

NORTH MAHARASHTRA UNIVERSITY

JALGAON 425001, INDIA



**SYLLABUS UNDER
FACULTY OF SCIENCE & TECHNOLOGY**

**FOR COURSES RELATED
TO SUBJECT STATISTICS IN**

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

WITH EFFECT FROM ACADEMIC

YEAR 2018-2019

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS FOR

First Year of B.Sc. (Semester-I and Semester-II)

SUBJECT: STATISTICS

With effect from July 2018

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

Course Code	Title of Course	Semester	Credits	Teaching (Clock Hrs/week)	Total Teaching Hours	Marks Wt	
						INT (CA)	EXT (UA)
ST-101	DESCRIPTIVE STATISTICS-I	I	2	02	30	40	60
ST-102	PROBABILITY AND PROBABILITY DISTRIBUTIONS -I	I	2	02	30	40	60
ST-103	STATISTICS PRACTICALS-I	I	2	04/Batch	60	40	60
ST-201	DESCRIPTIVE STATISTICS-II	II	2	02	30	40	60
ST-202	PROBABILITY AND PROBABILITY DISTRIBUTIONS -II	II	2	02	30	40	60
ST-203	STATISTICS PRACTICALS-II	II	2	04/Batch	60	40	60

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

Internal (40 Marks):

Internal Practical Exam Paper- 30 marks.
Journal -10 Marks

External (60 Marks):

External Practical Exam Paper- 50 marks.
Viva-voce -10 Marks

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

Aims and Objectives

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

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

ST-101 DESCRIPTIVE STATISTICS-I

1. INTRODUCTION TO STATISTICS (2L,4M)

- 1.1 Meaning of Statistics: numerical information, science, decision making science, general definition of Statistics as science.
- 1.2 Scope of Statistics: In the field of Industry, Biological Sciences, Medical Sciences, Economics Sciences, Social Sciences, Management Sciences, Agriculture, Insurance, Information Technology, Education and Psychology. Importance of quantification, scope of statistical methods.
- 1.3 Statistical institutes and organizations: ISI, NSS, Bureau of Economics and Statistics in States, Indian Institute of Population Sciences(IIPS).
- 1.4 Limitations of statistics.

2. CONCEPT OF POPULATION AND SAMPLE (4L,8M)

- 2.1 Population, statistical population, census, sample, sampling.
- 2.2 Objectives of sampling. Advantages of sampling over census.
- 2.3 Methods of sampling; Simple random sampling with and without replacement, Stratified sampling and Systematic sampling.
- 2.4 Illustrations from real life situations.

3. PRESENTATION OF DATA (6L,12M)

- 3.1 Meaning of data, Raw data, and Qualitative and Quantitative data.
- 3.2 Attributes and Variables, continuous and discrete variables.
- 3.3 Primary data and Secondary data.
- 3.4 Sources of secondary data.
- 3.5 Measurement scales: nominal, ordinal, ratio and interval scales.
- 3.6 Illustrations from real world situations.
- 3.7 Tabular presentation of data :- Meaning of table, Parts of table and construction of table(up to three factors of classification)
- 3.8 Diagrammatic representation of data: simple, Multiple and subdivided bar diagrams, pie diagram.
- 3.9 Frequency distribution: - Meaning of frequency, class, exclusive and inclusive classes, Open-end classes, class width, mid-value, class boundaries and limit, relative frequency.

- 3.10 Cumulative frequency distribution: less than, more than type.
- 3.11 Guidelines for construction of classes, Sturges formula.
- 3.12 Graphical representation of data:-Histogram (equal and unequal classes), Frequency curve, Frequency Polygon, ogives, stem & leaf chart.
- 3.13 Check sheet and Pareto diagram.

