

St. Xavier's College (Autonomous),  
Mumbai



Syllabus of the courses offered by the  
Department of Statistics  
(2018-19)

Contents:

Theory Syllabus for Courses: A.STA.1.01 – Descriptive Statistics (A).

Practical Course Syllabus for: A.STA.1. PR

**Academic/field/industrial visits and seminars may be organized by the Department, at other venues, as part of the curriculum.**

**F.Y.B.A**  
**(STATISTICS)**

**SEMESTER 1**

**COURSE : A.STA.1.01**

**DESCRIPTIVE STATISTICS (A)**

**[ 45 LECTURES ]**

**Learning Objectives:**

1. To introduce the technique of data collection and its presentation.
2. To emphasize the need for numerical summary measures for data analysis.

**Unit – 1**

**Data: Types , Collection and Management & Presentation of data.** (15 L)

Types of data from a population :

Qualitative and Quantitative data; Geographical, Time series data; Discrete and Continuous data, Panel and Cross Section data.

Different types of scales: Nominal, Ordinal, Ratio and Interval.

Collection of Data :

Concepts of statistical population and sample.

Primary data- designing a questionnaire / schedule, distinction between them, Problems when collecting data through the questionnaire.

Secondary data– its major sources including some government publications.

Elementary Categorical Data Analysis

Preparation of tables with two or three factors (variable /attributes) of classification. Requisites of a good table. Independence and Association for 2 attributes in a 2 x 2 table using Yule's coefficient of colligation and coefficient of association. Relationship between the two coefficients.

Univariate: Frequency distribution of discrete and continuous variables. Cumulative frequency distribution.

Graphical representation of frequency distribution by Histogram, Frequency polygon, Frequency curve and Ogives.

Diagrammatic representation using Bar diagrams and Pie chart.

Exploratory data analysis: Stem and Leaf diagram, Dot plot.

Bivariate : Frequency distribution, Marginal and Conditional frequency distributions.

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## **Unit 2**

### **Measures of Central Tendency or Location.**

**(15 L)**

Arithmetic mean and its properties (simple and weighted), Combined mean. Geometric mean, trimmed mean Quantiles (Median, Quartiles, Deciles, Percentiles.) Mode. (Grouping Method not expected). Empirical relationship between mean, median and mode.

Merits, Demerits and Uses of Mean, Median, Mode, G.M.

Requisites of a good average.

Choice of scale of measurement for each measure of central tendency.

### **Unit 3 : Absolute and Relative Measures of Dispersion.**

**(15 L)**

Range, Interquartile Range, Quartile Deviation, Mean Absolute Deviation, Standard Deviation (Variance) and their relative measures. Combined variance. Raw and Central moments up to fourth order and the relationship between them (without proof). Measures of Skewness and Kurtosis. Box-Whisker Plot.

### **List Of Recommended Reference Books**

1. Goon A.M., Gupta M.K., Dasgupta B. Fundamentals of Statistics, Volume I, The World Press Private Limited, Calcutta. Fifth edition.
2. Kothari, C.R.: Research Methodology, Methods and Techniques , Wiley Eastern Limited. First Edition.
3. Shah R.J.:Descriptive Statistics, Seth Publications. Eighth edition.
4. Spiegel, M.R.: Theory and Problems of Statistics, Schaum's Publishing Series. Tata McGraw-Hill. First edition.
5. Welling, Khandeparkar, Pawar, Naralkar : Descriptive Statistics : Manan Prakashan
6. S.P. Gupta : Statistical Methods, Sultan Chand & Sons. First edition.

7. Richard. I. Levin, David .S. Rubin: Statistics for Management . Fifth edition
8. Prem . S. Mann (2007) . Introductory Statistics (6<sup>th</sup> edition) John Wiley & Sons.
9. Allan Bluman (2009) Introductory Statistics. A step by step approach (7<sup>th</sup> edition). McGraw-Hill
10. [www.actuaries.org.uk](http://www.actuaries.org.uk)
11. [www.actuariesindia.org](http://www.actuariesindia.org)
12. [www.soa.org](http://www.soa.org)

**List of Practicals:**

1. Collection of Data from Secondary source (including Internet sites) / Primary source
2. Tabulation of data (Quantitative and Categorical)
3. Classification of data.
4. Graphs and Diagrams
5. Measures of Central Tendency.
6. Measures of Dispersion.
7. Skewness and Kurtosis.

Contents:

Theory Syllabus for Courses: A.STA.2.01 – Statistical Methods (A).

Practical Course Syllabus for: A.STA.2. PR

**Academic/field/industrial visits and seminars may be organized by the Department, at other venues, as part of the curriculum.**

**F.Y.B.A**  
**(STATISTICS)**

**SEMESTER 2**

**COURSE : A.STA.2.01**

**Title: Statistical Methods (A).**

**Learning Objectives :**

**To study:**

- 1. Concept of probability**
- 2. Probability distribution**

**No. of lectures: 45**

**Unit 1**

**(15L)**

**Elementary probability theory.**

Random Experiment, Sample Point & Sample Space.

Discrete Sample Space, Definition of Event, Elementary Event, Algebra of Events.

Mutually exclusive events, Exhaustive events. Subjective Probability.

Classical, Empirical and Axiomatic definitions of probability.

