Only used when index=&quot;integration&quot;. Default is 1.</td>
</tr>
<tr>
<td>w</td>
<td>real in range [0,1]. Relative weight of proportion of visited states in volatility (see seqivolatility). Only used when index=&quot;volatility&quot;. Default is .5.</td>
</tr>
<tr>
<td>with.missing</td>
<td>logical: should non-void missing values be treated as a regular state? If FALSE (default) missing values are ignored.</td>
</tr>
</tbody>
</table>

Details

The function transforms the provided state sequences into binary sequence of positive and negative states. When dss = TRUE, the count of positive and negative elements give the number of positive and negative spells. The binary state sequence object is returned as an attribute.

When neg.states=NULL, states not listed on the pos.states argument are considered as negative and conversely when pos.states=NULL. When with.missing=TRUE, the missing state nr will be considered as positive if included in the pos.states list or as negative if in neg.states. When with.missing=FALSE (default) missing states are ignored. However, when missing values appear within a spell, such as in AA*ABB, the DSS sequence will have two consecutive occurrences of the spell. For the example we would have AAB, i.e. if A is positive and B negative, a proportion of 2/3 of positive spells.

When both pos.states and neg.states are provided, states of the alphabet (including the nr code when with.missing=TRUE) that belong nor to pos.states nor to neg.states are ignored.

For index="share", letting npos be the number of positive states and nneg the number of negative states in the sequence, the function returns the value of npos/(npos + nneg) for each sequence. With dss=TRUE, this is the normative volatility of Brzinsky-Fay.

For index="volatility", the function returns the objective volatility of the binary sequences. See seqivolatility.

For index="integration", the function returns the index of integrative potential for the positive state. See seqintegration.

Value

A numeric vector with
- when index="share", the proportion of positive states (or spells) within each sequence;
- when index="volatility", the objective volatility of the sequences;
- when index="integration", the index of integration into a positive state.

The binary sequence as an attribute sbinary.
Author(s)

Gilbert Ritschard

See Also

seqindic

Examples

data(ex1)
sx <- seqdef(ex1[1:13], right="DEL")
nr <- attr(sx,'nr') ## code for missing values

seqipos(sx, pos.states=c("A","B"))
seqipos(sx, pos.states=c("A","B"), with.missing=TRUE)

## ignoring state "D"
seqipos(sx, pos.states=c("A","B"), neg.states=c("C",nr), with.missing=TRUE)

seqipos(sx, pos.states=c("A","B"), dss=FALSE)
seqipos(sx, pos.states=c("A","B",nr), dss=FALSE, with.missing=TRUE)

seqipos(sx, pos.states=c("A","B"), index="volatility")
seqipos(sx, pos.states=c("A","B"), index="integration")

## retrieving the binary sequences
ip <- seqipos(sx, pos.states=c("A","B"))
attr(ip,"sbinary")
ip <- seqipos(sx, pos.states=c("A","B"), with.missing=TRUE)
attr(ip,"sbinary")

State frequencies in each individual sequence

Description

Returns the state frequencies (total durations) for each sequence in the sequence object.

Usage

seqistatd(seqdata, with.missing=FALSE, prop=FALSE)

Arguments

seqdata a sequence object (see seqdef function).
with.missing logical: if set as TRUE, total durations are also computed for the missing status (gaps in the sequences). See seqdef on options for handling missing values when creating sequence objects.
seqivolatility

Prop

Logical: if TRUE, proportions of time spent in each state are returned instead of absolute values. This option is specially useful when sequences contain missing states, since the sum of the state durations may not be the same for all sequences.

Author(s)

Alexis Gabadinho

References


Examples

data(actcal)
actcal.seq <- seqdef(actcal,13:24)
seqistatd(actcal.seq[1:10,])

## Example using "with.missing" argument
data(ex1)
ex1.seq <- seqdef(ex1, 1:13, weights=ex1$weights)
seqistatd(ex1.seq)
seqistatd(ex1.seq, with.missing=TRUE)

seqivolatility

Volatility of individual state sequences

Description

Returns Brzinsky-Fay’s objective volatility of each sequence.

Usage

seqivolatility(seqdata, type=1, w=.5, with.missing=FALSE)

Arguments

seqdata a state sequence object (stslist) as returned by seqdef.

type either 1 or 2. The default type=1 is the indicator adjusted such that it can reach its bounds 0 and 1. Type 2 is the unadjusted indicator (see Details).

w real in the range [0, 1]. Weight given to the proportion of states visited (see Details).

with.missing logical: should non-void missing values be treated as a regular state? If FALSE (default) missing values are ignored.
Details

The (objective) volatility is the weighted average between the proportion \( p_{\text{visited}} \) of states visited and the frequency \( f_{\text{trans}} \) of transitions (state changes). Formally,

\[
\text{volatility} = w \cdot p_{\text{visited}} + (1 - w) \cdot f_{\text{trans}}
\]

The proportion of states visited is computed as \((\text{visited} - 1)/(|a| - 1)\) when \( \text{type}=1 \) and as \( \text{visited}/|a| \) when \( \text{type}=2 \). Here, \( \text{visited} \) is the number of states visited and \( |a| \) the size of the alphabet.

The frequency of transition is \( f_{\text{trans}} = \frac{\text{trans}_{n}}{\text{max}\cdot\text{trans}_{n}} \) where \( \text{trans}_{n} \) is the number of transitions (state changes) within the sequence, and \( \text{max}\cdot\text{trans}_{n} \) the maximum possible transitions in the sequence.

For the normative volatility computed for a set of positive states, see seqipos.

Value

A numeric vector with the volatility of each sequence.

Author(s)

Gilbert Ritschard

References

Brzinsky-Fay, C. Unused Resources: Sequence and Trajectory Indicators. International Symposium on Sequence Analysis and Related Methods, Monte Verita, TI, Switzerland, Oct 10-11, 2018

See Also

seqintegration, seqipos, seqindic

Examples

data(ex1)
sx <- seqdef(ex1[,1:13], right="DEL")

seqivolatility(sx)
seqivolatility(sx, type=2)
seqivolatility(sx, with.missing=TRUE)
seqivolatility(sx, w=.7, with.missing=TRUE)
seqlegend

Plot a legend for the states in a sequence object

Description

Plots a legend for the states in a sequence object. Useful if several graphics are plotted together and only one legend is necessary. Unless specified by the user, the `cpal` and `labels` attributes of the sequence object are used for the colors and text appearing in the legend (see seqdef).

Usage

```r
seqlegend(seqdata, with.missing = "auto", cpal = NULL, missing.color = NULL, ltext = NULL, position = "topleft", cex = 1, fontsize, ...)
```

Arguments

- `seqdata`: a sequence object as returned by the seqdef function.
- `with.missing`: if set to "auto" (default), a legend for the missing state is added automatically if one or more of the sequences in seqdata contains a missing state. If TRUE a legend for the missing state is added in any case. Setting to FALSE omits the legend for the missing state.
- `cpal`: alternative color palette to use for the states. If user specified, a vector of colors with number of elements equal to the number of distinct states. By default, the 'cpal' attribute of the 'seqdata' sequence object is used (see seqdef).
- `missing.color`: alternative color for representing missing values inside the sequences. By default, this color is taken from the "missing.color" attribute of the sequence object being plotted.
- `ltext`: optional description of the states to appear in the legend. Must be a vector of character strings with number of elements equal to the number of distinct states. If unspecified, the 'labels' attributes of the 'seqdata' sequence object is used (see seqdef).
- `position`: the position of the legend in the graphic area. For accepted values, see legend. Defaults to "topleft".
- `cex`: size of the font for the labels. A value less than 1 decreases the font size, a value greater than 1 increases the font size. Defaults to 1.
- `fontsize`: Deprecated. Use cex instead.

Author(s)

Alexis Gabadinho
Examples

```r
## Loading the 'actcal' example data set
## and defining a sequence object with
## (activity statuses from jan. to dec. 2000)
## the data in columns 13 to 24
data(actcal)
actcal.seq <- seqdef(actcal,13:24,
labels=c("> 37 hours", "19-36 hours", "1-18 hours", "no work"))

## Plotting the sequences frequency,
## the states distribution
## and the legend
par(mfrow=c(2,2))
seqiplot(actcal.seq, idxs=0, with.legend=FALSE, border=NA, space=0)
seqfplot(actcal.seq, pbarw=TRUE, with.legend=FALSE)
seqdplot(actcal.seq, with.legend=FALSE)
seqlegend(actcal.seq)
```

---

**seqlength**

*Sequence length*

---

**Description**

Returns the length of sequences.

**Usage**

```r
seqlength(seqdata, with.missing=TRUE)
```

**Arguments**

- `seqdata`: a sequence object created with the `seqdef` function.
- `with.missing`: logical: should non-void missing values be treated as a regular state? Default is TRUE. If FALSE missing values are considered as void.

**Details**

The length of a sequence is computed by counting its number of non-void elements, i.e. including non-void missing values. The `seqlength` function returns a vector containing the length of each sequence in the provided sequence object.

**Author(s)**

Alexis Gabadinho and Gilbert Ritschard
Examples

```r
## Loading the 'famform' example data set
data(famform)

## Defining a sequence object with the 'famform' data set
ff.seq <- seqdef(famform)

## Retrieving the length of the first 10 sequences
## in the ff.seq sequence object
seqlength(ff.seq)
```

```r
seqLLCP(seq1, seq2)
```

Arguments

- `seq1`: a sequence from a sequence object.
- `seq2`: a sequence from a sequence object.

Value

an integer being the length of the longest common prefix of the two sequences.

References


See Also

- `seqdist`

Examples

```r
data(famform)
famform.seq <- seqdef(famform)

## The LCP's length between sequences 1 and 2
## in the famform sequence object is 2
seqLLCP(famform.seq[1,], famform.seq[2,])
```
seqLLCS

Description

Returns the length of the longest common subsequence of two sequences. This attribute is described in Elzinga (2008).

Usage

seqLLCS(seq1, seq2)

Arguments

seq1 a sequence from a sequence object
seq2 a sequence from a sequence object

Value

an integer being the length of the longest common subsequence of the two sequences.

References


See Also

seqdist

Examples

LCS.ex <- seqdef(LCS.ex)
seqLLCS(LCS.ex[1,], LCS.ex[3,])
seqlogp

Logarithm of the probabilities of state sequences

Description

Compute the logarithm of the probability of each state sequence obtained from a state transition model. The probability of a sequence is equal to the product of each state probability of the sequence. There are several methods to compute a state probability.

Usage

seqlogp(seqdata, prob="trate", time.varying=FALSE, begin="freq", weighted=TRUE)

Arguments

seqdata The sequence to compute the probabilities.
prob either the name ("trate" or "freq") of the probability model to use to compute the state probabilities, or an array specifying the transition probabilities at each position t (see details).
time.varying Logical. If TRUE, the probabilities (transitions or frequencies) are computed separately for each time t point.
begin Model used to compute the probability of the first state. Either "freq" to use the observed frequencies on the first period or a vector specifying the probability of each state of the alphabet.
weighted Logical. If TRUE, uses the weights specified in seqdata when computing the observed transition rates.

