AGEC 622
07_univariate_distributions Exercises
Due before the beginning of the next class

- Complete the exercises in the provided notebook "07_exercises_LASTNAME_FIRSTNAME.xlsx".
- **Rename your file, replacing "LASTNAME_FIRSTNAME" with your actual names.**
- 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 this homework by emailing your xlsx file to henry@tamu.edu, **with the subject "AGEC 622 exercises 07"**.

1) **Question 1**

The overall objective of this question is to characterize the probabilities of various financial outcomes for a crop production enterprise over a five-year planning horizon.

a) **Build a model for the crop price**. You will generate stochastic forecasts for the crop price using an AR time series model. Determine an appropriate number of differences for the price data. Determine the optimal (in some sense) number of lags for the AR model. Set up *stochastic* forecasts for the crop price for the five years following the historical period. Determine a probability distribution that you believe is appropriate for drawing stochastic errors/innovations. Things you might consider: hypothesis testing for normality (will the tests have adequate power?) and plotting a PDF for the recovered residuals/errors/innovations.

b) **Build a model for the crop yield**. Use a simple linear trend to model the crop yield. Again set up *stochastic* forecasts for 2019 through 2023. Sample stochastic errors for the forecasts from a probability distribution that you deem appropriate.

c) **Build a model the gasoline price**. Build an AR model *for the natural logarithm of* the gasoline price. Assume that $\ln(P_{gas})$ is non-stationary. After estimating the AR model, plot a PDF of the residuals. Assume that these are non-normal. Use an empirical distribution for drawing random innovations for use in calculating stochastic forecasts for $\ln(P_{gas})$ for 2019 through 2023.

d) **Build a model for variable cost (VC)**. Assume that VC is a function of the gasoline price (*not* the natural logarithm of P_{gas}). Set up a simple linear regression model, and generate stochastic forecasts for VC (using stochastic forecasts for P_{gas} derived from your model in part c) using any distribution you deem appropriate for the stochastic errors.

e) **Calculate financial variables for the enterprise**. Assume that net returns (NR) are

$$NR \equiv Acres \times P_{crop} \times Yield - Acres \times VC - FC$$

Assume the following:

- The farm plants 1,000 acres in all years.
- Beginning cash for 2019 is $100,000.
- Total fixed costs (FC) are $150,000 for 2019, and this increases by 5% per year.

Calculate NR and ending cash (beginning cash + NR) for each year for 2019 through 2023.

f) **Simulate NR and ending cash**.

Determine the following values:

- Expected ending (2023) cash
- The probability ending (2023) cash is less than $0
- The probability ending (2023) cash is less than $100,000