



Rayat Shikshan Sanstha's
R. B. Narayanrao Borawake College, Shrirampur
(Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

Department of Statistics

FYUG (Statistics) Syllabus as per NEP-2020

Implemented
From
Academic Year: 2023-24

F.Y.B.Sc. (Statistics) Core Subjects (Semester-I)

Year	Semester	Course Type	Course Code	Course Title	Theory/ Practical	Credits	No. of Theory/ Practical to be conducted	Page No.
1 st	I	DSC (Major)	ST-MJ-111T	Descriptive Statistics-I	Theory	2	30T	4-6
			ST-MJ-112T	Elementary Probability Theory	Theory	2	30T	7-9
			ST-MJ-113P	Statistics Practical-I	Practical	2	15P	10-11
		VSC	ST-VSC-114T	Foundation of R Software	Theory	2	30T	12-13
		SEC	ST-SEC-115P	Statistical Techniques Using MS-Excel-I	Practical	2	15P	14-15
		IKS	ST-IKS-116T	Ancient Science and Statistics in India	Theory	2	30T	16-17

F.Y.B.Sc. (Statistics) Core Subjects (Semester-II)

Year	Semester	Course Type	Course Code	Course Title	Theory/ Practical	Credits	No. of Theory/ Practical to be conducted	Page No.
1 st	II	DSC (Major)	ST-MJ-121T	Descriptive Statistics-II	Theory	2	30T	19-20
			ST-MJ-122T	Discrete Probability Distributions	Theory	2	30T	21-23
			ST-MJ-123P	Statistics Practical-II	Practical	2	15P	24-25
		VSC	ST-VSC-124T	Statistical Computing Using R Software	Practical	2	15P	26-27
		SEC	ST-SEC-125P	Statistical Techniques Using MS-Excel-II	Practical	2	15P	28-29

Syllabus for F. Y. B. Sc. (Statistics) Semester- I

DISCIPLINE SPECIFIC CORE COURSE (ST-MJ-111T):
Descriptive Statistics-I

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-MJ-111T – Descriptive Statistics-I	2	2	---

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To acquaint students with some basic concepts in Statistics.
- To understand the concept of primary data, secondary data, data collection methods, statistical population and sampling methods.
- To compute various measures of central tendency and measures of dispersion.
- To compute raw and central moments and various measures of skewness and kurtosis.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Understand meaning and importance of statistics.

CO-2: Understand the concept of primary data, secondary data, data collection methods, statistical population and sampling methods.

CO-3: Compute various measures of central tendency and measures of dispersion.

CO-4: Compute raw and central moments and various measures of skewness and kurtosis.

SYLLABUS OF ST-MJ-111T:**[30 Hours]****UNIT-I: Introduction to Statistics****[2 Hours]**

1.1 Meaning of Statistics as a Science.

1.2 Importance of Statistics.

UNIT-II: Population and Sample**[8 Hours]**

2.1 Types of characteristics: Attributes: Nominal scale, ordinal scale, Variables: Interval scale, ratio scale, discrete and continuous variables,

2.2 Types of data: primary data, secondary data, cross-sectional data, time series data, and directional data.

2.3 Data collection methods (Survey, laboratory experiments, simulation), concept of big data, role of statistics in data science. Concept and types of statistical population: Finite population, infinite population, homogeneous population and heterogeneous population.

2.4 Concept of a sample and Methods of sampling: Probability sampling, Simple random sampling with and without replacement (SRSWR and SRSWOR), stratified random sampling, systematic sampling, cluster sampling and two-stage sampling (only Description).

2.5 Non-probability sampling: Judgment sampling, Quota sampling, Convenience and Snowball sampling.

2.6 Frequency Classification: Raw data and its classification, ungrouped frequency distribution, Sturge's rule, grouped frequency distribution, cumulative frequency distribution, inclusive and exclusive methods of classification, Open end classes, and relative frequency distribution.

UNIT-III: Summary Statistics:

[13 Hours]

3.1 Measures of Central Tendency:

Concept of central tendency of statistical data, Statistical averages, characteristics of a good statistical average. Arithmetic Mean (A.M.): Definition, Properties of A.M, combined mean of a number of groups, merits and demerits, trimmed arithmetic mean. Mode and Median: Definition, formulae (for ungrouped and grouped data), merits and demerits. Empirical relation between mean, median and mode. Partition Values: Quartiles, Deciles and Percentiles (for ungrouped and grouped data), Box Plot. Geometric Mean (G.M.): Definition, merits and demerits. Harmonic Mean (H.M.): Definition, merits and demerits. Order relation between arithmetic mean, geometric mean and harmonic mean. Weighted A.M.

