Lab 1 -Introduction to Bayesian

January 18, 2024

Question 1

Generate random samples from different distributions:

$$\text{samples\_bernoulli} \sim \text{Bernoulli}(0.6)$$
$$\text{samples\_binomial} \sim \text{Binomial}(10, 0.6)$$
$$\text{samples\_poisson} \sim \text{Poisson}(1.5)$$
$$\text{samples\_normal} \sim \text{Normal}(0, 4)$$
$$\text{samples\_uniform} \sim \text{Uniform}(-2, 2)$$
$$\text{samples\_beta} \sim \text{Beta}(2, 1)$$
$$\text{samples\_gamma} \sim \text{Gamma}(2, 0.5)$$
$$\text{samples\_inverse\_gamma} \sim \text{Inverse-gamma}(2, 0.5)$$

Question 2

Generate 50 random samples from a discrete distribution with given probabilities.

Question 3

Generate samples using conditional distribution based on a Bernoulli distribution:

$$X \sim \text{Bernoulli}(0.6)$$
$$Y = \begin{cases} \text{Gamma}(2, 0.5) & \text{if } X = 0 \\ \frac{1}{\text{Gamma}(2,0.5)} & \text{if } X = 1 \end{cases}$$

Question 4

Generate samples from a Beta-Binomial distribution:

$$Y \sim \text{Beta}(2, 4)$$
$$X \sim \text{Binomial}(10, Y)$$

Question 5

Draw 50 samples from a bivariate normal distribution with mean vector $\mu = [2, 2]$ and covariance matrix $\Sigma = \begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix}$.

Question 6

Draw random samples from a unit square.

Question 7

Draw random samples from a unit circle.

Question 8

Find the normalizing constant for a given function using Monte Carlo simulation.

Question 9

Find the normalizing constant for the product of two independent distributions.

Question 10

Find the normalizing constant for a bivariate distribution using Monte Carlo simulation or double integration.