STA723 - Individual Case Study

March 25, 2021

A chemical engineering experiment was run to study heat transfer in a shallow fluidized bed. Data are collected on the following four candidate regressors - X_1: fluidizing gas flow rate in pounds per hour, X_2: supernatant gas flow rate in pounds per hour, X_3: supernatant gas inlet nozzle opening in millimeters, X_4: supernatant gas inlet temperature (°F).

The measured responses are Y_1: heat transfer coeffcient, Y_2: thermal efficiency. Twenty observations were gathered. The data can be found on Sakai.

1. Build a regression model for predicting heat transfer coefficient Y_1 using the regressors $X_{1:4}$. Motivate all modeling decisions.

2. Suppose that for a new run of the experiment, we observe $x_1 = 116.9$ and $x_2 = 172.1$ only. Estimate the associated heat transfer coefficient. Estimate the probability that this coefficient exceeds 100.

3. Now, suppose that we only observe the indicator variable $Z = 1\{Y_1 > 100\}$. Build a model using $X_{1:4}$ for explaining the probability that the heat transfer coefficient exceeds 100.

4. Does your regression model for Y_1 do a good job of predicting Y_2?

Please be rigorous in providing a full justification for each of your answers, including all relevant statistical details, calculations and results. Report the results in a manner interpretable by a chemical engineer interested in the study conclusions.