3.2 Measures of Dispersion:

Concept of dispersion, characteristics of good measure of dispersion, Range, coefficient of range, Quartile deviation (Semi-interquartile range): Definition, merits and demerits, coefficient of quartile deviation. Mean deviation: Definition, merits and demerits, minimal property (without proof), coefficient of mean deviation. Mean squared deviation: Definition, minimality property of mean squared deviation (with proof). Variance and standard deviation: Definition, merits and demerits, Properties of variance, combined variance for n groups (derivation for two groups). Coefficient of variation (C.V.)

UNIT IV: Moments, Skewness and Kurtosis:

[7 Hours]

4.1 Raw moments for ungrouped and grouped data. Central moments for ungrouped and grouped data, Effect of change of origin and scale. Relations between central moments and raw moments, upto 4-th order (without proof).

4.2 Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequency distribution. Bowley's coefficient of skewness: Bowley's coefficient of skewness lies between -1 to 1 (with proof), interpretation using Box plot. Karl Pearson's coefficient of skewness. Measures of skewness based on moments.

4.3 Concepts of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions. Measures of kurtosis based on moments.

ESSENTIAL/RECOMMENDED READINGS:

- 1) Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, NewDelhi.
- 2) Ghosh, J. K. and Mitra, S. K., Parthasarthy, K. R. (1993). Glimpses of India's Statistics Heritage, Wiley publishing Co.
- 3) Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, The World Press Pvt. Ltd., Calcutta.
- 4) Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, NewDelhi.
- 5) Gupta, S. C. and Kapoor, V. K. (1997). Fundamentals of Applied Statistics, Third Edition, Sultan Chand and Sons Publishers, NewDelhi.
- 6) Neil A. Weiss, (2016). Introductory Statistics, Tenth Edition, Pearson.
- 7) Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, NewDelhi.
- 8) Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, NewDelhi.
- 9) Snedecor G. W. and Cochran W. G. (1989). Statistical Methods, Eighth Ed. East- West Press.

DISCIPLINE SPECIFIC CORE COURSE (ST-MJ-112T):
Elementary Probability Theory

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-MJ-112T – Elementary Probability Theory	2	2	---

LEARNING OBJECTIVES:

The Learning objectives of this course are as follows:

- To distinguish between random and non-random experiments.
- To find the probabilities of an events.
- To obtain a probability distribution of random variable in the given situation.
- To compute mathematical expectation of discrete random variable in the given situation.

COURSE OUTCOMES:

After completion of this course student will able to:

CO-1: Distinguish between random and non-random experiments. Understand the basic concept of probability.

CO-2: Compute conditional probability.

CO-3: Obtain a univariate probability Distribution.

CO-4: Compute mathematical expectation of discrete random variable in the given situation.

SYLLABUS OF ST-MJ-112T:

[30 Hours]

UNIT-I Basics of Probability:

[10 Hours]

Experiments/Models, Ideas of deterministic and non-deterministic models. Random experiment, concept of statistical regularity.

1.1 Definitions of -(i) sample space, (ii) discrete sample space: finite and countably infinite (iii) event (iv) elementary event (v) complement of an event (vi) certain event (vii) impossible event. Concept of occurrence of an event.

1.2 Algebra of an events and its representation in set theory notation. Occurrence of the following events.

- | | |
|--------------------------------------|-------------------------------------------------|
| (i) at least one of the given events | (ii) none of the given events |
| (iii) all of the given events | (iv) mutually exclusive events |
| (v) mutually exhaustive events | (vi) exactly one event out of the given events. |

1.3 Classical definition of probability and its limitations. Probability model, probability of an event, equiprobable and non-equiprobable sample space.

1.4 Axiomatic definition of probability. Theorems and results on probability with proofs based on axiomatic definition such as $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

Generalization $P(A \cup B \cup C)$, $0 \leq P(A) \leq 1$, $P(A) + P(A^c) = 1$, $P(\Phi) = 0$, $P(A) \leq P(B)$ when $A \subset B$ Boole's inequality.

UNIT-II Conditional Probability and Bayes' Theorem: [8 Hours]

2.1 Definition of conditional probability of an event. Results on conditional probability.

2.2 Independence of two events: $P(A \cap B) = P(A) \cdot P(B)$. Pair-wise independence and mutual independence for three events

2.3 Multiplication theorem $P(A \cap B) = P(A) \cdot P(B|A)$. Generalization to $P(A \cap B \cap C)$.

2.4 Partition of the sample space, prior and posterior probabilities.

2.5 Baye's theorem (with Proof).

2.6 Applications of Bayes' theorem in real life. True positive, false positive and true negative, false negative, sensitivity and specificity of test as application of Bayes' theorem.

UNIT -III Univariate Probability Distributions [6 Hours]

(Defined on Discrete sample Space):

3.1 Concept and definition of a discrete random variable.

3.2 Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.), $F(\cdot)$ of discrete random variable, properties of c.d.f..

