# SHIVAJI UNIVERSITY, KOLHAPUR
# REVISED SYLLABUS FOR F. Y. B. Sc. STATISTICS
## (w.e. from June, 2013)

## B. Sc. I : SEMESTER I

## PAPER-I

### DESCRIPTIVE STATISTICS -I

**OBJECTIVES:**

The main objective of this course is to acquaint students with some basic concepts in statistics. They will be introduced to some elementary statistical methods of analysis of data and at the end of this course students are expected to be able,

1) To compute various measures of central tendencies, dispersion, moments, skewness, kurtosis and to interpret them.
2) To analyze data pertaining to attributes and to interpret the results.

**CONTENTS:**

**Unit 1. Nature of data and Measures of Central Tendency**: **(12)**

1.1 : Meaning of primary and secondary data. Qualitative data (Attributes): nominal and ordinal scale. Quantitative data (Variables): Interval and ratio scale, discrete and continuous variables, raw data.

1.2 : Concept of central tendency of statistical data, Statistical average, Requirements of good statistical average.

1.3 : **Arithmetic Mean (A.M)**: Definition, Effect of change of origin and scale, Deviation of observations from A.M., Mean of pooled data, Weighted A.M.

1.4 : **Geometric Mean (G.M)**: Definition, Properties: i) G. M. of pooled data (for two groups), ii) G. M. of ratio of two series, is the ratio of their G. M's.

1.5 : **Harmonic Mean (H.M.)**: Definition, Relation: A.M ≥ G.M ≥ H.M (proof for n = 2 positive observations).

1.6 : **Median**: Definition, Derivation of formula for grouped frequency distribution.

1.7 : **Mode**: Definition, Derivation of formula for grouped frequency distribution. Empirical relation between Mean, Median and Mode. Graphical method of determination of Median and Mode.

1.8 : **Partition values** Quartiles, Deciles and Percentiles,

1.9 : Comparison between averages in accordance with requirements of good average.

1.10 : Situations where one kind of average is preferable to others.

1.11 : Examples to illustrate the concept.

**Unit 2. Measures of Dispersion:** **(12)**

2.1 : Concept of dispersion, Absolute and Relative measures of dispersion, Requirements of a good measure of dispersion.

2.2 : Range: Definition, Coefficient of range.

2.3 : Quartile Deviation (Semi-interquartile range): Definition, Coefficient of Q.D.

2.4 : Mean Deviation: Definition, Coefficient of M.D., Minimal property of M.D.

2.5 : Mean Square Deviation: Definition, Minimal property of M.S.D.

2.6 : Variance and Standard Deviation: Definition, Effect of change of origin and scale, S.D. of pooled data (proof for two groups).

2.7 : Coefficient of Variation: Definition and use.
2.8 : Comparison of S.D. with other measures.
2.9 : Examples to illustrate the concept.

**Unit 3. Moments, Skewness and Kurtosis:** **(10)**

3.1 : Moments: Raw moments ($\mu_r'$) and Central moments ($\mu_r$) for ungrouped and grouped data.
3.2 : Effect of change of origin and scale on central moments, relation between central moments and raw moments (up to 4th order).
3.3 : Sheppard's corrections.
3.4 : Skewness: Concept of skewness of a frequency distribution, Types of skewness.
3.5 : Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness, Measure of skewness based on moments.
3.6 : Kurtosis: Concept of kurtosis of a frequency distribution, Types of kurtosis.
3.7 : Measure of kurtosis based on moments.
3.8 : Illustrative Examples.

**Unit-4. Theory of Attributes:** **(11)**

4.1: Attributes: Notation, dichotomy, class frequency, order of class, positive and negative class frequency, ultimate class frequency, fundamental set of class frequency, relationships among different class frequencies (up to three attributes).
4.2: Concept of Consistency, conditions of consistency (up to three attributes).
4.3: Concept of Independence and Association of two attributes.
4.4: Yule's coefficient of association (Q): Definition, interpretation.Coefficient of colligation (Y): Definition, interpretation. Relation between Q and Y:
$Q = 2Y/(1+Y^2)$, $|Q| \geq |Y|$.
4.5: Illustrative examples.

