Simulation Exercise #05: Stochastic Data

INF301 – System Modeling and Simulation – W05

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Report Guidelines

Use a notebook on the Google Collaboratory platform to generate a report containing any explanations and comments you deem relevant, along with your codes and figures.

The graphs in the figures should be self-explanatory, with axis names and data captions. Use a font size appropriate for presentation in a document.

The language to be used is Python. However, the use of pre-built Python libraries is not permitted, except for those used in the examples.

Submit a single notebook file in ipynb format, with the file name in the format SE0N_NameSurname.ipynb, where N is the SE number, Name is your first name, and Surname is your last name.

Remember that plagiarism will not be tolerated under any circumstances!

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Problem 1 (40 points)

Consider the following two AR processes, with zero initial conditions and w being white noise with a uniform distribution, zero mean, and variance equal to 2.

$$\text{(I)}\quad x(k) = w(k) + \tfrac{3}{2}x(k-1) - x(k-2) + \tfrac{1}{4}x(k-3)$$

$$\text{(II)}\quad x(k) = w(k) + \tfrac{3}{2}x(k-1) - \tfrac{1}{2}x(k-2) + \tfrac{3}{4}x(k-3)$$

a) From the characteristic polynomials, draw conclusions about the stability of these systems.

b) Study the stability of the same systems using a simulation approach.

c) Analyze the results and provide the proper comments.

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Problem 2 (60 points)

Model the following autocorrelation data as an AR process of:

a) First-order;
b) Second-order;
c) Third-order.

τ	$R_{xx}(\tau)$
0	10,0
1	7,0
2	6,5
3	5,5
4	6,0
5	4,0
6	2,0
7	1,0

For each model, compare the predicted autocorrelation values with the original data. Begin by modeling the process and then create a simulation instance. From the simulation results, calculate the autocorrelation coefficients and variance. Compare them with the original data, and provide the proper comments.

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