Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE

Of Arts, Science and Commerce, BARAMATI

(AUTONOMOUS)

Board of Studies (Statistics)

Course Structure B.Sc.: 2019-2020

Class	Sem	Code	Paper Title	Credit
F.Y.B.Sc	I	STAT1101	Descriptive Statistics- I	2
		STAT1102	Discrete Probability and Probability Distributions - I	2
	II	STAT1201	Descriptive Statistics-II	2
		STAT1202	Discrete Probability and Probability Distributions – II	2
	Annual	STAT1203	Practical	4
SYBSc	III	STAT2301	Discrete Probability Distributions and Time Series	3
		STAT2302	Some Standard Continuous Probability Distributions	3
	IV	STAT2401	Statistical Methods and Use of R software	3
		STAT2402	Continuous Probability Distributions and Exact tests	3
	Annual	STAT2403	Practical	4
T.Y.B.Sc.	V	STAT3501	Distribution Theory	3
		STAT3502	Theory of Estimation	3
		STAT3503	Sampling Method	3
		STAT3504	Design of Experiments	3
		STAT3505	Statistical Process Control	3
		STAT3506	(A) Regression Analysis (B) Actuarial Statistics	3
	VI	STAT3601	Time Series	3
		STAT3602	Testing of Hypothesis	3
		STAT3603	Reliability and Survival Analysis	3
		STAT3604	Operation Research	3
		STAT3605	Introduction to Stochastic	3
		STAT3606	(A) Clinical Trials (B) Official Statistics	3
		STAT3607	Practical – I	4
		STAT3608	Practical – II	4
		STAT3609	Project	4

Course Structure B.Com.: 2019-2020

Class	Sem	Code	Paper Title	Credit
F.Y.B.Com	I	COMBS1104A	Business Statistics-I	3
	II	COMBS1204A	Business Statistics-II	3
S.Y.B.Com.	I	COMBS2306D	Business Statistics-I	3
	II	COMBS2406D	Business Statistics-II	3
T.Y.B.Com.	I	COMBS3505D	Business Statistics-III	3
		COMBS3506D	Business Statistics-IV	3
	II	COMBS3605D	Business Statistics-III	3
		COMBS3606D	Business Statistics-IV	3

Course Structure B.Sc.(C.S.): 2019-2020

Class	Sem	Code	Paper Title	Credit
F.Y.B.Sc (C.S.)	I	CSST-1101	Statistical Methods I	2
		CSST-1102	Probability and some continuous probability distributions	2
	II	CSST-1201	Statistical Methods II	2
		CSST-1202	Statistical Testing of Hypothesis and Use of R Software	2
	Annual		Practical	4

Course Structure B.B.A.(CA): 2019-2020

Class	Sem	Code	Paper Title	Credit
F.Y.B.B.A.(CA)	III		Elements of Statistics	3

Course Structure PG.(M.Sc.): 2019-2020

Class	Sem	Code	Paper Title	Credit
M.Sc. - I	I	STAT-4101	Mathematical Analysis	4
		STAT-4102	Integral Calculus and Statistical Computing	4
		STAT-4103	Linear Algebra	4
		STAT-4104	Probability Distributions	4
		STAT-4105	Sampling Theory	4
		STAT-4106	Practical-I	4
	II	STAT-4201	Probability Theory	4
		STAT-4202	Regression Analysis	4
		STAT-4203	Parametric Inference	4
		STAT-4204	Multivariate Analysis	4
		STAT-4205	Practical – II	4
		STAT-4206	Practical – III	4

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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
II	STAT1201	Descriptive Statistics-II	2
	STAT1202	Discrete Probability and Probability Distributions – II	2
Annual	STAT1203	Practical	4

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. Analyze data pertaining to attributes and to interpret the results.
3. 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 (6L)

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 (12L)

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 Kutosis (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.

Unit 5 Theory of Attributes (6L)

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.

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. (Semester- II)**
Paper Code: **STAT-1201**
Paper : **I** Title of Paper : Descriptive Statistics- 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 in Statistics. They will be introduced to some elementary statistical methods of analysis of data and basic concept of life table and demography.

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 (18 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 $E(\varepsilon) =0$, $Var(\varepsilon) = \sigma^2$. 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: Demography (12 L)

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

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

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

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

2.5 Interpretations of different rates, uses and applications.

2.6 Trends in vital rates due to the latest census.

Unit 3: Life Table (6 L)

3.1 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. Mukhopadhya 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. (Annual)**
Paper Code: **STAT-1203**
Paper : **III** Title of Paper: Practical

Credit : 4 credits No. of lectures: 80

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 and concept of discrete bivariate random variable and its probability distribution.

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.

v) Analyze the data with respect to Bivariate discrete distributions and.

vi) Know applications of some standard discrete probability distributions-

vii) Inculcate computational skills using R software.

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

Semester	Paper Code	Title of Paper	No. of Credits
I	COMBS1104A	Business Statistics-I	2
II	COMBS1204A	Business Statistics-II	2

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

Academic Year 2019-2020

Class : F.Y. B. **Com**. (Semester- II)
Paper Code: COMBS1204A
Paper : I Title of Paper: Business Statistics-II
Credit : 2 credits No. of lectures: 36

A) Learning Objectives:

i) Understand concept of permutation and combination.

ii) Handle problems involving maximize the profit and minimize the cost with linear constraints.

iii) To use correlation and regression to estimate the relationship between two variables.

