P R E F A C E

The principal purpose of writing this book "**GATE Statistics PYQ solutions**" is to cater to the needs of the candidates aspiring for "**GATE Statistics**" exam. It provides explanations of the previous year questions from the year **2019 to 2024**. To help students, we have compiled this book in a user-friendly and well-structured manner. **Book includes 11 chapters. First chapter is General Aptitude, next two chapters are of Mathematics syllabus and the rest chapters are of Statistics syllabus. Each chapter is divided into three sections which are MCQ, MSQ and NAT. Questions are sorted year-wise.** This fine sorting of questions will help the students to prepare for each subtopic effectively.

The book will help the reader to understand and solve all the previous year questions. Regular practice is the key to success in any competitive exam, and this book allows you to hone your problem-solving skills. We have tried to keep the material as simple as possible with easy explanations. The practice of these questions will help the students not only for GATE exam but also for other competitive exams like IIT-JAM, CUET, CSIR NET and other PhD entrances.

A word or suggestion from your side may add another feather to the cap in the compilation of questions in this book. The author looks forward to the comments, suggestions, and criticism from the students. Constructive suggestions and user feedback would be highly appreciated, gratefully acknowledged, and suitably incorporated. We wish all the best to all aspirants who are preparing for these exams.

A C K N O W L E D G E M E N T

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Exam Details

Mode of Examination	Computer Based Test
Duration of Exam	180 minutes
Total number of Questions	65
Total Marks	100
Language of Examination	English

Exam Pattern

Sections	**Section I** (General Aptitude)	**Section II** (Mathematics)
Number of Questions	10	55
Marks	5 questions of 1 mark each and 5 questions of 2 marks each	25 questions of 1 mark each and 30 questions of 2 marks each
Negative Marking	For 1-mark MCQ, 1/3 mark will be deducted for a wrong answer. For 2-mark MCQ, 2/3 mark will be deducted for a wrong answer. There will be no negative marking for MSQ & NAT.	
Types of Question	MCQ	MCQ, MSQ, NAT

Cut off

Year	General	EWS/OBS-NCL	SC / ST / PwD	Organizing Institute
2024	26.6	23.9	17.7	IISc Bengaluru
2023	25	22.5	16.6	IIT Kanpur
2022	25	22.5	16.6	IIT Kharagpur
2021	25	21.5	16.6	IIT Bombay
2020	25	22.5	16.6	IIT Delhi
2019	32.5	29.2	21.7	IIT Madras

Syllabus

Calculus: Finite, countable and uncountable sets; Real number system as a complete ordered field, Archimedean property; Sequences of real numbers, convergence of sequences, bounded sequences, monotonic sequences, Cauchy criterion for convergence; Series of real numbers, convergence, tests of convergence, alternating series, absolute and conditional convergence; Power series and radius of convergence; Functions of a real variable: Limit, continuity, monotone functions, uniform continuity, differentiability, Rolle's theorem, mean value theorems, Taylor's theorem, L' Hospital rules, maxima and minima, Riemann integration and its properties, improper integrals; Functions of several real variables: Limit, continuity, partial derivatives, directional derivatives, gradient, Taylor's theorem, total derivative, maxima and minima, saddle point, method of Lagrange multipliers, double and triple integrals and their applications.

Matrix Theory: Subspaces of and , span, linear independence, basis and dimension, row space and column space of a matrix, rank and nullity, row reduced echelon form, trace and determinant, inverse of a matrix, systems of linear equations; Inner products in and , Gram-Schmidt orthonormalization; Eigen values and eigen vectors, characteristic polynomial, Cayley-Hamilton theorem, symmetric, skew-symmetric, Hermitian, skewHermitian, orthogonal, unitary matrices and their eigen values, change of basis matrix, equivalence and similarity, diagonalizability, positive definite and positive semi-definite matrices and their properties, quadratic forms, singular value decomposition.

Probability: Axiomatic definition of probability, properties of probability function, conditional probability, Bayes' theorem, independence of events; Random variables and their distributions, distribution function, probability mass function, probability density function and their properties, expectation, moments and moment generating function, quantiles, distribution of functions of a random variable, Chebyshev, Markov and Jensen inequalities.

Standard Discrete and Continuous Univariate Distributions: Bernoulli, binomial, geometric, negative binomial, hypergeometric, discrete uniform, Poisson, continuous uniform, exponential, gamma, beta, Weibull, normal.

