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: 24ScStaU1101
Course Name: Descriptive Statistics

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

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

Prerequisite Courses:

- Basic Mathematics.

Course Objectives:

- To study different types of data.
- To Study Statistical Population and sample.
- To compute different types of measures of central tendency and dispersion.
- To Study the concept of skweness, kurtosis.
- To study kind and extent of relationship between two variable.

Course Outcomes:

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

- Categories data set according to the types of data sets.
- Compute the appropriate measures of central tendency for the data set.
- Compute the appropriate measures of dispersion for the data set.
- Compute different types of moments for 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	**Population and Sample**	**03**
	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.	

Unit 2	**Measures of Central Tendency**	**10**
	2.1 Concept of central tendency of statistical data, Statistical averages, characteristics of a good statistical average. 2.2 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. 2.3 Mode and Median: Definition, merits and demerits. Empirical relation between mean, median and mode. 2.4 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. 2.5 Weighted Mean: weighted A.M., G.M. and H.M. 2.6 Situations where one kind of average is preferable to other.	
Unit 3	**Measures of Dispersion**	**07**
	3.1 Concept of dispersion, characteristics of good measure of dispersion. 3.2 Range, Semi-interquartile range (Quartile deviation): Definition, merits and demerits. 3.3 Mean deviation: Definition, merits and demerits, minimality property (without proof) 3.4 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. 3.5 Measures of dispersion for comparison: Coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation (C.V.).	
Unit 4	**Moments, Skewness and Kurtosis**	**06**
	4.1 Moments: Raw moments (m'_r) for ungrouped and grouped data. Central moments (m_r) for ungrouped and grouped data, Effect of change of origin and scale. Relations between central moments and raw moments upto 4^{th} order. 4.2 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. Karl Pearson's coefficient of skewness, Measures of skewness based on moments (β_1,γ_1). 4.3 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). 4.4 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 5	**Correlation**	**04**
	5.1 Covariance between two variables (m_{11}) : Definition, computation, effect of change of origin and scale. 5.2 Karl Pearson's coefficient of correlation (r) : Definition, Properties: (i) $-1 \leq r \leq 1$ (ii) Effect of change of origin and scale Computation for ungrouped data and grouped frequency distributed data with interpretation. 5.3 Spearman's rank correlation coefficient: Definition, computation and interpretation (without ties). In case of ties, compute Karl Pearson's correlation coefficient between ranks. (Derivations are not expected)	

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.

Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune - 5

FirstYear of B.Sc.

Course under NEP 2020

Course Code: 24ScStaU1102
Course Name: Lab Course on 24ScStaU1101

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

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

Prerequisite Courses:

- Basic Mathematics.

Course Objectives:

- 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 measures of central tendency and dispersion applicable to the data set.
- Use appropriate measure of central tendency and dispersion applicable to the data set.
- Compute the measures of skweness and kurtosis
- 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.
2	Diagrammatic and Graphical representation of statistical data-II: Frequency Polygon, Frequency curve, Ogive curve (less and more than type)

3	Diagrammatic and Graphical representation of statistical data-III: Pie chart, Sub-divided bar diagram, Multiple bar diagram, Stem and leaf.
4	Computation of measures of central tendency and dispersion (ungrouped data). Use of an appropriate measure and interpretation of results and computation of partition values.
5	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.
6	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.
7	Measures of Skewness, Kurtosis based quartiles, Box plot.
8	Moments, Measures of Skewness, Kurtosis based moments.
9	Scatter diagram, computation of correlation coefficient
10	Computation of Spearman's Rank Correlation Coefficient.
11	Represent Attributes data in contingency table, Computation of frequencies of attributes.
12	Check Consistency of data, independence of attributes, Computation of Yule coefficient of association and it's interpretation.
13	Project work (equivalent to 3 practicals)

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: 24ScStaU1601

Course Name: Lab Course on Data Analysis Using MS-EXCEL

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

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–

- Create, Save a file and folder.
- Use different basic functions from MS_EXCEL.
- 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 using statistical functions.
- Compute the measures of skweness and kurtosis
- Use Data analysis tool park for different statistical functions.