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: Permutations and Combinations [4L]

Permutations of 'n' dissimilar objects taken 'r' at a time (with or without repetition)

$^{n}P_{r} = \frac{n!}{(n-r)!}$ (without proof).

Combinations of 'r' objects taken from 'n' objects $^{n}C_{r} = n^{!}/r^{!}\ (n-r)^{!}$ (without proof) problems, Applications.

UNIT 2: Sample Space, Events and Probability [10L]

Experiments and random experiments. Ideas of deterministic and nondeterministic experiments. Definition of – sample space, discrete sample space, events. Types of events, Union and intersections of two or more events, mutually exclusive events. Complementary event, Exhaustive event. Simple examples, Classical definition of probability, Addition theorem of probability without proof (upto three events are

expected), Definition of Conditional probability Definition of independence of two events simple numerical problems.

UNIT 3: Linear Programming Problems (LPP) (for two variables only) [6L]

Definition and terms in a LPP, formulation of LPP, Solution by Graphical method, problems.

UNIT4: Correlation and Regression [10L]

Concept and type of correlation scatter diagram, interpretation with respect to magnitude and direction of relationship.

Karl Pearson's coefficient of correlation for ungrouped data. Spearman's rank correlation coefficient.

Concept of regression. Lines of regression for ungrouped data, predictions using lines of regression. Regression coefficients and their properties (without proof).

UNIT5: Index numbers [6L]

Concept of index number, price index number, price relatives. Problems in construction of index number. Construction of price index number:

Weighted index Number, Laspeyre's, Paasche's and Fishers method. Cost of living / consumer price index number: Definition and problems in construction.

Methods of construction: Family budget and aggregate expenditure. Inflation Uses of index numbers, commonly used index numbers.

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 Mukhopadhya 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 Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye: Probability & Statistics for Engineers & Scientists

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Course Structure for F. Y. B. Sc. (Computer Science) STATISTICS

Semester	Paper Code	Title of Paper	No. of Credits
I	CSST-1101	Statistical Methods I	2
	CSST-1102	Probability and some continuous probability distributions	2
II	CSST-1201	Statistical Methods II	2
	CSST-1202	Statistical Testing of Hypothesis and Use of R Software	2
Annual	CSST-1203	Practical	4

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

Academic Year 2019-2020

Class : F.Y. B. Sc. (Computer Science) (Semester- I)
Paper Code: CSST-1101
Paper : I Title of Paper: Statistical Methods I
Credit : 2 credits No. of lectures: 36

A) Learning Objectives:

1. To compute various measures of central tendency, dispersion, skewness and kurtosis.
2. Compute the correlation coefficient for bivariate data and interpret it.

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: Data Representation (6L)

1.1 Definition, importance, scope and limitations of statistics w.r.to computer science.

1.2 Data Condensation: Types of data (Primary and secondary), Attributes and variables, discrete and Continuous variables, classification and construction of frequency distribution.

1.3 Graphical Representation: Histogram, Frequency polygon, Frequency curve, Ogive Curves, Steam and leaf chart.

1.4 Numerical problems related to real life situations.

UNIT2: Measures of central tendency (8L)

2.1 Concept of central tendency, requisites of good measures of central tendency.

2.2 Arithmetic mean: Definition, computation for ungrouped and grouped data, combined mean, weighted mean, merits and demerits.

2.3 Median and Mode: Definition, formula for computation for ungrouped and grouped data, graphical method, merits and demerits. Empirical relation between mean, median and mode (without proof)

2.4 Partition Values: Quartiles, Percentiles, Deciles, Box Plot.

2.5 Numerical problems related to real life situations.

UNIT3: Measures of Dispersion (6L)

3.1 Concept of dispersion and measures of dispersion, requisites of good measures of dispersion, absolute and relative measures of dispersion.,

3.2 Range and Quartile Deviation: definition for ungrouped and grouped data and their coefficients, merits and demerits.,

3.3 Variance and Standard deviation: definition for ungrouped and grouped data, coefficient of variation, combined variance & standard deviation, merits and demerits.

3.4 Numerical problems related to real life situations.

UNIT4: Moments, Skewness and Kurtosis (8L)

4.1 Raw and central moments: definition for ungrouped and grouped data (only first four moments), relation between central and raw moments upto fourth order. (without proof)

4.2 Measures of Skewness: Types of skewness, Pearson's and Bowley's coefficient of skewness, Measures of skewness based on moments.,

4.3 Measures of Kurtosis: Types of kurtosis, Measures of kurtosis based on moments

4.4 Numerical problems related to real life situations

UNIT 5: Correlation (For bivariate raw data) (8L)

5.1 Concept of bivariate data, scatter diagram, concept of correlation, positive correlation, negative correlation, zero correlation.

5.2 Karl Pearson's coefficient of correlation, properties of correlation coefficient, interpretation of correlation coefficient.

5.3 Spearman's rank correlation coefficient (formula with and without ties).

5.4 Numerical problems

References:

1 Fundamentals of Applied Statistics (3rd Edition), Gupta and Kapoor, S.Chand and Sons, New Delhi, 1987.

2 An Introductory Statistics, Kennedy and Gentle.

3 Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.