## Books Recommended


1. Bhat B. R., Srivenkatramana T. and Madhava Rao K. S. (1996): Statistics: A Beginner's Text, Vol. 1, New Age International (P) Ltd.
2. Croxton F. E., Cowden D.J. and Kelin S. (1973): Applied General Statistics, Prentice Hall of India.
3. Goon A.M., Gupta M.K., and Dasgupta B.: Fundamentals of Statistics Vol. I and II, World Press, Calcutta.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
5. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Lowa State University Press.
6. Waiker and Lev.: Elementary Statistical Methods.
7. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics.- Sultan & Chand

# B. Sc. I : SEMESTER I

## PAPER II:

## ELEMENTARY PROBABITITY THEORY

**OBJECTIVES:**

The main objective of this course is to acquaint students with some basic concepts of probability, axiomatic theory of probability, concept of random variable, probability distribution (univariate and bivariate).

By the end of this course students are expected to be able,

1) To distinguish between random and non-random experiments.
2) To find the probabilities of various events.

**CONTENTS:**

**Unit-1. Sample space and Events:** **(12)**

1.1: Concepts of experiments and random experiments.
1.2: Definitions: Sample space, Discrete sample space (finite and countably infinite), Event, Elementary event, Compound event.favourable event.
1.3: Algebra of events (Union, Intersection, Complementation).
1.4: Definitions of Mutually exclusive events, Exhaustive events, Impossible events, Certain event.
1.5: Power set |P(Ω) (sample space consisting at most 3 sample points).
1.6: Symbolic representation of given events and description of events in symbolic form.
1.7: Illustrative examples.

**Unit-2. Probability:** **(13)**

2.1: Equally likely outcomes (events), apriori (classical) definition of probability of an event. Equiprobable sample space, simple examples of computation of probability of the events based on Permutations and Combinations.
2.2: Axiomatic definition of probability with reference to a finite and countably infinite sample space.
2.3: Proof of the results:

i) $P(\Phi) = 0$, ii) $P(A^c) = 1 - P(A)$,

iii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (with proof) and its generalization (Statement only).

iv) If $A \subset B$, $P(A) \le P(B)$, v) $0 \le P(A \cap B) \le P(A) \le P(A \cup B) \le P(A) + P(B)$.

2.4: Definition of probability in terms of odd ratio.
2.5: Illustrative examples based on results in (2.3) and (2.4) .

**Unit-3. Conditional Probability:** **(10)**

3.1: Definition of conditional probability of an event.
3.2: Multiplication theorem for two events. Examples on conditional probability.
3.3: Partition of sample space.
3.4: Idea of Posteriori probability, Statement and proof of Baye's theorem, examples on Baye's theorem.
3.5: Elementary examples.

**Unit-4. Independence of events:** **(10)**

4.1: Concept of Independence of two events.

4.2: Proof of the result that if A and B are independent then, i) A and $B^c$, ii) $A^c$ and B iii) $A^c$ and $B^c$ are independent.

4.3: Pairwise and Mutual Independence for three events.

4.4: Elementary examples.

## Books Recommended:


1. Bhat B. R., Srivenkatramana T and Madhava Rao K. S. (1997): Statistics: a Beginner's Text, Vol. II, New Age International (P) Ltd.
2. Edward P. J., Ford J. S. and Lin (1974): Probability for Statistical Decision-Making, Prentice Hall.
3. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
4. Mood A. m., Graybill F. A. and Boes D. C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
5. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.
6. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.
7. Meyer P.L.(1970): Introductory Probability and Statistical Applications, Addision Wesley.
8. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)
9. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics.- Sultan & Chand
10. Mukhopadhyay P. (2006) : Probability. Books and Allied (P) Ltd


**Note:** 1. In theory examination, the weight age to the numerical problems should not exceed 40%.

2. Students can use scientific calculators in theory examination.

# B. Sc I : SEMESTER II

## PAPER-III

## DESCRIPTIVE STATISTICS II

**OBJECTIVES:**

The main objective of this course is to acquaint students with some basic concepts in statistics. They will be introduced to some elementary statistical methods of analysis of data and at the end of this course students are expected to be able,

1) To compute correlation coefficient, interpret its value and use in regression analysis
2) Understand concept of multivariate distributions.

