MSDS 413, Assignment 7
Multivariate Time Series Models (TS7)

Introduction

For this assignment, you will use the datasets and R script (TS7.R) included in the zip file (TS7.zip), posted to the Module 7 Overview page of Canvas. You will read the data files into R and conduct the requested analyses.

The instructions for submitting your assignment follow the Procedure section below.

The following list defines the data sets and their respective variables.

The file q-fdebt.txt contains the U.S. quarterly federal debts held by foreign and international investors, and federal reserve banks. The data are from the Federal Reserve Bank of St. Louis, from 1970 to 2012 for 171 observations, and not seasonally adjusted. The debts are in billions of dollars.

- year: year of the debts
- mon: starting month of the quarterly debts
- hbfin: debt held by foreign and international investors
- hbfrbn: debt held by federal reserve banks

Your objective is to explore the time series behavior of these data sets including EDA, modeling, model diagnostics, and interpretation.

Procedure

The following steps are necessary to complete this assignment. Address each and every part and ensure that you cover all the details specified in the questions.

1. **Debt** (30 points) Use the file q-fdebt.txt which contains the U.S. quarterly federal debts held by foreign and international investors, and federal reserve banks.
   - 1.1. Use EDA to justify a log transformation and a first difference transformation, z_{it}, of each time series for $i = 1, 2$ hbfin and hbfrbn, respectively.
   - 1.2. Obtain the first 5 lags of sample cross-correlation matrices of the z_{it}.
   - 1.3. Test $H_0 : \rho_1 = \cdots = \rho_{10} = 0$ versus $H_a : \rho_j \neq 0$ for some j, where $j \in \{1, ..., 10\}$. Draw a conclusion using the 5% significance level.

2. **GDP** (30 points) Consider the growth rates, in percentages, of the quarterly real GDP of United Kingdom, Canada, and the United States located in the object **qgdp** in the **MTS** R package.
   2.1. Use EDA to justify a VAR(4) model.
   2.2. Fit a VAR(4) model to the series and perform model checking.
   2.3. Simplify the model by removing insignificant parameters with type-I error rates at $\alpha = 0.05$.
   2.4. From each model's diagnostics, compare the VAR(4) and the simplified models. Suggest and justify which model, if either, is best.
   2.5. Generate a multivariate forecast from your best model.
3. **Report** (20 points) Write an executive summary of the outcomes of your GDP analysis.

Deliverables

Your instructor may modify these and all the following directions. See Section Submission Directions below. The assignment deliverables, each in pdf format, are as follows:

- *Only if requested by instructor*
  - The program or script
  - Logs
  - Outputs
- Mandatory
  Data analysis write-up: no programs, logs, or just code outputs; **complete EDA and model diagnostics are expected unless otherwise instructed; I will be looking for innovative interpretations in the assignments over and above the rote adherence to assignment requirements. Only partial credit will be awarded for rote adherence to assignment requirements.**.

The data analysis must follow and use the item numbering of each assignment, i.e., use the numbers, say, 1 - 5, with the sub-lettering if used. These deliverables are provided according to the instructions in the Submission Directions section below.

Submission Directions

Title Page

Include a title page with your name and the assignment designation. Leave room for instructor comments.

File Names

The assignment write-up file shall be submitted to Canvas according to the schedule in the syllabus using the item (1) naming convention below. The naming convention is case sensitive. Use letters and numbers as given. **The file name parts have no spaces or other separator characters**. TS7Lastname.pdf (submit via Canvas)

The parts are the assignment code, TS7; your last name with only the first letter capitalized; a period, and lastly, the extension "pdf". Generically,

TS7Lastname.pdf

For example: Suppose your name is Student McStats. Your filename then is:

TS7Mcstats.pdf

The analysis write-up file must be submitted for grading. Each write-up requires a title page for instructor comments. The analysis may use either R or any other statistics package you wish, or if you use more than one package, you must use the germane tables, plots, etc., in a single report. If you use more than one package, differences and similarities should be indicated.

email

ONLY IF REQUESTED email your instructor the program (script or code), log and output as separate pdf files. The R log and output may be combined. The file names shall be as follows:

- The program or script file names
  - TS7LastnameRprog.pdf
- The log file names
  - TS7LastnameRlog.pdf