

STA 3180 Statistical Modelling: Monte Carlo Methods

Monte Carlo Methods - STA 3180 Statistical Modelling

Monte Carlo methods are a class of computational algorithms that use random numbers to generate numerical results. They are used in a variety of fields, including physics, finance, and engineering. Monte Carlo methods are particularly useful for solving complex problems that cannot be solved analytically.

Key Concepts

- Monte Carlo methods are a type of computational algorithm that use random numbers to generate numerical results.
- Monte Carlo methods are used in a variety of fields, including physics, finance, and engineering.
- Monte Carlo methods are particularly useful for solving complex problems that cannot be solved analytically.
- Monte Carlo methods can be used to estimate parameters, simulate systems, and optimize decisions.

Definitions

- **Random Number Generator:** A random number generator is a computer program or hardware device that generates a sequence of numbers that are unpredictable and random.
- **Simulation:** Simulation is the imitation of the operation of a real-world process or system over time.
- **Optimization:** Optimization is the process of finding the best solution to a problem by exploring all possible solutions and selecting the one that best meets the criteria.

Coding Examples

Example 1: Estimating Pi

Start of Code

```
import random
n = 1000000
inside = 0
for i in range(n):
    x = random.random()
    y = random.random()
    if x*x + y*y <= 1:
        inside += 1
pi = 4 * inside / n
print(pi)
```

End of Code

Example 2: Simulating a Coin Toss

Start of Code

```
import random
n = 100
heads = 0
for i in range(n):
    if random.random() < 0.5:
        heads += 1
print(heads/n)
```

End of Code

Practice Multiple Choice Questions

Q1. What is the purpose of Monte Carlo methods?

- A. To generate random numbers
- B. To solve complex problems
- C. To estimate parameters
- D. To simulate systems

Answer: B. To solve complex problems