Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune - 5

First Year of B.Sc.
Course under NEP 2020

Course Code: 23ScStaU1101
Course Name: Descriptive Statistics

Teaching Scheme: 4 Hours/Week **Credit: 04**
Examination Scheme: CIA: 40 Marks **End-Sem : 60 Marks**

Prerequisite Courses:

- Basic Mathematics.

Course Objectives:

- To study different types of the data, different methods of sampling.
- To learn graphical representation, summary statistics of the data.
- To Study the concept of Skweness, Kurtosis and correlation.
- To learn attributes and its measure of association.

Course Outcomes:

On completion of the course, student will be able to–

- Represent the data in tabular and different types of the graphs as well as to interpret it.
- Compute the appropriate measures of central tendency and dispersion applicable to the data set.
- Interpret the data in terms of skweness and kurtosis while analyzing the real data set.
- Find the kind of relation and extent of relation between two variables.

Course Contents

Unit 1	**Introduction to Statistics**	**02 lectures**
	1.1 Meaning of Statistics as a science. 1.2 Importance of Statistics. 1.3 Scope of Statistics: In the field of Industry, Biological sciences, Medical sciences, Economics, Social sciences, Management sciences, Agriculture, Insurance, Information Technology, Education and Psychology.	
Unit 2	**Population and Sample**	**05 lectures**
	2.1 Types of characteristics: Attributes: Nominal scale, ordinal scale, Likert scale. Variables: Interval scale, ratio scale. Discrete and continuous variables. 2.2 Types of data: (a) Primary data, Secondary data. (b) Cross-sectional data, Time series data, Directional data.	

	Notion of a statistical population and sample: Finite population, infinite population, homogeneous population and heterogeneous population. 2.3 Methods of sampling (description only): Simple random sampling with and without replacement (SRSWR and SRSWOR), Stratified Random Sampling, Systematic Sampling, Cluster sampling and Two-stage sampling.	
Unit 3	**Graphical Representation**	**03 lectures**
	3.1 Classification: Raw data and its classification, ungrouped frequency distribution, grouped frequency distribution, cumulative frequency distribution, inclusive and exclusive methods of classification, open end classes, relative frequency distribution. 3.2 Data visualization technique : Bar diagram, Histogram, frequency polygon, frequency curve, pie diagram.	
Unit 4	**Measures of Central Tendency**	**12 lectures**
	4.1 Concept of central tendency of statistical data, Statistical averages, characteristics of a good statistical average. 4.2 Arithmetic Mean (A.M.): Definition, effect of change of origin and scale, combined mean of a number of groups, merits and demerits, trimmed arithmetic mean. 4.3 Mode and Median: Definition, merits and demerits. Empirical relation between mean, median and mode. 4.4 Partition values: Quartiles, Deciles and Percentiles. Geometric Mean (G.M.): Definition, merits and demerits. Harmonic Mean (H.M.): Definition, merits and demerits. Order relation between arithmetic mean, geometric mean, harmonic mean. 4.5 Weighted Mean: weighted A.M., G.M. and H.M. 4.6 Situations where one kind of average is preferable to other.	
Unit 5	**Measures of Dispersion**	**08 lectures**
	5.1 Concept of dispersion, characteristics of good measure of dispersion. 5.2 Range, Semi-interquartile range (Quartile deviation): Definition, merits and demerits. 5.3 Mean deviation: Definition, merits and demerits, minimality property (without proof) 5.4 Variance and standard deviation: Definition, merits and demerits, effect of change of origin and scale, combined variance for n groups (derivation for two groups).Mean squared deviation: Definition, minimality property of mean squared deviation. 5.5 Measures of dispersion for comparison: Coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation (C.V.).	
Unit 6	**Moments, Skewness and Kurtosis**	**10**