Details

The sequence likelihood $P(s)$ is defined as the product of the probability with which each of its observed successive state is supposed to occur at its position. Let $s = s_1 s_2 \cdots s_\ell$ be a sequence of length $\ell$. Then

$$P(s) = P(s_1, 1) \cdot P(s_2, 2) \cdots P(s_\ell, \ell)$$

with $P(s_t, t)$ the probability to observe state $s_t$ at position $t$.

The question is how to determinate the state probabilities $P(s_t, t)$. Several methods are available and can be set using the prob argument.

One commonly used method for computing them is to postulate a Markov model, which can be of various order. We can consider probabilities derived from the first order Markov model, that is, each $P(s_t, t), t > 1$ is set as the transition rate $p(s_t|s_{t-1})$. This is available in seqlogp by setting prob="trate".

The transition rates may be considered constant over time/positions (time.varying=FALSE), that is estimated across sequences from the observations at positions $t$ and $t-1$ for all $t$ together. Time varying transition rates may also be considered (time.varying=TRUE), in which case they are computed separately for each position, that is estimated across sequences from the observations.
at positions $t$ and $t-1$ for each $t$, yielding an array of transition matrices. The user may also specify his own transition rates array or matrix.

Another method is to use the frequency of a state at each position to set $P(s_t, t)$ (prob="freq"). In the latter case, the probability of a sequence is independent of the probability of the transitions. Here again, the frequencies can be computed all together (time.varying=FALSE) or separately for each position $t$ (time.varying=TRUE).

For $t = 1$, we set $P(s_1, 1)$ to the observed frequency of the state $s_1$ at position 1. Alternatively, the begin argument allows to specify the probability of the first state.

The likelihood $P(s)$ being generally very small, seqlogp return $-\log P(s)$. The latter quantity is minimal when $P(s)$ is equal to 1.

Value

A vector containing the logarithm of each sequence probability.

Author(s)

Matthias Studer and Alexis Gabadinho (with Gilbert Ritschard for the help page)

Examples

## Creating the sequence objects using weights
data(biofam)
biofam.seq <- seqdef(biofam, 10:25, weights=biofam$wp00tbgs)

## Computing sequence probabilities
biofam.prob <- seqlogp(biofam.seq)
## Comparing the probability of each cohort
cohort <- biofam$birthyr>1940
boxplot(biofam.prob~cohort)

seqmeant(seqdata, weighted=TRUE, with.missing=FALSE, prop=FALSE, serr=FALSE)
Arguments

seqdata a sequence object as defined by the seqdef function.

weighted logical: if TRUE, the weights (weights attribute) attached to the sequence object are used for computing weighted mean total time.

with.missing logical: if set to TRUE, cumulated durations are also computed for the missing status (gaps in the sequences). See seqdef on options for handling missing values when creating sequence objects.

prop logical: if TRUE, proportions of time spent in each state are returned instead of absolute values. This option is especially useful when sequences contain missing states, since the sum of the state durations may not be the same for all sequences.

serr logical: if TRUE, the variance and standard deviation of the total time spent in the states, as well as the standard error of the mean are also computed.

Value

An object of class stslist.meant. There are print and plot methods for such objects.

Author(s)

Alexis Gabadinho

References


See Also

plot.stslist.meant for basic plots of stslist.meant objects and seqmtplot (seqplot with type="mt") argument for more sophisticated plots of the mean durations allowing grouping and legend.

Examples

```r
## Defining a sequence object with columns 13 to 24
## in the actcal example data set
data(actcal)
actcal.lab <- c("> 37 hours", "19-36 hours", "1-18 hours", "no work")
actcal.seq <- seqdef(actcal,13:24,labels=actcal.lab)

## Computing the mean time in the different states
seqmeant(actcal.seq)

## Mean times with their standard error
seqmeant(actcal.seq, serr=TRUE)
```
seqmodst

Sequence of modal states

Description
Sequence made of the modal state at each position.

Usage
seqmodst(seqdata, weighted=TRUE, with.missing=FALSE)

Arguments
- seqdata: a state sequence object as defined by the `seqdef` function.
- weighted: if TRUE, distributions account for the weights assigned to the state sequence object (see `seqdef`). Set as FALSE if you want ignore the weights.
- with.missing: If FALSE (default value), returned distributions ignore missing values.

Details
In case of multiple modal states at a given position, the first one is taken. Hence, the result may vary with the alphabet order.

Value
an object of class `stslist.modst`. This is actually a state sequence object (containing a single state sequence) with additional attributes, among which the `Frequencies` attribute containing the transversal frequency of each state in the sequence. There are print and plot methods for such objects. More sophisticated plots can be produced with the `seqplot` function.

Author(s)
Alexis Gabadinho

References

See Also
- `plot.stslist.modst` for default plot method, `seqplot` for higher level plots.
Examples

```r
## Defining a sequence object with the data in columns 10 to 25
## (family status from age 15 to 30) in the biofam data set
data(biofam)
biofam.seq <- seqdef(biofam, 10:25, labels=biofam.lab)

## Modal state sequence
seqmodst(biofam.seq)

## Examples using weights and with.missing arguments
data(ex1)
ex1.seq <- seqdef(ex1, 1:13, weights=ex1$weights)

seqmodst(ex1.seq)
seqmodst(ex1.seq, weighted=FALSE)
seqmodst(ex1.seq, weighted=FALSE, with.missing=TRUE)
```

**seqmpos**

Number of matching positions between two sequences.

Description

Returns the number of common elements, i.e., same states appearing at the same position in the two sequences.

Usage

```r
seqmpos(seq1, seq2, with.missing=FALSE)
```

Arguments

- `seq1`: a sequence from a sequence object.
- `seq2`: a sequence from a sequence object.
- `with.missing`: if TRUE, gaps appearing at the same position in both sequences are also considered as common elements.

Author(s)

Alexis Gabadinho (with Gilbert Ritschard for help page)

See Also

`seqLLCP, seqLLCS`
Examples

data(famform)
famform.seq <- seqdef(famform)

seqmpos(famform.seq[1,], famform.seq[2,])
seqmpos(famform.seq[2,], famform.seq[4,])

## Example with gaps in sequences
a <- c(NA,"A",NA,"B","C")
b <- c(NA,"C",NA,"B","C")

ex1.seq <- seqdef(rbind(a,b))

seqmpos(ex1.seq[1,], ex1.seq[2,])
seqmpos(ex1.seq[1,], ex1.seq[2,], with.missing=TRUE)

---

seqnum

Transform into a sequence object with numerical alphabet.

Description

The function `seqnum` transforms the provided state sequence object into an equivalent sequence object in which the original alphabet is replaced with an alphabet of numbers ranging from 0 to (nbstates-1).

Usage

```
seqnum(seqdata, with.missing=FALSE)
```

Arguments

- `seqdata` a state sequence object as defined by the `seqdef` function.
- `with.missing` logical: Should missing elements in the sequences be turned into numerical values as well? The code for missing values in the sequences is retrieved from the 'nr' attribute of seqdata.

Details

The first state (for example 'A') is coded with the value 0, the second state (for example 'B') is coded with the value 1, etc... The function returns a sequence object containing the original sequences coded with the new numerical alphabet ranging from 0 to (nbstates-1)

Author(s)

Alexis Gabadinho
seqpcplot

Description

A decorated parallel coordinate plot to render the order of the successive elements in sequences. The sequences are displayed as jittered frequency-weighted parallel lines. The plot is also embedded as the type="pc" option of the seqplot function and serves as plot method for eseq and seqelist objects.

Examples

data(actcal)
actcal.seq <- seqdef(actcal, 13:24)

## The first 10 sequences in the actcal.seq
## sequence object
actcal.seq[1:10,]
alphabet(actcal.seq)

## The first 10 sequences in the actcal.seq
## sequence object with numerical alphabet
seqnum(actcal.seq[1:10,])

## states A, B, C, D are now coded 0, 1, 2, 3
alphabet(seqnum(actcal.seq))

seqpcplot

Parallel coordinate plot for sequence data

Usage

seqpcplot(seqdata, group = NULL, weights = NULL, cex = 1, lwd = 1/4,
cpal = NULL, grid.scale = 1/5, ltype = "unique",
embedding = "most-frequent", lorder = NULL, lcourse = "upwards",
filter = NULL, hide.col = "grey80", alphabet = NULL,
missing = "auto", order.align = "first", main = NULL, xlab = NULL,
ylab = NULL, xaxis = TRUE, yaxis = TRUE, axes = "all", xtlab = NULL,
cex.lab = 1, rows = NA, cols = NA, plot = TRUE, seed = NULL,
weighted = TRUE, with.missing = TRUE,
title, cex.plot, ...)

seqpcfilter(method = c("minfreq", "cumfreq", "linear"), level = 0.05)
Arguments

seqdata The sequence data. Either an event sequence object of class seqelist (see seqecreate) or a state sequence object of class stslist (see seqdef).

group a vector (numeric or factor) of group memberships of length equal the number of sequences. When specified, one plot is generated for each different membership value.

weights a numeric vector of weights of length equal the number of sequences. When NULL, the weights are taken from the seqdata object.

cex Plotting text and symbols magnification. See par.

lwd expansion factor for line widths. The expansion is relative to the size of the squared symbols.

cpal color palette vector for line coloring.

grid.scale Expansion factor for the translation zones.

ltype the type of sequence that is drawn. Either "unique" to render unique patterns or "non-embeddable" to render non-embeddable sequences.

embedding The method for embedding sequences embeddable in multiple non-embeddable sequences. Either "most-frequent" (default) or "uniformly". Relevant only with ltype = "non-embeddable".

lorder line ordering. Either "background" or "foreground".

lcourse Method to connect simultaneous elements with the preceding and following ones. Either "upwards" (default) or "downwards".

filter list of line coloring options. See details.

hide.col Color for sequences filtered-out by the filter specification.

alphabet a vector of response levels in the order they should appear on the y-axis. This argument is solely relevant for seqelist objects.

missing character. Whether and how missing values should be displayed. Available are "auto", "show" and "hide". If "auto", the plot will show missings only if present. "hide" will fade out missings and "show" will always show missings. If with.missing=FALSE, missing is turned into "hide". If with.missing=TRUE and missing="hide", missing is turned into "auto".

order.align Aligning method. For aligning on order positions use either "first" (default) or "last". Option "first" numbers the positions from the beginning while "last" numbers them from the end. With order.align = "time", the elements in the sequences are aligned on their rounded timestamps.

main title for the graphic.

xlab label for the x axis

ylab label for the y axis

xaxis logical: Should x-axis be plotted?

yaxis logical: Should y-axis be plotted?

axes if set as "all" (default value) x-axes are drawn for each plot in the graphic. If set as "bottom" and group is used, axes are drawn only under the plots at the bottom of the graphic area. If FALSE, no x-axis is drawn.
seqpcplot

xtlab labels for the x-axis ticks.
cex.lab x and y labels magnification. See par.
rows, cols integers. Number of rows and columns of the plot panel.
plot logical. Should the plot be displayed? Set as FALSE to retrieve the seqpcplot object without plotting it.
seed integer. Start seed value.
weighted logical. Should weights be accounted for? Default is TRUE.
with.missing logical. Should we care about possible missings? Default is TRUE. See also the missing argument.
method character string. Defines the filtering function. Available are "minfreq", "cumfreq" and "linear".
level numeric scalar between 0 and 1. The frequency threshold for the filtering methods "minfreq" and "cumfreq".
title Deprecated. Use main instead.
cex.plot Deprecated. Use cex.lab instead.
... arguments to be passed to other methods, such as graphical parameters (see par).

