System Identification

University of Florida
Mechanical and Aerospace Engineering

HW #2
Issued: September 19, 2008
Due : in class on September 26, 2008

Problem 1. 1. Download the MATLAB function `F_sim_system1.p` from the class website that produces noisy output signal for a 1st order linear discrete time system $y[k+1] = ay[k] + bu[k]$, for a given initial condition and an input signal $\{u[k]\}$. Read the "readme.txt" for help on using the function. Use the function to gather measurements of the output of the system. Estimate the parameters a and b by choosing an appropriate input signal type (step, sinusoidal, etc.), length of the signal N, and an initial condition.

2. Choose a few values of N and plot the least squares estimates a and b obtained as a function of "data length" N. What conclusion do you draw from this plot?

3. Repeat the above, but now with the MATLAB function `F_sim_system2.p`, which simulates a different first order system.

Problem 2. The function `F_sim_system3.p` (available from the class website) also simulates a first order system, but now you can't specify the initial condition. Instead the function chooses the initial condition. Obtain least squares estimates of a and b.

Problem 3. We know that the Laplace transform of the signal $y(t) = e^{\zeta t}1(t)$, where $\zeta \in \mathbb{C}$, is $Y(s) = 1/(s-\zeta)$, with the ROC specified by $Re(s) > Re(\zeta)$. Compute the Laplace transform for a large number of values of s in the region specified by $0 < Re(s) < 50$ and $-50 < Imag(s) < 50$. Provide a surface plot of $|Y(s)|$ and $\angle(Y(s))$ for the values of s in this region.