

## 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**.