Details

For plots by groups specified with the group argument, plotted line widths and point sizes reflect relative frequencies within group.

The filter argument serves to specify filters to gray less interesting patterns. The filtered-out patterns are displayed in the hide.col color. The filter argument expects a list with at least elements type and value. The following types are implemented:

Type "sequence": colors a specific pattern, for example assign
filter = list(type = "sequence", value = "(Leaving Home, Union)-(Child)").

Type "subsequence": colors patterns which include a specific subsequence, for example
filter = list(type = "subsequence", value = "(Child)-(Marriage)").

Type "value": gradually colors the patterns according to the numeric vector (of length equal to the number of sequences) provided as "value" element in the list. You can give something like
filter = list(type = "value", value = c(0.2, 1, ...)) or provide the distances to the medoid as value vector for example.

Type "function": colors the patterns depending on the values returned by a [0,1] valued function of the frequency x of the pattern. Three native functions can be used: "minfreq", "cumfreq" and "linear". Use filter = list(type = "function", value = "minfreq", level = 0.05) to color patterns with a support of at least 5% (within group). Use filter = list(type = "function", value = "cumfreq", level = 0.5) to highlight the 50% most frequent patterns (within group). Or, use filter = list(type="function",value="linear") to use a linear gradient for the color intensity (the most frequent trajectory gets 100% intensity). Other user-specified functions can be provided by giving something like
filter = list(type="function",value=function(x, arg1, arg2) {return(x/max(x) * arg1/arg2)}, arg1 = 1, arg2 = 1). This latter function adjusts gradually the color intensity of patterns according to the frequency of the pattern.
The function `seqpcfilter` is a convenience function for type "function". The three examples above can be imitated by `seqpcfilter("minfreq",0.05)`, `seqpcfilter("cumfreq",0.5)` and `seqpcfilter("linear")`. If a numeric scalar is assigned to `filter`, the "minfreq" filter is used.

Value

An object of class "seqpcplot" with various information necessary for constructing the plot, e.g. coordinates. There is a summary method for such objects.

Author(s)

Reto Bürgin (with Gilbert Ritschard for the help page)

References


See Also

`seqplot`, `seqdef`, `seqecreate`

Examples

```r
## plot biofam data
##
## plot state sequences in STS representation
##
## creating the weighted state sequence object.
##
## selecting the first 20 weighted sequences (sum of weights = 18)
##
## Distinct successive states (DSS)
```
seqpcplot

## =========================================

seqplot(seqdata = biofam.seq, type = "pc", order.align = "first")

## .. or (equivalently)

biofam.DSS <- seqdss(seqdata = biofam.seq) # prepare format
seqpcplot(seqdata = biofam.DSS)

## plot event sequences
## ====================

biofam.eseq <- seqecreate(biofam.seq, tevent = "state") # prepare data

## plot the time in the x-axis
seqpcplot(seqdata = biofam.eseq, order.align = "time", alphabet = lab)

## ordering of events
seqpcplot(seqdata = biofam.eseq, order.align = "first", alphabet = lab)

## ... or
plot(biofam.eseq, order.align = "first", alphabet = lab)

## additional arguments
## ======================

## non-embeddable sequences
seqpcplot(seqdata = biofam.eseq, ltype = "non-embeddable",
          order.align = "first", alphabet = lab)

## align on last event
par(mar=c(4,8,2,2))
seqpcplot(seqdata = biofam.eseq, order.align = "last", alphabet = lab)

## use group variables
seqpcplot(seqdata = biofam.eseq, group = biofam$sex[1:20],
          order.align = "first", alphabet = lab)

## color patterns (Parent)-(Married) and (Parent)-(Left+Marr+Child)
par(mfrow = c(1, 1))
seqpcplot(seqdata = biofam.eseq,
         filter = list(type = "sequence",
                        value=c("(Parent)-(Married)",
                                "(Parent)-(Left+Marr+Child)")),
         alphabet = lab, order.align = "first")

## color subsequence pattern (Parent)-(Left)
seqpcplot(seqdata = biofam.eseq,
         filter = list(type = "subsequence",
                        value = "(Parent)-(Left)"),
         alphabet = lab, order.align = "first")

## color sequences over 10% (within group) (function method)
seqpcplot(seqdata = biofam.eseq,
    filter = list(type = "function",
                 value = "minfreq",
                 level = 0.1),
    alphabet = lab, order.align = "first", seed = 1)

## .. same result using the convenience functions
seqpcplot(seqdata = biofam.eseq,
    filter = 0.1,
    alphabet = lab, order.align = "first", seed = 1)

seqpcplot(seqdata = biofam.eseq,
    filter = seqpcfilter("minfreq", 0.1),
    alphabet = lab, order.align = "first", seed = 1)

## highlight the 50% most frequent sequences
seqpcplot(seqdata = biofam.eseq,
    filter = list(type = "function",
                 value = "cumfreq",
                 level = 0.5),
    alphabet = lab, order.align = "first", seed = 2)

## .. same result using the convenience functions
seqpcplot(seqdata = biofam.eseq,
    filter = seqpcfilter("cumfreq", 0.5),
    alphabet = lab, order.align = "first", seed = 2)

## linear gradient
seqpcplot(seqdata = biofam.eseq,
    filter = list(type = "function",
                 value = "linear"),
    alphabet = lab, order.align = "first", seed = 2)

seqpcplot(seqdata = biofam.eseq,
    filter = seqpcfilter("linear"),
    alphabet = lab, order.align = "first", seed = 1)

---

**seqplot**  
*Plot state sequence objects*

**Description**

High level plot functions for state sequence objects that can produce state distribution (chronograms), frequency, index, transversal entropy, sequence of modes, meant time, and representative plots.
seqplot

Usage

seqplot(seqdata, group = NULL, type = "i", main = NULL, cpal = NULL,
missing.color = NULL, ylab = NULL, yaxis = TRUE, axes = "all",
xtlab = NULL, cex.axis = 1, with.legend = "auto", ltext = NULL,
cex.legend = 1, use.layout = (!is.null(group) | with.legend != FALSE),
legend.prop = NA, rows = NA, cols = NA, title, cex.plot, withlegend, ...)

seqdplot(seqdata, group = NULL, main = NULL, ...)
seqfplot(seqdata, group = NULL, main = NULL, ...)
seqIplot(seqdata, group = NULL, main = NULL, ...)
seqHtplot(seqdata, group = NULL, main = NULL, ...)
seqmsplot(seqdata, group = NULL, main = NULL, ...)
seqmtplot(seqdata, group = NULL, main = NULL, ...)
seqrplot(seqdata, group = NULL, main = NULL, ...)

Arguments

seqdata State sequence object created with the `seqdef` function.

Grouping variable of length equal to the number of sequences. When not NULL, a distinct plot is generated for each level of group.

type the type of the plot. Available types are "d" for state distribution plots (chronograms), "f" for sequence frequency plots, "Ht" for transversal entropy plots, "i" for selected sequence index plots, "I" for whole set index plots, "ms" for plotting the sequence of modal states, "mt" for mean times plots, "pc" for parallel coordinate plots and "r" for representative sequence plots.

main Character string. Title for the graphic. Default is NULL.

cpal Color palette used for the states. By default, the cpal attribute of the seqdata sequence object is used (see `seqdef`). If user specified, a vector of colors of length and order corresponding to `alphabet(seqdata)`.

missing.color Color for representing missing values inside the sequences. By default, this color is taken from the missing.color attribute of seqdata.

ylab Character string. an optional label for the y-axis. If set to NA, no label is drawn.

yaxis Logical. Should the y-axis be plotted? When set as TRUE (default value), sequence indexes are displayed for "i" and "I", mean time values for "mt", percentages for "d" and "f", and state/event labels for "pc". Ignored for "r".

axes Character string or logical. If set as "all" (default value) x axes are drawn for each plot in the graphic. If set as "bottom" and group is used, axes are drawn only under the plots located at the bottom of the graphic area. If FALSE, no x-axis is drawn.

xtlab Vector of length equal to the number of columns of seqdata. Optional labels for the x-axis tick labels. If unspecified, the column names of the seqdata sequence object are used (see `seqdef`).

cex.axis Real value. Axis annotation magnification. When type = "r" and for seqrplot(), it also determines the magnification of the plotted text and symbols. See par.
with.legend Character string or logical. Defines if and where the legend of the state colors is plotted. The default value "auto" sets the position of the legend automatically. Other possible value is "right". Obsolete value TRUE is equivalent to "auto".

ltext Vector of character strings of length and order corresponding to alphabet(seqdata). Optional description of the states to appear in the legend. If unspecified, the label attribute of the seqdata sequence object is used (see seqdef).

cex.legend Real. Legend magnification. See legend.

use.layout Logical. Should layout be used to arrange plots when using the group option or plotting a legend? When layout is activated, the standard 'par(mfrow=....)' for arranging plots does not work. With with.legend=FALSE and group=NULL, layout is automatically deactivated and 'par(mfrow=....)' can be used.

legend.prop Real in range [0,1]. Proportion of the graphic area devoted to the legend plot when use.layout=TRUE and with.legend=TRUE. Default value is set according to the place (bottom or right of the graphic area) where the legend is plotted.

rows,cols Integers. Number of rows and columns of the plot panel when use.layout=TRUE.

title Deprecated. Number of rows and columns of the plot panel when use.layout=TRUE.

cex.plot Deprecated. Use cex.axis instead.

withlegend Deprecated. Use with.legend instead.

... arguments to be passed to the function called to produce the appropriate statistics and the associated plot method (see details), or other graphical parameters. For example the weighted argument can be passed to control whether (un)weighted statistics are produced or with.missing argument to take missing values into account when computing transversal or longitudinal state distributions.

Details

seqplot is the generic function for high level plots of state sequence objects with group splits and automatic display of the color legend. Many different types of plots can be produced by means of the type argument. Except for sequence index plots, seqplot first calls the specific function producing the required statistics and then the plot method for objects produced by this function (see below). For sequence index plots, the state sequence object itself is plotted by calling the plot.stslist method. When splitting by groups and/or displaying the color legend, the layout function is used for arranging the plots.

