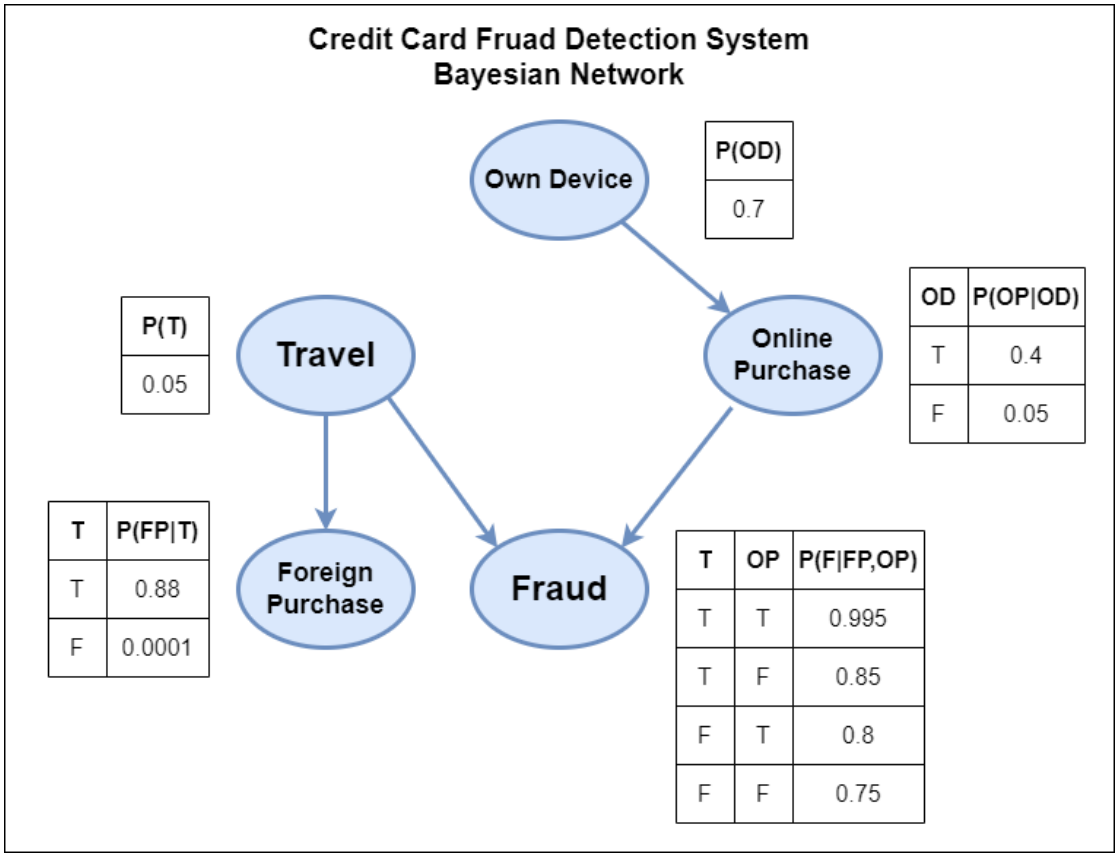
CS561 Assignment 1 Report

Submitted By – Akshat Mittal, 200101011
Dhananjai, 200101029

Exercise 1: Bayesian Network

The Bayesian network represents a probabilistic graphical model depicting the relationships between various random variables involved in a scenario.
Based on the description given in question and assumptions made as mentioned below, we came to following Bayesian Network for "*Credit Card Fraud Detection System"*.
The CPTs corresponding to each node along with dependencies are also shown in the figure.