Jointly distributed random variables and their distribution functions, probability mass function, probability density function and their properties, marginal and conditional distributions, conditional expectation and moments, product moments, simple correlation coefficient, joint moment generating function, independence of random variables, functions of random vector and their distributions, distributions of order statistics, joint and marginal distributions of order statistics; multinomial distribution, bivariate normal distribution, sampling distributions: central, chi-square, central t, and central F distributions.

Convergence in distribution, convergence in probability, convergence almost surely, convergence in r-th mean and their inter-relations, Slutsky's lemma, Borel-Cantelli lemma; weak and strong laws of large numbers; central limit theorem for i.i.d. random variables, delta method.

Stochastic Processes: Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson process, birth-and-death process, pure-birth process, pure-death process, Brownian motion and its basic properties.

Estimation: Sufficiency, minimal sufficiency, factorization theorem, completeness, completeness of exponential families, ancillary statistic, Basu's theorem and its applications, unbiased estimation, uniformly minimum variance unbiased estimation, Rao-Blackwell theorem, Lehmann-Scheffe theorem, Cramer-Rao inequality, consistent estimators, method of moments estimators, method of maximum likelihood estimators and their properties; Interval estimation: pivotal quantities and confidence intervals based on them, coverage probability.

Testing of Hypotheses: Neyman-Pearson lemma, most powerful tests, monotone likelihood ratio (MLR) property, uniformly most powerful tests, uniformly most powerful tests for families having MLR property, uniformly most powerful unbiased tests, uniformly most powerful unbiased tests for exponential families, likelihood ratio tests, large sample tests.

Non-parametric Statistics: Empirical distribution function and its properties, goodness of fit tests, chi-square test, Kolmogorov-Smirnov test, sign test, Wilcoxon signed rank test, MannWhitney U-test, rank correlation coefficients of Spearman and Kendall.

Multivariate Analysis: Multivariate normal distribution: properties, conditional and marginal distributions, maximum likelihood estimation of mean vector and dispersion matrix, Hotelling's T 2 test, Wishart distribution and its basic properties, multiple and partial correlation coefficients and their basic properties.

Regression Analysis: Simple and multiple linear regression, R2 and adjusted R2 and their applications, distributions of quadratic forms of random vectors: Fisher-Cochran theorem, Gauss-Markov theorem, tests for regression coefficients, confidence intervals.

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NUMBER OF QUESTIONS ASKED IN GATE-STATISTICS (2019 to 2024)							
TOPICS		**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
1	GENERAL APTITUDE	10	10	10	10	10	10
2	CALCULUS	7	5	6	4	5	5
3	MATRIX THEORY	5	5	5	6	7	7
4	PROBABILITY	6	3	9	11	10	7
5	STANDARD DISCRETE & CONTINUOUS UNIVARIATE DISTRIBUTIONS	5	8	11	9	12	10
6	STOCHASTIC PROCESSES	5	5	5	4	4	4
7	ESTIMATION	8	5	3	5	6	4
8	TESTING OF HYPOTHESES	2	6	7	4	4	7
9	NON-PARAMETRIC STATISTICS	1	-	1	2	1	1
10	MULTIVARIATE ANALYSIS	7	11	4	3	3	4
11	REGRESSION ANALYSIS	8	6	3	3	2	5

CHAPTER-1 GENERAL APTITUDE

PREVIOUS YEARS EXAM QUESTIONS

Multiple Choice Questions (MCQ)

(2019)

1. The fishermen, _____the flood victims owed their lives, were rewarded by the government.

(A) whom (B) to which
(C) to whom (D) that

(2019)

2. Some students were not involved in the strike.

If the above statement is true, which of the following conclusions is/are logically necessary?

(1) Some who were involved in the strike were students.
(2) No student was involved in the strike.
(3) At least one student was involved in the strike.
(4) Some who were not involved in the strike were students.

(A) 1 and 2 (B) 3
(C) 4 (D) 2 and 3

(2019)

3. The radius as well as the height of a circular cone increases by 10%. The percentage increase in its volume is _____.

(A) 17.1 (B) 21.0
(C) 33.1 (D) 72.8

(2019)

4. Five numbers $10, 7, 5, 4$ and 2 are to be arranged in a sequence from left to right following the directions given below:

1. No two odd or even numbers are next to each other.
2. The second number from the left is exactly half of the left-most number.
3. The middle number is exactly twice the right-most number.

