Package ‘VAR.etp’

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Description

Estimation, Hypothesis Testing, Prediction in Stationary Vector Autoregressive Models

Details

Package: VAR.etp
Type: Package
Version: 0.7
Date: 2014-12-2
License: GPL-2

The data set dat.rda is from Lutkepohl’s book.
It is German Macradata in log difference.
Bootstrap bias-correction and prediction intervals are also included.
Estimation and Forecasting based on Predictive Regression is also included.

Author(s)

Jae H. Kim
Maintainer: Jae H. Kim

Description

Lutkepohl’s data

Usage

data(dat)

References


Examples

data(dat)
data1

Description

stock return data used in Kim (2014)

Usage

data(data1)

References


Examples

data(data1)

PR.Fore

Improved Augmented Regression Method for Predictive Regression

Description

Function for forecasting based on Improved ARM

Usage

PR.Fore(x, y, M, h = 10)

Arguments

x predictor or matrix of predictors in column
y variable to be predicted, usually stock return
M Estimation results of the function PR.IARM
h forecasting period

Details

Function for forecasting based on Improved ARM

Value

Fore Out-of sample and dynamic forecasts for y and x
Note

Author(s)
jae H. Kim

References

Examples
```r
data(data1)
# Replicating Table 5 (excess return)
y=data1$ret.nyse.vw*100 -data1$tbill*100
x=cbind(log(data1$dy.nyse), data1$tbill*100); k=ncol(x)
p=4
Rmat1=Rmatrix(p,k,type=1,index=1); Rmat1$Rmat; rvec1=Rmat1$rvec
M=PR.IARM(x,y,p,Rmat1,rvec1)
PRF=PR.Fore(x,y,M)
```

Description
Function for Improved ARM (IARM) estimation and testing

Usage
```r
PR.IARM(x, y, p, Rmat = diag(k * p), rvec = matrix(0, nrow = k * p))
```

Arguments
- `x` predictor or a matrix of predictors in column
- `y` variable to be predicted, usually data1 return
- `p` AR order
- `Rmat` Restriction matrix, refer to function Rmatrix
- `rvec` Restriction matrix, refer to function Rmatrix

Details
**Value**

- **LS**: Ordinary Least Squares Estimators
- **IARM**: IARM Estimators
- **AR**: AR parameter estimators
- **ARc**: Bias-corrected AR parameter estimators
- **Fstats**: Fstats and their p-values
- **Covbc**: Covariance matrix of the IARM estimators (for the predictive coefficients only)

**Note**


**Author(s)**

Jae H. Kim

**References**


**Examples**

```r
data(data1)
# Replicating Table 5 (excess return) of Kim (2014)
y=data1$ret.nyse.vw*100 -data1$tbill*100
x=cbind(log(data1$dy.nyse), data1$tbill*100);

Rmat1=Rmatrix(p=1,k=2,type=1,index=0); Rmat=Rmat1$Rmat; rvec=Rmat1$rvec
M=PR.IARM(x,y,p=1,Rmat,rvec)
```

**Description**

Function to select the order p by AIC or BIC

**Usage**

```r
PR.order(x, y, pmax = 10)
```
`PR.order`

**Arguments**

- `x` predictor or a matrix of predictors in column
- `y` variable to be predicted, usually stock return
- `pmax` maximum order for order selection

**Details**


**Value**

- `p.aic` order chosen by AIC
- `p.bic` order chosen by BIC

**Note**


**Author(s)**

Jae H. Kim

**References**


**Examples**

```r
data(data1)
# Replicating Table 5 (excess return)
y=data1$ret.nyse.vw*100 -data1$tbill*100
x=cbind(log(data1$dy.nyse), data1$tbill*100); k=ncol(x)

p=PR.order(x,y,pmax=10)$p.bic; # AR(1)
```
Rmatrix

Improved Augmented Regression Method for Predictive Regression

Description

Function to generate restriction matrices

Usage

Rmatrix(p, k, type = 1, index = 0)

Arguments

p
AR order
k
number of predictors
type
type = 1: H0: b1=b2=b3=0; type = 2: H0: b1+b2+b3=0
index
index=0: H0 applies for all parameters; index=k: H0 applies for kth predictor

Details

Function to generate restriction matrices

Value

rmat
this value should be passed to PR.IARM
rvec
this value should be passed to PR.IARM

Author(s)

Jae H. Kim

References


Examples

Rmat1=Rmatrix(p=1,k=1,type=2,index=1); Rmat=Rmat1$rmat; rvec=Rmat1$rvec
Description

