

**Economics 144: Project 1**  
**Winter 2022, UCLA**  
**Instructor: Dr. Rojas**

**Due Date: February 17, 2022 by 5PM (PST)**

For this project you will fit a forecasting model with different trends, and also perform trend and seasonal adjustments. You may choose any data of your choice provided your time-series data suggest the presence of both, trend and seasonality.

The assignment that you will submit, consists of a written report which includes answers to questions below (including plots), and R source code. You can also simply write your project in R Markdown and submit the knitted file (make sure to make the code visible).

Make sure all the plots conform to the standards delineated in Chapter 4<sup>b</sup>, e.g., correct time units, axis labels, legends, etc.

Your report needs to be typed (no limit on the number of pages) and will consist of 5 parts:

I. (5%) Introduction (describe the data, provide some background on the topic, etc.).

II. (75%) Results (answers and plots). Consists of two parts:

1. Modeling and Forecasting Trend (8% each)

- (a) Show a time-series plot of your data.
- (b) Does your plot in (a) suggest that the data are covariance stationary? Explain your answer.
- (c) Plot and discuss the ACF and PACF of your data.
- (d) Fit a linear and nonlinear (e.g., polynomial, exponential, quadratic + periodic, etc.) model to your series. In one window, show both figures of the original times series plot with the respective fit.
- (e) For each model, plot the respective residuals vs. fitted values and discuss your observations.
- (f) For each model, plot a histogram of the residuals and discuss your observations.
- (g) For each model, discuss the associated diagnostic statistics ( $R^2$ ,  $t$ -distribution,  $F$ -distribution, etc.)
- (h) Select a trend model using AIC and one using BIC (show the values obtained from each criterion). Do the selected models agree?
- (i) Use your preferred model to forecast  $h$ -steps (at least 16) ahead. Your forecast should include the respective uncertainty prediction interval. Depending on your data,  $h$  will be in days, months, years, etc.

2. Trend and Seasonal Adjustmennts (7% each)

- (a) Perform an additive decomposition of your series. Remove the trend and seasonality, and comment on the ACF and PACF of the residuals (i.e., what is left after detrending and seasonally adjusting the series). Comment on the results.
- (b) Perform a multipliative decomposition of your series. Remove the trend and seasonality, and comment on the ACF and PACF of the residuals (i.e., what is left after detrending and seasonally adjusting the series). Comment on the results.
- (c) Which decomposition is better, additive or multiplicative? Why?
- (d) Based on the two decompositions, and interpretation of the random components, would your models for the cycles be similar (additive vs. multiplicative) or very different? Why?

III. (5%) Conclusions and Future Work (state your conclusion regarding your final model and forecast, and provide some insight as to how it could be improved).

IV. (5%) References (include the source of your data and any other resources).

V. (10%) R Source code. Your code needs to include proper comments to help e.g., a non-R expert understand and run your code. If you do not submit your code, you will not receive credit for the assignment.