Package 'sufficientForecasting'

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Type Package

Title Sufficient Forecasting using Factor Models

Version 0.1.0

Description The sufficient forecasting (SF) method is implemented by this package for a single time series forecasting using many predictors and a possibly nonlinear forecasting function. Assuming that the predictors are driven by some latent factors, the SF first conducts factor analysis and then performs sufficient dimension reduction on the estimated factors to derive predictive indices for forecasting. The package implements several dimension reduction approaches, including principal components (PC), sliced inverse regression (SIR), and directional regression (DR). Methods for dimension reduction are as described in: Fan, J., Xue, L. and Yao, J. (2017) <doi:10.1016/j.jeconom.2017.08.009>, Luo, W., Xue, L., Yao, J. and Yu, X. (20

License GPL (>= 3)

Encoding UTF-8

LazyData true

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Imports gam, stats

Depends R (>= 2.10)

Suggests knitr, rmarkdown

VignetteBuilder knitr

URL https://github.com/JingFu1224/sufficientForecasting

BugReports https://github.com/JingFu1224/sufficientForecasting/issues

NeedsCompilation no

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R topics documented:

`dataExample` *A simulated dataset*

Description

This is a simulated dataset consisting of predictors, responses, and additional predictors to make forecasting at a future time. In this example, the dimension of predictors is p=100, and the number of observed time periods is T=100.

Usage

```
dataExample
```

Format

- `dataExample$X` simulated predictors; a p by T matrix
- `dataExample$y` simulated responses; a T by 1 vector
- `dataExample$newX` simulated new predictors for forecasting; a p by 1 vector

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`getK` *Estimate the number of common factors K*

Description

Estimate the number of common factors K

Usage

```
getK(y, X, Kmax = 12)
```

Arguments

`y`	Response, T by 1 vector
`X`	Predictors, p by T matrix
`Kmax`	A prescribed upper bound that possibly increases with p and T (default = 12)

Value

Estimate of K

References

Bai, J., and Ng, S. (2002), Determining the number of factors in approximate factor models, *Econometrica* 70(1), 191-221.

Li, H., Li, Q. and Shi, Y. (2017), Determining the number of factors when the number of factors can increase with sample size, *Journal of Econometrics* 197(1), 76–86.

`SF` *Select a method from PC, SIR and DR to do point prediction*

Description

Select a method from PC, SIR and DR to do point prediction

Usage

```
SF(
  y,
  X,
  newX = NULL,
  K = "default",
  L = 1,
  method = "SIR.LM",
  hyperparameter = list()
)
```

Arguments

`y`	Response, T by 1 matrix
`X`	Predictors, p by T matrix
`newX`	New predictors, a vector contains p entries (or `NULL`)
`K`	The number of common factors (default = obtained by `getK`)
`L`	The number of predictive indices, L is required to be no greater than K (default = 1)
`method`	Select one from `PC`, `SIR.LM`, `SIR.LLM` and `DR` to do point prediction (default = `SIR.LM`)
`hyperparameter`	A list of parameters for the corresponding method **For `SIR.LM` and `SIR.LLM`:** arguments `discretization` and `nslices`. See `SF.SIR` for detail **For `DR`:** arguments `etaopg` and `nslices`. See `SF.DR` for detail

Value

Out-of-sample forecast for newX; or in-sample forecast for the last observed data point if newX is NULL

References

Fan, J., Xue, L. and Yao, J. (2017), Sufficient forecasting using factor models, *Journal of econometrics* 201(2), 292–306

Luo, W., Xue, L., Yao, J. and Yu, X. (2022), Inverse moment methods for sufficient forecasting using high-dimensional predictors, *Biometrika* 109(2), 473–487.

Yu, X., Yao, J. and Xue, L. (2022), Nonparametric estimation and conformal inference of the sufficient forecasting with a diverging number of factors, *Journal of Business & Economic Statistics* 40(1), 342–354.