		lectures
	6.1 Moments: Raw moments (m'_r) for ungrouped and grouped data. Central moments (mr) for ungrouped and grouped data, Effect of change of origin and scale. Relations between central moments and raw moments upto 4^{th} order (with proof). 6.2 Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequency distribution and its relation with central tendency. Bowley's coefficient of skewness : Bowley's coefficient of skewness lies between − 1 to 1, interpretation using box and whisker plot. Karl Pearson's coefficient of skewness, Measures of skewness based on moments ($\beta 1, \gamma 1$). 6.3 Concepts of kurtosis, Types of kurtosis: Leptokurtic, Mesokurtic and Platykurtic frequency distributions and its relation with dispersion. Measures of kurtosis based on moments ($\beta 2, \gamma 2$). 6.4 Properties of β_1 and β_2 (i) $\beta_2 \geq 1$ (ii) $\beta_2 \geq \beta_1 + 1$ Statement of results related measures of skewness and kurtosis).	
Unit 7	**Correlation**	**12 lectures**
	7.1 Bivariate data, Scatter diagram and interpretation. 7.2 Concept of correlation between two variables, positive correlation, negative correlation, no correlation. 7.3 Covariance between two variables (m11) : Definition, computation, effect of change of origin and scale. 7.4 Karl Pearson's coefficient of correlation (r) : Definition, Properties: (i) $-1 \leq r \leq 1$ (with proof), (ii) Effect of change of origin and scale (with proof). Computation for ungrouped data and grouped frequency distributed data with interpretation. 7.5 Spearman's rank correlation coefficient: Definition, derivation of formula, computation and interpretation (without ties). In case of ties, compute Karl Pearson's correlation coefficient between ranks. (Spearman's rank correlation coefficient formula with correction for ties not expected.)	
Unit 8	**Theory of Attributes**	**08 lectures**
	8.1 Attributes: Classification, notion of manifold classification, dichotomy, class frequency, order of a class, positive class frequency, negative class frequency, ultimate class frequency, relationship among different class frequencies (up to three attributes), and dot operator to	

	find the relation between frequencies, fundamental set of class frequencies. 8.2 Consistency of data up to 3 attributes. 8.3 Concepts of independence and association of two attributes. 8.4 Yule's coefficient of association(Q), $-1 \leq Q \leq 1$, its interpretation.	

References:

1. Agarwal B. L. (2003). Programmed Statistics, 2nd edition, New Age International Publishers, NewDelhi.
2. Das (2009). Statistical Methods, Tata Mcgraw Hill *Publishing.*
3. Dixit P.G, Prayag V.R.,.Descriptive Statistics,Nirali prakashan., Pune
4. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. 1, 6th Revised Edition, The World Press Pvt. Ltd., Calcutta.
5. Gore.Anil, Pranjapesharayu ,Kulkarni Madhav. Statistics for everyone. SIPFAcadamy publisher,Nashik
6. Gupta, S. C. and Kapoor, V. K. (2000). Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons Publishers, New Delhi.
7. Krzanowski (2007). Statistical Principals and Techniques in Scientific and Social Research, Oxford University Press Inc., New York.
8. Mohanty (2016). Basic Statistics, Scientific Publisher
9. Mukhopadhyay P. (2015). Applied Statistics ,*Publisher*: Books & Allied (*P*) Ltd.
10. Purohit, S. G., Gore S. D.,Deshmukh S. R (2008). Statistics Using R, Narosa Publishing House, NewDelhi
11. Rastogi (2015). Biostatistics, 3rd Edition, Publisher Medtec
12. Robert S. Witte, John S. Witte (2017). Statistics, *Publisher*: Wiley
13. Roussas, George G. (2016). First course in mathematical statistics.2nd edition Publisher: Academic Press.

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune - 5

FirstYear of B.Sc.
Course under NEP 2020

Course Code: 23ScStaU1102
Course Name: Statistics Practical -I

Teaching Scheme: TH: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Basic Mathematics.

Course Objectives:

- To study different types of the data, different methods of sampling.
- To learn graphical representation, summary statistics of the data.
- To Study the concept of Skweness, Kurtosis and correlation.
- To learn attributes and its measure of association.

Course Outcomes:

On completion of the course, student will be able to–

- Represent the data in tabular and different types of the graphs as well as to interpret it.
- Compute the appropriate measures of central tendency and dispersion applicable to the data set.
- Interpret the data in terms of skweness and kurtosis while analyzing the real data set.
- Find the kind of relation and extent of relation between two variables.

