EEE 391
Basics of Signals and Systems
Spring 2022–2023
MATLAB Mini Project 2
due: 17 May 2023, Wednesday by 23:00 on Moodle

1) First and second-order recursive equations are useful in describing, modeling, and characterizing a variety of systems in basic sciences, engineering, finance, daily life, etc.

Give three examples of first-order and three examples of second-order systems that can be modeled by recursive equations. The examples can be from any area that you like (e.g., basic sciences, engineering, economics, finance, fashion, daily life, etc.). Describe your model in detail and write the corresponding recursive equation, indicating what each term and coefficient corresponds to. You do not need to solve these examples.

Solve the following examples of recursive systems:

1) A water reservoir with 5,000 tons of water on day zero, loses 3% of its water content through water usage and evaporation every day. On the average, the reservoir gains 65 tons of water every day through rain immediately and 180 tons through rivers flowing into the reservoir with a delay of 12 hours.

i) Build a recursive model, indicating what each term is clearly.

ii) Find the amount of water at the start of each day starting on day zero. First, do this by analysis to find a complete solution and then write a MATLAB program to solve the above recursive model, with suitable initial conditions. Make a plot of the amount of water (in tons) with respect to number of days between days 0 and 200.

iii) Is the reservoir a stable system? Explain.

2) At the start of a certain year, 40,000 TL is deposited in a bank account earning 9% interest per year. After the initial deposit, in the succeeding years, 1,000 TL is deposited or 2,500 TL is withdrawn from the account alternately (The first year 1,000 TL deposited, the next year 2,500 TL withdrawn, the following year 1,000 TL deposited etc.).

i) Build a recursive model, indicating what each term is clearly.

ii) Find the balance of the bank account at the start of each year after the deposit. First, do this by analysis to find a complete solution and then write a MATLAB program to solve the above recursive model, with suitable initial conditions. Make a plot of the balance of the bank account with respect to number of years between years 0 and 200.

iii) Is the system stable? Justify.

Submit the results of your own work in the form of a well-documented report on Moodle. Borrowing full or partial code from your peers or elsewhere is not allowed and will be penalized. Please include all evidence (plots, MATLAB codes, MATLAB command window print-outs, etc.) as needed in your report. Append your MATLAB code at the end of your assignment, do not upload it separately. The axes of all plots should be scaled and labeled. Typing your report instead of handwriting some parts will be better. Please do not upload any photos/images of your report. Your complete report should be uploaded on Moodle as a single good-quality pdf file by the given deadline. Please try to upload several hours before the deadline to avoid last minute problems that may cause you to miss the deadline. Please DO NOT submit any hardcopies or files by e-mail. All assignments need to go through Turnitin.

IMPORTANT NOTE:
Please name the pdf file you submit on Moodle as follows using only lower-case English characters for your first name, middle name (if any), and lastname. Please use your full name as it appears on the Bilkent system.

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