

Please complete these problems before the exercise session on Tuesday 12 December, 2023, 8:30. Please be prepared to present your solutions to any problems that you completed successfully.

1. Compare the one sample  $t$ -test, the one sample sign test, and the one sample Wilcoxon signed rank test.
  - (a) State the general statistical assumptions needed for applying these tests, and explain how the assumptions needed for applying these tests differ from each other.
  - (b) State the null hypotheses of the tests and explain how the null hypotheses of these tests differ from each other. State also the alternative hypotheses of the tests and explain how the alternative hypotheses of these tests differ from each other.
  - (c) Which one of these three tests requires the mildest assumptions?
2. Download the file `iris.txt` from the course website.
  - (a) Use the two sample  $t$ -test to investigate whether there is a statistically significant difference in the mean sepal width (variable: `sepal_width`) between the species *Iris setosa* and *Iris virginica* (categorical variables: `Iris-setosa` and `Iris-virginica`). Formulate both the null hypothesis and the alternative hypothesis for this test, and use significance level 5%. Interpret the test result. How did you check the statistical assumptions of the  $t$ -test?
  - (b) Use the variance comparison test to investigate whether there is a statistically significant difference in the variances of the sepal widths between the species *Iris setosa* and *Iris virginica*. Formulate both the null hypothesis and the alternative hypothesis for this test, and use significance level 5%. Interpret the test result. How did you check the statistical assumptions of the variance comparison test?
3. Download the file `mtcars.txt` from the course website. Compare the *horsepowers* (variable: `hp`) of cars with automatic transmission (categorical variable: `am=0`) and manual transmission (categorical variable: `am=1`).

Your task is to investigate whether there is a statistically significant difference between the *horsepower* between cars with automatic transmission and cars with manual transmission. Consider using both,

- (i) the two sample  $t$ -test, and
- (ii) the two sample Wilcoxon signed rank test.

Formulate the null hypothesis and alternative hypothesis for each test. Using significance level 5%, interpret the test results for (i) and (ii). How did you check the statistical assumptions for (i) and (ii)? What are your conclusions?

**The exercises continue on the next page!**

4. Download the file `patients.txt` from the course website. The file contains measurements of the systolic blood pressure of a random sample of 10 patients from before and after surgery.

Based on this (imaginary) medical study, your task is to investigate whether surgery tends to lower the systolic blood pressure in a statistically significant way. How would you formulate the null hypothesis and alternative hypothesis? Which statistical test would you use? Using significance level 5% for your statistical test of choice, interpret the test results.