Exercise Series 09: Statistical Estimation

Exercise 1

In a production batch of 50,000 items, a sample of 400 items yielded a mean weight per item of 200 g with a standard deviation of 50 g.

Task: Estimate the mean weight of the production both as a **point estimate** and as a **confidence interval** at the 95% confidence level.

Exercise 2

Consider a normal population with variance $\sigma^2 = 0.64$. A simple random sample of size n = 16 is drawn, with a sample mean of $\bar{x} = 84.6$.

Calculate the **confidence interval for the population mean** at $\alpha = 0.05$.

Exercise 3

To check the quality of a pipetting system, 10 water samples are taken and the weights of these 10 volumes are measured (in mg) as follows:

1.051; 1.027; 1.033; 1.034; 1.025; 1.023; 1.025; 1.028; 1.024; 1.021

Sample mean = 1.0291 mg, sample standard deviation = 0.0083 mg

1. Provide a **point estimate** for the mean m and the variance σ^2.

2. Estimate the mean m of the weights using a **95% confidence interval**.

3. Estimate the variance σ^2 using a **95% confidence interval**.

Exercise 4 (covered in class)

A fish trader delivers boxes of white tuna to a canning factory. Upon receiving the boxes, the manager doubts the displayed weight. He samples 25 boxes, obtaining:

$\bar{x} = 1.98$ t, s = 0.11 t

Assuming the weight is **normally distributed**, calculate a **95% confidence interval** for the mean weight of the boxes.

Exercise 5

A fish farm manager wants to know the **average size** of the farmed fish population in his ponds.

- From a sample of $n = 64$ fish, the mean size is 32 cm with a standard deviation of 12 cm.
    1. Calculate a **90% confidence interval** for the mean size.
- In another sample of $n = 100$ fish, 46 individuals were found to carry a parasite.
    2. Calculate a **95% confidence interval** for the proportion of parasitized fish.

Exercise 6 (for students)

In a batch of approximately 500 cocoons of a bivoltine breed of *Bombyx mori*, 20 cocoons are randomly sampled and weighed (g):

0.64; 0.65; 0.73; 0.60; 0.65; 0.77; 0.82; 0.64; 0.66; 0.72; 0.87; 0.84; 0.66; 0.76; 0.63; 0.52; 0.66; 0.45; 0.74; 0.79

1. Provide a **point estimate** of the batch variance.

2. Calculate a **95% confidence interval** for the batch variance σ^2 .

Exercise 7 (for students)

Proteins are measured in a random sample of size 4 from a dairy stock:

$\bar{x} = 30$ g/L, $s'^2 = 16$ (g/L)^2

Calculate a **95% confidence interval** for the mean protein concentration (m).