

# 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 state
x <- 0
# Create an empty vector to store the results
results <- c()
# Loop through the steps
for (i in 1:n) {
  # Propose a new state
  x_proposed <- rnorm(1, mean = x, sd = 1)
  # Calculate the acceptance probability
  A <- min(1, dnorm(x_proposed, mean = x, sd = 1) / dnorm(x, mean = x,
    sd = 1))
```

```
# Generate a random number between 0 and 1
u <- runif(1)
# Compare the random number to the acceptance probability
if (u < A) {
  # Accept the proposed state
  x <- x_proposed
}
# Store the result
results <- c(results, x)
}
End of Code
```

[CORRECT]