Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure for F. Y. B. Sc. STATISTICS

Semester	Paper Code	Title of Paper	No. of Credits
I	STAT1101	Descriptive Statistics- I	2
	STAT1102	Discrete Probability and Probability Distributions - I	2
	STAT1103	Practical-I	2
II	STAT1201	Descriptive Statistics-II	2
	STAT1202	Discrete Probability and Probability Distributions – II	2
	STAT1203	Practical-II	2

SYLLABUS(CBCS) FOR F. Y. B. Sc. STATISTICS (w.e. from June, 2019)

Academic Year 2019-2020

Class : **F.Y. B. Sc. (Semester- I)**
Paper Code: **STAT-1101**
Paper : **I** Title of Paper : Descriptive Statistics- I
Credit : 2 credits No. of lectures: 36

A) Learning Objectives:

1. Compute various measures of central tendency, dispersion, skewness and kurtosis.
2. Visualization of data.

B) Learning Outcome:

The main outcome of this course is to acquaint students with initial description of the data as part of a more extensive statistical analysis by using some elementary statistical methods.

TOPICS/CONTENTS:

UNIT1: Organization and presentation of data (4L)

1.1 Meaning, importance and scope of statistics.

1.2 Classification and tabulation.

1.3 Construction of frequency distribution.

UNIT2: Population and Sample (8L)

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

2.2 Types of data
(a) Primary data, secondary data
(b) Cross-sectional data, chronological data.

2.3 Notion of a statistical population: Finite population, infinite population, homogeneous population and heterogeneous population. Notion of a sample and a random sample.

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

UNIT3: Univariate data analysis (16L)

3.1 Classification : Raw data and its classification, ungrouped frequency distribution, Sturges' rule, method of classification inclusive and exclusive, open end classes , (grouped frequency distribution cumulative frequency distribution), relative frequency distribution

3.2 Measures of Central Tendency: Concept of central tendency of statistical data, statistical average, characteristics of a good statistical average.
Arithmetic Mean (AM): Definition effect of change of origin and scale, combined mean

of a number of groups, merits and demerits, trimmed arithmetic mean.

Median: Definition, merits and demerits, Partition values: Quartiles deciles and percentiles (for ungrouped and grouped data).

Mode: Definition, merits and demerits, empirical relation between mean, median and mode (without proof)

Geometric Mean (GM): Definition, formula, merits and demerits

Harmonic Mean (HM): Definition, formula, merits and demerits

Relation between H.M., G.M. and A.M.

3.3 Measures of Dispersion: Concept of dispersion, characteristics of good measures of dispersion. Range, semi-interquartile range (quartile deviation): Definition, merits and demerits. Mean deviation Definition, merits and demerits, minimality property (without proof).

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 (without proof), merits and demerits measures of dispersion for comparison: coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation (CV)

UNIT4: Moments, Skewness and Kurtosis (8L)

Raw moments (μ_r') for ungrouped and grouped data.

Central moments (μ_r) for ungrouped and grouped data, effect of change of origin and scale.

Relations between central moments and raw moments, up to 4th order

Concept of skewness of frequency distribution: Definition, type of skewness, measures of skewness;

i. Karl Pearson coefficient of skewness
ii. Pearsonian coefficient of skewness
iii. Bowley's coefficient of skewness

Bowley's coefficient of skewness lies between -1 to 1 (with proof)

Interpretation using box plot

Concept of kurtosis of frequency distribution: Definition, types of kurtosis, measure of kurtosis based on moments and partition values. Examples and problem.

References:

1. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
2. Gupta and Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
3. Sarma K. V. S. (2001) Statistics made it simple: Do it yourself on PC. Prentce Hall of India, New Delhi.
4. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
5. B. L. Agarwal : Programmed Statistics, New Age International Publishers, New Delhi.
6. David Freedman, Robert Pisani, Roger Purves: Statistics
7. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye: Probability & Statistics for Engineers & Scientists

SYLLABUS(CBCS) FOR F. Y. B. Sc. STATISTICS (w.e. from June, 2019)

Academic Year 2019-2020

Class : **F.Y. B. Sc. (Semester- I)**
Paper Code: **STAT-1102**
Paper : **II** Title of Paper : Discrete Probability and Probability Distributions - I

Credit : 2 credits No. of lectures: 36

A) Learning 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 visualization of nature of distribution.

