

# Theory of Science – Experiments and Evaluation

## Exercise 1

*To be worked on in the exercise session March 11. Written solutions prepared individually during the following week(s). Solutions for this and next two exercises due on March 29 in a single pdf document. The exercise next week will be a continuation of this one.*

The file `vitdata.txt` contains hypothetical exam result data (inspired by, but completely different from, exam data for the Algorithms & Datastructures course). The data contains results for 300 (hypothetical) students, and shows for each student:

*Program:* The study program the student is enrolled in. Either “BLA” or “CRU”

*Gender:* The student’s gender. Either “A” or “B”

*Q1-Q4:* For 4 different multiple-choice questions, whether the student answered the question correctly (1) or not (0)

*Q5-Q8:* Points obtained in 4 problems where answers give a point score in the range 0-25.

*Total:* Total points obtained, computed as the sum of points in Q5-Q8, plus 7 points for each correct answer in Q1-Q4.

We consider the following hypotheses:

**H1** The probability that a student gets question 1 right is 50%

**H2** The average total that students obtain is less than 50 points.

**H3** BLA students get better exam results than CRU students

**H4** Question 5 is more difficult than question 8

**A.** For each of the four hypotheses:

- Determine whether it is a one sample performance hypothesis, or a two-sample comparative hypothesis
- Perform a preliminary investigation of the plausibility of the hypothesis using descriptive analysis tools (boxplots, histograms, biplots, ...)

**B.** For H1 and H2:

- Identify a statistical test that is suitable to test the hypothesis
- Apply the test to the `vitdata` and determine whether the hypothesis is rejected at a significance level of 0.01.

## Online Tools

The exercises are best done with tools like Python (Numpy, Scipy.stats), Maple, Matlab, R, etc. If you are not experienced with any of these tools, then there are a number of easy-to-use online tools. The functionality of these tools is sometimes a bit limited, but sufficient for our purpose.

Histograms (no overlays), Binomial, t-test:

<http://www.socscistatistics.com/Default.aspx>

Scatterplots:

<http://www.alcula.com/calculators/statistics/scatter-plot/>