AC – 28/03/2025
Item No. – 6.3 (N) (5ab) Sem. III & IV

As Per NEP 2020

University of Mumbai

Syllabus for Minor Vertical 2 (Scheme-III)		
Faculty of Science.		
Board of Studies in Statistics.		
B.A. Second Year Programme Minor - Statistics		
Semester	**III & IV**	
Title of Paper	**Sem.**	**Total Credits 4**
I) Statistical Methods-I	**III**	**2**
II) Practical based on statistical Methods-I		**2**
Title of Paper		**Credits**
I) Statistical Methods-II	**IV**	**2**
II) Practical based on Statistical Methods-II		**2**
From the Academic Year		**2025-26**

Semester-III

Minor-I

Name of the course: Statistical Methods -I

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	**Introduction:** Statistical Methods-I paper covers basic concept of probability and probability distribution which is useful to gain in-depth knowledge of probability and standard discrete distributions of other than statistics students of same faculty.
2	**Vertical :**	Minor
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks

Credit:2	**MINOR SUBJECT** **STATISTICAL METHODS-I**	No. of Hours: 30
	CO2: Students will be able to, 1. Understand the concept of probability and its applications. 2. Differentiate between random and non-random experiment. 3. Understand the meaning of continuous and discrete random variable. 4. Understand discrete distributions and their properties. 5. Solve the examples of probability **OC2: On successful completion of this course Students Should be able to,** 1. Calculate probabilities and conditional probabilities. 2. Identify the types of events. 3. Compute the expectation of the univariate discrete random variable. 4. Write probability mass functions (pmf) of various discrete distribution and their real-life applications. 5. Apply the concept of probability in real-life situations.	
Unit	**Elementary Probability Theory**	**Lectures**

I	• Definitions: Trial, random experiment, sample point and sample space. • Definition of an event and different types of events: compound event, complementary event, equally likely events, certain event, impossible event, mutually exclusive and exhaustive events. • Different definitions of Probability: Classical (Mathematical), Empirical(Statistical) and Axiomatic definitions of Probability. Properties of probability • Conditional probability. • Independence of events, pairwise and mutual independence of three events. • Theorems (with proof)and their applications: i. Addition theorem on probability for two and three events ii. Multiplication theorem on probability for two events. iii. Bayes' theorem.	**10**
Unit	**Discrete random variables**	**Lectures**
II	• Random variable: discrete and continuous random variables. Definition and properties of probability mass function . cumulative distribution function. • Raw and Central moments (definition only) and their relationship. (up toorder four). • Concepts of Skewness and Kurtosis and their uses for random variables. • Expectation and variance of a random variable. Theorems and properties on Expectation and variance of random variables with proof. • Joint probability mass function of two discrete random variables. • Marginal and conditional distributions. • Covariance and Coefficient of Correlation. Independence of two random variables.	**10**
Unit	**Standard Discrete Probability Distributions**	**Lectures**
III	1. Definition and derivation of mean and variance of the followingdistributions: 2. Discrete Uniform distribution 3. Bernoulli and Binomial distributions 4. Poisson distribution 5. Hypergeometric distribution 6. Geometric distribution.	10

	7. Recurrence relation for probabilities of Binomial and Poisson distributions. 8. Poisson approximation to Binomial distribution (only statement) and its applications.	

Reference Books

1. David S. : Elementary Probability, Cambridge University Press.
2. Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House.
3. Hogg R.V. and Tannis E.P. : Probability and Statistical Inference.McMillan Publishing Co. Inc.
4. Pitan Jim : Probability, Narosa Publishing House.
5. Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II :The World Press Private Limited, Calcutta.
6. Mukhopadhyay P. An Introduction to the Theory of Probability, World Scientific Publishing Company, 2011.
7. Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990
8. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons

Format of Question Paper:
Internal Continuous Assessment: (20 marks)

5Assignment/viva Quizzes, Class Tests, presentation, project, assignment etc	**Class Test**	**Total**
05	15	20

Semester End Examination: (30 marks)

Semester End Examination will be of 30 marks of 01 hour duration covering entire syllabus of the semester. Examiners should frame sub questions for Q.1, Q2 and Q3. Each question carrying 15 marks. Attempt any two out of three questions.

