

STA 3180 Statistical Modelling: Simulation

STA 3180 Statistical Modelling - Lecture Notes on Simulation

Introduction

Simulation is a powerful tool for understanding and analyzing complex systems. It is a way of using computers to create models of real-world situations, allowing us to explore the behavior of those systems under different conditions. Simulation can be used to study the effects of changes in input parameters, to predict outcomes, and to gain insight into the behavior of complex systems.

Key Concepts

* **Random Number Generation***: Random numbers are essential for simulation. They are used to generate random variables that represent the inputs to the system being simulated.

* **Monte Carlo Simulation***: Monte Carlo simulation is a type of simulation that uses random numbers to generate outcomes. This type of simulation is often used to study the behavior of complex systems.

* **Stochastic Processes***: Stochastic processes are processes that involve randomness. They are often used in simulation to model the behavior of a system over time.

* **Discrete Event Simulation***: Discrete event simulation is a type of simulation that models the behavior of a system over discrete time intervals.

Definitions

* **Simulation***: Simulation is a method of using computers to create models of real-world situations, allowing us to explore the behavior of those systems under different conditions.

* **Random Number Generation***: Random number generation is the process of generating random numbers for use in simulation.

* **Monte Carlo Simulation***: Monte Carlo simulation is a type of simulation that uses random numbers to generate outcomes.

* **Stochastic Processes***: Stochastic processes are processes that involve randomness. They are often used in simulation to model the behavior of a system over time.

* **Discrete Event Simulation***: Discrete event simulation is a type of simulation that models the behavior of a system over discrete time intervals.

Coding Examples

Example 1 - Generating Random Numbers

Start of Code

```

```
Generate a random number between 0 and 1
import random
random_number = random.random()
```

```
print(random_number)
...
```

End of Code

### ### Example 2 - Simulating Coin Flips

Start of Code

```
...

Simulate 10 coin flips
import random

Set the number of flips
num_flips = 10

Initialize a list to store the results
results = []

Simulate the flips
for i in range(num_flips):
 # Generate a random number between 0 and 1
 random_number = random.random()

 # If the random number is less than 0.5, it's heads
 if random_number < 0.5:
 results.append('H')
 # Otherwise, it's tails
 else:
 results.append('T')

Print the results
print(results)
...
```

End of Code

### ## Practice Multiple Choice Questions

1. What is the purpose of simulation?
  - A. To study the effects of changes in input parameters
  - B. To predict outcomes
  - C. To gain insight into the behavior of complex systems
  - D. All of the above

Answer: D. All of the above