Package 'BootPR'

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Type Package

Title Bootstrap Prediction Intervals and Bias-Corrected Forecasting

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Description Contains functions for bias-
Corrected Forecasting and Bootstrap Prediction Intervals for Autoregressive Time Series.

License GPL-2

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Contents

BootPR-package *Bootstrap Prediction Intervals and Bias-Corrected Forecasting*

Description

The package provides alternative bias-correction methods for univariate autoregressive model parameters; and generate point forecats and prediction intervals for economic time series.

A future version will include the case of vector AR models.

Details

Package:	BootPR
Type:	Package
Version:	1.0
Date:	2023-08-31
License:	GPL version 2 or newer

Author(s)

Jae H. Kim

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Andrews.Chen *Andrews-Chen median-unbiased estimation for AR models*

Description

This function returns the Andrews-Chen estimates for AR coefficients, residuals, and AR forecasts generated using the Andrews-Chen estimates

Usage

```
Andrews.Chen(x, p, h, type)
```

Arguments

x	a time series data set
p	AR order
h	the number of forecast periods
type	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Value

coef	Andrews-Chen median-unbiased estimates
ecm.coef	the coefficients in the ADF form
resid	residuals
forecast	point forecasts from Andrews-Chen estimates

Note

The Andrew-Chen estimator may break down when the AR order is very high. I recommend that AR order be kept low

Author(s)

Jae H. Kim

References

Kim, J.H., 2003, Forecasting Autoregressive Time Series with Bias-Corrected Parameter Estimators, International Journal of Forecasting, 19, 493-502.

Andrews, D.W. K. (1993). Exactly median-unbiased estimation of first order autoregressive / unit root models. Econometrica, 61, 139-165.

Andrews, D.W. K., & Chen, H. -Y. (1994). Approximate median unbiased estimation of autoregressive models. Journal of Business & Economic Statistics, 12, 187-204.

Examples

```
data(IPdata)
BootBC(IPdata,p=1,h=10,nboot=200,type="const+trend")
```

ARorder *AR model order selection*

Description

AR model selection using AIC, BIC, HQ

Usage

```
ARorder(x, pmax, type)
```

Arguments

x	a time series data set
pmax	the maximum AR order
type	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Value

ARorder	AR orders selected by AIC, BIC and HQ
Criteria	the values of AIC, BIC and HQ

Author(s)

Jae H. Kim

Examples

```
data(IPdata)
ARorder(IPdata,pmax=12,type="const+trend")
```

BootAfterBootPI *Bootstrap-after-Bootstrap Prediction*

Description

This function calculates bootstrap-after-bootstrap prediction intervals and bootstrap bias-corrected point forecasts

Usage

```
BootAfterBootPI(x, p, h, nboot, prob, type)
```

Arguments

x	a time series data set
p	AR order
h	the number of forecast periods
nboot	number of bootstrap iterations
prob	a vector of probabilities
type	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Value

PI	prediction intervals
forecast	bias-corrected point forecasts

Author(s)

Jae H. Kim

References

Kim, J.H., 2001, Bootstrap-after-Bootstrap Prediction Intervals for Autoregressive Models, Journal of Business & Economic Statistics 19, 117-128

Kilian, L. (1998). Small sample confidence intervals for impulse response functions. The Review of Economics and Statistics, 80,218-230.

Examples

```
data(IPdata)
BootAfterBootPI(IPdata,p=1,h=10,nboot=100,prob=c(0.05,0.95),type="const+trend")
```

`BootBC` *Bootstrap bias-corrected estimation and forecasting for AR models*

Description

This function returns bias-corrected parameter estimates and forecasts for univariate AR models.

Usage

```
BootBC(x, p, h, nboot, type)
```

Arguments

`x`	a time series data set
`p`	AR order
`h`	the number of forecast period
`nboot`	number of bootstrap iterations
`type`	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Value

`coef`	Bootstrap bias-corrected parameter estimates
`resid`	residuals
`forecast`	point forecasts from bootstrap bias-corrected parameter estimates

Author(s)

Jae H. Kim

References

Kim, J.H., 2003, Forecasting Autoregressive Time Series with Bias-Corrected Parameter Estimators, International Journal of Forecasting, 19, 493-502.