B) Learning Outcome:

Students are expected to be able,

1) To distinguish between random and non-random experiments.
2) To find the probabilities of various events.
3) To obtain probability distribution of univariate discrete random variables.

TOPICS/CONTENTS:

Unit-1. Sample space and Events: (6L)

1.1 Concepts of experiments, deterministic and nondeterministic experiments.

1.2 Definitions: Sample space, Types of sample space, Event, Types of Events: Elementary event, Complementary event, sure event, impossible event.

1.3 Concept of occurrence of an event, Equally-likely events

1.4 Algebra of events (Union, Intersection, Complementation).

1.5 Definitions of Mutually exclusive events, Exhaustive events.

1.6 Algebra of events and its representation of events 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.

1.7 Illustrative examples.

Unit-2. Probability: (8L)

2.1 Concept of Permutations and Combinations

Equiprobable and nonequiprobable sample space, Classical definition of probability, examples.

Probability model, probability of an event, examples. Axiomatic approach of probability.

2.2 Proof of the results:

i) $P(\Phi) = 0$,

ii) $P(A^c) = 1 - P(A)$,

iii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (Addition theorem of probability) and its generalization (Statement only).

iv) If $A \subset B$, $P(A) \leq P(B)$

v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$.

vi) $P(A \cup B) \leq P(A) + P(B)$ (Boole's Inequality) and its generalization (Statement only).

2.3 Definition of probability in terms of odd ratio.

2.4 Illustrative examples

Unit-3. Conditional Probability and Independence of events: (6L)

3.1 Definition of conditional probability of an event.

3.2 Multiplication theorem for two and three events.

3.4 Partition of sample space.

3.5 Idea of Posteriori probability, Statement and proof of Bayes' theorem, examples on Bayes' theorem.

3.6 Sensitivity and specificity

3.7 Concept of Independence of two events.

3.8 Proof of the result that if events A and B are independent then,

i) A and B^c,

ii) A^c and B

iii) A^c and B^c are independent.

3.9 Pairwise and Mutual Independence for three events.

3.10 Illustrative examples.

Unit-4. Univariate Probability Distributions (finite sample space): (8L)

4.1 Definition of discrete random variable.

4.2 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).

4.3 Probability distribution of function of random variable.

4.4 Median and Mode of a univariate discrete probability distribution.

4.5 Illustrative examples.

Unit-5 Mathematical expectation (Univariate random variable) (8L)

5.1 Definition of expectation of a random variable, expectation of a function of a random variable.

5.2 Definition of variance, standard deviation (s.d.), Effect of change of origin and scale on mean, variance and s.d.of random variable.

5.3 Definition of raw, central and factorial moments of univariate probability distributions and their interrelations

5.4 Definition of moment generating function (m.g.f.), deduction of moments from m.g.f.and properties of m.g.f.: i) $M_x(0) = 1$ ii) Effect of change of origin and scale on m.g.f. iii) Additive property of m.g.f.

5.5 Definition of cumulant generating function (c.g.f) deduction of cumulants from c.g.f. and properties of c.g.f.: ii) Effect of change of origin and scale on c.g.f. iii) Additive property of c.g.f.

5.6 Probability generating function (p.g.f)

5.7 Nature of probability distribution by using Pearsonian Coefficient of skewness and kurtosis Raw moments, mean and variance by using m.g.f.

5.8 Illustrative examples.

References:

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. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
3. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.
4. Gupta and Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
5. Meyer P.L.(1970): Introductory Probability and Statistical Applications, Edition Wesley.
6. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)
7. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
8. B. L. Agarwal : Programmed Statistics, New Age International Publishers, New Delhi.
9. Wayne W. Daniel : Biostatistics

SYLLABUS (CBCS) FOR F. Y. B. Sc. STATISTICS (w.e. from June, 2019)

Academic Year 2019-2020

Class : **F.Y. B. Sc. (Sem-I)**
Paper Code: **STAT-1103**
Paper : **III** Title of Paper: Practical-I

Credit : 2 credits No. of lectures: 40

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

A) Learning Objectives:

The main objective of this course is to acquaint students with concept of developing computing abilities.

