4. Exercise

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Contact by questions
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Problem 1: Linear Congruential Generator

For 16-bit computers it was recommended to combine three multiplicative generators with $m_1 = 32363$, $a_1 = 157$, $m_2 = 31727$, $a_2 = 146$, $m_3 = 31657$, and $a_3 = 142$. The period of this generator is approximately 8×10^{12}.

a) Generate 5 random numbers with the combined generator, using the initial seeds $X_{i,0} = 100, 300, 500$, for the individual generators $i = 1, 2, 3$.

b) Apply the tests described in the class to the generator.

Problem 2: Characteristics of Random Numbers

Test the following sequence of numbers for uniformity and independence, using procedures presented in class.

0.594, 0.928, 0.515, 0.055, 0.507, 0.351, 0.262, 0.797, 0.788, 0.442, 0.097, 0.798, 0.227, 0.127, 0.474, 0.825, 0.007, 0.182, 0.929, 0.852

Problem 3: Characteristics of Random Numbers

In some applications, it is useful to be able to quickly skip ahead in a pseudo-random number sequence without actually generating all of the intermediate values.

a) For a linear congruential generator with $c = 0$, show that $X_{i+n} = a^n X_i \mod m$.

b) Show that $(a^n X_i) \mod m = (a^n \mod m) X_i \mod m$

c) Use this result to compute X_5 with a congruential generator with $m = 100$, $a = 19$, and $c = 0$. Start with $X_0 = 63$ and check your answer by computing X_5 in the usual way.

Problem 4: Random-Variate Generator

Develop a random-variate generator for a random variable X with the pdf

$$f(x) = \begin{cases} e^{2x}, & -\infty < x \leqslant 0 \\ e^{-2x}, & 0 < x < \infty \end{cases}$$

Problem 5: Random-Variate Generator

Develop a generation scheme for the triangular distribution with pdf

$$f(x) = \begin{cases} \frac{1}{2}(x-2), & 2 \leqslant x \leqslant 3 \\ \frac{1}{2}\left(2 - \frac{x}{3}\right), & 3 < x \leqslant 6 \\ 0, & \text{otherwise} \end{cases}$$

Generate 10 values of the random variate, compute the sample mean, and compare it to the true mean of the distribution.

Problem 6: Simulation models, reading

Download the paper »Modeling and simulation best practices for wireless ad hoc networks« by Perrone et. al from the website of the class.

Discuss the paper and the findings of the authors. What are their main point?