Time Series Analysis: Project.

Olivier Wintenberger: olivier.wintenberger@upmc.fr

Recommendations: Groups of at most 3 students working on a sufficiently long time series of interest in an open dataset of their convenience containing also some explanatory time series.

The project must be done in the R programming language and the results presented in a pdf file.

Preliminary

Subsample the dataset as follows: the 10 most recent data (interesting and explanatory) for testing, the rest for training. The 3 first parts of the projects are based on the training set only. The last one compares the predictive power of the different models on the test set. The 2 first parts are based on the time series of interest only.

I) Preprocessing

Remove trend, seasonality and anomalies on the time series of interest if necessary.

II) Model fitting on the time series of interest

1) MA model

Choose the order of the MA model thanks to an ACF.
Fit the MA model with the chosen order.
Goodness of fit statistics to check whether the residuals are reasonably WN.

2) AR model

Choose the order of the AR model thanks to PACF.
Fit the AR model with the chosen order.
Goodness of fit statistics to check whether the residuals are reasonably WN.

3) ARMA model

Choose the orders of the ARMA model thanks to AIC.
Fit the ARMA model with the chosen orders.
Goodness of fit statistics to check whether the residuals are reasonably WN.

4) Residuals

Goodness of fit statistics to check whether the residuals are gaussian.

5) GARCH model
Fit a GARCH(1,1) model on the residuals.
Test the nullity of the parameter β.
If the test cannot be rejected, fit an ARCH(1) model.
Test the nullity of the parameter α.
Goodness of fit statistics of the chosen model (GARCH(1,1), ARCH(1) or SWN).

6) Prediction intervals for the 10 most recent data
Construct the prediction intervals on the one step estimator for the same ARMA-GARCH model provided by the rugarch package.

III) Training on the times series of interest using explanatory times series

1) Preprocessing
Remove trend, seasonality and anomalies on the explanatory time series following the exact same pre-processing than for the time series of interest.

2) Time varying coefficients
Use a dynamical model with the explanatory time series and some (the order of the AR model) past values of the time series of interest for predicting the present value of the time series of interest.

3) QLIK
Tune the hyperparameters thanks to the KFAS using QFAS. Discuss which coefficients can be regarded as constant through time.

4) Prediction
Use the Kalman's recursion on the tuned dynamical model to produce intervals of prediction for the 10 most recent data.

IV) Conclusion

Compare the 3 different prediction intervals from the two steps procedure, the one step procedure, and the dynamical model. Conclude.