4 Introduction to Linear Regression Analysis, Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley

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

Academic Year 2019-2020

Class : F.Y. B. Sc. (Computer Science) (Semester- I)
Paper Code: CSST-1102
Paper : II Title of Paper: Probability and some continuous probability distributions

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 some standard continuous distributions.

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 continuous random variables.
4) To use distributions in real life situations.

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:

a) at least one of the given events

b) none of the given events

c) all of the given events

d) mutually exclusive events

e) mutually exhaustive events

f) exactly one event out of the given events.

1.7 Numerical problems related to real life situations.

Unit-2. Probability: (12L)

2.1 Concept of Multiplication principle and Permutation and Combination

2.2 Classical Probability: Classical definition of probability, examples ,Probability model, probability of an event, examples. Axiomatic definition of probability.

Proof of the results:

i) $0 \leq P(A) \leq 1$,

ii) $P(A)+P(A^c)=1$

iii) $P(\Phi) = 0$

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

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

Numerical problems related to real life situations.

2.3 Conditional Probability

- Concepts and definitions of Conditional Probability
- Definition of conditional probability of an event.
- Multiplication theorem for two events. Examples.
- Partition of sample space.
- Idea of Posterior probability, Statement and proof of Bayes' theorem, examples on Baye's theorem.

2.4 Independence of Events

- Concept of Independence of two events.
- 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.
- Pair wise and Mutual Independence for three events.
- Numerical problems related to real life situations.

UNIT 3: Discrete random Variable (4L)

3.1 Definition of random variable and discrete random variable

3.2 Definition of probability mass function, distribution function and its properties

3.3 Definition of expectation and variance, theorems on expectation

3.4 Numerical problems related to real life situations

UNIT 4: Standard Discrete distribution (13L)

4.1 Uniform Distribution : definition, mean, variance

4.2 Bernoulli Distribution : definition, mean, variance, additive property

4.3 Binomial Distribution : definition, mean, variance, additive property

4.4 Poisson Distribution : definition, mean, variance, mode, additive property, limiting case of B(n, p)

4.5 Numerical problems related to real life situations

References:

8. Bhat B. R., Srivenkatramana T and Madhava Rao K. S. (1997): Statistics: a Beginner's Text, Vol. II, New Age International (P) Ltd.
9. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
10. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.
11. Gupta and Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
12. Meyer P.L.(1970): Introductory Probability and Statistical Applications, Edition Wesley.
13. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)
14. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

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

Academic Year 2019-2020

Class : F.Y. B. Sc. (Computer Science) (Semester- II)
Paper Code: CSST-1201
Paper : I Title of Paper: Statistical Methods II
Credit : 2 credits No. of lectures: 36

A) Learning Objectives:

1. The main objective of this course is to acquaint students with concept of discrete random variable and its probability distribution.
2. Fit linear regression to two variables and multiple regression (for trivariate data).
3. To study the discrete random variables and their distributions and also some standard discrete probability distributions with real life situations.

B) Learning Outcome:

Students are expected to be able,

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

2) Know some standard discrete probability distributions with real life situations.

3) How to fit the regression model to the given bivariate data

TOPICS/CONTENTS:

UNIT 1: Regression (for ungrouped data) (5L)

1.1 Regression, illustrations, appropriate situations for regression and correlation

1.2 Linear regression

1.3 Fitting of straight line using least squares method

1.4 Properties of regression coefficients : $b_{xy} \cdot b_{yx} = r^2$, $b_{xy} * b_{yx} \leq 1$, $b_{xy} = r\,(\sigma x / \sigma y)$ and $b_{yx} = r\,(\sigma_y / \sigma_x)$, coefficient of determination.

1.5 Numerical problems related to real life situations

UNIT 2: Multiple Regression and Multiple, partial Correlation (For Trivariate Data) (8L)

2.1 Concept of multiple regressions, Yule's Notations.

2.2 Fitting of multiple regression planes.

2.3 Partial regression coefficients, interpretations.

2.4 Concept of multiple correlation: Definition of multiple correlation coefficient and its formula..

2.5 Concept of partial correlation. Definition of partial correlation coefficient and its formula.

UNIT 3: Time series (6L)

3.1 Meaning and utility

3.2 Components of time series

3.3 Additive and multiplicative models

3.4 Methods of estimating trend : moving average method, least squares method and exponential smoothing method

3.5 Numerical problems related to real life situations

Unit-4. Continuous Random Variable: (6L)

4.1 Definition of continuous random variable(r.v.)

4.2 Probability density function (p.d.f.)

4.3 cumulative distribution function (c.d.f.)

4.4 Calculation of Mean, Mode ,Median,Variance,Standard deviation for Continuous random variable.

4.5 Numerical problems related to real life situations.

Unit-5. Standard Continuous Probability Distributions: (12L)

5.1 Uniform Distribution: statement of p.d.f., mean, variance, nature of probability curve.

5.2 Exponential Distribution: statement of p.d.f. of the form, $f(x) = (1/\theta)\, e^{(-x/\theta)}$, mean, variance, nature of probability curve, lack of memory property.

