

Time series Modeling & Analysis

DATS 6450

LAB # 1

Using the following Python libraries develop a program to answer the questions below:

```
import matplotlib.pyplot as plt
import pandas as pd
from statsmodels.tsa.stattools import adfuller
```

- 1- Load the time series data called tute1.
- 2- This date relates to the quarterly sales for a small company over period 1981-2005.
- 3- Sales contains the quarterly sales, AdBudget is the advertisement budget and GPD is the gross domestic product for a small company.
- 4- Plot Sales, AdBudget and GPD versus time step.
- 5- Find the time series statistics (average, variance and standard deviation) of Sales, AdBudget and GPD.
- 6- Display the Average, variance, and standard deviation as follow:
 - a. The Sales mean is : ----- and the variance is : ----- with standard deviation : -----
 - b. The AdBudget mean is : ----- and the variance is : ----- with standard deviation : -----
 - c. The GDP mean is : ----- and the variance is : ----- with standard deviation : -----
- 7- Prove that the Sales, AdBudget and GDP in this time series dataset is stationary. Hint: To show a process is stationary, you need to show that data statistics is not changing by time. You need to create 100 sub-sequences from the original sequence and save the average and variance of each sub-sequence. Plot all means and variances and show that the means and variances are almost constant. To create sub-sequences, start with a sequence with the first sales data and find the mean. Then create another sub-sequence by adding the second sales date to the first sub-sequence, then find the corresponding mean. Repeat this process till you added the last sales date to the last sub-sequence and find the average. Repeat the same procedures for variances.
Hint: Create a loop for the length of the dataset and use the following command to bring new data sample at each iteration:

```
pd.read_csv('tute1.csv').head(i) # where i is the number of samples
```

- 8- Plot all average and variance. Write down your observation about if this time series data is stationary or not? Why?
- 9- Perform an ADF-test to check if the Sales, AdBudget and GDP stationary or not (confidence interval 95% or above). Does your answer for this question reinforce your observations in the previous step?
- 10- Add an appropriate x-label, y-label, legend, and title to each graph.

Submission guidelines:

- A. Write a formal report for this LAB and include graphs (add appropriate title, x-label, y-label, and legend if applies) and the developed python code.
- B. The developed python must be included at the end of your report as an appendix.
- C. The softcopy of the developed Python code .py must also be submitted separately. Please make sure the developed python code runs without any error by testing it through Pycharm software.
The developed python code with any error will subject to 50% points penalty.
- D. Make sure to answer all the questions asked. Your report should be written in a formal format. A formal report includes a cover page, abstract, introduction, answering questions, conclusion, appendix, and references. Upload a formal **report (as a single pdf)** plus **the .py file** through BB by the due date.

1- Cover Page: A formal report must have a cover page which includes :

- Course number and name.
- Instructor(s) name(s).
- Lab number or title
- Your name
- Initials and Date.

2- Abstract :

A brief description of the LAB. The abstract should not exceed four or five sentences. The abstract should be self contained and meaningful on its own with the intent that any reader can understand the primary purpose and findings of the lab at a very high summary level.

3- Introduction : In your own words, explain the reason for performing the experiment and give a concise summary of the theory involved, including any mathematical detail relevant to later discussion in the report.

4- Method, theory, and procedures: A brief explanation of the theory and method behind the LAB.

5- Answer to asked questions: Make sure to answer all the questions asked in the LAB. You may need to add figures, table or chart in this section. All figures should have correct x-label, y-label, title and legend. This also applies to all charts and tables.

6- Conclusion : This section should reflect your understanding of the LAB. Important points to include are a brief discussion of your final results, an interpretation of the actual experimental results as they apply to the objectives of the LAB set out in the introduction should be given. Also discuss any problems encountered and how they were resolved.

7- Appendix: A copy of the developed python code to be added in this section. Make sure to run your Python code in Pycharm before submission and make sure the code runs without an error. **50%-point reduction for a LAB or homework submission with an error in Python code.**

8- References (if applies)