Package 'ForecastCombinations'

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Type Package

Title Forecast Combinations

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Description Aim: Supports the most frequently used methods to combine forecasts. Among others: Simple average, Ordinary Least Squares, Least Absolute Deviation, Constrained Least Squares, Variance-based, Best Individual model, Complete subset regressions and Information-theoretic (information criteria based).

Depends quantreg, quadprog, utils

Suggests MASS

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NeedsCompilation no

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R topics documented:

`Forecast_comb` *Forecasts combination using regression, robust regression, constrained regression or variance based*

Description

Combine different forecasts. Use simple average, Ordinary Least Squares (OLS), robust regression, inverse mean squared error (IMSE), constrained least squares (CLS), or simply use the best forecast based on the MSE metric.

Usage

```
Forecast_comb(obs, fhat, fhat_new= NULL, Averaging_scheme= c("simple", "ols", "robust",
"cls", "variance based", "best") )
```

Arguments

obs	Observed series
fhat	fhat Matrix of available forecasts. These are used to retrieve the weights. How each forecast should be weighted in the overall combined forecast.
fhat_new	Matrix of available forecasts as a test set. Optional, default to NULL.
Averaging_scheme	Which averaging scheme should be used?

Details

Performs simple forecast averaging where each forecast carries equal weight: $\frac{1}{p}$ with p the column dimension of fhat. OLS forecast combination is based on

$$obs_t = const + \sum_{i=1}^{p} w_i \widehat{obs}_{it} + e_t,$$

where obs is the observed values and $\widehat{obs}$ is the forecast, one out of the p forecasts available.

Robust regression performs the same, but minimize different loss function, which is less sensitive to outliers (see quantile regression and references therein).

Constrained least squares minimize the sum of squared errors under the restriction that the weights sum up to 1, and that the forecasts themselves are unbiased (no intercept in the regression).

The variance-based method computes the mean squared error and weigh the forecasts according to their accuracy. Accurate forecasts (based on MSE metric) receive relatively more weight.

The best restric all the weights to zero apart from the best forecast, again based on the MSE. Essentially selecting only one forecast to be used.

Value

Forecast_comb returns a list that contains the following objects:

fitted	Vector of fitted values.
pred	Vector of prediction. This object is empty if there was no test matrix fhat_new provided.
weights	Vector of weights based on the Averaging_scheme.

Author(s)

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References

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Clemen, R.T. (1989) Combining forecasts: A review and annotated bibliography. International Journal of Forecasting 5, 559-583.

Koenker, R. (2005) Quantile Regression. Cambridge University Press.

Timmermann, A.G. (2006) Forecast combinations. In: Elliott, G., Granger, C.W., Timmermann, A. (Eds.), Handbook of Economic Forecasting, Elsevier, 135-196.

Examples

```
 library(MASS)
 tt <- NROW(Boston)/2
 TT <- NROW(Boston)
 y <- Boston[1:tt, 14] # dependent variable is columns number 14

 # Create two sets of explanatory variables
 x1 <- Boston[1:tt, 1:6] # The first 6 explanatories
 x2 <- Boston[1:tt, 7:13]# The last 6 explanatories

#create two forecasts based on the two different x1 and x2
 coef1 <- lm(y~as.matrix(x1))$coef
 coef2 <- lm(y~as.matrix(x2))$coef
 f1 <- t(coef1 %*% t(cbind(rep(1,tt), Boston[(tt+1):TT, 1:6] )))
 f2 <- t(coef2 %*% t(cbind(rep(1,tt), Boston[(tt+1):TT, 7:13] )))
 ff <- cbind(f1, f2)
scheme=c("simple", "ols", "robust", "variance based", "cls", "best")

example0 <- list()

 for ( i in  scheme) {
  example0[[i]] <- Forecast_comb(obs = Boston[(tt+1):TT, 14] ,
  fhat = ff, Averaging_scheme = i)
  cat(i, ":",  sqrt(mean((example0[[i]]$fitted - Boston[(tt+1):TT, 14] )^2)), "\n" )
 }

# Compare with
apply(ff, 2, function(x) {  sqrt(mean((x - Boston[(tt+1):TT, 14])^2)) }  )
```

`Forecast_comb_all` *All posible combinations forecast averaging*

Description

Combine different forecasts using complete subset regressions. Apart from the simple averaging, weights based on information criteria (AIC, corrected AIC, Hannan Quinn and BIC) or based on the Mallow criterion are also available.