The seqdplot, seqfplot, seqiplot, seqIplot, seqHtplot, seqmsplot, seqmtplot, seqpcplot and seqrplot functions are aliases for calling seqplot with type argument set respectively to "d", "f", "i", "I", "Ht", "ms", "mt", "pc" or "r".

A State distribution plot (type="d") represents the sequence of the cross-sectional state frequencies by position (time point) computed by the seqstatd function and rendered with the plot.stslist.statd method. Such plots are also known as chronograms.

A Sequence frequency plots (type="f") displays the most frequent sequences, each one with an horizontal stack bar of its successive states. Sequences are displayed bottom-up in decreasing order of their frequencies (computed by the seqtab function). The plot.stslist.freq plot method is called for producing the plot.

The idxs optional argument may be specified for selecting the sequences to be plotted (default is 1:10, i.e. the 10 most frequent sequences). The width of the bars representing the sequences is by
default proportional to their frequencies, but this can be disabled with the pbarw=FALSE optional argument. If weights have been specified when creating seqdata, weighted frequencies are used unless you set the weighted=TRUE option. See examples below, the seqtab and plot.stslist.freq manual pages for a complete list of optional arguments and Müller et al., (2008) for a description of sequence frequency plots.

In sequence index plots (type="i" or type="I"), the requested individual sequences are rendered with horizontal stacked bars depicting the states over successive positions (time). Optional arguments are idxs for specifying the indexes of the sequences to be plotted (when type="i" defaults to the first ten sequences, i.e idxs=1:10). For plotting nicely a (big) whole set one can use type="I" which is the same as using idxs=NULL together with the additional graphical parameters border=NA and space=0 to suppress bar borders and space between bars. The sortv argument can be used to pass a vector of numerical values for sorting the sequences or to specify a sorting method. See plot.stslist for a complete list of optional arguments and their description.

The interest of sequence index plots has, for instance, been stressed by Scherer (2001) and Brzinsky-Fay et al. (2006). Notice that index plots for thousands of sequences result in very heavy PDF or POSTSCRIPT graphic files. Dramatic file size reduction may be achieved by saving the figures in bitmap format with using for instance the png graphic device instead of postscript or pdf.

The transversal entropy plot (type="Ht") displays the evolution over positions of the cross-sectional entropies (Billari, 2001). Cross-sectional entropies are computed by calling seqstatd function and then plotted by calling the plot.stslist.statd plot method.

The modal state sequence plot (type="ms") displays the sequence of the modal states with each mode proportional to its frequency at the given position. The seqmodst function is called which returns the sequence and the result is plotted by calling the plot.stslist.modst plot method.

The mean time plot (type="mt") displays the mean time spent in each state of the alphabet as computed by the seqmeant function. The plot.stslist.meant plot method is used to plot the resulting statistics. Set serr=TRUE to display error bars on the mean time plot.

The representative sequence plot (type="r") displays a reduced, non redundant set of representative sequences extracted from the provided state sequence object and sorted according to a representativeness criterion. The seqrep function is called to extract the representative set which is then plotted by calling the plot.stslist.rep method. A distance matrix is required that is passed with the diss argument or by calling the seqdist function if diss=NULL. The criterion argument sets the representativeness criterion used to sort the sequences. Refer to the seqrep and plot.stslist.rep manual pages for a complete list of optional arguments. See Gabadinho and Ritschard (2013) for more details on the extraction of representative sets. Also look at the examples below.

For decorated parallel coordinate plots (type="pc") see the specific manual page of seqpcplot.

Author(s)

Alexis Gabadinho (with Gilbert Ritschard for the help page)

References


See Also

plot.stslist.statd, plot.stslist.freq, plot.stslist, plot.stslist.modst, plot.stslist.meant, plot.stslist.rep, seqrep, seqpcplot, seqsplot.

Examples

```r
## ======================================================  
## Creating state sequence objects from example data sets  
## ======================================================  

## biofam data set  
data(biofam)  
## We use only a sample of 300 cases  
set.seed(10)  
biofam <- biofam[sample(nrow(biofam),300),]  
biofam.seq <- seqdef(biofam, 10:25, labels=biofam.lab)

## actcal data set  
data(actcal)  
## We use only a sample of 300 cases  
set.seed(1)  
actcal <- actcal[sample(nrow(actcal),300),]  
actcal.lab <- c("> 37 hours", "19-36 hours", "1-18 hours", "no work")  
actcal.seq <- seqdef(actcal,13:24,labels=actcal.lab)

## ex1 using weights  
data(ex1)  
ex1.seq <- seqdef(ex1, 1:13, weights=ex1$weights)

## Sequence frequency plots
```
## Plot of the 10 most frequent sequences
seqplot(biofam.seq, type="f")

## Grouped by sex
seqfplot(actcal.seq, group=actcal$sex)

## Unweighted vs weighted frequencies
seqfplot(ex1.seq, weighted=FALSE)
seqfplot(ex1.seq, weighted=TRUE)

## Modal states sequence
## same as
seqmsplot(biofam.seq)

## Computing a distance matrix
## with OM metric
costs <- seqcost(biofam.seq, method="INDELSLOG")
biofam.om <- seqdist(biofam.seq, method="OM", sm=costs$sm, indel=costs$indel)

## Plot of the representative sets grouped by sex
## using the default density criterion
seqrplot(biofam.seq, group=biofam$sex, diss=biofam.om)

## Plot of the representative sets grouped by sex
## using the "dist" (centrality) criterion
seqrplot(biofam.seq, group=biofam$sex, criterion="dist", diss=biofam.om)

## First ten sequences
seqiplot(biofam.seq)

## All sequences sorted by age in 2000
## grouped by sex
## using 'border=NA' and 'space=0' options to have a nicer plot
seqiplot(actcal.seq, group=actcal$sex, idxs=0, border=NA, space=0, sortv=actcal$age00)
## biofam grouped by sex
seqplot(biofam.seq, type="d", group=actcal$sex)

## actcal grouped by sex
seqplot(actcal.seq, type="d", group=actcal$sex)

## Cross-sectional entropy plot
## ===============
seqplot(biofam.seq, type="Ht", group=biofam$sex)

## Meant time plot
## ===============
## actcal data set, grouped by sex
seqplot(actcal.seq, type="mt", group=actcal$sex)

## biofam data set, grouped by sex
seqmtplot(biofam.seq, group=biofam$sex)

---

seqpm

*Find substring patterns in sequences*

### Description

Search for a pattern (substring) into sequences.

### Usage

```
seqpm(seqdata, pattern, sep="")
```

### Arguments

- **seqdata**: a sequence object as defined by the `seqdef` function.
- **pattern**: a character string representing the pattern (substring) to search for.
- **sep**: state separator used in the pattern definition.

### Details

This function searches a pattern (a character string) into a set of sequences and returns the results as a list with two elements: 'Nbmatch' the number of occurrences of the pattern and 'MatchesIndex' the vector of indexes (row numbers) of the sequences that match the pattern (see examples below).

### Value

A list with two elements (see details).
Author(s)

Alexis Gabadinho

Examples

data(actcal)
actcal.seq <- seqdef(actcal,13:24)

## search for pattern "DAAD"
## (no work-full time work-full time work-no work)
## results are stored in the 'daad' object
daad <- seqpm(actcal.seq,"DAAD")

## Looking at the sequences
## containing the pattern
actcal.seq[dtaad$MIndex,]

## search for pattern "AD"
## (full time work-no work)
seqpm(actcal.seq,"AD")

seqprecaryty

Description

The precarity index returned by the function seqprecaryty is a modified complexity index that takes account of the ordering (possibly only partial order) of the states and the precarity degree of the first state in the sequence. The signed proportions (transition-based weighted proportions of negative transitions) used for setting the default correction factor can be extracted per se by means of the function seqprecorr. (See details.)

Usage

seqprecaryty(seqdata, correction=NULL, otto=.2, a=1, b=1.2, 
startpm=NULL, method="TRATEDSS",
state.order=alphabet(seqdata, with.missing), state.equiv=NULL, 
with.missing=FALSE, ...)

seqprecorr(seqdata, state.order=alphabet(seqdata, with.missing), state.equiv=NULL, 
penalized="BOTH", method="TRATEDSS", weight.type="ADD", startpm=NULL, 
with.missing=FALSE, border.effect = 10, tr.type)

Arguments

seqdata a state sequence object (class stslist) as returned by the seqdef function.
correction Vector of non-negative correction factor values. If NULL, the correction factors are set as 1 minus the value returned by seqprecorr.
seqprecarity

otto  Scalar in the range [0,1]. Trade-off weight between the precariety degree of the initial state and the corrected complexity. Default is otto=.2.

a  Non-negative real value. Exponent weight of the complexity. Default is 1.

b  Non-negative real value. Exponent weight of the correction factor. Default is 1.2.

stprec  Vector of state precariety degrees. If NULL the values are derived from the state order using seqprecstart. If not NULL, the values will be normalized by their maximum.

state.order  Vector of short state labels defining the order of the states. First the less precarious (most positive) state and then the other states in increasing precariousness order. States of the alphabet that are not included here (and are not equivalent to one of the listed state) define the non-comparable states.

state.equiv  List of state equivalence classes. Each class in the list is given as the vector of the short labels of the states forming the class.

method  One of 'FREQ', 'FREQ+', 'TRATE', 'TRATE+', 'TRATEDSS' (default), 'TRATEDSS+', 'RANK', 'RANK+', or 'ONE'. Method for determining transition weights. Weights based on transition probabilities: 'FREQ' overall frequency of the transitions, 'TRATE' transition probabilities, and 'TRATEDSS' transition probabilities in the DSS sequences. 'RANK' differences between state precariety degrees. 'ONE' no weight. With the + form the returned penalty is adjusted by the mean transition weight in the sequence.

weight.type  One of 'ADD' (default), 'INV', or 'LOGINV'. When method is one of 'FREQ', 'TRATE' or 'TRATEDSS', how weights are derived from the transition probabilities: 'ADD' additive (1-p), 'INV' inverse (1/p), and 'LOGINV' log of inverse. Ignored when any other method is selected.

penalized  One of 'BOTH' (default), 'NEG', 'POS', or 'NO'. What should be penalized or rewarded? 'NEG' only negative transitions, 'POS' only positive transitions (with negative penalization), 'BOTH' penalize negative transitions and reward positive ones, 'NO' no penalization. Can also be logical with TRUE equivalent to 'BOTH' and FALSE equivalent to 'NO'.

with.missing  Logical. Should the missing state be considered as an element of the alphabet?

border.effect  Value (strictly greater than 1) used to adjust estimated transition probabilities to avoid border effect. Default is 10. See details.

tr.type  Deprecated. Use method instead.

