

NBE-E4030 - Experimental and Statistical Methods in Biological Sciences  
Exam 1, 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.

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1. (sampling 6 p.) Explain the following terms with examples
  - (a) random sampling (2 p.)
  - (b) cluster sampling (2 p.)
  - (c) stratified sampling (2 p.)
2. (central limit theorem 6 p.)
  - (a) State the central limit theorem (including required assumptions). (2 p.)
  - (b) The central limit theorem is an asymptotical result. How does that affect applicability of the central limit theorem? (2 p.)
  - (c) Give an example of an application of the central limit theorem. (2 p.)
3. (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.)

4. (two-way ANOVA, 6 p.) Two-way analysis of variance was performed to assess the effect of gender (male, female) and age (three age groups 1, 2, 3) on performance in several tests (A, B, C, D, E). Corresponding line graphs are given below

- (a) In which tests (A, B, C, D and/or E) there are two main effects? (Justify your answer) (2 p.)
- (b) In which tests (A, B, C, D and/or E) there are two main effects and no interaction? (Justify your answer) (2 p.)
- (c) In which tests (A, B, C, D and/or E) there is interaction effect and no main effect? (Justify your answer) (2 p.)

