Package 'VARsignR'

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Title Sign Restrictions, Bayesian, Vector Autoregression Models

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Imports HI, minqa

Description Provides routines for identifying structural shocks in Vector Autoregression (VAR) models using sign restrictions.

License GPL (>= 2)

License_is_FOSS yes

License_restricts_use no

SystemRequirements gcc (>= 4.0)

NeedsCompilation no

Repository CRAN

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R topics documented:

`irfplot` *Plotting impulse responses with error bands from VAR posterior draws*

Description

Generates plots of impulse responses with error bands from VAR posterior draws

Usage

```
irfplot(irfdraws=NULL,type="median", labels=unlist(dimnames(irfdraws)[3]),
        save=FALSE, bands=c(0.16, 0.84), grid=TRUE, bw=FALSE)
```

Arguments

`irfdraws`	A $draws \times steps \times nvar$ array of posterior impulse responses.
`type`	A string, either "median" or "mean" response, specifying the type of response to be plotted. the default is "median".
`labels`	A list of variable labels for impulse response plots, The default are the variable names of the model.
`save`	A logical statement to save the graph in the current working directory. The default is 'FALSE'.
`bands`	A list of length 2 containing the error bands of the impulse responses. The default is c(0.16, 0.84).
`grid`	A logical statement on whether or not to generate grid lines in the plots. The default is 'TRUE'.
`bw`	A logical statement on whether or not to generate black and white or colour graphs. The default is 'FALSE'.

Details

This function generates plots of impulse responses with error bands from VAR posterior draws produced by a Bayesian VAR model.

Value

The function returns a plot of the IRFs with user-selected percentiles.

Note

Users should consult the reference papers and the package vignette for more information.

Author(s)

Christian Danne

See Also

`rfbvar`, `uhlig.reject`, `uhlig.penalty`, `rwz.reject`.

Examples

```
## Not run:
# Replication of Figure 5 of Uhlig (2005)

set.seed(12345)
data(uhligdata)

# variable labels for plots
vl <- c("GDP","GDP Deflator","Comm.Pr.Index","Fed Funds Rate",
        "NB Reserves", "Total Reserves")

# estimates the model
model1 <- rfbvar(Y=uhligdata, nlags=12, draws=1000, constant=FALSE,
                 steps=60, shock=4)

# get posterior draws
irfdata1 <- model1$IRFS

# plot impulse response functions
irfplot(irfdraws=irfdata1, type="mean", labels=vl, save=FALSE, bands=c(0.16, 0.84),
        grid=TRUE, bw=FALSE)


## End(Not run)
```

---

rfbvar *Reduced form BVAR with a flat Normal-Wishart prior*

Description

Estimates a reduced form Bayesian vector autoregression (BVAR) model with a flat Normal-Wishart prior.

Usage

```
rfbvar(Y=NULL, nlags=4, draws=1000, constant=TRUE, steps=24, shock=1)
```

Arguments

Y	A ts object containing the data series used for estimation; this should be of size $T \times nvar$.
nlags	The number of lags to include of each variable. The default value is 4.
draws	An integer value for the number of Markov Chain Monte Carlo (MCMC) sampling replications. The default value is 1000.
constant	A logical statement on whether to include an intercept in the model. The default is 'TRUE'.
steps	An integer value for the horizon of the impulse response calculations. The default value is 24.
shock	An integer value specifiying for which shock the impulse responses are calculated. The number corresponds to the variable ordering in Y. The default value is 1.

Details

This function estimates a reduced form BVAR model using a flat Normal-Wishart prior. Reduced form shocks are identified using a standard Cholesky decomposition. The ordering in the decomposition corresponds to the ordering of the variables in Y. The size of the shock is one standard deviation. Impulse response draws are only returned for the variable specified in $shock$. In order to get the remaining impulse responses, re-run the model for different values of $shock$ (see example below).

Value

A list of the posterior draws, which contains:

IRFS	A $draws \times steps \times nvar$ array of posterior impulse responses.
Bdraws	A $draws \times nvar$ array of posterior draws of the model coefficients $beta$.
Sdraws	A $draws \times nvar$ array of posterior draws of the model's variance-covariance matrix $Sigma$.

