Package 'nowcasting'

August 1, 2019

Type Package

Title Predicting Economic Variables using Dynamic Factor Models

Version 1.1.4

Depends R (>= 3.4.0)

Date 2019-07-31

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Description It contains the tools to implement dynamic factor models to forecast economic variables. The user will be able to construct pseudo real time vintages, use information criteria for determining the number of factors and shocks, estimate the model, and visualize results among other things.

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BugReports https://github.com/nmecsys/nowcasting/issues

URL https://github.com/nmecsys/nowcasting

Encoding UTF-8

LazyData true

RoxygenNote 6.1.1

NeedsCompilation no

Suggests knitr, rmarkdown

Imports corpcor, httr, lubridate, matlab, RCurl, xts, zoo, DBI, magic, RMySQL, Matrix, vars, stats

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Repository CRAN

Date/Publication 2019-08-01 05:00:02 UTC

R topics documented:

`base_extraction` *Create a real time data base*

Description

Create a time series matrix `mts` extracting information from Bacen (Banco Central do Brasil) API.

Usage

```
base_extraction(series_code)
```

Arguments

`series_code`	Vector with the series encoding following the Bacen (Banco Central do Brasil) standards.

References

Central Bank of Brazil

Examples

```
# Extracting GDP serie at real-time from Central Bank of Brasil data base
## Not run:
gdp<-base_extraction(22099)
# Industrial production (21859) serie at real-time from Central Bank of Brasil data base
ind_prod<-base_extraction(21859)

# Creating real time data base with the series:
```

```
# Vehicles production (1373);
# Industrial production, general index (21859).
mybase<-base_extraction(c(1373,21859))

# Creating real time data base with the series:
# Exchange rate - Free - United States dollar (1);
#  Interest rate - CDI (12).
mybase<-base_extraction(c(1,12))

# Creating real time data base with the series:
# Vehicles production (1373);
# Credit Sales Index (1453);
# Retail sales (1455);
# Industrial production, general index (21859).
mybase<-base_extraction(c(1373,1453,1455,21859))
## End(Not run)
```

`Bpanel` *Balanced panel*

Description

This function transforms the original monthly time series to its stationary representation following the user specification. The time series with more than 1/3 missing, i.e. NAs, are deleted and the remaining are modified such that the missings and outliers are replaced by an approximated value.

The missings and outliers are "corrected" following the same method available in the replication files of Giannone et al. 2008. Outliers are defined as observations that lie more than 4 IQR from the median. All missings and outliers are replaced by the median. A centered moving average of degree **k** is calculated, forming a new panel. Then the missings and outliers are replaced by their equivalent observations on this new panel. We've made an important modification on the outlier_correction function found in the above mentioned files: Here the median of an even-sized sample is calculated by the mean of the two most central values, rather than using the largest of those numbers. Because of this modification the results obtained with the original replication files in (USGDP) are slightly different from those found here.

Usage

```
Bpanel(base, trans, NA.replace = T, aggregate = F, k.ma = 3,
  na.prop = 1/3, h = 12)
```

Arguments

`base`	A `mts` with the series to be transformed.
`trans`	A `vector` where each coordinate is a code for the transformation of the correspondent coordinate in the `base` argument. The transformation is specified by codes, as follows:

- trans = 0: the original serie is preserved;

- trans = 1: monthly rate of change

$$\frac{x_{i,t} - x_{i,t-1}}{x_{i,t-1}}$$

- trans = 2: monthly difference

$$x_{i,t} - x_{i,t-1}$$

- trans = 3: monthly difference in year-over-year rate of change

$$\frac{x_{i,t} - x_{i,t-12}}{x_{i,t-12}} - \frac{x_{i,t-1} - x_{i,t-13}}{x_{i,t-13}}$$

- trans = 4: monthly difference in year difference

$$(x_{i,t} - x_{i,t-12}) - (x_{i,t-1} - x_{i,t-13})$$

- trans = 5: yearly difference

$$(x_{i,t} - x_{i,t-12})$$

- trans = 6: yearly rate of change

$$\frac{x_{i,t} - x_{i,t-12}}{x_{i,t-12}}$$

- trans = 7: quarterly rate of change

$$\frac{x_{i,t} - x_{i,t-3}}{x_{i,t-3}}$$

`NA.replace` A `boolean` indicating whether missing values, not part of the jagged edges, should be replaced.

`aggregate` A `boolean` representing if you want aggregate the monthly variables to represent quarterly quantities. If `TRUE` the aggregation is made following the approximation of *Mariano and Murasawsa 2003*.

`k.ma` A `numeric` representing the degree of the moving average correction if `NA.replace = TRUE`.

`na.prop` A `numeric` representing the proportion of NA allowed. Default is 1/3.

`h` A `numeric` representing the number of steps ahead to forecasting. Default is 12.