**Unit-1. Correlation:** **(11)**

1.1: Bivariate Data.
1.2: Concept of correlation between two variables, Types of correlation.
1.3: Scatter diagram, its utility.
1.4: Covariance: Definition, Effect of change of origin and scale.
1.5: Karl Pearson's coefficient of correlation (r): Definition, Computation for ungrouped and grouped data, Properties : i) $-1 \leq r \leq 1$, ii) Effect of change of origin and scale.(iii) Interpretation when r = – 1, 0, 1.
1.7: Spearman's rank correlation coefficient: Definition, Computation (for with and without ties). Derivation of the formula for without ties and modification of the formula for with ties.
1.8: Illustrative examples.

**Unit-2. Regression:** **(11)**

2.1: Concept of regression, Lines of regression, Fitting of lines of regression by the least square method.
2.2: Regression coefficients ($b_{xy}$, $b_{yx}$) and their geometric interpretations, Properties: i) $b_{xy} \times b_{yx} = r^2$ , ii) $b_{xy} \times b_{yx} \leq 1$, iii) $(b_{xy} + b_{yx}) / 2 \geq r$, iv) Effect of change of origin and scale on regression coefficients, v) the point of intersection of two regression lines.
2.3: Derivation of acute angle between the two lines of regression.
2.4: Coefficient of determination.
2.5: Illustrative examples.

**Unit-3: Multiple Linear Regression (for trivariate data only):** **(12)**

3.1 Concept of multiple linear regression, Plane of regression, Yule's notation, correlation matrix.
3.2 Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation.
3.3 Residual: definition, order, properties, derivation of mean and variance, Covariance between residuals.

**Unit-4: Multiple and Partial Correlation (for trivariate data only):** **(11)**

4.1 Concept of multiple correlations. Definition of multiple correlation coefficient $R_{i.jk}$, derivation of formula for multiple correlation coefficient.

4.2 Properties of multiple correlation coefficient; i) $0 \leq R_{i.jk} \leq 1$, (ii) $R_{i.jk} > |r_{ij}|$, (iii) $R_{i.jk} > |r_{ik}|$ $i = j = k = 1, 2, 3.$ $i \neq j, i \neq k$.

4.3 Interpretation of $R_{i.jk} = 1$, $R_{i.jk} = 0$, coefficient of multiple determinantion R21.23.

4.4 Concept of partial correlation. Definition of partial correlation coefficient rij.k, derivation of formula for $r_{ij.k.}$

4.5 Properties of partial correlation coefficient (i) $-1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij.k} \cdot b_{ji.k} = r^2_{ij.k}$.

4.6 Examples and problems.

## Books Recommended


1. Bhat B. R., Srivenkatramana T. and Madhava Rao K. S. (1996): Statistics: A Beginner's Text, Vol. 1, New Age International (P) Ltd.
2. Croxton F. E., Cowden D.J. and Kelin S. (1973): Applied General Statistics, Prentice Hall of India.
3. Goon A.M., Gupta M.K., and Dasgupta B.: Fundamentals of Statistics Vol. I and II, World Press, Calcutta.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
5. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Iowa State University Press.
6. Waiker and Lev.: Elementary Statistical Methods.
7. Srivastav D. S.: A text book of Demography.
8. Kapur,J.N and Gupta,H.C,:Fundamentals of Mathematical Statistics.S.Chand and sons,New Delhi.
9. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics.- Sultan & Chand


## B. Sc I : SEMESTR II

## PAPER IV

## DISCRETE PROBABILITY DISTRIBUTIONS

**OBJECTIVES:**

The main objective of this course is to acquaint students with some basic concepts of probability, axiomatic theory of probability, concept of random variable, probability distribution (univariate). By the end of this course students are expected to be able,

1) To apply discrete probability distributions studied in this course in different situations.

2) Distinguish between discrete variables and study of their distributions.

3) Know some standard discrete probability distributions with real life situations.
4) Understand concept of bivariate distributions and computation of related probabilities.

