

Practicals 8: F-test and ANOVA

Data for these practicals are available in an Excel spreadsheet.

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

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





Test both differences in mean values and the accuracy between the two manufacturers. Would you buy a thermometer produced by any of these companies? Voluntary task: go to a homeware shop, check thermometers there, and let the class know if the temperature pattern is similar to Termom, Celsiusmet, or different from both.

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

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

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

Species	Nest altitude (m a.s.l.)
 <p>Sea eagle</p>	160, 180, 224, 175, 305, 280
 <p>Blackbird</p>	780, 540, 180, 380, 685, 430
 <p>Raven</p>	1200, 830, 450, 1050, 870, 930
 <p>Red crossbill</p>	780, 830, 680, 1005, 970, 950

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

B. The number of insect herbivore species was recorded on three species of trees in a forest (9 randomly chosen individuals per species). The following numbers of herbivore species were recorded:

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

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

Lime: 10,7,15,12,9,8, 12, 11, 7

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

C. 20 experimental rats were given four types of nutrition. The 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?

D. Wheat (*Triticum aestivum*) was cultivated in pots with three substrates: sandy, clay, and peaty. Chlorophyll concentration [$\mu\text{mol per cm}^2$ of leaf area] was then analyzed in the 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?

E. Speed of cars was measured by traffic police on the Nové Sady Street in Brno. The drivers exceeding the speed limit of 50 km h^{-1} were punished by a fine. In addition to the speed, car color was recorded. The resulting speed data (in km h^{-1}) were the 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 color? Should the police focus more on drivers driving cars of a particular color?