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Objective

- In this project we will further analyze random variables and their various properties.
- We will use MATLAB to generate pseudo random number and analyze its properties.
- We will use pseudo random number to simulate practical problems.
- We will verify empirical result to analytical ones we have studied.

Basic random variable

Mathlab's pseudo random number generator

- Uniform random variable U[0 1]: rand(m,n)
- Gaussian random variable N(0,1): randn(m,n)

Note: the final outcome is determined by the initial state of rand pseudo random number generator, to set the initial state you can do the following: rand('seed',1234);

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Other random variables I

Continuous uniform r.v. [a,b]

- uniform = a + (b-a).*rand(1,t);

Discrete uniform r.v. [a b]

- uniform = ceil(a + (b-a).* rand(1,t));

Gaussian r.v with mean m and variance of a^2

- normal = m + a.*randn(1,t)

Poisson r.v. with paramter 1: poissrnd(1,1,t)

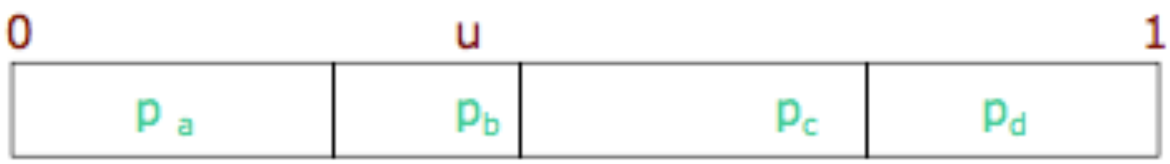
Binomial r.v. with n=100, p =0.05: binornd(100,0.05,1,t)

Geometric r.v. with p=0.1: geornd(0.1, 1,t)

Other random variables II

Now, consider the discrete random variable with given pmf. Any discrete distribution p_k can be sampled by constructing the cumulant, now say discrete random variable with pmf as

$$p(X=1)=p_a \qquad p(X=2)=p_b$$
$$p(X=3)=p_c \qquad p(X=4)=p_d$$



Other random variables III

Now, consider the **PR generation with an arbitrary cdf F(x)** using the transformation method.(Refer to Selection 4.9 in textbook)

Consider a sequence of independent identically distributed (iid) uniformly distributed PR rv's denoted by $\{U_i, i = 1, 2, \ldots\}$ defined on [0, 1]. Then the desired $\{X_i, i = 1, 2, \ldots\}$ defined by

$$X_i = F^{-1}(U_i), i=1,2,\ldots, \quad (1)$$

is a sequence of iid rv with a cdf of F(x).

Other random variables III

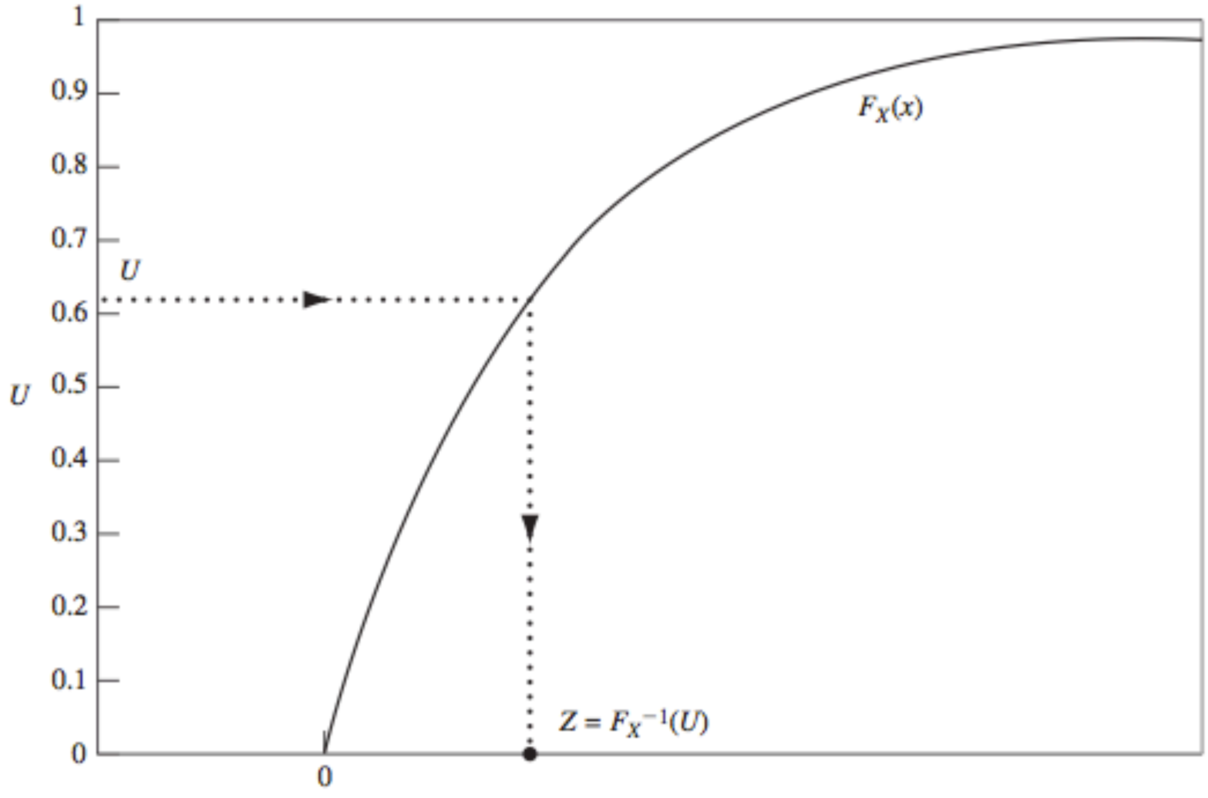


FIGURE 4.19
Transformation method for generating a random variable with cdf $F_X(x)$.

Evaluation

Let us evaluate its sample mean and sample variance to verify whether they are close to the theoretical mean and variance.

- sample mean: mean(X)
- sample variance: var(X)

Let us evaluate its pdf/pmf to verify whether they are close to the theoretical one.

- histogram: hist(x) (needs to normalize)

Demo