

Pramod Parajuli

Simulation and Modeling, CS-331

Chapter 3

System Simulation

System Simulation

- Analytical methods directly produce general solutions.
- Numerical methods produce solutions in steps; each step gives the solution for one set of conditions. The steps are repeated to expand the range of the solution
- In case of static models like corporate model, the distinction between terms 'simulation' and 'numerical computation' can not be distinguished however in dynamic models, it can be
- Solving the equations of the model, step by step, with increasing values of time - ***simulation***

System Simulation

- System simulation – the technique of solving problems by the observation of the performance over time, of a dynamic model of the system
- Not only the time constraint, but randomized selection in a step-by-step transition system is also considered as system simulation

Black board example

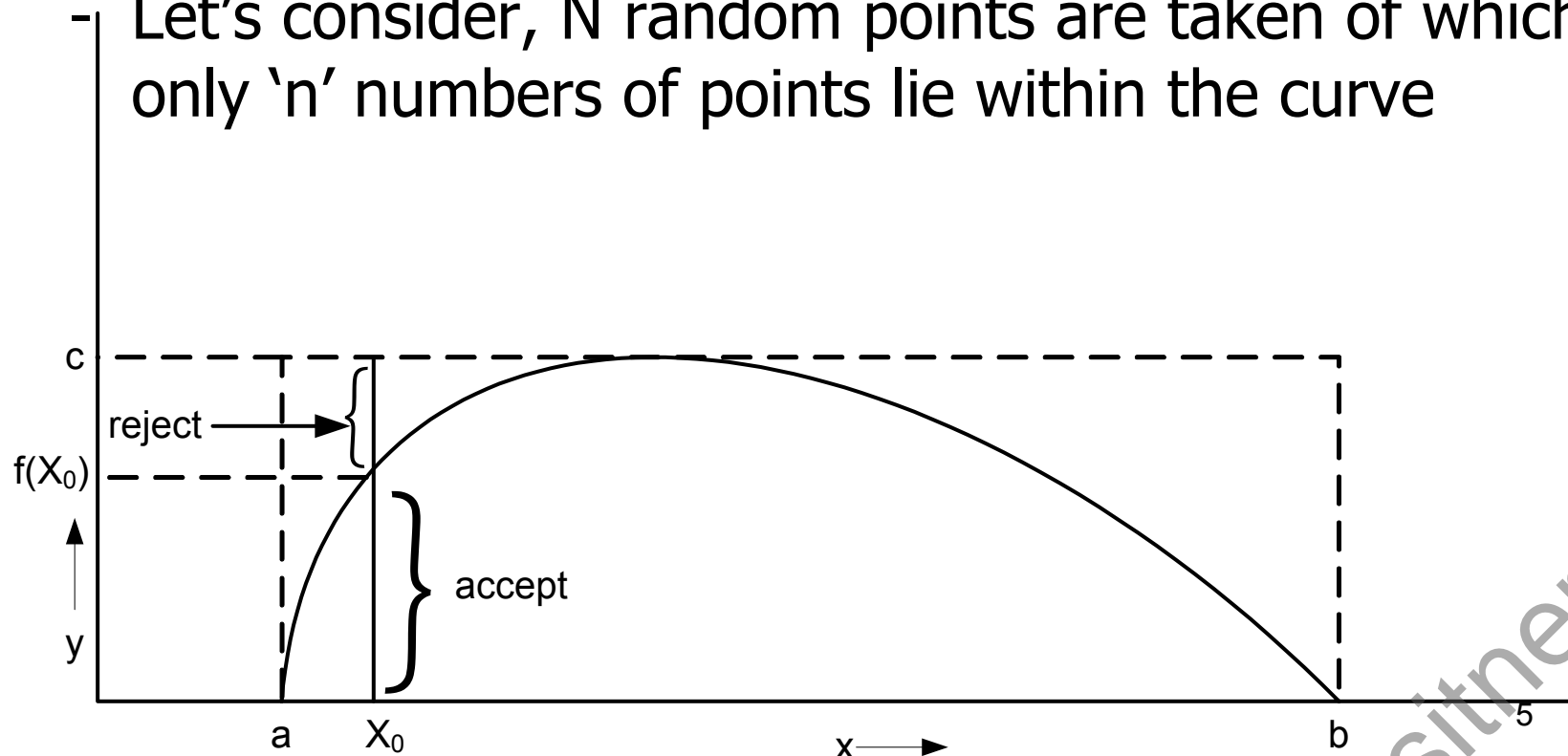
The Monte Carlo Method

- Originally used for variable reduction
- Uses random numbers as the input sample
- Computational technique applied to static models

- Define a function and select random numbers
- Test the function against the random numbers
- The good accuracy can be achieved by increasing the number of random samples

The Monte Carlo Method

- Let $f(x)$ be a function defined and has lower and upper bounds a , b and c .
- The function will be bounded by the area $c \cdot (b-a)$
- Let's consider, N random points are taken of which only ' n ' numbers of points lie within the curve



(C) Pramod Parajuli, 2004

The Monte Carlo Method

- The ratio will lead to;

$$\frac{n}{N} = \int_a^b \frac{f(x)dx}{c(b-a)}$$

- It seems like when the value of 'n' is increased, the accuracy will be increased, but since the value of 'n' again depends on 'N', the accuracy is increased for greater value of N
- Only the points satisfying $Y \leq f(x_0)$ are accepted otherwise rejected
- If rejected then another point is selected randomly

Simulation vs. Analytical methods

- Simulation gives specific solution for given set of data whereas analytical method gives solution for all of the conditions
- To find the general solution, the simulation needs to be repeated many times
- For analytical study, the system should be modeled by using some specific format
- Simulation consists of lots of step by step execution. If the simulation is run for several times, then there will be increase in detail complexity
- Ideal way for simulation-use extension of mathematical solⁿ

Experimental Nature of Simulation

- Simulation: observe the way in which all variables of the model change with time
- Instead of using analytical solutions, a system might be tested against lots of input samples and the output is observed
- The relationship between input and output can be discovered
- Requires lots of simulation runs
- Popular in system study
- Must be planned as a series of experiments