Course Contents

Sr. No.	Title of Experiment/ Practical
1	Diagrammatic and Graphical representation of statistical data-I: Bar diagram, Histogram, Frequency Polygon, Ogive curve (less and more than type)
2	Diagrammatic and Graphical representation of statistical data-II: Pie chart, Sub-divided bar diagram, Multiple bar diagram, Stem and leaf, Mosaic plot.
3	Use of random number tables to draw SRSWOR, SRSWR sample
4	Use of random number tables to draw stratified sample and systematic sample.
5	Computation of measures of central tendency and dispersion (ungrouped data). Use of an appropriate measure and interpretation of results and computation of partition values.
6	Computation of measures of central tendency and dispersion (grouped data)-I Use of an appropriate measure and interpretation of results and computation of partition values.
7	Computation of measures of central tendency and dispersion (grouped data)-II Use of an appropriate measure and interpretation of results and computation of partition values.
8	Measures of Skewness, Kurtosis based quartiles, Box plot.

9	Moments, Measures of Skewness, Kurtosis based moments.
10	Scatter diagram, computation of correlation coefficient and Spearman's Rank Correlation Coefficient.
11	Attributes
12	Project work (equivalent to 4 practicals)

Shivajinagar, Pune - 5

FirstYear of B.Sc. (OE)
Course under NEP 2020

Course Code: 23ScStaU1401
Course Name: Fundamentals of Statistics-I
Teaching Scheme: 2 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Basic Mathematics

Course Objectives:

- To study different types of the data, different methods of sampling.
- To learn graphical representation, summary statistics of the data.

Course Outcomes:

On completion of the course, student will be able to–

- Represent the data in tabular and different types of the graphs as well as to interpret it.
- Compute the appropriate measures of central tendency and dispersion applicable to the data set.

Course Contents

Unit 1	**Introduction to Statistics**	**02 lectures**
	1.1 Meaning of Statistics as a science. 1.2 Importance of Statistics. 1.3 Scope of Statistics: In the field of Industry, Biological sciences, Medical sciences, Economics, Social sciences, Management sciences, Agriculture, Insurance, Information Technology, Education and Psychology. 1.4 Statistical organizations in India and their functions: CSO, ISI, NSSO, IIPS, Bureau of Economics and Statistics. Introduction to contributions by Indian Statisticians :P C Mahalnobis P V Sukhatme, C R Rao , V. S. Huzurbazar.	
Unit 2	**Population and Sample**	**05 lectures**
	2.1 2.1 Types of characteristics: Attributes: Nominal scale, ordinal scale, Likert scale. Variables: Interval scale, ratio scale. Discrete and continuous variables. 2.2 Types of data: (a) Primary data, Secondary data. (b) Cross-sectional data, Time series data, Directional data. 2.3 Notion of a statistical population and sample: Finite population, infinite population, homogeneous population and heterogeneous population. Methods of sampling (description only): Simple random sampling with and without replacement (SRSWR and SRSWOR), Stratified Random Sampling, Systematic Sampling.	
Unit 3	**Graphical Representation**	**03 lectures**

	3.1 3.1 Classification: Raw data and its classification, ungrouped frequency distribution, grouped frequency distribution, cumulative frequency distribution, inclusive and exclusive methods of classification, open end classes, relative frequency distribution. 3.2 3.2 Data visualization technique : Bar Diagram, Histogram, frequency polygon, frequency curve, pie diagram.	
Unit 4	**Measures of Central Tendency**	**12 lectures**
	4.1 Concept of central tendency of statistical data, Statistical averages, characteristics of a good statistical average. 4.2 Arithmetic Mean (A.M.): Definition, effect of change of origin and scale, combined mean of a number of groups, merits and demerits, trimmed arithmetic mean. 4.3 Mode and Median: Definition, merits and demerits. Empirical relation between mean, median and mode. 4.4 Partition values: Quartiles, Deciles and Percentiles. Geometric Mean (G.M.): Definition, merits and demerits. Harmonic Mean (H.M.): Definition, merits and demerits. Order relation between arithmetic mean, geometric mean, harmonic mean. 4.5 Situations where one kind of average is preferable to other.	
Unit 5	**Measures of Dispersion**	**08 lectures**
	5.1 5.1 Concept of dispersion, characteristics of good measure of dispersion. 5.2 5.2 Range, Semi-interquartile range (Quartile deviation): 5.3 Variance and standard deviation: Definition, merits and demerits, effect of change of origin and scale, 5.4 combined variance for 2 groups 5.5 Measures of dispersion for comparison: Coefficient of range, coefficient of quartile deviation and Coefficient of variation (C.V.).	

