STA2007H – EXPERIMENTAL DESIGN PROJECT

In groups of 2 to 4 students you should conduct an experiment from beginning to end (individual projects are not accepted). Think of a good experiment, something you would like to investigate, design the experiment, carry it out, analyse the data and write a short report. You have to decide on what you wish to do. Some examples of simple experiments are given below and also a checklist of considerations for completing the task.

Please hand in only one report for each group. **Hand-in Date: see Vula.** For late handins, the total mark available will decrease by 20% per day or part thereof. Give an estimate of the contribution of each student in the group to the project, as a percentage. All students must sign the project and plagiarism form.

Please hand in a hard copy at the reception of the Department of Statistical Sciences, and an electronic version (in .pdf format) via Vula (assignments tab).

A few points that you should consider:

- It must be a proper experiment, not an observational study.
- It should be feasible with respect to costs and time.
- Carefully choose the response variable, so that it is not unlikely that it will be normal, or easily transformed to a normal. For example, small counts and yes and no responses lead to Poisson and Binomial response, respectively – avoid those.
- Make sure that the experiment is ethical, and causes no harm to any creatures or the environment. NOTE: whenever animals or humans or rare plants are involved, you need ethical clearance from a university committee.
- All analyses and all graphs must be done using R.
- Do a small pilot study to check that your full experiment will work.

A checklist for PLANNING experiments (from Dean and Voss, *Design and Analysis of Experiments*):

1. Define the objectives (what do you want to find out)
2. Identify all sources of variation, including
   (a) treatment factors and their levels
   (b) experimental units
   (c) blocking factors
3. Choose a rule for assigning the experimental units to the treatments (the way the randomisation is carried out).
4. Specify the measurements to be made, the experimental procedure, and the anticipated difficulties.

5. Run a pilot experiment. This is a mini-experiment based on only a few observations to test the experimental procedures, the feasibility of the design. The pilot experiment can generate information needed for sample size calculations (power analysis).
6. Specify the model.
7. Outline the analysis.
8. Calculate the number of observations needed.
9. Review above decisions and revise where necessary.
10. Now run your experiment.

Some examples of simple experiments (don't use these, think of your own):

1. Does the boiling point of water differ with different concentrations of salt?
2. Compare the effect of different locations of an observer on the speed at which subjects locate occurrences of the letter 'e' in a written passage.
3. Compare the proportion of words remembered from lists of related or unrelated words, under various conditions such as silence and distraction.
4. Compare the height of bean plants given water with different concentrations of salt.
5. Whether the rate at which the outermost layer of an egg shell comes off easily after being placed in vinegar depends on the concentration of the vinegar.

Some Guidelines

Break-down of marks

Objectives and Originality	5
Experiment and Design	6
Randomization procedure	4
Pilot study	4
Data collection	5
Analysis and presentation of results	6
Model Checking / Residual Analysis	4
Conclusions and Interpretation	6
Overall impression and clarity	10
Total	50

Some more guidelines

1. Limit tables, computer output and graphs to what is truely informative.
2. The report must be typeset.
3. There is no need to put everything that you can find into an appendix. If you want to attach an appendix, limit this to what is really needed to understand your report.
4. Give the original data somewhere, either in the report or in the appendix.
5. Also give the original randomisation used.
6. Do **NOT** put computer output directly into the report, edit all tables, leaving in only the information necessary. Limit decimal places to three or less.
7. Graphs with poor resolution make a bad impression and will be penalized. (For MSWord, in R save graphs as .svg files).

8. Every graph should have a short caption which explains just enough to understand it without having to read in the main text. So should tables.

9. As a guideline, we would estimate that 10 pages should be (more than) enough space for the report, including appendices.

10. Use a spell check!