IIIT Vadodara
WINTER 2021-2022
MA202 Numerical Techniques
Lab # 9 Monte Carlo Integration

Exercise 1

Write a program to numerically evaluate the integral of the function $f(x) = \frac{\sin(\lambda x)}{x}$, from $x = -10$ to $x = 10$, for the values of $\lambda = 0.01,0.1,1,10,100$. Repeat the same exercise as above for $g(x) = \exp(\sin(\lambda x))$, for which the integration limits are $x = 0$ to $x = 5\pi$. Note that your answers should be accurate upto 5th significant digit. Also mention the estimated error in the evaluation. Do clearly mention number of sampling done in each case.

Exercise 2

Write a program to numerically integrate the multi-dimensional integral $\int_{-L}^{L} dx_1 \int_{-L}^{L} dx_2 \cdots \int_{-L}^{L} dx_n \ \exp[-\frac{1}{2}(x_1^2 + x_2^2 + \cdots + x_n^2)]$. Take $n = 8,9,10$ and $L = 10$ to evaluate the integral. Your answer should be accurate upto 5th significant digit. Please mention the number of sampling needed as also the variance estimate in each case.

Exercise 3

Use the above written program to evaluate this integral $\int_{-L}^{L} dx_1 \int_{-L}^{L} dx_2 \cdots \int_{-L}^{L} dx_n \ \exp[-\frac{1}{2} x^T \cdot A \cdot x]$, where the matrix $x = (x_1, x_2, \cdots, x_n)$, and the matrix A is such that, $A_{ij} = 1$ when $|i - j| = 1$, else $A_{ij} = 0$. Take $n = 8,9,10$ and $L = 10$ to evaluate the integral. Your answer should be accurate upto 5th significant digit. Please mention the number of sampling needed as also the variance estimate in each case.