Computing and Data Science

Simulations

Assignment no. 3

3rd Year

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1. Solve this integral using Monte Carlo simulation:

$$\int_1^5 \frac{x^4}{3}\,dx$$

Using the below random numbers:

86043 23973 66248 97697 38244 50918 55441 51217 54786 04940
50807 51453 03462 61157 65366 61130 26204 15016 85665 97714
92168 82530

Answer:

First calculate the integration:

$$\int_1^5 \frac{x^4}{3}\,dx = \left[\frac{x^5}{15}\right]_1^5 = 208.2666667$$

Second draw container with:

- Width of this container = 1 to 5 = 4
- The height of this container = up to 208.33333
  - Say the height = 210
- X = RN *0.1 because it must be between 1-5
- Y= $\frac{RN}{100} * 210$
  - If $\frac{x^4}{3}$ **>** y it is under curve & M++
  - If $\frac{x^4}{3}$ **<** y it is above curve & not update M
  - If $\frac{x^4}{3}$ **=** y it is on curve & not update M

Random Number for X	X coordinate	Random number of Y	Y Coordinate = (RN)*210	$\frac{X^4}{3}$	M	N
32	3.2	0.39	81.9	34.9525	0	1
24	2.4	0.89	186.9	11.0592	0	2
38	3.8	0.24	50.4	69.504533	1	3
45	4.5	0.09	18.9	136.6875	2	4
18	1.8	0.55	115.5	3.4992	2	5
44	4.4	0.15	31.5	124.936533	3	6
12	1.2	0.17	35.7	0.6912	3	7
49	4.9	0.40	84	192.16003	4	8
50	0.5	0.80	168	0.020833	4	9
14	1.4	0.53	111.3	1.280533	4	10
46	4.6	0.26	54.6	149.24853	5	11
11	1.1	0.57	119.7	0.488033	5	12
36	3.6	0.66	138.6	55.9872	5	13
11	1.1	0.30	63	0.488033	5	14
26	2.6	0.20	42	15.232533	5	15
41	4.1	0.50	105	94.192033	5	16
16	1.6	0.85	178.5	2.184533	5	17
14	1.4	0.92	193.2	1.280533	5	18
16	1.6	0.88	184.8	2.184533	5	19
25	2.5	0.30	63	13.020833	5	20

$$I = \frac{M}{N} * A$$

Where: A = 4*210 = 840

$$I = \frac{5}{20} * 840 = 210$$

2. Consider the previous random walk problem, the drunk can take steps in four directions which are forward, backward, left, and right. The probabilities associated with these are 40%, 10%, 25%, and 25%. However, the distance covered is not equal in all directions as in the previous problem. The distance covered in the forward, backward, left and tight steps are 75 cm, 45 cm, 60 cm, and 60 cm respectively. Simulate the walk using the same random numbers stated in the previous problems for 20 steps and find the location at the end of the 20 steps, in which the starting point at the X and Y coordinates is (0,0)

Answer:

Direction	Probability	Cumulative	Random Numbers Assigned
Forward - F	40	40	1- 40
Backward-B	10	50	41 - 50
Left - L	25	75	51-75
Right - R	25	100	76-00

When:

- the drunk steps in the forward direction, y+75
- the drunk steps in the backward direction, y--45
- the drunk steps to the right direction, x+60
- the drunk steps to the left, x-60

Using Random Numbers:

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6 2 0 6 8 5 7 7 9 8 4 8 2 6 2 1 3 9 8 4

Step	Random Numbers	Direction	X Coordinate	Y Coordinate
1	86	R	60	0
2	04	F	60	75
3	32	F	60	150
4	39	F	60	225
5	73	L	0	225
6	66	L	-60	225
7	24	F	-60	300
8	89	R	0	300
9	76	R	60	300
10	97	R	120	300
11	38	F	120	375
12	24	F	120	450
13	45	B	120	405
14	09	F	120	480
15	18	F	120	555
16	55	L	60	555
17	44	B	60	510
18	15	F	60	585
19	12	F	60	660
20	17	F	60	735

His position after all steps is The position is (60,735)