**Unit-1. Univariate Probability Distributions (finite sample space): (10)**

1.1: Definition of discrete random variable.
1.2: Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.) of a discrete random variable, Properties of c.d.f. (statements only).
1.3: Probability distribution of function of random variable.
1.4: Median and Mode of a univariate discrete probability distribution.
1.5: Examples.

**Unit-2. Mathematical expectation (Univariate random variable): (10)**

2.1: Definition of expectation of a random variable, expectation of a function of a random variable.
2.2: Results on expectation, i) $E(c) = c$, where $c$ is a constant,
ii) $E(aX + b) = a\,E(X) + b$, where a and b are constants.
2.3: Definitions of mean, variance of univariate distributions. Effect of change of origin and scale on mean and variance.
2.4: Definition of raw, central moments. Pearson's coefficient of skewness, kurtosis.
2.5: Definition of probability generating function (p.g.f.) of a random variable. Effect of change of origin and scale on p.g.f. Definition of mean and variance by using p.g.f.
2.6: Examples.

**Unit-3. Some Standard Discrete Probability Distributions: (finite sample space): (12)**

3.1: Idea of **one point**, **two point** distributions and their mean and variances.
3.2: **Bernoulli Distribution**: p.m.f., mean, variance, distribution of sum of independent and identically distributed Bernoulli variables.
3.3: **Discrete Uniform Distribution**: p.m.f., mean and variance.
3.4: **Binomial Distribution**: Binomial random variable, p.m.f.with parameters(n, p), Recurrence relation for successive probabilities, Computation of probabilities of different events, mean and variance, mode, skewness, p.g.f., Additive property of binomial variates. Examples.
3.5: **Hyper geometric Distribution**: p.m.f.with parameters (N, M, n), Computation of probability of different events, Recurrence relation for successive, probabilities, mean and variance of distribution assuming $n \leq N - M \leq M$, approximation of Hypergeometric to Binomial. Examples.

**Unit-4. Bivariate Discrete Distribution: (13)**

4.1: Definition of bivariate discrete random variable (X,Y) on finite sample space, Joint p.m.f., and c.d.f., Properties of c.d.f. (without proof). Computation of probabilities of events in bivariate probability distribution, concept of marginal and conditional probability distribution, independence of two discrete r.v.s, Examples.

4.2 : Mathematical Expectation: Definition of expectation of function of r.v. in bivariate distribution, Theorems on expectations: (i) $E(X+Y) = E(X) + E(Y)$ (ii) $E(XY) = E(X)\cdot E(Y)$ when X and Y are independent, expectation and variance of linear combination of two discrete r.v.s., definition of conditional mean, conditional variance, covariance and correlation coefficient, $Cov(aX+bY, cX+dY)$, distinction between uncorrelated and independent variables, joint p.g.f, proof of the p.g.f. of sum of two independent r.v.as the product of their p.g.f. examples.

## **Books Recommended:**


1. Bhat B. R., Srivenkatramana T and Madhava Rao K. S. (1997): Statistics: a Beginner's Text, Vol. II, New Age International (P) Ltd.
2. Edward P. J., Ford J. S. and Lin (1974): Probability for Statistical Decision-Making, Prentice Hall.
3. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
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7. Meyer P. L. (1970): Introductory Probability and Statistical Applications, Addision Wesley.
8. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)


**Note:** 1. In theory examination, the weightage to the numerical problems should not exceed 40%.
2. Students can use scientific calculators in theory examination.

# **Practical Paper-I**

**Pre requisites:** Knowledge of the topics in the theory papers.

**Objectives:** At the end of this course students are expected to be able-

1. To represent statistical data diagrammatically and graphically.
2. To compute various measures of central tendency, dispersion, moments, skewness and kurtosis.
3. To compute correlation coefficient, regression coefficients, multiple and partial correlation coefficient. To analyze the data pertaining to discrete variables & to interpret the results.
4. To understand Consistency, Association and Independence of Attributes.
5. To interpret summary Statistics of computer output.
6. To know applications of some standard discrete probability distributions.

