

Science 2 -Assignment 2 (2024)
(Total Marks 20)

Submit on or before 19th February, 2024

Q1. Perform integration using the Monte Carlo method* for the functions applicable to you. The functions you need to use is your Roll Number % 5 + 1. Therefore, if your Roll Number is 2021101110, take option 1. Similarly for 2021101113, take option 4. Attach your script as well.

1. (a) $\sin x$ in the range $[-\pi, \pi]$ (b) $x \sin x$ in the range $[-\pi, \pi]$
2. (a) $\cos x$ in the range $[-\pi, \pi]$ (b) $x^2 \cos x$ in the range $[-\pi/2, \pi/2]$
3. (a) e^x in the range $[-3, 3]$ (b) $e^x \cos x$ in the range $[-1, 1]$
4. (a) $x^2 + 2x$ in the range $[-1, 1]$ (b) $x^2 \sin x$ in the range $[-\pi/2, \pi/2]$
5. (a) $1 + ax$ in the range $[-5, 5]$ (b) $\cos x - \cos 2x$ in the range $[-\pi/2, \pi/2]$

(*Plot the integration value as a function of N (number of samples) where $N = 10, 10^2, 10^3, 10^4$) **(5+5)**

Q2. You need to simulate 1D Random Walks with N timesteps with step size of 1 in each timestep. The person has equal probabilities of moving in either direction, i.e, at each step the person can move -1/+1.

i) A drunk person starts out at initial position "a". Plot the probability that the person returns back to the origin after N timesteps for different values of N in the range of 1 to 100. **(3 marks)**

ii) Now assume, two drunk people start out at initial positions "a" and "b" respectively. Plot the probability that they meet again after N timesteps for different values of N in the range of 100 to 1000, with the increment of 50. **(4 marks)**

iii) Plot the mean displacement for a drunk person after N steps for different values of N in the range of 1 to 100. You can assume that the person starts out at the origin. **(3 marks)**

To compute probabilities (in subparts i and ii) and mean (in subpart iii) simulate the experiments appropriate number of times (at least 1000).

$a = -(\text{Roll Number \% } 5 + 1), \quad b = 2 * (\text{Roll Number \% } 10)$

Therefore, if your Roll Number is 2021101132, then $a = -3, b = 4$.