Kilian, L. (1998a). Small sample confidence intervals for impulse response functions. The Review of Economics and Statistics, 80,218-230.

Examples

```
data(IPdata)
BootBC(IPdata,p=1,h=10,nboot=100,type="const+trend")
```

`BootPI` *Bootstrap prediction intevals and point forecasts with no bias-correction*

Description

This function returns bootstrap forecasts and prediction intervals with no bias-correction

Usage

```
BootPI(x, p, h, nboot, prob, type)
```

Arguments

`x`	a time series data set
`p`	AR order
`h`	the number of forecast periods
`nboot`	number of bootstrap iterations
`prob`	a vector of probabilities
`type`	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Value

`PI`	prediction intervals
`forecast`	bias-corrected point forecasts

Author(s)

Jae H. Kim

References

Thombs, L. A., & Schucany, W. R. (1990). Bootstrap prediction intervals for autoregression. Journal of the American Statistical Association, 85, 486-492.

Examples

```
data(IPdata)
BootPI(IPdata,p=1,h=10,nboot=100,prob=c(0.05,0.95),type="const+trend")
```

IPdata *US industrial production data*

Description

From Extended Nelson-Plosser data set, annua1, 1860-1988

Usage

```
data(IPdata)
```

References

Andrews, D.W. K., & Chen, H. -Y. (1994). Approximate median-unbiased estimation of autoregressive models. Journal of Business & Economic Statistics, 12, 187-204.

Examples

```
data(IPdata)
```

LS.AR *OLS parameter estimates and forecasts, no bias-correction*

Description

The function returns parameter estimates and forecasts from OLS estimation for AR models

Usage

```
LS.AR(x, p, h, type, prob)
```

Arguments

x	a time series data set
p	AR order
h	the number of forecast period
prob	a vector of probabilities
type	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Value

coef	OLS parameter estimates
resid	OLS residuals
forecast	point forecasts from OLS parameter estimates
PI	Prediction Intervals based on OLS parameter estimates based on normal approximation

Author(s)

Jae H. Kim

Examples

```
data(IPdata)
LS.AR(IPdata,p=6,h=10,type="const+trend", prob=c(0.05,0.95))
```

Plot.Fore *Plotting point forecasts*

Description

The function returns plots the point forecasts

Usage

```
Plot.Fore(x, fore, start, end, frequency)
```

Arguments

x	a time series data set
fore	point forecasts
start	starting date
end	ending date
frequency	data frequency

Details

frequency=1 for annual data, 4 for quarterly data, 12 for monthly data

start=c(1980,4) indicates April 1980 if frequency=12

end = c(2000,1) indicates 1st quarter of 2000 if freqeuncy = 4

Value

plot

Author(s)

Jae H. Kim

Examples

```
data(IPdata)
BootF <- BootBC(IPdata,p=1,h=10,nboot=100,type="const+trend")
Plot.Fore(IPdata,BootF$forecast,start=1860,end=1988,frequency=1)
```

Plot.PI *Plotting prediction intervals and point forecasts*

Description

The function returns plots the point forecasts and prediction intervals

Usage

```
Plot.PI(x, fore, Interval, start, end, frequency)
```

Arguments

x	a time series data set
fore	point forecasts
Interval	Prediction Intervals
start	starting date
end	ending date
frequency	data frequency

Details

frequency=1 for annual data, 4 for quarterly data, 12 for monthly data

start=c(1980,4) indicates April 1980 if frequency=12

end = c(2000,1) indicates 1st quarter of 2000 if freqeuncy = 4

Value

plot

Author(s)

Jae H. Kim

Examples

```
data(IPdata)
PI <- ShamanStine.PI(IPdata,p=1,h=10,nboot=100,prob=c(0.025,0.05,0.95,0.975),type="const+trend",0)
Plot.PI(IPdata,PI$forecast,PI$PI,start=1860,end=1988,frequency=1)
```