Conditional Probability, Independence of  $n$  Events. ( $n = 2, 3$ ).

Theorems on Addition & Multiplication of Probabilities,

Bayes' Theorem (All theorems with proofs).

## **Unit 2**

**(15L)**

### **Discrete Random variable:**

#### Univariate :

Random variable. Definition, Properties of Probability Mass Function & Cumulative Distribution Function. Expectation and variance of a random variable. Theorems on Expectation and Variance .

Raw & Central Moments and the relationship between them (without proof).  
Concept of Skewness and Kurtosis..

#### Bivariate :

Joint Probability Mass Function of two Discrete Random Variables, Marginal and Conditional Probability Distributions, Independence of Two Random Variables.

Theorems on Expectation, Variance.

Covariance, Correlation coefficient between two random variables

## **Unit 3**

**(15L)**

### **Standard Discrete Probability Distributions:**

Discrete Uniform distribution, Bernoulli distribution, Binomial Distribution, Poisson Distribution, Hypergeometric Distribution. Derivation of mean, & variance, Calculation of Expected frequencies.

Binomial approximation to Poisson and Hypergeometric approximation to Binomial Distribution (statement only)

Degenerate distribution.

### **List of Practicals**

1. Probability
2. Discrete Random Variable
3. Bivariate Probability Distributions
4. Binomial, Poisson and Hypergeometric Distributions
5. Calculation of Expected frequency from a conducted experiment.

### **List Of Recommended Reference Books**

1. Statistical Methods : Welling, Khandeparkar, Pawar, Naralkar Manan Publications. First edition.
2. Statistical Methods : R.J. Shah – Seth Publications. Tenth edition.
3. Basic Statistics : B.L. Agarwal – New Age International Ltd. Fifth edition
4. Theory and Problems of Statistics : Spiegel M.R. – Schaums Publishing Series, Tata Mcgraw - Hill. First edition
5. Probability and Statistical Inference : Hogg R.V, Tanis E.P. – Macmillan Publishing Co. Inc.

6. Fundamentals of Mathematical Statistics : S. C. Gupta, V.K.Kapoor – Sultan Chand & Sons. Eleventh edition.
7. Statistical Methods : S.P. Gupta – Sultan Chand & Sons. Thirty third edition.
8. Fundamentals of Statistics , Volume II, - Goon A.M., Gupta M.K., Dasgupta B. – The World Press Pvt. Ltd, Calcutta. Fifth edition.
9. Richard. I. Levin, David .S. Rubin: Statistics for Management Fifth edition
10. Prem . S. Mann (2007) . Introductory Statistics (6<sup>th</sup> edition) John Wiley & Sons.
11. Allan Bluman (2009) Introductory Statistics. A step by step approach (7<sup>th</sup> edition). McGraw-Hill
12. [www.actuaries.org.uk](http://www.actuaries.org.uk)
13. [www.actuariesindia.org](http://www.actuariesindia.org)
14. [www.soa.org](http://www.soa.org)

Contents:

Theory Syllabus for Courses:

A.STA.3.01 – Descriptive Statistics (B).

A.STA.3.02 – Operations Research.

Practical Course Syllabus for: A.STA.3. PR

**Academic/field/industrial visits and seminars may be organized by the Department, at other venues, as part of the curriculum.**

**S.Y.B.A. STATISTICS**

**COURSE : A.STA.3.01**

**DESCRIPTIVE STATISTICS ( B)**

**(45 L)**

**LEARNING OBJECTIVE : To orient students on techniques of data analysis.**

**Unit-1: Analysis of Bivariate Data.** **(15 L)**

Scatter diagram. Product Moment correlation coefficient and its properties. Rank correlation-Spearman's measure. Concept of linear regression. Principle of least squares. Fitting of straight line by method of least squares. Relation between regression coefficients and correlation coefficient. Coefficient of determination. Fitting of curves reducible to linear form by transformation. Fitting of quadratic curve using least squares.

**Unit-2 : Index Numbers.** **(15 L)**

Index number as a comparative tool. Stages in the construction of Index Numbers.

Simple and Composite Index Numbers.

Fixed base Index Numbers. Chain Base Index Numbers, Base shifting, Splicing and Deflating. Price and Quantity Index Numbers - Laspeyres', Paasche's, Marshal-Edgeworth's,



Dorbisch-Bowley's and Fisher's Index Numbers. Value Index Number. Time reversal test. Factor reversal test, Circular test. Cost of Living Index Number. Concept of Real Income based on the Consumer Price Index Number.  
Problems in the construction of Consumer Price Index Number.

### **Unit-3 : TIME SERIES**

**(15)**

#### **L)**

Definition of Time series. Its components. Models of Time Series.

Estimation of trend by i) Freehand curve method. ii) Method of semi averages. iii) Method of moving averages iv) Method of least squares v) Exponential smoothing method

Estimation of seasonal component by i) Method of simple averages  
ii) Ratio to moving average method iii) Ratio to trend method.

