Assignment 2

Assignment 2 is due <u>Friday October 14th</u> by 5pm. Submissions should be uploaded to the *Submission Box* on Blackboard. Feel free to prepare your answers on your computer or write by hand, scan it as a DOCX/PDF file, or take pictures and upload the JPG files. Only JPG, DOCX, or PDF formats will be accepted. Do <u>not submit/email</u> your answers to lecturers/tutors. Complete the following exercises and show your work.

1. (50 points) In this problem, we are interested in the time series properties of bond returns. We collect monthly data from $1942M01$ to $2021M12$ for the following variables:

   - *b1ret* denotes the 1-year bond return,

   - *t30ret* denotes the 30-day return on treasury bill,

   - *cpiret* denotes the inflation rate.

   We will be focusing on the bond return variable *b1ret* throughout this analysis. Create a second variable *b1ret1* from the original variable, where *b1ret1* has observations from 1942M01 to 2020M12. We will be using *b1ret1* for estimation, and forecast the months of 2021 at the end.

   You can find the dataset titled *"BondReturns.csv"* under the Course Resources on Blackboard. Please use the dataset and your own script to answer the following question:

   (a) (5 points) Plot the TS variable and comment on its features.

   (b) (10 points) Estimate a quadratic trend for this TS variable. Write down the equation and test the regression residuals "**Res1**" for stationary and autocorrelation.

   (c) (10 points) Using the ACF and PACF for the stationary version of *Res1* to propose an initial ARIMA model for *Res1*.

   (d) (10 points) Provide several ARIMA models and discuss which ARIMA model you would pick as the final model. Explain your reasoning.

   (e) (10 points) Using your final ARIMA model and the trend model in part (b), forecast the months of 2021.

   (f) (5 points) Discuss if these forecasts are reasonable. Explain your reasoning.

2. (50 points) In this problem, we are interested in examining the factors affecting the petrol prices. Petrol prices in New Zealand is split into three components: importer cost, importer's margin, and the taxes. We collect the weekly data on the following variables from $2004W16$ (week 16) to $2020W23$ (week 23):

- *Dubai* denotes the Dubai crude oil prices,

- *Price* denotes the discounted retail petrol price,

- *Margin* denotes the importer's margin,

- *Cost* denotes the importer's cost.

We will be focusing on the variable *Margin* and *Cost* throughout this analysis. We will also restrict our attention to the period from $2004W16$ to $2019W52$ for estimation. We will be forecasting the first 23 weeks of 2020 at the end.

You can find the dataset titled *"PetrolPrices.csv"* under the Course Resources in the Blackboard. Use the 5% significance level. Please follow the procedure below for the analysis:

(a) (5 points) Plot the margin and cost variables and comment on their features. Determine the order of integration for the two variables. Define the hypotheses and report the relevant test statistic and P-value. Interpret your findings.

(b) (10 points) Estimate the model where *Margin* is regressed on a linear trend and *Cost*. Write down the equation and comment on the coefficient of *Cost*. Test the regression residuals "**Res2**" for stationarity, autocorrelation, and heteroskedasticity.

(c) (10 points) Analyse the variable *Res2* and propose a final ARIMA model for this variable.

(d) (10 points) Estimate an ARCH(1) model for *Res2*, where the mean equation is the ARIMA model you proposed in the previous part. Carry out the necessary tests and explain your findings.

(e) (10 points) Propose a final volatility model for *Res2*. Carry out the necessary tests and explain your findings.

(f) (5 points) Using the final model you proposed in part (e), forecast *Margin* using the correct standard error for the first 23 weeks of the year 2020.