Note

Users should consult the reference papers and the package vignette for more information.

Author(s)

Christian Danne

References

Canova, F. (2007), Methods for Applied Macroeconomic Research, Princeton, NJ: Princeton University Press.

See Also

rwz.reject, uhlig.penalty, uhlig.reject.

Examples

```
## Not run:
# Replication of Figure 5 of Uhlig (2005)

set.seed(12345)
data(uhligdata)

# variable labels for plots
vl <- c("GDP","GDP Deflator","Comm.Pr.Index","Fed Funds Rate",
        "NB Reserves", "Total Reserves")

# FED funds rate shock
model1 <- rfbvar(Y=uhligdata, nlags=12, draws=1000, constant=FALSE,
                 steps=60, shock=4)

# get posterior irf draws
irfdata1 <- model1$IRFS

# plot impulse response functions
irfplot(irfdraws=irfdata1, type="mean", labels=vl, save=FALSE, bands=c(0.16, 0.84),
```

```
        grid=TRUE, bw=FALSE)

## End(Not run)
```

`rwz.reject` *Identifying VAR shocks using Rubio-Ramirez et al's (2010) rejection method*

Description

Identifies stuctural shocks using Rubio-Ramirez et al's rejection method and estimates a Bayesian vector autoregression model with a flat Normal-Wishart prior.

Usage

```
rwz.reject(Y=NULL, nlags=4, draws=200, subdraws=200, nkeep=1000,
            KMIN=1, KMAX=4, constrained=NULL, constant=TRUE, steps=24)
```

Arguments

`Y`	A ts object containing the data series used for estimation; this should be of size $T \times nvar$.
`nlags`	The number of lags to include of each variable. The default value is 4.
`draws`	An integer value for the number of Markov Chain Monte Carlo (MCMC) sampling replications. The default value is 200.
`subdraws`	An integer value for the number of subdraws over the rejection routine.The default value is 200.
`nkeep`	An integer value for the number of desired MCMC draws that meet the imposed sign restrictions. The default value is 1000.
`KMIN`	An integer value for the first period of the impulse responses to which the sign restrictions apply. The default value is 1.
`KMAX`	An integer value for the last period of the impulse responses to which the sign restrictions apply. The default value is 4.
`constrained`	A list of sign restrictions of length <= nvar. The first entry of the list characterises the shock of interest. you MUST specify a sign restriction for the shock of interest.
`constant`	A logical statement on whether to include an intercept in the model. The default is 'TRUE'.
`steps`	An integer value for the horizon of the impulse response calculations. The default value is 24.

Details

This function estimates a structural VAR model using a flat Normal-Wishart prior. Structural shocks are identified using Rubio-Ramirez et al's (2010) rejection method. The size of the shock is one standard deviation. Rubio-Ramirez et al's (2010) method allows to identify multiple shocks at the same time. For convenience, however, only one shock of interest is estimated at a time by the sign restrictions provided. The MCMC routine stops when either enough draws have been found

that satisfy the sign restrictions (specified in $nkeep$) or the maximum number of $draws$ has been reached.

Sign restrictions are specified as follows: The first entry of $constrained$ is shock of interest corresponding to the column of the variable in Y. You MUST specify a sign restriction for the shock of interest on itself. Restrictions of the shock of interest on other variables are optional. The sign of the entry in the list corresponds to the direction of the sign, e.g. >0 or <0. Variables that are not listed in $constrained$ remain unconstrained. In the example below, the shock of interest is the 4th variable (FED funds rate) in Y. The sign indicates that the effect on itself is contrained to be positive. The responses of the 2nd, 3rd, and 5th variable in the model to a positive FED funds rate shock is restricted to be negative. The responses of the 1st and 6th variable are unconstrained.

Value

A list of the posterior draws, which contains:

`IRFS`	A $draws \times steps \times nvar$ array of posterior impulse responses.
`Bdraws`	A $draws \times nvar$ array of posterior draws of the model coefficients $beta$.
`Sdraws`	A $draws \times nvar$ array of posterior draws of the model's variance-covariance matrix $Sigma$.