3.3 Mode and median of a univariate discrete probability distribution.

UNIT -IV Mathematical Expectation (Univariate Random variable) [6 Hours]

4.1 Definition of expectation (Mean) of a random variable, expectation of a function of a random variable, moment generating function (m.g.f.) and cumulative generating function (c.g.f.). Properties of m.g.f and c.g.f.

4.2 Definitions of variance, standard deviation (s.d.) and coefficient of variation (c.v.) of univariate probability distribution, effect of change of origin and scale on mean, variance.

4.3 Definition of raw, central and factorial raw moments of univariate probability distributions and their interrelations (without proof).

4.4 Coefficients of skewness and kurtosis based on moments.

ESSENTIAL/RECOMMENDED READINGS:

- 1) Agarwal B. L. (2003). Programmed Statistics, second 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) Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
- 4) Hogg, R. V. and Craig R.G. (1989). Introduction to Mathematical Statistics, Ed. MacMillan Publishing Co., New York.

- 5) Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley Publishing Co., London.
- 6) Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, McGraw Hill Book Company.
- 7) Rao, VLS Prakash (2008). First Course in Probability and Statistics, New Age International Publishers, New Delhi.
- 8) Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.

DISCIPLINE SPECIFIC CORE COURSE (ST-MJ-113P):
Statistics Practical- I

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-MJ-113P – Statistics Practical- I	2	---	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To use various graphical and diagrammatic techniques and interpretation.
- To compute various measures of central tendency, dispersion, skewness and kurtosis.
- To interpret summary statistics of computer output.
- To summarize and analyze the data using computer.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Use various graphical and diagrammatic techniques and interpretation.

CO-2: Analyse data pertaining to discrete and continuous variables and to interpret the results.

CO-3: Compute various measures of central tendency, measures of dispersion.

CO-4: Compute raw and central moments and various measures of skewness and kurtosis

CO-5: Interpret summary statistics

SYLLABUS OF BO-MJ-113P:

List of Practicals of ST-MJ-113P

[60 Hours]

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1. Diagrammatic representation of statistical data: simple and subdivided bar diagrams, multiple bar diagram, percentage bar diagram, pie diagram. | [1 P] |
| 2. Graphical representation of statistical data: Histogram, frequency curve and ogive curves. Determination of mode and median graphically. | [1 P] |
| 3. Tabulation | [1 P] |
| 4. Use of random number tables to draw SRSWOR, SRSWR, stratified sample and systematic sample. | [1 P] |
| 5. Computation of measures of central tendency (Ungrouped data) | [1 P] |
| 6. Computation of measures of central tendency (Grouped data) | [1 P] |
| 7. Computation of measures of dispersion (Ungrouped data) | [1 P] |

- | | | |
|------------|---------------------------------------------------------------|--------------|
| 8. | Computation of measures of dispersion (Grouped data). | [1 P] |
| 9. | Computation of moments (Ungrouped data) | [1 P] |
| 10. | Computation of moments (Grouped data). | [1 P] |
| 11. | Measures of skewness and kurtosis, Box plot. (Ungrouped data) | [1 P] |
| 12. | Measures of skewness and kurtosis. (Grouped data) | [1 P] |
| 13. | Project (Project is equivalent to three practicals) | [3 P] |

Notes:

1. For project, a group of maximum 5 students be made.
2. All the students in a group are given equal marks for project.
3. Different data sets from newspapers, internet and magazines may be collected and students will be asked to use Statistical techniques/tools which they have learnt.
4. Students must complete all the practicals to the satisfaction of the teacher concerned.
5. Students must produce at the time of practical examination, the laboratory journal along with the completion certificate signed by the Head of the Department.

VOCATIONAL SKILL COURSE (ST-VSC-114T):
Foundation of R Software

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-VSC-114T - Foundation of R Software	2	2	---

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To learn how to install R, how to get help in R, data types operations with data vectors.
- To learn matrix operations, data handling and strings.
- To learn manipulating data and functions in R.
- To study loops in R programming.

COURSE OUTCOMES:

After completion of this course student will able to:

CO-1: Install R, writing commands in R console and R editor.

CO-2: Do matrix operations, data handling and strings.

CO-3: Know commonly used functions in R and manipulating data.

CO-4: know loops used in R programming.

SYLLABUS OF BO-VSC-114T:**[30 Hours]****Unit-I: Introduction to R****[6 Hours]**

1.1.What is R, Why R, installing R, R environment How to get help in R, packages and libraries in R, R console and Editor.

1.2.Basic syntax in R:command prompt, R script file, variables in R, reserved keywords in R, constant in R: numeric constant and character constant

1.3.Data types: numeric, integer, complex, character, logical and raw; R operators.

Unit-II: Understanding Data Structures in R**[9 Hours]**

2.1 Scalar: numeric, integer, complex, character, logical and examples.

2.2 Vectors: atomic (homogenous) vectors and its types, recursive (heterogeneous) vector and examples.

2.3 Calculations with data vectors: addition, subtraction, multiplication & division; r as a calculator with scalars and data vectors: power operations, integer and modulo divisions; built in functions and assignments.

