Package 'anm'

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Title Analog model for downscaling

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Depends R (>= 1.4), clim.pact, xtable

Description The package contains an analog model for statistical/empirical downscaling.

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URL http://www.r-project.org http://cran.r-project.org,
http://www.stats.bris.ac.uk/~masgc/, http://www.met.rdg.ac.uk/cag/

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R topics documented:

anm *The Analog method*

Description

anm is used to compute the analog method.

Usage

```
anm(formula,data,weights=NULL,cross.valid=NULL)
```

Arguments

formula	a symbolic description of the model to be fit.
data	the data.frame containing the variables in the model.
weights	an optional matrix of weights to be used in the fitting process.
cross.valid	an optional matrix of booleans. If not specified, a cross validation is used in the fitting process.

Details

Models for *anm* are specified symbolically. A typical model has the form *predictand* ~ *terms* where *terms* is a series of predictors whose specification can be of the for *first* + *second*. anm calls the lower level function anmFit.

Value

An object of class "anm". An object of class "anm" is a list containing the following components:

coefficients	a vector containing the values for the principal components corresponding to the maximum among observations.
contrasts	(not used).
call	the matched call.
terms	the terms object used.
model	the model frame used.
x	the matrix used for predictors.
y	the predictand.
weights	the matrix of weights.
cross.valid	equals to True if the cross.validation will be used for the fitting process.
data	the input data.frame.

Author(s)

Alexandra Imbert

References

URL http://www.R-project.org/

See Also

predictAnm, stepANM

Examples

```
library(survival)
library(clim.pact)
data(temp.era)
data(susendal)
y<-susendal$V6 # temperatures
X<- eof$PC[,c(1,2)]
calibration <- c(susendal$V4>1979 & susendal$V4<1990 & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12))
evaluation <- c((susendal$V4>1990 & susendal$V4<1993 | susendal$V4==1990) & (susendal$V3==1 | susendal$V3==2 | sus
y.calib <- y[calibration]
y.eval <- y[evaluation]
eof.calib <- c(eof$yy>1979 & eof$yy<1990)
eof.eval <- c(eof$yy> 1990 & eof$yy<1993| eof$yy==1990)
period <- c(calibration, evaluation)
y.period <- y[(susendal$V4>1979 & susendal$V4<1993) & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12)]
test.data <-data.frame(y=y.period,
                       X1=X[eof$yy< 1993 & eof$yy> 1979,1],
                       X2=X[eof$yy< 1993 & eof$yy> 1979,2],
                       yy=eof$yy[eof.calib | eof.eval],
                       mm=eof$mm[eof.calib | eof.eval],
                       dd=eof$dd[eof.calib | eof.eval])
anm(y ~ X1 + X2,data=test.data)
```

`anmFit` *Support function for anm*

Description

Basic computing engine called by anm to implement the analog method. This should usually not be used directly.

Usage

```
anmFit(x, y, tol = 1e-07, ...)
```

Arguments

`x`	design matrix of dimension n * p.
`y`	vector of observations of length n.
`tol`	if equal to 1, information is printed during the running of step.
`...`	currently disregarded.

Value

A list with components

`coefficients`	vector containing the highest value among observations and the values of the predictors at this date.
`residuals`	*n* vector.
`fitted.values`	*n* vector.
`effects`	*n* vector.
`rank`	integer, giving the rank.
`df.residual`	degrees of freedom of residuals.
`qr`	the QR decomposition, see qr.

Author(s)

Alexandra Imbert

References

URL `http://www.R-project.org/`

See Also

anm, predictAnm

`eof` *Daily common EOF.*

Description

See EOF

`plotANM` *Plot Diagnostics for an anm Object.*

Description

Three plots are provided: a plot of the minimum distances versus time, a plot comparing the analogs from EOF and observations and a plot of errors versus time.

Usage

```
plotANM(x,tmp,station,eof.file,leps)
```

Arguments

x	the anm object inheriting from anm routine and for which prediction is desired.
tmp	True if the analysis is on temperature, False if on precipitation.
station	the name of the station.
eof.file	string giving the name of the eof file used for the study.
leps	if true, postscripts are created for the plots.

