Problem Set 6

AGEC 317

This problem set refers to "PS6.xlsx".

Please complete the work for this Problem Set in a **Microsoft Word or Excel document**, and submit your work with answers to eCampus by **April 7th at 11:59PM.**

You have production data from an electricity supplier in Texas. The supplier has many power plants that can produce electricity using either natural gas or coal. The data you have contain information on total electricity production, natural gas usage, and coal usage for many power plants. The supplier also has two production regions that are overseen by two district managers. Patrick Stewart oversees the DFW region, and Jonathan Frakes oversees the Houston region. The variables you have are:

- *Production*: total electricity production for a single plant, in kWh

- *NatGas*: total natural gas usage, in MMBtu

- *Coal*: total coal usage, in tons

- *Frakes*: indicator =1 for power plants in Frake's managerial region, =0 for power plants in Stewart's managerial region.

In addition, you have the following information:

- Price of natural gas: $1.62 per MMBtu

- Price of coal: $34.51 per ton

- Residential price of electricity: $9 per kWh

- Each power plant has a fixed-cost of $200 per day to remain in operation.

The supplier has assumed a production function of the form:

$$Production_i = \beta_0 + \beta_1 NatGas_i + \beta_2 NatGas_i^2 + \beta_3 Coal_i + \beta_4 Coal_i^2 + \beta_5(NatGas_i \times Coal_i) + \beta_6 Frakes_i + \varepsilon_i$$

Given that production function, the profit function for a given power plant is:

$$\pi_i = P(Production_i) - \gamma_{NatGas}(NatGas_i) - \gamma_{Coal}(Coal_i) - \phi$$

where P is the retail price of electricity, γ_{NatGas} is the price of natural gas, γ_{Coal} is the price of coal, and ϕ is the power plant's fixed cost.

1. Does the Houston region - overseen by Frakes - produce more, less, or the same amount of electricity than Stewart's region? Given your answer, what would you do if you were CEO of the supplier?

2. Solve for the level of natural gas and coal inputs that **maximize profits** for a power plant in Frake's region. Provide you answer for both inputs, and provide the optimal level of profit.

3. Suppose that the closure of foreign markets resulting from the COVID-19 pandemic, the following prices change:

   - Natural gas falls to $0.99 per MMBtu
   - Coal falls to $20.45 per ton

   In addition to these market forces, suppose the State of Texas decides to protect financially vulnerable citizens by capping the retail electricity price at $5 per kWh. With these changes, re-solve for the optimal level of input usage. How has usage changed? How have profits changed?