Package ‘MSGARCHelm’

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Type Package

Title Hybridization of MS-GARCH and ELM Model

Version 0.1.0

Description Implements the three parallel forecast combinations of Markov Switching GARCH and extreme learning machine model along with the selection of appropriate model for volatility forecasting. For method details see Hsiao C, Wan SK (2014). <doi:10.1016/j.jeconom.2013.11.003>, Hansen BE (2007). <doi:10.1111/j.1468-0262.2007.00785.x>, Elliott G, Gargano A, Timmermann A (2013). <doi:10.1016/j.jeconom.2013.04.017>.

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License GPL-3

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fcastelm — *Extreme Learning Machine Forecasting*

Description

The fcastelm function computes the volatility forecasting performance of Extreme Learning Machine (ELM) model with root mean square error (RMSE), mean absolute error (MAE), MAPE etc.

Usage

```
fcastelm(data, stepahead=6, nlags=5, freq = frequency(data),
hn=10, est=c("lm"), rep=20, combt=c("mean"))
```

Arguments

`data`	Univariate time series data.
`stepahead`	The forecast horizon.
`nlags`	Lags of the data to use as inputs.
`freq`	Frequency of the time series.
`hn`	Number of hidden nodes.
`est`	Estimation type for output layer weights. Can be "lasso" (lasso with CV), "ridge" (ridge regression with CV), "step" (stepwise regression with AIC) or "lm" (linear regression). Default: est=c("lm").
`rep`	Number of networks to train, the result is the ensemble forecast.
`combt`	Combination operator for forecasts when rep > 1. Can be "median", "mode" (based on KDE estimation) and "mean". Default: combt=c("mean")

Details

It helps to find the most appropriate Extreme Learning Machine model for the time series volatility forecasting.

Value

$forecast_elm: Forecasted value of Extreme Learning Machine.

$accuracy_elm: Performance matrices of ELM model

References

Engle, R. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation, Econometrica, 50, 987-1008.

Huang, G.B., Zhu Q.Y., and Siew, C.K. (2006). Extreme learning machine: Theory and applications. Neurocomputing, 70, 489-501.

Examples

```
library(MSGARCHelm)
data(ReturnSeries_data)
fcastelm(ReturnSeries_data)
```

---

msgarchelm_BG *Bates and Granger MS-GARCH-ELM Combination*

Description

This function computes combined time series volatility forecast of Markov Switching GARCH (MS-GARCH) and Extreme Learning Machine (ELM) model according to the approach of Bates and Granger (1969).

Usage

```
msgarchelm_BG(data, stepahead=10, nlags=3, modelcomb=c("sGARCH",
"gjrGARCH"), distcomb=c("norm", "std"), freq = frequency(data),
hn=10, est=c("lm"), rep=20, combt=c("mean"))
```

Arguments

data	Univariate time series data.
stepahead	The forecast horizon
nlags	Lags of the data to use as inputs in the Extreme Learning Machine (ELM).
modelcomb	Combination of volatility models in two different regimes in the MS-GARCH model. Valid models are "sARCH", "sGARCH", "eGARCH", "gjrGARCH", and "tGARCH". Default: modelcomb=c("sGARCH", "gjrGARCH").
distcomb	List with element distribution in the MS-GARCH model. distribution is a character vector (of size 2) of conditional distributions. Valid distributions are "norm", "snorm", "std", "sstd", "ged", and "sged". Default: distcomb=c("norm", "std").
freq	Frequency of the time series.
hn	Number of hidden nodes in the ELM model.
est	Estimation type for output layer weights in the ELM. Can be "lasso" (lasso with CV), "ridge" (ridge regression with CV), "step" (stepwise regression with AIC) or "lm" (linear regression). Default: est=c("lm").
rep	Number of networks to train, the result is the ensemble forecast in the ELM.
combt	Combination operator for forecasts in the ELM model when rep > 1. Can be "median", "mode" (based on KDE estimation) and "mean". Default: combt=c("mean").

Details

Bates and Granger (1969) introduce the idea of combining forecasts. Their approach builds on portfolio diversification theory and uses the diagonal elements of the estimated mean squared prediction error matrix in order to compute combination weights. This function gives the combined volatility forecast of Markov Switching GARCH model and Extreme Learning machine model based on Bates and Granger (1969) approach.

Value

$ fcast_comb: Forecasted value of combined model according to Bates and Granger (1969).

$accuracy_combined: Performance matrices of the combined model.

References

Bates, J. M., and Granger, C. W. (1969). The Combination of Forecasts. Journal of the Operational Research Society, 20(4), 451–468.

Hsiao, C., and Wan, S. K. (2014). Is There An Optimal Forecast Combination? Journal of Econometrics, 178(2), 294–309.

Timmermann, A. (2006). Forecast Combinations. In: Elliott, G., Granger, C. W. J., and Timmermann, A. (Eds.), Handbook of Economic Forecasting, 1, 135–196.

Examples

```
library(MSGARCHelm)
data(ReturnSeries_data)
msgarchelm_BG(ReturnSeries_data)
```

---

msgarchelm_NG *Newbold and Granger MS-GARCH-ELM Combination*

Description

Computes time series volatility forecast combination of MS-GARCH and ELM model according to the approach by Newbold and Granger (1974) and evaluate its performance.