References:

1.Goon, A. M., Gupta, M. K. and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. 1, 6th Revised Edition, The World Press Pvt. Ltd., Calcutta

2.Gupta, S. C. and Kapoor, V. K. (2000). Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons Publishers, New Delhi.

3. Mohanty (2016). Basic Statistics, Scientific Publisher

4. Mukhopadhyay P. (2015). Applied Statistics ,*Publisher*: Books & Allied (*P*) Ltd.

Modern College of Arts, Science and Commerce, Shivajinagar, Pune – 5

First Year of B.Sc.

Course under NEP 2020

Course Code: 23ScStaU1501
Course Name: Data Analysis Using MS-EXCEL

Teaching Scheme: 4 Hours/Week **Credit: 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Descriptive Statistics.

Course Objectives:

- To learn graphical representation, summary statistics of the data.

Course Outcomes: On completion of the course, student will be able to–

- Represent the data in tabular and different types of the graphs using MS_EXCEL.
- Compute the appropriate measures of central tendency and dispersion applicable to the data set using MS_EXCEL.

Course Content:

- **All Practicals are to be performed using MS-Excel**

Sr. No.	Title of Experiment/ Practical
1	Data Entry, basics of MS_EXCEL (Copy, Paste, drag, to create a column, table etc)
2	To create folder, File, Save a file.
3	Mathematical calculations, text data, Frequency distribution.
4	Diagrammatic and Graphical representation of statistical data-I: Bar diagram, Histogram, Frequency Polygon. Frequency curve.
5	Diagrammatic and Graphical representation of statistical data-II: Pie chart, Multiple bar diagram.
6	Use of random numbers to draw SRSWOR, SRSWR, stratified sample and systematic sample.
7	Computation of measures of central tendency and dispersion (ungrouped data). Use of an appropriate measure and interpretation of results and computation of partition values.
8	Computation of measures of central tendency and dispersion (grouped data)-I Use of an appropriate measure and interpretation of results and computation of partition values.
9	Computation of measures of central tendency and dispersion (grouped data)-II Use of an appropriate measure and interpretation of results and computation of partition values.
10	Measures of Skewness, Kurtosis, Box plot.
11	Scatter diagram , computation of Correlation coefficient and Spearman's Rank Correlation Coefficient.
12	Project work (equivalent to 4 practicals)

First Year of B.Sc.
Course under NEP 2020

Course Code: 23ScStaU1601
Course Name: Data Analysis Using R software

Teaching Scheme: 4 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:
Descriptive Statistics.
Course Objectives:
To learn graphical representation, summary statistics of the data.
Course Outcomes: On completion of the course, student will be able to use R software for statistical analysis.

Sr.No.	Title of Experiment/ Practical
1	Use of basic R software commands c( ), scan( ), rep( ), seq( )
2	To find Min, max and sort, extract the data.
3	To Create Data.frame, matrix, edit ( ), accessing resident data sets.
4	To Save a R file and import the excel file in R.
5	To draw SRSWOR, SRSWR, and systematic sample.
6	To calculate summary statistics using summary ( ) and fivenum( ). Calculate arithmetic mean (AM), geometric mean (GM), harmonic mean (HM), median, mode for ungrouped data.
7	To calculate quantiles, range, quartile deviation (QD), variance, coefficient of variation (CV) for ungrouped data.
8	Measures of Skewness, Kurtosis based quartiles and Moments for ungrouped data, Box plot.
9	Diagrammatic and Graphical representation of statistical data: Bar diagram, Histogram, pie chart.
10	Diagrammatic and Graphical representation of statistical data: Subdivided and multiple bar diagram.
11	Diagrammatic and Graphical representation of statistical data: Scatter diagram, Heatmap, Correlogram,
12	Computation of Correlation coefficient and Spearman's Rank Correlation Coefficient.
13	Project work (equivalent to 3 practical)

First Year of B.Sc.
Course under NEP 2020

Course Code: 23ScStaU1901 **Course Name:** Indian Official statistics
Teaching Scheme: 2 Hours/Week **Credit: 2**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Basic concepts of Arithmetic

Course Objectives:

- To learn statistical system in India

Course Outcomes: On completion of the course, student will be able to **u**nderstand the statistical systems of government of India.