Author(s)

Alexandra Imbert

See Also

anm, stepANM, predictAnm, printAnm

Examples

```
library(survival)
library(clim.pact)
data(temp.era)
data(susendal)
y<-susendal$V6 # temperatures
X<- eof$PC[,c(1,2)]
calibration <- c(susendal$V4>1979 & susendal$V4<1990 & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12))
evaluation <- c((susendal$V4>1990 & susendal$V4<1993 | susendal$V4==1990) & (susendal$V3==1 | susendal$V3==2 | sus
y.calib <- y[calibration]
y.eval <- y[evaluation]
eof.calib <- c(eof$yy>1979 & eof$yy<1990)
eof.eval <- c(eof$yy> 1990 & eof$yy<1993| eof$yy==1990)
period <- c(calibration, evaluation)
y.period <- y[(susendal$V4>1979 & susendal$V4<1993) & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12)]
test.data <-data.frame(y=y.period,
                       X1=X[eof$yy< 1993 & eof$yy> 1979,1],
                       X2=X[eof$yy< 1993 & eof$yy> 1979,2],
                       yy=eof$yy[eof.calib | eof.eval],
                       mm=eof$mm[eof.calib | eof.eval],
                       dd=eof$dd[eof.calib | eof.eval])
test.anm<-anm(y ~ X1 + X2,data=test.data)
plotANM(test.anm,TRUE,"Susendal","eof_ERA-15_TEM_16E31E-64N73N_DJF",FALSE)
```

---

predictAnm *Predict method for anm objects.*

Description

Returns the predicted values based on the anm object.

Usage

```
predictAnm(object,newdata=NULL,se.fit=FALSE, ...)
```

Arguments

object	the anm object inheriting from anm routine.
newdata	an optional independant data. If specified, only the vector of predictions is returned.
se.fit	if false, only the vector of predictions is returned.
...	further arguments passed to or from other methods.

Value

A list with components

problem.dimension	the number of predictor variables.
period.length	the time period.
d.min	the vector of minimum distances.
date.min	the vector containing the dates corresponding to the minimum distances.
analog	the vector of predictions.
maxi.anlg	monthly maxima values of predictions.
mini.anlg	monthly minima values of predictions.
error	vector of errors between predictions and observations at each date.
correlation	correlation coefficient between predictions and observations.
rmse	root mean square errors between predictions and observations.

Author(s)

R.E. Benestad and Alexandra Imbert

References

URL http://www.R-project.org/

See Also

anm, stepANM

Examples

```
library(survival)
library(clim.pact)
data(temp.era)
data(susendal)
y<-susendal$V6 # temperatures
X<- eof$PC[,c(1,2)]
calibration <- c(susendal$V4>1979 & susendal$V4<1990 & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12))
evaluation <- c((susendal$V4>1990 & susendal$V4<1993 | susendal$V4==1990) & (susendal$V3==1 | susendal$V3==2 | sus
y.calib <- y[calibration]
y.eval <- y[evaluation]
eof.calib <- c(eof$yy>1979 & eof$yy<1990)
eof.eval <- c(eof$yy> 1990 & eof$yy<1993| eof$yy==1990)
period <- c(calibration, evaluation)
y.period <- y[(susendal$V4>1979 & susendal$V4<1993) & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12)]
test.data <-data.frame(y=y.period,
                       X1=X[eof$yy< 1993 & eof$yy> 1979,1],
                       X2=X[eof$yy< 1993 & eof$yy> 1979,2],
                       yy=eof$yy[eof.calib | eof.eval],
                       mm=eof$mm[eof.calib | eof.eval],
                       dd=eof$dd[eof.calib | eof.eval])
test.anm<-anm(y ~ X1 + X2,data=test.data)
res <- predictAnm(test.anm)
```

`printAnm` *Print some components of an anm object.*

Description

Prints the coefficients of an anm object.

Usage

```
printAnm(x, digits = max(3, getOption("digits") - 3), ...)
```

Arguments

`x`	the anm object.
`digits`	the vector defining the format of printing.
`...`	currently disregarded.

Author(s)

Alexandra Imbert

References

URL http://www.R-project.org/

See Also

anm, predictAnm

Examples

```
library(survival)
library(clim.pact)
data(susendal)
data(temp.era)
y<-susendal$V6 # temperatures
X<- eof$PC[,c(1,2)]
calibration <- c(susendal$V4>1979 & susendal$V4<1990 & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12))
evaluation <- c((susendal$V4>1990 & susendal$V4<1993 | susendal$V4==1990) & (susendal$V3==1 | susendal$V3==2 | sus
y.calib <- y[calibration]
y.eval <- y[evaluation]
eof.calib <- c(eof$yy>1979 & eof$yy<1990)
eof.eval <- c(eof$yy> 1990 & eof$yy<1993| eof$yy==1990)
period <- c(calibration, evaluation)
y.period <- y[(susendal$V4>1979 & susendal$V4<1993) & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12)]
test.data <-data.frame(y=y.period,
                       X1=X[eof$yy< 1993 & eof$yy> 1979,1],
                       X2=X[eof$yy< 1993 & eof$yy> 1979,2],
                       yy=eof$yy[eof.calib | eof.eval],
                       mm=eof$mm[eof.calib | eof.eval],
                       dd=eof$dd[eof.calib | eof.eval])
test.anm<-anm(y ~ X1 + X2,data=test.data)
printAnm(test.anm)
```

`stepANM` *Choose a model by the analog method in a stepwise algorithm*

Description

Performs the analog method step by step to select a model and plots on the same graph both correlation and rmse at each step.

