

STA 3180 Statistical Modelling: Markov Chain Monte Carlo

Extra Practice Problems: Markov Chain Monte Carlo

1. Explain how to calculate the acceptance probability for a Metropolis-Hastings algorithm.

The acceptance probability for a Metropolis-Hastings algorithm is calculated by comparing the ratio of the posterior probabilities of the current and proposed states. The acceptance probability is then given by the formula:

$$A(x_i, x_j) = \min\left(1, \frac{P(x_j|y)}{P(x_i|y)}\right)$$

Where x_i is the current state and x_j is the proposed state.

[CORRECT]

2. Write a code in R to generate a random walk using the Metropolis-Hastings algorithm.

Start of Code

```
# Generate a random walk using the Metropolis-Hastings algorithm
# Set the number of steps
n <- 100
# Set the initial value
x <- 0
# Create an empty vector to store the values
x_vec <- c()
# Set the step size
step_size <- 0.5
# Set the acceptance probability
acceptance_prob <- 0.5
# Generate the random walk
for (i in 1:n) {
  # Generate a random number
  x_proposed <- x + rnorm(1, mean = 0, sd = step_size)
  # Calculate the acceptance probability
  acceptance_prob <- min(1, exp(x_proposed - x))
  # Generate a random number between 0 and 1
  u <- runif(1)
  # Accept or reject the proposed value
  if (u < acceptance_prob) {
```

```
      x <- x_proposed
    }
    # Store the value
    x_vec <- c(x_vec, x)
  }
End of Code
```

[CORRECT]