Course Contents

Unit 1	**Introduction**	**03 lectures**
	● Contribution of Indian Statisticians. Prof. P.C. Mahalonobis, Prof. C.R.Rao, Prof. P.V. Sukhatme, Prof. Huzurbazar Prof. B.K.Kale.	
Unit 2	**The Statistical system in India**	**08 lectures**
	● The Central and State Government organizations. ● National statistical commission. ● Functions of the important statistical agencies in India CSO, National Sample Survey Organization (NSSO), MOSPI, NSSTA, NSO.	
	Methods of Collection of Official Statistics	
	● Introduction to Nation wise Censuses- population, economic, agriculture ● Introduction to Nation wise Sample Surveys ● State Statistical Systems.	
Unit 4	**Applications of Official Statistics**	**09 lectures**
	● Overview of agricultural statistics ● Overview of social statistics ● Overview of economic statistics ● Overview of labor and employment statistics ● National income	

Reference Books :

1) Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
2) www.mospi.gov.in.
3) Reports of Censuses, NSSO
4) Glimpses of Indian Statistical heritage: J K Ghosh, Sujit Kumar Mitra, K R Parthasarathy.

(Course under NEP 2020)

Course Code: 23ScStaU2101
Course Name: Discrete Probability and Probability Distributions

Teaching Scheme: 4 Hours/Week **Credit: 4**

Examination Scheme: CIA: 40 Marks **End-Sem : 60 Marks**

Course Objectives: To introduce students to:

- the basic concepts of probability, axiomatic approach of probability, concept of independence of two events, conditional probability and Bayes law
- the concept of random variable and univariate probability distribution.
- the concept of independence of variables involved.
- Standard discrete probability distributions based on finite and infinite sample space.
- Interrelations between Standard discrete probability distributions.

Course Outcomes: On completion of the course, student will be able to–

- Distinguish between random and non-random experiments.
- Study of concept of probability of an event.
- Identify random variables of interest and find their probability distributions.
- Identify different real life situations where standard discrete probability distributions can be applied.
- Identify limiting distributions.

Course Contents:

Unit 1	**Probability**	**12 lectures**
	1.1 1.1 Permutations and Combinations, Experiments/Models, deterministic and non-deterministic models. Random experiment. 1.2 Definitions of - (i) Sample space, (ii) Discrete sample space (finite and countably infinite) (iii) Continuous sample space, (iv) Events, (v) Elementary event, (vi) Complement of an event, (vii) Certain event, (viii) Impossible event.etc. 1.3 Concept of occurrence of an event. 1.4 Algebra of events and its representation in set theory notation. 1.5 Classical definition of probability and its limitations. 1.6 Probability model, equiprobable and non-equiprobable sample space. 1.7 Axiomatic definition of probability, theorems on probability, proofs based on axiomatic definition, computation of probability of an event.	
Unit 2	**Conditional probability, Independence and Bayes' Theorem**	**08 lectures**
	2.1 Conditional probability of an event.	

	2.2 Independence of two events. 2.3 Pair-wise independence and mutual independence for three events. 2.4 Multiplication theorem $P(A \cap B) = P(A) \cdot P(B|A)$ and its generalization. 2.5 Partition of the sample space. 2.6 Bayes' theorem(Statement only), Applications of Bayes' theorem in real life.	
Unit 3	**Univariate Probability Distributions**	**10 lectures**
	3.1 Concept and definition of a discrete random variable. 3.2 Probability mass function (p.m.f.) and distribution function (d.f.),$F_X(\cdot)$, of discrete random variable, Characteristic properties of distribution function. 3.3 Mode and median of a univariate discrete probability distribution. 3.4 Definition of expectation (mean) of a random variable, properties of expectation, expectation of a function of a random variable, moment generating function (m.g.f.) and cumulant generating function(c.g.f.) and their properties. 3.5 Definitions of variance, properties of variance, standard deviation (s.d.) and coefficient of variation (c.v.) of univariate probability distribution 3.6 Definition of raw, central moments and factorial raw moments of univariate probability distributions and their interrelations. 3.7 Coefficient of skewness and kurtosis based on moments. 3.8 Examples and Problems.	