2.4 Matrices, list, data frames, using c, cbind, rbind, attach and detach functions in R, factors and array.

Unit-III: Importing Data and Strings [5 Hours]

3.1 Importing and Reading Tabular Data files.

3.2 Importing and Reading CSV files.

3.3 Importing and Reading excel and other Data Files, Saving and writing data files.

3.4 Strings: Display and Formatting, Print and Format Function, Print and Format with Concatenate, Paste Function; String Splitting; Manipulations with Strings and Alphabets

Unit-IV: Manipulating Data and Functions in R [5 Hours]

4.1 Selecting rows/observations, selecting columns/fields, merging data, relabeling the column names, converting variable types, data sorting, and data aggregation.

4.2 Commonly used Mathematical Functions, Commonly used Summary Functions.

4.3 User-defined functions, local and global variable.

Unit V: R Programming [5 Hours]

5.1 While loop.

5.2 If loop.

5.3 For loop.

5.4 Arithmetic operations.

ESSENTIAL / RECOMMENDED READINGS:

- 1) The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, Springer 2013.
- 2) A Beginner's Guide to R (Use R) By Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Springer 2009.
- 3) Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R Authors: Heumann, Christian, Schomaker, Michael, Shalabh, Publisher” Springer 2016
- 4) R Programming For Dummies, 2ed Andrie de Vries, Joris Meys, Wiley (India), Low price edition.
- 5) Essentials of R with Data Analytics, Saroj Dahiya Ratnoo, Himmat Singh Ratnoo, Wiley (India), Low price edition.
- 6) Statistics using R, Sudha G. Purohit, Sharad D. Gore, Shailaja R. Deshmukh, Narosa Publishing House PVT. Ltd.

SKILL ENHANCEMENT COURSE (ST-SEC-115P):
Statistical Techniques Using MS-Excel-I

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-SEC-115P - Statistical Techniques Using MS-Excel-I	2	---	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To learn how to use statistics in Excel to analyze trends and accurately forecast results to help you make better decisions.
- To apply custom data formats and layouts.
- To perform operations with formulas and functions.
- To summarize data by using functions.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Perform Operations with Formulas and Functions.

CO-2: Draw diagrams and graphs and interpret it.

CO-3: Compute and interpret averages and dispersions.

CO-4: Compute and interpret skewness and kurtosis.

SYLLABUS OF ST-SEC-115P**List of Practicals of ST-SEC-115P [60 Hours]**

- | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1. Introduction to MS-EXCEL | [1P] |
| 2. Working with basic Excel functions (Mathematical) | [1P] |
| 3. Working with basic Excel functions (Statistical) | [1P] |
| 4. Formatting data in an Excel worksheet | [1P] |
| 5. Tabulation | [1P] |
| 6. Diagrammatic representation of statistical data: simple and subdivided bar diagrams, multiple bar diagram, percentage bar diagram, pie diagram | [1P] |
| 7. Graphical representation of statistical data: Histogram, frequency curve and ogive curves. Determination of mode and median graphically | [1P] |

8. Computation of measures of central tendency (Ungrouped Data) [1P]
9. Computation of measures of central tendency (Grouped Data) [1P]
10. Computation of measures of dispersion (Ungrouped Data) [1P]
11. Computation of measures of dispersion (Grouped Data) [1P]
12. Computation of moments (Ungrouped data) [1P]
13. Computation of moments (Grouped data) [1P]
14. Measures of skewness and kurtosis, Box plot (Ungrouped Data) [1P]
15. Measures of skewness and kurtosis. (Grouped data) [1P]

ESSENTIAL/RECOMMENDED READINGS:

- 1) Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
- 2) Wayne L Winston .Microsoft Excel (2019), Data analysis and business modeling, Practical and solution files on the web.
- 3) Leonardo L wright Excel (2023): A Comprehensive Guide to become an Expert on Excel 2023 With All-in-One Approach, Kindle Edition.
- 4) CA Manmeet singh Mehta, Microsoft Excel Professional (2021) Guide, BPB publications.
- 5) Sudhir Kumar, The Basic Concepts of MS Excel, Book World Booksellers and Publishers.
- 6) Bernd Held, Excel Functions And Formulas, BPB publications.
- 7) S. Christian Albright, Wayne L Winston: Business Analytics: Data Analysis & Decision Making (MindTap Course List) 7th Edition.

**INDIAN KNOWLEDGE SYSTEM (ST-IKS-116T): Ancient Science
and Statistics in India**

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-IKS-116T - Ancient Science and Statistics in India	2	2	---

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To understand the origin and development of mathematics, astronomy, medicine and engineering in ancient India.
- To know the history of ancient higher educational institutes in India.
- To study the statistical heritage.
- To know the statistical organizations in India.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Get information about the origin and development of mathematics, astronomy, medicine and engineering in ancient India.

