

Exercises 3 – Comparison and hypothesis test

Exercise 1

A medicine has the mention “contains 320 mg of sodium iodide” marked on each sachet. An independent laboratory wants to verify this statement and analyses 100 samples. Their measurements lead to a mean value of 321.2 mg (per sachet) and a standard deviation of 3.9 mg.

Investigate whether the laboratory can contest the indication (at both the 95% and 99% confidence level).

Exercise 2

A metallic compound has been prepared with a well known method and is supposed to contain $x_0=25.6$ at.% of iron (Fe). In order to verify the composition, a technician has done a series of measurements on the same compound with the same apparatus having a known standard deviation of $\sigma=0.2$. The measurements are summarized as follows:

x_i	25.2	25.4	25.5	25.6	25.7	25.8	25.9
n_i	1	0	1	2	3	1	1

Is it correct to announce a value of 25.6 at.% of Fe in this compound?

Exercise 3

Two scales are used to do weight measurements in a laboratory, and a technician wants to make sure that both scales give the same result. Measurements (in kg) are made on a sample:

X_1	5.33	5.13	5.16	5.09	5.49	5.32	5.24	5.53	5.27	5.36
X_2	5.32	5.00	5.14	5.00	5.35	5.17	5.11	5.26	5.13	5.18

Consider two cases:

1. The results are supposed to be normally distributed with identical standard deviation $\sigma_1=\sigma_2=0.1$.
2. The results are supposed to be normally distributed, but with unknown variance.

For each case, compare the resulting mean values and decide whether the two values can be considered as consistent (meaning that there is no significant difference).

Exercise 4

A supermarket has in average a daily turnover^h of 1.5 million Euros with a standard deviation of 0.3 million Euros. During the first 30 days following a publicity campaign, they found a turnover of 1.62 million Euros per day.

Did the campaign have a significant positive impact?

Exercise 5

To verify if the fuel consumption (in liters per 100 km) of a new engine depends on the driver of the car, two identical cars are used on ten different road circuits.

The fuel consumptions have been measured as follows:

	1	2	3	4	5	6	7	8	9	10
A	6.3	10.9	8.2	15.6	16.1	15.5	4.7	14.1	9.2	14.9
B	12.9	10.5	7.6	20.7	25.3	14.6	6.2	16.0	9.0	17.7

Assuming that the differences between these number pairs are random samples from a normal distribution, test the hypothesis that the two drivers are equally effective.

Exercise 6 (homework)

An apparatus is used to measure the content of sodium (Na) in mineral water. To verify if the apparatus gives correct results, measurements have been done on one sample containing exactly 3.56 mg/liter of Na.

x_i	3.52	3.54	3.55	3.56	3.57	3.58	3.59
n_i	1	1	2	3	1	1	1

Would you confirm that the apparatus gives accurate results?

Exercise 7 (homework)

The content of sodium (Na) in water is measured on two different days at the same source. The technician wants to know if there is a difference between the Na content of the two samples.

Day 1	2.7	3.0	3.3	2.9	3.5	2.7	3.0	3.1	2.8	3.0
Day 2	2.7	2.5	3.0	2.7	2.5	2.6	2.9	2.7		

What do you think?

^h turnover (engl.) = chiffre d'affaire (fr.)