Unit 4	**Discrete Probability Distributions based on finite sample space**	**16 lectures**
	4.1 Degenerate distribution (one point distribution) P.m.f.: $P(X=c) = 1$, mean and variance. 4.2 Uniform discrete distribution on integers 1 to n: p.m.f. $P(X=x) = \begin{cases} \frac{1}{n} & , x = 1, 2, \cdots, n. \\ 0 & \text{otherwise}. \end{cases}$ mean, variance, M.G.F, distribution of sum of two discrete uniform random variable. median. 4.3 Bernoulli distribution: p.m.f. $P(X = x) = \begin{cases} p^x (1-p)^{1-x} & , x = 0,1 \\ & 0 < p < 1 \\ 0 & \text{otherwise} \end{cases}$ mean, variance ,M.G.F. and moments. Distribution of sum of two independent Bernoulli random variable.	

	4.4 Binomial distribution : p.m.f. P(X = x) = $\begin{cases} \binom{n}{x} p^x q^{(n-x)} & , x = 0,1,\ldots, n. \\ & ,0 < p < 1 \quad , q = 1 - p \\ 0 & \text{otherwise .} \end{cases}$ Notation : X ~B(n,p). , situations where this distribution is applicable. mean, variance, recurrence relation for successive probabilities, computation of probabilities of different events, mode of the distribution, m.g.f., c.g.f., moments , skewness (comments when p = 0.5, p > 0.5, p < 0.5), additive property. 4.5 Hypergeometric Distribution : p.m.f P(X = x) = $\frac{\binom{M}{x}\binom{N-M}{n-x}}{\binom{N}{n}}$, $x = 0,1,\cdots\cdots \min\{n, M\}, N > M$ 0 otherwise Notation : X ~H (N, M, n), situations where this distribution is applicable mean and variance, binomial approximation to hypergeometric distribution(Statement only) .Computation of probability. 4.6 Examples and problems.	
Unit-5	**Univariate discrete probability distributions based on countably infinite sample space.**	**14 lectures**
	5.1 **Poisson distribution**: Notation : X ~P(λ). $p(x) = \begin{cases} \frac{e^{-\lambda}\lambda^x}{x!} & , \quad x = 0,1,2 \ldots\ldots , \quad \lambda > 0 \\ 0 & \text{otherwise} \end{cases}$ Situations where this distribution is applicable. Mean, variance. m.g.f, and c.g.f. (State the formula only) , moments using c.g.f., skewness ,kurtosis, recurrence relation, conditional distribution X | X + Y , additive property, Poisson distribution as a limiting form of binomial distribution(Statement only).	

5.2 **Geometric distribution**: Notation: X ~G(p),
Geometric distribution on support (0, 1, 2..) ,
with p.m.f.

$$p(x) = \begin{cases} pq^x , & x = 0, 1, 2\ldots , 0 < p < 1, \ q = 1 - p. \\ 0 & \text{otherwise} \end{cases}$$

Geometric distribution on support (1,2..)
with p.m.f.

$$p(x) = \begin{cases} pq^{x-1} , & x = 1, 2\ldots \quad 0 < p < 1, q = 1 - p. \\ 0 & \text{otherwise} \end{cases}$$

distribution function, recurrence relation,
situations where this distribution is applicable.
mean, variance. m.g.f, c.g.f. .(State the formula only),moments , lack of memory property.
Examples and problems

5.3 Negative Binomial Distribution:

Probability mass function (p.m.f.)

□(□ = □) =$\left(\frac{□+□-1}{□}\right)$ □□ □□ ; □ = 0,1,2, ... ; 0 < □ < 1

□ = 1 − □ ; □ > 0

= 0 ; □□h□□□□□□.

Notation: □ ~ □□(□, □).

Nature of p. m. f. negative binomial distribution as waiting time distribution. M.G.F., C.G.F.(State the formula only)., mean, variance, skewness, kurtosis (recurrence relation between moments is not expected). Relation between geometric and negative binomial distribution. Poisson approximation to negative binomial distribution(Statement only). Real life situations.