## List of Practicals:

1. Graphical presentation of the frequency distribution (Histogram, frequency polygon, frequency curve, Location of Mode, Ogive curves, Location of Partition values).
2. Measures of Central Tendency I (ungrouped data).
3. Measures of Central Tendency II (grouped data).
4. Measures of the Dispersion I (ungrouped data).
5. Measures of the Dispersion II (grouped data).
6. Moments, Skewness & Kurtosis I (ungrouped data).
7. Moments, Skewness & Kurtosis II (grouped data).
8. Correlation coefficient and Spearman's Rank correlation (ungrouped data)
9. Correlation coefficient (grouped data)
10. Regression I (ungrouped data).
11. Regression II (grouped data).
12. Attributes I (Missing frequencies & consistency).
13. Attributes II (Association & Independence).
14. Applications of Binomial and Hypergeometric Distribution.
15. Multiple regression.
16. Multiple and partial correlation coefficients.
17. Bivariate Discrete distribution I.
    (Marginal & conditional distribution, computation of probabilities of events).
18. Bivariate Discrete distribution II
    (Expectations /conditional expectations / variances / conditional variance / covariance / correlation coefficient)
19. Using MS-EXCEL: Diagrammatic and Graphical presentation, Compute A.M., G.M., H.M., Variance, C.V., M.D.
20. Using MS-EXCEL: Moments, Correlation and Regression (ungrouped data).

**Notes**:

i) Elementary statistical analysis using MS-Excel: Numerical computations and computations using library functions.
ii) Knowledge of MS-EXCEL Spreadsheet should be tested on computers at the time of Viva-Voce.
iii) Student must complete all the practicals to the satisfaction of the teacher concerned.
iv) Students must produce laboratory journal along with completion certificate signed by Head of the Department, at the time of practical examination.

**Laboratory Requirements:**

Laboratory should be well equipped with sufficient number of electronic calculators and computers along with necessary Software's, UPS and Printers.

## Nature of Practical Question Paper of Statistics, B. Sc. I

a) In the practical question paper there shall be four questions each of twenty marks, a student has to attempt any two questions. In only one of the four questions there shall be a sub-question of about 5 marks based on MS-EXCEL.

b) Evaluation of the MS-EXCEL based questions will be online and should be demonstrated to examiner.

c) 5 marks are reserved for the journal and 5 marks for the oral examination.

d) Practical examination is of four hours duration which includes viva examination and on line demonstration.

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**EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS - (FOR REVISED SYLLABUS)**

| Sr. No. | Title of Old Paper | Title of New Paper |
|---|---|---|
| 1. | SEM. I / PAPER-I: DESCRIPTIVE STATISTICS I<br>SEM. II / PAPER-III: DESCRIPTIVE STATISTICS II | SEM. I / PAPER-I: DESCRIPTIVE STATISTICS I<br>SEM. II / PAPER III: DESCRIPTIVE STATISTICS II |
| 2. | SEM. I/PAPER-II: ELEMENTAY PROBABITITY THEORY<br>SEM. II / PAPER-IV: DISCRETE PROBABILITY DISTRIBUTIONS | SEM. I/PAPER II: ELEMENTAY PROBABITITY THEORY<br>SEM. II / PAPER IV: DISCRETE PROBABILITY DISTRIBUTIONS |
| 3. | Practical Paper I | Practical Paper I |

**STRUCTURE OF COURSE- -------**

**(Note – The structure & title of papers of the degree as a whole should be submitted at the time of submission/revision of first year syllabus.**

**<u>FIRST YEAR B.Sc. Statistics (NO. OF PAPERS Two)</u>**

| Sr. No. | Subjects | Marks |
|---|---|---|
| 1. | SEM. I / PAPER I: DESCRIPTIVE STATISTICS I | 50 |
| 2. | SEM. I / PAPER II: ELEMENTAY PROBABITITY THEORY | 50 |
| 3. | SEM. II / PAPER III: DESCRIPTIVE STATISTICS II | 50 |
| 4. | SEM.-II / PAPER-IV: DISCRETE PROBABILITY DISTRIBUTIONS | 50 |
| 5. | Practical Paper-I | 50 |
| | **Total** | **250** |