Package ‘smoothAPC’

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Title Smoothing of Two-Dimensional Demographic Data, Optionally Taking into Account Period and Cohort Effects
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Description The implemented method uses for smoothing bivariate thin plate splines, bivariate lasso-type regularization, and allows for both period and cohort effects. Thus the mortality rates are modelled as the sum of four components: a smooth bivariate function of age and time, smooth one-dimensional cohort effects, smooth one-dimensional period effects and random errors.
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autoSmoothAPC

Smoothes demographic data using automatically estimated parameters and optionally taking into account period and cohort effects

Description

If period and cohort effects are taken into account (effects = TRUE) the method uses all available years and diagonals for estimation of the period and cohort effects.

Usage

autoSmoothAPC(data, effects = TRUE, cornerLength = 7,
affdDiagonals = NULL, affdYears = NULL, lower = head(c(0.01, 0.01, 0.01, 2, 0.001, 2, 0.001), 3 + effects * 4), upper = head(c(1.2, 1.8, 1.2, 12, 0.4, 12, 0.4), 3 + effects * 4), init = head(c(0.1, 0.1, 0.2, 4, 0.001, 4, 0.001), 3 + effects * 4), reltol = 0.001, parameters = NULL, trace = F, control = list(nnzmax = 1e+06, nsubmax = 2e+06, tmpmax = 2e+05), weights = NULL)

Arguments

data Demographic data (log mortality) presented as a matrix. Row numbers represent ages and column numbers represent time.
effects Controls if the cohort and period effects are taken into account.
cornerLength Sets the smallest length of a diagonal to be considered for cohort effects.
affdDiagonals Diagonals to be used for cohort effects. The first diagonal is at the bottom left corner of the data matrix (maximal age and minimal time in the data matrix).
affdYears Years to be used for period effects.
lower Lowest possible values for the optimization procedure.
upper Highest possible values for the optimization procedure.
init Initial values for the optimization procedure.
reltol Relative tolerance parameter to be supplied to optim function.
parameters Optional model parameters. If not provided, they are estimated.
trace Controls if tracing is on.
control The control data passed directly to rq.fit.sfn function.
weights Define how much every observation effect the resulting smooth surface. The parameter must have same dimentions as data parameter. Weights can be set to reciprocal of estimated standard deviation of the data.
Value

A list of four components: smooth surface, period effects, cohort effects and parameters used for smoothing (passed as a parameter or estimated).

Author(s)

Alexander Dokumentov

References

http://robjhyndman.com/publications/mortality-smoothing/

See Also

smoothAPC and signifAutoSmoothAPC. The latter might give slightly better performance.

Examples

library(demography)
m <- log(fr.mort$rate$female[1:30, 150:160])
plot(m)
sm <- autoSmoothAPC(m)
plot(sm)
plot(sm, "period")
plot(sm, "cohort")

plot.matrix

Presents matrix as a heatmap

Description

Presents matrix as a heatmap

Usage

## S3 method for class 'matrix'
plot(x, labs = c("X", "Y"), color.palette = c("default", "special"), main = "", ...)
plot.smAPC

**Arguments**

- `x`: Matrix to plot.
- `labs`: Vector of labels for X and Y axes.
- `color.palette`: Character string "default" or "special" or a function accepting one argument and returning a color palette (for example `rainbow`).
- `main`: Title for the plot.
- `...`: Other parameters. They are currently ignored.

**Examples**

```r
plot(matrix(rnorm(100), 10, 10), main = "noise")
plot(matrix(1:100, 10, 10), c("Dimension 1", "Dimension 2"), main = "Value")

library(demography)
m <- log(fr.mort$rate$female[1:30, 150:160])
plot(m)
plot(m, color.palette = "special")
plot(m, color.palette = rainbow)
```

