

DOE Laboratory (200 points)

Objective:

The objective of this laboratory is to demonstrate your ability to conduct a DOE and then analyze and use the results.

Over break, an anonymous benefactor constructed 16 catapults. These catapults have several factors that can be varied:

1. Projectile type
2. # of rubber bands
3. Pull back angle
4. Release angle
5. Cup position

You will be assigned to a group and given a catapult to use. In order to complete all requirements for this laboratory within the allotted time, we have made some decisions. First, the release angle will be set to a constant 45 degrees.

Screening DOE

A Minitab worksheet has been created for the purposes of this laboratory. A screening DOE will be performed to determine which of the factors below are significant.

1. Ball type, wiffleball or practice golf ball
2. # of rubber bands, 1 or 3
3. Pull back angle: 50 or 90 degrees measured from the "back" (Your instructor will demonstrate.)
4. Cup position: 1 or 6 (Your instructor will demonstrate the positions.)

The spreadsheet has been set up for you to take 2 replicates in random order. Be careful to minimize variation in your set up. Try to use the same pull back angle each time. Use the supplied aluminum foil to pinpoint the location of your projectile. Make sure that the base of your catapult does not move between runs. Make sure that your tape measure is straight.

After you have taken the required data, analyze your results to determine which factors are significant.

Predictive Model (Equation)

Discuss your results with your instructor before constructing your predictive model. (equation) After discussion with your instructor, construct the best model possible for your data. Once you have constructed that model, you must use it to perform two tasks:

1. Determine the best settings to throw your selected projectile 80 inches.
2. Determine the distance that your selected projectile will be thrown if you use 2 rubber bands, the cup position of 4, and an angle of 70 degrees.

When you have answered those questions, call your instructor over to watch as you do your verification runs.

Required Submission:

1. Data table with your raw data for each treatment combination.
2. Pareto chart from your screening run.
3. Main effects plot from your screening run.
4. Predictive equation obtained from best analysis of your data.
5. Settings that you used to throw your projectile 80 inches. Actual distance obtained for 3 throws.
6. Distance predicted for given settings. Actual distance obtained for 3 throws.
7. Discussion of your results including
 - a. What factors, if any, were significant?
 - b. What interactions, if any, were significant?
 - c. What is the approximate uncertainty or your predictive model (equation), that is the prediction intervals?