Method Description

General Information

Type of Entry (*Academic, Practitioner, Researcher, Student*)	**Student**
First Name	**Waddah**
Last Name	**Waheeb**
Country	**Malaysia**
Type of Affiliation (*University, Company-Organization, Individual*)	**University**
Affiliation	**Universiti Tun Hussein Onn Malaysia**

Team Members (*if applicable*):

1st Member	
First Name	
Last Name	
Country	
Affiliation	
2nd Member	
First Name	
Last Name	
Country	
Affiliation	

Information about the method utilized

Name of Method	**PEEF (PEriod-based Ensemble Forecasting model)**
Type of Method (*Statistical, Machine Learning, Combination, Other*)	**Combination of Statistical Models**
Short Description (up to 200 words)	**Forecast each given period (i.e., monthly, weekly, etc.) by an ensemble forecasting model. Each of the ensemble models uses combination of different number of statistical models. These statistical models are ETS, BATS, BaggedETS, THIEF, TBATS, and Regression with ARIMA errors. The mixture function from the opera package was used to combine the forecasts.**

PEEF: PEriod-based Ensemble Forecasting model

Description:

Initially, different statistical models were used to forecast the data. These models are: Automatic ARIMA (Hyndman and Khandakar, 2008), ETS (Hyndman et al., 2002), BaggedETS (Bergmeir et al., 2016), THIEF (Athanasopoulos, 2017), BATS (De Livera et al., 2011), and TBATS (De Livera et al., 2011). All models were applied using the packages forecast v. 8.3 (Hyndman et al., 2018) and thief v. 0.3 (Hyndman and Kourentzes, 2018) in the R statistical software (R Core Team, 2018).

The available data was split into training and out-of-sample sets. The size of the out-of-sample set equals to the needed points to be forecasted in the competition. If negative forecasts appeared, the original data was transformed using log function then the forecasts were calculated again.

The forecasting performance of these models were ranked based on the OWA metric. It was found that some models perform good as compared to others based on the period (i.e., monthly, weekly, etc.) and/or the type of the series (i.e., financial, macro, etc.). Therefore, a combination of these models were used.

To build the ensemble models, the mixture function with Polynomial Potential aggregation rule in opera v. 1.0 package (Gaillard, 2015; Gaillard and Goude, 2016) was used to combine the forecasts. The out-of-sample data was used in the weighting.

Returning now to the selection of the models, for daily time series, ETS produced the best results as compared to others. BATS and TBATS produced almost same results. Bagged ETS showed best results in Macro time series. Therefore, ETS, BATS and Bagged ETS were chosen. With regards to weekly time series, TBATS and Regression with ARIMA errors produced the best forecasts as compared to other models.

For monthly and quarterly time series, in general, THIEF was the most accurate model. ETS followed THIEF with quarterly time series, while BATS and TBATS with the monthly time series. The final selected models for the monthly and quarterly time series were THIEF, BATS, TBATS, and ETS. Similarly, TBATS and ETS were chosen for yearly time series.

With hourly time series, THIEF, BATS, ARIMA, TBATS were in the top. However, different combinations showed almost same results. Therefore, the best results achieved with minimum number of models was selected which is the

THIEF and TBATS combination. Table 1 summarizes the selected models for each period.

Table 1. Selected models per period.

Period	Selected models
Daily	ETS, BATS and Bagged ETS
Weekly	Regression with ARIMA errors and TBATS
Monthly	THIEF, BATS, TBATS, and ETS
Quarterly	THIEF, BATS, TBATS, and ETS
Yearly	TBATS and ETS
Hourly	THIEF and TBATS

Reproduce the forecasts:

There is a file for each period. The data used in the scripts was downloaded from https://github.com/carlanetto/M4comp2018/tree/master/data. After filtering the data based on the period, the selected models, as shown in Table 1, are fitted using the training set. Then, models' forecasts are aggregated using the mixture function with Polynomial Potential aggregation rule in order to obtain the combination weights. Or simply you can load the saved weights.

After obtaining the weights, these weights with the forecasts from the selected models using the whole time series (i.e., combining the training and out-of-sample sets) are used to produce the submitted forecasts.

References:

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