...  Arguments passed to seqprecorr

Details

The precariety index of a sequence \( x \) is based on the complexity index (Gabadinho et al., 2010) \( c(x) \) (See the seqici function) and is defined as

\[
\text{prec}(x) = \lambda a(x_1) + (1 - \lambda) r(x)^\beta c(x)^\alpha
\]

where \( a(x_1) \) is the degree of precariety (argument stprec) of the starting state in sequence \( x \), \( r(x) \) is the correction factor (argument correction) for the sequence. The \( \lambda \) parameter (argument otto)
determines the trade-off between the importance of the precarity of the starting state and of the corrected complexity index. Parameters $\alpha$ and $\beta$ (argument a and b) are exponent weights of respectively the complexity and the correction factor.

When correction = NULL (default), $r(x)$ is determined as $r(x) = 1 + q(x)$, where the penalty $q(x)$ is the difference between the weighted proportion of negative and positive transitions. This penalty $q(x)$ can be obtained separately by means of the function seqprecorr. The argument penalized allows to chose between three strategies for computing $q(x)$: only penalizing negative weights (in which case $q(x)$ is the proportion of negative transitions), only rewarding (with negative penalties) positive transitions, and applying both positive and negative penalties. The transitions can be weighted and the type of transition weights used is selected with the method argument. For weights based on transition probabilities, the way how these probabilities are transformed into weights is controlled with weight.type. To avoid a border effect, when any computed transition probability $p$ is close from 1 ($p > 1 - .1/d$), all $p$’s are adjusted as $p − p/d$, where $d$ is the border.effect parameter.

When equivalent classes are provided, the class mean precarity degree is assigned to each state of the class (see seqprecstart). For the count of transitions a same state value is assigned to all equivalent states.

Non-comparable states (those not listed on the state.order argument and not equivalent to a listed state) all receive the mean value (.5) as state precarity degree. Transitions from and to non-comparable states are ignored and replaced by a transition between the states that immediately precede and follow a spell in non-comparable states.

When there are missing states in the sequences, set with.missing = TRUE to treat the missing state as an additional state. In that case the missing state will be considered as non-comparable unless you include the nr attribute of seqdata in state.order or state.equiv. With with.missing = FALSE, transitions to and from the missing state will just be ignored. However, when with.missing = FALSE, there will be no stprec value for the missing state and, as a result, the precarity value will be NA for sequences starting with a missing state. To drop these starting missing states, use left='DEL' in seqdef when defining the state sequence object.

**Value**

For seqprecarity, an object of class seqprec with the value of the precarity index for each sequence. The returned object has an attribute stprec that contains the state precarity degree used at the starting position. The associated print method (print.seqprec) prints the state precarity values without the additional attribute.

For seqprecorr, an object of class seqprecorr with the weighted proportions $q(x)$ and as additional attributes: tr the used transition weights; signs the transitions signs; state.noncomp the non-comparable states; and state.order the used state order. The associated print method (print.seqprecorr) prints the $q(x)$ values without the additional attributes.

**Author(s)**

Gilbert Ritschard

**References**


See Also

seqici, seqprecstart, seqindic.

Examples

```r
## Defining a sequence object with columns 13 to 24
## in the 'actcal' example data set
actcal <- actcal[1:200,]  ## Here, only a subset
actcal.seq <- seqdef(actcal[,13:24])

## precarity using the original state order
prec <- seqprecarity(actcal.seq)
ici <- seqici(actcal.seq)  ## complexity

seqn <- seqformat(actcal.seq, to="SPS", compress=TRUE)
tab <- data.frame(seqn,ici,prec)
names(tab) <- c("seq","ici","prec")
head(tab)

## Assuming A and B as equivalent regarding precarity
prec2 <- seqprecarity(actcal.seq, state.equiv=list(c("A","B")))
tab <- cbind(tab,prec2)
names(tab)[ncol(tab)] <- "prec2"

## and letting C be non-comparable
prec3 <- seqprecarity(actcal.seq, state.order=c("A","B","D"),
state.equiv=list(c("A","B")))
tab <- cbind(tab,prec3)
names(tab)[ncol(tab)] <- "prec3"
head(tab)

## Extracting the q(x) used for the correction factor (1-q(x))
q <- seqprecorr(actcal.seq, state.order=c("A","B","D"),
state.equiv=list(c("A","B")))

## correction factor
corr.f <- 1 + q
## number of non neutral correction factors
length(corr.f[corr.f != 1])

## Precarity with rank-based transition weights
prec.rank <- seqprecarity(actcal.seq, method='RANK')

## Precarity in presence of missing values:
## missing state treated as an additional state
```
## by default right missings are dropped from the sequences

s.ex1 <- seqdef(ex1[,1:13])
seqprecarity(s.ex1, with.missing=TRUE)

<table>
<thead>
<tr>
<th>seqprecstart</th>
<th>State precarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Determines the initial state precarity degree from the state ordering. (See details.)</td>
<td></td>
</tr>
</tbody>
</table>

### Usage

```r
seqprecstart(seqdata, state.order=alphabet(seqdata, with.missing), state.equiv=NULL, stprec=NULL, with.missing=FALSE)
```

### Arguments

- **seqdata**: a state sequence object (class `stslist`) as returned by the `seqdef` function.
- **state.order**: Vector of short state labels defining the order of the states. First the less precarious (most positive) state and then the other states in increasing precariousness order. States of the alphabet that are not included here define the non-comparable states.
- **state.equiv**: List of state equivalence classes. The classes in the list are each set as the vector of the short labels of the states forming the class.
- **stprec**: Vector of user defined state precarity degrees ordered conformably with the alphabet of `seqdata`.
- **with.missing**: Logical. Should the missing state be considered as an element of the alphabet?

### Details

When `stprec=NULL`, the initial state precarity degrees are set as equivalently spaced values between 0 and 1 assigned to the states in the specified order.

Equivalent states get the mean value of the states in the equivalence class.

Incomparable states (those not on the `state.order` list and not member of an equivalent class having a state listed in `state.order`) receive the average of all state precarity degrees.

When `stprec` is user defined, the provided vector is normalized by its maximal value and mean value of states in a class are assigned to all class members.

Only one state per class needs to be on the state order list. If more than one member is on the state order list they should be listed consecutively. Note that currently no check is performed.

When `with.missing=TRUE`, use the `seqdata, "nr"` argument to possibly include it in the `state.order` or `state.equiv`. 
**Value**

The vector of assigned precarity degrees sorted according to the original order of states in the alphabet.

**Author(s)**

Gilbert Ritschard

**References**


**See Also**

seqprecarity.

**Examples**

```r
## Defining a sequence object with columns 13 to 24
## in the 'actcal' example data set
data(actcal)
actcal <- actcal[1:200,] ## Here, only a subset
actcal.seq <- seqdef(actcal[,13:24])

## state precarity levels using the original state order
seqprecstart(actcal.seq)

## Assuming A and B as equivalent regarding precarity
seqprecstart(actcal.seq, state.equiv=list(c("A","B")))

## and letting C be non-comparable
seqprecstart(actcal.seq, state.order=c("A","B","D"), state.equiv=list(c("A","B")))
```

---

**seqrecode** *Recoding state sequence objects and factors*

**Description**

Utilities for recoding factors or state sequence objects created with seqdef.

**Usage**

```r
seqrecode(seqdata, recodes, otherwise = NULL,
labels = NULL, cpal = NULL)
recodef(x, recodes, otherwise=NULL, na=NULL)
```
Arguments

seqdata  The state sequence object to be recoded (created with seqdef).
recodes  A list specifying the recoding operations where each element is in the form newcode=oldcode or newcode=c(oldcode1,oldcode2,...). The rules are treated in the same order as they appear, hence subsequent rules may modify the first ones.
otherwise  NULL or Character. Level given to cases uncovered by the recodes list. If NULL, old states remain unchanged.
labels  optional state labels used for the color legend of TraMineR’s graphics. If NULL (default), the state names in the alphabet are also used as state labels (see seqdef).
cpal  an optional color palette for representing the newly defined alphabet in graphics. If NULL (default), a color palette is created from the colors in seqdata by assigning to newcode the color of the first old state listed as oldcode and by leaving the colors of the other states unchanged.
x  A factor to be recoded.
na  Character vector. If not NULL, the list of states that should be recoded as NA (missing values).

Value

The recoded factor or state sequence object.

Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

See Also

seqdef to create a state sequence object.

Examples

## Recoding a state sequence object with seqrecode
data(actcal)

## Creating a state sequence object
actcal.seq <- seqdef(actcal,13:24, labels=c("> 37 hours", "19-36 hours", 
"1-18 hours", "no work"))

## Regrouping states B and C and setting the whole alphabet to A BC D
actcal.new <- seqrecode(actcal.seq, 
                        recodes = list("A"="A", "BC"=c("B", "C"), "D"="D"))

## Crosstabulate the first column of the recoded and 
## original state sequence objects
table(actcal.new[,1], actcal.seq[,1])

## Same as before but using automatically original 
## codes for unspecified states.
actcal.new2 <- seqrecode(actcal.seq, 
                        recodes = list("BC"=c("B", "C")))
table(actcal.new2[,1], actcal.seq[,1])

## Same as before but using otherwise
actcal.new3 <- seqrecode(actcal.seq, recodes = list("A"="A", "D"="D"),
otherwise="BC")
table(actcal.new3[,1], actcal.seq[,1])

## Recoding factors
## Recoding the marital status to oppose married to all other case
maritalstatus <- recode(actcal$civsta00,
recodes=list("Married"="married"), otherwise="Single")
summary(maritalstatus)
table(maritalstatus, actcal$civsta00)

## Recoding the number of kids in the household
## -2 is a missing value
nbkids <- recode(actcal$nbkid00,
recodes=list("None"=0, "One"=1, "Two or more"=2:10), na=-2)
table(nbkids, actcal$nbkid00, useNA="always")

---

seqrep

Extracting sets of representative sequences

Description

Returns either an as small as possible set of non redundant representatives covering (having in their neighborhood) a desired percentage of all sequences, or a given number of patterns with highest coverage. Special cases are single representatives such as the medoid or the sequence pattern with densest neighborhood. See `plot.stslist.rep` for the plot method and `seqplot` for other plot options.