Usage

```
Forecast_comb_all(obs, fhat, fhat_new = NULL)
```

Arguments

obs	Observed series.
fhat	fhat Matrix of available forecasts.
fhat_new	Matrix of available forecasts as a test set. Optional, default to NULL.

Details

OLS forecast combination is based on

$$obs_t = const + \sum_{i=1}^{p} w_i \widehat{obs}_{it} + e_t,$$

where obs is the observed values and $\widehat{obs}$ is the forecast, one out of the p forecasts available.

The function computes the complete subset regressions. So a matrix of forecasts based on all possible subsets of fhat is returned.

Those forecasts can later be cross-sectionally averaged to create a single combined forecast.

Additional weight-vectors which are based on different information criteria are also returned. This is in case the user would like to perform the frequensit version of forecast averaging or based on the Mallows criterion (see references for more details).

Although the function is geared towards forecast averaging, it can be used in any other application as a generic complete subset regression.

Value

Forecast_comb_all returns a list that contains the following objects:

pred	Vector of fitted values if fhat_new is not NULL or the vector of predictions if fhat_new is provided.
full_model_crit	List. The values of information criteria computed based on a full model, the one which includes all available forecasts.
aic	A vector of weights for all possible forecast combinations based on the Akaike's information criterion.
aicc	A vector of weights for all possible forecast combinations based on the corrected Akaike's information criterion.

bic	A vector of weights for all possible forecast combinations based on the Bayesian's information criterion.
hq	A vector of weights for all possible forecast combinations based on the Hannan Quinn's information criterion.
mal	A vector of weights for all possible forecast combinations based on the Mallow's information criterion.

Author(s)

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References

Hansen, B. (2008) Least-squares forecast averaging. Journal of Econometrics, Vol. 146, No. 2. , pp. 342-350

Kapetanios, G., Labhard V., Price, S. Forecasting Using Bayesian and Information-Theoretic Model Averaging. Journal of Business & Economic Statistics, Vol. 26, Iss. 1, 2008

Koenker R. (2005) Quantile Regression. Cambridge University Press.

Graham, E., Garganob, A., Timmermann, A. (2013) Complete subset regressions. Journal of Econometrics. Vol 177, 2, pp. 357-373.

Examples

```
library(MASS)
tt <- NROW(Boston)/2
TT <- NROW(Boston)
y <- Boston[1:tt, 14] # dependent variable is columns number 14
 # Create two sets of explanatory variables
 x1 <- Boston[1:tt, 1:6] # The first 6 explanatories
 x2 <- Boston[1:tt, 7:13]# The last 6 explanatories
# create two forecasts based on the two different x1 and x2
 coef1 <- lm(y ~ as.matrix(x1))$coef
 coef2 <- lm(y ~ as.matrix(x2))$coef
 f1 <- t(coef1 %*%  t(cbind(rep(1,tt), Boston[(tt+1):TT, 1:6] )))
 f2 <- t(coef2 %*% t(cbind(rep(1,tt), Boston[(tt+1):TT, 7:13] )))
 ff <- cbind(f1,f2)
 comb_all <- Forecast_comb_all(obs = Boston[(tt+1):TT, 14], fhat = ff)
 # To get the combined forecasts from the all subset regression:
 Combined_forecast <- apply(comb_all$pred, 1, mean)
# To get the combined forecasts based on aic criteria for example:
Combined_forecast_aic <- t(comb_all$aic %*% t(comb_all$pred))
```

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