`Roy.Fuller` *Roy-Fuller median-unbiased estimation*

Description

This function returns parameter estimates and forecasts based on Roy-Fuller medin-unbiased estimator for AR models

Usage

```
Roy.Fuller(x, p, h, type)
```

Arguments

`x`	a time series data set
`p`	AR order
`h`	the number of forecast period
`type`	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Value

`coef`	Roy-Fuller parameter estimates
`resid`	residuals
`forecast`	point forecasts from Roy-Fuller parameter estimates

Author(s)

Jae H. Kim

References

Kim, J.H., 2003, Forecasting Autoregressive Time Series with Bias-Corrected Parameter Estimators, International Journal of Forecasting, 19, 493-502.

Roy, A., & Fuller, W. A. (2001). Estimation for autoregressive time series with a root near one. Journal of Business & Economic Statistics, 19(4), 482-493.

Examples

```
data(IPdata)
Roy.Fuller(IPdata,p=6,h=10,type="const+trend")
```

ShamanStine.PI *Bootstrap prediction interval using Shaman and Stine bias formula*

Description

The function returns bias-corrected forecasts and bootstrap prediction intervals using Shaman and Stine bias formula for univariate AR models

Usage

```
ShamanStine.PI(x, p, h, nboot, prob, type, pmax)
```

Arguments

x	a time series data set
p	AR order
h	the number of forecast periods
nboot	number of bootstrap iterations
prob	a vector of probability values
type	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend
pmax	for exogenous lag order algorithm, pmax = 0, for endogenous lag order algorithm, pmax is an integer greater than 0

Value

PI	prediction intervals
forecast	bias-corrected point forecasts

Author(s)

Jae H. Kim

References

Kim, J.H., 2004, Bootstrap Prediction Intervals for Autoregression using Asymptotically Mean-Unbiased Parameter Estimators, International Journal of Forecasting, 20, 85-97.

Kim, J.H., 2003, Forecasting Autoregressive Time Series with Bias-Corrected Parameter Estimators, International Journal of Forecasting, 19, 493-502.

Shaman, P., & Stine, R. A. (1988). The bias of autoregressive coefficient estimators. Journal of the American Statistical Association, 83, 842-848.

Stine, R. A., & Shaman, P. (1989). A fixed point characterization for bias of autoregressive estimators. The Annals of Statistics,17, 1275-1284.

Kilian, L. (1998a). Small sample confidence intervals for impulse response functions. The Review of Economics and Statistics, 80,218-230.

Examples

```
data(IPdata)
ShamanStine.PI(IPdata,p=1,h=10,nboot=100,prob=c(0.05,0.95),type="const+trend",pmax=0)
```

`Stine.Shaman` *bias-corrected estimation based on Shaman-Stine formula*

Description

The function returns parameter estimates and bias-corrected forecasts using Shaman and Stine bias formula for univariate AR models

Usage

```
Stine.Shaman(x, p, h, type)
```

Arguments

`x`	a time series data set
`p`	AR order
`h`	the number of forecast period
`type`	"const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Value

`coef`	Bias-corrected parameter estimates using Shama-Stine formula
`resid`	residuals
`forecast`	point forecasts from bias-corrected parameter estimates

Author(s)

Jae H. Kim

References

Kim, J.H., 2003, Forecasting Autoregressive Time Series with Bias-Corrected Parameter Estimators, International Journal of Forecasting, 19, 493-502.

Shaman, P., & Stine, R. A. (1988). The bias of autoregressive coefficient estimators. Journal of the American Statistical Association, 83, 842-848.

Stine, R. A., & Shaman, P. (1989). A fixed point characterization for bias of autoregressive estimators. The Annals of Statistics,17, 1275-1284.

Kilian, L. (1998a). Small sample confidence intervals for impulse response functions. The Review of Economics and Statistics, 80,218-230.

Examples

```
data(IPdata)
Stine.Shaman(IPdata,p=6,h=10,type="const+trend")
```

Index