#### **List of Practicals:**

- 1 Correlation Analysis
- 2 Regression Analysis.
- 3 Curve fitting by the Method of Least Squares.
- 4 Index Numbers.
- 5 Time-Series

#### **REFERENCES:**

13. Goon A.M., Gupta M.K., Dasgupta B. Fundamentals of Statistics, Volume I, The World Press Private Limited, Calcutta. Fifth edition.
14. Kothari, C.R.: Research Methodology, Methods and Techniques , Wiley Eastern Limited. First Edition.
15. Shah R.J.:Descriptive Statistics, Seth Publications. Eighth edition.
16. Spiegel, M.R.: Theory and Problems of Statistics, Schaum's Publishing Series. Tata McGraw-Hill. First edition.
17. Welling, Khandeparkar, Pawar, Naralkar : Descriptive Statistics : Manan Prakashan
18. S.P. Gupta : Statistical Methods, Sultan Chand & Sons. First edition.
19. Richard. I. Levin, David .S. Rubin: Statistics for Management . Fifth edition
20. Prem . S. Mann (2007) . Introductory Statistics (6<sup>th</sup> edition) John Wiley & Sons.
21. Allan Bluman (2009) Introductory Statistics. A step by step approach (7<sup>th</sup> edition). McGraw-Hill
22. S.C.G upta ,V.K.Kapoor : Fundamentals of Applied Statistics, Third edition, Sultan Chand & Sons.
23. [www.actuaries.org.uk](http://www.actuaries.org.uk)
24. [www.actuariesindia.org](http://www.actuariesindia.org)
25. [www.soa.org](http://www.soa.org)

**Title: Operations Research.**

**Learning Objectives :**

To provide students with an insight into

1. The structures and processes that Operations Research can offer and the practical utility of its techniques.
2. Techniques of Operations Research used for scheduling and controlling projects.

No. of lectures: 45

**Unit 1**

**(15L )**

Linear Programming Problem (L.P.P.) :

Definition, Mathematical Formulation. Concepts of Solution, Feasible Solution, Basic Feasible Solution, Optimal solution, , Slack, Surplus & Artificial variable, Standard form, Canonical form

Graphical Method & Simplex Algorithm to obtain the solution to an L.P.P.

Problems involving Unique Solution, Multiple Solution, Unbounded Solution and Infeasible Solution

**Unit 2**

**(15 L)**

Transportation Model

Definition, Mathematical Formulation Concepts of Feasible solution, Basic feasible solution Optimal and multiple solution.

Initial Basic Feasible Solution using

- (i) Vogel's Approximation Method.
- (ii) MODI Method for optimality.

Problems involving unique solution, multiple solutions, degeneracy, maximization, prohibited route(s) and production costs.

Unbalanced Transportation problems.

Assignment model

Definition, Mathematical formulation. Solution by Hungarian Method.

Unbalanced Assignment problems.

Problems involving Maximization & prohibited assignments.

### **Unit 3.**

(15 L)

#### **Network Analysis**

Concept of project as an organized effort with time management.  
Objective and Outline of the techniques.  
Diagrammatic representation of activities in a project  
Gantt Chart and Network Diagram.  
Slack time and Float times. Determination of Critical path.  
Probability consideration in project scheduling.  
Project cost analysis ,Resource leveling, Resource allocation

#### **List Of Recommended Reference Books**

1. PERT and CPM, Principles and Applications : Srinath., 2<sup>nd</sup> edition, East West Press Pvt Ltd
2. Operations Research : Kantiswaroop, P.K.. Gupta and Manmohan Gupta.4<sup>th</sup> edition , Sultan Chand and Sons
3. Operations Research : S.D. Sharma , 11<sup>th</sup> edition Kedarnath, Ramnath & Co
4. Operations Research : H.A.Taha , 6<sup>th</sup> edition , Prentice Hall of India

#### **List of Practicals:**

1. Linear Programming Problem
2. Transportation Problem
3. Assignment Problem.
4. Network Analysis
5. Introduce a practical for solving LPP using EXCEL

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Contents:

Theory Syllabus for Courses:

A.STA.4.01 – Statistical Method (B).

A.STA.4.02 – Data Analysis.

Practical Course Syllabus for: A.STA.4. PR

Cross faculty Course: **SPC.4.01.DS (DESCRIPTIVE STATISTICS)**

**Academic/field/industrial visits and seminars may be organized by the Department, at other venues, as part of the curriculum.**

**S.Y.B.A. STATISTICS**

**COURSE : A.STA.4.01**

**STATISTICAL METHODS ( B)**

**[ 45 LECTURES ]**

**LEARNING OBJECTIVES :**

- To study :**
- 1) Continuous probability distributions**
  - 2) Testing of hypotheses.**

**Unit 1 : Continuous Random variable**

**(15 L)**

Concept and properties of Probability Density Function and Cumulative Probability distribution Function. Expectation and variance of a random variable and its properties. Measures of location, dispersion, skewness and kurtosis. Raw and Central Moments. (Simple illustrations.),

**Unit 2: Some Standard Continuous Probability Distributions.**

**(15 L)**

Rectangular Distribution, Exponential Distribution and Normal Distribution. Derivation of mean, median and variance for Rectangular and Exponential distribution. Properties of Normal Distribution and Normal Curve (without proof).

Normal Approximation to Binomial and Poisson Distributions (without proof).

and using graph / probability histogram

**Unit 3 : Sampling Distribution.**

**(15L)**

Concept of Parameter, Statistic, Estimator and bias. Sampling distribution.of estimator. Standard error and M.S.E. of an estimator.

Central Limit Theorem (Statement only).

Sampling distribution of sample mean and sample proportion for large samples.