B) Learning Outcome:

At the end of this course students are expected to be able

i) Represent statistical data diagrammatically and graphically.

ii) Compute various measures of central tendency, dispersion, moments, skewness and kurtosis.

iii) Compute correlation coefficient, regression coefficients and to interpret the results.

iv) Interpret summary Statistics of computer output.

INDEX

SYLLABUS(CBCS) FOR F. Y. B. Sc. STATISTICS (w.e. from June, 2019)

Academic Year 2019-2020

Class : **F.Y. B. Sc. (Semester- II)**
Paper Code: **STAT-1201**
Paper : **I** Title of Paper : Descriptive Statistics- I
Credit : 2 credits No. of lectures: 36

A) Learning Objectives:

1. 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 basic concept of life table and demography.
2. Analyze data pertaining to attributes and to interpret the results.

B) Learning Outcome:

Students are expected to be able,

1 Compute the correlation coefficient for bivariate data and interpret it.
2 Fit linear, quadratic and exponential curves to the bivariate data to investigate relation between two variables.
3 Applications of demography in the field of insurance, government etc.

TOPICS/CONTENTS:

Unit I: Bivariate Data Analysis (14 L)

1.1 Correlation

1.1.1 Bivariate data, Scatter diagram.

1.1.2 Concept of correlation between two variables, positive correlation, negative correlation, no correlation. Interpretation of correlation using scatter diagram.

1.1.3 Covariance between two variables: Definition, computation, effect of change of origin and scale.

1.1.4 Karl Pearson's coefficient of correlation (r): Definition, computation for ungrouped data and interpretation. Properties: (i) $-1 \leq r \leq 1$ (with proof) (ii) Effect of change of origin and scale (with proof).

1.1.5 Spearman's rank correlation coefficient: Definition, derivation of formula, computation and interpretation (without ties). In case of ties, compute Karl Pearson's correlation coefficient between ranks. (Spearman's rank correlation coefficient formula with correction for ties not expected.)

1.2 Fitting of curves to the bivariate data

1.2.1 Fitting of line ($Y = a + b X$),

1.2.2 Fitting of second degree curve ($Y = a + bX + cX^2$),

1.2.3 Fitting of exponential curves of the type $Y = ab^X$ and $Y = aX^b$. In all these curves parameters are estimated by the method of least squares.

1.3 Linear Regression Model

1.3.1 Meaning of regression, difference between correlation and regression,

1.3.2 Concept of error in regression, error modeled as a continuous random variable. Simple linear regression model: $Y= a + b X + \varepsilon$, where ε is a continuous random variable with $E(\varepsilon) =0$, $Var(\varepsilon) =$

σ^2. Estimation of a, b by the method of least squares. Interpretation of parameters. Formula of the estimator of σ^2.

1.3.3 Concept of residual, plot of residual against X, concept of explained and unexplained variation, concept of coefficient of determination

Unit 2: Theory of Attributes (6 L)

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. Consistency of data upto 2 attributes.

Concepts of independences and association of two attributes.

Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, interpretation (with proof).

Definition of odds ratio and its interpretation.

Unit 3: Demography (10 L)

3.1 Vital events, vital statistics, methods of obtaining vital statistics, rates of vital events, sex ratios, dependency ratio.

3.2 Death/Mortality rates: Crude death rates, specific (age, sex etc.) death rate, standardized death rate (direct and indirect), infant mortality rate.

3.3 Fertility/Birth rate: Crude birth rates, general fertility rate, specific (age, sex etc.) fertility rates, total fertility rates.

3.4 Growth/Reproduction rates: Gross reproduction rate, net reproduction rate.

3.5 Interpretations of different rates, uses and applications.

3.6 Trends in vital rates due to the latest census.

Unit 4: Life Table (6 L)

4.1 Introduction, Construction of life table, functions (l_x, d_x, p_x, q_x, L_x, T_x, e_x) and their interpretation, expectation of life, example and problems.

