

Instructions: Each assignment will include a PDF file (like this one) with the assignment questions and an Excel file, with an Answers sheet and any data or models that we provide you with. You must download both the PDF and Excel files. You have to enter your answers in the Answers sheet of the same Excel file you have downloaded, then save and upload the Excel file. You must upload the same Excel file you downloaded. Further instructions are provided in the Online Assignment Tools Guide (see **Assignments** in eClass).

Put your answers in the appropriate cells (salmon-colored cells) in the **Answers** sheet. Use paste special ... values to for all numerical answers. The other cells in the Answers sheet are locked, which means you won't be able to enter values into those cells. Do not change the format of cells in the Answers sheet. Save your file with the appropriate name and in the appropriate format ("HW#_ID.xlsx").

Marking will be based on the answers in the Answers worksheet of the file you upload. We will only look at the rest of the file if there is an appeal (and even then, the answers in the Answers sheet take precedence.) If you wish to appeal a mark, then the file you uploaded must include your supporting work for each question. It is a good idea to make one worksheet for each question.

Total points: 41, of which 1 point is for following the submission instructions provided above.

Forecasting the number of service requests for Edmonton 311

In this assignment, we continue to use the data from HW#2 (the "Daily" worksheet) and will progress from the simple exponential smoothing (SES) to double exponential smoothing (DES) and triple exponential smoothing (TES) methods. We will also use the holdout analysis in the assignment so make sure to understand how this approach works.

Part 1: Within-sample comparison

First, we will perform a within-sample comparison of DES and TES based on how these methods perform at one-day-ahead forecasting between 8-Jan-22 to 17-Dec-22. We leave out 1-Jan-22 to 7-Jan-22 for the initialization of TES. We leave out 18-Dec-22 to 31-Dec-22 for an out-of-sample comparison of the methods; see the second part of the assignment.

Note that when you are using the DES method you start forecasting earlier than 7-Jan-22, but to perform a fair comparison between the two methods, you will calculate the within-sample performance measures only for 8-Jan-22 to 17-Dec-22.

1. (12 pts.) Implement the DES method to calculate the one-day-ahead forecasts for 8-Jan-22 to 17-Dec-22. Use solver to determine the values of LS and TS that minimize RMSE (calculated only based on the interval 8-Jan-22 to 17-Dec-22), subject to the constraint that LS and TS are between 0.01 and 0.99. Report the following:
 - (2 pts. feasibility, 1 pt. consistency, 2 pts. optimality) Optimal values for LS, TS, and the RMSE for 8-Jan-22 to 17-Dec-22,
 - (7 pts.) Values of the level, trend, and one-day-ahead forecasts for 11-Dec-22 to 17-Dec-22.
2. (12 pts.) Implement the TES method to calculate the one-day-ahead forecasts for 8-Jan-22 to 17-Dec-22. Assume a weekly seasonal pattern, which means $p = 7$. Use solver to determine the values of LS, TS, and SS that minimize RMSE (calculated only based on the interval 8-Jan-22 to 17-Dec-22), subject to the constraint that LS, TS, and SS are between 0.01 and 0.99. Report the following:
 - (2 pts. feasibility, 1 pt. consistency, 2 pts. optimality) Optimal values for LS, TS, SS, and the RMSE for 8-Jan-22 to 17-Dec-22,

- (7 pts.) Values of the level, trend, seasonality indices, one-day-ahead forecasts for 11-Dec-22 to 17-Dec-22.

Hint: You may find the Weekday function useful for the TES forecast calculations.

Part 2: Out-of-sample comparison

Second, we will perform an out-of-sample comparison of DES and TES, based on the forecasts for 18-Dec-22 to 31-Dec-22. This is our hold-out data so we are going to treat it as the future. This means the learning phase ends on 17-Dec-22 and the prediction phase starts on 18-Dec-22.

3. (8 pts.) Implement the DES method to obtain the k-day-ahead forecasts for 18-Dec-22 to 31-Dec-22. Use the same values of LS and TS that you found in Question 1. The difference is that now you must stop updating the level and trend after 17-Dec-22. Report the following:
 - (7 pts.) DES Forecasts for 18-Dec-22 to 31-Dec-22,
 - (1 pt.) The RMSE of DES method for 18-Dec-22 to 31-Dec-22.
4. (8 pts.) Implement the TES method to obtain the k-day-ahead forecasts for 18-Dec-22 to 31-Dec-22. As before, assume a weekly seasonal pattern, with $p = 7$, and use the same values of LS, TS, and SS that you found in Question 2. The difference is that now you must stop updating the level, trend, and seasonal indices after 17-Dec-22. Report the following:
 - (7 pts.) TES Forecasts for 18-Dec-22 to 31-Dec-22.
 - (1 pt.) The RMSE of TES method for 18-Dec-22 to 31-Dec-22.