4. MEASURES OF CENTRAL TENDENCY (LOCATION) (8L,16M)

- 4.1 Meaning of central tendency of data, objectives, and requirements of a good measure of Central Tendency.
- 4.2 Arithmetic mean (A.M.): Definition, effect of change of origin and scale, sum of deviations from A.M., combined mean for k groups, merits and demerits.
- 4.3 Geometric mean (G.M.): Definition, merits, demerits and its uses.
- 4.4 Harmonic Mean (H.M.): Definition, merits and demerits, uses
- 4.5 Median: Definition, computation formula(without derivation), graphical method of determining median, merits and demerits,
- 4.6 Mode: Definition, computation formula(without derivation), graphical method of determining median, merits and demerits,
- 4.7 Weighted Means: A.M., G.M., H.M.
- 4.8 $A.M. > G.M. > H.M.$ (for 2 and 3 values)
- 4.9 Trimmed mean
- 4.10 Use of appropriate measure of central tendency in different situation.
- 4.11 Empirical relation among mean, median and mode.
- 4.12 Partition values:-Quartiles, deciles, & percentiles (Definition and Computation for ungrouped and grouped data). Box plot.
- 4.13 Examples and problems.

5. MEASURES OF DISPERSION (6L,12M)

- 5.1 Meaning of Dispersion of data and objective. Requirements of a good measure of dispersion.
- 5.2 Range .Definition, Merits and Demerits, uses.
- 5.3 Quartile Deviation (Q.D.): Definition, computation, merits and demerits.
- 5.4 Mean deviation (M.D.) , Definition, computation, merits and demerits Minimal Property of Mean Deviation without proof .
- 5.5 Mean Squared Deviation. Definition, Minimal property with proof, Variance and Standard deviation.

- 5.6 Properties of variance and Standard Deviation i) Combined Variance and Standard deviation for two groups (with proof) and its extension for k groups ii).Effect of change of origin and scale iii) $S.D. \geq M.D.$
- 5.7 Absolute and relative measures of dispersion :Coefficient of range, Coefficient of Q.D., Coefficient of M.D., Coefficient of variation (C.V.), Uses Of C.V.
- 5.8 Examples and problems.

6. MOMENTS

(4L, 8M)

- 6.1 Raw & central moments with Sheppard's correction; Effect of change of origin and scale on central moments.
- 6.2 Moments about an arbitrary constant for grouped and ungrouped data.
- 6.3 Relation between central moments and raw moments (up to 4-th order).

BOOKS FOR REFERENCE:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
2. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I and II, 8th Edition, the World Press Pvt. Ltd., Kolkata.
4. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
5. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
6. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
7. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi.
8. Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.

ST-102 PROBABILITY AND PROBABILITY DISTRIBUTIONS-I**1. SAMPLE SPACE AND EVENTS (5L, 10M)**

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

2. PROBABILITY (For finite sample space only) (10L, 20M)

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

3. CONDITIONAL PROBABILITY AND INDEPENDENCE (7L, 14M)

- 3.1 Independence of events, pair wise and mutual independence for three events.
- 3.2 Conditional probability of an event
- 3.3 Multiplication theorem of probability (with proof)

- 3.4 Partition of sample space.
- 3.5 Theorem of total probability with proof.
- 3.6 Bayes' theorem (with proof)
- 3.7 Examples and problems.

4. UNIVARIATE PROBABILITY DISTRIBUTION

(8L, 16M)

- 4.1 Concepts and definition of discrete random variable.
- 4.2 Probability mass function of a discrete random variable.
- 4.3 Distribution functions of a discrete random variable.
- 4.4 Statement of properties of a distribution function.
- 4.5 Concept of symmetric random variable.
- 4.6 Median and mode of a discrete random variable.
- 4.7 Definition of Expectation of discrete random variable.
- 4.8 Function of random variable.
- 4.9 Examples and problems.

