Package 'pcdpca'

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Title Dynamic Principal Components for Periodically Correlated Functional Time Series

Version 0.4

Description Method extends multivariate and functional dynamic principal components to periodically correlated multivariate time series. This package allows you to compute true dynamic principal components in the presence of periodicity. We follow implementation guidelines as described in Kidzinski, Kokoszka and Jouzdani (2017), in Principal component analysis of periodically correlated functional time series <arXiv:1612.00040>.

Depends R (>= 3.3.1)

Imports freqdom, fda

License GPL-3

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NeedsCompilation no

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R topics documented:

pcdpca *Compute periodically correlacted DPCA filter coefficients*

Description

For a given periodically correlated multivariate process `X` eigendecompose it's spectral density and use an inverse fourier transform to get coefficients of the optimal filters.

Usage

```
pcdpca(X, period = NULL, q = 30, freq = (-1000:1000/1000) * pi)
```

Arguments

`X`	multivariate stationary time series
`period`	period of the periodic time series
`q`	window for spectral density estimation as in `spectral.density`
`freq`	frequency grid to estimate on as in `spectral.density`

Value

principal components series

References

Kidzinski, Kokoszka, Jouzdani Dynamic principal components of periodically correlated functional time series Research report, 2016

See Also

`pcdpca.inverse`, `pcdpca.scores`

Examples

```
## Prepare some process
library(fda)
library(freqdom)

MSE = function(X,Y=0){ sum((X-Y)**2) / nrow(X) }

d = 7
n = 100
A = t(t(matrix(rnorm(d*n),ncol=d,nrow=n))*7:1)
B = t(t(matrix(rnorm(d*n),ncol=d,nrow=n))*7:1)
C = t(t(matrix(rnorm(d*n),ncol=d,nrow=n))*7:1)

X = matrix(0,ncol=d,nrow=3*n)
X[3*(1:n) - 1,] = A
```

```
X[3*(1:n) - 2,] = A + B
X[3*(1:n) ,] = 2*A - B + C

basis = create.fourier.basis(nbasis=7)
X.fd = fd(t(Re(X)),basis=basis)
plot(X.fd)

## Hold out some datapoints
train = 1:(50*3)
test = (50*3) : (3*n)

## Static PCA ##
PR = prcomp(as.matrix(X[train,]))
Y1 = as.matrix(X) %*% PR$rotation
Y1[,-1] = 0
Xpca.est = Y1 %*% t(PR$rotation)

## Dynamic PCA ##
XI.est = dpca(as.matrix(X[train,]),
   q=3,
   freq=pi*(-150:150/150),
   Ndpc=1)  # finds the optimal filter
Y.est = freqdom::filter.process(X, XI.est$filters )
Xdpca.est = freqdom::filter.process(Y.est, t(rev(XI.est$filters)) )    # deconvolution

## Periodically correlated PCA ##
XI.est.pc = pcdpca(as.matrix(X[train,]),
   q=3,
   freq=pi*(-150:150/150),period=3)  # finds the optimal filter
Y.est.pc = pcdpca.scores(X, XI.est.pc)  # applies the filter
Y.est.pc[,-1] = 0 # forces the use of only one component
Xpcdpca.est = pcdpca.inverse(Y.est.pc, XI.est.pc)  # deconvolution

## Results
cat("NMSE PCA = ")
r0 = MSE(X[test,],Xpca.est[test,]) / MSE(X[test,],0)
cat(r0)
cat("\nNMSE DPCA = ")
r1 = MSE(X[test,],Xdpca.est[test,]) / MSE(X[test,],0)
cat(r1)
cat("\nNMSE PCDPCA = ")
r2 = MSE(X[test,],Xpcdpca.est[test,]) / MSE(X[test,],0)
cat(r2)
cat("\n")
```

`pcdpca.inverse` *Retrieve a process from given scores*

Description

For given scores `Y` and dynamic principal components `XI` retrive a series from which scores `Y` were calculated. This procedure should be seen as the inverse of `pcdpca.scores`.

Usage

```
pcdpca.inverse(Y, XI)
```

Arguments

`Y`	scores process
`XI`	principal components series

Value

Retrived process X

References

Kidzinski, Kokoszka, Jouzdani Dynamic principal components of periodically correlated functional time series Research report, 2016

See Also

`pcdpca.scores`, `pcdpca`

`pcdpca.scores` *Compute periodically correlated DPCA scores, given the filters XI*

Description

Compute periodically correlated DPCA scores, given the filters XI

Usage

```
pcdpca.scores(X, XI)
```

Arguments

`X`	multivariate time series
`XI`	series of filters returned from pcdpca

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