228.371 Statistical Methods for Engineers and Technologists

DOE project assignment

Weighting: 30%

Due: 5pm, Friday 22nd May, 2015 (see note 1)

AIM: To design a two-level multifactor experiment (≥ 3 factors), collect data, analyse the data, and derive appropriate, actionable conclusions from the analysis. You need to use either a 2^k full factorial design or a 2^{k-p} fractional factorial design.

If you are using a full factorial design, the experimental strategy must include blocking (i.e. the experiment should run in 2 or more blocks).

Also, one of your experimental goals must be to determine an optimum factor setting (within the scope of a two-level experiment) to obtain a certain desired response (i.e. max Y, min Y or a target Y, depending on your experiment).

Brief

Design, perform, analyse (via Minitab) and report on an experiment of your own devising, based on the material presented on designed experiments. Your experiment can be the everyday, home type experiment or a lab-based experiment (see note 2). Try to choose something you are interested in or have wondered about. Also try to ensure that your experiment has a purpose (as a common example, boiling water under different conditions is valid enough, but inherently pointless unless you can use the results for some purpose!)

Once you decide what experiment you will run, make a guess on what your major conclusions will be and write them down (i.e. specify your key hypotheses in the scope and objectives section of the research). Upon completion of your experiment and analysis, compare your guesses against the actual conclusions drawn from the experiment. If appropriate or possible, carry out some confirmation trials to test your model predictions.

Your report must follow the structure below:

Element/Title	Description/Content to be included	Marks
Introduction	State the problem and the associated process that you are going to investigate. The experimental factors and the response variable(s) (you are free to have more than one response variable if your objectives requires) should be discussed in this section.	10%
Objectives	The objectives, research hypotheses and expected results should be presented in this section.	10%
Materials and Method	Describe how the factorial experiment was conducted. The description should include, but not be limited to: how nonexperimental variables (background variables and nuisance variables) were dealt with; the method(s) of randomisation; number of replicates; measurement considerations (accuracy, precision etc.); the experimental factors and their operating levels (high and low levels); design issues including resolution and confounding.You also need to describe how you conducted the confirmation runs to verify your model's prediction at the optimum factor settings. Include one or two photographs depicting your experimental set up. Any practical problems encountered (e.g. measurement problems) and steps taken to tackle these should also be explicitly stated in this section.	25%
Results and Discussion	Full analysis of results (you need to use Minitab) providing the outputs and graphs are clearly understandable to the reviewer / marker. Use the analysis strategy discussed in study guide/lecture slides. The lab handouts would also be useful. You should also show/discuss: The practical or engineering significance of the significant main effects and interactions. The final statistical model that predicts Y, with appropriate consideration of its adequacy. Include a discussion about what the confirmation runs indicated about your model.	40%
Conclusion	Extent to which aims and objectives were satisfied, your final model, limitations of your study, and suggested improvements to your experimentation and/or analysis.	15%
Total Marks		100%

Notes

1. Submission:
   - This assignment must be uploaded via Stream. In addition to the project report (in MS Word or pdf), the accompanying Minitab project file should also be uploaded. Please do not email directly to teaching staff.

   - 'Turnitin' plagiarism detection software will be applied to each assignment on upload. This will compare assignments with published sources, and also with previous assignments.

2. Report presentation and length

   - The report should be no more than 20 pages (including any appendices).

   - Present and discuss your findings, putting each graph, table or analysis that is being referred to into the text at that point (rather than in appendices). This makes it easier for the marker to read. Look at some academic journal papers for guidance on this if necessary.

   - All tables and figures should be numbered. All analyses and outputs of Minitab must be relevant and justified. Thus no table or figure should be left unexplained.

   - If your experiment is a laboratory experiment, sufficient evidence must be provided to convince us that your work is original.

3. Some ideas of suitable experiments (taken from past projects):

   - Stationary bike / treadmill (slope, speed, seat height etc. = heart rate, distance).
   - Baking bread / muffins / biscuits etc. (ingredients, oven temp, oven time etc. = total rise, sensory quality of product)
   - Photography (speed of film, light, shutter speed etc. = picture quality)
   - Sustain of a guitar string (gauge, length, age etc. = length of sustain)
   - Darts (left hand / right hand, distance, lighting etc. = consistency of hitting bullseye)

4. You are welcome to discuss your experimental ideas with your lecturer (for Albany students in particular, email could be a convenient option).

5. Banned topics include...

- Experiments based on computer / PS / Xbox (etc.) games. While entertaining to play they are somewhat tedious to read about, and only pseudo-random in the nature of their error variation, which leads to validity issues.

- Experiments that involve consumption of alcohol (or any other drug) as a factor. Such a factor is not controllable in its 'levels' (e.g. drunk/sober); nonlinear in its effects; and there are complicated ethical problems and risk management considerations!

- Experiments that constitute a danger to yourself, classmates or the public, such as exceeding speed limits or taking undue risks while driving vehicles, making and/or discharging weapons in public places (although controlled target shooting etc. is OK), cycling while juggling and blindfolded etc.

6. Useful URLs for experimental ideas:

http://curiouscat.com/bill/101doe.cfm (Author: late William Hunter)

http://www.amstat.org/publications/jse/v2n1/mackisack.html (Author: Margaret Mackisack)