5.3 Normal Distribution: statement of p.d.f., identification of parameters, nature of probability density curve, standard normal distribution, symmetry, distribution of aX+b, aX+bY+c where X and Y are independent normal variables, computations of probabilities using normal probability table, normal approximation to binomial and Poisson distribution , central limit theorem (statement only), normal probability plot.

5.4 Numerical problems related to real life situations.

References:

1. Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.
2. Statistical Methods, J. Medhi, New Age International, 1992.
3. Introduction to Linear Regression Analysis,Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley
4. Time Series Methods, Brockwell and Davis, Springer, 2006.
5. Time Series Analysis,4th Edition, Box and Jenkin, Wiley, 2008.
6. Introduction to Discrete Probability and Probability Distributions, Kulkarni M.B., Ghatpande S.B, 2007.

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

Academic Year 2019-2020

Class : F.Y. B. Sc. (Computer Science) (Semester- II)
Paper Code: CSST-1202
Paper : II Title of Paper: Statistical Testing of Hypothesis and Use of R Software
Credit : 2 credits No. of lectures: 36

A) Learning Outcome:
The main outcome of this course is to use statistical software and testing of hypothesis.

B) Learning Objectives:
Students are expected to be able
1. To testing of statistical hypothesis in real life.
2. To handle with statistical software.
3. To differentiate between parametric and non-parametric test.

TOPICS/CONTENTS:

Unit-1 Introduction to R-software (5L)

1.1 Introduction to R, features of R, getting help in R.
1.2 Vectors and vector arithmetic:
(e) Creating of vector using functions c, seq, rep.
(f) Arithmetic operations on vectors using operations +, -, *, /, ^.
(g) Numerical functions: log, sort, max, min, unique, range, length, var, prod, sum, summary, fivenum, etc.
(h) Accessing vectors.
1.3 Data frames: Creation using data.frame, subset and transform commands.
1.4 p, q, d, r functions.

Unit-2 Concepts and definitions related to Testing of Hypothesis (6L)

2.1 Definitions: population, statistic, SRSWR, SRSWOR, random sample from a probability distribution, parameter, statistic, standard error of estimator, sampling distributions.
2.2 Concept of null hypothesis and alternative hypothesis, critical region, level of significance, type I and type II error, power, one sided and two sided tests, p-value.

Unit-3 Large Sample Tests **(7L)**

3.1 Ho: $\mu = \mu_o$ Vs H1: $\mu \neq \mu_o$, $\mu < \mu_o$, $\mu > \mu_o$ (One sided and two sided tests)

3.2 Ho: $\mu_1 = \mu_2$ Vs H1: $\mu_1 \neq \mu_2$, $\mu_1 < \mu_2$, $\mu_1 > \mu_2$ (One sided and two sided tests)

3.3 Ho: $P = P_o$ Vs H1: $P \neq P_o$, $P < P_o$, $P > P_o$ (One sided and two sided tests)

3.4 Ho: $P_1 = P_2$ Vs H1: $P_1 \neq P_2$, $P_1 < P_2$, $P_1 > P_2$ (One sided and two sided tests)

3.5 Numerical problems related to real life situations.

Unit-4 Test based on t distribution **(7L)**

4.1 Ho: $\mu = \mu_o$ Vs H1: $\mu \neq \mu_o$, $\mu < \mu_o$, $\mu > \mu_o$ (One sided and two sided tests)

4.2 Ho: $\mu_1 = \mu_2$ Vs H1: $\mu_1 \neq \mu_2$, $\mu_1 < \mu_2$, $\mu_1 > \mu_2$ (One sided and two sided tests)

4.3 Paired t-test.

4.4 Test of significance of correlation coefficient for bivariate raw data.

4.5 Test of significance of regression coefficients for bivariate raw data.

4.6 Numerical problems related to real life situations.

Unit-5 Test based on Chi-Square distribution **(4L)**

5.1 Chi square test for goodness of fit

5.2 Test for independence of attributes (m X n contingency table)

5.3 Test for significance of variation for a population.

5.4 Numerical problems related to real life situations.

Unit-6 Simulation **(7L)**

6.1 Introduction to Simulation, merits and demerits and pitfall.

6.2 Pseudo-random number generator ,requisites of a good random number generator, Testing these requirements by using various test of hypothesis using Run test, goodness of fit test, Sign test etc.

6.3 Model Sampling from uniform and exponential distribution.

6.4 Model sampling from Normal distribution using Box-Muller transformation.

6.5 Numerical problems related to real life situations.

References:

1) Statistical Methods (An Introductory Text), Medhi J., New Age International,(1992).
2) Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.
3) Fundamentals of Applied Statistics (3rd Edition), Gupta and Kapoor, S.Chand and Sons, New Delhi, 1987.
4) Purohit, S.G.; Gore, S.D. and Deshmukh, S.R. (2015). Statistics using R, second edition. Narosa Publishing House, New Delhi.
5) Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye: Probability & Statistics for Engineers & Scientists

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

Academic Year 2019-2020

Class : F.Y. B. Sc. (Computer Science) (Semester- II)
Paper Code: CSST-1203
Paper : III Title of Paper: Practical
Credit : 4 credits No. of lectures: 36

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 discrete bivariate random variable and its probability distribution.

B) Learning Outcome:

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

vi) Represent statistical data diagrammatically and graphically.

