

M.Tech (Online) Data Science and Business Analytics Stream Entrance Exam

Duration: 60 minutes | Total: 20 Questions

General Instructions

1. This paper contains 20 questions. All questions are compulsory.
2. Each question has four options (A, B, C, D). Mark your answer in the 'Mark here' column.
3. Each question may have one or more correct answers. Evaluate each option independently.
4. There is no negative marking.
5. Use of calculators, mobile phones, or any electronic device is NOT permitted.

1 Which of the following properties hold for any square matrix A?

A	$\det(A^T) = \det(A)$	<input type="radio"/> Mark here
B	$\det(2A) = 2 \cdot \det(A)$ [for an $n \times n$ matrix]	<input type="radio"/> Mark here
C	$\det(AB) = \det(A) \cdot \det(B)$	<input type="radio"/> Mark here
D	$\text{rank}(A) = \text{rank}(A^T)$	<input type="radio"/> Mark here

2 A fair die is rolled twice. What is the probability that the sum of the two outcomes equals 7?

A	1/6	<input type="radio"/> Mark here
B	7/36	<input type="radio"/> Mark here
C	1/7	<input type="radio"/> Mark here
D	5/36	<input type="radio"/> Mark here

3 What is the time complexity of accessing an element by index in a Python list (i.e., `arr[i]`)?

A	$O(\log n)$	<input type="radio"/> Mark here
B	$O(n)$	<input type="radio"/> Mark here
C	$O(1)$	<input type="radio"/> Mark here

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D	$O(n \log n)$	<input type="radio"/> Mark here
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4 Which measure of central tendency is most affected by extreme outliers in a dataset?		
A	Median	<input type="radio"/> Mark here
B	Mode	<input type="radio"/> Mark here
C	Mean	<input type="radio"/> Mark here
D	Geometric mean	<input type="radio"/> Mark here

5 Which of the following are correct statements about partial derivatives of $f(x, y)$?		
A	$\partial f/\partial x$ treats y as a constant	<input type="radio"/> Mark here
B	$\partial^2 f/\partial x \partial y$ always equals $\partial^2 f/\partial y \partial x$ for any function f	<input type="radio"/> Mark here
C	The gradient $\nabla f = (\partial f/\partial x, \partial f/\partial y)$ points in the direction of steepest ascent	<input type="radio"/> Mark here
D	If $\partial f/\partial x = 0$ and $\partial f/\partial y = 0$ at a point, that point is necessarily a local minimum	<input type="radio"/> Mark here

6 A system of linear equations $Ax = b$ has infinitely many solutions when:		
A	$\det(A) \neq 0$	<input type="radio"/> Mark here
B	$\text{rank}(A) = \text{rank}([A b]) = n$, where n is the number of unknowns	<input type="radio"/> Mark here
C	$\text{rank}(A) = \text{rank}([A b]) < n$	<input type="radio"/> Mark here
D	$\text{rank}(A) < \text{rank}([A b])$	<input type="radio"/> Mark here

7 A bag contains 5 red, 3 blue, and 2 green balls. Two balls are drawn without replacement. What is the probability that both are red?		
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M.Tech (Online) Data Science and Business Analytics Stream Entrance Exam

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A	1/4	<input type="radio"/> Mark here
B	2/9	<input type="radio"/> Mark here
C	5/18	<input type="radio"/> Mark here
D	1/5	<input type="radio"/> Mark here

8 What is the output of the following Python code?

```
def f(x, lst=[]):  
    lst.append(x)  
    return lst  
  
print(f(1))  
print(f(2))
```

A	[1] [2]	<input type="radio"/> Mark here
B	[1] [1, 2]	<input type="radio"/> Mark here
C	[1, 2] [1, 2]	<input type="radio"/> Mark here
D	Error: list is immutable default	<input type="radio"/> Mark here

9 A dataset has mean $\mu = 50$ and standard deviation $\sigma = 10$. Which statements are correct?

A	Approximately 68% of data lies within [40, 60] if the distribution is normal	<input type="radio"/> Mark here
B	The variance of the dataset is 100	<input type="radio"/> Mark here
C	Multiplying every value by 2 gives a new standard deviation of 20	<input type="radio"/> Mark here
D	Adding 5 to every value increases the standard deviation to 15	<input type="radio"/> Mark here

10 Using integration by parts, $\int x \cdot e^x dx$ equals:

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A	$e^x(x - 1) + C$	<input type="radio"/> Mark here
B	$e^x(x + 1) + C$	<input type="radio"/> Mark here
C	$x \cdot e^x + C$	<input type="radio"/> Mark here
D	$e^x/x + C$	<input type="radio"/> Mark here

11	Which of the following expressions correctly count the number of ways to choose 3 items from 8 distinct items?	
A	$8! / (3! \times 5!)$	<input type="radio"/> Mark here
B	$8P3 / 3!$	<input type="radio"/> Mark here
C	56	<input type="radio"/> Mark here
D	$8! / 3!$	<input type="radio"/> Mark here

