AGEC622 - Agribusiness Analysis and Forecasting
Assignment #2

- Write down all the names that you worked with on this assignment.
- Complete the exercises in the provided notebook "02_assignment.xlsx".
- If there is more than one question, note that each will have its own tab in the workbook.
- Work vertically down the sheet within your notebook. Separate the individual parts of the question(s) (a, b, c, ...) using dividing rows like the blue example dividers in the file.
- Submit your completed .xlsx file via Canvas.

Question 1. In this question, you will reproduce a Dickey-Fuller test statistic of -2.9 using simulations. You will create a random walk time series and look at the performance of the Dickey-Fuller test when applied to that synthetic data. You will generate a non-stationary time series (e.g., a random walk) and then manually apply the Dickey-Fuller regression to estimate the test statistic.

(a) Create a random walk data series. Create 100 observations, where each observation is

$$Y_t = Y_{t-1} + \epsilon_t$$

where ϵ_t is stochastic, and is normally distributed with a mean of zero and a standard deviation of one (i.e. =NORM()). Assume the starting value of $Y_0 = 100$. Also note that this synthetic time series is known with certainty to be non-stationary.

(b) Manually generate the first difference of Y_t, call it D_1.

(c) Use Simetar's "Simple Regression" and run

$$D_{1,t} = \alpha + \beta Y_{t-1} + u_t$$

(d) Simulate T-Test using 1000 trials (before simulating, press F9 a few times to make sure your regression output values dynamically updating).

(e) Use =PERCENTILE(simulated values, 0.05) to generate the 5th percentile of the simulated T-Test values. Is this what you expected? Why?

(f) Generate a PDF from the simulated values and change the "Confidence Level" from 95% to 90% level. Observe the "Lower Quantile" value. Is this what you expected? Why?

(g) Calculate the probability of a T-Test value being less than -2.9. Is this what you expected? Why?

Question 2. The overall objective of this question is to use an AR model to characterize the probability of corn price falling below or above per bushel at various times following the last available historical observation.

(a) **Determine differences**. Use the DF test to determine a number of differences that will render the data stationary.

(b) **Generate Dickey-Fuller t-statistics manually.** Check if the original series is stationary. Run the OLS equation that was estimated to calculate the DF (Dickey-Fuller) test statistic, and demonstrate that your estimated t-statistics value is the same as the DF value for 0 differences generated from part a).

(c) **Determine the optimal number of lags**. Use SAC, PAC and SIC approaches to determine the optimal number of lags and compare the results.

(d) **Estimate the AR model**. Use Simetar's "Time Series" wizard. Use the appropriate values using SAC from the previous step to specify the model. Ask Simetar for 5 "forecast periods".

(e) **Simulate the price**. Use the AR model, including a stochastic error/innovation term (use NORM() for this, with mean of zero and using the standard deviation of the residuals from the AR model), to simulate the price for 5 periods ahead. Check that the mean stochastic values for each period are close to the deterministic forecasts that Simetar generated.

(f) **Answer the main questions**:

- What is the probability that March-25 price will be less than $4.45 per bushel?
- What is the probability that April-25 price will be more than $4.3 per bushel?
- What is the probability that May-25 price will be between $4.5 and $5.5 per bushel?
- What is the probability that July-25 price will be less than $4.0 and greater than $5.0 per bushel?
- Create a "Fan Graph" for the 5 simulated series. Format the vertical axis with the minimum value of 3.0 and the maximum of 6.5.
- Create a PDF of the 5 simulated series (all in one graph). Format the horizontal axis by giving the minimum value of 2.0 and the maximum of 8.0.

By looking at both graphs, is this what you expected? Explain.