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

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

ix) Interpret summary Statistics of computer output.

x) Analyze the data with respect to Bivariate discrete distributions and.

xi) Know applications of some standard discrete probability distributions.

Sr. No.	Title of Experiments
1.	a) Measures of Central Tendency and Dispersion – I b) Measures of Central Tendency and Dispersion – II
2.	Problems on Simple Probability, Conditional Probability, Bayes' Theorem and Independence of Event
3.	Measures of Skewness and Kurtosis
4.	Correlation and Linear Regression (For raw data) , Fitting of Second Degree and Exponential curve (for bivariate raw data)
5.	a) Multiple and Partial Correlation and Regression b) Multiple and Partial Correlation and Regression Using **R**
6.	Time Series Analysis
7.	Fitting of Binomial distribution
8.	Fitting of Poisson distribution
9.	Fitting of Normal distribution
10.	Large Sample Tests
11.	Model Sampling from Uniform and Exponential distribution
12.	Test Based on t distribution
13.	Test Based on Chi-Square distribution
14.	Diagrammatic Representation and Descriptive Statistics for Raw Data using **R**
15.	Computation of probabilities of discrete and continuous probability distributions using **R**
16.	Fitting of Normal Distribution using **R**
17.	Model Sampling from Exponential Distribution Normal Distribution (Box Muller Transformation etc.) using **R**
18.	Project(2)

Anekant Education Society's
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Autonomous

Course Structure for F. Y. B. B.A.(C.A.). STATISTICS

Semester	Paper Code	Title of Paper	No. of Credits
II		Elements of Statistics	3

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

Academic Year 2019-2020

Class : F.Y. B. B.A.(C.A.) (Semester- II)
Paper Code: 1204
Paper : IV Title of Paper: Elements of Statistics
Credit : 3 credits No. of lectures: 48

A) Learning Objectives:

1 Understand the power of excel spreadsheet in computing summary statistics.

2 Understand the concept of various measures of central tendency and variation and their importance in business.

3 Understand the concept of probability and simulation in business world and decision making

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:

Unit 1. Population, Sample and Data Condensation (5)

Definition and scope of statistics, concept of population and sample with Illustration, Raw data, attributes and variables, classification, frequency distribution, Cumulative frequency distribution.

Unit 2. Measures of Central Tendency and Dispersion (13)

Concept of central Tendency, requirements of good measures of central tendency, Arithmetic mean, Median, Mode for grouped and ungrouped data, concept of dispersion, Absolute and relative measure of dispersion, range, variance, standard deviation, coefficient of variation.

Unit 3. Introduction to Statistical Functions Using Excel **(6)**

Concept of population and sample, Qualitative and Quantitative variables, Raw data, Basic Spreadsheet concept, data entry and its summary statistics using excel functions, preparation of grouped and ungrouped frequency distribution using excel, creating bar charts like histogram, multiple bar diagram, subdivided bar diagram and percentage bar diagram, pie chart, frequency curves and ogive curves.

(There will be no theory question on above chapter separate practical exam of 20 marks of one hour should be conducted on it)

Unit 4. Fundamental Principals of Counting **(6)**

Permutations of 'n' dissimilar objects taken 'r' at a time (with or without repetitions). ${}^{n}P_{r}$ = n! / (n – r) ! (without proof). Combinations of 'r' objects taken from 'n' objects ${}^{n}C_{r}$ = n! / (r! (n – r)!) (without proof). Simple examples and applications.

Unit 5. Elementary Probability Theory **(8)**

Random experiments, Sample space, Events, algebra of events, Classical definition of probability, addition theorem of probability (without proof), examples and problems.

Unit-6. Univariate Probability Distributions (finite sample space): **(5)**

Definition of discrete random variable, 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), Probability distribution of function of random variable, Median and Mode of a univariate discrete probability distribution, Illustrative examples.

Unit 7. Simulation Techniques **(5)**

Random Number Techniques, Monte Carlo Simulation examples and problems.

Total Lectures : 48

References:

1) S.C.Gupta - Fundamentals of Statistics - Sultan chand & sons,Delhi.
2) D.N.Elhance - Fundamentals of Statistics – Kitab Mahal ,Allahabad.
3) Montgomery D.C. – Statistical Quality Control – John Wiley and sons.
4) Goon, Gupta and Dasgupta - Fundamentals of Statistics – The world press private Ltd., Kolkata.
5) Hogg R.V. and Craig R.G. – Introduction to Mathematical Statistics Ed 4(1989) – Macmillan Pub. Co. New York.
6) Gupta S.P. – Statistical Methods, Pub – Sultan Chand and sons , New Delhi.

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Course Structure for M.Sc. I STATISTICS

Semester	Paper Code	Title of Paper	No. of Credits
I	STAT-4101	Mathematical Analysis	4
	STAT-4102	Integral Calculus and Statistical Computing	4
	STAT-4103	Linear Algebra	4
	STAT-4104	Probability Distributions	4
	STAT-4105	Sampling Theory	4
	STAT-4106	Practical-I	4

SYLLABUS(CBCS) FOR M.Sc. STATISTICS (w.e.f. June, 2019)
Academic Year 2019-2020

Class : M. Sc. (Semester- I)
Paper Code: STAT-4101
Paper : I Title of Paper : Mathematical Analysis
Credit : 4 credits No. of lectures: 60

A) Learning Objectives: Students should:

1 Apply mathematical concepts and principles to perform numerical and symbolic computations.
2 Use technology appropriately to investigate and solve mathematical and statistical problems.
3 Use calculus to analyze and evaluate properties of real valued functions.
4 Have a deeper understanding of mathematical theory.
5 Be familiar with several subfields of mathematics (e.g, numerical analysis, topology, operations research).
6 Understand the concepts required for further studies in Probability Theory and Asymptotic Inference.