Point and interval estimation of single mean and single proportion, for large sample only.

Statistical tests - Concept of Hypotheses. (Null and Alternative Hypotheses.). Types of Errors, Critical Region, Level of Significance, p-value,

Large Sample Tests using Central Limit Theorem, if necessary.

- For testing specified value of population mean
- For testing specified value in difference of two population means
- For testing specified value of population proportion
- For testing specified value in difference of two population proportions.

### **TOPICS FOR PRACTICALS.**

1. Continuous Random Variables.
2. Uniform, Exponential Distributions.
3. Normal Distribution
4. Testing of Hypotheses
5. Estimation
6. Large Sample Tests.

### **REFERENCES:**

15. Statistical Methods : Welling, Khandeparkar, Pawar, Naralkar Manan Publications. First edition.
16. Statistical Methods : R.J. Shah – Seth Publications. Tenth edition.
17. Basic Statistics : B.L. Agarwal – New Age International Ltd. Fifth edition
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**DATA ANALYSIS**

[ 45 LECTURES ]

**LEARNING OBJECTIVES :**

**3. Techniques for data collection and its analysis.**

**4. Basic techniques of forecasting.**

Unit 1 Sampling: (15 L)

Concepts of population, population unit, sample, sample size, parameter, statistic, estimator, unbiasedness, bias, mean square error (M.S.E.) and standard error.

Census and Sample Surveys:

Steps in conducting sample survey

Concepts of Sampling errors and Non-sampling errors.

Concepts of non-probability sampling and probability sampling.

Sampling with replacement: Sampling without replacement.

Simple random sample ( SRS )

Drawing Simple random sample ( SRS ) using

(a) Lottery Method and

(b) Random numbers

Estimation of Population mean

Introduction to: Stratified sampling, Systematic sampling, Cluster sampling, Two stage sampling.

Application to Market Research in various fields.

NSSO, CSO and their functions.

Unit 2 Application of chi-square distribution & measures of association (15 L)

Definition of Chi-square distribution.

Applications of chi-square distribution :

(1) Test of significance for specified value of variance from a normal population

(2) Test of goodness of fit

(3) Independence of Attributes for :

(i) 2 x 2 contingency table. (With Derivation of Test statistic)

(ii) r x c contingency table (Without Derivation of Test statistic)

Measures of association

(i) Yule's coefficient (ii) Coefficient of Colligation (iii) Phi-coefficient

Prospective study and retrospective study

Relative risk & Odds ratio.

### Unit 3 Applications using R software

Introduction to R. Creation of vectors using various functions.

Arithmetic operations of vectors. Accessing vectors. Various numerical functions. Creation of data frames. Subset and Transform commands.

Import CSV file into R. Computing various measures of central tendency, dispersion, skewness and kurtosis.

Computing pdf, cdf, quantile points.

Drawing a random sample from discrete and continuous distributions.

Correlation and Regression with one independent variable.

#### **TOPICS FOR PRACTICALS:**

1. Sampling Techniques
2. Chi-Square distribution.
3. Practicals using R.

#### **REFERENCE:-**

1. S.C.Gupta and V.K. Kapoor: Fundamentals of Applied Statistics Sultan.Chand Publication , 3<sup>rd</sup> edition
2. Cochran : Sampling Techniques, Wiley Publication, 3<sup>rd</sup> edition
3. Naresh Malhotra : Market Research, 5<sup>th</sup> edition
4. Kothari C.R.: Quantitative Techniques ,Wiley Eastern Limited ,5<sup>th</sup> edition
5. R.J Shah: Statistical Methods,10<sup>th</sup> edition, Sage publications.
6. S.C.Gupta, V.K.Kapoor: Fundamentals of Mathematical Statistics, 11<sup>th</sup> Edition Sultan Chand & Sons .
7. Vishwas R. Pawgi & Saroj A. Ranade: Statistical Methods Using R Software 1<sup>st</sup> edition, Nirali Prakashan.
8. Michael J. Crawley: The R Book, 2<sup>nd</sup> editon, Wiley Publications

Contents:

Theory Syllabus for Courses:

A.STA.5.01 – Probability & Sampling Distributions (A).

A.STA.5.02 – Sampling Techniques.

A.STA.5.03 – Applied Statistics (A)

Practical Course Syllabus for: A.STA.5. PR

**Academic/field/industrial visits and seminars may be organized by the Department, at other venues, as part of the curriculum.**

**T.Y.B.A STATISTICS**

**Course: A.STA.5.01**

**Title: Probability & Sampling Distributions (A)**

**Learning Objectives :**

- 1) To understand the patterns in the data of large populations.
- 2) To obtain data summarizing methods.
- 3) To know the relationship between various distributions.

**No. of lectures: 45**

**Unit 1**

**(15L)**

**Univariate and Bivariate random variables (Discrete and Continuous)**

Probability generating functions ,Moment Generating Functon, Cumulant generating Function. Their properties. Relationship between moments and cumulants and their uses.

Discrete joint probability mass function,, Continuous joint probability density function.

Marginal densities, covariance, correlation coefficient.

Independence of random variables.

Conditional Distribution, conditional expectation and conditional variance.