Which is the second number from the right?

(A) 2 (B) 4
(C) 7 (D) 10

(2019)

5. Until Iran came along, India had never been _____ in kabaddi.

(A) defeated (B) defeating
(C) defeat (D) defeatist

(2019)

6. Since the last one year, after a 125 basis point reduction in repo rate by the Reserve Bank of India, banking institutions have been making a demand to reduce interest rates on small saving schemes. Finally, the government announced yesterday a reduction in interest rates on small saving schemes to bring them on par with fixed deposit interest rates.

Which one of the following statements can be inferred from the given passage?

(A) Whenever the Reserve Bank of India reduces the repo rate, the interest rates on small saving schemes are also reduced
(B) Interest rates on small saving schemes are always maintained on par with fixed deposit interest rates
(C) The government sometimes takes into consideration the demands of banking institutions before reducing the interest rates on small saving schemes
(D) A reduction in interest rates on small saving schemes follow only after a reduction in repo rate by the Reserve Bank of India

(2019)

7. In a country of 1400 million population, 70% own mobile phones. Among the mobile phone owners, only 294 million access the Internet. Among these Internet users, only half buy goods from e-commerce portals. What is the percentage of these buyers in the country?

(A) 10.50 (B) 14.70
(C) 15.00 (D) 50.00

(2019)

8. The nomenclature of Hindustani music has changed over the centuries. Since the medieval period dhrupad styles were identified as baanis. Terms like gayaki and baaj were used to refer to vocal and instrumental styles, respectively. With the institutionalization of music education, the term gharana became acceptable. Gharana originally referred to hereditary musicians from a particular lineage, including disciples and grand disciples.

Which one of the following pairings is NOT correct?

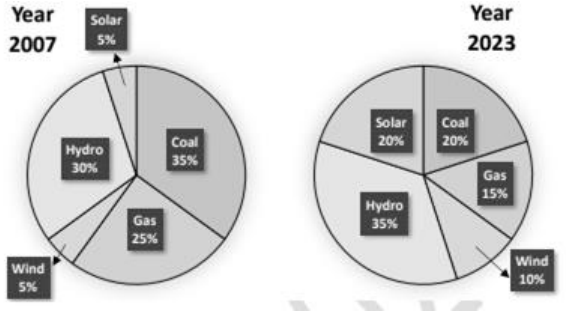
(2024)

57. A person sold two different items at the same price. He made 10% profit in one item, and 10% loss in the other item. In selling these two items, the person made a total of

(A) 1% profit (B) 2% profit
(C) 1% loss (D) 2% loss

(2024)

58. The pie charts depict the shares of various power generation technologies in the total electricity generation of a country for the years 2007 and 2023.



The renewable sources of electricity generation consist of Hydro, Solar and Wind. Assuming that the total electricity generated remains the same from 2007 to 2023, what is the percentage increase in the share of the renewable sources of electricity generation over this period?

(A) 25% (B) 50%
(C) 77.5% (D) 62.5%

(2024)

59. A cube is to be cut into 8 pieces of equal size and shape. Here, each cut should be straight and it should not stop till it reaches the other end of the cube. The minimum number of such cuts required is

(A) 3 (B) 4
(C) 7 (D) 8

(2024)

60. In the 4×4 array shown below, each cell of the first three rows has either a cross $(\mathbf{X})$ or a number.

1	X	4	3
X	5	5	4
3	X	6	X

The number in a cell represents the count of the immediate neighboring cells (left, right, top, bottom, diagonals) NOT having a cross (X). Given that the last row has no crosses$(\mathbf{X})$, the sum of the four numbers to be filled in the last row is

(A) 11 (B) 10
(C) 12 (D) 9

Answer Key									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
C	C	C	C	A	C	A	C	B	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	B	D	D	B	D	C	B	B	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	B	C	C	B	C	D	A	C	A
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
C	D	B	B	C	D	C	C	B	B
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
C	C	A	D	B	D	A	D	A	A
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
C	A	A	C	B	C	C	D	A	A

EXPLANATION

Multiple Choice Questions (MCQ)

1. Explanation: The preposition 'to' connects the 'whom' (Fishermen) to the flood victims 'whom' works as the object of the preposition here. Hence, it is correct answer.

'which' refer to things or matters at hand rather than people. 'that' and 'whom' are contextually incorrect here.

