Beckham Carver

4/20/22

STAT 4025

Dr. Robinson

**Homework 10**

1. [From HW9] Using the contrast approach, find the 95% confidence interval on the difference in mean pull strength for Anchor Type B with high foam density and Anchor Type B low foam density – do this in R (1 pt) AND by hand (2 pts). Show which betas refer to each mean (2 pts) [5 pts]

Linear model:

m1 <- lm(pull\_force~Foam\_Dense +

Anchor\_Type + Foam\_Dense:Anchor\_Type, data = anchor)

Beta Representation:

Y= B0 + B1Foam\_Denselow + B2Anchor\_TypeB + B3Anchor\_Type + B4Foam\_Denselow:Anchor\_TypeB + B5Foam\_Denselow:Anchor\_TypeC

So, for anchor\_b high vs anchor\_b low, we have the following betas:

= (B0 + B2) – (B1 + B2 + B4)

= 1B0 – 1B1 – 1B4

= [ 1 , -1 , 0 , 0 , -1 , 0 ]

Our confidence interval produced is:

Lower <> Est.<> Upper

190.7741 <> 217 <> 243.2259

1. An engineer is interested in the effects of cutting speed (A), tool geometry (B), and cutting angle (C) on shot pattern diameter (mm) for rifle barrels. Two levels of each factor are chosen, and three replicates of a 23 factorial design are run. The results located in the file ‘barrel\_accuracy.csv’. [19 pts]
   1. Write out the effect for factor B using the ‘lower-case’ notation and interpret the slope coefficient for factor B. [2 pts]

The slope coefficient is 5.6667 meaning its effect increases pattern diameter, the effect for is b = (-(1) – a + b + ab - c – ac + bc + abc)/4n

* 1. Write out the expression for the full regression model. [2 pts]

Y = B0 + B1A + B2B + B3C + B4A:B + B5A:C + B6B:C

Y = 40.8333 + 0.1667A + 5.6667B + 3.4167C -0.8333A:B -4.4167A:C -1.4167B:C

* 1. By hand, compute the sum of squares associated with the main effect for factor B. [2 pts]

= -26 - 42.3333 + 39.66666 + 54.6666666 -34.66666 -37.66666 + 49.3333 + 42.33333

= 45.33334

= 45.33334^2 / (2^3 \* 3)

= 85.62965

Determine the best model for predicting barrel accuracy by keeping only those terms whose terms which are statistically significant at the 0.05 level AND any main effects that are involved in a statistically significant interaction. [2pts]

m2best <- lm(pattern\_diameter~ (A + B + C)^2 - A - A:B - B:C,data=barrel)

* 1. Using interaction and main effect plots, what coded factor levels of A, B and C would you recommend using for minimum pattern diameter? Explain. [3pts]

Just looking at the plots, I would recommend using all of the methods at their LOWEST level. All means are tightest and lowest when the lowest level is chosen for each method. The interaction that improves tightness does not outweigh the cost of implementing any method at the higher value.

* 1. Produce an appropriate contour plot for conveying which combination of A, B and C produce optimal pattern diameter (i.e. diameter minimized). Interpret the plot. [2 pts]

Diagram

Description automatically generated

* 1. Find a 95% confidence interval on the pattern diameter at the optimal setting of A, B and C. [3 pts]

Lower <> Est.<> Upper

19.1988 <> 25.99 <> 32.80112

* 1. Analyze the residuals. Are there any obvious patterns? Check for Normality as well as equal variance across each level of your main effects. [3 pts]

Out of time, I would use a Shapiro wilks test and plot my residuals. The data should be pretty normal.