Indian Institute of Technology, Madras - BS in Data Science and Applications

Notations :

1.Options shown in green color and with ✔ icon are correct.

2.Options shown in red color and with ✖ icon are incorrect.

Question Paper Name :	IIT M DEGREE AN2 EXAM QPE2 16 JULY 2023
Subject Name :	2023 July: IIT M DEGREE AN2 EXAM QPE2
Creation Date :	2023-07-10 17:54:46
Duration :	120
Total Marks :	575
Display Marks:	Yes
Share Answer Key With Delivery Engine :	Yes
Actual Answer Key :	Yes
Calculator :	Scientific
Magnifying Glass Required? :	No
Ruler Required? :	No
Eraser Required? :	No
Scratch Pad Required? :	No
Rough Sketch/Notepad Required? :	No
Protractor Required? :	No
Show Watermark on Console? :	Yes
Highlighter :	No
Auto Save on Console?	Yes
Change Font Color :	No
Change Background Color :	No

Find the estimate $V(s_2)$ for every-visit MC.

Your answer should have exactly two places after the decimal point.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

2.74 to 2.76

Statistical Computing

Section Id :	64065339132
Section Number :	8
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	10
Section Marks :	35
Display Number Panel :	Yes
Group All Questions :	No
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	64065382966
Question Shuffling Allowed :	No
Is Section Default? :	null

Question Number : 156 Question Id : 640653578991 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 0

Question Label : Multiple Choice Question

THIS IS QUESTION PAPER FOR THE SUBJECT "DEGREE LEVEL : STATISTICAL COMPUTING (COMPUTER BASED EXAM)"

ARE YOU SURE YOU HAVE TO WRITE EXAM FOR THIS SUBJECT?

CROSS CHECK YOUR HALL TICKET TO CONFIRM THE SUBJECTS TO BE WRITTEN.

(IF IT IS NOT THE CORRECT SUBJECT, PLS CHECK THE SECTION AT THE TOP FOR THE SUBJECTS REGISTERED BY YOU)

Options :

6406531933088. ✔ YES

6406531933089. ✖ NO

Sub-Section Number :	2
Sub-Section Id :	64065382967
Question Shuffling Allowed :	Yes
Is Section Default? :	null

Question Number : 157 Question Id : 640653578992 Question Type : MSQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Consider an Accept-Reject method to draw samples from Beta(3, 4) distribution. Which among the following can act as a proposal distribution? Select all that apply:

Options :

6406531933090. ✔ Normal(0, 4)

6406531933091. ✖ Uniform(0, 1/2)

6406531933092. ✖ Bernoulli{0, 1}

6406531933093. ✔ *F*(2, 2)

6406531933094. ✔ Beta(0.5, 0.5)

Question Number : 158 Question Id : 640653578996 Question Type : MSQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Consider a random variable X with the following distribution:

$$f(x) = \begin{cases} \alpha + (1 - \alpha - \beta)e^{-\lambda} & \text{, for } x = 0 \\ \beta + (1 - \alpha - \beta)\lambda e^{-\lambda} & \text{, for } x = 1 \\ (1 - \alpha - \beta)\dfrac{e^{-\lambda}\lambda^x}{x!} & \text{, for } x > 1 \end{cases}$$

where, $0 < \alpha < 1, 0 < \beta < 1$. Then, which among the following is/are true?

Options :

6406531933103. ✖ X follows a one-inflated Poisson distribution.

6406531933104. ✔ For $\alpha = 0, \beta = 0$, X follows Poisson(λ) distribution.

6406531933105. ✔ For $\alpha = 0$, X follows a one-inflated Poisson distribution.

6406531933106. ✖ For $\beta = 0$, X follows a one-inflated Poisson distribution.

Sub-Section Number :	3
Sub-Section Id :	64065382968
Question Shuffling Allowed :	Yes
Is Section Default? :	null

Question Number : 159 Question Id : 640653578993 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 2

Question Label : Multiple Choice Question

In ratio-of-uniforms, for a target distribution F with finite support, consider enclosing the set C in a box $[a, b] \times [c, d]$ for the accept-reject set. What happens to the algorithm when b is halved?

Options :

6406531933095. ✔ The method need not produce samples from F.

6406531933096. ✖ On average, the method will generate the samples fast.