References:

1. Gupta S. C. and Kapoor V. K.: Fundamentals of Mathematical Statistic, Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.
2. Gupta S. P.: Statistical Methods, Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.
3. Mukhopadhyay Parimal (1999): Applied Statistics, New Central Book Agency, Pvt. Ltd. Calcutta. 11.
4. Goon A. M., Gupta, M. K. and Dasgupta, B. (1986): Fundamentals of Statistics, Vol. 2, World Press, Calcutta.
5. Gupta S. C. and Kapoor V. K. (1987): Fundamentals of Applied Statistics, S. Chand and Sons, New Delhi.
6. Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East.
7. Shailaja R. Deshmukh (2009): Actuarial Statistics An Introduction Using R, University Press (India) Private Limited.

SYLLABUS (CBCS) FOR F. Y. B. Sc. STATISTICS (w.e. from June, 2019)

Academic Year 2019-2020

Class : **F.Y. B. Sc. (Semester-II)**
Paper Code: **STAT-1202**
Paper : **II** Title of Paper : Discrete Probability and Probability Distributions - II

Credit : 2 credits No. of lectures: 36

A) Learning Objectives:

The main objective of this course is to acquaint students with concept of developing computing abilities and discrete bivariate random variable and its probability distribution.

B) Learning Outcome:

Students are expected to be able,

1) To apply discrete bivariate 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.

TOPICS/CONTENTS:

Unit-1. Introduction to R-Software. [4L]

1.1 Introduction to R, features of R, getting help in R.
1.2 Vectors and vector arithmetic:

(a) Creating of vector using functions c, seq, rep.
(b) Arithmetic operations on vectors using operations +, -, *, /, ^.
(c) Numerical functions: log, sort, max, min, unique, range, length, var, prod, sum, summary, fivenum, etc.
(d) Accessing vectors.

1.3 Data frames: Creation using data. Frame, subset and transform commands.
1.4 p, q, d, r functions.

Unit-2. Bivariate Discrete Distribution: [14L]

2.1: 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).

2.2: Computation of probabilities of events in bivariate probability distribution, concept of marginal and conditional probability distribution, independence of two discrete r.v.s. Examples.

2.3: 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 m.g.f, proof of the m.g.f. of sum of two independent r.v.as the product of their m.g.f. examples.

Unit-3. Some Standard Discrete Probability Distributions: (Finite sample space) [12L]

3.1: Review of random variable based on infinite sample space.

3.2: Degenerate Distribution:

3.3: Discrete Uniform Distribution: p.m.f., mean and variance.

3.4: Bernoulli Distribution**:** p.m.f., mean, variance, distribution of sum of independent and identically distributed Bernoulli variables.

3.5: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, m..g.f., deduction of moments from m.g.f. Additive property of binomial variables. Examples. Conditional distribution of X given (X+Y) for Binomial distributions.

3.6: 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.

3.7: Real life situations.

Unit-4: Standard Discrete Probability Distribution for Countably infinite sample space: Poisson Distribution: [6L]

4.1: Review of random variable based on countably infinite sample space.

4.2: Definition of Poisson with parameter λ. Mean, variance**,** mode, m.g.f., c.g.f. skewness, kurtosis, Recurrence relation for successive Probabilities, Additive property of Poisson distribution.

4.3: Poisson distribution as a limiting case of Binomial distribution, examples.

4.4: Conditional distribution of X given (X+Y) for Poisson distributions.

4.5 Real life situations.

References:

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 Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
3. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.
4. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.
5. Meyer P. L. (1970): Introductory Probability and Statistical Applications, Edition Wesley.
6. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)
7. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
8. B. L. Agarwal : Programmed Statistics, New Age International Publishers,New Delhi.
9. Purohit, S.G.; Gore, S.D. and Deshmukh, S.R. (2015). Statistics using R, second edition. Narosa Publishing House, New Delhi.

SYLLABUS (CBCS) FOR F. Y. B. Sc. STATISTICS (w.e. from June, 2019)

Academic Year 2019-2020

Class : **F.Y. B. Sc. (Sem-II)**
Paper Code: **STAT-1203**
Paper : **III** Title of Paper: Practical-II

Credit : 2 credits No. of lectures: 40

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

A) Learning Objectives:

The main objective of this course is to acquaint students with concept of developing computing abilities.

B) Learning Outcome:

At the end of this course students are expected to be able to

1. Analyze the data with respect to Bivariate discrete distributions and.

2. Know applications of some standard discrete probability distributions.

INDEX