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AMAR (All Methods Are Right)

In a nutshell the method consists in an extensive grid search in a large space of different learning algorithms, multi-step-ahead strategies, hyperparameters, embedding orders, dummy variables, preprocessing strategies (differentiation and detrending).
The learning algorithms taken into consideration are

1. Linear (L),
2. Random Forest (RF) with the number of trees as hyperparameter
3. Lazy Learning (LL), [2] with the max number of neighbors as hyperparameter
4. 4Theta (4T, code of the organizers)
5. Univariate temporal fitting (U).

The multi-step-ahead strategies taken into consideration are:

1. Iterated
2. Directed
3. MIMO [1,3]

The size of the hyperparameters is controlled by the variable C in the code
The embedding order ranges in [1,4].
Two differentiation strategies are considered: None, Differences
A dummy variable mechanism is considered to detect seasonality.

Once the space exploration is performed, the 5 best models in terms of normalized mean squared error and normalized cost (average of smape and mase) are selected. The normalization is done with respect to the naïve predictor.

Once the best model configurations are stored, the method computes for each series a number of continuations on the basis of the best 10 models (5 best NMSE and 5 best SMAPE). The distribution of the continuations is used to compute the median (final prediction) and the confidence intervals

References:

[1] G. Bontempi and S. Ben Taieb. Conditionally dependent strategies for multiple-step-ahead prediction in local learning. International Journal of Forecasting, 27(3):689–699, 2011.
[2] M. Birattari, G. Bontempi, and H. Bersini. Lazy learning meets the recursive least-squares algorithm. In M. S. Kearns, S. A. Solla, and D. A. Cohn, editors, NIPS 11, pages 375–381, Cambridge, 1999. MIT Press.
[3] S. Ben Taieb, A. Sorjamaa, and G. Bontempi. Multiple-output modeling for multi-step-ahead time series forecasting. Neurocomputing, 73(10):1950–1957, 2010.

A concise non-executable pseudo-code in R syntax is contained in the file *pseudo.R*

The code to perform forecasting is made of 4 scripts:

a) *read.R*: IN: ***.csv**, OUT: **TSERIES.all.Rdata**. script reading the original .csv files and creating a Rdata object (file **TSERIES.Rdata**) containing a list TSERIES where each element contains the historical data and the horizon
b) *calibration.R*: IN: **TSERIES.Rdata**, OUT: **calibration.all.Rdata**. This script performs model selection on the basis of 2 out-of-sample cost functions: the normalized NMSE (ratio NMSE model and NMSE naïve) and the normalize SMAPE (ratio SMAPE model and SMAPE naïve). The model selection procedure searches in a space characterized by a number of learning techniques, embedding orders, detrending strategies, differentiation strategies, hyperparameters and use of dummy variables
   Script save in the file **calibration.all.Rdata** a dataframe allFF which contains for each series the configuration of the best 5 models in terms of NMSE and SMAPE
   For each of the stored model the parameters are
      1) method: learning strategy (see variable Methods)
      2) order: embedding order
      3) detrend: detrending strategy (1 no detrending, 2 linear detrend)
      4) diff: differentiation strategy
      5) C: hyperparameter (e.g. number of trees of the random Forest))of the learning strategy
      6) dummy: dummy strategy
      7) cost: in terms of NMSE or sMAPE normalized with respect to the one of naive strategy

c) *mpred.R*: IN: **calibration.all.Rdata,** OUT**: TS.pred.Rdata** The script takes as input the file **calibration.all.Rdata** and returns for each series a number of continuations on the basis of the best 10 models (5 best NMSE and 5 best SMAPE) which is stored in the file **TS.pred.Rdata**
d) *predict.*R: IN: **TS.pred.Rdata** OUT: **Pred.csv, Lower.corr.csv, Upper.corr.scv**. On the basis of the number of continuations stored in **TS.pred.Rdata** the script returns the submitted continuation (median) and the upper and lower bound

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M4 competition submission code
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