(8 points) 1. The influence of different moisture levels on the length of rice plants is to be examined. Ten different moisture levels (1: lowest level; 10: highest level) are applied, each to eight plots with 20 rice plants each. After one week the mean increase of plant length per plot is calculated.
Decide whether the mean rice lengths on the different moisture levels are all equal or not.

(0.5 points) (a) Read the data file "RiceGrowth.txt" into the R workspace.

(0.5 points) (b) How many factors, how many levels for each factor are given.

(1 point) (c) Describe the data by statistical parameters and visualize them in a suitable way, discuss outliers.

(1 point) (d) Give the right testing procedure and its assumptions.

(1 point) (e) Formulate the hypotheses to be tested.

(1 point) (f) Compute the ANOVA on level of significance $\alpha = 0.01$.
Assume the test-assumptions are fulfilled.

(1 point) (g) Interpret the result with respect to the given question above.

(2 points) (h) Decide, whether a Tukey test makes sense. If yes, apply the Tukey test with $\alpha = 0.05$ and decide which means are equal, i.e. put populations with equal means into one group.

(6 points) 2. In 24 forest stands thickness of mulch and ph of the soil have been measured. Thickness of mulch is categorized from level 1 (= lowest level) to level 5 (= highest level). Is there a significant variation in ph between different levels of thickness of mulch? How large is the variation between the mulch levels compared with that within the mulch levels?

(0.5 points) (a) Read the data file "MulchPH.csv" into the R workspace.

(1 point) (b) Describe the data by statistical parameters and visualize them in a suitable way, discuss outliers.

(0.5 points) (c) Which model for an ANOVA would you choose to analyze the data.

(1 point) (d) Formulate the statistical hypotheses to answer the given problem and set significance level $\alpha = 0.05$ for testing.

(1 point) (e) Run the test procedure on significance level 0.05 using model comparison via ANOVA (full versus reduced model) - assume the test-assumptions are fulfilled.

(2 points) (f) Interpret the result with respect to the given questions above.

(7 points) 3. The influence of two different fertilizers and three levels of irrigation on the biomass of banana plants had been investigated.

(0.5 points) (a) Read the data file "bananabiomass.txt" into the R workspace. How many factors, how many levels for each factor, how many replications per factor combination are given.

(1 point) (b) Describe the data by statistical parameters and visualize them in a suitable way, so that also interactions between irrigation and fertilizer can be investigated. Discuss your observations.

(1 point) (c) Which model for an ANOVA would you choose to analyze the experimental data.

(1 point) (d) Formulate the hypotheses to be tested.

(1 point) (e) Compute the ANOVA (assume the test-assumptions are fulfilled) on level of significance $\alpha = 0.01$.

(1.5 points) (f) Interpret the result.

This exercise has 3 questions, for a total of 20 points.