B) Learning Outcome:
1 Understand the fundamentals ideas and applications of calculus.
2 Employ technology to investigate mathematical concepts and applications.

TOPICS/CONTENTS:

Unit-1

Set of real numbers, supremum and infimum of sets of real numbers, real field, Euclidean spaces, Finite, Countable and uncountable sets, metric spaces, interior points and limit points of a set, open set, closed set. (These concepts will be introduced through metric spaces and R^n will be considered as a special case) Compactness, Heine-Borel theorem.

(15L)

Unit-2

Sequence of real numbers, convergence and divergence of sequence, subsequences of a sequence, Cauchy sequences, Bolzano-Weierstrass theorem, completeness of R, limit inferior, limit superior of the sequences, some special sequences. **(15L)**

Unit-3

Series of real numbers, convergence of series, tests for convergence of series (ratio test, root test), alternative series, conditional and absolute convergence, power series and radius of convergence, examples and problems on these concepts. **(15L)**

Unit-4

Introduction to sequence and series of functions, pointwise convergence of sequence of functions, uniform convergence of sequence of functions, consequence of uniform convergence, uniform convergence of series of functions, consequence of uniform convergence. **(15L)**

References:

1. Apostol T.M. (1975). Mathematical Analysis: A modern approach to advanced calculus. Addison-Wesley
2. Rudin, W. (1985). Principles of Mathematical Analysis, McGraw-Hill
3. Goldberg R.R.(1964): Methods of Real Analysis-Blaisell Publishing company, New York, U.S.A.
4. Bartle R.G. & Sherbert D.R. (2000): Introduction to Real Analysis-John Wiley & Sons Inc.
5. Bartle R. G. (1976). Elements of Real Analysis, John Wiley
6. Mapa S. K. (2018) Inroduction to Real Analysis, Sarat Book Distributors, Kolkata
7. Ghorpade, S. R. and Limaye, B. V. (2006). A Course in Calculus and Real Analysis, Springer
8. Ajit Kumar (2019), A Basic Course in Real Analysis, A Chapman & Hall Book

SYLLABUS (CBCS) FOR M.Sc. STATISTICS (w.e.f. June, 2019)
Academic Year 2019-2020

Class : M. Sc. (Semester- I)
Paper Code: STAT-4102
Paper : II Title of Paper : Integral Calculus and Statistical Computing
Credit : 4 credits No. of lectures : 60

A) Learning Objectives: Students should:

1 Apply mathematical concepts and principles to perform numerical and symbolic computations.
2 Use technology appropriately to investigate and solve mathematical and statistical problems.
3 Use calculus to analyze and evaluate properties of real valued functions.
4 Be able to apply problem solving and logical skills
5 Have a deeper understanding of mathematical theory
6 Be familiar with several subfields of Statistics (e.g, Numerical Analysis, Simulation).

B) Learning Outcome:

1 Understand the fundamentals ideas and applications of calculus.
2 Employ technology to investigate mathematical concepts and applications.

TOPICS/CONTENTS:

Unit-1

Limits of function, monotonic function, continuous function, uniformly continuous function, types of discontinuity **(10L)**

Unit-2

Differentiability, mean value theorems, Differentials of composite functions and the chain rule, a sufficient condition for the existence of the differential, partial derivatives of higher order and Taylor's formula, Applications of partial differentiation. **(15L)**

Unit-3

Inverse function theorem (without proof), implicit function theorem (without proof), definitions and existence of Riemann integral, refinement of partitions, Darbou'x theorem (without proof), condition of integrability, Riemann sums, fundamental theorem of calculus, definition and existence of Riemann-Stieltjes integral, a condition of integrability. **(15L)**

Unit-4

Newton–Raphson method for two or more simultaneous transcendental equations, Bisection method, Secant method, Regula Falsi Method, Newton Raphson method (for Bivariate), Aiken's extrapolation, Gauss Jordan Gauss elimination, Gauss seidel, Gauss Jacobi, Concept of Interpolation and extrapolation, Newton's bivariate interpolation formula, Newton Gregory Formula for Bivariate Data, Unconstrained Optimization: Grid search method, Gradient search: Steepest descent method, Newton's, method, Simpson's rule, Trapezoidal rule for univariate and bivariate integrals and its errors, Simulation : Linear congruential generator ; Monte Carlo method to evaluate single and multiple integrals, Jackknife technique and Bootstrap technique **(20L)**

References:

1. Apostol T.M. (1975). Mathematical Analysis: A modern approach to advanced calculus. Addison-Wesley
2. Rudin, W. (1985). Principles of Mathematical Analysis, McGraw-Hill
3. Goldberg R.R.(1964): Methods of Real Analysis-Blaisell Publishing company, New York, U.S.A.
4. Bartly R.G. & Sherbert D.R. (2000): Introduction to Real Analysis-John Wiley & Sons Inc.
5. Bartle, R. G. (1976). Elements of Real Analysis, John Wiley
6. Ghorpade, S. R. and Limaye, B. V. (2006). A Course in Calculus and Real Analysis, Springer
7. Ajit Kumar (2019), A Basic Course in Real Analysis, A Chapman & Hall Book
8. Krishnamurthy and Sen: Numerical Algorithms(East West press Pvt. Ltd.)
9. S.S. Sastry (4th edition ,2009)Prentice Hall : Introductory methods of Numerical Analysis.
10. V. Rajaraman (1993): Computer Oriented numerical methods. Prentice Hall

SYLLABUS (CBCS) FOR M.Sc. STATISTICS (w.e.f. June, 2019)
Academic Year 2019-2020

Class : M. Sc. (Semester- I)
Paper Code: STAT-4103
Paper : III Title of Paper : Linear Algebra
Credit : 4 credits No. of lectures: 60

A) Learning Objectives:

1 Use the basic concepts of vector and matrix algebra
2 Understand real vector spaces and subspaces and apply their properties.
3 Solve systems of linear equations using various methods
4 Understand basic mathematical concepts required in advanced statistical and machine learning techniques.

B) Learning Outcome:

Students will demonstrate competence with the basic ideas of linear algebra including concepts of linear systems, independence, theory of matrices, linear transformations, bases and dimension, eigenvalues, eigenvectors and diagonalization.

TOPICS/CONTENTS:

Unit-1

Vector space, subspace, linear dependence and independence, basis and dimension of a vector space, orthogonal and orthonormal vectors, null space, Gram-Schmidt Orthogonalization process, orthonormal basis, orthogonal projection of vector, linear transformation, algebra of matrices, row and column spaces of a matrix, elementary operations and elementary matrices, rank of a matrix. **(15 L)**

Unit-2

Inverse of a matrix null space and nullity, partitioned matrices, permutation matrix, reducible / irreducible matrix, primitive / imprimitive matrix, idempotent matrix, Kronecker product, Generalised inverse, Moore-Penrose generalized inverse, solution of a system of homogenous and non-homogeneous linear equation, theorem related to existence of solution and examples **(15 L)**

Unit-3

Characterstic roots of a matrix algebraic and geometric multiplicities of a characteristic root, right and left characteristic, vector, orthogonal property of characteristic vector Cayley-Hamilton theorem and its applications. **(15 L)**

Unit-4

Spectral decomposition of a real symmetric matrix singular value decomposition nth power of a matrix, Choleskey decomposition of real quadratic form, reduction and classification of simultaneous reduction of two quadratic forms, maxima and minima of ratio of quadratic form. **(15 L)**

References:

1 . Graybill, F.A(1961) An Introduction to Linear Statistical Models Vol 1,McGraw-Hill Bokk Company Inc.
2 . Hadely G.(1962) Linear Algebra,Narosa Publishing House.
3 . Harville D. (1997) Matrix Algebra From Statistics Perspective,Springer.
4 . Rao A.R. and Bhimasankaram P.(2000),Linear Algebra,Second edition,Hindustan Book Agency.
5 . Rao C.R. (2001) Linear Statistical Inference and Its Application,Second Edition,Wiley.
6 . Schott J. (2016) Matrix Analysis for Statistics,Third edition Wiley.
7 . Searl S.B.(2006) Matrix Algebra Useful for Statistics,Wiley.
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SYLLABUS (CBCS) FOR M.Sc. STATISTICS (w.e.f. June, 2019)
Academic Year 2019-2020

Class : M. Sc. (Semester- I)
Paper Code: STAT-4104
Paper : IV Title of Paper : Probability Distributions
Credit : 4 credits No. of lectures: 60

A) Learning Objectives:

1. Providing students with a formal treatment of probability theory.
2. Understand characteristics about discrete and continuous random variable and their probability distributions.
3. Prepare students for modeling real data using distributions
4. Develop understanding of distribution theory related for further advanced topics in statistical inference.

B) Learning Outcome:

Students should be able to:

1. Develop problem-solving techniques needed to accurately calculate probabilities.
2. Apply problem-solving techniques to solving real-world events.
3. Apply selected probability distributions to solve problems.

TOPICS/CONTENTS:

Unit 1:

Random experiments and it's sample space, probability axioms, random variables, probability distribution of random variables, discrete and continuous random variable, functions of random variables and its distribution, mixture of probability distribution, m.g.f, p.g.f of distribution function. **(15 L)**

Unit 2:

Multiple random variables, joint, marginal and conditional distribution, variance covariance matrix, independence of random variables, marginal and conditional densities using joint densities, conditional expectations and variance, convolution of random variable, compound distribution, multiple and partial correlation coefficient, exponential family of distribution, location and scale families, non-regular family. **(15 L)**

Unit 3:

Bivariate normal, bivariate Poisson, bivariate exponential, (Olkins method 3 types) Weibull (2 and 3 parameter), multinomial, Dirichlet, sampling distribution of statistics from univariate normal random samples. **(15 L)**

Unit 4:

Non-central χ^2, t, F distribution and their properties, distribution of linear and quadratic forms in iid and standard normal variable (technique based on m.g.f.), Independence of two linear forms, Independence of two quadratic forms and independence of linear and quadratic forms, Fisher's Cochrans theorem, order statistic, joint distribution of order statistic, distribution of r^{th} order statistic, joint distribution of (r^{th} and s^{th} order statistic and their function), distribution of range. **(15 L)**

References:

1 Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics, John wiley & Sons (Asia)

2 Hogg R. V. and Crag R. G. (1978): Introduction to Mathematical Statistics Ed.4.

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4 Johnson N.L. & Kotz S.(1996) Distributions in statistics Vol.I .VolI and Vol III John Wiley and sons Inc.)