References:

1. Gupta, S. C. and Kapoor, V. K. (2000). Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons Publishers, New Delhi.
2. Agarwal B. L. (2003). Programmed Statistics, 2nd edition, New Age International Publishers, New Delhi.
3. B.L.S. Prakasarao, (2008). A First Course in Probability and Statistics, World Scientific Publishing Company.
4. Ross S. (2002). A First Course in Probability, 6th edition, Pearson Education, Inc. & Dorling

	Kindersley Publishing, Inc. 5. *Roussas*, George G. (2016). First course in mathematical *statistics.*2nd edition *Publisher:* Academic Press.	

Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune – 5

First Year of B.Sc. 2023

(Course under NEP 2020)

Course Code: 23ScStaU2102 **Course Name: Statistics Practical II**

Teaching Scheme: 4 Hours/Week **Credit: 2**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Pre-requisites : Knowledge of the topics in Major theory paper 23ScStaU2101

Course outcome: On completion of the course, student will be able to understand :

- Standard discrete probability distributions based on finite and infinite sample space.
- Fitting of univariate probability distributions
- To compute probabilities of univariate probability distributions.

Sr.No.	Title of Experiment/ Practical
1	Problems on permutations and combinations.
2	Problems on probability and conditional probability.
3	Problems of independence and Bayes' theorem.
4	Fitting of binomial distribution and computation of expected frequencies.
5	Fitting of Poisson distribution and computation of expected frequencies.
6	Fitting of negative binomial distribution and computation of expected frequencies
7	Applications of Bernoulli and binomial distribution.
8	Applications of uniform and Poisson distribution.
9	Applications of hypergeometric distribution.
10	Applications of negative binomial and geometric distribution.
11	Model sampling from binomial, Poisson, Discrete Uniform distribution.
12	Model sampling from Geometric and Negative Binomial distribution.
13	Project (equivalent to 3 Practical)

Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune – 5

First Year of B.Sc. 2023 (Minor)
(Course under NEP 2020)

Course Code: 23ScStaU2301
Course Name: Exploratory Data analysis.

Teaching Scheme: 4 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Course outcome: On completion of the course, student will be able:

- To use various graphical and diagrammatic techniques and interpret.
- To compute various measures of central tendency, dispersion, skewness and kurtosis.
- To compute correlation coefficient.

Sr.No	Title of Experiment/ Practical
1	Diagrammatic representation of statistical data.
2	Tabulation , Graphical representation of statistical data.
3	Use of random numbers to draw SRSWOR, SRSWR, stratified sample and systematic sample.
4	Computation of measures of central tendency (ungrouped data). Use of an appropriate measure and interpretation of results and computation of partition values
5	Computation of measures of central tendency (grouped data). Use of an appropriate measure and interpretation of results and computation of partition values
6	Computation of measures of Dispersion (ungrouped data). Use of an appropriate measure and interpretation of results and computation of partition values.
7	Computation of measures of Dispersion (grouped data). Use of an appropriate measure and interpretation of results and computation of partition values.
8	Measures of skewness and kurtosis, Box plot.
9	Scatter plot, Karl Pearson correlation coefficient.
10	Rank correlation.
11	Fitting of line of regression.
12	Diagrammatic and graphical representation of statistical data using MS-Excel.
13	Computation of summary statistics using MS-Excel.
14	Project (equivalent to 2 Practical).

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FirstYear of B.Sc. (OE)
Course under NEP 2020

Course Code: 23ScStaU2401
Course Name: Fundamentals of Statistics-II

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Basic Mathematics.
- Graphical representation and Measures of Central tendency and dispersion.

Course Objectives:

- To Study the concept of Skewness, Kurtosis and correlation.
- To learn attributes and its measure of association.

Course Outcomes:

On completion of the course, student will be able to–

- Interpret the data in terms of skewness and kurtosis while analyzing the real data set.
- Find the kind of relation and extent of relation between two variables.