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, subdivided bar diagram.
6	Pivot table, Vlookup, logical functions.
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 and whisker plot.
11	Scatter diagram, Bubble plot, computation of Correlation coefficient and Spearman's Rank Correlation Coefficient.
12	Project work (equivalent to 4 practicals)

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: 24ScStaU2101
Course Name: Discrete Probability Distributions

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

Examination Scheme: CIA: 20 Marks **End-Sem: 30 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.
- Study the concept of conditional and independent events
- 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	8 Lectures
	1.1 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. 1.2 Concept of occurrence of an event, Algebra of events. 1.3 Classical definition of probability and its limitations. 1.4 Probability model, equiprobable and non-equiprobable sample space. 1.5 Axiomatic definition of probability, theorems on probability, computation of probability of an event. 1.6 Conditional probability and Independence of two events. 1.7 Pair-wise independence and mutual independence for three events. Multiplication theorem for two events. 1.8 Partition of the sample space. Bayes' theorem (Statement only), and its applications.	
Unit 2	**Univariate Probability Distributions**	5 Lectures
	2.1 Concept and definition of a discrete random variable. 2.2 Probability mass function (p.m.f.) and distribution function (d.f.),$F_X(\cdot)$, of discrete random variable, Characteristic properties of distribution function. 2.3 Mode and median of a univariate discrete probability distribution. Definition of expectation (mean) of a random variable its properties, moment generating function (m.g.f.) and cumulant generating function(c.g.f.). 2.4 Definitions of variance and its properties. standard deviation (s.d.) and coefficient of variation (c.v.) of univariate probability distribution 2.5 Definition of raw, central moments and factorial raw moments of univariate probability distributions and their interrelations. 2.6 Examples and problem	

Unit 3	**Discrete Probability Distributions based on finite sample space**	10 Lectures

3.1 Degenerate distribution (one point distribution)

P.m.f.: P(X=c) =1, mean and variance.

3.2 Uniform discrete distribution on integers 1 to n:

$$\text{p.m.f. } P(X=x) = \begin{cases} \frac{1}{n} & , x = 1, 2, \cdots, n. \\ 0 & \text{otherwise .} \end{cases}$$

mean, variance, M.G.F, distribution of sum of two discrete uniform random variable.

3.3 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.

3.4 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 (statements only)

3.5 Hypergeometric Distribution : p.m.f

$$P(X = x) = \begin{cases} \dfrac{\binom{M}{x}\binom{N-M}{n-x}}{\binom{N}{n}} & , x = 0, 1, \cdots\cdots \min\{n, M\}, N > M \\ 0 & \text{otherwise} \end{cases}$$

Notation : X ~H (N, M, n),

situations where this distribution is applicable

3.6 Mean and variance, binomial approximation to hypergeometric distribution(Statement only) .Computation of probability,

	3.7 Examples and problems.	
Unit-4	**Univariate discrete probability distributions based on countably infinite sample space.**	7 Lectures
	4.1 **Poisson distribution**: Notation : X ~P(λ). $p(x)=\begin{cases}\frac{e^{-\lambda}\lambda^{x}}{x!}, & x=0,1,2\ldots\ldots,\ \lambda>0\\ 0 & \text{otherwise}\end{cases}$ 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). 4.2 **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. $p(x)=\begin{cases}pq^{x-1}, & x=1,2\ldots\ 0<p<1,\ q=1-p.\\ 0 & \text{otherwise}\end{cases}$ 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 **4.3 Negative Binomial Distribution**: Probability mass function (p.m.f.) $P(X=x)=\binom{x+k-1}{x}p^{k}q^{x}\ ;x=0,1,2,\ldots\ ;0<p<1$ $;q=1-p\ ;k>0$ $=0\quad ;\ otherwise.$ Notation: $X\sim NB(k,p)$. Nature of p. m. f. negative binomial distribution as waiting time distribution. M.G.F., C.G.F.(State the formula only)., mean, variance, 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: 24ScStaU2102
Course Name: Lab Course on 24ScStaU2101
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

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

- Standard discrete probability distributions based on finite sample space.
- Standard discrete probability distributions based on Infinite sample space.
- Application of univariate discrete probability distributions.
- Fitting of univariate probability distributions.
- Model sampling from univariate probability distributions.
- To compute probabilities of univariate probability distributions.

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

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: 24ScStaU2601
Course Name: Lab Course on MS-EXCEL for Discrete Probability Models

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

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

Pre-requisites: Knowledge of the topics in Major theory

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

- Fitting of univariate probability distributions using MS_Excel.
- To compute probabilities of univariate probability distributions using MS_Excel.
- Model sampling form univarite discrete probability distributions.
- Sketching discrete probability distributions.
- Application of discrete probability distributions.
- Identify limiting distributions.

.

***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)