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Lab assignment 1

The goal of this lab assignment is for students to

- familiarize with the theory of time series analysis covered by Chapter 1 in the book.
- present the results from analysis orally in a clear and concise way
- (practice the mathematical writing skills)

Tasks:

1. Find a time series data that (can) includes a seasonal component, for example, quarterly data, monthly data, ….
   For example, if you search for "time series data download" you will find a lot of choices.
   Make sure that the series is fairly long, at least 10 years.
2. Split the data in **two parts**, the most recent year, and the previous years. Time series analysis will be applied on the second part, and the last year data will be used as the "correct answer" when forecasting.
3. Start by plotting the time series and examine the main features of the graphs, i.e., check whether there is a drift, a deterministic trend, a combination of drift and a deterministic trend, a seasonal component, any apparent sharp changes in behavior, any outlying observations, ….
4. Remove any drift, deterministic trend and seasonal components in order to get stationary residuals.
   Do that, by both using methods **S1** and **S2** (see Chapter 1.5).
5. Test if the residuals or the differenced series are iid Noise according to the methods in Chapter 1.6.
6. Regardless of the conclusion from 5, use the results from method **S1** to **forecast the forthcoming year** (just using the estimated trend and the estimated seasonal component) and compare it to the "correct answer".

The result from this assignment will be **presented orally** on Wednesday 31 January. The presentation should be supported by slides (PowerPoint, Latex, …) and submitted in the **pdf** format under *Assignments* on *Canvas*, together with a filled-in *HomeworkLog* document describing each group member's work input

This lab will be continued (Lab assignment 2) when we have deeper knowledge of how stationary time series can be modelled.
In that lab we will complete the analysis with more advanced methods, the ones that are introduced in Chapter 2-6.
The results from these two assignments must then be combined into **one report** written in a word processing program (e.g., Word or LaTeX). It's a good idea to start writing the first part of the report already now.

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Presentation instructions

The presentation should provide a good picture of the obtained results and contain at least the following:

- Purpose of the study. Problem formulation.
- Data presentation.
- Formulation of the statistical methods applied.
- The results of the analysis
- Model checking
- Discussions of the results and conclusions

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The design of the report

In summary, the final report must contain the following parts:

- Cover sheet
- Introduction
- (Theory, not needed here)
- Method
- Results
- Conclusion/Discussion
- Appendix (if necessary)

To get tips on what each part should contain, read the instructions below.

Whom is the report aimed at?

- It is important to consider whom you are addressing in your writing.
- When it comes to laboratory reports, you should direct your writing towards someone with knowledge that is just below your own.
- Assume that the reader has no idea what the lab is about, so don't write in a way that only the teacher can understand.
- You should strive to be able to read and understand your report after a few months and then be able to follow what you have done.

Cover sheet

- Your group numbers.
- Names of all student collaborators in the group.
- Which course and which homework it is.
- Submission date and version of the report. For example, version 1 for the first submission, version 2 for the resubmission.
- Names of all teachers on the course.

Structure

In general, when it comes to reports, you should strive to have the following structure:

1. Describe the problem (Introduction).
2. Describe the approach (Method/Implementation).
3. Present the result (Results).
4. Analyze the result (Conclusion/Discussion).

This enables the report to have a clear common thread.

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Introduction

- Explain the problem (in your own words).
  The reader must be able to understand your report without reading the tasks of the homework.

Theory (this part is not something we require you to include in this report, but here are some tips if this is included).

- The theory needed to solve the problem is described here.
- It should be written in general terms (not in terms of the problem).
- If you use mathematical expressions, you must define all unknown variables, parameters, and symbols, ...

Method

- Here, the approach used to solve the problem is described.
  It should be written in such a way that the reader will be able to repeat the study after reading it.
- Here, for example, must hypotheses be presented.
- You must not enter your programming code.
- The code must be put in Appendix with references to sections of the Appendix, so we can easily find the function calls you used.

Results

- Here, the results produced to solve the problem are presented (objectively).
  For example, figures, results from tests and checking of assumptions can be presented here.
- Also, findings such as a hypothesis is rejected or not, are presented here, not under Conclusion/Discussion.
- It is not okay to start a section with a graph or figure; it should start with a text.
- It is not okay to just line up results one after the other.
  You should think of the reader and guide the reader through the results.
- The figures and tables you include must be commented on in the text and should have captions that can be referred to in the text, so it is easy to find the appropriate figure or table.
- It is important to bring relevant prints and figures (bring only what you need to support your conclusions, "make it simple").
- It is not okay to paste program printouts right into the text.
  You can either create a table or make a figure from the printout.

Conclusion/Discussion

- Here, the result is viewed more subjectively, i.e., reasoning about the results presented.
  For example, one should present what practical conclusions can be drawn from the test, what
- information the figures give, and whether the assumptions made are met?
- You should reconnect your result to the problem statement:
  - What do the results mean (have we received answers to what was requested)
  - Limitations of the study and suggestions for improvement.

Appendices

- Things are added here that are not necessary to understand the report but can provide a deeper understanding.

Good Luck!