12	A circle has centre (3, -2) and passes through the point (7, 1). What is its equation?	
A	$(x-3)^2 + (y+2)^2 = 25$	<input type="radio"/> Mark here
B	$(x+3)^2 + (y-2)^2 = 25$	<input type="radio"/> Mark here
C	$(x-3)^2 + (y+2)^2 = 5$	<input type="radio"/> Mark here
D	$(x-3)^2 + (y-2)^2 = 25$	<input type="radio"/> Mark here

13	Let A be an $n \times n$ matrix with eigenvalues $\lambda_1, \lambda_2, \dots, \lambda_n$. Which of the following are always true?	
A	$\text{tr}(A) = \lambda_1 + \lambda_2 + \dots + \lambda_n$	<input type="radio"/> Mark here
B	$\det(A) = \lambda_1 \times \lambda_2 \times \dots \times \lambda_n$	<input type="radio"/> Mark here
C	If all eigenvalues are distinct, A is always symmetric	<input type="radio"/> Mark here

M.Tech (Online) Data Science and Business Analytics Stream Entrance Exam

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D	A and A^T share the same set of eigenvalues	<input type="radio"/> Mark here
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14	You need to search for a target value in a sorted array of 10^6 elements. Which approach gives the best worst-case time complexity, and what is it?	
A	Linear search — $O(n)$	<input type="radio"/> Mark here
B	Binary search — $O(\log n)$	<input type="radio"/> Mark here
C	Hashing the array first, then $O(1)$ lookup — but $O(n)$ preprocessing	<input type="radio"/> Mark here
D	Jump search — $O(\sqrt{n})$	<input type="radio"/> Mark here

15	Events A and B satisfy $P(A) = 0.4$, $P(B) = 0.5$, $P(A \cup B) = 0.7$. Which of the following conclusions is correct?	
A	A and B are mutually exclusive	<input type="radio"/> Mark here
B	A and B are independent	<input type="radio"/> Mark here
C	A and B are both independent and mutually exclusive	<input type="radio"/> Mark here
D	A and B are neither independent nor mutually exclusive	<input type="radio"/> Mark here

16	For $f(x, y) = x^3 + y^3 - 3xy$, which of the following are true about its critical points?	
A	$(0, 0)$ is a critical point	<input type="radio"/> Mark here
B	$(1, 1)$ is a critical point	<input type="radio"/> Mark here
C	The Hessian determinant at $(1, 1)$ is positive, confirming a local minimum	<input type="radio"/> Mark here
D	$(0, 0)$ is a saddle point	<input type="radio"/> Mark here

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17 You need an LLM to extract all dates from a 500-word document and return them as a JSON array, using the fewest tokens possible. Which prompt achieves this best?

A	"Please read the following document carefully and then kindly extract all the dates that you can find in it and return them as a list in JSON format."	<input type="radio"/> Mark here
B	"Extract all dates from the text below. Return ONLY a JSON array of strings, no explanation.\n\n{text}"	<input type="radio"/> Mark here
C	"What are the dates in this text? List them."	<input type="radio"/> Mark here
D	"You are a helpful assistant. Your task is to find dates. The text is given. Extract dates and format as JSON."	<input type="radio"/> Mark here

18 Two algorithms A and B are tested on 30 datasets each. Algorithm A has mean accuracy 85% ($\sigma = 4\%$) and B has mean accuracy 83% ($\sigma = 8\%$). A t-test gives $p = 0.09$. At a 5% significance level, which conclusion is valid?

A	A is significantly better than B	<input type="radio"/> Mark here
B	B is significantly better than A	<input type="radio"/> Mark here
C	There is insufficient statistical evidence to conclude a significant difference	<input type="radio"/> Mark here
D	The result is inconclusive because the sample size is too small to run a t-test	<input type="radio"/> Mark here

19 You want to represent a sparse 1000×1000 matrix (mostly zeros) in Python for efficient row-wise operations. Which approaches are appropriate?

A	A standard 2D Python list of lists (1000×1000)	<input type="radio"/> Mark here
B	A dictionary of dictionaries: {row: {col: value}}	<input type="radio"/> Mark here
C	scipy.sparse.csr_matrix (Compressed Sparse Row)	<input type="radio"/> Mark here
D	A NumPy dense array of shape (1000, 1000)	<input type="radio"/> Mark here

20	A continuous random variable X has PDF $f(x) = kx^2$ for $x \in [0, 3]$, and 0 elsewhere. What is the value of k and $E[X]$?	
A	$k = 1/9, E[X] = 2.25$	<input type="radio"/> Mark here
B	$k = 1/9, E[X] = 2.0$	<input type="radio"/> Mark here
C	$k = 1/27, E[X] = 2.25$	<input type="radio"/> Mark here
D	$k = 3, E[X] = 9/4$	<input type="radio"/> Mark here

— End of Question Paper —