Usage

```
seqrep(seqdata, criterion = "density", score = NULL, decreasing = TRUE,
coverage = 0.25, nrep = NULL, pradius = 0.10, dmax = NULL, diss = NULL,
weighted = TRUE, trep, tsim, dist.matrix, ...)
```

Arguments

- **seqdata**: a state sequence object as defined by the `seqdef` function.
- **criterion**: the representativeness criterion for sorting the candidate list. One of "freq" (sequence frequency), "density" (neighborhood density), "mscore" (mean state frequency), "dist" (centrality) and "prob" (sequence likelihood). See details.
- **score**: an optional vector of representativeness scores for sorting the sequences in the candidate list. The length of the vector must be equal to the number of sequences in the sequence object.
if a score vector is provided, indicates whether the objects in the candidate list must be sorted in ascending or descending order of this score. Default is TRUE, i.e. descending. The first object in the candidate list is then supposed to be the most representative.

coverage: coverage threshold, i.e., minimum proportion of sequences that should have a representative in their neighborhood (neighborhood radius is defined by \(pradius\)).

nrep: number of representative sequences. If NULL (default), the size of the representative set is controlled by coverage.

pradius: neighborhood radius as a percentage of the maximum (theoretical) distance \(d_{max}\). Defaults to 0.1 (10%). Sequence \(y\) is redundant to sequence \(x\) when it is in the neighborhood of \(x\), i.e., within a distance \(pradius*d_{max}\) from \(x\).

dmax: maximum theoretical distance. Used to derive the neighborhood radius as \(pradius*d_{max}\). If NULL, the value of \(d_{max}\) is derived from the dissimilarity matrix.

diss: matrix of pairwise dissimilarities between sequences in \(seqdata\). If NULL, the matrix is computed by calling the seqdist function. In that case, optional arguments to be passed to the seqdist function (see ... hereafter) should also be provided.

weighted: logical: Should weights assigned to the state sequence object be accounted for? (See seqdef.) Set as FALSE to ignore the weights.

trep: Deprecated. Use coverage instead.

tsim: Deprecated. Use pradius instead.

dist.matrix: Deprecated. Use diss instead.

... optional arguments to be passed to the seqdist function, mainly dist.method specifying the metric for computing the distance matrix, norm for normalizing the distances, indel and sm for indel and substitution costs when Optimal Matching metric is chosen. See seqdist manual page for details.

Details

The representative set is obtained by an heuristic. Representatives are selected by successively extracting from the sequences sorted by their representativeness score those which are not redundant with already retained representatives. The selection stops when either the desired coverage or the wanted number of representatives is reached. Sequences are sorted either by the values provided as score argument or by specifying one of the following as criterion argument: "freq" (sequence frequency), "density" (neighborhood density), "mscore" (mean state frequency), "dist" (centrality) and "dist" (sequence likelihood).

With the sequence frequency criterion, the more frequent a sequence the more representative it is supposed to be. Therefore, sequences are sorted in decreasing frequency order.

The neighborhood density is the number—density—of sequences in the neighborhood of the sequence. This requires to set the neighborhood radius \(pradius\). Sequences are sorted in decreasing density order.

The mean state frequency criterion is the mean value of the transversal frequencies of the successive states. Let \(s = s_1s_2\cdots s_{\ell}\) be a sequence of length \(\ell\) and \((f_{s_1}, f_{s_2}, \ldots, f_{s_{\ell}})\) the frequencies of the
states at (time-)position \((t_1, t_2, \ldots, t_\ell)\). The mean state frequency is the sum of the state frequencies divided by the sequence length

\[ MSF(s) = \frac{1}{\ell} \sum_{i=1}^{\ell} f_{s_i} \]

The lower and upper boundaries of \(MSF\) are 0 and 1. \(MSF\) is equal to 1 when all the sequences in the set are identical, i.e. when there is a single sequence pattern. The most representative sequence is the one with the highest score.

The centrality criterion is the sum of distances to all other sequences. The smallest the sum, the most representative the sequence.

The sequence likelihood \(P(s)\) is defined as the product of the probability with which each of its observed successive state is supposed to occur at its position. Let \(s = s_1 s_2 \cdots s_\ell\) be a sequence of length \(\ell\). Then

\[ P(s) = P(s_1, 1) \cdot P(s_2, 2) \cdots P(s_\ell, \ell) \]

with \(P(s_t, t)\) the probability to observe state \(s_t\) at position \(t\).

The question is how to determinate the state probabilities \(P(s_t, t)\). One commonly used method for computing them is to postulate a Markov Chain model, which can be of various order. The implemented criterion considers the probabilities derived from the first order Markov model, that is each \(P(s_t, t)\), \(t > 1\) is set to the transition rate \(p(s_t|s_{t-1})\) estimated across sequences from the observations at positions \(t\) and \(t - 1\). For \(t = 1\), we set \(P(s_1, 1)\) to the observed frequency of the state \(s_1\) at position 1.

The likelihood \(P(s)\) being generally very small, we use \(-\log P(s)\) as sorting criterion. The latter quantity reaches its minimum for \(P(s)\) equal to 1, which leads to sort the sequences in ascending order of their score.

Use criterion="dist" and nrep=1 to get the medoid and criterion="density" and nrep=1 to get the densest sequence pattern.

For more details, see Gabadinho & Ritschard, 2013.

Value

An object of class \texttt{stslist.rep}. This is actually a state sequence object (containing a list of state sequences) with the following additional attributes:

Scores \hfill a vector with the representative score of each sequence in the original set given the chosen criterion.

Distances \hfill a matrix with the distance of each sequence to its nearest representative.

Statistics \hfill a data frame with quality measures for each representative sequence: number \(na\) of sequences attributed to the representative, number \(nb\) of sequences in the representative’s neighborhood, mean distance \(MD\) to the representative and a few other indexes.

Quality \hfill overall quality measure.

Print, plot and summary methods are available. More elaborated plots are produced by the \texttt{seqplot} function using the \texttt{type="r"} argument, or the \texttt{seqrplot} alias.
Author(s)

Alexis Gabadinho (with Gilbert Ritschard for the help page)

References


See Also

seqplot, plot.stslist.rep, dissrep, disscenter

Examples

```r
## Defining a sequence object with the data in columns 10 to 25
## (family status from age 15 to 30) in the biofam data set
data(biofam)
biofam.seq <- seqdef(biofam, 10:25, labels=biofam.lab)

## Computing the distance matrix
costs <- seqsubm(biofam.seq, method="TRATE")
biofam.om <- seqdist(biofam.seq, method="OM", sm=costs)

## Representative set using the neighborhood density criterion
biofam.rep <- seqrep(biofam.seq, diss=biofam.om, criterion="density")
biofam.rep
summary(biofam.rep)
plot(biofam.rep)
```

seqsep

Adds separators to sequences stored as character string

Description

Adds separators to sequences stored as character string.

Usage

seqsep(seqdata, sl=1, sep="-")
Arguments

- `seqdata`: a dataframe or matrix containing sequence data, as vectors of states or events.
- `sl`: the length of the states (the number of characters used to represent them). Default is 1.
- `sep`: the character used as separator. Set by default as "-".

See Also

- `seqdecomp`.

Examples

```r
seqsep("ABAAAAAAD")
```

---

**seqST**

**Sequences turbulence**

Description

Computes Elzinga’s turbulence for each sequence in a sequence data set.

Usage

```r
seqST(seqdata, norm=FALSE, silent=TRUE, with.missing=FALSE)
```

Arguments

- `seqdata`: a state sequence object as returned by the `seqdef` function.
- `norm`: logical: should the turbulence index be normalized?
- `silent`: logical: should messages about running operations (extracting dss and durations, computing turbulence) be displayed?
- `with.missing`: logical: should non-void missing values be treated as a regular state? If FALSE (default) missing values are ignored.

Details

Sequence turbulence is a measure proposed by *Elzinga & Liefbroer (2007)*. It is based on the number \( \phi(x) \) of distinct subsequences that can be extracted from the distinct successive state (DSS) sequence and the variance of the consecutive times \( t_i \) spent in the distinct states. For a sequence \( x \), the formula is

\[
T(x) = \log_2(\phi(x) \frac{s_{t,\text{max}}^2(x) + 1}{s_t^2(x) + 1})
\]

where \( s_t^2(x) \) is the variance of the successive state durations in sequence \( x \) and \( s_{t,\text{max}}^2(x) \) is the maximum value that this variance can take given the total duration of the sequence. This maximum is computed as

where \( \phi(x) \) is the number of distinct subsequences in the sequence \( x \), \( s_t^2(x) \) is the variance of the state durations, and \( s_{t,\text{max}}^2(x) \) is the maximum possible variance given the total duration of the sequence.
\[ s_{t, \text{max}}^2 = (d - 1)(1 - \bar{t})^2 \]

where \( \bar{t} \) is the mean consecutive time spent in the distinct states, i.e. the sequence duration divided by the number \( d \) of distinct states in the sequence.

The function searches for missing states in the sequences and if found, adds the missing state to the alphabet for the computation of the turbulence. In this case the seqdss and seqdur functions for extracting the distinct successive state sequences and the associated durations are called with the \{with.missing=TRUE\} argument. Thus, a missing state in a sequence is considered as the occurrence of an additional symbol of the alphabet and two or more consecutive missing states are considered as two or more occurrences of this additional state. E.g. the DSS of A-A-*-*-*-*B-B-C-C-D is A-*B-C-D and the associated durations are 2-3-2-2-1.

The normalized value is obtained by subtracting 1 to the index and dividing by the turbulence value of a sequence made by the successive repetition of the alphabet up to the maximal length in seqdata.

**Value**

a sinlge-column matrix of length equal to the number of sequences in seqdata containing the turbulence value of each sequence. Normalized values are returned when norm=TRUE.

**Author(s)**

Alexis Gabadinho and Gilbert Ritschard

**References**


**See Also**

seqdss, seqdur. For other measures of sequence complexity see seqient and seqici.

**Examples**

```r
## Loading the 'actcal' example data set
data(actcal)
## Here we consider only the first 10 sequences
actcal <- actcal[1:10,]

## Defining a sequence object with data in columns 13 to 24
## (activity status from january to december 2000)
actcal.seq <- seqdef(actcal[,13:24], informat='STS')

## Computing the sequences turbulence
turb <- seqST(actcal.seq)
```
## Histogram for the turbulence

```r
hist(turb)
```

## Normalized turbulence

```r
turb.norm <- seqST(actcal.seq, norm=TRUE)
```

---

**seqstatd**  
*Sequence of transversal state distributions and their entropies*

### Description

Returns the state frequencies, the number of valid states and the entropy of the state distribution at each position in the sequence.

### Usage

```r
seqstatd(seqdata, weighted=TRUE, with.missing=FALSE, norm=TRUE)
```

### Arguments

- `seqdata`: a state sequence object as defined by the `seqdef` function.
- `weighted`: if *TRUE*, distributions account for the weights assigned to the state sequence object (see `seqdef`). Set as *FALSE* if you want ignore the weights.
- `with.missing`: If *FALSE* (default value), returned distributions ignore missing values.
- `norm`: if *TRUE* (default value), entropy is normalized, i.e., divided by the entropy of the alphabet. Set as *FALSE* if you want the entropy without normalization.

### Details

In addition to the state distribution at each position in the sequence, the `seqstatd` function provides also for each time point the number of valid states and the Shannon entropy of the observed state distribution. Letting $p_i$ denote the proportion of cases in state $i$ at the considered time point, the entropy is

$$h(p_1, \ldots, p_s) = - \sum_{i=1}^{s} p_i \log(p_i)$$

where $s$ is the size of the alphabet. The log is here the natural (base e) logarithm. The entropy is 0 when all cases are in the same state and is maximal when the same proportion of cases are in each state. The entropy can be seen as a measure of the diversity of states observed at the considered time point. An application of such a measure (but with aggregated transversal data) can be seen in *Billari (2001)* and *Fussell (2005)*.