6406531933097. ✖ On average, the method will generate the samples low.

6406531933098. ✖ There will not be any effect on the sample generation.

Question Number : 160 Question Id : 640653578994 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 2

Question Label : Multiple Choice Question

The mixed congruential method is used to generate pseudorandom draw of size 1000 from $U(0, 1)$. The histogram for the 1000 generated pseudorandom numbers is as follows:
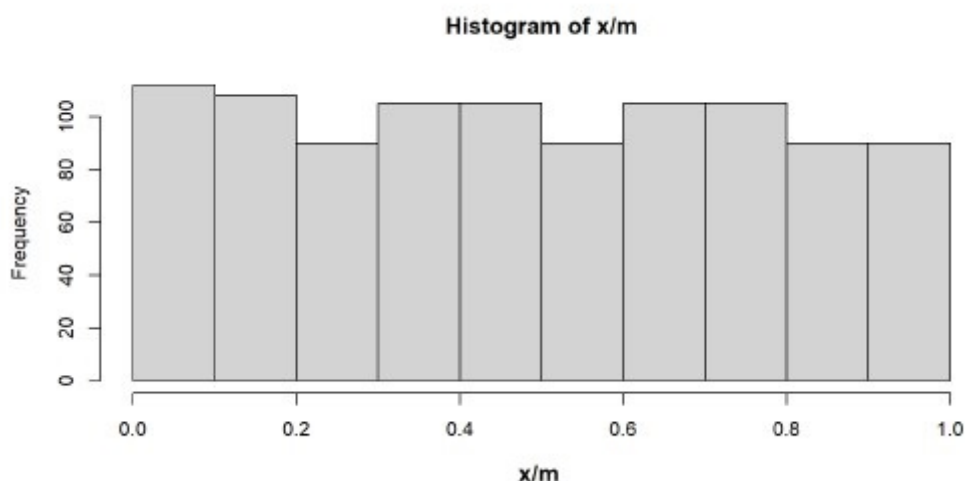
Histogram of x/m

By visualizing the plotted histogram, do the pseudorandom draws appear to be i.i.d $U(0, 1)$ distributed?

Options :

6406531933099. ✖ Yes

6406531933100. ✖ No

6406531933101. ✔ Insufficient information

Question Number : 161 Question Id : 640653579006 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 2

Question Label : Multiple Choice Question

Which among the following method can be used to generate samples from $Z \sim Normal(0, 1)$?

Options :

6406531933126. ✔ Box-Muller

6406531933127. ✖ Accept reject with exponential(1) proposal

6406531933128. ✖ Inverse transform

6406531933129. ✖ All of these

Sub-Section Number :	4
Sub-Section Id :	64065382969
Question Shuffling Allowed :	Yes
Is Section Default? :	null

Question Number : 162 Question Id : 640653578995 Question Type : SA Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Short Answer Question

To generate pseudorandom draws using the multiplicative congruential method, we have set *seed* = 5, *a* = 7 and *m* = 4. After how many steps, will the deterministic sequence follows?

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

2

Sub-Section Number :	5
Sub-Section Id :	64065382970
Question Shuffling Allowed :	No
Is Section Default? :	null

Question Id : 640653578997 Question Type : COMPREHENSION Sub Question Shuffling Allowed : No Group Comprehension Questions : No Question Pattern Type : NonMatrix Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Question Numbers : (163 to 164)

Question Label : Comprehension

Use the following information and answer the given subquestions.

The target distribution has a probability density function given by $f(x) = 10x^9$, where $x \in (0, 1)$. A uniform distribution $U(0, 1)$ is used as the proposal distribution.

Sub questions

Question Number : 163 Question Id : 640653578998 Question Type : SA Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Short Answer Question

What is the acceptance probability for the accept-reject in this case? (Enter your answer rounded to two decimal places)

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

0.10

Question Number : 164 Question Id : 640653578999 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 2

Question Label : Multiple Choice Question

An analyst advised to change the proposal distribution to *Beta*(2, 1). Shall we act upon his/her advice?

Options :

6406531933108. ✖ Yes, because it will increase the efficiency.

6406531933109. ✔ No, because it will reduce the efficiency.

6406531933110. ✖ Insufficient information to determine.