Usage

```
msgarchelm_NG(data, stepahead = 10, nlags = 5, modelcomb =
c("sGARCH", "gjrGARCH"), distcomb = c("norm", "std"), freq =
frequency(data), hn = 10, est = c("lm"), rep = 20,
combt = c("mean"))
```

Arguments

data	Univariate time series data.
stepahead	The forecast horizon.
nlags	Lags of the data to use as inputs in the Extreme Learning Machine (ELM).
modelcomb	Combination of volatility models in two different regimes in the MS-GARCH model. Valid models are "sARCH", "sGARCH", "eGARCH", "gjrGARCH", and "tGARCH". Default: modelcomb=c("sGARCH", "gjrGARCH").
distcomb	List with element distribution in the MS-GARCH model. distribution is a character vector (of size 2) of conditional distributions. Valid distributions are "norm", "snorm", "std", "sstd", "ged", and "sged". Default: distcomb=c("norm", "std").
freq	Frequency of the time series.
hn	Number of hidden nodes in the ELM model.
est	Estimation type for output layer weights in the ELM. Can be "lasso" (lasso with CV), "ridge" (ridge regression with CV), "step" (stepwise regression with AIC) or "lm" (linear regression). Default: est=c("lm").
rep	Number of networks to train, the result is the ensemble forecast in the ELM.
combt	Combination operator for forecasts in the ELM model when rep > 1. Can be "median", "mode" (based on KDE estimation) and "mean". Default: combt=c("mean").

Details

It gives the combined volatility forecast of Markov Switching GARCH model and Extreme Learning machine model based on Newbold and Granger (1974) approach. Here MS-GARCH model is restricted to two regime. The Newbold and Granger (1974) approach extracts the combination weights from the estimated mean squared prediction error matrix.

Value

$ fcast_comb: Forecasted value of combined model. $accuracy_combined: Performance matrices of the combined model.

References

Hsiao, C., and Wan, S. K. (2014). Is There An Optimal Forecast Combination? Journal of Econometrics, 178(2), 294–309.

Newbold, P., and Granger, C. W. J. (1974). Experience with Forecasting Univariate Time Series and the Combination of Forecasts. Journal of the Royal Statistical Society, Series A, 137(2), 131–165.

Examples

```
library(MSGARCHelm)
data(ReturnSeries_data)
msgarchelm_NG(ReturnSeries_data)
```

`msgarchelm_OLS` *MS-GARCH-ELM combination based on OLS regession*

Description

This function computes combined time series volatility forecast of Markov Switching GARCH (MS-GARCH) and Extreme Learning Machine (ELM) model according to weights of ordinary least squares (OLS) regression.

Usage

```
msgarchelm_OLS(data, stepahead = 10, nlags = 5, modelcomb =
c("sGARCH","gjrGARCH"), distcomb = c("norm", "std"), freq =
frequency(data), hn =10, est = c("lm"), rep = 20, combt =
c("mean"))
```

Arguments

`data`	Univariate time series data.
`stepahead`	The forecast horizon
`nlags`	Lags of the data to use as inputs in the Extreme Learning Machine (ELM).
`modelcomb`	Combination of volatility models in two different regimes in the MS-GARCH model. Valid models are "sARCH", "sGARCH", "eGARCH", "gjrGARCH", and "tGARCH". Default: modelcomb=c("sGARCH", "gjrGARCH").
`distcomb`	List with element distribution in the MS-GARCH model. distribution is a character vector (of size 2) of conditional distributions. Valid distributions are "norm", "snorm", "std", "sstd", "ged", and "sged". Default: distcomb=c("norm", "std").
`freq`	Frequency of the time series.
`hn`	Number of hidden nodes in the ELM model.
`est`	Estimation type for output layer weights in the ELM. Can be "lasso" (lasso with CV), "ridge" (ridge regression with CV), "step" (stepwise regression with AIC) or "lm" (linear regression). Default: est=c("lm").
`rep`	Number of networks to train, the result is the ensemble forecast in the ELM.
`combt`	Combination operator for forecasts in the ELM model when rep > 1. Can be "median", "mode" (based on KDE estimation) and "mean". Default: combt=c("mean").

Details

The OLS combination method (Granger and Ramanathan (1984)) uses ordinary least squares to estimate the weights for the combination. An appealing feature of the method is its bias correction through the intercept – even if one or more of the individual predictors are biased, the resulting combined forecast is unbiased. This function gives the combined volatility forecast of Markov Switching GARCH model and Extreme Learning machine model based on OLS approach.

Value

$fcast_comb: Forecasted value of combined model according to ordinary least squares.

$accuracy_combined: Performance matrices of the combined model.

References

Granger, C., and Ramanathan, R. (1984). Improved Methods Of Combining Forecasts. Journal of Forecasting, 3(2), 197–204.

Nowotarski, J., Raviv, E., Trueck, S., and Weron, R. (2014). An Empirical Comparison of Alternative Schemes for Combining Electricity Spot Price Forecasts. Energy Economics, 46, 395–412.

Timmermann, A. (2006). Forecast Combinations. In: Elliott, G., Granger, C. W. J., and Timmermann, A. (Eds.), Handbook of Economic Forecasting, 1, 135–196.

Examples

```
library(MSGARCHelm)
data(ReturnSeries_data)
msgarchelm_OLS(ReturnSeries_data)
```

ReturnSeries_data *Return Series Data*

Description

Monthly return series of international soybean price start from January 1980.

Usage

```
data("ReturnSeries_data")
```

Format

A data frame with 107 observations on the following variable.

Details

Dataset contain 107 0bservations of monthly return series of International soyabean price. It is obtained from World Bank "Pink sheet"

Source

https://www.worldbank.org/en/research/commodity-markets

References

https://www.worldbank.org/en/research/commodity-markets

Examples

```
data(ReturnSeries_data)
## maybe str(ReturnSeries_data) ; plot(ReturnSeries_data) ...
```

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