### Author(s)

Alexis Gabadinho (with Gilbert Ritschard for the help page)
References


See Also

`plot.stslist.statd` the plot method for objects of class `stslist.statd`, `seqdplot` for higher level plot of transversal distributions and `seqHtplot` for plotting the transversal entropy over sequence positions.

Examples

data(biofam)
biofam.seq <- seqdef(biofam,10:25)
sd <- seqstatd(biofam.seq)
## Plotting the state distribution
plot(sd, type="d")

## Plotting the entropy indexes
plot(sd, type="Ht")

## ===============
## example with weights
## ===============
data(ex1)
ex1.seq <- seqdef(ex1, 1:13, weights=ex1$weights)

## Unweighted
seqstatd(ex1.seq, weighted=FALSE)

seqstatd(ex1.seq, weighted=TRUE)

seqstatf

*State frequencies in the whole sequence data set*

Description

Overall frequency of each state of the alphabet in the state sequence object.

Usage

`seqstatf(seqdata, weighted = TRUE)`
Arguments

seqdata a sequence object as defined by the seqdef function.

weighted Logical. Should frequencies account for weights when present in the state sequence object (see seqdef). Default is TRUE. If no weights were assigned during the creation of the sequence object, weighted=TRUE will yield the same result as weighted=FALSE since each sequence is allowed a weight of 1.

Details

The seqstatf function computes the (weighted) count and frequency of each state of the alphabet in seqdata, i.e., the (weighted) sum of the occurrences of a state in seqdata.

Value

A data frame with as many rows as states in the alphabet and two columns, one for the count (Freq) and one for the percentage frequencies (Percent).

Author(s)

Alexis Gabadinho

See Also

seqstats for the state distribution by time point (position), seqistat for the state distribution within each sequence.

Examples

## Creating a sequence object from the actcal data set
data(actcal)
actcal.lab <- c("> 37 hours", "19-36 hours", "1-18 hours", "no work")
actcal.seq <- seqdef(actcal, 13:24, labels=actcal.lab)

## States frequencies
seqstatf(actcal.seq)

## Example with weights
data(ex1)
ex1.seq <- seqdef(ex1, 1:13, weights=ex1$weights)

## Unweighted
seqstatf(ex1.seq, weighted=FALSE)

## Weighted
seqstatf(ex1.seq, weighted=TRUE)
seqstatl  List of distinct states or events (alphabet) in a sequence data set.

Description

Returns a list containing distinct states or events found in a data frame or matrix containing sequence data, the alphabet.

Usage

seqstatl(data, var=NULL, format="STS")

Arguments

data  a data frame or matrix containing sequence data.

var  the list of columns containing the sequences. Default NULL means all columns. Whether the sequences are in the compressed (character strings) or extended format is automatically detected from the number of columns.

format  the format of the sequence data set. One of "STS", "SPS", "DSS". Default is "STS". The seqstatl function uses the seqformat function to translate between formats when necessary.

Author(s)

Alexis Gabadinho

References


See Also

seqformat

Examples

data(actcal)
seqstatl(actcal,13:24)
seqsubsn

Number of distinct subsequences in a sequence.

Description

Computes the number of distinct subsequences in a sequence using Elzinga’s algorithm.

Usage

seqsubsn(seqdata, DSS=TRUE, with.missing=FALSE)

Arguments

seqdata a state sequence object as defined by the seqdef function.

DSS if TRUE, the sequences of Distinct Successive States (DSS, see seqdss) are first extracted (e.g., the DSS contained in "D-D-D-A-A-A-A-A-A-D" is "D-A-D"), and the number of distinct subsequences in the DSS is computed. If FALSE, the number of distinct subsequences is computed from sequences as they appear in the input sequence object. Hence the number of distinct subsequences is in most cases much higher with the DSS=FALSE option.

with.missing logical: should non-void missing values be treated as a regular state? If FALSE (default) missing values are ignored.

Details

The function first searches for missing states in the sequences and if found, adds the missing state to the alphabet for the extraction of the distinct subsequences. A missing state in a sequence is considered as the occurrence of an additional symbol of the alphabet, and two or more consecutive missing states are considered as two or more occurrences of the same state. The with.missing=TRUE argument is used for calling the seqdss function when DSS=TRUE.

Value

Vector with the number of distinct subsequences for each sequence in the input state sequence object.

Author(s)

Alexis Gabadinho (with Gilbert Ritschard for the help page)

See Also

seqdss.
Examples

```r
data(actcal)
actcal.seq <- seqdef(actcal,13:24)

## Number of subsequences with DSS=TRUE
seqsubsn(actcal.seq[1:10,])

## Number of subsequences with DSS=FALSE
seqsubsn(actcal.seq[1:10,],DSS=FALSE)
```

---

**seqtab**

*Frequency table of the sequences*

**Description**

Computes the frequency table of the sequences (count and percent of each sequence).

**Usage**

```
seqtab(seqdata, idxs = 1:10, weighted = TRUE, format = "SPS", tlim)
```

**Arguments**

- `seqdata` a sequence object as defined by the `seqdef` function.
- `idxs` returns the table for the sequences at ranks `idxs` in the list of distinct sequences sorted in decreasing order of their frequencies. Default is `1:10`, i.e. the 10 most frequent sequences. Can be any subset, like `5:10` (fifth to tenth most frequent sequences) or `c(2,10)` (second and tenth most frequent sequences). Set `idxs=0` to get the table for the whole set of distinct sequences.
- `weighted` if `TRUE` (default), frequencies account for the weights, if any, assigned to the state sequence object (see `seqdef`). Set to `FALSE` for ignoring weights.
- `format` format used for displaying the rownames (the sequences) in the output table. Default is SPS format, which yields shorter and more readable sequence representations. Alternatively, "STS" may be specified.
- `tlim` Deprecated. Use `idxs` instead.

**Details**

The `weighted` argument has no effect when no weights were assigned to the state sequence object since weights default in that case to 1.

**Value**

An object of class `stslist.freq`. This is actually a state sequence object (containing a list of state sequences) with added attributes, among others the `freq` attribute containing the frequency table. There are `print` and `plot` methods for such objects. More sophisticated plots can be produced with the `seqplot` function.
seqtransn

Number of transitions in a sequence

Description

Computes the number of transitions (state changes) in each sequence of a sequence object.

Usage

`seqtransn(seqdata, with.missing=FALSE, norm=FALSE, pweight=FALSE)`
Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>seqdata</td>
<td>a state sequence object as defined by the seqdef function.</td>
</tr>
<tr>
<td>with.missing</td>
<td>logical: should non-void missing values be treated as a regular state? If FALSE (default) missing values are ignored.</td>
</tr>
<tr>
<td>norm</td>
<td>logical. If set as TRUE, the number of transitions is divided by its theoretical maximum, the length of the sequence minus 1. When the length of the sequence is 1, the normalized value is set as 0 (non-normalized value).</td>
</tr>
<tr>
<td>pweight</td>
<td>logical. EXPERIMENTAL! If set as TRUE, when counting transitions each transition does not account for 1 but for its probability (transition rate) as observed in the data.</td>
</tr>
</tbody>
</table>

Details

A transition in a sequence is a state change between time/position \( t \) and \( t + 1 \). For example, the sequence "A-A-A-A-B-B-A-D-D-D" contains 3 transitions. The maximum number of transitions a sequence can contain is \( \ell - 1 \) where \( \ell \) is the length of the sequence. The number of transitions is obtained by subtracting 1 to the length of the the Distinct Successive State (DSS) sequence.

Value

a state sequence object containing the number of transitions of each sequence in the object given as argument.

Author(s)

Alexis Gabadinho (with Gilbert Ritschard for the help page)

References


See Also

seqdss.

Examples

```r
## Creating a sequence object from columns 13 to 24
## in the 'actcal' example data set
data(actcal)
actcal.seq <- seqdef(actcal,13:24)

## Computing the number of transitions
actcal.trans <- seqtransn(actcal.seq)

## Displaying the DSS for the first 10 sequences
actcal.trans[1:10]
```
## Example with with.missing argument

data(ex1)
ex1.seq <- seqdef(ex1, 1:13)

seqtransn(ex1.seq)
seqtransn(ex1.seq, with.missing=TRUE)

---

**seqtrate**  
*Compute transition rates between states*

### Description

Returns a matrix with transition rates between states, computed from a set of sequences.

### Usage

```r
seqtrate(seqdata, sel.states = NULL, time.varying = FALSE, weighted = TRUE, 
lag = 1, with.missing = FALSE, count = FALSE, statl)
```

### Arguments

- `seqdata` - a sequence object as defined by the `seqdef` function.
- `sel.states` - a list of states or events for which the transition rates will be computed. If omitted (default), transition rates are computed between the distinct states in seqdata (obtained with the `alphabet` function).
- `time.varying` - Logical. If TRUE, return an array containing a distinct matrix for each time unit. The time is the third dimension (subscript).
- `weighted` - Logical. If TRUE, compute transition rates using weights specified in seqdata.
- `lag` - Integer. Time between the two states considered to compute transition rates (one by default).
- `with.missing` - Logical. If FALSE (default value), returned transition rates ignore missing values.
- `count` - Logical. Should counts of transition be returned instead of transition probabilities. Default is FALSE.
- `statl` - Deprecated. Use `sel.states` instead.

### Details

Transition rates are the probabilities of transition from one state to another observed in the sequence data. Substitution costs based on transition rates can be used when computing distances between sequences with the optimal matching method (see `seqdist`).

### Value

A matrix of dimension `ns * ns`, where `ns` is the number of states in the `alphabet` of the sequence object.
Author(s)
Matthias Studer, Alexis Gabadinho, and Gilbert Ritschard

References

See Also
seqdist seqsubm alphabet.

Examples
```r
## Loading the 'actcal' example data set
data(actcal)

## Defining a sequence object with data in columns 13 to 24
## (activity status from January to December 2000)
actcal.seq <- seqdef(actcal[,13:24])

## Computing transition rates
seqtrate(actcal.seq)

## Computing transition rates between states "A" and "B" only
seqtrate(actcal.seq, c("A", "B"))

## Example with weights
##
## Example with weights
##
data(ex1)
ex1.seq <- seqdef(ex1[,1:13], weights=ex1$weights)

seqtrate(ex1.seq, weighted=FALSE)
seqtrate(ex1.seq, weighted=FALSE, count=TRUE)

## weights are accounted for by default
seqtrate(ex1.seq)
seqtrate(ex1.seq, count=TRUE)
```

seqtrees

Tree structured analysis of a state sequence object.

