

NBE-E4030 - Experimental and Statistical Methods in Biological Sciences
Exam 2, 2016

In the exam you may have your pens and pencils, a ruler and an eraser plus a pocket calculator (empty the memory!!!). On top of that you may have one A4 of notes. The rules for the note are: size A4, text on one side only, it must be hand-written, your name has to be on the top right corner of the note. Other things, such as formulae books, calculators and tables, you may **not** have in the exam.

1. (validity and reliability 6 p.) Explain the following terms with examples
 - (a) reliability of an experimental study (3 p.)
 - (b) validity of an experimental study (3 p.)
2. (parametric and nonparametric tests, 6 p.) Compare one sample t -test, one sample sign test and Wilcoxon one sample signed rank test.
 - (a) Give the general statistical assumptions needed for applying these tests, and explain how the assumptions needed for applying these tests differ from each other. (3 p.)
 - (b) Give the null hypotheses of the tests and explain how the null hypotheses of these tests differ from each other. Give also the alternative hypotheses of the tests and explain how the alternative hypotheses of these tests differ from each other. (2 p.)
 - (c) Which one of these three tests requires mildest assumptions? (1 p.)
3. (two-way ANOVA, 6 p.)
 - (a) Give an example of a situation where you could apply two-way analysis of variance. (2 p.)
 - (b) Present the two-way ANOVA model (mathematically) and list the underlying assumptions. (4 p.)

4. (visualization 6 p.) Box plots of three samples were drawn using default settings in R, see below.

- (a) Which one of the samples (1, 2 or 3) has the lowest sample median? (Justify your answer) (2 p.)
- (b) Which one of the samples (1, 2 or 3) has the highest sample variance? (Justify your answer) (2 p.)
- (c) Are any of the underlying distributions (1, 2 or 3) skew? If yes, which ones? (Justify your answer) (2 p.)