Course Contents

Unit 1	**Moments, Skewness and Kurtosis**	**10 lectures**
	1.1 Moments: Raw moments (m'_r) for ungrouped and grouped data. Central moments (m_r) for ungrouped and grouped data, Relations between central moments and raw moments upto 4^{th} order (without proof). 1.2 Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequency distributions relation with central tendency, Bowley's coefficient of skewness Karl Pearson's coefficient of skewness. Measures of Skewness based on moments (β_1,γ_1). 1.3 Concepts of kurtosis, Types of kurtosis: Leptokurtic, Mesokurtic and Platykurtic frequency distributions and its relation with dispersion. Measures of kurtosis based on moments (β_2,γ_2)	
Unit 2	**Correlation**	**10 lectures**
	2.1 Bivariate data, Scatter diagram and interpretation. 2.2 Concept of correlation between two variables, positive correlation, negative correlation, no correlation. 2.3 Covariance between two variables (m_{11}) : Definition, computation, effect of change of origin and scale. 2.4 Karl Pearson's coefficient of correlation (r) : Definition, Properties: (i) $-1 \le r \le 1$ (ii) Effect of change of origin and scale Computation for ungrouped data and grouped frequency	

	distributed data with interpretation. 2.5 Spearman's rank correlation coefficient: Definition, derivation of formula, computation and interpretation (without ties).	
Unit 3	**Line/Curve Fitting**	**10 lectures**
	3.1 Simple linear regression, principle of least squares. 3.2 Fitting of polynomials and exponential curves.	

References:

1. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. 1, 6th Revised Edition, The World Press Pvt. Ltd., Calcutta
2. Gupta, S. C. and Kapoor, V. K. (2000). Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons Publishers, New Delhi.
3. Mohanty (2016). Basic Statistics, Scientific Publisher
4. Mukhopadhyay P. (2015). Applied Statistics ,*Publisher*: Books & Allied (*P*) Ltd.

Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune – 5

First Year of B.Sc. 2023
(Course under NEP 2020)

Course Code: 23ScStaU2501
Course Name: MS Excel for Discrete Probability Models.

Teaching Scheme: 4 Hours/Week **Credit: 2**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Pre-requisites: Knowledge of the topics in Major theory paper 23ScStaU2101

Course outcome: On completion of the course, student will be able to understand :

- Fitting of univariate probability distributions using M.S.Excel.
- To compute probabilities of univariate probability distributions using M.S.Excel.

***All practical are to be performed using MS-Excel**

Sr.No.	Title of Experiment/ Practical
1	Fitting of Binomial distribution and computation of expected frequencies.
2	Fitting of Poisson distribution and computation of expected frequencies.
3	Fitting of Negative Binomial distribution and computation of expected frequencies.
4	Application of Discrete Uniform distribution.
5	Application of Bernoulli and Binomial distribution.
6	Application of Poisson distribution.
7	Application of geometric and negative binomial distribution.
8	Application of hypergeometric distribution.
9	Model sampling from uniform, binomial and Poisson distribution.
10	Model sampling from Geometric and Negative Binomial distribution.
11	Sketching of probability distributions I
12	Sketching of probability distributions II
13	Project (equivalent to 3 Practical's)

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Modern College of Arts, Science and Commerce,

Shivajinagar, Pune – 5

First Year of B.Sc. 2023
(Course under NEP 2020)

Course Code: 23ScStaU2601
Course Name: R software for Discrete Probability Models.

Teaching Scheme: 4 Hours/Week **Credit: 2**

Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Pre-requisites: Knowledge of the topics in Major theory paper 23ScStaU2101

Course outcome: On completion of the course, student will be able to understand:

- Fitting of univariate probability distributions using R software.
- To compute probabilities of univariate probability distributions using R software.

***All practical are to be performed using R software**

Sr.No	Title of Experiment/ Practical
1	Fitting of Binomial distribution and computation of expected frequencies.
2	Fitting of Poisson distribution and computation of expected frequencies.
3	Fitting of Negative Binomial distribution and computation of expected frequencies.
4	Application of Discrete Uniform distribution.
5	Application of Bernoulli and Binomial distribution.
6	Application of Poisson distribution.
7	Application of geometric and negative binomial distribution.
8	Application of hypergeometric distribution.
9	Model sampling from uniform, binomial and Poisson distribution.
10	Model sampling from Geometric and Negative Binomial distribution.
11	Sketching of probability distributions I
12	Sketching of probability distributions II
13	Project (equivalent to 3 Practical's)