Bias-correction given with stationarity Correction

Usage

VAR.BaBPR(x, p, h, nboot = 500, nb = 200, type = "const", alpha = 0.95)

Arguments

x data matrix in column
p AR order
h forecasting period
nboot number of 2nd-stage bootstrap iterations
nb number of 1st-stage bootstrap iterations
type "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend
alpha 100(1-alpha) percent prediction intervals

Details

Bias-correction given with stationarity Correction

Value

Intervals Prediction Intervals
Forecast Point Forecasts
alpha Probability Content of Prediction Intervals

Note

Bias-correction given with stationarity Correction

Author(s)

Jae H. Kim

References

VAR.Boot

Examples

```r
data(dat)
VAR.BabPR(dat,p=2,h=10,nboot=200,nb=100,type="const",alpha=0.95)
# nboot and nb are set to low numbers for fast execution in the example
# In actual implementation, use higher numbers such as nboot=1000, nb=200
```

Description

The function returns bias-corrected parameter estimators and Bias estimators based on the bootstrap

Usage

```r
VAR.Boot(x, p, nb = 200, type = "const")
```

Arguments

- `x`: data matrix in column
- `p`: AR order
- `nb`: number of bootstrap iterations
- `type`: "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Details

Kilian’s (1998) stationarity-correction is used for bias-correction

Value

- `coef`: coefficient matrix
- `resid`: matrix of residuals
- `sigu`: residual covariance matrix
- `Bias`: Bootstrap Bias Estimator

Author(s)

Jae H. Kim

References

Examples

data(dat)
VAR.Boot(dat,p=2, nb=200, type="const")

Description

No Bias-correction is given

Usage

VAR.BPR(x, p, h, nboot = 500, type = "const", alpha = 0.95)

Arguments

- **x**: data matrix in column
- **p**: AR order
- **h**: forecasting 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
- **alpha**: 100(1-alpha) percent prediction intervals

Details

Bootstrap Prediction Intervals for VAR(p) Model

Value

- **Intervals**: Prediction Intervals
- **Forecast**: Point Forecasts
- **alpha**: Probability Content of Prediction Intervals

Note

No Bias-correction is given

Author(s)

Jae H. Kim

References

VAR.est

Examples

data(dat)
VAR.BPR(dat,p=2,h=10,nboot=200,type="const",alpha=0.95)
# nboot is set to a low number for fast execution in the example
# In actual implementation, use higher number such as nboot=1000

Description

This function returns least-squares estimation results for VAR(p) model

Usage

VAR.est(x, p, type = "const")

Arguments

x
  data matrix in column
p
  AR order
type
  "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Details

VAR estimation

Value

coef
  coefficient matrix
resid
  matrix of residuals
sigu
  residual covariance matrix
zzmat
  data moment matrix
zmat
  data moment matrix
tratio
  matrix of tratio corresponding to coef matrix

Note

See Chapter 3 of Lutkepohl (2005)

Author(s)

Jae H. Kim
References

Examples

```r
# replicating Section 3.2.3 of of Lutkepohl (2005)
data(dat)
M=VAR.est(dat,p=2,type="const")
print(M$coef)
print(M$tratio)
```

VAR.FOR

<table>
<thead>
<tr>
<th>VAR Forecasting</th>
</tr>
</thead>
</table>

Description
Generate point forecasts and prediction intervals

Usage

```r
VAR.FOR(x, p, h, type = "const", alpha = 0.95)
```

Arguments

- `x` data matrix in column
- `p` VAR order
- `h` Forecasting Periods
- `type` "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend
- `alpha` 100(1-alpha) percent prediction intervals

Details
Prediction Intervals are based on normal approximation

Value

- **Intervals** Prediction Intervals, out-of-sample and dynamic
- **Forecast** Point Forecasts, out-of-sample and dynamic
- **alpha** Probability Content of Prediction Intervals

Note
See Chapter 3 of Lutkepohl (2005)
VAR.Fore

Author(s)
Jae H. Kim

References

Examples
# replicating Section 3.5.3 of Lutkepohl (2005)
data(dat)
VAR.FOR(dat, p=2, h=10, type="const", alpha=0.95)

VAR.Fore  VAR Forecasting

Description
Generate point forecasts using the estimated VAR coefficient matrix

Usage
VAR.Fore(x, b, p, h, type = "const")

Arguments
x  data matrix in column
b  matrix of coefficients from VAR.est or VAR.Rest
p  VAR order
h  Forecasting Periods
type "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Details
Generate point forecasts using the estimated VAR coefficient matrix

