## A Forecasting Project Requirement

Your task is to analyze a time series data you are interested in, make forecasts, and present your project to a group of business professionals. Your audience is familiar with basic concepts of econometrics and forecasting. In this project, you will make optimal forecasts on the time series of your choice and assess your forecasts using in-sample and out-of-sample evaluations. In the end, you will deliver a video presentation of your project. Each group member should participate in the video creation and presentation. The video should be about 10-15 minutes long.

**Step 1. Explore the data and perform in-sample evaluations**

First, select a univariate time series that captures your interest and has a minimum of 100 observations. It is important to choose a series that exhibits sufficient dependence to effectively apply forecasting models in subsequent analyses. For instance, stock prices might not be suitable for forecasting as they often resemble white noise.

Next, load the chosen data into RStudio and plot the time series. It is common for time series to exhibit trends and seasonality, and these components need to be appropriately removed to achieve stationarity. The procedures for handling deterministic and stochastic seasonality are described in chapter 7, while the procedures for handling deterministic and stochastic time trends are explained in chapter 10. Along the way, you should employ augmented Dickey-Fuller tests to confirm that the resulting time series is stationary. Ensure to plot this series and clearly indicate that it is the series you will utilize for the subsequent analysis.

Use the full sample to create ACF (Autocorrelation Function) and PACF (Partial Autocorrelation Function) correlograms of the series. Analyze the patterns observed in the correlograms and employ linear models such as MA (Moving Average), AR (Autoregressive), or ARMA (Autoregressive Moving Average) to model the time series. Use the full sample to estimate the models and present the ACF and PACF correlograms of the residuals obtained from each model. Verify if the residuals resemble white noise using the Q-Test. Select the three best models obtained thus far, write down the estimated regression equations, summarize the model estimation and evaluation in a table (similar to table 8.2 on page 214 in your textbook), and generate up to six-step ahead forecasts, that is h=1, 2, 3, 4, 5 and 6. Plot the multi-step forecasts and their corresponding bands for each

specification, and provide comments on your preferred model and the reasons behind your choice.

**Step 2. Perform out-of-sample evaluations**

In the second step, you will use the three best models from the in-sample assessment for the out-of-sample assessment. Additionally, include two simple forecasts as benchmarks: 1) a naïve model, where the optimal forecast of the next period is the value of this period, $f_{t,1} = y_t$ and 2) a simple average of the last four observations, $f_{t,1} = (y_t + y_{t-1} + y_{t-2} + y_{t-3})/4$. These models do not require estimation.

Split the sample into two parts: the first 90% serves as the estimation sample, while the remaining 10% serves as the prediction sample. As a priori choices, use the quadratic loss function to find your optimal forecasts. Additionally, choose two forecasting horizons to make two types of forecasts: one-step ahead forecasts (h=1) and two-step ahead forecasts (h=2).

The following procedure should be conducted for each type of forecasting. Apply three schemes: the fixed sampling scheme, the recursive scheme, and the rolling scheme to collect forecasting errors. After obtaining forecasting errors, conduct forecast optimality tests (MPE and informational efficiency tests) for each model, calculate MSE, MAE, MAPE(%), and provide a descriptive evaluation of the average loss in a table similar to Table 9.6 on page 243 (excluding the last column).

Lastly, create combined forecasts from the top three models using three linear combination schemes:

1. An equal-weighted forecast.
2. A forecast that weights each individual forecast by the inverse of its MSE.
3. An OLS weighted optimal forecast.

Display the weights and MSE of these three combined forecasts in a table format, similar to Table 9.8 on page 246, and provide comments on which combination scheme you prefer. Use your favorite model and combination scheme to make a single one-step ahead forecast with all your sample data. Do the same to make a single two-step ahead forecast.

**Step 3. Create the final video of your project**

Create a complete video to cover the two steps described above with a short introduction and a brief discussion on the implications of your forecasts. Please provide a one-sentence summary of each group member's contributions to the project. Your submission should include:

1. A video presentation in .mp4 format
2. presentation slides
3. R code
4. data file

Please name your video , Group <#> Final Project - Step3.

**A note of reminder:**

1. Do not use any functions in R such as decompose() to decompose the series for you.