(International) Bachelor Econometrics and Operations Research
FEB23001(X)-19 Tijdreeksanalyse / Time Series Analysis
Assignment 1

This assignment consists of 3 pages, with questions 1.a - 1.g

Instructions

This assignment should be made with a team of two students, or individually. Teams of three or more students are not allowed. It is not allowed to cooperate with other teams, or to copy their results.

The results of this assignment should be delivered in the form of a report of max. 8 pages (not including a possible appendix). The report may be written in English or Dutch. The report should provide a detailed and careful description of your results and interpretation. Make the report self-contained, so that it can be read without reading these instructions first. All relevant results should be included in the report (preferably in tables and graphs). 'Raw' output from EViews (or other software) may be attached as an appendix, but should not be included in the main text of the report.

The deadline for submitting your report is Friday May 22, 2020 at 16:59h. Reports should be submitted via Canvas as a PDF file with the name "`FEB23001-19-A1-XXXXXX-YYYYYY.pdf`", where `XXXXXX` and `YYYYYY` are the 6-digit student IDs of the two group members.

Note 1: Motivate your answers! For example, answers like "Yes" or "No" to question 1.b will not be rewarded any points.

Note 2: Some questions in the assignment are not specified up to the last detail and require you to make some choices yourself. Explain and motivate your choices in your report.

Note 3: Although easy-to-use and convenient, it is not required to make the assignment with EViews. You are free to use other programs such as Stata or Matlab. In case you write your own code, provide this in the appendix!

Note 4: **It is not allowed to copy-paste text from the exercises or from assignments of previous years. This will be considered as plagiarism and will be treated as such.**

Good luck!!

Questions related to this assignment should be posted on the discussion board on Canvas – see the course syllabus for further details.

ASSIGNMENT 1

DATA

The Excel file `FAUTO.xlsx` contains monthly observations on the retail sales of foreign autos (in thousands of units) in the US over the period January 1970 – December 2019.[1] Column B contains the original data, while column C contains the seasonally adjusted time series. A dummy variable DREC is also included, which takes the value 1 during recession periods and 0 during expansions.[2]

1.a) Using the full sample period January 1970 – December 2019, examine whether the time series of foreign auto sales displays any of the 'key features' [(i) trend; (ii) seasonality; (iii) aberrant observations; (iv) heteroskedasticity; (v) nonlinearity] discussed in Chapter 2. You may involve both the original and the seasonally adjusted series in your analysis. You may also want to consider transformations of the time series such as monthly or annual changes, and use the graphical and auxiliary regression tools discussed in Chapter 2. Are there specific observations that are very 'influential' for the answer to this question?

In the remainder of this assignment we will only work with the seasonally adjusted time series.

1.b) Based on the entire sample period January 1970 – December 2019, is the time series of foreign auto sales normally distributed? Are there specific observations in the time series or specific sub-periods in the sample period that are very 'influential' for the answer to this question?

1.c) Using the complete sample period January 1970 – December 2019, compute the first 60 empirical autocorrelations and partial autocorrelations for the time series of foreign auto sales. Examine the patterns and the significance of the (partial) autocorrelations. What kind of AR, MA or ARMA model do the (partial) autocorrelations suggest?

1.d) Estimate the parameters in AR(p) and MA(q) models for $p = 0, \ldots, 6$ and $q = 1, \ldots, 6$ for the time series of foreign auto sales. Include an intercept in all models to allow for a non-zero unconditional mean. Set the "`Sample`" to 1970M7-2019M12, in order to make sure that you effectively use the same number of observations for all models. Record (and report) the values of the Akaike Information Criterion and the Schwarz Information Criterion. Which model do these criteria indicate as the preferred choice?

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[1] U.S. Bureau of Economic Analysis, Motor Vehicle Retail Sales: Foreign Autos [FAUTONSA], retrieved from FRED, Federal Reserve Bank of St. Louis; `https://fred.stlouisfed.org/series/FAUTONSA`, May 8, 2020.

[2] Based on the turning points provided at `http://www.nber.org/cycles/`

1.e) Estimate the parameters in an AR(2) model for the time series of foreign auto sales (using the complete sample period January 1970 – December 2019). [Remember to include an intercept!] What are the roots of the AR(2) polynomial? Compute the values of the first 24 'implied' autocorrelations (that is, what are the values of the autocorrelations of an AR(2) process for the estimates $\hat{\phi}_1$ and $\hat{\phi}_2$ obtained here),and compare these with the empirical autocorrelations. How closely do they match?

1.f) Inspect the properties of the time series of residuals from the estimated AR(2) model. In particular, address the following questions:

i) What are the autocorrelation properties of the residuals, and what does this imply for the adequacy of the estimated AR(2) model?

ii) What are the autocorrelation properties of the squared residuals? What does this imply for the assumption of homoskedasticity of the shocks ε_t?

iii) Are the residuals normally distributed?

Again, examine whether there are specific observations that may be driving the answers to these questions.

1.g) Re-estimate the AR(2) model for the time series of foreign auto sales using the sample period January 1970 – December 1989 ($T = 240$ observations). Construct one-step ahead point forecasts for the sample period January 1990 – December 2019 (360 observations). Evaluate the accuracy of these point forecasts in 'absolute' terms, by considering their a) unbiasedness, b) accuracy, and c) efficiency. Also evaluate the 'relative' accuracy of the point forecasts obtained from the AR(2) model by comparing them with so-called 'random walk' forecasts, where $\hat{y}_{T+1|T} = y_T$, that is, the forecast is simply the observed value in the previous month.