

List of Problems

Your task is to carry out one of the projects proposed below. Perform the experimental planning according to the design that is most appropriate for the problem. Run the experiment(s), analyze the data and present your conclusions in a report. When writing the report, consider the following requirements:

- 1) State the problem and write a brief description of the experimental and technical implementation.
- 2) If not given in the problem description, define the response variable(s) and factors and levels. Motivate the chosen experimental design and describe relations, table of contrasts, alias structure etc. Keep a log of the experimental runs (see for instance table 5.6 on p. 216 in [1]).
- 3) The analysis of data (estimation of main effects, standard error/variance, calculation of degrees of freedom, significance tests, etc.) should be as clear as possible. Describe the methods you apply in connection to the data.
- 4) Summarize your conclusions and, if appropriate, give suggestions for further improvements.

Recommendations for the report layout:

The report should include the following sections: introduction, experimental setup (technical details and etc.), experimental (statistical) design, data analysis, results and discussion. If you use external sources, include the reference(s). Illustrating the results by a suitable graphics is an advantage. However, do not include figure(s) or table(s) without referring to them in the text. For example, "The normal probability plot in Fig. 1 shows that...". Figures must be accompanied by a comprehensive description.

Below follow the suggested problems.

Problem 1: Movie night

It is Friday night and you are going to watch a movie. Your choice of tonight's snack is, of course, homemade popcorn! How are you going to make the most out of this?

Problem 2: Morning routine

On an ordinary morning you usually start by taking a shower, which results in hair that needs styling and drying. Now, if you have long or thick hair you may feel that this takes a long time. Try to optimize your morning routine. The question is: which styling routine do you choose to dry your hair as fast as possible? Factors that may be of importance are styling products, dryer speed, dryer heat, use of towel, weather, etc.

Problem 3: Bake sponge cakes

Most people like their sponge cakes (sockerkaka) as fluffy as possible. You would prefer a cake that is high and porous. A sponge cake usually consists of eggs, milk/water, butter, sugar and baking soda. How do you make an optimal cake?

This is an experiment that is to be carried out using a split plot design (See for instance chapter 9 in [1]).

A recipe:

3 eggs
300 ml sugar
2 tsp vanilla sugar
2 tsp baking soda
75 g butter
100 ml water or milk
300 ml (180 g) flour (wheat)

Whisk the eggs together with the sugar until it turns white and fluffy.

Mix all the dry ingredients and add to the egg whisk.

Melt the butter and add water or milk. Add this to the batter and blend it all to a smooth consistency.

Pour the batter into a buttered cake mould and bake at 175 degrees for 45 minutes.

Alternative setup: Bake an optimal bread with dry or wet yeast instead.

Problem 4: Mentos and soft drink fun

Mentos and soft drinks mixed together produce a fountain effect. Your task is to figure out how to make use of this effect to shoot a cork as far as possible. There is also a possibility of optimizing the flight time of the cork instead. Appropriate factors might be different types of soft drinks (i.e. Coke, Diet Coke, Fanta), amount of Mentos, elevation angle, etc.

Warning: This is a task suitable for outdoor execution.

Problem 5: Breath-hold experiment

The aim is to investigate which factors influence the time that you can hold your breath. Try to hold it for as long as you can, however start breathing again when you get contractions of the diaphragm.

Hints: Factors that may influence the response

- Body position during the attempt (sitting, lying down or standing).
- Relaxation time before the attempt.
- Number of repeated breath holds before the current one. Make sure to rest at least 2 minutes after each repetition.

- Face positioned in/out of water. Note, never try this alone! Ask a friend to check on you every 15 seconds.
- Walking/standing still/doing sit-ups during the breath hold.

Alternative setup: Your pulse is influenced by the above factors. Try to lower your pulse as much as possible during a fixed time instead.

A Problem of Your Own

In this assignment the task is to investigate a problem or a process that is of interest to you. It could be something that you came across in your studies or work, something related to a hobby of yours or a problem in everyday life. Plan the work according to the following list:

- 1) State the problem and define the goal of experiment
- 2) Collect information about the work that has been done earlier in this area
- 3) Choose response variable(s)
- 4) Choose factors and levels
- 5) Choose an appropriate design for the experiment
- 6) Execute the experiment according to the design
- 7) Analyze the data and draw conclusions
- 8) If appropriate, give suggestions for further experiments

Estimate the effects and decide whether they are significant or not by appropriate significance test method(s). Verify your model (where you include the significance effects) by plotting the residuals. Your report should be written in such a way that other groups are able to reproduce your experiment and verify your results. Do NOT use statistical or other software packages unless you interpret the output in a comprehensible way.

Project presentations

Each group should give a 10-minute presentation on **Feb 26**.

- All group members should participate in the presentation.
- Present your problem, methods, results and conclusions.
- Highlight difficulties you had with the experiment and your solutions to them.
- Conclude with future work or suggestions for further experiments.

List to sign up for a presentation time will be available at office L3101.

Important! You should attend all presentations to be able to give comments and suggestions to your classmates.

References:

[1] Box G.E. et al., Statistics for experimenters, John Wiley & Sons, Inc., New Jersey, second edition, 2005.

The report for one of the problems on the list should be written in English or Swedish and handed in to Sofia Tapani. The report for the project of your own should be written in English and handed in to Dmitrii Zholud. The deadline for the reports is **25 February** at four o'clock.

Sofia Tapani and Dmitrii Zholud February 12, 2009