Value
Fore  Point Forecasts, out-of-sample and dynamic

Note
See Chapter 3 of Lutkepohl (2005)
**VAR.irf**

**Author(s)**
Jae H. Kim

**References**

**Examples**

```r
# replicating Section 3.5.3 of Lutkepohl (2005)
data(dat)
b = VAR.est(dat, p = 2, type = "const")$coef
VAR.Fore(dat, b, p = 2, h = 10, type = "const")
```

<table>
<thead>
<tr>
<th>VAR.irf</th>
<th>Orthogonalized impulse response functions from an estimated VAR(p) model</th>
</tr>
</thead>
</table>

**Description**
This function returns Orthogonalized impulse response functions

**Usage**

```r
VAR.irf(b, p, sigu, h = 10, graphs = FALSE)
```

**Arguments**
- `b`: VAR coefficient matrix, from VAR.est or similar estimation function
- `p`: VAR order
- `sигу`: VAR residual covariance matrix, from VAR.est or similar estimation function
- `h`: response horizon, the default is set to 10
- `graphs`: logical, if TRUE, show the impulse-response functions, the default is FALSE

**Details**
VAR impulse response functions

**Value**
- `impmat`: matrix that contains orthogonalized impulse-responses

**Note**
See Lutkepohl (2005) for details
VAR.LR

Author(s)

Jae H. Kim

References


Examples

# replicating Table 3.4 and Figure 3.11 Lutkepohl (2005)
data(dat)
M=VAR.est(dat,p=2,type="const")
b=M$coef; sigu=M$sigu
VAR.irf(b,p=2,sigu,graphs=TRUE)

VAR.LR

The Likelihood Ratio test for parameter restrictions

Description

Likelihood Ratio test for zero parameter restrictions based on system VAR estimation

Bootstrap option is available: iid bootstrap or wild bootstrap

Bootstrap is conducted under the null hypothesis using estimated GLS estimation: see Kim (2014)

Usage

VAR.LR(x, p, restrict0, restrict1, type = "const", bootstrap=0, nb=500)

Arguments

x            data matrix in column
p            VAR order
restrict0    Restriction matrix under H0
restrict1    Restriction matrix under H1, if "full", the full VAR is estimated under H1
type         "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend
bootstrap    0 for no bootstrap; 1 for iid bootstrap; 2 for wild bootstrap
nb           the number of bootstrap iterations
Details

Restriction matrix is of m by 3 matrix where m is the number of restrictions. A typical row of this matrix (k,i,j), which means that (i,j) element of Ak matrix is set to 0. Ak is a VAR coefficient matrix (k = 1,...,p).

The bootstrap test is conducted using the GLS estimation under the parameter restrictions implied by the null hypothesis: see Kim (2014) for details.

Kim (2014) found that the bootstrap based on OLS can show inferior small sample properties.

There are two versions of the bootstrap: the first is based on the iid resampling and the second based on wild bootstrapping.

The Wild bootstrap is conducted with Mammen’s two-point distribution.

Value

- **LRstat**: LR test statistic
- **pval**: p-value of the LR test
- **Boot.pval**: p-value of the test based on bootstrapping

Note

See Chapter 4 of Lutkepohl (2005)

Author(s)

Jae H. Kim

References


Examples

data(dat)
# replicating Table 4.4 of Lutkepohl (2005)
restrict1="full"
restrict0 = rbind(c(4,1,1), c(4,1,2), c(4,1,3), c(4,2,1),
c(4,2,2),c(4,2,3),c(4,3,1),c(4,3,2),c(4,3,3))
VAR.LR(dat,p=4,restrict0,restrict1,type="const")
VAR.Pope

Bias-correction for VAR parameter estimators based on Pope’s formula

Description
The function returns bias-corrected parameter estimators and bias estimators based on Pope’s asymptotic formula.

Usage
VAR.Pope(x, p, type = "const")

Arguments
- x: data matrix in column
- p: AR order
- type: "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend

Details
Kilian’s (1998) stationarity-correction is used for bias-correction.

