Statistics.
Exercises - 1. lecture

Exercise 1

The result X of a distance measurement is supposed to be $N(\mu, \sigma^2)$, where $\mu = 30m$ and $\sigma = 5cm$. Determine

(a) $P(X \leq 30)$.

(b) $P(X \geq 29.9)$.

(c) $P(29.9 \leq X \leq 30.15)$.

Exercise 2

Assume that we have gathered 4 independent measurements of the distance in exercise 1.

(a) What is the probability, that all 4 measurements are above $30m$?

(b) What is the probability, that all 4 measurements are below $29.9m$?

(c) What is the probability, that at least one measurements is above $30.15m$?

Exercise 3

Simulate a 1000×4 data matrix with 1000 samples of size 4 and distribution as in exercise 1.

(a) How many of the samples have all 4 measurements above $30m$?

(b) How many of the samples have all 4 measurements below $29.9m$?

(c) How many of the samples have at least one of the 4 measurements above $30.15m$?

(d) Compare with the results of exercise 2.

Exercise 4

Suppose that we have gathered 1000 measurements of different distances, which are normally distributed with individual means, but with the same spread $\sigma = 5cm$.

What is the expected number of measurements having a deviation from the mean, which exceeds:

(a) $7.5cm$?

(b) $15cm$?

Exercise 6

Suppose that the variance prior to an adjustment is $\sigma_0^2 = 1$.

(a) Suppose that the number of redundants is 20. Determine the probability that the posterior variance is between 0.8 and 1.2. (Hint: The posterior variance multiplied by 20 har a χ^2-distribution with 20 degrees of freedom).

(b) Repeat the calculation above, when the number of redundants is only 10.