List 13

Exercise 1. Dangerous noise for humans is one that exceeds 120 dB. It was decided to check if there is excessive noise at some point in the airport. For this purpose, the noise level was measured 7 times, on each day of the week, and the following values (in dB) were obtained:
123.6, 118.5, 131.1, 122.6, 121.9, 125.1, 119.7.
Can we say at the significance level of 0.05 that the airport area is dangerous for humans in terms of creative noise?

Exercise 2. Certain drills should drill holes of a similar depth in the wood. Five such holes were measured and the results (in cm) were obtained:
5.0, 3.8, 4.1, 4.4, 4.0.
At the significance level of 0.1, can we say that the variance of the hole depth is equal to 0.05 cm^2?

Exercise 3. The average time to complete certain specific activities by the two robotic arms was compared. For this purpose, the time of recalling these activities was measured several times, obtaining the results [in s]:
Arm 1: 15.1, 14.7, 15.5, 14.1, 15.2, 17.0
Arm 2: 13.8, 15.4, 15.2, 13.3, 14.8
At the significance level of 0.05, can we conclude that the second robotic arm performs activities faster than the first?

Exercise 4. The same object was measured several times for each of the three micrometers and the following results were obtained (in mm):
Micrometer I: 4.3, 4.7, 4.8, 4.7
Micrometer II: 4.7, 4.8, 4.5, 4.7
Micrometer III: 5.1, 4.9, 4.9, 5.2
Assuming that the distribution is normal, check at significance level 0.05

   a) the homogeneity of the variance,
   b) the equality of the mean size of object using three different micrometers.
   c) Do micrometer 1 and 2 differ significantly from micrometer 3 in terms of mean size measured?

Exercise 5. The table below shows the results of an experiment in which the engineer wants to determine the relationship between the final amount of chemical production Y (in kg) depending on the amount of raw material used X (in liters):

X	5	6	9	10	12	12	14	16	17	23
Y	31	45	40	55	72	74	68	93	79	105

   a) On the basis of the graph of points with coordinates (x, y) from the table, check what type of relationship between the examined features can be expected.
   b) Determine the correlation coefficient between the amount of raw material used and the final amount of chemical production.

c) Calculate the linear regression equation of the final amount of chemical production depending on the amount of raw material used.
d) Check the significance of linear regression.
e) Add a linear regression function to an existing scatter plot.
f) Determine the amount of raw material used after using 15 liters of raw material.
g) Determine and interpret the coefficient of determination.

Take a significance level equal to 0.05.

Exercise 6. Ship travel time between two ports (in h) was examined several times depending on the wind speed in these areas (in km/h) and the temperature at the water surface (in °C). The results are presented in the table:

Time	2.1	3.2	2.7	2.5	3.3	3.8	1.9	3.0
Wind	45	30	33	35	34	25	47	35
Temp.	10	12	9	13	5	4	11	7

a) On the basis of graphs of points with coordinates (x, y) from the data, check what the relationship between the examined features may be. Note: plots for two independent variables should be made separately.
b) Determine the correlation coefficients between the wind speed and ship travel time and also between the temperature at the water surface and ship travel time.
c) Calculate the multiple linear regression equation of ship travel time depending on the wind speed and the temperature at the water surface.
d) Check the significance of multiple linear regression.
e) Determine the ship travel time with wind speed 35km/h and 6°C as the temperature at the water surface.
f) Determine and interpret the coefficient of multiple determination.

Take a significance level equal to 0.05.

Exercise 7. In order to check the safety on the road with two pedestrian crossings, the speed of the passenger car (in km/h) was measured every four seconds. The following results were obtained.

Time	4	8	12	16	20	25	30
Speed	51	41	17	32	48	33	14

a) On the basis of the graph of points with coordinates (x, y) from the table, check what type of relationship between the examined features can be expected.
b) Determine the correlation coefficient between time and car speed.
c) Calculate the polynomial regression equation for car speed depending on driving time.
d) Decide on the degree of the regression polynomial and check the significance of regression coefficients.
e) Add a polynomial regression functions to an existing plot.
f) Determine the car speed after 14 seconds.
g) Determine and interpret the coefficient of determination.

Take a significance level equal to 0.05.

Exercise 8. In one IT company, computers were checked for efficiency. For this purpose, a program was launched on each of them and the program execution time was measured (in min). The results are presented in the interval table below.

Execution time	1-4	4-7	7-10	10-13	13-16	16-19
Frequency	4	23	21	18	5	3

At significance level 0.1 verify if the execution time in that company is normally distributed.