**Description**

Presents demographic data as a heatmap

**Usage**

```r
## S3 method for class 'smAPC'
plot(x, component = c("all", "surface", "period", "cohort", "residuals", "original"), labs = c("Age", "Time"), color.palette = c("default", "special"), main = "", ...)```

**Arguments**

- `x`: Result of smoothing (object of class `smAPC`).
- `component`: "smooth", "period", "cohort", "residuals" or "original".
- `labs`: Vector of labels for X and Y axes.
plot3d

- `color_palette`: Character string "default" or "special" or a function accepting one argument and returning a color palette (for example `rainbow`).
- `main`: Title for the plot.
- `...`: Other parameters. They are currently ignored.

**Author(s)**

Alexander Dokumentov

**Examples**

```r
library(demography)
m <- log(fr.mort$rate$female[1:30, 150:160])
sm <- autoSmoothAPC(m)

plot(sm)
plot(sm, "surface")
plot(sm, "cohort")
plot(sm, "period")
plot(sm, "residuals")
plot(sm, "original", main = "Original data")
```

---

**plot3d**

*Presents data as a 3D surface*

**Description**

Presents data as a 3D surface

**Usage**

```r
plot3d(x, ...)
```

**Arguments**

- `x`: Data to plot.
- `...`: Other parameters.
plot3d.matrix  

Presents matrix as a 3D surface

Description

Presents matrix as a 3D surface

Usage

```r
## S3 method for class 'matrix'
plot3d(x, labs = c("X", "Y", "Z"),
      color.palette = c("default", "special"), ...)
```

Arguments

- `x`  
  Matrix to plot.
- `labs`  
  Vector of labels for X, Y and Z axes.
- `color.palette`  
  Character string "default" or "special" or a function accepting one argument and returning a color palette (for example `rainbow`).
- `...`  
  Other parameters. They are currently ignored.

Author(s)

Alexander Dokumentov

Examples

```r
plot3d(matrix(rnorm(100), 10, 10))
plot3d(matrix(1:100, 10, 10), c("Dimension 1", "Dimension 2", "Value"))

library(demography)
m <- log(fr.mort$rate$female[1:30, 150:160])
plot3d(m)
plot3d(m, color.palette = "special")
plot3d(m, color.palette = rainbow)
```
plot3d.smAPC

Presents demographic data as a 3D surface

Description

Presents demographic data as a 3D surface

Usage

```r
## S3 method for class 'smAPC'
plot3d(x, component = c("all", "surface", "period", "cohort", "residuals", "original"), labs = c("Age", "Time", NA), color.palette = c("default", "special"), ...)
```

Arguments

- `x`: Result of smoothing (object of class smAPC).
- `component`: "smooth", "period", "cohort", "residuals" or "original".
- `labs`: Vector of labels for X, Y and Z axes.
- `color.palette`: Character string "default" or "special" or a function accepting one argument and returning a color palette (for example `rainbow`).
- `...`: Other parameters. They are currently ignored.

Author(s)

Alexander Dokumentov

Examples

```r
library(demography)
m <- log(fr.mort$rate$female[1:30, 150:160])
sm <- autoSmoothAPC(m)

plot3d(sm)
plot3d(sm, "surface", color.palette = "special")
plot3d(sm, "cohort")
plot3d(sm, "period")
plot3d(sm, "residuals")
plot3d(sm, "original", color.palette = rainbow)
```
signifAutoSmoothAPC

Significantly smooths demographic data using automatically estimated parameters and taking into account only significant period and cohort effects.

Description

It is a heuristic procedure which tries to figure out positions of period and cohort effects in the data. It also uses a few steps to estimate model’s parameters. The procedure is supposed to outperform autoSmoothAPC slightly.

Usage