Value
- coef: Bias-corrected coefficient matrix
- resid: matrix of residuals
- sigu: residual covariance matrix
- Bias: Bias Estimate

Author(s)
Jae H. Kim

References
**Examples**

```r
data(dat)
VAR.Pope(dat,p=2,type="const")
```

---

**VAR.Rest**  
*VAR parameter estimation with parameter restrictions*

**Description**

Estimation of VAR with 0 restrictions on parameters

**Usage**

```r
VAR.Rest(x, p, restrict, type = "const", method = "gls")
```

**Arguments**

- **x**: data matrix in column  
- **p**: VAR order  
- **restrict**: Restriction matrix under H0  
- **type**: "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend  
- **method**: "ols" for OLS estimation, "gls" for EGLS estimation

**Details**

Restriction matrix is of m by 3 matrix where m is the number of restrictions. A typical row of this matrix (k,i,j), which means that (i,j) element of Ak matrix is set to 0. Ak is a VAR coefficient matrix (k = 1,...,p).

**Value**

- **coef**: coefficient matrix  
- **resid**: matrix of residuals  
- **sigu**: residual covariance matrix  
- **zmat**: data matrix  
- **tstat**: matrix of tratio corresponding to coef matrix

**Note**

See Chapter 5 of Lutkepohl

**Author(s)**

Jae H. Kim
**References**


**Examples**

```r
data(dat)
#replicating Section 5.2.10 of Lutkepohl (2005)
restrict = rbind( c(1,1,2), c(1,1,3), c(1,2,1), c(1,2,2), c(1,3,1),
c(2,1,1), c(2,1,2), c(2,1,3), c(2,2,2), c(2,2,3), c(2,3,1), c(2,3,3),
c(3,1,1), c(3,1,2), c(3,1,3), c(3,2,1), c(3,2,2), c(3,2,3), c(3,3,1), c(3,3,3),
c(4,1,2), c(4,1,3), c(4,2,1), c(4,2,2), c(4,2,3), c(4,3,1), c(4,3,2), c(4,3,3))
M = VAR.Rest(dat,p=4,restrict,type="const",method="gls")
print(M$coef)
print(M$tstat)
```

---

**VAR.select**  
*Order Selection for VAR models*

**Description**

AIC, HQ, or SC can be used

**Usage**

```r
VAR.select(x, type = "const", ic = "aic", pmax)
```

**Arguments**

- `x` data matrix in column
- `type` "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend
- `ic` choose one of "aic", "sc", "hq"
- `pmax` the maximum VAR order

**Details**

Order Section Criterion

**Value**

- `IC` Values of information criterion for VAR models
- `p` AR order selected

**Note**

See Chapter 4 of Lutkepohl
**Author(s)**

Jaeh. Kih

**References**


**Examples**

```r
data(dat)
# replicating Section 4.3.1 of Lutkepohl (2005)
VAR.select(dat,pmax=4,ic="aic")
```

---

**VAR.Wald**

Wald test for parameter restrictions

**Description**

Wald test for zero parameter restrictions based on system VAR estimation

Bootstrap option is available: iid bootstrap or wild bootstrap

Bootstrap is conducted under the null hypothesis using estimated GLS estimation: see Kim (2014)

**Usage**

```r
VAR.Wald(x, p, restrict, type = "const", bootstrap=0, nb=500)
```

**Arguments**

- `x` data matrix in column
- `p` VAR order
- `restrict` Restriction matrix under H0
- `type` "const" for the AR model with intercept only, "const+trend" for the AR model with intercept and trend
- `bootstrap` 0 for no bootstrap; 1 for iid bootstrap; 2 for wild bootstrap
- `nb` the number of bootstrap iterations

**Details**

Restriction matrix is of m by 3 matrix where m is the number of restrictions. A typical row of this matrix (k,i,j), which means that (i,j) element of Ak matrix is set to 0. Ak is a VAR coefficient matrix (k = 1,..,p). Under H1, the model is full VAR.

The bootstrap test is conducted using the GLS estimation under the parameter restrictions implied by the null hypothesis: see Kim (2014) for details.

Kim (2014) found that the bootstrap based on OLS can show inferior small sample properties.

There are two versions of the bootstrap: the first is based on the iid resampling and the second based on wild bootstrapping.

The Wild bootstrap is conducted with Mammen’s two-point distribution.
**VAR.Wald**

**Value**

- Fstat: Wald test statistic
- pval: p-value of the test based on F-distribution
- Boot.pval: p-value of the test based on bootstrapping

**Note**

See Chapter 3 of Lutkepohl

**Author(s)**

Jae H. Kim

**References**


**Examples**

```r
data(dat)
# replicating Section 3.6.2 of Lutkepohl (2005)
restrict = rbind( c(1,1,2),c(1,1,3), c(2,1,2),c(2,1,3))
VAR.Wald(dat,p=2,restrict,type="const")
```
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