Therefore, the correct sentence is:

The Fishermen, **to whom** the flood victims owed their lives, were rewarded by the government.

∴ Option (C) is correct.

2. Explanation:

Statement 1: is the opposite of given, hence logically unnecessary.

Statement 2: Cannot be said as we do not have enough information. Hence it is logically unnecessary.

Statement 3: Cannot be said as we do not have enough information. Hence it is logically unnecessary.

Statement 4: is the same as given, hence logically necessary.

∴ Option (C) is correct.

3. Explanation: Volume of a circular cone is given by

$$V = \frac{1}{3}\pi r^2 h.$$

where r is radius, h is height of a circular cone.

Given that radius as well as the height increases by 10%

new radius $= 1.1r$

new height $= 1.1\text{h}$

Now, the volume will be.

$V' = \frac{1}{3}\pi(1.1r)^2(1.1h) = 1.331\left(\frac{1}{3}\pi r^2 h\right) = 1.331\ \text{V}.$

Hence, the increase in volume is $0.331\ \text{V}$.

Percentage increase in volume $= \frac{0.331\ \text{V}}{\text{V}} \times 100 = 33.1\%$

∴ Option (C) is correct.

4. Explanation: Five numbers $10, 7, 5, 4$ and 2 are to be arranged in a sequence from left to right.

(1) No two odd or even numbers are next to each other. The odd numbers will get arrange in second and fourth position.

(2) The second number from the left is exactly half of the left-most number. Left most position is even number, and second number from left is odd number, so only possibility to hold above condition is 10 and 5.

Sequence - 10 5 _ _ _

We need to fill the fourth position with an odd number, so, 7 will appear at fourth position.

Sequence - 10 5 _ 7 _

(3) The middle number is exactly twice the right most number.

Now, the remaining numbers are 4 and 2.

4 is exactly twice of 2.

So, the right most number will be 2 and the middle number will be 4.

Sequence: 10 5 4 7 2

The second number from right is 7

∴ Option (C) is correct.

5. Explanation: The given sentence is an example of the past perfect tense.

The past perfect tense used to express an action that began in the past and completed before some point in the past.

Structure

Subject + had + the third form of the verb

The correct sentence is:

Until Iran come along, India had never been **defeated** in Kabaddi

∴ Option (A) is correct.

6. Explanation:

Option (A) is incorrect as the statement says that the banking institutions had been demanding the reduction 'since the last one year' before it was fulfilled, implying that it is not something that happens usually. Hence, it cannot be said that whenever the Reserve Bank of India reduces the repo rate, the interest rates on Small Saving schemes are also reduced.

Option (B) is incorrect. The phrase 'to bring them on par with fixed deposit interest rates' in the statement maintained on par with fixed deposit interest rates.

Option (D) is incorrect as there is no information provided in the statement to support this inference.

Option (C) is correct answer.

7. Explanation: Total population who buy goods from e-commerce portals $= \frac{294}{2} = 147$ million

Percentage of e-commerce buyers in the country $= \frac{147}{1400} \times 100 = 10.5\%$

∴ Option (A) is correct.

8. Explanation: Dhrupad styles were identified as baanis. Therefore, pair in option (A) is correct.

Gayaki and baaj were used to refer to vocal. Therefore, pair in option (B) is correct.

Gharana originally referred to hereditary musicians from a particular lineage. Therefore, pair in option (D) is correct.

Given pair in option (C) is not correct.

∴ Option (C) is correct.

9. Explanation: Starting time = 7 AM, Distance = $540\ \text{km}$

Speed of the first train $= 80\ \text{km/h}$, speed of the second train $= 100\ \text{km/h}$

As they are moving in two opposite directions, their relative speed will get added.

Relative Speed $= (80 + 100) = 180\ \text{km/hr}$

$\text{Time} = \frac{\text{Distance}}{\text{Relative speed}}$

$\text{Time} = \frac{540}{180} = 3\ \text{hr}$

3 hours after 7 AM, i.e., at 10 AM, they will be 540 km apart.

∴ Option (B) is correct.

10. Explanation: A head-hunter functions by killing people for a price. The number of heads here implies the number of people he/she has been paid to kill for.

In ancient times the prestige of a kingdom depended upon the number of taxes that it was able to levy on its people in the same manner that the prestige of a head-hunter depended on the number of heads he/she collected.

Here the comparison is made to bring out the inhuman nature of both the activities head-hunting