

## List of Problems

You may 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 a 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 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 influences 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 the above factors. Try to lower your pulse as much as possible during a fixed time instead.

References:

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

The report should be written in English and handed in to Dmitrii Zholud no later than **24 February** at four o'clock.

Dmitrii Zholud      January 1, 2010