References

Giannone, D., Reichlin, L., & Small, D. (2008). Nowcasting: The real-time informational content of macroeconomic data. Journal of Monetary Economics, 55(4), 665-676.<doi:10.1016/j.jmoneco.2008.05.010>

Mariano, R. S., & Murasawa, Y. (2003). A new coincident index of business cycles based on monthly and quarterly series. Journal of applied Econometrics, 18(4), 427-443.<doi:10.1002/jae.695>

Examples

```
# Example from database BRGDP:
data(BRGDP)
Bpanel(BRGDP$base, rep(3,ncol(BRGDP$base)))
```

BRGDP — *Real Time Database of 100 economic variables from 12/11/2018*

Description

a list containing the database, a vector of transformation for the function Bpanel, a vector of delays for the function PRTDB, and the GDP time series.

Usage

```
BRGDP
```

Format

The format is: List of 4 $ base : Time-Series [1:227, 1:100] from 2000 to 2019: NA NA NA NA NA NA NA NA NA NA ... ..- attr(*, "dimnames")=List of 2 .. ..$: NULL .. ..$: chr [1:100] "DIVIDA_6" "IBC_BR" "PMC_TOTAL" "PIM_BCONSND" ... $ trans: num [1:100] 5 3 3 3 3 3 3 3 3 3 ... $ delay: num [1:100] 14 42 42 42 42 42 35 35 35 35 ... $ GDP : Time-Series [1:75] from 2000 to 2018: 106 110 114 114 110 ...

ICfactors — *Information criteria for determining the number of factors in a factors model*

Description

Minimizes the selected information criterion to determine the number of factors to be used in an approximate factor model.

Usage

```
ICfactors(x, rmax = 20, type = 2)
```

Arguments

x	a dataset;
rmax	a positive integer corresponding to the maximum number of factors for which the information criterion should be tested;
type	a positive integer corresponding to the chosen information criterion (1,2,3). The default is 2.

Value

A `list` containing two elements:

`r_star`	The number of factors minimizing the information criterion;
`IC`	A vector of values of the information criterion for the number of factors within the selected range.

References

Bai, J., Ng, S. (2002). Determining the Number of Factors in Approximate Factor Models. Econometrica, 70(1), 191-221. <doi:10.1111/1468-0262.00273>

`ICshocks` *Information criterion for determining the number of shocks in a factor model*

Description

The function gives the number of shocks that minimizes the information criterion.

Usage

```
ICshocks(x, r = NULL, p = NULL, delta = 0.1, m = 1)
```

Arguments

`x`	a dataset;
`r`	a positive integer corresponding to the number of factors;
`p`	a positive integer corresponding to the number of lags to be considered within the model.
`delta`	a real number within the range (0,1/2) for the sensitivity of the tolerance level to the size of the dataset;
`m`	a finite positive real number defining the tolerance level;

Value

A `list` containing two elements:

`q_star`	The number of shocks minimizing the information criterion;
`p`	The number of lags used.

References

Bai, J., Ng, S. (2007). Determining the Number of Primitive Shocks in Factor Models. Journal of Business & Economic Statistics, 25(1), 52-60. <https://doi.org/10.1198/073500106000000413>

month2qtr *Monthly to quarterly transformation*

Description

It transforms a monthly time series in a quarterly one, selecting the last month of the quarter to represent the value of the quarter.

Usage

```
month2qtr(x, reference_month = 3)
```

Arguments

x	a ts or mts in monthly frequency
reference_month	a vector to define the reference month that will represent the quarter. Default is 3. The options are 1, 2, 3 or 'mean'.

Value

The correspondent quarterly transformation.

Examples

```
 ## Not run:
# Selecting only the last month of time series IPCA:
month2qtr(BRGDP$base[,"IPCA"], reference_month = 3)

# Selecting only the first month of time series IPCA:
month2qtr(BRGDP$base[,"IPCA"], reference_month = 1)

## End(Not run)
```

nowcast *Nowcasting of a quarterly time series using a dynamic factor model.*

Description

Estimate nowcasting and forecasting models for quarterly or monthly time series. For more details read the Vignettes.

Usage

```
nowcast(formula, data, r = NULL, q = NULL, p = NULL, method = "EM",
  blocks = NULL, frequency = NULL)
```

Arguments

formula	An object of class "formula": a symbolic description of the model to be fitted.
data	A monthly time series matrix (mts) of stationary variables.
r	number of commom factors.
q	Dynamic rank. Number of error terms.
p	AR order of factor model.
method	There are three options: "2s" (two stages without factors aggregation as in Giannone et al. 2008); "2s_agg" (two stages with factors aggregation); "EM" (Expected Maximization as in Bańbura et al. 2011).
blocks	a matrix that defines the variables loaded into the factors.
frequency	A vector of integers indicating the frequency of the variables: 4 for quarterly, 12 for monthly.