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

ST-103 STATISTICS PRACTICALS-I**INSTRUCTIONS:**

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

LIST OF PRACTICALS:

Topic No.	Topic for Practical	No. of Practical
1.	Introduction to MS-Excel (2010 or higher version).	2
2.	Drawing random samples by using SRSWOR, SRSWR, Stratified, systematic sampling etc.	2
3.	Graphical representation of statistical data : Histogram, simple bar diagram, multiple bar diagram, frequency curve, frequency polygon, ogives, Pareto diagram etc.	3
4.	(I) Computation of Measures of central tendency for ungrouped data (II) Computation of Measures of central tendency for grouped data	3
5.	(I) Computation of Measures of dispersion for ungrouped data (II) Computation of Measures of dispersion for grouped data	3
6.	Raw and Central Moments (with Sheppard's correction)	2

ST-201 DESCRIPTIVE STATISTICS-II**1. SKEWNESS AND KURTOSIS (4L,8M)**

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

2. CORRELATION (8L,16M)

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

3. REGRESSION (9L,18M)

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

4. THEORY OF ATTRIBUTES (6L, 12M)

- 4.1 Concept of attribute, dichotomy, manifold classification, Notations.
- 4.2 Class frequency, order of class, positive class frequency, negative class frequency, contra class frequency, ultimate class frequency

- 4.3 Relation between class frequencies,
- 4.4 Method of dot operator to express any class frequency in terms of positive class frequencies.
- 4.5 Fundamental set of class frequencies: Definition, determination whether a set of frequencies is fundamental set of or not (two attributes).
- 4.6 Independence and association of two attributes
- 4.7 Yule's coefficient of association (Q) and its interpretation.
- 4.8 Properties of Q ($-1 \leq Q \leq 1$) and interpretation of (Q).
- 4.9 Examples and problems.

5. MEASURES OF INEQUALITY

(3L, 6M)

- 5.1 Gini coefficient
- 5.2 Lorenz curve
- 5.3 Examples and problems

FOR REFERENCE:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
1. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
2. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I and II, 8th Edition, the World Press Pvt. Ltd., Kolkata.
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4. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
5. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
6. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi.
7. Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.
8. Montgomery, D. C; Peck, E. A.; Vining, G. G. (2006). Introduction to Linear Regression Analysis, John Wiley and Sons.

ST-202 PROBABILITY AND PROBABILITY DISTRIBUTIONS-II**1. MATHEMATICAL EXPECTATION (Univariate Random Variable) (6L,12M)**

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

2. BIVARIATE PROBABILITY DISTRIBUTION (Finite Sample Space) (6L,12M)

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

3. MATHEMATICAL EXPECTATION (Bivariate Random Variable) (4L, 8M)

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

4. SOME STANDARD DISCRETE PROBABILITY DISTRIBUTIONS (14L, 28M)

- 4.1 Discrete Uniform distribution on integers 1 to n : p.m.f., c.d.f., mean, variance of Uniform distribution, real life situations, comment of mode and median.

4.2 Bernoulli distribution, Its p.m.f., mean, variance, moments, distribution of sum of independent and identically distributed Bernoulli variables.

4.3 Binomial Distribution : Its p.m.f.,

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

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

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

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

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

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

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

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

4.6 Poisson Distribution: Its p.m.f., $P(X = x) = \begin{cases} \frac{e^{-\lambda} \lambda^x}{x!} & ; x = 0, 1, 2, \dots \quad \lambda > 0. \\ 0 & ; \text{ otherwise} \end{cases}$

Statement of Mean, Variance and additive Property (without derivation). Derivation of Poisson distribution as a limiting case of binomial distribution.

4.7 Examples and problems.

BOOKS FOR REFERENCE:

1. Agarwal B. L. (2003). Programmed Statistics, 2nd edition, New Age International Publishers, New Delhi.
1. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
2. Hogg, R. V. and Craig R. G. (1989). Introduction to Mathematical Statistics, Ed. 4. MacMillan Publishing Co., New York.
3. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
4. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

5. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.
6. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
7. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.

ST-203 STATISTICS PRACTICALS-II

INSTRUCTIONS:

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

LIST OF PRACTICALS:

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

Reference Websites:

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

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