Theory Question Paper Pattern:

Q 1	Max. marks: 15	Attempts any two questions out of Three.
Q 2	Max. marks: 15	
Q 3	Max. marks: 15	

Semester-III

Minor-I

Name of the course: Practical based on Statistical Methods -I

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	**Introduction:** Statistical Methods-I paper covers basic concept of probability and probability distribution which is useful to gain in-depth knowledge of probability and standard discrete distributions of other than statistics students of same faculty.
2	**Vertical :**	Minor
3	**Type :**	Practical
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted**:	50 Marks

Credit: 2	**Minor Practical Paper- I**	No. of Hours: 60
	List of Practical on Statistical Methods-I	
	1. Probability 1 2. Probability 2 3.Univariate Discrete random variable 4. Bivariate Discrete random variable 5. Binomial Distribution 6. Poisson Distribution 7. Hypergeometric Distribution 8. Geometric distribution. Practicals using EXCEL	

Refrence Books

1. Medhi J. : Statistical Methods, An Introductory Text, Second Edition,New Age International Ltd.
2. Agarwal B.L. : Basic Statistics, New Age International Ltd.
3. Spiegel M.R. : Theory and Problems of Statistics, Schaum' s Publications series. Tata McGraw-Hill.
4. Kothari C.R. : Research Methodology, Wiley Eastern Limited.
5. David S. : Elementary Probability, Cambridge University Press.
6. Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House.
7. Hogg R.V. and Tannis E.P. : Probability and Statistical Inference.McMillan PublishingCo. Inc.
8. Pitan Jim : Probability, Narosa Publishing House.
9. Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II :The World Press Private Limited, Calcutta.
10. Elhance D. N, Elhance V, Aggarwal B. M, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi, 2018.
11. Mukhopadhyay P. An Introduction to the Theory of Probability, World Scientific Publishing Company, 2011.
12. Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990
13. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
14. Schaum Series book in O.R. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.
15. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley & Sons.
16. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
17. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.
18. Operations Research: S.D.Sharma.11th edition, KedarNath Ram Nath& Company.
19. Operations Research: H. A.Taha.6th edition, Prentice

Format of Practical Question Paper:
Internal Practical Continuous Assessment: (20 marks)

Journal	Assignment/Viva	Total
05	15	20

Semester End Practical Examination: (30 marks)

Semester End practical Examination will be of 30 marks of 01 hour duration covering all practical listed above of the semester. Examiners should frame questions for Q.1, Q.2 and Q.3. Each question carrying 10 marks. All questions are compulsory to solve.

Practical Question Paper Pattern:

Q 1	Max. marks: 10	All questions are compulsory.
Q 2	Max. marks: 10	
Q 3	Max. marks: 10	

A student must have a certified journal before appearing for the practical examination.

In case a student does not possess a certified journal, he/she is not qualified for journal 5 marks

For each paper minimum 75% of the practical must be completed to the journal certified.

Semester-IV
Minor
Statistical Method-II

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	**Introduction:** Statistical Methods-II paper covers basic concept of probability and probability distribution which is useful to gain in-depth knowledge of probability and standard discrete distributions of other than statistics students of same faculty.
2	**Vertical :**	Minor
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks

Credit:2	**MINOR SUBJECT** **STATISTICAL METHODS-II**	No. of Hours:30
	CO2: Students will be able to, 1. Understand the fundamental concepts of continuous probability distributions. 2. Study the concept of estimate and estimator. 3. Understand the concept of testing of hypothesis and large sample test. **OC2: Students Should be able to,** 1. Explain the continuous probability distributions such as Uniform, Exponential, Normal distributions and apply to real life applications. 2. Compute mean, variance and standard deviations for continuous probability distributions. 3. Apply testing of hypothesis technique to solve statistical problems.	
Unit	**Continuous Probability Distributions**	**Lectures**

I	• Concept of continuous random variable, probability density function and its properties. Cumulative distribution functions of continuous random variables and its properties. • Definition and derivation of mean, variance and median of Uniform and Exponential distributions. Memory less property of Exponential distribution. • Normal distribution. Properties of Normal distribution (without proof). Normal approximation to Binomial and Poisson distribution (statement only). Properties of Normal curve. Use of normal tables.	**10**
Unit	**Estimation**	**Lectures**
II	• Sampling from a distribution: Concept of a statistic, parameter ,estimate and estimator, sampling distribution of statistic. • Concept of bias and standard error of an estimator. • Central Limit theorem (statement only).	10
	• Sampling distribution of sample mean and sample proportion. (For largesample only) • Standard errors of sample mean and sample proportion. • Point and Interval estimate of single mean, single proportion from sample of large size. • Point and interval estimate of difference between two means and proportions.	
Unit	**Testing of Hypothesis and Large Sample Test**	**Lectures**
III	Testing of hypothesis: • Concept of hypothesis • Simple and composite hypothesis • Null and alternate hypothesis • Test statistic, Critical region, Types of error, Level of significance and power of the test. Large sample tests: • For testing specific value of population mean • For testing specific value in difference of two means • For testing specific value of population proportion • For testing specific value of difference of population proportion(development of critical region is not expected)	10

Reference Books

1. Agarwal B. L, Basic Statistics, New Age International P Ltd. Delhi, 2015
2. Saxena S., Kapoor J. N., Mathematical Statistics, Sultan Chand & Sons, Delhi, 2010
3. Gupta S. P, Statistical Methods, Sultan Chand and Sons, New Delhi, 2002
4. Kapoor V. K, Gupta S. C, Fundamental of Mathematical Statistics, S Chand & Sons, Delhi, 2008
5. Grewal P. S. Methods of Statistical Analysis, Sterling Publishers, 1990
6. Mukhopadyay P., An Introduction to the theory of Probability, World Scientific Publishing Company,2011

Format of Question Paper:
Internal Continuous Assessment: (20 marks)

Assignment/viva Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	**Class Test**	**Total**
05	15	20

Semester End Examination: (30 marks)

Semester End Examination will be of 30 marks of 01 hour duration covering entire syllabus of the semester. All questions are Compulsory.
Theory Question Paper Pattern:

Q 1	Attempt any one question out of two questions (Module I and II)	Max. marks: 10
Q 2	Attempt any two questions out of three questions (Module I)	Max. marks: 10
Q 3	Attempt any two questions out of three questions (Module II)	Max. marks: 10

Semester-IV

Minor-II

Name of the course: Practical based on Statistical Methods -II

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	**Introduction:** Statistical Methods-II paper covers basic concept of continuous probability distribution, estimation theory and hypothesis testing methods which is useful to gain in-depth knowledge of given concept for other than statistics students of same faculty.
2	**Vertical :**	Minor
3	**Type :**	Practical
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted**:	50 Marks

Credit: 2	**Minor Subject** **Practical on Statistical Methods-II**	No. of Hours: 60
	CO2: Students will be able to, 1. Understand the fundamental concepts of continuous probability distributions. 2. Study the concept of estimate and estimator. 3. Understand the concept of testing of hypothesis and large sample test. **OC2: Students Should be able to,** 1. Explain the continuous probability distributions such as Uniform, Exponential, Normal distributions and apply to real life applications. 2. Compute mean, variance andstandard deviations for continuous probability distributions. 3. Apply testing of hypothesis technique to solve statistical problems.	

	List of Practicals on Statistical Methods -II	
	1. Continuous Random Variable 2. Uniform and Exponential Distribution 3. Normal Distribution and application of central limit theorem 4. Point and Interval Estimation. 5. Testing of Hypothesis 6. Large Sample Test Practical's using EXCEL	**60**

Reference Books

1 Medhi J.: Statistical Methods, An Introductory Text, Second Edition, New Age International Ltd.

2 Agarwal B. L.: Basic Statistics, New Age International Ltd.

3 Spiegel M. R.: Theory and Problems of Statistics, Schaum'sPublications series. Tata McGraw-Hill.

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5 David S.: Elementary Probability, Cambridge University Press.

6 Hogg R. V. and Tannis E.P.: Probability and Statistical InferenceMcMillan Publishing Co. Inc.

7 Goon A. M., Gupta M. K., Dasgupta B.: Fundamentals of Statistics,Volume II : The World PressPrivate Limited, Calcutta.

8 Miller I. & Miller M (2006), John E. Freund's Mathematical Statistics with applications, 7th edition, Pearson Education Asia

9 Gupta, S. C. and Kapoor, V. K. (2002), Fundamentals of Mathematical Statistics, eighth Edition,Sultan Chand and Sons Publishers, New Delhi.

10 Gupta, S. C. and Kapoor, V. K. (2004), Fundamentals of Applied Statistics, Third Edition, SultanChand and Sons Publishers, New Delhi.

11 Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC.Prentce Hall of India,New D

Format of Practical Question Paper:
Internal Practical Continuous Assessment: (20 marks)

Journal	Assignment/Viva	Total
05	15	20

Semester End Practical Examination: (30 marks)

Semester End practical Examination will be of 30 marks of 01 hour duration covering all practical listed above of the semester. Examiners should frame questions for Q.1, Q.2 and Q.3. Each question carrying 10 marks. All questions are compulsory to solve.

Practical Question Paper Pattern:

Q 1	Max. marks: 10	All questions are compulsory.
Q 2	Max. marks: 10	
Q 3	Max. marks: 10	

A student must have a certified journal before appearing for the practical examination.

In case a student does not possess a certified journal, he/she is not qualified for journal 5 marks
For each paper minimum 75% of the practical must be completed to the journal certified.

Sd/-	**Sd/-**	**Sd/-**
Sign of the BOS Chairman	**Sign of the Offg. Associate Dean**	**Sign of the Offg. Dean**
Dr. Santosh Gite	**Dr. Madhav R. Rajwade**	**Prof. Shivram S. Garje**
Board of Studies in Statistics	**Faculty of Science & Technology**	**Faculty of Science & Technology**