

EE263 homework 3 additional exercises

1. *Simple fitting.* You are given some data $x_1, \dots, x_N \in \mathbf{R}$ and $y_1, \dots, y_N \in \mathbf{R}$. These data are available in `simplefitdata.m` on the course web site.
 - (a) Find the best affine fit, *i.e.*, $y_i \approx ax_i + b$, where ‘best’ means minimizing $\sum_{i=1}^N (y_i - (ax_i + b))^2$. (This is often called the ‘best linear fit’.) Set this up and solve it as a least-squares problem. Plot the data and the fit in the same figure. Give us a and b , and submit the code you used to find a and b .
 - (b) Repeat for the best least-squares cubic fit, *i.e.*, $y_i \approx ax_i^3 + bx_i^2 + cx_i + d$.
2. *Estimating parameters from noisy measurements.* In this problem you will compare a least-squares estimate of a parameter vector (which uses all available measurements) with a method that uses just enough measurements. Carry out the following steps.
 - (a) First we generate some problem data in Matlab. (You’re free to use any other software system instead.) Generate a 50×20 matrix A using `A=randn(50,20)`. (This chooses the entries from a normal distribution, but this doesn’t really matter for us.) Generate a noise vector v of length 50 using `v=0.1*randn(50,1)`. Generate a measurement vector x of length 20 using `x=randn(20,1)`. Finally, generate a measurement vector $y = Ax + v$.
 - (b) Find the least-squares approximate solution of $y = Ax$, and call it x^{ls} . Find the relative error $\|x^{\text{ls}} - x\|/\|x\|$.
 - (c) Now form a 20-long truncated measurement vector y^{trunc} which consists of the first 20 entries of y . Form an estimate of x from y^{trunc} . Call this estimate x^{jem} (‘Just Enough Measurements’). Find the relative error of x^{jem} .
 - (d) Run your script (*i.e.*, (a)–(c)) several times. You’ll generate different different data each time, and you’ll get different numerical results in parts (b) and (c). Give a one sentence comment about what you observe.

Note. Since you are generating the data randomly, it is remotely possible that the second method will work better than the first, at least for one run. If this happens to you, quickly run your script again. Do not mention the incident to anyone.