Massachusetts Institute of Technology

6.435 System Identification

Prof. M. A. Dahleh — Out 2/9/1994

Problem Set No. 1 — Due 2/21/1994

Reading: Read Ch 2, Sections 4.1, 4.2, and Ch 6.

Problem 1: Do the following problems from Ljung'book:

a. 2E.2

b. 2E.3 (a)

c. 2E.5

d. 2D.1

Problem 2: Verify all the examples covered in class.

Problem 3: For system S_1 discussed in class, suppose the input is given as $u = -ky$ for some fixed constant k. Is it possible to estimate the parameters a, b using the least squares approach. Explain. How about if $u = -ky + r$ with r being a WG, zero mean input with variance σ^2. Explain your results numerically and theoretically for $k = \sigma = .5$.

Problem 4: Given the following system:

$$Ay = Bu + We$$

where:

$$A = 1 + .5q^{-1} \quad B = q^{-1} \quad W = \frac{1 + .2q^{-1}}{1 + .6q^{-1}}$$

Simulate the system with both u and e as WG with zero mean and unity variance.

a. Use the "spa" function in Matlab to obtain an estimate of the frequency response of $H = B/A$, using the simulated data. Explain the results.

b. Use the "arx" function in Matlab to estimate the parameters of A and B assuming you knew the corresponding orders and the amount of delay the system has. Are the estimates biased? Verify your results theoretically (as done in class).

c. Can your results be improved if you knew W apriori? How can you use this information in your estimation algorithm? Verify your claims both numerically and theoretically.

d. Do your extimates change if you assumed that the system has no delays (again using "spa" and "arx").

Problem 5 Repeat all of the above for a step input, again with random noise.