2019 Spring –SPC&O HW#12

1. For the yield problem in Problem 4 of hw#10,

(a) Construct the ANOVA table for variation sources from "Between Tests" and "Within Tests" (You are not allowed to use Excel for this problem.

(b) Construct, without excel, the ANOVA table for all factor effects (including all interactions effects) and errors. (You are not allowed to use Excel for this problem.)

(c) Build a model using the significant effects found in (b).

(d) Construct the ANOVA table for the model built in (c). (You are not allowed to use Excel for this problem)

(e) Calculate the R^2 and adjusted R^2 for the model in (d). (You are not allowed to use Excel for this problem)

(f) Use Excel to validate your calculation in (d)~(e).

2. The objective of the "Glove Box Door" experiment is to achieve parallelism equal to zero. Calculate **the-smaller-the-better** SN ratios for the experiments and perform the following analysis

(a) Calculate, without excel, the sum of squares total (SST). What is the degree of freedom for SST.

(b) Calculate, without excel, the sum of squares for the main effect of each factor. What are their DOF?

(c) If we assume all the third and higher-order interaction effects are insignificant and pool them together as the "errors", what are the sum of squared errors (SSE) and its corresponding DOF?

(d) Construct, without excel, an ANOVA table by assuming that all the third and higher-order interaction effects are insignificant and pooled together as errors and calculate each of the main and two-factor effects' p-value with the F test.

(e) Construct, without excel, a partial model with significant main or two-factor interaction effects based on the F-tests in (d) and perform ANOVA for the partial model.

(f) Calculate, without excel, the R^2 and adjusted R^2 for the model built in (e).

(g) Use excel to validate your calculation in (e)~(f).

3. Use the observations of **test wafer 1** and **test wafer 3** in Tables 4.4 (b) of Chapter 4 (lecture handout) to (pool together the high-order interaction effects for SSE and MSE). Construct ANOVA tables for the main effects on the SN ratio and the average of the thickness. (It should be noted that the sum of squares formulas

listed on slide 15 of SPCO7.pdf are only for "full-factorial" complete design of experiments, where all possible combination of factor levels are all tested. In this problem, there are 6 factors, each with 3 levels. A full factorial design of experiments would require 3^6=729 tests. However, with OA design, L18, there were only 18 experimental tests. Therefore, you should not use the formulas on slides 15. Instead, you should refer to slide 4 of SPCO7, where the sum of squares is actually multiplied by the "sample size" of the average.)

4. Suppose the earning margin of a hotel is possibly affected by its located area's nearby total number hotel rooms, the nearest distance to other hotels, the nearby total office space, the nearby number of colleges, the nearby average household income, and the distance to downtown. 19pring-HW12.xls collects data from 100 hotels (inns).

a) Are there any multicollinearity effects among the possible factors?
b) Are there any nonlinear and/or interaction effects of the possible factors on the margin?
c) Perform regression analysis (including effect significance tests and ANOVA) to build a best model to predict the hotel margin.