

# Problem Set 5

AGEC 317

**This problem set refers to “PS5.xlsx”. Questions 1 - 8 refer to soybean production, and 9 - 10 refer to corn production.**

Please complete the work for this Problem Set in a **Microsoft Word document**, and submit your work with answers to eCampus by **March 20th at 11:59PM**.

You have data on total soybean and corn production for some U.S. states in 2019, and information on capital and labor inputs, as well as water usage and regulatory information. The United States Department of Agriculture (USDA) Risk Management Agency (RMA) is interested in the following analysis.

1. For 2019, is there a significant difference between the area planted and area harvested for soybeans? What does this suggest about crop failure? (*Hint: you will need to run an F-test and then t-test on the area planted and area harvested, much like in Problem Set 1*) **Provide the results from any statistical test in your answer.**
2. The RMA wants to estimate capital and labor elasticity with respect to soybean production. The agency assumes a Cobb-Douglas form of production:

$$Y_i = AK_i^\alpha L_i^\beta$$

where  $Y_i$  is total yield in bushels/acre,  $K_i$  is total capital inputs (\$ per acre), and  $L_i$  is total labor inputs (average hours worked per week). **Provide the results from a regression** where you recover  $\hat{\alpha}$  and  $\hat{\beta}$ .

3. Describe what  $\hat{\alpha}$  and  $\hat{\beta}$  represent. (Interpret the results)
4. Does soybean production in U.S. in 2019 exhibit decreasing, constant, or increasing returns to scale? What does this mean?
5. Last year, assume that a new federal restriction limited the amount of NPK fertilizer in soybean production for *some states*. The variable  $NPKRestriction_i$  equals 1 if the state is regulated, and 0 otherwise. The amount of water used (on average, in thousands of acre feet) is represented by  $Water_i$ . Estimate the following model:

$$Y_i = \beta_0 + \beta_1 NPKRestriction_i + \beta_2 Water_i + \varepsilon_i$$

Provide the regression results.

6. Did the restriction on fertilizer use lead to higher or lower yields (or did it have no effect)? Provide evidence for your answer.
7. Does the amount of water used on the field affect soybean yield?
8. Come up with a new model that shows whether the partial effect of water use on soybean yield is different for regulated vs non-regulated states. (*Hint: you will need to use an interaction term*) Please provide:
  - The formal model
  - Model results
  - Your answer on whether the partial effect of water on yield is different for regulated vs. non-regulated states.

9. Look at Corn production. Estimate the following model, where corn yield is a quadratic function of water inputs:

$$Y_i = \beta_0 + \beta_1 Water_i + \beta_2 Water_i^2 + \varepsilon_i$$

Given your model results, what is the optimal amount of water (in thousands of acre-feet) to use on a corn field?

10. (**Extra Credit**): The model you just estimated is biased. The yield of corn may be a function of many things, but you did not control for these things in your model. Explain what could be an important factor that drives corn yield, but is also correlated to the amount of water you put on the field.