Aalto University
School of Electrical
Engineering

Exercise and Homework Round 3

These exercises (except for the last) will be gone through on **Friday, September 30, 12:15–14:00** in the exercise session. The last exercise is a homework which you should return via mycourses by **Friday, October 7 at 12:00**.

Exercise 1. (Least squares drone positioning)

(a) Rewrite the drone model in Exercise 1 of Round 1 into a model of the form of Equation (3.14) in the course book.

(b) Write down the least-squares cost function J for the problem and minimize it analytically.

(c) What kind of form does each individual coordinate estimate have? Why?

Exercise 2. (Biased estimator)

Compute the expected value of the regularized estimator in (3.40).

Exercise 3. (Regularized and sequential drone positioning)

(a) Write down the regularized squares position estimate for the drone in the previous section with prior mean $\mathbf{m}$ and covariance $\mathbf{P}$.

(b) Simulate measurements from the drone model and compare numerically the regularized and non-regularized estimates. What kind of effect does does the prior have?

(c) Implement a sequential version of the regularized estimation and verify that the result is the same as that of the batch regularized estimation.

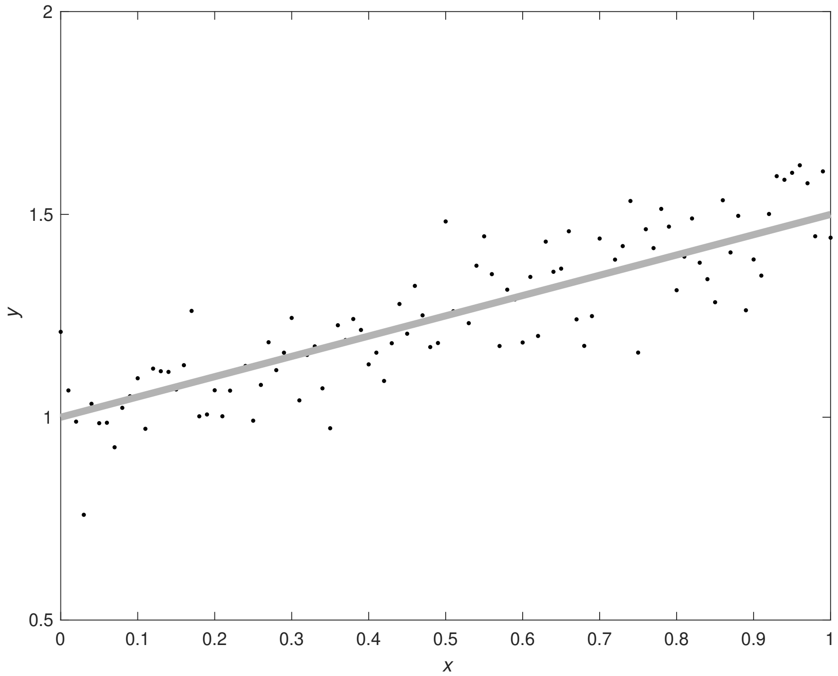

Figure 1: Linear regression problem

Homework 3 (DL Friday, October 7 at 12:00)

Here the aim is to look into least squares linear regression – and learn to be cautious with notation. We consider a linear regression problem with given data (x_n, y_n) for $n = 1, \ldots, N$ (see Figure 1). Thus in this case x_n is not an unknown, but the regressor. So don't get blindfolded by the notation!

(a) Compute least squares estimators for a and b in

$$y_n = a\, x_n + b + r_n \tag{1}$$

by computing the minimum of $J(a, b) = \sum_{n=1}^{N} (y_n - a\, x_n - b)^2$.

(b) Convert the above problem into problem of the form $J(\mathbf{x}) = (\mathbf{y} - \mathbf{G}\,\mathbf{x})^\mathsf{T} (\mathbf{y} - \mathbf{G}\,\mathbf{x})$, minimize it with the given matrix expressions in the course book, and show that the result is the same as in (a). Hint: put $\mathbf{x} = (a, b)$.