## **Unit 2**

(15 L)

### **Standard Univariate Discrete Probability Distributions:**

Uniform Distribution, Bernoulli's Distribution, Binomial Distribution, Poisson

Distribution Geometric Distribution, Negative Binomial Distribution :

The following aspects to be discussed wherever applicable to the above stated distributions:

Mode, Median, Derivation of m.g.f., c.g.f., Moments , Additive property, Recurrence Relationship for central moments. Skewness and Kurtosis.

Limiting distribution ( without proof)

Truncated Binomial and Truncated Poisson distributions.: p.m.f. Mean and variance.

(with simple illustrations)

## **Unit 3**

### **Standard Univariate Continuous Probability Distributions:**

(15 L)

Rectangular and Exponential distributions, Laplace distribution, Gamma distribution (with single and double parameter). Beta distribution ( Type I and Type II )

The following aspects to be discussed wherever applicable to the above stated distributions:

Mode, Median, Derivation of M.g.f., C.g.f., Moments, , Skewness and Kurtosis. Additive property. Limiting distribution ( without proof)

### **List Of Recommended Reference Books**

1. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor : 8<sup>th</sup> edition, Sultan Chand & Sons.
2. Outline of Statistical Theory – Volume I, A.M. Goon, M. K. Gupta, B. Dasgupta :
3. 3<sup>rd</sup> edition, The World Press Pvt Ltd.
4. Introduction to Theory of Statistics, Mood, Graybill and Boes: 3<sup>rd</sup> edition, Mc Graw-Hill Publishers.
5. Introduction to Mathematical Statistics, R. V. Hogg & A. T. Craig : 4<sup>th</sup> edition, Collier Mc Millan Publishers.
6. Probability and Statistical Inference, R. V. Hogg & E. A. Tanis : 3<sup>rd</sup> edition, Mc

Millan Publishing Co.

7. Mathematical Statistics, John E. Freund : 5<sup>th</sup> edition, Prentice-Hall of India Pvt Ltd.

**Topics for Practicals**

1. Distribution of random variables : M.g.f , C.g.f.
2. Bivariate Probability Distribution and Joint m.g.f.
3. Binomial Distribution
4. Poisson Distribution
5. Geometric and Negative Binomial distribution.
6. Normal Distribution

**T.Y.B.A STATISTICS**  
**A.STA.5.02**

**Course:**

**Title: Sampling Techniques**

**Learning Objectives :**

- 5. To understand various sampling techniques.**
- 6. To apply these techniques in real life situation.**
- 7. Comparison of sampling techniques.**

**No. of lectures: 45**

**Unit 1**

**(15L)**

**Simple Random Sampling (with and without replacement):**

SRS for Variables :

Estimation of population Mean and Total .Expectation and Variance of these Estimators. Unbiased estimators of the variance of these estimators

SRS for Attributes :

Estimation of Population proportion and Variance of these estimators.

Estimation of sample size based on desired accuracy , in case of variables and attributes.

Confidence interval for Population Mean and Proportion.

**Unit 2**

**(20L)**

**Ratio and Regression Estimators under SRSWOR:**

Ratio estimators for population mean, ratio and total. Expectation and M.S.E. of Estimators. Unbiased Estimators of M.S.E.

Regression estimation of population mean and total.

Expectation. Variance and Minimum variance.

Comparison of ratio estimator, regression estimator and mean per unit estimator

**Stratified Random Sampling:**

Concepts of Stratified population and stratified sample.

Estimation of population mean and Total based on stratified sample. Expectation and variance of estimator of population mean and Total assuming SRSWOR within strata. Unbiased estimator of the variances of these

estimators.

Proportional allocation, Optimum allocation with and without varying costs. Comparison of simple random sampling and stratified random sampling with proportional and optimum allocations (Neyman. Allocation)

### **Unit 3**

(10L)

#### **Systematic Random Sampling.**

Sampling procedure. Estimation of population mean and total.

(Assuming  $N = nk$ )

Expectation and variance of estimators.

Expression for variance in terms of (i)  $S^2$  and  $S^2_{wsy}$  (ii) intra class correlation coefficient..

#### **List Of Recommended Reference Books**

1. Sampling Techniques : W.G. Cochran, 3<sup>rd</sup> edition, Wiley Eastern Ltd.
2. Sampling Theory and Methods : M.N.Murthy, 1<sup>st</sup> edition, Statistical Publishing Society.
3. Sampling Theory : Des Raj, 1<sup>st</sup> edition, McGraw-Hill Publishing Co.
4. Sampling Theory of Surveys with Applications : P.V.Sukhatme and B.V.Sukhatme, 3<sup>rd</sup> edition, Iowa State University Press.
5. Fundamentals of Applied Statistics: S.C.Gupta and V.K.Kapoor, 3<sup>rd</sup> edition, Sultan Chand & Sons.

#### **Topics for Practicals.**

1. SRS for variables.
2. SRS for attributes.
3. Estimation of samples size in case of SRS.
4. Confidence Limits in case of SRS.
5. Stratified random sampling.
6. Ratio and Regression methods of estimations.
7. Systematic sampling.

**T.Y.B.A STATISTICS**  
**Title: Applied Statistics ( A)**

**Course: A.STA.5.03**

**Learning Objectives :**

**To apply Statistics to the Insurance industry.**

**No. of lectures: 45**

**Unit 1**

**(15L)**

**Concepts of Vital Statistics & Mortality Tables :**

Vital Statistics:

Crude death rate, Age specific death rate & Standardized death rate.

