ASSIGNMENT 4

Question 1 (20 points): In this question, you simulate the folowing autoagressive (AR), moving average (MA) and ARMA processes to understand there behavior:

- AR(3): $Y_t = 0.2 + 0.4Y_{t-1} + 0.2Y_{t-2} + \alpha_3 Y_{t-3} + \varepsilon_t$
- MA(2): $Y_t = 0.4_1 \varepsilon_{t-1} + 0.5 \varepsilon_{t-2} + \varepsilon_t$
- ARMA(2,1): $Y_t = \alpha_0 + 0.5Y_{t-1} + 0.3_2 Y_{t-2} + 0.8\varepsilon_{t-1} + \varepsilon_t$

You need to complete these tasks:

i. Simulate the series and draw the time plot.
ii. Plot the ACF and PACF of each simulated series..
iii. Briefly comment on whether the plots follow the theoretical behavior expected from each model.

<u>Guidance:</u>

- Use 200 observations for each simulation. The disturbance follows $\varepsilon_t \sim N(0,1)$ as a white noise.
- For the AR(3) process, you need to generate the intial values and use the for loop to generate the full series:
    ```
    forvalues i = 4(1)200{
          quiet replace y1 =  0.4*y[_n-1] + ... + rnormal(0,1) if t==`i'
                          }
    ```
    Note: `y[_n-1]` refers to the one-period lag of the current observation t within the loop. Choose a value of α_3 that ensures the series is stationary.
- For the MA(2), generate the entire disturbance series e_t of 200 values first and ompute each value of Y_t as the sum of the relevant error terms$t$ using
    ```
    quiet replace y2 = … in 3/200.
    ```
- For ARMA(2,1), install and use the function `sim_arma` to generate the full series. A sample code is:
    ```
    sim_arma y3, nobs(200) ar(α₁ α₂) ma(β₁)
    ```

Due to randomness in simulation, the generated data will differ each time you run the process.

Questions 2 (30 points): Use the daily data on Bitcoin price on the sheet '`Bitcoin`' and perform a forecasting analysis. Complete the following tasks:

i.   Import the data, and keep only the period from the beginning of 2023 to the end of the sample.
ii.   Determine the appropriate differencing to achieve stationarity.
iii. Use the ACF and PACF plots to identify 2-3 candidate models. Estimate these models and select the best specification.
iv.   Provide point forecasts for the next 60 days. Discuss briefly your findings regarding the predictability of Bitcoin prices.

Question 2 (20 points): The sheet 'VN RGDP' provides an estimate of Vietnam Real GDP over the past 54 years. It is a small sample size that is just sufficient for analysis and forecasting. Perform the following tasks:

i.   Import the data.
ii.   Suggest appropriate transformation to achieve stationary. *Hint*: there are various transformations aside from the first difference.
iii. Identify the appropriate model and generate point forecasts for the next 10 years. You need to make sure that the point forecast resemble the historical pattern.

Questions 3 (30 points): Use the data on the sheet 'NewCar', which captures retail sales for new car dealers (unit: million USD), and perform forecasting. Complete the following tasks:

i.   Import the data and use period of 2010-2019 for analysis. *Hint*: use the option if tin(,) when performing your next steps.
ii.   Determine the appropriate differencing to achieve stationary. Use the ACF and PACF plots to pick at least three candidate models.
iii. Estimate your candidate models and select your best specification.
iv.   Provide points forecasting for the next 3 years (2020 – 2022). Compare with the real data and your forecasts, and make short comments (2-3 sentences) on the performance of your forecasts.
v.   (**) (20 points bonus). Compare forecasting accuracy between the three candidate models your select with the real data and make a short comment.