Value

A list containing two elements:

yfcst	the original y series and its in-sample and out-of-sample estimations.
reg	regression model between y and the estimated factors. Not available for EM method.
factors	the estimated factors and DFM model coefficients.
xfcst	the original regressors and their out-of-sample estimations.

References

Giannone, D., Reichlin, L., & Small, D. (2008). Nowcasting: The real-time informational content of macroeconomic data. Journal of Monetary Economics, 55(4), 665-676.<doi:10.1016/j.jmoneco.2008.05.010>

Bańbura, M., & Rünstler, G. (2011). A look into the factor model black box: publication lags and the role of hard and soft data in forecasting GDP. International Journal of Forecasting, 27(2), 333-346. <doi:10.1016/j.ijforecast.2010.01.011>

Bańbura M., Giannone, D. & Reichlin, L. (2011). Nowcasting, in Michael P. Clements and David F. Hendry, editors, Oxford Handbook on Economic Forecasting, pages 193-224, January 2011. <doi:10.1093/oxfordhb/9780195398649.001.0001>

See Also

base_extraction

Examples

```
## Not run:
### Method 2s (Using the Mariano and Murasawa aggregation method on the variables)
data(USGDP)
gdp_position <- which(colnames(USGDP$base) == "RGDPGR")
base <- Bpanel(base = USGDP$base[,-gdp_position],
               trans = USGDP$legend$Transformation[-gdp_position],
```

```
               aggregate = TRUE)
data <- cbind(USGDP$base[,"RGDPGR"], base)
colnames(data) <- c("RGDPGR", colnames(base))
frequency <- c(4, rep(12, ncol(data) -1))
now2s <- nowcast(formula = RGDPGR ~ ., data = data, r = 2, p = 2, q = 2,
                 method = '2s', frequency = frequency)


### Method 2s_agg (Using the Mariano and Murasawa aggregation method on the factors)
data <- Bpanel(base = USGDP$base,
               trans = USGDP$legend$Transformation,
               aggregate = FALSE)
frequency <- c(rep(12, ncol(data) -1), 4)
now2s_agg <- nowcast(formula = RGDPGR ~ ., data = data, r = 2, p = 2, q = 2,
                     method = '2s_agg', frequency = frequency)


### Method EM
# Replication of the NY FED nowcast
data(NYFED)
base <- NYFED$base
blocks <- NYFED$blocks$blocks
trans <- NYFED$legend$Transformation
frequency <- NYFED$legend$Frequency
data <- Bpanel(base = base, trans = trans, NA.replace = F, na.prop = 1)
nowEM <- nowcast(formula = GDPC1 ~ ., data = data, r = 1, p = 1,
                 method = "EM", blocks = blocks, frequency = frequency)


## End(Not run)
```

`nowcast.plot` *Plot for the nowcast output function*

Description

Make plots to visualize the output of the nowcast function

Usage

```
nowcast.plot(out, type = "fcst")
```

Arguments

`out`	output of the nowcast function.
`type`	'fcst', 'factors', 'eigenvalues' or 'eigenvectors'. The 'eigenvalues' and 'eigenvectors' options are only available for the two stages methods.

Examples

```
## Not run:
data <- Bpanel(base = USGDP$base,
               trans = USGDP$legend$Transformation,
               aggregate = FALSE)
frequency <- c(rep(12, ncol(data) -1), 4)
now2s_agg <- nowcast(formula = RGDPGR ~ ., data = data, r = 2, p = 2, q = 2,
                     method = '2s_agg', frequency = frequency)

nowcast.plot(now2s_agg, type = "fcst")
nowcast.plot(now2s_agg, type = "factors")
nowcast.plot(now2s_agg, type = "eigenvalues")
nowcast.plot(now2s_agg, type = "eigenvectors")

## End(Not run)
```

---

nowcasting *Nowcast Analysis and Create Real-Time Data Basis*

Description

This package is an initiative of the Center for Statistical and Computational Methods (NMEC) belonging to the Brazilian Institute of Economics (IBRE) of the Getulio Vargas Foundation (FGV).

The purpose of this package is to allow R users to implement dynamic factor models that have gained prominence in the nowcasting literature.

In this version of the package we present three methods, based on seminal articles in this literature: *Giannone et al. 2008*, *Bańbura et al. 2011* and *Bańbura and Rünstler 2011*. Some backend functions are adaptations and translations of these paper's *replication files* available in MATLAB. One can find these *replication files* in the following url: https://www.newyorkfed.org/research/economists/giannone/pub

Note

The authors would like to thank the support by the Getulio Vargas Foundation (FGV).