Crude birth rate, General fertility rate, Age specific fertility rate & Total fertility rate. Gross & Net Reproduction rates.

Mortality Table:

Various mortality functions. Probabilities of living and dying. The force of mortality. Estimation of  $\mu_x$  from the mortality table.

Mortality table as a population model. Stationary population.

Expectation of life and Average life at death. Central death rate.

**Unit 2.**

**(15 L)**

**Compound Interest and Annuities Certain:**

Accumulated value and present value, nominal and effective rates of interest. Discount and discounted value, Varying rates of interest. Equation of value. Equated time of payment.

Present and accumulated values of annuity certain, perpetuity (immediate and due) with and without deferment period.

Present and accumulated values of

- i) increasing annuity
- ii) increasing annuity when successive installments form
  - a) arithmetic progression

b) geometric progression.

Redemption of Loan.

### **Unit 3.**

(15 L)

#### **Assurance Benefits:**

Present value in terms of commutation functions of Life annuities and Temporary life annuities (immediate and due) with and without deferment period. Present values of variable and increasing life annuities (immediate and due)

Present value of assurance benefits in terms of commutation functions of i) pure endowment assurance ii) temporary assurance iii) endowment assurance iv) whole life assurance v) double endowment assurance vi) increasing temporary assurance

vii) increasing whole life assurance viii) special endowment assurance

ix) deferred temporary assurance x) deferred whole life assurance.

Net premiums and Level annual premiums for the various assurance plans.

Natural and Office premiums.

#### **List Of Recommended Reference Books**

1. Neill A. : Life Contingencies, First edition, Heineman educational books London
2. Dixit S.P., Modi C.S., Joshi R.V. : Mathematical Basis of Life Assurance, First edition Insurance Institute of India
3. Gupta S. C. & Kapoor V. K. : Fundamentals of Applied Statistics, Fourth edition, Sultan Chand & Sons.

#### **TOPICS FOR PRACTICALS**

1. Mortality tables & Vital Statistics
2. Annuities
3. Life annuities
4. Assurance benefits

Contents:

Theory Syllabus for Courses:

A.STA.6.01 – Probability & Sampling Distributions (B).

A.STA.6.02 – Analysis of Variance & Design of Experiments.

A.STA.6.03 – Applied Statistics (B)

Practical Course Syllabus for: A.STA.6. PR

**Academic/field/industrial visits and seminars may be organized by the Department, at other venues, as part of the curriculum.**

**T.Y.B.A**  
**(STATISTICS)**

**SEMESTER 6**

**COURSE : A.STA.6.01**

**PROBABILITY & SAMPLING DISTRIBUTIONS (B) [45 Lectures]**

**LEARNING OBJECTIVES :**

- 1) **To understand the patterns in the data of large populations.**
- 2) **To obtain data summarizing methods.**
- 3) To know the relationship between various distributions.

**Unit 1**

**( 15 lectures)**

**Transformation of random variables & Standard Univariate Continuous Probability Distributions.**

One-dimensional and two-dimensional continuous random variables. Jacobian of Transformation, Simple illustrations related to standard distributions

**Normal Distribution**

Definition. Derivation of its M.G.F., C.G.F., Mean, Median, Mode, S.D., M.D. Recurrence Relationship for moments. Distribution of linear function of Normal variables. Fitting of Normal Distribution. Central Limit Theorem with proof for i.i.d.r.v.s.

Log Normal Distribution : Determination of Mean and Variance and its properties

**Unit 2**

**Chi-Square Distribution:**

**(15 lectures)**

Definition, its M.G.F., C.G.F, Moments, Mode, Derivation of distribution of Sum of Squares of standard normal variates, Additive property. Distributions of Sample Mean, Sample Variance and their independence for a sample drawn from Normal population.

Asymptotic Property (without proof)

**Applications of Chi-Square Distribution:**

Test of significance for specified variance of Normal population..

Test for Goodness of Fit.

**Unit 3**

**t-distribution :**

**( 15 lectures)**

Definition of Student's t-statistic. Derivation of its density function. Moments . Asymptotic



property.

**Applications of t-distribution:**

Tests of significance for:

- i) Single population mean
- ii) Difference between two population means
  - a) with equal variances based on independent samples.
  - b) based on paired observations.
- iii) Correlation coefficient ( without proof).

**F-distribution :**

Definition., Derivation of density function Derivation of distribution of reciprocal of F-variate. Moments ,mode .Test for equality of variances of two normal populations. Relationship between F, Chi-Square and t-distributions.

**Topics for practicals:**

- 1. Rectangular and Exponential distribution.
- 2. Chi-square distribution
- 3. t – distribution
- 4. F distribution.

**REFERENCE BOOKS**

- 1. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor : 8<sup>th</sup> edition, Sultan Chand & Sons.
- 2. Outline of Statistical Theory – Volume I, A.M. Goon, M. K. Gupta, B. Dasgupta : 3<sup>rd</sup> edition, The World Press Pvt Ltd.
- 3. Introduction to Theory of Statistics, Mood, Graybill and Boes: 3<sup>rd</sup> edition, Mc Graw-Hill Publishers.
- 4. Introduction to Mathematical Statistics, R. V. Hogg & A. T. Craig : 4<sup>th</sup> edition, Collier Mc Millan Publishers.
- 5. Probability and Statistical Inference, R. V. Hogg & E. A. Tanis : 3<sup>rd</sup> edition, Mc Millan Publishing Co.
- 6. Mathematical Statistics, John E. Freund : 5<sup>th</sup> edition, Prentice-Hall of India Pvt Ltd.