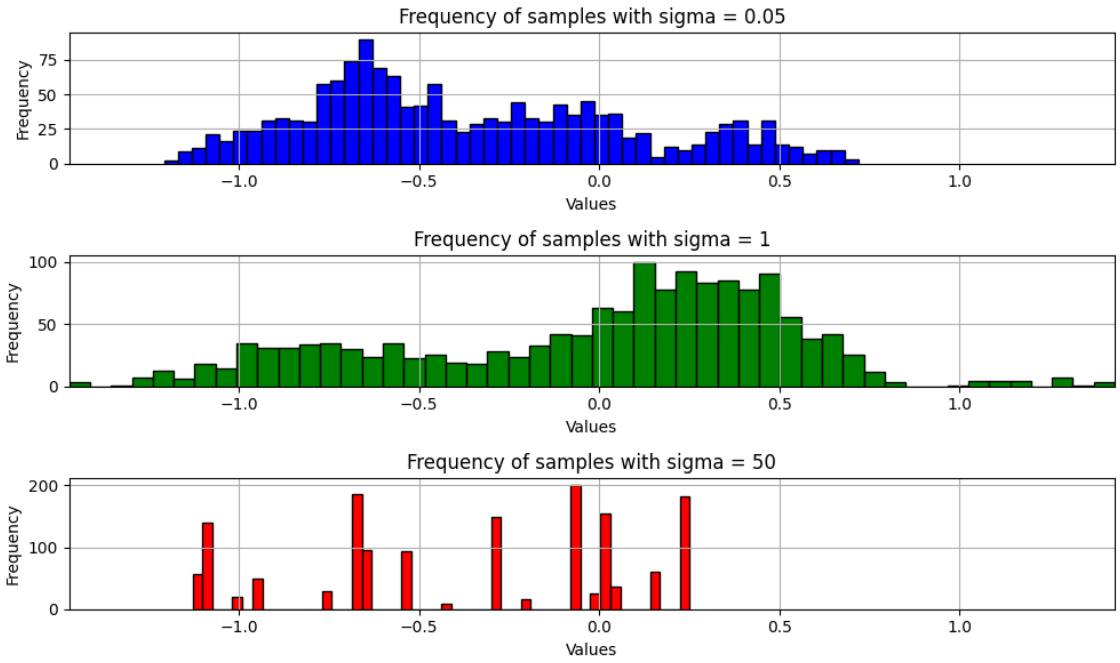


- Probability of a person travelling is 0.05 while that of he owns a device is 0.7. These variables doesn't have parents.
- Now the probability of online purchase in case person owns a device is 0.4 while 0.05 if he doesn't own one.
- Similarly, the probability of foreign purchase is 0.88 if person is travelling while just 0.0001 if he does not.
- Some assumptions are made for the *'Fraud'* variable. It depends on two things: *'Travel'* and *'Online Purchase'*.
- I have assumed the given values in description describe the following probabilities:
    - P(~F | T, OP) = 5%
    - P(~F | ~T, OP) = 20%
    - P(~F | T, ~OP) = 15% and
    - P(~F | ~T, ~OP) = 25%
- These values were slightly unclear from the language and thus, I have assumed these values in order to get the CPT for fraud.

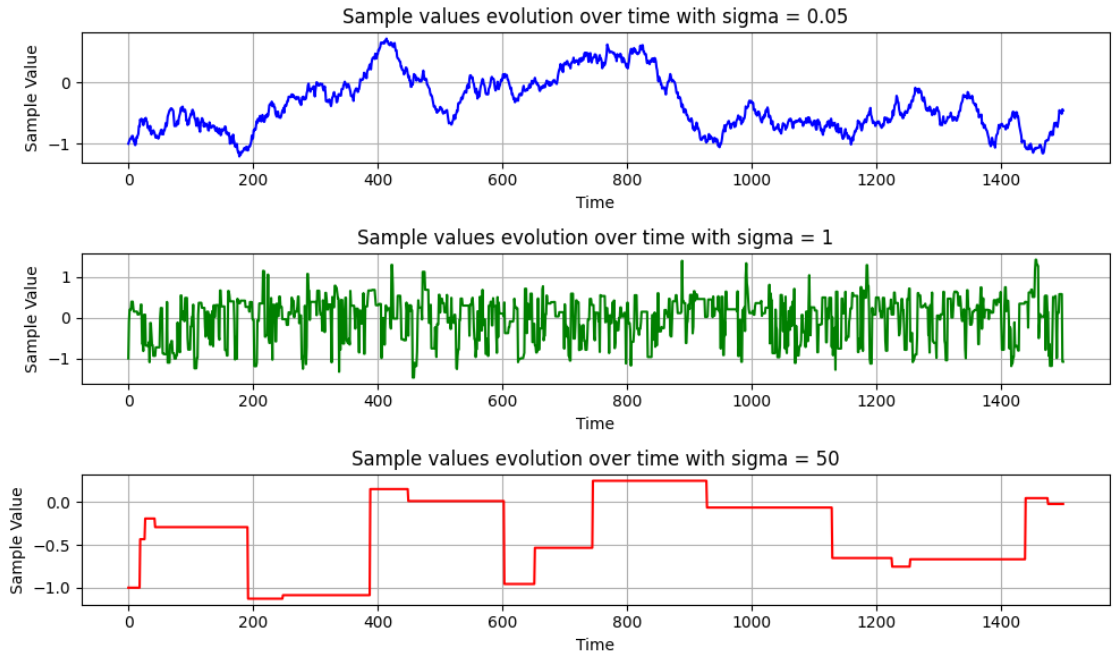
Exercise 2: Metropolis-Hastings algorithm

Metropolis-Hastings Algorithm is a MCMC method for sampling and making an inference for the required probability.
The samples were generated for 3 different values of sigma: 0.05 (low), 1 (medium) and 50 (High) starting with initial sample of x = -1 and plotted in two different ways.

1. **Frequency of samples**



2. **Evolution of samples over time**



<u>Conclusion</u>:

- From the graphs we can see that with the increase of sigma, the graphs get more and more flattened.
- The high variance proposal produces a reasonable looking histogram because of a poor choice of bin width and the low variance proposal would appear to explore the space well.
- A common feature of such diagnostic approaches is that great care is required in order to reach the correct conclusions.