```r
signifAutoSmoothAPC(data, p.value = 0.05, cornerLength = 7,
  lower = c(0.01, 0.01, 0.01, 1, 0.001, 1, 0.001), upper = c(1.2, 1.8, 1.2,
  12, 0.4, 12, 0.4), init = c(0.1, 0.1, 0.2, 4, 0.001, 4, 0.001),
  reltol = 0.001, trace = F, control = list(nnzlimax = 1e+06, nsubmax =
  2e+06, tmpmax = 2e+05), weights = NULL)
```

Arguments

- **data**: Demographic data (log mortality) presented as a matrix. Row numbers represent ages and column numbers represent time.
- **p.value**: P-value used to test the period and the cohort effects for significance. The lower the value the fewer diagonals and years will be used to find cohort and period effects.
- **cornerLength**: Minimal length of a diagonal to be considered for cohort effects.
- **lower**: Lowest possible values for the optimization procedure.
- **upper**: Highest possible values for the optimization procedure.
- **init**: Initial values for the optimization procedure.
- **reltol**: Relative tolerance parameter to be supplied to `optim` function.
- **trace**: Controls if tracing is on.
- **control**: The control data passed directly to `rq.fit.sfn` function.
- **weights**: Define how much every observation effect the resulting smooth surface. The parameter must have same dimensions as `data` parameter. Weights can be set to reciprocal of estimated standard deviation of the data.

Value

A list of six components: smooth surface, period effects, cohort effects, parameters used for smoothing, diagonals used for cohort effects and years used for period effects.

Author(s)

Alexander Dokumentov
smoothAPC

References

http://robjhyndman.com/publications/mortality-smoothing/

See Also

autoSmoothAPC, smoothAPC.

Examples

library(demography)
m <- log(fr.mort$rate$female[1:30, 120:139])
plot(m)
sm <- signifAutoSmoothAPC(m)
plot(sm)
plot(sm, "surface")
plot(sm, "period")
plot(sm, "cohort")

smoothAPC                               Smooths demographic data optionally taking into account period and cohort effects

Description

Smooths demographic data optionally taking into account period and cohort effects

Usage

smoothAPC(data, lambda = 1, lambdaaa = 1, lambdayy = 1, lambdaay = 1,
lambdaYearsEffect = 5, thetaYearsEffect = 0.1 * lambda,
lambdaCohortEffect = 5, thetaCohortEffect = 0.1 * lambda,
cornerLength = 7, effects = TRUE, affdDiagonals = NULL,
affdYears = NULL, control = list(nnz1max = 1e+06, nsubmax = 2e+06, tmpmax = 2e+05), weights = NULL)

Arguments

data         Demographic data (log mortality) presented as a matrix. Row numbers represent
              ages and column numbers represent time.
lambda       Controls "general flexibility" of the smooth surface.
lambdaaa     Controls "flexibility" of the smooth surface in age direction (first dimension).
lambdayy     Controls "flexibility" of the smooth surface in years direction (second dimension).
smoothAPC

- \( \lambda_{\text{aa}} \) Controls "flexibility" of the smooth surface in age and years directions.
- \( \lambda_{\text{y}} \) Controls "flexibility" of the period effects.
- \( \theta_{\text{y}} \) Reduces the likelihood of period effects.
- \( \lambda_{\text{c}} \) Controls "flexibility" of the cohort effects.
- \( \theta_{\text{c}} \) Reduces the likelihood of cohort effects.
- cornerLength Sets the smallest length of a diagonal to be considered for cohort effects.
- effects Controls if the cohort and period effects are taken into account.
- affdDiagonals Diagonals to be used for cohort effects.
- affdYears Years to be used for period effects.
- control Control data passed directly to \texttt{rq.fit.sfn} function.
- weights Define how much every observation affects the resulting smooth surface. The parameter must have the same dimensions as data parameter. Weights can be set to reciprocal of estimated standard deviation of the data.

**Value**

List of three components: smooth surface, period effects, cohort effects.

**Author(s)**

Alexander Dokumentov

**References**

http://robjhyndman.com/publications/mortality-smoothing/

**See Also**

\texttt{autoSmoothAPC}, \texttt{signifAutoSmoothAPC}.

**Examples**

```r
library(demography)
m <- log(fr.mort$rate$female[1:30, 150:160])
sm <- smoothAPC(m, lambdaaa = 0.2, lambdayy = 0.1, lambdaay = 0.4, effects = FALSE)
plot(sm, "original")
plot(sm)
```
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