10. Analysis of Variance (ANOVA)

*Note: Most of datasets are in **data_ANOVA.xlsx**. Data for R are at **http://edu.modas.lu/data***

Task 1. Data **"*chickens*"** contains the results of an experiment, conducted to measure and compare the effectiveness of various feed supplements on the growth rate of chickens.

a) Check whether feeding influences the growth rate. Define the most efficient feeding.

b) Perform pairwise comparisons b/w conditions and define significant differences (use Bonferroni and FDR corrections, Lecture 9 in **Excel**, and TukeyHSD in **R**)

Task 2. To test the effectiveness of various denture adhesives, an instrument called the TA.XT2i Texture Analyzer made by Texture Technologies Corp. was used to measure the force required to separate dentures from a mouth and gum cast. The force requited for separation was recorded in decigrams. The adhesives were: (A) karaya, (B) karaya with sodium borate, (C) carboxymethylcellulose sodium (32%) and ethylene oxide homopolymer, and (D) carboxylmethylcellulose sodium (49%) and athylene oxide homopolymer. Results are given in table "***adhesives***".

Are there any significant differences among these denture adhesives holding abilities? If yes, define significant pairs (FDR in Excel and TukeyHSD in R).

Task 3. An instructor in a second-term calculus course wishes to determine whether the year in college has any effect on the performance of his students on their final exam. The table "***grades***" lists the exam grade (out of 150) for students categorized by year.

Are there significant differences in performance among years?

Task 4. Data "***teeth***" contains the result of an experiment, conducted to measure the effect of various doses of vitamin C on the tooth growth (model animal – Guinea pigs). Vitamin C and orange juice were given to animals in different quantities.

a) Compare the effects due to treatment (vitamin, orange juice) and concentration. Provide a proper ANOVA model.

b) Perform a simple post hoc analysis: plot mean tooth growth for different conditions. What interesting observation you can get, based on your analysis of this data?

Task 5. Each of six garter snakes (*Thamnophis radix*) was observed during the presentation of petri dishes containing solutions of different chemical stimuli. The number of tongue flicks during a 5-minute interval of exposure was recorded. The three petri dishes were presented to each snake in random order. See data in "***snakes***" table.

Does solution affect tongue flicks? Do different snakes have a constant effect on tongue flicks? Perform post hoc analysis for significant factor using FDR correction or TukeyHSD.

Task 6. In an attempt to find the most effective methods for training companion dogs for the physically challenged, an experiment was conducted to compare three different training reward systems. All the animals in the study where Labrador retrievers and were 6 to 8 months old at the start of experiment. Individual dogs were assigned to a combination of training regime and reward system randomly. At the end of a 10-week period the dogs were given a standardized test to measure their ability to function as companion dogs for visually impaired. The results are given in table "***dogs***".

Perform analysis of this data to the best of your knowledge.

Task 7. A limnologist documenting the water quality of a large freshwater lake measured water clarity. In table "***lake***" data collected at random times during January, May and September at two locations in this lake are given. Does location and time have significant effects on lake's clarity?

Perform analysis of this data to the best of your knowledge.

Ref: Clover T. and Mitchell K. An Introduction to Biostatistics, McGraw-Hill Higher Education, 2002, ISBN 0-07-112119-4