TMA4267 Spring 2025 Assignment 3: Design of experiments

About

The topic is design of experiments (DOE). The purpose is to provide insight and training in planning, performing and analysing a statistical experiment, as well as to report the results.

Requirements of the hand-in

- The project can be done alone or in groups of two or three.
- The report should be no longer than 8 pages.
- The R code you use (including your collected observations) should be added to the report (but not presented as part of the report)

In short: 5 main steps of the assignment

1. Use DOE to plan an experiment with at least 3 factors each at 2 levels. You need to do a minimum of 16 single experiments (2^3 in duplicate, 2^4 or fractions of 2^5 or higher). The response needs to be continuous so that the experiment can be analysed with linear regression.
2. Plan how the collection of data can be done, focus on genuine run replicates and randomization. Discuss if you need blocking.
3. Collect your data.
4. Analyse the data.
5. Report on findings.

The task

Carry out a k-factor two-level experiment where the goal is to determine how the various factors influence a response. You should yourself decide what kind of experiment to perform. This may be a laboratory experiment or be from a problem in your daily life. We highly recommend that you discuss your chosen experiment with the course teacher or assistant before conducting the experiment.

Alternatively, you may do a different statistical analysis, using multiple linear regression or another suitable method, using your own data. In this case you should present a brief sketch to the course teacher before the project starts.

Important You are strongly encouraged to collect *at least* 16 observations, for example, in a full design with 4 factors, or do two repetitions of 3 factors. The more observations, the better statistical power you will have to find evidence of effects. With only 8 observations we rarely get interesting findings.

Issues to be addressed

- Describe the problem you want to study and your main hypotheses.
- Why is this interesting?
- What prior knowledge do you have?

Selection of factors and levels

- Which factors do you think are relevant to the problem described above?
- Do you expect an interaction between some of the factors?
- Which levels should be used, and why do you think these are reasonable?
- How can you control that the factors really are at the desired level?

Selection of response variable

- Which response variable will provide information about the problem described above?
- Are there several response variables of interest?
- How should the response be measured?
- What can you say about the accuracy of these measurements?

Choice of design

- 2^k factorial?
- 2^{k-p} fractional factorial or other design?
- Desired resolution of the design?
- Is it necessary or desirable to use a blocked design?
- Is it necessary or desirable with replicates?

Implementation of the experiment

- Randomization
- Describe any problems with the implementation.
- Is each experiments a genuine run replicate (reflects the total variability of the experiment)? Each trial should be performed independently and constitute a full trial.

Analysis of data

- Calculation of effects and assessment of statistical significance.
- Check the assumptions. Use residual plots.

Conclusion and recommendations

- Which conclusions can you draw from the experiment?
- Interpretation of significant effects, main and interaction plots.
- Remember that plots are illustrative and useful for presenting results (non-results).