Response Surface Methodology, Stat 579 Homework 10 Name: _____
Fall 2014 Prof. Erik B. Erhardt

Part I. (50 points) I recommend reading through all the parts of the HW (with my adjustments) before starting; this may save you some work.
MMA-RSM Chapter 10: 10.2, 10.4, 10.7, 10.12.

- For 10.4, (a) use the "pick the winner" strategy in the Taguchi analysis, (b) do a second analysis using $\bar{y}$ and $\ln(s^2)$. Comment on any differences between the two analyses in the conclusions you make.

General: Try to do all calculations in R. All R code for the assignment should be included with the part of the problem it addresses (for code and output use a fixed-width font, such as Courier). Code is used to calculate result; text is used to report and interpret results – do not report or interpret results in the code.

(10 pts) **1. 10.2** Consider Example 4.2 (p. 143) in Chapter 4. Suppose, in this process for manufacture of integrated circuits, that the temperature is very difficult to control: There is some concern over variability in wafer resistivity due to uncontrolled variability in temperature. Consider the other factors as control variables.

(a) (5 pts) From the analysis given in Chapter 4, can any of the control variables be used to exert some influence over this variability? Explain.

(b) (5 pts) It is of interest to maximize wafer resistivity and still minimize variability produced by changes in temperature. Can this be done? Explain.

(15 pts) **2. 10.4** Consider Exercise 10.3. Because E (furnace position) and D (oxide thickness) are unimportant, reduce the design to a 2^3 factorial with duplicate runs. Using temperature as a single noise variable, determine the optimal values of implant dose and time. Use a Taguchi analysis with the appropriate SNR ratio for a larger-thebetter situation.
For 10.4, (a) use the "pick the winner" strategy in the Taguchi analysis, (b) do a second analysis using $\bar{y}$ and $\ln(s^2)$. Comment on any differences between the two analyses in the conclusions you make.

(a) (5 pts) Use the "pick the winner" strategy in the Taguchi analysis.

(b) (10 pts) Do a second analysis using $\bar{y}$ and $\ln(s^2)$.

(10 pts) **3. 10.7** Consider Example 10.2. The design is criticized for not allowing interaction among the control variables to be studied.

(a) (5 pts) What design would be a good candidate to replace the crossed array in this example? Do not allow your design to admit a run size any greater than the design listed in the example. Use a design that allows quadratic effects in the control factors and allows construction of a response model that can be used to generate the process mean and variance models.

(b) (5 pts) Explain why your design is better than that used in the example.

(15 pts) **4. 10.12** Suppose a study is conducted with three control variables and two noise variables. A 2^{5-1} fractional factorial is used as the experimental design. Only the main effects and the x_1z_1, x_2z_1, and x_2z_2 interactions are found to be important. The interaction plots are shown in Fig. E10.1. The main effect plots are shown in Fig. E10.2. The purpose of the experiment is to determine condition on the control variables that minimize mean response.

(a) (5 pts) Give approximate conditions on x_1, x_2, and x_3 that result in minimum mean response.

(b) (5 pts) Give approximate conditions on x_1, x_2, and x_3 that give approximate minimum process variance.

(c) (5 pts) Is there a tradeoff between optimum conditions? Explain.