SIE 330R Homework, Spring 2023

HW 10 (Chapter 11)

Homework must be readable! Do not just send in numbers or charts. You must explain the homework answers Preferred to receive homework in Word doc format with any excel or Minitab results pasted into word document. You may choose to use pdf which is also OK.

Problems 11.4, 11.6, 11.7

11.4S. The region of experimentation for two factors are temperature $(100 \leq T \leq 300°\mathrm{F})$ and catalyst feed rate $(10 \leq C \leq 30\mathrm{lb/h})$. A first order model in the usual ± 1 coded variables has been fit to a molecular weight response, yielding the following model. *Note:* x1 is Temperature, and x2 is catalyst feed rate.

$$\hat{y} = 2000 + 125x_1 + 40x_2$$

(a)   Find the path of steepest ascent.

(b)   It is desired to move to a region where molecular weights are above 2500. Based on the information you have from the experimentation in this region, about how many steps along the path of steepest ascent might be required to move to the region of interest?

11.6. The data shown in Table P11.2 were collected in an experiment to optimize crystal growth as a function of three variables x_1, x_2, and x_3. Large values of y (yield in grams) are desirable. Fit a second order model and analyze the fitted surface. Under what set of conditions is maximum growth achieved?

(Note: since RSM files can be tricky to create, the minitab file for this question is loaded into the class D2L page under Content/Minitab Files from class/ at hw_11_6.mtw.)

Table P11.2

x_1	x_2	x_3	y
-1	-1	-1	66
-1	-1	1	70
-1	1	-1	78
-1	1	1	60
1	-1	-1	80
1	-1	1	70
1	1	-1	100
1	1	1	75
-1.682	0	0	100
1.682	0	0	80
0	-1.682	0	68
0	1.682	0	63
0	0	-1.682	65
0	0	1.682	82
0	0	0	113
0	0	0	100
0	0	0	118
0	0	0	88
0	0	0	100
0	0	0	85

11.7. The data in Table P11.3 were collected by a chemical engineer. The response y is filtration time, x_1 is temperature, and x_2 is pressure. Fit a second-order model.

(Note: since RSM files can be tricky to create, the minitab file for this question is loaded into the class D2L page under Content/Minitab Files from class/ at hw_11_7.mtw.)

Table P11.3

x_1	x_2	y
-1	-1	54
-1	1	45
1	-1	32
1	1	47
-1.414	0	50
1.414	0	53
0	-1.414	47
0	1.414	51
0	0	41
0	0	39
0	0	44
0	0	42
0	0	40

(a) What operating conditions would you recommend if the objective is to minimize the filtration time?

(b) What operating conditions would you recommend if the objective is to operate the process at a mean filtration time very close to 46?