

HW 5 5131 Fall 2014 Due Oct 6

September 29, 2014 Do the problems by hand and **check** the results whenever possible by substituting the solution into the difference equation and also verifying the initial conditions. You may wish to verify your results with MATLAB solutions to the problems when appropriate. You can use symbolic MATLAB to check results.

Harman Chapter 10 will be helpful.

Problem 1 15 Points if checked

- (a) Solve the difference equation

$$y(n) = ay(n-1).$$

- (b) Let $a = 0.9$ and $y(0) = 1$ and use MATLAB **stem** to plot the solution.

- (c) Write the solution as $y(n) = e^{bn}$ and find b .

Problem 2 20 Points if checked

Solve the following difference equations

(a) $y(n) - 1.25y(n-1) + 0.375y(n-2) = 0$.

(b) $y(n) - 0.6y(n-1) = 4u(n)$ with $y(0) = 0$.

Problem 3 20 Points if solved and checked with conv

Running Average: Consider the filter

$$y(n) = \frac{1}{3}[x(n) + x(n-1) + x(n-2)].$$

Calculate $y(n)$, $n = 0, \dots, 7$ for the input sequence $[x(0), x(1), \dots, x(7)]$ as follows

$$[2, 4, 6, 4, 2, 0, 0, 0] \quad x(n) = 0 \text{ for } n < 0, n > 7.$$

This is an example of a Finite Impulse Response (FIR) filter. Check your answer with the MATLAB command **conv**. The sequence is actually 11 points long but there are 0 values for $y(n \geq 7)$.

Problem 4 20 Points

- a. Make a discrete plot of the rabbit population from the Fibonacci series in Example 10.4, Page 470 Harman. (15 Points)
- b. What is the population after 12 months? (5 Points)

Problem 5 25 Points

You want to find out how long it takes to payoff a \$6000 loan if the interest is 12% a year. The loan equation is similar to Equation 10.1 in Harman Page 465 except that the input per month would be $-x(nT)$ where the x is the constant amount paid each month. Write the equation and program it in MATLAB for the inputs of

$$\begin{aligned}y(0) &= \text{The amount of the loan} \\I &= \text{Yearly interest rate} \\x(n) &= \text{Monthly payment}\end{aligned}$$

- a. In one case, you will pay $x(n) = \$200.00$ per month. Determine the number of months to pay off the debt.
- b. In another case, you will pay $x(n) = \$300.00$ per month. Determine the number of months to pay off the debt.
- c. Compare the interest you paid in the two cases.

Notes:

1. The last payment will usually drive the balance negative. Use the MATLAB **break** command to stop the loop when $y(n) < 0$.
2. To simplify the loop count, you could assume 36 or more months of payments. A better way to stop the loop is to use the **while** command and test for

$$y(n) > 0, \quad n = 2, 3, 4, \dots$$