Note

Users should consult the reference papers and the package vignette for more information.

Author(s)

Christian Danne

References

Rubio-Ramirez, J., Waggoner, D. and Zha, T. (2010), "Structural Vector Autoregressions: Theory of Identification and Algorithms for Inference", Review of Economic Studies, 77, 665-696.

See Also

`rfbvar`, `uhlig.penalty`, `uhlig.reject`.

Examples

```
## Not run:
# Replication of Figure 6 of Uhlig (2005) using Rubio-Ramirez et al's method

set.seed(12345)
data(uhligdata)

# variable labels for plots
vl <- c("GDP","GDP Deflator","Comm.Pr.Index","Fed Funds Rate",
        "NB Reserves", "Total Reserves")

# sign restrictions
# shock of interest enters first.
# you MUST provide a restriction for the shock of interest
# restriction variable 4 is >0
# 2nd, 3rd, and 5th variable are <0.
# 1st and 6th variable are unrestricted
```

```
constr <- c(+4,-3,-2,-5)

# estimates the model
model4 <- rwz.reject(Y=uhligdata, nlags=12, draws=200, subdraws=200, nkeep=1000,
                     KMIN=1, KMAX=6, constrained=constr, constant=FALSE, steps=60)

# get posterior draws
irfdata4 <- model4$IRFS

# plot impulse response functions
irfplot(irfdraws=irfdata4, type="mean", labels=vl, save=FALSE, bands=c(0.16, 0.84),
        grid=TRUE, bw=FALSE)


## End(Not run)
```

---

uhlig.penalty *Identifying VAR shocks using Uhlig's (2005) penalty function method*

Description

Identifies stuctural shocks using Uhlig's penalty function method and estimates a Bayesian vector autoregression model with a flat Normal-Wishart prior.

Usage

```
uhlig.penalty(Y=NULL, nlags=4, draws=1000, subdraws=1000, nkeep=1000, KMIN=1, KMAX=4,
            constrained=NULL, constant=TRUE, steps=24, penalty=100, crit=0.001)
```

Arguments

Y	A ts object containing the data series used for estimation; this should be of size $T \times nvar$.
nlags	The number of lags to include of each variable. The default value is 4.
draws	An integer value for the number of Markov Chain Monte Carlo (MCMC) sampling replications. The default value is 1000.
subdraws	An integer value for the number of iterations of the penalty function minimisation routine.The default value is 1000.
nkeep	An integer value for the number of desired MCMC draws that meet the imposed sign restrictions. The default value is 1000.
KMIN	An integer value for the first period of the impulse responses to which the sign restrictions apply. The default value is 1.
KMAX	An integer value for the last period of the impulse responses to which the sign restrictions apply. The default value is 4.
constrained	A list of sign restrictions of length <= nvar. The first entry of the list characterises the shock of interest. you MUST specify a sign restriction for the shock of interest.

`constant`	A logical statement on whether to include an intercept in the model. The default is 'TRUE'.
`steps`	An integer value for the horizon of the impulse response calculations. The default value is 24.
`penalty`	An value (>= 0) for the penalty applied to the responses that do not satisfy the imposed sign restrictions. The default is 100.
`crit`	An value for the critical difference between two penalty function minimisation runs for which a draw gets rejected. The default is 0.001

Details

This function estimates a structural VAR model using a flat Normal-Wishart prior. Structural shocks are identified using Uhlig's (2005) penalty function method. The size of the shock is one standard deviation. The penalty method is a partial identification method. Hence, only one shock of interest is identified at a time by the sign restrictions provided. The MCMC routine stops when either enough draws have been found that satisfy the sign restrictions (specified in $nkeep$) or the maximum number of $draws$ has been reached.

Sign restrictions are specified as follows: The first entry of $constrained$ is shock of interest corresponding to the column of the variable in Y. You MUST specify a sign restriction for the shock of interest on itself. Restrictions of the shock of interest on other variables are optional. The sign of the entry in the list corresponds to the direction of the sign, e.g. >0 or <0. Variables that are not listed in $constrained$ remain unconstrained. In the example below, the shock of interest is the 4th variable (FED funds rate) in Y. The sign indicates that the effect on itself is contrained to be positive. The responses of the 2nd, 3rd, and 5th variable in the model to a positive FED funds rate shock is restricted to be negative. The responses of the 1st and 6th variable are unconstrained.

