Time Series Analysis and Prediction (TSAP)

2023/2024

Project Assignment

Time Series Analysis and Forecasting

1 Introduction

In the project of this course, you will have to analyze a time series of interest, model it and produce forecasts based on univariate and multivariate models. We provide a dataset suggestion, but encourage you to search for a dataset of your interest to use in the project. The main requirements are:

- Have one time series of interest and at least two other "relatable" timeseries
- The timeseries of interest present cyclic patterns (seasonality)

Discuss with the professor about the dataset until the class of 18th october.

2 Suggested Dataset

The consumer price index (CPI) is considered one of the most important macroeconomic indicators. CPI data are of crucial importance for countries governments that require reliable measures of price change to make correct decisions. Wages, salaries, government payments, pensions, rent, and other payments are related to the CPI and require accurate estimates of inflation. [1].

CPIs account for changes in the general level of prices of goods and services that families acquire for consumption. CPI is computed for sub-groups of products/services (Education, Food and non-alcoholic beverages, Alcoholic Beverages, Tobacco, and Narcotics, etc) and for all the products/services together. Your duty in this assignment is to analyse and predict CPI for a given country, chosen from a set of countries with data available in the supplied dataset.

Consider the dataset available at UCStudent (CPITimeSeries.csv). This dataset contains monthly CPI values for 191 different countries. For each country different indicators are available. Consider for this assignment the indicator related to all services/products together, i.e., **Consumer Price Index, All items (PCPI_IX)** For more information, read *cpi-manual-concepts-and-methods.pdf* available at UCStudent.

3 Objective

Your task is to analyse and forecast CPI Time Series (TS). The first step is to select the indicator PCPI_IX from a country (that should be different from the ones chosen by the other groups). Ask professor opinion

[1] Text extracted from https://www.imf.org/en/Capacity-Development/Training/ICDTC/Schedule/OL/2022/CPIxOL22-05 on 22/09/2022

about the chosen country :-). Consider data from 1990 until today. If you will be using a different dataset, discuss it with the professor for approval.

4 Project main steps

You should apply the methods thought during the course to your time series (only the ones that are suited to it) and provide a critical analysis on time series description, modeling and forecasting. Consider implementing the steps described in the next sub-section.

4.1 TS splitting

Split your TS into two: the first part of the TS should be used for characterization, modeling and training, whilst some of the last part of the TS should be used to assess the forecasting performance of your methods. The amount of data left for testing is something you should also define in function of your TS.

4.2 Basic description techniques & transformations

Assume a decomposition model and describe your TS concerning, trend, seasonality and erratic component. Assess TS stationarity and if not atationnary, try to stationarize it.

4.3 Model fitting

Consider the different models studied and fit models to data and verify fitting quality. Note that not all the models studied may be useful, or even possible to be applied.

4.4 TS Forecasting

Use exponential smoothing and the fitted models to perform forecastings on the part of the data never used before. Report forecasting performances.

4.5 Multivariate modelling & Forecasting

Consider TS from other countries compare them and evaluate their relation with the TS from your country. Apply multivariate models and perform forecasts.

5 Documentation

You are requested to submit your report in a IEEE paper format (you can find Word and Latex templates here: https://www.ieee.org/conferences/publishing/templates.html). The suggested number of pages is 4. You can exceed this limit by one or two pages if you really need to (**6 pages max**).

Write your article in a IMRaD format (Introduction, Methods, Results and Discussion):

- Introduction:
  - Describe the "problem" you are addressing, why it is important and the challenges facing.
  - Describe the dataset you worked with.
  - Give a small overview of the state of the art in this topic.
- Methods:

  - Describe the methods you used to characterize, model and forecast the TS, and how you analyze and validate your result.

- Results:
  - Show the results you obtained. Represent them in plots and/or tables.

- Discussion & Conclusion:
  - Discuss your results, in scope with the state of the art.
  - Derive some conclusions
  - Identify future steps to develop the work, so other can build upon your research

Besides those sections, you must provide an abstract, title and authors identification on the first page.

5.1 Requirements

Practical assignment is meant to be done in groups of two persons. Groups of three persons may be allowed if the course has an odd number of students.

5.2 Project Submission & Deadlines

1. **Project First Milestone (Deadline: 5th November 2023!)**
   Deliverables:
   - Basic description and transformations;
2. **Project Final Goal (Deadline: 10th December 2023!)**
   Deliverables:
   - All the work developed, including the one reported in the first milestone.
3. **Presentation and Discussion (Classes of 13th December 2023!)**

Acknowledgments

All the data, CPI related descriptions and support documents were obtained from the International Monetary Fund website (https://data.imf.org/?sk=4FFB52B2-3653-409A-B471-D47B46D904B5).