**T.Y.B.A**  
**(STATISTICS)**

**SEMESTER 6****COURSE : A.STA.6.02.****Analysis of Variance & Design of Experiments**

[ 45 LECTURES ]

**LEARNING OBJECTIVES :**

- 1) **To introduce and apply the techniques and methodology available for designing and analysis of experiments.**
- 2) **To emphasize the need for sound and unambiguous interpretation of experimentation.**

Unit 1. **Analysis of Variance (Fixed effect models) :** **(15 lectures)****One way classification** (With equal and unequal observations per class)

Mathematical model and its assumptions. Estimation of parameters by Least Squares Method. Expectation and variance of the estimators. Expectation of various sums of squares, ANOVA table

**Multiple comparisons of treatments**

( i ) Least Significant difference test.. ( ii ) Tukey's test. (iii) Dunnet's test.

**Two way classification** (with one observation per cell)

Mathematical model and its assumptions. Estimation of parameters by Least Squares Method. Expectation and variance of the estimators. . Expectation of various sums of squares. ANOVA table

Unit 2. **Design of Experiments:** **( 15 lectures)**

Experiment, experimental unit, treatment, replicate, block, experimental error and precision.

Principles of design of experiment: Replication, Randomization and Local Control.

Choice of size, shape of plots and block in different agriculture and non-agriculture experiments.

**Completely randomized design.(CRD) & Randomized block design (RBD).**

Mathematical model and its assumptions. Expectation of various sums of squares  
Estimation of parameters by Least Squares Method. ANOVA table  
Standard errors of treatment differences.

Efficiency of RBD over CRD.

Missing plot technique for one observation in RBD.

Unit 3. **Latin square design (LSD)** **(15 lectures)**

Mathematical model and its assumptions. Expectation of various sums of squares  
Estimation of parameters by Least Squares Method. Standard errors of treatment differences, ANOVA table.

Efficiency of CRD over RBD.

Missing plot technique for one observation in LSD.

#### Symmetrical Factorial Experiments:

Purpose and advantages.

$2^2, 2^3$  experiments. Calculation of main and interactions effects.

Yates method.

Analysis of  $2^2, 2^3$  experiments

Concepts of Confounding in  $2^3$  experiments.

### **Topics for Practicals**

- One Way ANOVA / CRD.
- Two Way ANOVA / RBD.
- LSD..
- Missing Plot Technique.
- Factorial Experiment.

### **References**

1. Fundamentals of Applied Statistics: S.C.Gupta and V.K.Kapoor, 3<sup>rd</sup> edition, Sultan Chand & Sons.
2. Designs and Analysis of Experiments : M. N. Das and N.C. Giri 2<sup>nd</sup> edition, Wiley Eastern Ltd.
3. Designs and Analysis of Experiments : D.C. Montgomery, 6<sup>th</sup> edition, Wiley Eastern Ltd.
4. Applied Multivariate Analysis and Experimental Designs: N. Krishnan Namboodiri, Lewis F. Carter. Hubert M. Blalock. JR., 1<sup>st</sup> edition, McGraw –Hill, Inc.
5. Experimental Designs : William G. Cochran, Gertrude M. Cox, 2<sup>nd</sup> edition, Bombay, Asia Publishing House.
6. The Design of Experiments : Sir Ronald A. Fisher, 9<sup>th</sup> edition, Collier Macmillan Publishers.

**T.Y.B.A**

**(STATISTICS)**

**SEMESTER 6**

**COURSE : A.STA.6.03**

**LEARNING OBJECTIVES :**

- 1) To learn techniques of mathematical modelling
- 2) To study methods to solve the formulated problems.
- 3) To learn the applications of operations research in industry.

## APPLIED STATISTICS – ( B )

[ 45 LECTURES ]

### Unit DECISION THEORY:

1. Decision making under uncertainty Laplace criterion, Maximax (Minimin) criterion, Maximin (Minimax) criterion, Hurwicz  $\alpha$  criterion, Minimax Regret criterion.

Decision making under risk: Expected Monetary value criterion, Expected Opportunity Loss Criterion, EPPI, EVPI Decision tree analysis.

### GAME THEORY:

Definitions of Two person Zero Sum Game, Saddle Point, Value of the Game, Pure and Mixed strategy  
Optimal solution of two person zero sum games: Dominance property,

Derivation of formulae for (2 x 2) game. Graphical solution of (2 x n) and (m x 2) games.

### Unit SIMULATION:

2. Scope of simulation applications. Types of simulation. Monte Carlo Technique of Simulation. Elements of discrete event simulation. Generation of random numbers. Sampling from probability distribution. Inverse method. Generation of random observations from i) Uniform distribution ii) Exponential distribution iii) Gamma distribution iv) Normal distribution. Simulation techniques applied to inventory and Queuing models.

