Applied Stochastic Process

Simulation

CHEUNG Ying Lun

Capital University of Economics and Business

Exercise

Suppose $X \sim Geo(p)$ with $p = 0.5$. Find $\mathbb{E}\left[g(X)\right]$ where

▶ $g(X) = |X|^3$.

▶ $g(X) = \cos(X)$.

▶ $g(X) = \mathrm{e}^X$.

▶ $g(X) = \log(X)$

Monte Carlo Simuation

Definition

The Monte Carlo method is a class of computational algorithms that rely on repeated random sampling to provide approximate solutions to a (complex) problem.

Steps in Monte Carlo simulation:

1. Determine the model
   1.1 Dynamic/static model, deterministic/stochastic model
   1.2 Statistical properties (e.g., distribution, dependence) of input variables

2. Generate N independent sets of random inputs

3. Perform the desired deterministic calculation with the generated inputs

4. Analyze the statistical properties of the results (e.g., expectation, distribution, moments)

首都经济贸易大学
CAPITAL UNIVERSITY OF ECONOMICS AND BUSINESS

Applications of simulation

1. Calculate π
2. Financial stress testing
3. Weather forecasting
4. AI for video games
5. Flight simulator
6. ...

Advantages:

- ► Usually much cheaper and easier than real operation
- ► "What-if" analysis is possible
- ► Insight can be obtained about the interaction and importance of variables and parameters in a system

Disadvantage:

- ► Model building can be difficult
- ► Model can only serve as an approximation
- ► Results are numerical (i.e., analytical solution cannot be obtained)