CO-2: Get information about the ancient higher educational institutes in India.

CO-3: Get information about the Indian statisticians.

CO-4: Know statistical organizations in India.

SYLLABUS OF ST-IKS-116T:

[30 Hours]

Unit-I: Development in Different Branches of Science in Ancient India

[7 Hours]

1.1 Mathematics: Vedic Period, Post-Vedic Mathematics, Arithmetic, Algebra, Geometry, Trigonometry.

1.2 Astronomy: Astronomy during Vedic Period, Post-Vedic Astronomy, the Originality of Indian Astronomy.

1.3 Medicine: Ayurveda, Scope of Ayurveda, Origin and antiquity, Development and Decline of Ayurveda, Application of Ayurveda to other forms of life, Later Development of Ayurveda, Spread of Ayurveda Outside India.

1.4 Engineering and Architecture in Ancient India: Prehistoric Period, Architecture during Harappan Period, Vedic Period, Post-Vedic Period, Buddhist Stupa and Viharas, Temple Architecture, Rock-Cut Architecture.

Unit-II: History of Ancient Higher Educational Institutes in India [8 Hours]

- 2.1 Educational Centres in Ancient India
- 2.2 Taxila or Takshashila, in ancient India
- 2.3 Nalanda University
- 2.4 Vikramshila University
- 2.5 Vallabhi University
- 2.6 Jagaddala University.
- 2.7 Nagarjuna Vidyapeeth.
- 2.8 Kanthalloor University

Unit-III: Introduction to Statistics and Contribution of Indian Statisticians [8 Hours]

- 3.1 Definition, history of Statistics, development of Statistics
- 3.2 Scope of Statistics: in the field of industry, biological sciences, medical sciences, economics, social sciences, management sciences, agriculture, insurance, information technology, education and psychology.
- 3.3 C. R. Rao, P.C. Mahalanobis, P. V. Sukhatme, V. S. Huzurbazar, Debabrata Basu, Jayanta Kumar Ghosh, Kantilal Mardia, K. C. Sreedharan Pillai, Pranab K. Sen, Raj Chandra Bose, Raghu Raj Bahadur, Samarendra Nath Roy.

Unit-IV: Statistical organizations in India [7 Hours]

- 4.1 Central Statistical Organization.
- 4.2 Indian Statistical Institute.
- 4.3 National Sample Survey Organization.
- 4.4 International Institute Population Science.
- 4.5 National Statistical Office.
- 4.6 Registrar General of India (Devnar, Mumbai).
- 4.7 Bureau of Economics and Statistics.

ESSENTIAL/RECOMMENDED READINGS:

- 1) Ghosh, J. K. and Mitra, S. K., Parthasarthy, K. R. (1993). Glimpses of India's Statistics Heritage, Wiley publishing Co.
- 2) Goon, A. M., Gupta, M. K. and Das gupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, the World Press Pvt. Ltd., Calcutta.
- 3) Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
- 4) Neil A. Weiss, (2016). Introductory Statistics, Tenth Edition, Pearson.
- 5) Sahana Singh (2017). The educational Heritage of ancient India, Notion press
- 6) Pathak R. P. (2014). Higher Education in ancient India, Kanishka Publishers.



Syllabus for F. Y. B.Sc. (Statistics) Semester -II

**DISCIPLINE SPECIFIC CORE COURSE (ST-MJ-121T): Descriptive
Statistics-II**

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-MJ-121T - Descriptive Statistics-II	2	2	---

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To study correlation between two variables.
- To study regression analysis for bivariate data.
- To study non-linear regression.
- To study various types of index numbers.
- To study theory of attributes.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: compute the correlation coefficient for bivariate data and interpret it.

CO-2: fit linear, quadratic and exponential curves to the bivariate data to investigate relation between two variables.

CO-3: compute and interpret various index numbers.

CO-4: understand theory of attributes.

SYLLABUS OF ST-MJ-121T:

[30 Hours]

UNIT-I: Correlation:

[7 Hours]

1.1. Bivariate data, Scatter diagram and interpretation. Concept of the correlation between two variables, positive correlation, negative correlation, no correlation. Covariance between two variables: Definition, effect of change of origin and scale.

1.2. Karl Pearson's coefficient of correlation (r): Definition, computation for ungrouped data and interpretation. Properties of correlation coefficient.

1.3. 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-II: Regression Analysis:

[8 Hours]

- 2.1 Concept of dependent and independent variables.
- 2.2 Identification of response and predictor variables and relation between them.
- 2.3 Meaning of regression, difference between correlation and regression, Connection between correlation and regression. Fitting of line $Y = a + bX$. a and b are estimated using least square method. Regression coefficients.
- 2.4 Explained and unexplained variation, coefficient of determination and standard error of an estimate of line of regression. Interchanging the role of X and Y .