Description
Facility for growing a regression tree for a state sequence object.
Usage

seqtree(formula, data = NULL, weighted = TRUE, min.size = 0.05,
        max.depth = 5, R = 1000, pval = 0.01, weight.permutation = "replicate",
        seqdist.args = list(method = "LCS", norm = "auto"), diss = NULL,
        squared = FALSE, first = NULL, minSize, maxdepth, seqdist_arg)

Arguments

formula  a formula where the left hand side is a state sequence object (see seqdef) and the
         right hand specifies the candidate variables for partitioning the set of sequences.
weighted  Logical. If TRUE, use the weights of the state sequence object.
data  a data frame where variables in the formula will be searched
min.size  minimum number of cases in a node, in percentage if less than 1.
max.depth  maximum depth of the tree.
R  Number of permutations used to assess the significance of the split.
pval  Maximum p-value, in percent.
weight.permutation  Weights permutation method: "diss" (attach weights to the dissimilarity matrix), "replicate" (replicate case according to the weights arguments), "rounded-replicate" (replicate case according to the rounded weights arguments), "random-sampling" (random assignment of covariate profiles to the objects using distributions defined by the weights.)
seqdist.args  list of arguments directly passed to seqdist, only used if diss=NULL
diss  An optional dissimilarity matrix. If not provided, a dissimilarity matrix is computed using seqdist and seqdist.args
squared  Logical. If TRUE, the dissimilarity matrix is squared
first  Character. An optional variable name to force the first split.
minSize  Deprecated. Use min.size instead.
maxdepth  Deprecated. Use max.depth instead.
seqdist_arg  Deprecated. Use seqdist.args instead.

Details

The function provides a simplified interface for applying disstree on state sequence objects.

The seqtree objects can be "plotted" with seqtreedisplay. A print method is also available which prints the medoid sequence for each terminal node.

Value

A seqtree object with same attributes as disstree objects.

The leaf membership is in the first column of the fitted attribute. For example, the leaf memberships for a tree dt are in dt$fitted[,1].
Author(s)

Matthias Studer (with Gilbert Ritschard for the help page)

References


See Also

`seqtreedisplay`, `disstree`

Examples

```r
data(mvad)

## Defining a state sequence object
mvad.seq <- seqdef(mvad[, 17:86])

## Growing a seqtree from Hamming distances:
## Warning: The R=10 used here to save computation time is
## much too small and will generate strongly unstable results.
## We recommend to set R at least as R=1000.
## To comply with this small R value, we set pval = 0.1.
seqt <- seqtree(mvad.seq~ male + Grammar + funemp + gcse5eq + fmpr + livboth,
                 data=mvad, R=10, pval=0.1, seqdist.arg=list(method="HAM", norm="auto"))
print(seqt)

## Growing a seqtree from an existing distance matrix
mvad.dhd <- seqdist(mvad.seq, method="DHD")
seqt <- seqtree(mvad.seq~ male + Grammar + funemp + gcse5eq + fmpr + livboth,
                data=mvad, R=10, pval=0.1, diss=mvad.dhd)
print(seqt)

### Following commands only work if GraphViz is properly installed
## Not run:
seqtreedisplay(seqt, type="d", border=NA)
seqtreedisplay(seqt, type="I", sortv=cmdscale(mvad.dhd, k=1))

## End(Not run)
```

### seqtreedisplay

**Graphical rendering of a sequence regression tree**

**Description**

Generate a graphical representation of a regression tree of state sequence data.
seqtreedisplay

Usage

seqtreedisplay(tree, filename = NULL, seqdata = tree$info$object,
only.leaf = FALSE, sortv = NULL, diss = NULL, cex.main = 3,
with.legend = "auto", cex.legend = cex.main, axes = FALSE,
image.format = "png", with.quality = TRUE, cex.quality = cex.main,
legend.text = NULL, show.tree = TRUE, show.depth = FALSE,
imgLeafOnly, dist.matrix, title.cex, withlegend, legend.fontsize,
imageformat, withquality, quality.fontsize, legendtext, showtree,
showdepth, ...)

disstreedisplay(tree, filename = NULL, image.data= NULL, image.fun = plot,
only.leaf = FALSE, cex.main = 3, image.format = "png",
with.quality = TRUE, cex.quality = cex.main,
legend.text = NULL, show.tree = TRUE, show.depth = FALSE,
imagedata, imagefunc, imgLeafOnly, title.cex, imageformat,
withquality, quality.fontsize, legendtext, showtree, showdepth, ...)

Arguments

tree A seqtree object (as produced by seqtree) for seqtreedisplay. A disstree
object (as produced by disstree) for disstreedisplay.

filename The name of a file where to save the plot (overwritting existing file). If NULL, a
temporary file is created.

seqdata The sequence object containing the state sequences plotted in the nodes.

only.leaf Logical. If TRUE sequences are plotted only in terminal nodes.

sortv Argument passed to seqplot
diss Argument passed to seqplot
cex.main Node title magnification. See par.

with.legend Logical. Should the color legend be displayed on the plot?
cex.legend Legend magnification. See par. If not specified, use the value of cex.main.

axes Argument passed to seqplot
image.format Image format of the output file (filename)

with.quality If TRUE, a node displaying fitting measures of the tree is added to the plot.
cex.quality Fitting measure text magnification. See par. If not specified, use the value of
cex.main.

legend.text Character. Optional text information that should be added.
show.tree Logical. Should the tree be shown on the screen?
show.depth Logical. If TRUE, the splits are ordered according to their global pseudo-R2.
image.fun A function to plot the individuals in a node, see details.
image.data a data.frame that will be passed to image.fun.
imgLeafOnly Deprecated. Use only.leaf instead.
dist.matrix Deprecated. Use diss instead.
seqtreedisplay

- **title.cex**: Deprecated. Use `cex.main` instead.
- **withlegend**: Deprecated. Use `with.legend` instead.
- **legend.fontsize**: Deprecated. Use `cex.legend` instead.
- **imageformat**: Deprecated. Use `image.format` instead.
- **withquality**: Deprecated. Use `with.quality` instead.
- **quality.fontsize**: Deprecated. Use `cex.quality` instead.
- **legendtext**: Deprecated. Use `legend.text` instead.
- **showtree**: Deprecated. Use `show.tree` instead.
- **showdepth**: Deprecated. Use `show.depth` instead.
- **imagedata**: Deprecated. Use `image.data` instead.
- **imagefunc**: Deprecated. Use `image.fun` instead.
- **...**: additional arguments passed to `seqplot`

**Details**

This function generates a tree image. For each node, it invokes `seqplot` for the selected lines of `seqdata` as argument. You should at least specify the type of the plot to use (type="d" for instance, see `seqplot` for more details).

The plot is actually not generated as an R plot, but with GraphViz (www.graphviz.org). Hence, `seqtreedisplay` only works when GraphViz is correctly installed.

Conversion to image formats other than "jpeg" or "png" is done using ImageMagick (www.imagemagick.org). To use this feature, ImageMagick (www.imagemagick.org) should hence also be installed.

**Value**

None

**Author(s)**

Matthias Studer (with Gilbert Ritschard for the help page)

**See Also**

See `seqtree` and `disstree` for examples, and `disstree2dot` for generating "dot" files.
stlab  

Get or set the state labels of a sequence object

Description

This function gets or sets the state labels of a sequence object, that is, the long labels used when displaying the state legend in plotting functions.

Usage

stlab(seqdata)
stlab(seqdata) <- value

Arguments

seqdata  
a state sequence object as defined by the seqdef function.

value  
a vector of character strings containing the labels, of length equal to the number of states in the alphabet. Each string is attributed to the corresponding state in the alphabet, the order being the one returned by the alphabet.

Details

The state legend is plotted either automatically by the plot functions provided for visualizing sequence objects or with the seqlegend function. A long label is associated to each state of the alphabet and displayed in the legend. The state labels are defined when creating the sequence object, either automatically using the values found in the data or by specifying a user defined vector of labels. The stlab function can be used to get or set the state labels of a previously defined sequence object.

Value

For ’stlab’ a vector containing the labels.
For ’stlab<-’ the updated sequence object.

See Also

seqdef

Examples

## Creating a sequence object with the columns 13 to 24
## in the 'actcal' example data set
## The color palette is automatically set
data(actcal)
actcal.seq <- seqdef(actcal,13:24)

## Retrieving the color palette
stlab(actcal.seq)
## Changing the state labels

```r
stlab(actcal.seq) <- c("Full time","Part time (19-36 hours)",
    "Part time (1-18 hours)", "No work")
```

## Description

Checks the presence of deprecated arguments, assigns value of a deprecated argument to the corresponding new argument name, and issues warning messages.

## Usage

```r
TraMineR.check.depr.args(arg.pairs)
```

## Arguments

- `arg.pairs`: List of pairs of old and new argument names
  
  (e.g. `alist(newname1 = oldname1,newname2 = oldname2)`)  

## Details

To be used inside functions. For developers only.

For each specified pair of new and old argument names, the function checks if the old argument name is specified. If so and the new one is not, a warning message is raised and the argument value is assigned to the new argument name. If one of the names declared in `check.depr.args()` arguments is not an argument of the parent function or if both the new and old argument names are specified an error is raised.

The function does not detect when the new and the old argument names are specified together and the new argument value is its default value. In this case, the value associated with the old argument name is assigned to the new name and a warning message is raised.

The function works whether the argument names are explicitly declared or not in the call to the checked function.

The only requirement for the function to work is that the deprecated arguments should be listed WITHOUT default values in the definition of the checked function.

## Value

None.

## Author(s)

Pierre-Alexandre Fonta, Gilbert Ritschard
TraMineR.checkupdates  
*Check for TraMineR updates*

**Description**

Check if the installed version of TraMineR is up-to-date. This function only prints a message and does not need any argument. It connects to the TraMineR webserver (http://traminer.unige.ch).

**Usage**

TraMineR.checkupdates()

**Value**

Return your current version number of TraMineR and the latest stable and development version number if more recent versions are available.

**Author(s)**

Nicolas S. Müller

TraMineRInternal  
*Access to TraMineR internal functions*

**Description**

Functions allowing other packages to access some TraMineR internal functions. Corresponding functions are respectively TraMineR.setlayout, TraMineR.Legend, DTNInit, seqeage, seqgbar, DTNsplit, and tmrWeightedInertiaDist. For experts only.

**Usage**

TraMineRInternalLayout(...)  
TraMineRInternalLegend(...)  
TraMineRInternalNodeInit(...)  
TraMineRInternalSeqeage(...)  
TraMineRInternalSeqgbar(...)  
TraMineRInternalSplitInit(...)  
TraMineRInternalWeightedInertiaDist(diss, diss.size, is.dist, individuals, sweights, var)
Arguments

... Arguments passed to or from other methods.

diss See tmrWeightedInertiaDist().
diss.size See tmrWeightedInertiaDist().
is.dist See tmrWeightedInertiaDist().
individuals See tmrWeightedInertiaDist().
sweights See tmrWeightedInertiaDist().
var See tmrWeightedInertiaDist().
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