### Unit MULTIPLE LINEAR REGRESSION:

3. Multiple linear regression model with two independent variables: Assumptions of the model, Derivation of ordinary least square (OLS) estimators of regression coefficients, Properties of least square estimators (without proof) Concept of  $R^2$  and adjusted  $R^2$ . Procedure of testing
  - i) overall significance of the model ii) significance of individual coefficients iii) significance of contribution of additional independent variable to a model. Confidence intervals for the regression coefficients. Concept of Autocorrelation, Heteroscedasticity , Multicollinearity.

### Topics for practicals:

- Decision Theory.
- Game theory.
- Simulation..
- Multiple Linear regression.

### References

1. Operations Research : Kantiswaroop, P.K. Gupta and Manmohan, 4<sup>th</sup> edition, Sultan Chand & Sons.
2. Operations Research : S. D. Sharma, 11<sup>th</sup> edition, Kedarnath, Ramnath & Co. .
3. Operations Research : H.A. Taha, 6<sup>th</sup> edition, Prentice Hall of India.

4. Operations Research: V.K. Kapoor, 7<sup>th</sup> edition, Sultan Chand & Sons.
5. Damodar Gujrathi : Basic Econometrics, Second edition McGraw-Hill Companies.
6. Vohra N.D. Quantitative Techniques in Management Third edition McGraw Hill Co.

***SUBJECT (THEORY): STATISTICS***

**CLASS: S.Y.B.A**

**COURSE CODE: SPC.4.01.DS**

**TITLE: DESCRIPTIVE STATISTICS**

**LEARNING OBJECTIVES:**

- 3. To introduce the technique of data collection and its presentation.**
- 4. To emphasize the need for numerical summary measures for data analysis.**

**Total Number of lectures: 45**

UNIT I	<p><b>DATA: TYPES , COLLECTION AND PRESENTATION</b></p> <p>Types of data from a population : Qualitative and Quantitative data; Geographical, Time series data; Discrete and Continuous data, Different types of scales: Nominal, Ordinal, Ratio and Interval. Concepts of statistical population and sample. Primary data- Idea of questionnaire / schedule,with its merits and demerits. Secondary data– its major sources including some government publications. Elementary Categorical Data Analysis Preparation of tables with two or three factors (variable /attributes) of classification. Requisites of a good table. Independence and Association for 2 attributes in a 2 x 2 table using Yule’s coefficient of association. Frequency distribution of discrete and continuous variables. Cumulative frequency distribution.</p> <p>Graphical representation of frequency distribution by Histogram, Frequency polygon, Frequency curve and Ogives. Stem and Leaf display Diagrammatic representation using Bar diagrams and Pie chart.</p>	15 Lectures
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UNIT II	<b>MEASURES OF CENTRAL TENDENCY</b> Arithmetic mean and its properties (simple and weighted), Combined mean. Quantiles (Median, Quartiles, Deciles, Percentiles.) Mode. Empirical relationship between mean, median and mode. Merits, Demerits and Uses of Mean, Median, Mode. Requisites of a good average. Choice of scale of measurement for each measure of central tendency.	15 Lectures
UNIT III	<b>MEASURES OF DISPERSION AND CORRELATION</b> <u>Measures of Dispersion</u> Range, Interquartile Range, Quartile Deviation, Standard Deviation (Variance) and their relative measures. Combined variance. Measures of Skewness and concept of Kurtosis. Box-Whisker Plot. <u>Simple Linear Correlation</u> Bivariate Data, Scatter diagram, Product moment correlation coefficient and its properties. Rank correlation- Spearman's measure.	15 lectures

## REFERENCES

1. Allan Bluman: Introductory Statistics. A step by step approach, 7<sup>th</sup> edition, (2009) McGraw-Hill.
2. Goon, Atindra Mohan; Gupta, Milan Kumar & Dasgupta, Bhagabat: Fundamentals of statistics. [vol. 1] (6th ed.) Calcutta. World Press Private Ltd., 1983.--(519.5GOO)
3. Kothari, C.R.: Research methodology : methods and techniques. (2nd ed. reprint) New Delhi. Wishwa Prakashan, 2004(2011). 81-224-1522-9--(001.422KOT)
4. Spiegel, Murray R. & Stephens, Larry J.: Theory and problems of statistics. (3rd Ed.) New York. McGraw-Hill, 1999. 0-07-116766-8--(519.5076SPI/STE)
5. Mann, Prem S.: Introductory statistics. (2nd ed.) New York. John Wiley & Sons, Inc., 1995. 0-471-31009-3--(519.5MAN)
6. Levin, Richard I.; Rubin, David S.; Siddiqui, Masood H. & Rastogi, Sanjay: Statistics for management. (8th ed.) Noida. Pearson India Education Services Pvt. Ltd, 2017. 978-93-325-8118-0--(519.5024658Lev)
7. R.J.Shah: Descriptive Statistics, Eighth edition, Seth Publications.
8. Gupta, S.P.: Statistical methods. (44th ed.) New Delhi. Sultan Chand & Sons, 2014. 93-5161-028-4--(519.5Gup)
9. Welling, Khandeparkar, Pawar, Naralkar : Descriptive Statistics, Manan Prakashan.
10. [www.actuaries.org.uk](http://www.actuaries.org.uk)

11. [www.actuariesindia.org](http://www.actuariesindia.org)

12. [www.soa.org](http://www.soa.org)

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