

Practicals 8: F-test and ANOVA

1 (to be skipped in 2019). Temperature of water in one pot was measured by different thermometers manufactured by two companies: Termom and Celsimet. Each of them provided 10 thermometers for the testing, The aim of the testing was to detect potential systematic bias (whether the thermometers of one company show in average different values from those made by the other) and whether there is a difference in accuracy. The data were as following:

Termom: 18, 19, 18, 17, 16, 19, 18, 17, 19, 18 Celsimet: 17, 15, 21, 20, 19, 22, 15, 16 ,18, 17





Test both differences in mean values and in the accuracy between the two manufacturers. Would you buy a thermometer produced by any of these companies?

2. In a fertilizer application experiment, plants growing in pots (one plant/one pot) were fertilized by different kinds of fertilizer. Dry-weight of above ground biomass was determined for each pot at the end of the experiment. The resulting masses we following:

Type of fertilizer	Biomass DW in g
Water (control)	87,95,74,85,89,97
Mineral NPK diluted in water	140,180,155,164,157,149
Mineral solid slowly decomposing NPK	150,190,165,185,171,182
Ammonium nitrate	123,145,136,134,141, 131
Organic manure	145,161,175,149,141, 169

Does application of different types of fertilizer affect plant biomass? If yes, how?

3. Distribution of four bird species on gradient of altitude was studied in Moravia by recording altitudes of their nests. The resulting data were as following:

Species	Nest altitude (m a.s.l.)
 <p data-bbox="159 517 284 555">Sea eagle</p>	160, 180, 224, 175, 305, 280
 <p data-bbox="159 763 288 801">Blackbird</p>	780, 540, 180, 380, 685, 430
 <p data-bbox="159 978 244 1010">Raven</p>	1200, 830, 450, 1050, 870, 930
 <p data-bbox="159 1209 328 1245">Red crossbill</p>	780, 830, 680, 1005, 970, 950

Does the mean of the altitudinal range differ between the species?

A. Number of insect herbivore species were recorded on three species of trees in a forest (9 randomly chosen individuals per species). Following numbers of herbivore species were recorded:

Beech: 3,5,4,3,7,8,4,6,5

Spruce: 1,2,1,4,2,1,2,3,1,2

Lime: 10,7,15,12,6,4, 20, 11, 7

Do the tree species differ in the species richness of herbivore communities? If yes, how?

B. 20 experimental rats were given 4 types of nutrition. Effect of these types of nutrition on rat intelligence was measured by the time the rats needed to find a way from a labyrinth.

Nutrition	Time in seconds
Control nutrition	56,75,65,85,74
Fat enriched	102,108,95,84,115
Sugar enriched	85,92,75,69,79
Control nutrition + beer	45, 56,53,61,57

Does nutrition have an effect on rat intelligence? How do individual nutrition types affect rat intelligence?

C. Wheat (*Triticum aestivum*) was cultivated in pots with three different substrates: sandy, clay and peaty. Chlorophyll concentration [$\mu\text{mol per cm}^2$ of leaf area] was then analyzed in leaves of the experimental wheat plants. The results are summarized below.

sandy soil: 50, 45, 61, 54, 48, 42

clay: 53, 61, 59, 49, 58, 69

peaty soil: 31, 40, 41, 28, 35, 37

Does the soil type have a significant effect on chlorophyll concentration?

D. Speed of cars was measured by traffic police on the Nové Sady Street in Brno. The drivers exceeding the speed limit 50 km h^{-1} were punished by a fine. In addition to the speed, car colour was recorded. The resulting speed data (in km h^{-1}) were following

red cars: 50, 52, 47, 43, 40, 49, 49, 75, 48, 50, 48, 49

blue cars: 65,50, 47, 75, 45, 38, 67, 57, 54

black cars: 45, 76, 58, 53, 54, 50, 48, 49

yellow cars: 38, 49, 54, 49

Is the driving speed associated with car colour? Should the police focus more on drivers driving cars of a particular colour?