THE METROPOLIS HASTINGS ALGORITHM

Jash Ratanghayra: 234101019 Kishan Thakkar: 234101024

PROBLEM STATEMENT:

The objective of this assignment is to explore the Metropolis-Hastings algorithm, a Markov chain Monte Carlo (MCMC) method for sampling from a complex probability distribution.

Given a target distribution,

$P(x) = \alpha.\exp(-x^4).(2+ \sin(5x)+\sin(-2x^2))$

which is difficult to sample directly due to the complexity of the integral, the task is to employ the Metropolis-Hastings algorithm to generate samples from this distribution using a normal distribution as the proposal distribution.

IMPLEMENTATION:

- Defined the target distribution function P(x) as described.
- Implemented the Metropolis-Hastings algorithm with a normal distribution as the proposal distribution.
- Generated samples from the target distribution using the implemented algorithm for three different values of the proposal distribution standard deviation (σ).
- Plotted histograms of the generated samples and compared them with the actual distribution for each value of σ.
- Plotted the generated sample versus iteration (Markov chain) for each value of σ.
- Generated and saved plots as images, each containing two subplots for one value of σ to visualize the histogram of generated samples and the Markov chain.

CONCLUSION:

The implementation successfully demonstrates the usage of the Metropolis-Hastings algorithm to generate samples from a complex probability distribution, circumventing the difficulty of directly sampling from it. The generated samples exhibit similarity to the actual distribution, as evidenced by the histograms and Markov chain plots, validating the effectiveness of the algorithm in approximating the target distribution.

PROGRAM OUTPUT: