Khandesh College Education, Society's

PRATAP COLLEGE (AUTONOMOUS), AMALNER

An "Autonomous College" Affiliated to
KBC North Maharashtra University, Jalgaon

"A+"Grade NAAC Re-Accredited (3rd cycle)

SYLLABUS

FOR

F.Y.B.Sc. STATISTICS
(Semester I and II)

Under Choice Based Credit System (NEP-2020)
[w.e.f. Academic Year 2023-2024]

KES's Pratap College (Autonomous) Amalner

SYLLABUS FOR
First Year of B.Sc. (Semester-I and Semester-II)
SUBJECT: STATISTICS
With effect from July 2023 (NEP-2020)

F.Y.B.Sc. (Statistics) Course Structure

Semester-I

	BOS Code	Title of Course	Credits	Teaching (Clock Hrs/week)	Total TeachingHours	Marks Wt	
						INT(CA)	EXT (UA)
DSC-1	ST-MJ-101	Descriptive Statistics-I	2	02	30	20	30
DSC-2	ST-MJ-102	Probability And Probability Distributions –I	2	02	30	20	30
DSC-3	ST-MJP-103	Statistics Practicals-I	2	04/Batch	60	20	30
MIN-1	ST-MN-111	Descriptive Statistics	2	02	30	20	30
MIN-2	ST-MNP-112	Practicals Based On Descriptive Statistics	2	04/Batch	60	20	30
SEC-1	ST-SEC-104	Computational Statistics using MS-Excel	2	02	30	20	30
OE-1	ST-OE-121	Fundamental of Statistics-I	2	02	30	20	30

Semester-II

NEP code	CourseCode	Title of Course	Credits	Teaching (Clock Hrs/week)	Total TeachingHours	Marks Wt	
						INT (CA)	EXT (UA)
DSC-4	ST-MJ-151	Descriptive Statistics-II	2	02	30	20	30
DSC-5	ST-MJ-152	Probability And Probability Distributions –II	2	02	30	20	30
DSC-6	ST-MJP-153	Statistics Practicals-II	2	04/Batch	60	20	30
MIN-3	ST-MN-161	Probability And Probability Distributions	2	02	30	20	30
MIN-4	ST-MNP-162	Practicals Based On Probability And Probability Distributions	2	04/Batch	60	20	30
SEC-2	ST-SEC-154	Data Analysis using R	2	02	30	20	30
SEC-3	ST-SEC-155	Practicals on Data Analysis using R	2	04/Batch	60	20	30
OE-2	ST-OE-171	Fundamental of Statistics -II	2	02	30	20	30

Note: Distribution of Practical Examination marks will be as below:

Internal (20 Marks):

       Internal Practical Exam Paper- 15 marks.

       Journal   - 5 marks

External (30 Marks):

       External Practical Exam Paper- 25 marks.

       Viva-voce   - 5 Marks

Laboratory Requirements: One computer laboratory with at least 20 PCs or Laptops and 5 printers dedicated for conducting above mentioned two practical courses should be made available by College/Institute.

Aims and Objectives

Under this syllabus, students are expected to learn basic concepts of Statistics as:

- Role of Statistics in Science, Society and for National Development.
- Descriptive Statistics.
- Concept of Probability and Probability Distributions.
- Fundamental/Basic Statistical Analysis using Statistical Software MS-Excel.

ST-MJ-101 Descriptive Statistics-I

1. INTRODUCTION TO STATISTICS   (2L, 2M)

1.1 Meaning of Statistics: numerical information, science and decision making in science, general definition of Statistics as science.

1.2 Scope of Statistics: In the field of Industry, Biological Sciences, Medical Sciences, Economics Sciences, Social Sciences, Management Sciences, Agriculture, Insurance, Information Technology, Education and Psychology. Importance of quantification, scope of statistical methods.

1.3 Statistical institutes and organizations: ISI, NSS, Bureau of Economics and Statistics in States, Indian Institute of Population Sciences (IIPS).

1.4 Notable statisticians and their contributions:
   Dr. P. C. Mahalanobis, Dr. P. V. Sukhatme, Dr. V. S. Huzurbazar, Dr. C. R. Rao.

1.5 Limitations of statistics.

2. CONCEPT OF POPULATION AND SAMPLE   (4L,4M)

2.1 Population, statistical population, census, sample, sampling.

2.2 Objectives of sampling. Advantages of sampling over census.

2.3 Methods of sampling; Simple random sampling with and without replacement, Stratified sampling and Systematic sampling.

2.4 Illustrations from real life situations.

3. PRESENTATION OF DATA   (6L,6M)

3.1 Meaning of data, raw data, and Qualitative and Quantitative data.

3.2 Attributes and Variables, continuous and discrete variables.

3.3 Primary data and Secondary data.

3.4 Sources of secondary data.

3.5 Measurement scales: nominal, ordinal, ratio and interval scales.

3.6 Illustrations from real world situations.

3.7 Tabular presentation of data :- Meaning of table, Parts of table and construction of table(up to three factors of classification)

3.8 Diagrammatic representation of data: simple, Multiple and subdivided bar diagrams, pie diagram.

3.9 Frequency distribution: - Meaning of frequency, class, exclusive and inclusive classes, Open-end classes, class width, mid-value, class boundaries and limit, relative frequency.

3.10 Cumulative frequency distribution: less than, more than type. 3.11Guidelines for construction of classes, Sturges formula.

3.11 Graphical representation of data:-Histogram (equal and unequal classes), Frequency curve, Frequency Polygon, ogives, stem & leaf chart.

3.12 Check sheet and Pareto diagram.

4. MEASURES OF CENTRAL TENDENCY (LOCATION)   (8L,8M)

4.1 Meaning of central tendency of data, objectives, and requirements of a good measure of Central Tendency.

4.2 Arithmetic mean (A.M.): Definition, effect of change of origin and scale, sum of deviations from A.M., combined mean for k groups, merits and demerits.

4.3 Geometric mean (G.M.): Definition, merits, demerits and its uses.

4.4 Harmonic Mean (H.M.): Definition, merits and demerits, uses

4.5 Median: Definition, computation formula(without derivation), graphical method of determining median, merits and demerits,

4.6 Mode: Definition, computation formula(without derivation), graphical method of determining median, merits and demerits,

4.7 Weighted Means: A.M., G.M., H.M.

4.8 A.M.>G.M.>H.M.(for 2 and 3 values)

4.9 Trimmed mean

4.10 Use of appropriate measure of central tenancy in different situation. 4.11Empirical relation among mean, median and mode.

4.11 Partition values:-Quartiles, deciles, & percentiles (Definition and Computation for ungrouped and grouped data). Box plot.

4.12 Examples and problems.

5. MEASURES OF DISPERSION   (6L,6M)

5.1 Meaning of Dispersion of data and objective. Requirements of a good measure of dispersion.

5.2 Range .Definition, Merits and Demerits, uses.

5.3 Quartile Deviation (Q.D.): Definition, computation, merits and demerits.

5.4 Mean deviation (M.D.), Definition, computation, merits and demerits Minimal Property of Mean Deviation without proof.

5.5 Mean Squared Deviation. Definition, Minimal property with proof, Variance and Standard deviation.

5.6 Properties of variance and Standard Deviation i) Combined Variance and Standard deviation for two groups (with proof) and its extension for k groups ii).Effect of change of origin and scale iii) S.D. ≥ M.D.

5.7 Absolute and relative measures of dispersion :Coefficient of range, Coefficient of Q.D., Coefficient of M.D., Coefficient of variation (C.V.), Uses Of C.V.

5.8 Examples and problems.

6. MOMENTS   (4L, 4M)

6.1 Raw & central moments with Sheppard's correction; Effect of change of origin and scale on central moments.

6.2 Moments about an arbitrary constant for grouped and ungrouped data.

6.3 Relation between central moments and raw moments (up to 4th order).

BOOKS FOR REFERENCE:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.

2. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.

3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I and II, 8th Edition, the World Press Pvt. Ltd., Kolkata.

4. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.

5. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

6. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

7. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi.

8. Snedecor G. W. and Cochran W. G. (1989). Statistical Methods, Eighth Ed. East-WestPress.

ST-MJ-102 Probability And Probability Distributions-I

1. SAMPLE SPACE AND EVENTS   (5L, 5M)

1.1 Meaning of experiment, random experiment, deterministic and non-deterministic models.
1.2 Definitions of the terms: Outcome, Sample space (finite and infinite), Discrete sample space, Event, Elementary event, Compound event, Complementary event, Favorable event, Equally-likely events, Sure event, Impossible event.
1.3 Concept of occurrence of an event
1.4 Union and intersection of two or more events
1.5 Exhaustive events, Mutually exclusive events
1.6 Representation of sample space and events by Venn diagram
1.7 Occurrence of (i) at least one of the given events (ii) all of the given events (iii) none of the given events.
1.8 Examples and problem

2. PROBABILITY (For finite sample space only)   (10L, 10M)

2.1 Theory of Permutation and Combinations
2.2 Equiprobable sample space, probability of an event, certain event, impossible event, classical definition of probability and its limitations, relative frequency approach.
2.3 Non-equiprobable sample space, probability with reference to a finite sample space: probability assignment approach, probability of an event.
2.4 Axioms of probability
2.5 Probability of union of two events, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ and its generalization to three events (with proof).
2.6 Following results with proof
      i. $P(A') = 1 - P(A)$
      ii. $If\ A \subseteq B, then\ P(A) \leq P(B)$
      iii. $P(\bigcup_{i=1}^{n} A_i) \leq \sum_{i=1}^{n} P(A_i)$
2.7 Examples and problems.

3. CONDITIONAL PROBABILITY AND INDEPENDENCE   (7L, 7M)

3.1 Independence of events, pair wise and mutual independence for three events.
3.2 Conditional probability of an event
3.3 Multiplication theorem of probability (with proof)
3.4 Partition of sample space.
3.5 Theorem of total probability with proof.
3.6 Bayes' theorem (with proof)
3.7 Examples and problems.

4. UNIVARIATE PROBABILITY DISTRIBUTION   (8L, 8M)

4.1 Concepts and definition of discrete random variable.

4.2 Probability mass function of a discrete random variable.

4.3 Distribution functions of a discrete random variable.

4.4 Statement of properties of a distribution function.

4.5 Concept of symmetric random variable.

4.6 Median and mode of a discrete random variable.

4.7 Definition of Expectation of discrete random variable.

4.8 Function of random variable.

4.9 Examples and problems.

BOOKS FOR REFERENCE:

1. Agarwal B. L. (2003). Programmed Statistics, 2nd edition, New Age International Publishers, New Delhi.

2. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.

3. Hogg, R. V. and Craig R. G. (1989). Introduction to Mathematical Statistics, Ed. 4. MacMillan Publishing Co., New York.

4. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

5. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

6. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.

7. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.

8. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.

ST-MJP-103 Statistics Practicals-I

INSTRUCTIONS:

1. The total duration of external practical examination shall be 3 clock hours.
2. Student must complete all the practicals to the satisfaction of concerned teacher.
3. Student must produce at the time of the practical examination, the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of department.
4. All practicals must be carried out by using personal computers (PC) based on MS-Excel (2010 or higher version) software.
5. Encourage students to collect live data from real life situations. Such data may be used for practicals.

LIST OF PRACTICALS:

Topic No.	Topic for Practicals	No. of Practicals
1	Drawing random samples by using SRSWOR, SRSWR, Stratified, systematic sampling etc.	2
2.	Graphical representation of statistical data : Histogram, simple bar diagram, multiple bar diagram, frequency curve, frequency polygon, ogives, Pareto diagram etc.	3
3.	(I) Computation of Measures of central tendency for ungrouped data (II) Computation of Measures of central tendency for grouped data	3
4.	(I) Computation of Measures of dispersion for ungrouped data (II) Computation of Measures of dispersion for grouped data	3
5.	Raw and Central Moments	1
6.	Problems based on probability	1
7.	Problems based on univariate probability distributions	1
8.	Data analysis	1

ST-MN-111 Descriptive Statistics

Course Objectives:

- To understand the concept of sample, population and sampling

- To know about measures of central tendency and dispersion

- To study concept of bivariate data and correlation

- To learn about linear and nonlinear regression

Unit I Statistics and Presentation of Data   (8L, 8M)

- Definition, Importance, Scope and Limitations of Statistics.

- Population, statistical population, census, sample, sampling.

- Objectives of sampling. Advantages of sampling over census.

- Methods of sampling: Simple random sampling with and without replacement, Stratified sampling and Systematic sampling. Illustrations from real life situations.

- Meaning of data, Raw data, and Qualitative and Quantitative data.

- Attributes and Variables, continuous and discrete variables.

- Primary data and Secondary data, Sources of secondary data.

- Measurement scales: nominal, ordinal, ratio and interval scales.

- Frequency distribution: Meaning of frequency, class, exclusive and inclusive classes, open-end classes, class width, mid-value, class boundaries and limit, relative frequency.

- Cumulative frequency distribution: less than, more than type.

- Guidelines for construction of classes. Histogram (equal & unequal classes) and Pareto diagram.

Unit II Measures of Central Tendency and Dispersion   (7L, 7M)

- Meaning of central tendency of data, objectives, and requirements of a good measure of central tendency.

- Arithmetic mean (A.M.): Definition, sum of deviations from A.M., combined mean for k groups, merits and demerits. weighted A.M., Median: Definition, computation formula (without derivation), graphical method of determining median, merits and demerits.

- Mode: Definition, computation formula (without derivation), graphical method of determining median, merits and demerits.

- Use of appropriate measure of central tendency in different situation.

- Partition values:-Quartiles and Deciles (Definition and Computation for ungrouped and grouped data). Box plot.

- Meaning of Dispersion of data and objective. Requirements of a good measure of dispersion.

- Range .Definition, Merits and Demerits, uses.

- Quartile Deviation (Q.D.): Definition, computation, merits and demerits.

- Mean deviation (M.D.), Definition, computation, merits and demerits.

- Definition of Standard deviation and variance with computation.

- Coefficient of variation (C.V.), Uses of C.V.

- Examples and problems.

Unit-III Correlation   (8L 8M)

- Meaning of correlation between two variables, positive & negative correlation,

- Scatter diagram, Construction of scatter diagram and interpretation.

- Product moment correlation (Karl Pearson's correlation coefficient) and its properties, interpretation.(without proof)

- Rank correlation: Spearman's rank correlation coefficient.

- Examples and Problems

Unit -IV Regression   (7L, 7M)

- Meaning of regression, concept of linear and non-linear regression.

- Concept of method of least squares.

- Linear regression: Fitting of lines of regression by method of least squares.

- Regression coefficients and their properties (without proof).

- Examples and Problems

References

- Agarwal, B. L. (2017). Programmed Statistics, Third Edition, New Age International Publishers, New Delhi.

- Gupta, S. C. and Kapoor, V. K. (2019). Fundamentals of Mathematical Statistics, Eleventh Edition, Sultan Chand and Sons Publishers, New Delhi.

- Mood, A.M. Graybill, F.A. and Boes, D.C. (2007). Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

- Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC.

- Prentice Hall of India, New Delhi.

- Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.

- Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996). Statistics: A

- Beginner's Text, Vol. I, New Age International (P) Ltd.

ST-MNP-112 Practical Based On Descriptive Statistics

Course Outcomes
- After successful completion of this course, students are expected to:
- Draw random sample using sampling methods
- Construct tables and frequency distributions
- Compute measures of central tendency and dispersion
- Solve problems on probability

Topic No.	Topic for Practicals	No. of Practicals
1	Drawing random samples by using SRSWOR, SRSWR, Stratified, systematic sampling etc.	2
2.	Graphical representation of statistical data : Histogram, simple bar diagram, multiple bar diagram, frequency curve, frequency polygon, ogives, Pareto diagram etc.	3
3.	(III) Computation of Measures of central tendency for ungrouped data (IV) Computation of Measures of central tendency for grouped data	3
4.	(III) Computation of Measures of dispersion for ungrouped data (IV) Computation of Measures of dispersion for grouped data	3
5	Scatter diagram, correlation coefficient (ungrouped data)	1
6.	Rank correlation coefficient I	1
7.	Fitting of lines of regression	1
8..	Data analysis	1

ST-OE-121 Fundamental of Statistics-I

Introduction to Statistics (2L, 2M)
- Meaning of Statistics and its application in decision making
- Scope of Statistics in various fields
- Statistical institutes and organizations
- Notable statisticians and their contributions

Concept of Population and Sample (3L, 3M)
- Population, statistical population, and census
- Sample and advantages of sampling over census
- Methods of sampling: simple random sampling, stratified sampling, systematic sampling
- Real-life illustrations of sampling

Presentation of Data (5L, 5M)
- Meaning of data, raw data, and types of data (qualitative and quantitative)
- Attributes and variables, continuous and discrete variables
- Primary data and secondary data, sources of secondary data
- Measurement scales: nominal, ordinal, ratio, and interval scales
- Tabular presentation of data: construction and parts of a table
- Diagrammatic representation of data: bar diagrams, pie diagrams
- Frequency distribution: class, frequency, relative frequency
- Graphical representation of data: histograms, freqency curves, frequency polygons, ogives, stem & leaf charts
- Check sheet and Pareto diagram

Measures of Central Tendency (Location) (10L, 10M)
- Meaning and requirements of a good measure of central tendency
- Arithmetic mean: computation, properties, combined mean
- Geometric mean: computation, properties, uses
- Harmonic mean: computation, properties, uses
- Median: computation, graphical method, properties
- Mode: computation, graphical method, properties
- Weighted means: arithmetic mean, geometric mean, harmonic mean
- Empirical relation among mean, median, and mode
- Partition values: quartiles, deciles, percentiles, box plot

Measures of Dispersion (10L, 10M)
- Meaning and objective of dispersion
- Range: computation, properties, uses
- Quartile Deviation (Q.D.): computation, properties, uses
  o Mean deviation (M.D.): computation, properties, minimal property (only for ungrouped data)
- Mean Squared Deviation, variance, and standard deviation: computation, properties
- Properties of variance and standard deviation
- Absolute and relative measures of dispersion: coefficients of range, Q.D., M.D., variation
- Computation of Karl-Pearson coefficient of Skewness
- Computation of Bowleys coefficient of Skewness

BOOKS FOR REFERENCE:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.

2. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.

3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I and II, 8th Edition, the World Press Pvt. Ltd., Kolkata.

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5. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

6. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

7. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi.

ST-SEC-104 Computational Statistics using MS-Excel

Unit I Getting Started with Excel   **(8L, 5M)**
- Workbook and Worksheets
- Navigation with Keyboard
- Tabs and Ribbons
- File Menu
- Excel Options
- Create a New Workbook, Print and Save
- Understanding Worksheet Basics
- Protecting Excel Workbook and Worksheet
- Importing Data into Excel
- Exporting Data from Excel

Unit II Formulas and Functions   **(9L,10M)**
- Understanding Formulas
- Operators in Formula
- Defined Names
- Calculations
- Functions in Formula
- Logical Functions
- Summarizing Functions
- Text Function
- Lookup and Reference functions
- Data and Time Function
- Maths Functions
- Statistical Functions
- Problems and Examples

Unit-III Visualization and Presentation of Data   **(5L, 8M)**
- Diagrammatic representation of statistical data: simple and subdivided
- bar diagrams
- Multiple bar diagram
- Pie diagram
- Graphical representation of data: Histogram
- Frequency curve and ogive curves

Unit-IV Statistical Applications   **(8L, 7M)**
- Construction of frequency distribution
- Computation of mean, median and mode
- Computation of partition values

- Determination of measures of dispersion
- Computation of probabilities
- Problems and Examples

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1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.

2. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.

3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I and II, 8th Edition, the World Press Pvt. Ltd., Kolkata.

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6. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

7. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi.

SEMESTER-II
ST-MJ-151 Descriptive Statistics-II

1. SKEWNESS AND KURTOSIS   (4L,4M)

1.1 Concept of Skewness of a frequency distribution; Positive and negative skewness, symmetric frequency distribution
1.2 Bowley's coefficient of skewness, Limits of Bowley's coefficient of skewness
1.3 Karl Pearson's coefficient of skewness.
1.4 Kurtosis: Meaning, Types of Kurtosis:-leptokurtic, mesokurtic & platykurtic.
1.5 Measures of skewness and kurtosis based on moments.
1.6 Examples and Problems.

2. CORRELATION   (10L,10M)

2.1 Bivariate data. Ungrouped and grouped.
2.2 Meaning of correlation between two variables, positive & negative correlation,
2.3 Scatter diagram, Construction of scatter diagram and interpretation.
2.4 Covariance between two variables: Definition, Effect of change of origin and scale
2.5 Product moment correlation (Karl Pearson's correlation coefficient) and its properties, interpretation.
2.6 Rank correlation: Spearman's rank correlation coefficient, derivation of the Formula of rank correlation coefficient (without ties).Rank correlation with ties
2.7 Simple numerical examples and problems.

3. REGRESSION   (10L,10M)

3.1 Meaning of regression, concept of linear and non-linear regression.
3.2 Concept of method of least squares.
3.3 Linear regression: Fitting of lines of regression by method of least squares.
3.4 Regression coefficients and their properties (statement and proof).
3.5 Angle between the two lines of regression.
3.6 Standard error of regression estimate.
3.7 Explained and unexplained variation and coefficient of determination.
3.8 Non-linear regression: Fitting of non-linear curves of the following type
     (i) $y = a + bx + cx^2$ (ii) $y = ax^b$ (iii) $y = ab^x$
3.9 Examples and problems.

4. THEORY OF ATTRIBUTES   (6L, 6M)

4.1 Concept of attribute, dichotomy, manifold classification, Notations.
4.2 Class frequency, order of class, positive class frequency, negative class frequency, contra class frequency, ultimate class frequency
4.3 Relation between class frequencies,
4.4 Method of dot operator to express any class frequency in terms of positive class frequencies.
4.5 Fundamental set of class frequencies: Definition, determination whether a set of

frequencies is fundamental set of or not (two attributes).
4.6 Independence and association of two attributes
4.7 Yule's coefficient of association (Q) and its interpretation.
4.8 Properties of $Q(-1 \leq Q \leq 1)$ and interpretation of (Q).
4.9 Examples and problems.

FOR REFERENCE:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.

1. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.

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7. Snedecor G. W. and Cochran W. G. (1989). Statistical Methods, Eighth Ed. East-WestPress.

8. Montgomery, D. C; Peck, E. A.; Vining, G. G. (2006). Introduction to Linear Regression Analysis, John Wiley and Sons.

ST-MJ-152 Probability And Probability Distributions-II

1. MATHEMATICAL EXPECTATION (Univariate Random Variable)   (6L,6M)

1.1 Definition of expectation of a random variable, expectation of a function of a random variable.
1.2 Definitions of mean, variance of univariate probability distribution, effect of change of origin and scale on mean and variance.
1.3 Probability generating function (PGF), Simple properties, mean and variance using PGF.
1.4 Definition of raw, central and factorial moments of univariate probability distributions and their interrelations.
1.5 Concept of standardized random variable.
1.6 Examples and problems.

2. BIVARIATE PROBABILITY DISTRIBUTION (Finite Sample Space)   (6L,6M)

2.1 Definition of two-dimensional discrete random variable, its joint p.m.f. and its distribution function and their properties.
2.2 Computation of probabilities of events in bivariate probability distribution.
2.3 Concepts of marginal and conditional probability distributions.
2.4 Independence of two discrete random variables.
2.5 Examples and problems.

3. MATHEMATICAL EXPECTATION (Bivariate Random Variable)   (4L, 4M)

3.1 Definition of Mathematical Expectation of two-dimensional discrete random variable.
3.2 Theorems on expectations of sum and product of two jointly distributed random variables.
3.3 Conditional expectation.
3.4 Definitions of conditional mean and conditional variance.
3.5 Definition of raw and central moments.
3.6 Definition of covariance, correlation coefficient (ρ), independence and uncorrelatedness between two variables.
3.7 Variance of linear combination of two variables with proof.
3.8 Examples and Problems.

4. SOME STANDARD DISCRETE PROBABILITY DISTRIBUTIONS   (14L, 14M)

4.1 Discrete Uniform distribution on integers 1 *to n*: p.m.f., c.d.f., mean, variance of Uniform distribution, real life situations, comment of mode and median.
4.2 Bernoulli distribution, its p.m.f., mean, variance, moments, distribution of sum of independent and identically distributed Bernoulli variables.
4.3 Binomial Distribution : Its p.m.f.,

$$P(X = x) = \begin{cases} \binom{n}{x} p^x \, q^{n-x} & ; \ x = 0, 1, 2, \dots, n. \ p \in (0,1) \text{ and } q = 1 - p \\ 0 & ; \qquad otherwise \end{cases}$$

Notation $X \sim B(n, p)$

Recurrence relation for successive probabilities, computation of probabilities of different events, computation of median for given parameters, mode of the distribution.

4.4   Mean, variance, moments, skewness (comments when $p = 0.5, p > 0.5, p < 0.5$), p.g.f., additive property of binomial variables, conditional distribution of X given $X + Y$, where X and Y are independent, $B(n_1, p)$ and $B(n_2, p)$ variables.

4.5   Hypergeometric Distribution: Its p.m.f.,

$$P(X = x) = \begin{cases} \dfrac{\binom{M}{x}\binom{N-M}{n-x}}{\binom{N}{n}} & ; \ x = a, a+1, \dots, b \\ 0 & ; \quad otherwise \end{cases}$$

Where, $a = \max(0, n - N + M)$ and $b = \min(n, M)$

Computation of probability, situations where this distribution is applicable, binomial approximation to hypergeometric probabilities, mean and variance of the distribution.

4.6   Examples and problems.

BOOKS FOR REFERENCE:

1. Agarwal B. L. (2003). Programmed Statistics, 2nd edition, New Age International Publishers, New Delhi.
2. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
3. Hogg, R. V. and Craig R. G. (1989). Introduction to Mathematical Statistics, Ed. 4.MacMillan Publishing Co., New York.
4. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
5. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics,3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
6. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.
7. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, SeventhEd, Pearson Education, New Delhi.
8. Mayer P.L. (1970): Introductory Probability and Statistical Applications, Oxford and IBH publishing, New Delhi.

ST-MJP-153 Statistics Practicals-II

INSTRUCTIONS:

1. The total duration of external practical examination shall be 3 clock hours.
2. Student must complete all the practicals to the satisfaction of concerned teacher.
3. Student must produce at the time of the practical examination, the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of department.
4. All practicals must be carried out by using personal computers (PC) based on MS-Excel (2010 or higher version) software.
5. Encourage students to collect live data from real life situations. Such data may be used for practicals.

LIST OF PRACTICALS:

Topic No.	Topic for Practicals	No. of Practicals
1.	Computation of measures of skewness and kurtosis.	1
2.	Scatter diagram, correlation coefficient (ungrouped data).	2
3.	Fitting of lines of regression and computation of correlation coefficient (Grouped data).	2
4.	Rank Correlation(ungrouped data)	1
5.	Nonlinear regression: Fitting of second degree curve, exponential curve.	2
6.	Fitting of Binomial distribution and computation of probabilities.	1
7.	Model sampling from Discrete Uniform, Binomial and Hypergeometric distributions	2
8.	Applications of Binomial and Hypergeometric distributions	2
10.	Practical based on analysis of data collected by students in a batch of size not exceeding 15 students	2

ST-MN-161 Probability and Probability Distributions

1. SAMPLE SPACE AND EVENTS   (4L, 4M)
1.1 Meaning of experiment, random experiment, deterministic and non-deterministic models.
1.2 Definitions of the terms: Outcome, Sample space (finite and infinite), Discrete sample space, Event, Elementary event, Compound event, Complementary event, Favorable event, Equally-likely events, Sure event, Impossible event.
1.3 Concept of occurrence of an event
1.4 Union and intersection of two or more events
1.5 Exhaustive events, Mutually exclusive events
1.6 Representation of sample space and events by Venn diagram
1.7 Occurrence of (i) at least one of the given events (ii) all of the given events (iii) none of the given events.
1.8 Examples and problem

2. PROBABILITY (For finite sample space only)   (8L, 8M)
2.1 Equiprobable sample space, probability of an event, certain event, impossible event, classical definition of probability and its limitations, relative frequency approach.
2.2 Non-equiprobable sample space, probability with reference to a finite sample space: probability assignment approach, probability of an event.
2.3 Axioms of probability
2.4 Probability of union of two events, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ and its generalization to three events (without proof).
2.5 Following results (without proof)
   iv. $P(A') = 1 - P(A)$
   v. $If\ A \subseteq B, then\ P(A) \leq P(B)$
   vi. $P(\cup_{i=1}^{n} A_i) \leq \sum_{i=1}^{n} P(A_i)$

2.6 Examples and problems.

3. CONDITIONAL PROBABILITY AND INDEPENDENCE   (5L, 5M)

3.1 Independence of events, pair wise and mutual independence for three events.
3.2 Conditional probability of an event
3.3 Multiplication theorem of probability (without proof)
3.4 Partition of sample space.
3.5 Bayes' theorem (without proof)
3.6 Examples and problems.

4. UNIVARIATE PROBABILITY DISTRIBUTION   (8L, 8M)
4.1 Concepts and definition of discrete random variable.
4.2 Probability mass function of a discrete random variable.
4.3 Distribution functions of a discrete random variable.
4.4 Statement of properties of a distribution function.
4.5 Median and mode of a discrete random variable.
4.6 Definition of Expectation of discrete random variable.
4.7 Function of random variable.
4.8 Examples and problems.

5. MATHEMATICAL EXPECTATION (Univariate Random Variable)   (5L,5M)

5.1 Definition of expectation of a random variable, expectation of a function of a random variable.

5.2 Definitions of mean, variance of univariate probability distribution, effect of change of origin and scale on mean and variance.

5.3 Concept of standardized random variable.

5.4 Examples and problems.

REFERENCES

1. Agarwal B. L. (2003). Programmed Statistics, 2nd edition, New Age International Publishers, New Delhi.

2. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.

3. Hogg, R. V. and Craig R. G. (1989). Introduction to Mathematical Statistics, Ed. 4. MacMillan Publishing Co., New York.

4. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

5. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

6. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.

7. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.

8. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.

ST-MNP-162 Practicals based on Probability and Probability Distributions

List of Practicals:

Topic No.	Topic for Practicals	No. of Practicals
1	Problems based on Sample Space and Events	1
2	Problems based on probability	3
3.	Problems based on conditional probability and independence	3
4.	Problems based on Multiplication Theorem	1
5.	Problems based on Bayes Theorem	2
6	Problems based on univariate probability distributions	3
7.	Problems based on Mathematical Expectation and Variance	2

ST-OE-171 Fundamental of Statistics-II

Correlation   (15L, 15M)

- Bivariate data: ungrouped and grouped
- Meaning of correlation and types (positive and negative)
- Scatter diagram: construction and interpretation
- Covariance: definition, effect of change of origin and scale Product moment correlation (Karl Pearson's correlation coefficient) and its properties
- Rank correlation: Spearman's rank correlation coefficient (derivation without ties), rank correlation with ties

Regression   (15L, 15M)

- Meaning of regression and concept of linear and non-linear regression
- Method of least squares
- Linear regression: fitting of lines of regression by the method of least squares
- Regression coefficients and their properties (statement and proof)
- Angle between the two lines of regression
- Standard error of regression estimate
- Explained and unexplained variation and coefficient of determination
- Non-linear regression: fitting of non-linear curves

References

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
2. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I and II, 8th Edition, the World Press Pvt. Ltd., Kolkata.
4. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
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ST-SEC-154 Data Analysis using R

Introduction to R   (8L, 8M)

- Downloading and installation of R.

- Features of R, to start R and exit from R, Introduction to R screen.

- Meaning of package, base (standard package) package, to install package, to load a package to delete a package, learning about a package, getting help.

- Meaning of workspace, saving a workspace, loading a workspace,

- deleting a workspace.

- Data Types (Modes) in R: numeric, character, logical.

- Meaning of object, function. Types of function: built-in function and user defined function, naming an object.

- Data objects, Types of data object: scalar, vector, factor, data frame, list, array, matrix Functions for working with objects: mode( ), length( ), cbind( ), rbind(), names( ), ls( ), rm( )

- Types of operators: arithmetic operators, relational operators, logical operators.

- Expression: arithmetic expression, relational expression, logical expression.

- Precedence rule of arithmetic operators and logical operators.

Working with data objects and using functions   (8L, 8M)

- Vectors: creating a vector, modifying a vector, deleting a vector.

- Working with vectors: the functions to be discussed-c( ), rep( ), rev( ), sort(), diff( ), max( ), min( ), colon operator(:), seq( ), scan( ), cut( ), cat( ),table( ), which( ), unique( ) .

- Mathematical functions: abs( ), sqrt( ), log( ), log10( ), exp( ), sin( ), cos( ),tan( ), atan( ), round( ).

- Meaning of data frame, creation of data frame, modifying a data frame,deleting data frame, extracting elements from a data frame, use of $ sign. Functions to be discussed: subset( ), transform( ), attach( ), detach( ), with(), data.entry( ), edit( ), is.data.frame( ), as.data.frame( ).

Graphics   (6L, 6M)

- Low level and high level functions.

- Functions to be discussed: plot( ), lines( ), points( ), smooth.spline( ),curve( ), barplot( ), pie( ), hist( ), mtext( ), legend( ).

Statistical Applications (8L, 8M)

- Diagrams and Graphs: Bar Chart (Subdivided, multiple), Pie diagram,Stem and Leaf diagram,

- Histogram (equal as well as unequal class intervals), Ogive curve,Frequency polygon superimposed.

- Measures of Central Tendency: Mean, Mode, Median, G.M., H.M.,Partition values: Quartiles, Deciles, Percentiles.

- Measures of Dispersion: Range, M. D. about Mean, Mode, Median, S.D.,Variance and C.V.

- Examples and Problems

Refrences

- Purohit S.G., Gore S.D. and Deshmukh S.R. (2008). Statistics Using R. Narosa Pub.

- Peter Dalgaard. (2002). Statistics and computing: Introductory Statistics with R. Springer

- Maindonald, J. and Braum, J. (2007). Data Analysis and Graphics Using R: An example-based approach. Cambridge Series in Statistical and Probabilistic Mathematics.

- Hey-Jahans, C. (2012). An R Companion to Linear Statistical Models. CRC Press.

- Gardener, M. (2012). Beginning R: The Statistical Programming Language. Wiley & Sons.

- Acharya, S. (2018). Data Analytics using R. McGraw Hill Education.

- Wickham, H. and Grolemund, G. (2017). R for Data Science. O'Reilly Media.

- Lander, J.P. (2017). R for Everyone: Advanced Analytics and Graphics. Addison-Wesley Professional.

- Kabacoff, R.I. (2015). R in Action: Data Analysis and Graphics with R. Manning Publications.

ST-SEC-155 Practicals based on R

List of Practicals:

Topic No.	Topic for Practicals	No. of Practicals
1	Introduction to R software.	1
2	Data import and Export	2
3.	Data objects and built in functions used in R.	2
4.	Diagrammatic representation of data.	2
5.	Graphical representation of data.	2
6	Computation of measures of central tendency.	3
7.	Computation of measures of dispersion.	3

Reference Websites:

Teachers and students are expected to visit following websites for additional teaching learning material

1. www.freestatistics.tk(National Statistical Agencies)
2. www.psychstat.smsu.edu/sbk00.htm(Online book)
3. www.bmj.bmjournals.com/collections/statsbk/index.shtml
4. www.statweb.calpoly.edu/bchance/stat-stuff.html
5. www.amstat.org/publications/jse/jse-data-archive.html (International journal on teaching and learning of statistics)
6. www.amstat.org/publications/chance (Chance magazine)
7. www.statsci.org/datasets.html (Data sets)
8. www.math.uah.edu/stat (Virtual laboratories in Statistics)
9. www.amstat.org/publications/stats (STATS : the magazine for students of Statistics)
10. www.stat.ucla.edu/cases (Case studies in Statistics).
11. www.statsoft.com
12. www.statistics.com
13. www.indiastat.com
14. www.unstat.un.org
15. www.stat.stanford.edu
16. www.statpages.net
17. www.wto.org
18. www.censusindia.gov.in
19. www.mospi.nic.in
20. www.statisticsofindia.in

Students may also follow following links for online lectures:

https://nptel.ac.in/courses/111/104/111104120/

https://swayam.gov.in/nd2_cec20_mg13/

https://nptel.ac.in/courses/111/106/111106112/