Value

A list of the posterior draws, which contains:

`IRFS`	A $draws \times steps \times nvar$ array of posterior impulse responses.
`Bdraws`	A $draws \times nvar$ array of posterior draws of the model coefficients $beta$.
`Sdraws`	A $draws \times nvar$ array of posterior draws of the model's variance-covariance matrix $Sigma$.

Note

Users should consult the reference papers and the package vignette for more information.

Author(s)

Christian Danne

References

Uhlig, H. (2005), "What Are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure", Journal of Monetary Economics, 52, 381-419.

See Also

`rfbvar`, `rwz.reject`, `uhlig.reject`.

Examples

```
## Not run:
# Replication of Figure 14 of Uhlig (2005)

set.seed(12345)
data(uhligdata)

# variable labels for plots
vl <- c("GDP","GDP Deflator","Comm.Pr.Index","Fed Funds Rate",
        "NB Reserves", "Total Reserves")

# sign restrictions
# shock of interest enters first.
# you MUST provide a restriction for the shock of interest
# restriction variable 4 is >0
# 2nd, 3rd, and 5th variable are <0.
# 1st and 6th variable are unrestricted
constr <- c(+4,-3,-2,-5)

# estimates the model
model3 <- uhlig.penalty(Y=uhligdata, nlags=12, draws=2000, subdraws=1000,
                        nkeep=1000, KMIN=1, KMAX=6, constrained=constr,
                        constant=FALSE, steps=60, penalty=100, crit=0.001)

# get posterior draws
irfdata3 <- model3$IRFS

# plot impulse response functions
irfplot(irfdraws=irfdata3, type="mean", labels=vl, save=FALSE, bands=c(0.16, 0.84),
        grid=TRUE, bw=FALSE)


## End(Not run)
```

`uhlig.reject` *Identifying VAR shocks using Uhlig's (2005) rejection method*

Description

Identifies stuctural shocks using Uhlig's rejection method and estimates a Bayesian vector autoregression model with a flat Normal-Wishart prior.

Usage

```
uhlig.reject(Y=NULL, nlags=4, draws=200, subdraws=200, nkeep=1000,
             KMIN=1, KMAX=4, constrained=NULL, constant=TRUE, steps=24)
```

Arguments

`Y`	A ts object containing the data series used for estimation; this should be of size $T \times nvar$.
`nlags`	The number of lags to include of each variable. The default value is 4.

draws	An integer value for the number of Markov Chain Monte Carlo (MCMC) sampling replications. The default value is 200.
subdraws	An integer value for the number of subdraws over the rejection routine.The default value is 200.
nkeep	An integer value for the number of desired MCMC draws that meet the imposed sign restrictions. The default value is 1000.
KMIN	An integer value for the first period of the impulse responses to which the sign restrictions apply. The default value is 1.
KMAX	An integer value for the last period of the impulse responses to which the sign restrictions apply. The default value is 4.
constrained	A list of sign restrictions of length <= nvar. The first entry of the list characterises the shock of interest. you MUST specify a sign restriction for the shock of interest.
constant	A logical statement on whether to include an intercept in the model. The default is 'TRUE'.
steps	An integer value for the horizon of the impulse response calculations. The default value is 24.

Details

This function estimates a structural VAR model using a flat Normal-Wishart prior. Structural shocks are identified using Uhlig's (2005) rejection method. The size of the shock is one standard deviation. The rejection method is a partial identification method. Hence, only one shock of interest is identified at a time by the sign restrictions provided. The MCMC routine stops when either enough draws have been found that satisfy the sign restrictions (specified in $nkeep$) or the maximum number of $draws$ has been reached.

