2019

B.Sc.

3rd Semester Examination

STATISTICS (Honours)

Paper - SEC 1-T

MONTE CARLO METHOD

Full Marks : 40   Time : 2 Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practiable.

1. Answer any *five* out of eight questions :   2×5=10

   (a) Give an example to show how rolling a die can
       be used for Monte Carlo simulation.   2

   (b) How can you generate random variables from
       Binomial distribution by Monte Carlo method ?
                                                    2

   (c) What is Monte Carlo integration ?   2

[Turn Over]

(d) Explain the CDF inversion method to simulate 100 random variables from an Exponential distribution with mean λ. 2

(e) What is the basic idea of importance sampling? 2

(f) Give the command in R for generating 100 random variables from Uniform (0, 1) distribution. 2

(g) How can you generate the same sequence of random numbers every time ? 2

(h) How can you perform Monte Carlo simulation by tossing a coin ? 2

2. Answer any *four* out of six questions : 5×4=20

(a) Use Monte Carlo simulation to evaluate the probability more than 4 tails by tossing an unbiased coin 10 times. 5

(b) Explain the process of simulating random variables from standard normal distribution using Box Muller transformation by Monte Carlo methods? 5

(c) How do you compare the simulation of random variables using Monte Carlo methods with those simulated directly from R ? Explain the comparison with the help of cdf inversion method and the use of histograms.   5

(d) How can you use Monte Carlo simulation to find the probability of getting an odd sum by rolling an unbiased die twice ?   5

(e) Give the commands in R to approximate E[g(x)] where $X \sim Exp$ (2 = Mean) i.e.,

$$f(x) = \frac{1}{2}e^{-x/2} \; ; \; x > 0$$ using Monte Carlo simulation where $g(x)$ is a given function of the random variable X.   5

(f) Use importance sampling to evaluate the integral $P[Z \le 5.6]$ where $Z \sim N$ (0, 1).   5

3. Answer any *one* out of two questions :   10×1=10

(a) Use the CDF inversion method to simulate observations from a Cauchy distribution with location parameter 0.5 and scale parameter 1. Hence find the raw moments of the first two orders.   5+5

(b) (i) Explain with the help of an example the graphical demonstration of the Law of Large Numbers. 5

(ii) How can you approximate value of pi(π) by simulating dart throwing using Monte Carlo method in R ? 5

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Statistical Data Analysis using R

1. Answer any *five* out of eight questions : 2×5=10

   (a) Give the general syntax to create a matrix in R. Explain with an example. 2

   (b) How can you obtain a scatter plot in R ? 2

   (c) When is the abline ( ) command used in R ? 2

   (d) Given a vector of size 10, how can you extract the first 5 elements of the vector in R ? 2

   (e) What will be the output of log (−5.8) when executed on R console ? 2

   (f) How can you obtain the product of two matrices in R ? 2

   (g) Define histogram in R. 2

   (h) In R how you can import Data ? 2

2. Answer any *four* out of six questions : 5×4=20

   (a) How do you obtain the different descriptive statistics measures of a given set of raw data in R ? Explain with an example. 5

[Turn Over]

(b) Implement simple linear regression using lm(y~x).

5

(c) Suppose there are twelve multiple choice questions in an English class quiz. Each question has five possible answers and only one of them is correct. Write commands in R to find the probability of (given a student attempts to answer every question at random)

   (i) having exactly two correct answers.

   (ii) having at least ten correct answers.

   (iii) having four or less correct answers.   5

(d) What are the operations performed on matrix ?

5

(e) What is scatter plot ? Which function is used here ?   3+2

(f) Prepare a dataframe in R containing the following data.   1

Gender	Height
Male	135
Female	120
Male	165
Male	140
Female	125
Female	127

    (i) Write command in R to extract the height column from the whole dataframe.   2

    (ii) Write command in R to extract the height of females only.   2

3. Answer any *one* out of two questions :   10×1=10

(a) Create a vector using c(), seq(), and colon operator. Write a short note on box plot.   5+5

(b) Discuss briefly the commands in R used for various graphical representation of data.   10