5 Johnson N.L., Kotz S., Balkrishnan, N. Multivariate Distributions (John Wiley and sons)

6 Rohatagi V.K. & Saleh A.K.(2001) Introduction to probability theory and mathematical statistics. (John Wiley and sons)

7 Anirban DasGupta, Fundamentals of Probability: A First Course

8 Feller, Fundamentals of Probability: A First Course

SYLLABUS (CBCS) FOR M.Sc. STATISTICS (w.e.f. June, 2019)
Academic Year 2019-2020

Class : M. Sc. (Semester- I)
Paper Code: STAT-4105
Paper : V Title of Paper: Sampling Theory
Credit : 4 credits No. of lectures: 60

Learning Objectives:

1 To introduce the statistical aspects associated with the design and analysis of sample surveys, and to develop your understanding of the principles and methods used to design survey sampling schemes.
2 Distinguish between probability and non-probability sampling.
3 Understand the factors to consider when determining sample size.
4 Understand the steps in developing a sampling plan.
5 Handle the problem of non response or missing data.

Learning Outcomes:

Students are expected to

1 Define principal concepts about sampling
2 Explains the advantages of sampling.
3 Lists the stages of sampling process
4 Categorizes and defines the sampling methods
5 Apply the Simple Random Sampling (SRS) method
6 To analyze and solve problems
7 Use statistical softwares.

TOPICS/CONTENTS:

Unit 1:

Objectives of sample survey, planning for sample survey, concept of sampling distribution of statistic, Simple random sampling with replacement, Simple random sampling without replacement, systematic sampling and related results on estimation of population total, mean and proportion, circular systematic sampling, stratified sampling: formation of strata and number of strata, allocation problems and estimation problems, deep stratification and method of collapsed strata**.** **[15L]**

Unit 2:

Inclusion probabilities, Probability Proportional to Size With Replacement (PPSWR) methods, cumulative total method and Lahiri's method for estimation problem, estimation of finite population mean and total, PPSWOR method, Horvitz-Thompson estimator, its variance and properties, Des Raj estimators for a general sample size and Murthy's estimator for a sample of size 2, midzuno sampling design. **[15L]**

Unit 3:

Use of supplementary information for estimation, ratio and regression estimators using separate strata and combined strata, unbiased and almost unbiased ratio type estimators of population mean post stratification, variance of estimator of population mean under it, cluster sampling with clusters of equal sizes and unequal sizes, estimator of population mean and its properties, two stage sampling with equal first stage units, expected value and variance of sample mean, double sampling. **[20L]**

Unit 4:

Sampling and non-sampling errors, Response and non response errors, mathematical model for Response errors, Hansen Hurwitz technique Randomized response technique (RRT), Warner's model; related and unrelated questionnaire methods. **[10L]**

References:

1. Des Raj & Chandhok P.(1998), Sample survey theory (Narosa)
2. Murthy M.N.(1977) Sampling theory and methods (Statistical Publishing Society)
3. Sukhatme P.V. Sukhatme B.V. and C. Ashok Sampling theory of survey and applications (Indian society for Agricultural statistics)
4. W.G.Cochran, (1977) Sampling techniques (John Wiley and sons)

SYLLABUS (CBCS) FOR M.Sc. STATISTICS (w.e.f. June, 2019)
Academic Year 2019-2020

Class : M. Sc. (Semester- I)
Paper Code: STAT-4106
Paper : VI Title of Paper: Practical-I
Credit : 4 credits No. of lectures: 60

Sr. No.	Title of Experiments
1.	Matrices, G-Inverse and MPG-Inverse
2.	Eigen value, Eigen vectors, Spectral decomposition, Power of matrix
3.	Solution of system of linear equations using Gauss elimination, Gauss Jordon, Gauss Seidal, and Gauss Jacobi methods
4.	Application of Calley- Hamilton Theorem
5.	Classification and reduction of quadratic forms
6.	Plotting of density function and distribution functions and Computation of probability of events related to bivariate probability distribution computation of probability of non-central χ^2, t, F-distributions
7.	Model sampling from mixture distribution and bivariate probability distribution
8.	Estimation of parameters in simple random sampling using SRSWR and SRSWOR
9.	Systematic sampling
10.	PPS sampling
11.	Ratio and Regression estimates
12.	Stratified sampling (using ratio and regression)
13.	Cluster sampling with equal and unequal cluster size
14.	Two stage sampling
15	Double sampling
16	Simultaneous Transcendental equations
17.	Bivariate Interpolation
18.	Computation of integral by Riemann and Riemann-Stiltjes integral
19.	Computation of single, double integration and numerical integration using simulation
20.	Jackknife technique and Bootstrap technique