

Chapter 12

Introduction to Simulation Using MATLAB

A. Rakhshan and H. Pishro-Nik

12.1 Analysis versus Computer Simulation

A computer simulation is a computer program which attempts to represent the real world based on a model. The accuracy of the simulation depends on the precision of the model. Suppose that the probability of heads in a coin toss experiment is unknown. We can perform the experiment of tossing the coin n times repetitively to approximate the probability of heads.

$$P(H) = \frac{\text{Number of times heads observed}}{\text{Number of times the experiment executed}}$$

However, for many practical problems it is not possible to determine the probabilities by executing experiments a large number of times. With today's computers processing capabilities, we only need a high-level language, such as MATLAB, which can generate random numbers, to deal with these problems.

In this chapter, we present basic methods of generating random variables and simulate probabilistic systems. The provided algorithms are general and can be implemented in any computer language. However, to have concrete examples, we provide the actual codes in MATLAB. If you are unfamiliar with MATLAB, you should still be able to understand the algorithms.

12.2 Introduction: What is MATLAB?

MATLAB is a high-level language that helps engineers and scientists find solutions for given problems with fewer lines of codes than traditional programming languages, such as C/C++ or Java, by utilizing built-in math functions. You can use MATLAB for many applications including signal processing and communications, finance, and biology. Arrays are the basic data structure in MATLAB. Therefore, a basic knowledge of linear algebra is useful to use MATLAB in an effective way. Here we assume you are familiar with basic commands of MATLAB. We can use the built-in commands to generate probability distributions in MATLAB, but in this chapter we will also learn how to generate these distributions from the uniform distribution.