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References

Giannone, D., Reichlin, L., & Small, D. (2008). Nowcasting: The real-time informational content of macroeconomic data. Journal of Monetary Economics, 55(4), 665-676.<doi:10.1016/j.jmoneco.2008.05.010>

Bańbura, M., & Rünstler, G. (2011). A look into the factor model black box: publication lags and the role of hard and soft data in forecasting GDP. International Journal of Forecasting, 27(2), 333-346. <doi:10.1016/j.ijforecast.2010.01.011>

Bańbura M., Giannone, D. & Reichlin, L. (2011). Nowcasting, in Michael P. Clements and David F. Hendry, editors, Oxford Handbook on Economic Forecasting, pages 193-224, January 2011. <doi:10.1093/oxfordhb/9780195398649.001.0001>

NYFED *Example of replication files in Giannone et al. 2008*

Description

partial dataset used to replicate the results in the New York Fed Staff Nowcasting Report .

Usage

```
NYFED
```

Format

A `list` with 4 elements:

- `base` is a `mts` with 25 series and 385 observations. There are missing values;
- `legend` is a `data.frame` with specifications of the series in NYFED$base;
- `Time` is a `vector` of length 385 with dates;
- `blocks` is a `matrix` showing the groups of variables.

Source

This dataset is available in the following url: https://github.com/FRBNY-TimeSeriesAnalysis/Nowcasting

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PRTDB *Pseudo Real Time Data Base*

Description

Create a pseudo real time data base based on data and delays of disclosure stipulated by the user.

Usage

```
PRTDB(mts, delay, vintage = Sys.Date())
```

Arguments

`mts`	A `mts` with the series data.
`delay`	A numeric vector with the delay in days the information is available after the reference month. Each element corresponds to the series in the respective column in `mts`.
`vintage`	The day when the data is supposed to be collected.

Value

A mts with the series transformed.

Examples

```
# Pseudo Real Time Data Base from data base BRGDP
PRTDB(mts = BRGDP$base, delay = BRGDP$delay, vintage = "2017-10-01")
```

---

qtr2month *Quarterly to monthly transformation*

Description

It transforms a quarterly time series in a monthly one. The values of the quarterly ts are set to the last month of the quarter.

Usage

```
qtr2month(x, reference_month = 3, interpolation = FALSE)
```

Arguments

x	a ts or mts in quarterly frequency
reference_month	a integer to define the position of a quarter value in a quarter. Default is 3. The options are 1, 2 or 3.
interpolation	logical. The NA values can be estimated by linear interpolation (approx function from stats package). Default is FALSE.

Value

The correpondent monthly transformation.

Examples

```
# Selecting the quarterly GDP variable in BRGDP
qtr2month(BRGDP$GDP)
```

RTDB *Create Real Time Data Base*

Description

Create a time series matrix `mts` replicating the information available in a given date.

Usage

```
RTDB(series_code = NULL, vintage = NULL)
```

Arguments

`series_code`	vector with the series encoding following the Bacen (Banco Central do Brasil) standards.
`vintage`	the vintage encoded by the day of the extraction

References

Central Bank of Brazil

Examples

```
## Not run:
# Show series available:
RTDB()

# Show vintages available for the series 1:
RTDB(series_code = 1)

# Show series 1 data at vintage 2017-04-04:
RTDB(series_code = 1, vintage = "2017-04-04")

## End(Not run)
```

USGDP *Example of replication files in Giannone et al. 2008*

Description

Dataset available to replicate the results in *Giannone et al. 2008*.

Usage

```
USGDP
```

Format

A `list` with 2 elements:

- `base` is a `mts` with 193 series and 312 observations. There are missing values;
- `legend` is a `data.frame` with specifications of the series in USGDP$base.

Source

This dataset is available as *replication files* of the seminal work *Giannone 2008*. One can find these *replication files* in the following url: https://www.newyorkfed.org/research/economists/giannone/pub

References

Giannone, D., Reichlin, L., & Small, D. (2008). Nowcasting: The real-time informational content of macroeconomic data. Journal of Monetary Economics, 55(4), 665-676.<doi:10.1016/j.jmoneco.2008.05.010>

USGDPshort *Example of replication files in Banbura et al. 2011*

Description

Dataset available to replicate the results in *Banbura et al. 2011*.

Usage

```
USGDPshort
```

Format

A `list` with 2 elements:

- `base` is a `mts` with 26 series and 358 observations. There are missing values;
- `legend` is a `data.frame` with specifications of the series in USGDPshort$base.

Source

This dataset is available as *replication files* of the seminal work *Banbura et al 2011*. One can find these *replication files* in the following url: https://www.newyorkfed.org/research/economists/giannone/pub

References

Banbura, M., Giannone, D. & Reichlin, L. (2011). Nowcasting. Oxford Handbook on Economic Forecasting, ed. by M. P. Clements, and D. F. Hendry, pp. 63-90. Oxford University Press.

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