

## 2024 Spring – SPC&O HW#13

1. For the following yield problem as in Problem 3 of HW#11:

Test(order)	Temp.	Pressure	Time	Trial			Average
				1	2	3	
1 (4)	80	50	5	61.43	58.58	57.07	59.03
2(2)	120	50	5	75.62	77.57	75.75	76.31
3(7)	80	70	5	27.51	34.03	25.07	28.87
4(6)	120	70	5	51.37	48.49	54.37	51.41
5(1)	80	50	15	24.80	20.69	15.41	20.30
6((5)	120	50	15	43.58	44.31	36.99	41.63
7(8)	80	70	15	45.20	49.53	50.29	48.34
8(3)	120	70	15	70.51	74.00	74.68	73.07

- (a) For the predictive model built in Problem 1(c) of HW#12, perform the residual analysis, including the Q-Q plot, and residual plots vs. run order,  $\hat{y}$ ,  $\bar{y}$ ,  $x_i$ .
- (b) Perform Bartlett's test with  $\alpha=0.1$  for the variance of the replicates.
- (c) Construct the ANOVA table for variation sources from "Between Tests" and "Within Tests" (You are not allowed to use Excel for this problem)
- (d) Construct, without excel, the ANOVA table for variation sources from all factor effects (including all interactions effects) and errors. (You are not allowed to use Excel for this problem)
- (e) Build a model using the significant effects found in (d). (You are not allowed to use Excel for this problem)
- (f) Construct the ANOVA table for the model built in (e). (You are not allowed to use Excel for this problem)
- (g) Calculate the  $R^2$  and adjusted  $R^2$  for the model in (e) and the model in (f). (You are not allowed to use Excel for this problem)
- (h) Use Excel to validate your calculation in (c)~(g).

2. Use the observations of **test wafer 1** in SPCO3.1 to construct ANOVA tables for the main effects on the SN ratio of the thickness and ANOVA table for the average of the thickness.