Sign restrictions are specified as follows: The first entry of $constrained$ is shock of interest corresponding to the column of the variable in Y. You MUST specify a sign restriction for the shock of interest on itself. Restrictions of the shock of interest on other variables are optional. The sign of the entry in the list corresponds to the direction of the sign, e.g. >0 or <0. Variables that are not listed in $constrained$ remain unconstrained. In the example below, the shock of interest is the 4th variable (FED funds rate) in Y. The sign indicates that the effect on itself is contrained to be positive. The responses of the 2nd, 3rd, and 5th variable in the model to a positive FED funds rate shock is restricted to be negative. The responses of the 1st and 6th variable are unconstrained.

Value

A list of the posterior draws, which contains:

IRFS	A $draws \times steps \times nvar$ array of posterior impulse responses.
Bdraws	A $draws \times nvar$ array of posterior draws of the model coefficients $beta$.
Sdraws	A $draws \times nvar$ array of posterior draws of the model's variance-covariance matrix $Sigma$.

Note

Users should consult the reference papers and the package vignette for more information.

Author(s)

Christian Danne

References

Uhlig, H. (2005), "What Are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure", Journal of Monetary Economics, 52, 381-419.

See Also

rfbvar, rwz.reject, uhlig.penalty, .

Examples

```
## Not run:
# Replication of Figure 6 of Uhlig (2005)

set.seed(12345)
data(uhligdata)

# variable labels for plots
vl <- c("GDP","GDP Deflator","Comm.Pr.Index","Fed Funds Rate",
        "NB Reserves", "Total Reserves")

# sign restrictions
# shock of interest enters first.
# you MUST provide a restriction for the shock of interest
# restriction variable 4 is >0
# 2nd, 3rd, and 5th variable are <0.
# 1st and 6th variable are unrestricted
constr <- c(+4,-3,-2,-5)

# estimates the model
model2 <- uhlig.reject(Y=uhligdata, nlags=12, draws=200, subdraws=200, nkeep=1000, KMIN=1,
                       KMAX=6, constrained=constr, constant=FALSE, steps=60)

# get posterior draws
irfdata2 <- model2$IRFS

# plot impulse response functions
irfplot(irfdraws=irfdata2,type="mean", labels=vl, save=FALSE, bands=c(0.16, 0.84), g
        rid=TRUE, bw=FALSE)


## End(Not run)
```

---

uhligdata *Monthly US Macroeconomic Time Series*

Description

Contains monthly US macro data used by Uhlig (2005) for Real GDP (y), GDP deflator (yd), commodity price index (p), FED funds rate (i), non-borrowed reserves (rnb), and total reserves (rt) from 1965:1 - 2003:12. The data has been downloaded from the RATS website. Original data for the commodity price index was taken from Global Financial Data. The remaining data was taken from FRED. Quarterly time series have been interpolated to monthly frequency using the interpolation

methods by Bernanke et al. (1997) and Bernanke and Mihov (1998). For more details see Uhlig (2005).

Format

Multiple time series (mts) object, series names: "y", "yd", "p", "i", "rnb", "rt". Variables in the data, except the FED funds rate, are the log of the original data series times 100 in line with the transformations of the data of the original paper.

Note

Users should consult the reference papers and the package vignette for more information.

Author(s)

Christian Danne

Source

Data downloaded from the RATS website:

https://www.estima.com/procs_perl/uhligjme2005.zip.

Accessed: 2015-11-27.

References

Bernanke, B.S., Gertler, M., and Watson, M. (1997), "Systematic Monetary Policy and the Effects of Oil Price Shocks", Brookings Papers on Economic Activity, 1, 91-157.

Bernanke, B.S. and Mihov, I. (1998), "Measuring Monetary Policy", Quarterly Journal of Economics, 113, 869-902.

Uhlig, H. (2005), "What Are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure", Journal of Monetary Economics, 52, 381-419.

Examples

```
## Not run:

# Load and plot data
data(uhligdata)
plot(uhligdata)


## End(Not run)
```

VARsignR *Estimating VARs using sign restrictions*

Description

VARsignR is a collection of R routines for estimating and identifying structural shocks using sign restrictions in Bayesian Vector Autoregression (BVAR) models.

Details

Package:	VARsignR
Type:	Package
Version:	0.0.1
Date:	2015-11-27
License:	GPL (>= 2)
LazyLoad:	Yes
Depends:	HI

How to cite this package

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```

License

Author(s)

Christian Danne

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