Sub-Section Number :   6

Sub-Section Id :   64065382971

Question Shuffling Allowed :   No

Is Section Default? :   null

Question Id : 640653579000 Question Type : COMPREHENSION Sub Question Shuffling Allowed : No Group Comprehension Questions : No Question Pattern Type : NonMatrix Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Question Numbers : (165 to 166)

Question Label : Comprehension

Use the following information and answer the given subquestions.

Use ratio-of-Uniform method to sample from a distribution with pdf

$$f(x) = x^{\alpha-1}e^{-x}, \qquad \text{where } x \geq 0, \alpha > 1.$$

Suppose you enclose the set C in a box $[a, b] \times [c, d]$ for the accept-reject step.

Sub questions

Question Number : 165 Question Id : 640653579001 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 4

Question Label : Multiple Choice Question

Select the correct statements from the following:

Options :

6406531933111. ✖ $a = 0, \ b = \left(\dfrac{\alpha - 1}{e}\right)^{(1-\alpha)/2}, \ c = 0, \ d = \left(\dfrac{\alpha + 1}{e}\right)^{(\alpha+1)/2}$

6406531933112. ✖ $a = 0, \ b = \left(\dfrac{\alpha + 1}{e}\right)^{(\alpha+1)/2}, \ c = 0, \ d = \left(\dfrac{\alpha - 1}{e}\right)^{(\alpha-1)/2}$

6406531933113. ✔ $a = 0, \ b = \left(\dfrac{\alpha - 1}{e}\right)^{(\alpha-1)/2}, \ c = 0, \ d = \left(\dfrac{\alpha + 1}{e}\right)^{(\alpha+1)/2}$

6406531933114. ✖ As α increases, the probability of acceptance in accept-reject increases.

Question Number : 166 Question Id : 640653579002 Question Type : SA Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Short Answer Question

Find the probability of acceptance for the accept-reject if α = 3. Enter the answer correct to three decimal places.

Note: e = 2.723

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

0.310 to 0.318

Sub-Section Number :	7
Sub-Section Id :	64065382972
Question Shuffling Allowed :	No
Is Section Default? :	null

Question Id : 640653579003 Question Type : COMPREHENSION Sub Question Shuffling Allowed : No Group Comprehension Questions : No Question Pattern Type : NonMatrix Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Question Numbers : (167 to 168)

Question Label : Comprehension

Use the following information and answer the given subquestions.

The code snippet given below generate samples from the Beta(2, 2) distribution.

```
f   <- function(x) 6*x*(1-x)
rg  <- function(u) ifelse((9*u-1)>=0, (9*u-1)^(1/3), -(1-9*u)^(1/3))
g <- function(x) ........(1)

generate.sample <- function(f, c, g, rg, n) {
  n.sample      <- 0
  result.sample <- rep(NA, n)

  while (n.sample < n) {
    y <- rg(runif(1))
    u <- runif(1,0,1)
    if (u < f(y)/(c*g(y))) {
      n.sample <- n.sample+1
      result.sample[n.sample] = y
    }
  }

  result.sample
}
```

Sub questions

Question Number : 167 Question Id : 640653579004 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 4

Question Label : Multiple Choice Question

Complete the function (1), in the given code snippet.

Options :

6406531933116. ✖ $(x\text{^}3+1)/9$ if $x \in [0, 2]$

6406531933117. ✔ $x\text{^}2/3$ if $x \in [-1, 2]$

6406531933118. ✖ $(9*x-1)\text{^}(1/3)$ if $x \in [0, 1]$

6406531933119.

✖ $(9x^2+6)/9$ if $x \in [0, 1]$

6406531933120. ✖ $(9x^2+6)/24$ if $x \in [0, 0.5]$

Question Number : 168 Question Id : 640653579005 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 4

Question Label : Multiple Choice Question

Which of the following is/are true about the given code snippet?

Options :

6406531933121. ✔ Both Inverse Transform and Accept-Reject algorithms are implemented.

6406531933122. ✖ Only one of Inverse Transform and Accept-Reject algorithms are implemented.

6406531933123. ✖ The given implemented Accept-Reject is correct as the support of function g is the same as that of function f.

6406531933124. ✖ The given implemented Accept-Reject is incorrect for the given function f and g.

6406531933125. ✖ The given implemented Inverse Transform algorithm is correct as the cumulative distribution function of f is invertible.

Advanced Algorithms

Section Id :	64065339133
Section Number :	9
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	12