UNM Statistics Qualifying Exam Take-Home
Fall 2008

Due 12:00pm Friday August 15, 2008. Return to Roxanne Littlefield in the Math/Stat Dept Office.

Directions: The answer to each problem should be presented as a summary. It should be word processed and double spaced. An appendix is allowed for each problem but will be examined only at the discretion of the graders. The better organized your appendix is, the more likely it is to get examined.

You may **not** consult any other person when working on this exam or discuss your exam with anyone else regardless of whether or not the person is taking the exam. You may use your course notes as well as any available books or web resources for the exam. Questions pertaining to clarification about these questions can be directed to Curt Storlie, `storlie@stat.unm.edu`.

1. The data for this problem comes from a designed experiment conducted by 3M to optimize their production of bump-ons (little rubber bumps used on cabinet doors, etc.). The response of interest is the hardness of the bump-on. The factors selected for consideration are line speed (SPEED), amount of catalyst (CATALYST), and temperature on the line where the reaction takes place (TEMP). There were a total of 26 runs made in the experiment. The data is available for download at

`http://www.stat.unm.edu/~storlie/MMM_data.txt`

Joanne Nibbe works for 3M and is interested in where to set the input varaibles to achieve the target hardness. The target hardness (as measured by the amount of depression under a set force) is 0.50mm, while the acceptable range for bump-on hardness is 0.35mm to 0.65mm. Hardness above this range results in poor performance for absorbing impact, while hardness below this range is also undesirable due to lack of durability. In addition, it is desirable to have the line speed be set as fast as possible while still maintaining the desired hardness.

Using the data, build an appropriate regression model, making sure that you carefully assess all assumptions. Use this model to give Ms. Nibbe advice/recommendation on the best possbile settings of the input varaibles to achieve her goals. Write a succinct, coherent, and complete summary of your analysis.

2. An agricultural scientist is interested in the rye yield when three different level of fertilizers are available and two different type of seeds are available. Except for the presence of different fertilizers and different type of seeds, other conditions are the same. Data ryeyield.dat is available at

`http://math.unm.edu/~luyan`

(txt file of data is also available on my website).

(i) Build a model that best describes the relationship between the rye yield(bushels/acre) and the factors Fertilizer level and Seed type. Make sure that you carefully assess all assumptions and write a succinct, coherent, and complete summary of your analysis.

(ii) Suppose that one of the experimental units for each of two different treatment combinations died during the experiment period so that the response could not be measured for these two units. How would the degrees of freedom change in your analysis of variance table? Which type of sum of squares (I, II or III) would you use to perform your analysis in this case with missing data? Give a reason.

(iii) By using the appropriate multiple comparison method, specify which treatment combination (or combinations) resulted in the highest rye yield.