UNIT-III: Curve Fitting:**[8 Hours]**

- 3.1 Necessity and importance of drawing second degree curve.
- 3.2 Fitting of second-degree curve ($Y = a + bX + cX^2$),
- 3.3 Fitting of exponential curves of the type $Y = a b^X$ and $Y = aX^b$. In all these curves constants a , b , c are found out by the method of least squares. (Justification via determinant of matrix of second derivative/second derivative test).

UNIT V: Theory of Attributes:**[7 Hours]**

- 5.1.Attributes: Concept of a Likert scale, 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.
- 5.2.Consistency of data up to two attributes.
- 5.3.Concepts of independence and association of two attributes.
- 5.4.Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, interpretation.

ESSENTIAL/RECOMMENDED READINGS:

- 1) Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
- 2) Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, The World Press Pvt. Ltd., Calcutta.
- 3) Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, NewDelhi.
- 4) Gupta, S. C. and Kapoor, V. K. (1997). Fundamentals of Applied Statistics, Third Edition, Sultan Chand and Sons Publishers, New Delhi.
- 5) Montgomery, D. C; Peck, E. A.; Vining, G. G.(2006). Introduction to Linear Regression Analysis, John Wiley and Sons.

**DISCIPLINE SPECIFIC CORE COURSE (ST-MJ-122T): Discrete
Probability Distributions**

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-MJ-122T – Discrete Probability Distributions	2	2	---

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To study a degenerate distribution and uniform distribution.
- To study the Bernoulli's and the binomial distributions.
- To study the hypergeometric and the Poisson distributions.
- To study the geometric and the negative binomial distributions.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Understand concept of the various discrete probability distributions.

CO-2: Apply various discrete probability distributions in real life situation.

CO-3: Compute probability of the random variables for various discrete probability distributions.

CO-4: Compute mean, variance and moments for various discrete probability distributions.

CO-5: Fit various discrete probability distributions to the statistical data.

SYLLABUS OF ST-MJ-122T:**[30 Hours]****UNIT-I Some Standard Discrete Probability Distributions****[11 Hours]**

1.1. Degenerate distribution (one-point distribution): $P(X=c) = 1$, mean and variance.

1.2. Uniform discrete distribution on integers 1 to n: p.m.f., c.d.f., mean, variance, real life situations, comments on mode and median. Examples.

1.3. Bernoulli distribution: probability mass function (p.m.f.), mean, variance and moments.

1.4. Binomial distribution: p.m.f.

$$P(x) = {}^n C_x p^x q^{n-x}, \quad x = 0, 1, 2, \dots, n; \quad 0 < p < 1, \quad q = 1-p$$

$$= 0, \quad \text{otherwise}$$

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

1.5. Recurrence relation for successive probabilities, computation of probabilities of different events, mode of the distribution. Mean, variance, moment generating function (m.g.f.) and cumulative generating function (c.g.f.), Moments and skewness (comments when $p = 0.5$, $p > 0.5$, $p < 0.5$). Situations where this distribution is applicable. Additive property for binomial

distribution. Conditional distribution of X given (X+Y) for binomial distribution. Examples.

UNIT-II. Hypergeometric Distribution: [6 Hours]

2.1 Necessity and importance of hypergeometric distribution, capture-recapture method. p.m.f. of the distribution,

$$p(x) = \frac{M_{C_x} N_{-M} C_{n-x}}{N_{C_n}} ; x=0, 1, \dots, \min(M,n)$$

$$= 0, \quad \text{otherwise}$$

Notation: $X \sim H(N, M, n)$.

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

UNIT -III Poisson distribution: [7 Hours]

3.1 p.m.f. of the distribution $p(x) = \frac{e^{-m} m^x}{x!} ; x = 0, 1, 2, \dots, m > 0$

$$= 0, \quad \text{otherwise}$$

Notation: $X \sim P(m)$.

3.2 m.g.f. and c.g.f. Moments, mean, variance, skewness and kurtosis. Situations where this distribution is applicable.

3.3 Additive property of the Poisson distribution. Conditional distribution of X given (X+Y) for Poisson distribution. Poisson distribution as a limiting form of a binomial distribution. Examples.

UNIT -IV Geometric distribution: [6 Hours]

4.1 4.1 Notation: $X \sim G(p)$,

Geometric distribution on support (0, 1, 2, ...) with p.m.f. $p(x) = pq^x$.

Geometric distribution on support (1, 2, ...) with p.m.f. $p(x) = pq^{x-1}$.

$0 < p < 1, q = 1 - p$.

4.2 Mean, variance, m.g.f. and c.g.f. Situations where this distribution is applicable.

4.3 Lack of memory property. Examples.

ESSENTIAL/RECOMMENDED READINGS:

- 1) Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, New Delhi.
- 2) 2. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
- 3) 3. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
- 4) 4. Hogg, R.V. and Craig R.G. (1989). Introduction to Mathematical Statistics, Ed.
- 5) MacMillan Publishing Co., New York.
- 6) 5. Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley

Publishing Co., London.