Usage

```
stepANM(anm.obj,trace=1,steps=8)
```

Arguments

`anm.obj`	the anm object inheriting from anm routine.
`trace`	if equal to 1, information is printed during the running of the stepwise algorithm.
`steps`	maximum number of steps, forced to the number of predictor variables if *steps* exceeds it.

Value

A list with components

`Call`	the matched call.
`PC`	the predictor variables selected.
`anm.obj`	the anm object selected.
`coefficients`	the coeffecients of the anm object.
`step.min`	the number of steps which returns the minimum rmse.
`model`	the model corresponding to the minimum rmse.
`Rmse`	the minimum root mean square error.
`correlation`	the correlation between predictions and observations for the selected model.

Note

The running of the stepwise algorithm can be quite slow especially if the number of steps specified in the *steps* argument is high.

Author(s)

Alexandra Imbert

See Also

anm, predictAnm

Examples

```
library(survival)
library(clim.pact)
data(susendal)
data(temp.era)
y<-susendal$V6 # temperatures
X<- eof$PC[,c(1,2,3)]
calibration <- c(susendal$V4>1979 & susendal$V4<1990 & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12))
evaluation <- c((susendal$V4>1990 & susendal$V4<1993 | susendal$V4==1990) & (susendal$V3==1 | susendal$V3==2 | sus
y.calib <- y[calibration]
y.eval <- y[evaluation]
eof.calib <- c(eof$yy>1979 & eof$yy<1990)
eof.eval <- c(eof$yy> 1990 & eof$yy<1993| eof$yy==1990)
period <- c(calibration, evaluation)
y.period <- y[(susendal$V4>1979 & susendal$V4<1993) & (susendal$V3==1 | susendal$V3==2 | susendal$V3==12)]
test.data <-data.frame(y=y.period,
                       X1=X[eof$yy< 1993 & eof$yy> 1979,1],
                       X2=X[eof$yy< 1993 & eof$yy> 1979,2],
                       X3=X[eof$yy< 1993 & eof$yy> 1979,3],
                       yy=eof$yy[eof.calib | eof.eval],
                       mm=eof$mm[eof.calib | eof.eval],
                       dd=eof$dd[eof.calib | eof.eval])
test.anm<-anm(formula=y ~ X1 + X2 + X3,data=test.data)
stepANM(test.anm,steps=3)
```

susendal *Daily Susendal record.*

Description

A station record of daily mean temperature and daily precipitation from Susendal.

Usage

```
data(susendal)
```

Format

The dataset is a data.frame containing: V1:station number; V2:a vector holding day of month; V3:a vector holding the month; V4:a vector holding the year; V5:a vector holding daily precipitation in mm; V6:a vector holding daily mean temperature in deg C;

Source

The Norwegian Meteorological Institute, Climatology division.

References

The Norwegian Meteorological Institute, P.O. Box 43, 0313 Oslo, Norway (URL http://www.met.no)

temp.era *Daily winter common EOF.*

Description

Common EOFs for daily December-February temperature.

Usage

```
data(temp.era)
```

Format

A list

Value

EOF	EOF patterns.
W	Eigen values.
PC	Principal components of common PCA.
n.fld	Number of different predictors (see mixFields).
tot.var	Sum of all W squared.
id.t	Time labels for the fields (see catFields) - used in DS.
id.x	Spatial labels for the fields (see mixFields) - used in plotEOF.
mon	Month (1-12) [season (1-4) for daily data] to extract.
id.lon	Spatial labels for the fields (see mixFields) - used in plotEOF.
id.lat	Spatial labels for the fields (see mixFields) - used in plotEOF.
region	Describes the region analysed.
tim	Time information (usually redundant).
lon	Longitudes associated with EOF patterns.
lat	Latitudes associated with EOF patterns.
var.eof	Fractional variances associated with EOF patterns.
yy	years.
mm	months.
dd	days.
v.name	Name of element.
c.mon	Month-season information.
f.name	File name of original data.

Source

Rasmus E. Benestad rasmus.benestad@met.no.

References

Reference to methodology: R.E. Benestad (2001), "A comparison between two empirical downscaling strategies", Int. J. Climatology, vol 210, pp.1645-1668. [DOI 10.1002/joc.703].

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