Homework 10

Due 4/28/25 by end of the day

Directions: Reaching Chapter 13 will help with this assignment. Hint: it can be helpful (though not necessary) to redo the problems we did in class and then do the homework problems to make sure all of your equations are set up correctly.

1) A process engineer is trying to improve the life of a cutting tool. She has run a 2^3 experiment using cutting speed (A), metal hardness (B) and cutting angle (C) as the factors. The data from two replicates are shown in the table below:

	Replicate	
Run	I	II
(1)	221	311
a	325	435
b	354	348
ab	552	472
c	440	453
ac	406	377
bc	605	500
abc	392	419

Answer the following:

a. Do any of the three factors affect tool life? For this part, use Excel to do the calculations for main effects, coefficients and significance, and also check the answers for ANOVA in Minitab using alpha=0.05. Write out the relevant equations.
b. What combination of factor levels produces the longest tool life? Write out a model from the results you obtained in part a (hint: even if a main effect isn't found to be significant, you should still include it in the prediction model if an interaction with that effect is).
c. Is there a combination of cutting speed and cutting angle that always gives good results regardless of metal hardness? For this part, use Minitab to generate contour plots, as well as the interaction and main effects plots. Generate the AB interaction and A main effect plot in Excel and check against the Minitab plots.

2) Find the residuals from the tool life experiment in problem 1:
   a. Calculate the residuals for each data point in Excel.
   b. Plot the residual versus predicted in Excel.

c. Use Minitab to generate the normal probability plot, and residuals vs. predicted, as well as residuals versus factor levels.

3) Do problem 13.8 (13.14 in 7th edition) in Minitab
4) Consider the data in Problem 3 but suppose that four center points were added to this experiment. The molecular weights at the center points are 90, 87, 86, and 93.
    a. Conduct the curvature test by hand and compare with Minitab (hint: you need to uncheck the box to add center point to the model, and only include main effects and two-way interactions for Minitab)
    b. If curvature is significant in a problem like this, describe what strategy you would pursue to next to improve your model of the process.
5) Explain why a fractional factorial may be useful in some situations, and generally how to analyze them (*if this was covered in class – if we didn't get to fractional factorials skip this part)*