- 7) 6. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, McGraw Hill Book Company.
- 8) 7. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.

DISCIPLINE SPECIFIC CORE COURSE (ST-MJ-113P): Statistics
Practical-II

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-MJ-123P – Statistics Practical-II	2	---	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To compute correlation coefficient and its interpretation.
- To fit regression lines to the bivariate data.
- To fit second degree and exponential curves to the given data.
- To fit various discrete probability distributions to the given data.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: compute correlation coefficient, regression coefficients.

CO-2: compute probabilities of bivariate distributions.

CO-3: fit binomial and Poisson distributions.

CO-4: compute probabilities of bivariate distributions.

CO-5: draw random samples from Poisson and binomial distributions.

SYLLABUS OF ST-MJ-123P:**List of Practical's ST-MJ-123P****[60 Hours]**

- | | |
|--------------------------------------------------------------------------------------|------|
| 1. Computation of correlation coefficient and scatter diagram (Ungrouped data) | [1P] |
| 2. Computation of correlation coefficient (Grouped data) | [1P] |
| 3. Fitting of regression lines (Ungrouped data) | [1P] |
| 4. Fitting of regression lines (Grouped data) | [1P] |
| 5. Fitting of second-degree curve, exponential curve of type $Y = ab^x$, $Y = ax^b$ | [1P] |
| 6. Fitting of Binomial distribution and computation of expected frequencies. | [1P] |
| 7. Fitting of Poisson distribution and computation of expected frequencies. | [1P] |

- | | | |
|-----|---------------------------------------------------------|------|
| 8. | Applications of Binomial & hypergeometric distributions | [1P] |
| 9. | Applications of Poisson & geometric distributions | [1P] |
| 10. | Model sampling from Binomial distribution. | [1P] |
| 11. | Model sampling from the Poisson distribution. | [1P] |
| 12. | Model Sampling from geometric distribution | [1P] |
| 11. | Project (Project is equivalent to three practicals) | [3P] |

**VOCATIONAL SKILL COURSE (ST-VSC-124T): Statistical Computing
Using R Software**

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-VSC-124P - Statistical Computing Using R Software	2	---	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To learn how to draw diagrams using R.
- To learn how to draw graphs using r.
- To learn how to prepare frequency table and frequency distribution using R.
- To learn how compute averages and absolute measures of dispersion in R.
- To learn how to compute coefficient of skewness and kurtosis in R.

COURSE OUTCOMES:

After completion of this course student will able to

CO-1: Draw diagrams in R.

CO-2: Draw graphs in R.

CO-3: Prepare frequency table and frequency distribution in R.

CO-4: Compute averages and measures of dispersion in R.

CO-5: Compute coefficient of skewness and coefficient of kurtosis.

SYLLABUS OF ST-VSC-124P:

Unit-I: Diagrammatic Representation of Data

1.1 Simple bar diagram, subdivided bar diagram, multiple bar diagram and pie chart.

Unit-II: Graphical Representation of Data

2.1 Stem and leaf plot, preparation of frequency table, preparation of frequency distribution.

2.2 Rod or spike graph, histogram, frequency polygon, cumulative frequency curves.

Unit-III: Measures of Central Tendency

3.1 Arithmetic mean, median and mode.

3.2 Geometric mean, harmonic mean, quartiles, deciles, percentiles and box plot.

Unit-IV: Measures of Dispersion

4.1 Range, quartile deviation, mean deviation, standard deviation, variance and coefficient of variation

Unit V: Measures of Skewness and Kurtosis

5.1 Karl Pearson's coefficient of skewness, Bowlesy's coefficient of skewness and Pearsonian coefficient of skewness.

5.2 Coefficient of kurtosis.

List of Practicals ST-VSC-124P**[60 Hours]**

- | | |
|----------------------------------------------------------------|------|
| 1. Diagrammatic Representation of Data | [1P] |
| 2. Graphical Representation of Data | [1P] |
| 3. Preparation of Frequency Table | [1P] |
| 4. Preparation of Frequency Distribution | [1P] |
| 5. Measures of Central Tendency and Box Plot (Ungrouped Data) | [1P] |
| 6. Measures of Central Tendency (Grouped Data) | [2P] |
| 7. Measures of Dispersion (Ungrouped Data) | [1P] |
| 8. Measures of Dispersion (Grouped Data) | [2P] |
| 9. Measures of Skewness and Kurtosis | [1P] |
| 10. Computation of Correlation Coefficient and Scatter diagram | [1P] |
| 11. Fitting of Regression Lines | [1P] |

ESSENTIAL / RECOMMENDED READINGS:

- 1) 1. The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, Springer 2013.
- 2) A Beginner's Guide to R (Use R) By Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Springer 2009.
- 3) Introduction to Statistics and Data Analysis with Exercises, Solutions and Applications in R Authors: Heumann, Christian, Schomaker, Michael, Shalabh, Publisher" Springer 2016
- 4) R Programming for Dummies, 2ed Andrie de Vries, Joris Meys, Wiley (India), Low price edition.
- 5) Essentials of R with Data Analytics, Saroj Dahiya Ratnoo, Himmat Singh Ratnoo, Wiley (India), Low price edition.
- 6) Statistics using R, Sudha G. Purohit, Sharad D. Gore, Shailaja R. Deshmukh, Narosa Publishing House PVT. Ltd

**SKILL ENHANCEMENT COURSE (ST-SEC-125P): Statistical Techniques
Using MS-Excel-II**

Course Code & Title	Credits	Credit Distribution of the Course	
		Theory	Practical
ST-SEC-125P - Statistical Techniques Using MS-Excel-II	2	---	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To learn MS-Excel functions for correlation coefficient and regression.
- To analyze bivariate data using regression analysis tool in MS-Excel.
- To fit second degree and exponential curves to the given data using MS-Excel.
- To fit various discrete probability distributions to the given data with MS-Excel.
- To plot p.m.f and c.d.f curve of Binomial, Poisson, Geometric and Negative Binomial distribution in MS-Excel.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Use MS-Excel command for regression analysis.

CO-2: Compute correlation coefficient, regression coefficients lines of regression in MS-Excel.

CO-3: Fit binomial, Poisson and Negative Binomial distributions using MS-Excel.

CO-4: Compute probabilities of Binomial, Poisson, Geometric and Negative Binomial distributions using MS-Excel.

CO-5: Draw random samples from Poisson and binomial distributions using functions in MS-Excel.

CO-6: Compute various index numbers in MS-Excel.

SYLLABUS OF ST-SEC-124P:

UNIT-I Correlation and Regression

[4 Hours]

1.1. Definition of correlation, Karl Pearson's Correlation coefficient, properties of correlation, Bowley's correlation coefficient.

1.2. Row and column multiplication in MS-EXCEL, use of COV and CORR functions.

1.3. Data analysis tool pack in MS-EXCEL, Add-ins.

1.4. Definition of regression, data analysis with regression in MS-EXCEL with interpretation.

1.5. Analysis of residuals, Residual plots with interpretation, concept of outliers, residual sum of squares, regression sum of squares and error sum of squares, coefficient of determination and

its interpretation.

UNIT-II Computation of probabilities**[4 Hours]**

2.1 Concept of probability, definition of probability.

2.2 Calculation of probability mass function and Cumulative distribution function of some Discrete probability distributions, Bernouli's distribution, Binomial distribution, Poisson distribution, negative binomial distribution, Hypergeometric distribution

2.3 Use of functions: BINOMDIST, POISSON, HYPGEOMDIST, NEGBINOMDIST.

List of Practicals ST-SEC-125P**[60 Hours]**

1. Scatter diagram, correlation coefficient (ungrouped data). [1P]
2. Fitting of lines of regression (Y on X and X on Y) [1P]
3. Fitting of second-degree curve, exponential curve of type $Y = ab^x$, $Y = ax^b$ [1P]
4. Fitting of Binomial distribution and computation of expected frequencies. [1P]
5. Fitting of Poisson distribution and computation of expected frequencies. [1P]
6. Computation of Binomial probabilities and plot of p.m.f. and c.d.f. [1P]
7. Computation of Hypergeometric probabilities and plot of p.m.f. and c.d.f. [1P]
8. Computation of Poisson probabilities and plot of p.m.f. and c.d.f. [1P]
9. Computation of Geometric probabilities and plot of p.m.f. and c.d.f. [1P]
10. Model sampling from Binomial distribution. [1P]
11. Model sampling from Poisson distribution. [1P]
12. Random number generation from various discrete probability distributions. [1P]
13. Random sampling and periodic sampling [1P]

ESSENTIAL/ RECOMMENDED READINGS:

- 1) Agarwal B. L. (2003). Programmed Statistics, second 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) Wayne L Winston. Microsoft Excel (2019). Data analysis and business modeling, Practical and solution files on the web.
- 4) Leonardo L wright Excel (2023): A Comprehensive Guide to become an Expert on Excel 2023 With All-in-One Approach, Kindle Edition.
- 5) CA Manmeet singh Mehta, Microsoft Excel Professional (2021) Guide, BPB publications.
- 6) Sudhir Kumar, The Basic Concepts of MS Excel, Book World Booksellers and Publishers.
- 7) Bernd Held, Excel Functions and Formulas, BPB publications.
- 8) S. Christian Albright, Wayne L Winston: Business Analytics: Data Analysis & Decision Making (Mind Tap Course List) 7th Edition.