Examples

```
utils::data(dataExample,package = "sufficientForecasting")
SF(dataExample$y,dataExample$X,method = "SIR.LLM",
hyperparameter = list(nslices = 5,discretization = TRUE))
SF(dataExample$y,dataExample$X,dataExample$newX,method = "DR")
SF(dataExample$y,dataExample$X,dataExample$newX,method = "PC")
```

SF.CI *Conformal inference of the sufficient forecasting*

Description

Conformal inference of the sufficient forecasting

Usage

```
SF.CI(
  y,
  X,
  newX = NULL,
  type = "LM",
  K = "default",
  L = 1,
  alpha = 0.1,
  discretization = TRUE,
  nslices = 10
)
```

Arguments

y	Response, T by 1 matrix
X	Predictors, p by T matrix
newX	New predictors, a vector contains p entries (or NULL)
type	LM or LLM (default = LM)
K	The number of common factors (default = obtained by getK)
L	The number of predictive indices, L is required to be no greater than K (default = 1)
alpha	Mis-coverage rate
discretization	Hyperparameter in SIR (default = TRUE)
nslices	Hyperparameter in SIR (default = 10)

Value

A list with components

yhat Out-of-sample forecast for newX; or in-sample forecast for the last observed data point if newX is NULL

ci_lower Lower bound of conformal interval

ci_upper Upper bound of conformal interval

References

Yu, X., Yao, J. and Xue, L. (2022), Nonparametric estimation and conformal inference of the sufficient forecasting with a diverging number of factors, *Journal of Business & Economic Statistics* 40(1), 342–354.

Examples

```
utils::data(dataExample,package = "sufficientForecasting")
SF.CI(dataExample$y,dataExample$X,type = "LM",alpha = 0.05)
```

SF.DR *Directional regression for sufficient forecasting*

Description

Directional regression for sufficient forecasting

Usage

```
SF.DR(y, X, newX = NULL, K = "default", L = 1, etaopg = "default", nslices = 3)
```

Arguments

y	Response, T by 1 matrix
X	Predictors, p by T matrix
newX	New predictors, a vector contains p entries (or NULL)
K	The number of common factors (default = obtained by getK)
L	The number of predictive indices, L is required to be no greater than K (default = 1)
etaopg	hyperparameter in DR (default = obtained by opg)
nslices	hyperparameter in DR (default = 3)

Value

Out-of-sample forecast for newX; or in-sample forecast for the last observed data point if newX is NULL

References

Luo, W., Xue, L., Yao, J. and Yu, X. (2022), Inverse moment methods for sufficient forecasting using high-dimensional predictors, *Biometrika* 109(2), 473–487.

Examples

```
utils::data(dataExample,package = "sufficientForecasting")
SF.DR(dataExample$y,dataExample$X,dataExample$newX)
```

SF.PC *Principal component regression for sufficient forecasting*

Description

Principal component regression for sufficient forecasting

Usage

```
SF.PC(y, X, newX = NULL, K = "default", L = "default")
```

Arguments

y	Response, T by 1 matrix
X	Predictors, p by T matrix
newX	New predictors, a vector contains p entries (or NULL)
K	The number of common factors (default = obtained by getK)
L	The number of principal components used in the prediction, L is required to be no greater than K (default = K)

Value

Out-of-sample forecast for newX; or in-sample forecast for the last observed data point if newX is NULL

Examples

```
utils::data(dataExample,package = "sufficientForecasting")
SF.PC(dataExample$y,dataExample$X)
```

SF.SIR *Sliced inverse regression for sufficient forecasting*

Description

Sliced inverse regression for sufficient forecasting

Usage

```
SF.SIR(
  y,
  X,
  newX = NULL,
  type = "LM",
  K = "default",
  L = 1,
  discretization = TRUE,
  nslices = 10
)
```

Arguments

y	Response, T by 1 matrix
X	Predictors, p by T matrix
newX	New predictors, a vector contains p entries (or NULL)
type	LM or LLM (default = LM), type = LM fits a linear regression of the response on the estimated predictive indices; type = LLM fits a local linear regression
K	The number of common factors (default = obtained by getK)
L	The number of predictive indices, L is required to be no greater than K (default = 1)
discretization	Hyperparameter in SIR (default = TRUE)
nslices	Hyperparameter in SIR (default = 10)

Value

Out-of-sample forecast for newX; or in-sample forecast for the last observed data point if newX is NULL

References

Fan, J., Xue, L. and Yao, J. (2017), Sufficient forecasting using factor models, *Journal of econometrics* 201(2), 292–306.

Yu, X., Yao, J. and Xue, L. (2022), Nonparametric estimation and conformal inference of the sufficient forecasting with a diverging number of factors, *Journal of Business & Economic Statistics* 40(1), 342–354.

Examples

```
utils::data(dataExample,package = "sufficientForecasting")
SF.SIR(dataExample$y,dataExample$X,type = "LLM")
```

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