

St. Xavier's College (Autonomous),
Mumbai



Syllabus of the courses offered by the
Department of Statistics
(2015-16)



St. Xavier's College – Autonomous
Mumbai

STATISTICS

F.Y.B.Sc

Syllabus
For 1st Semester Courses in
Statistics
(June 2015 onwards)

Contents:

Theory Syllabus for Courses:

S.STA.1.01 – Descriptive Statistics (A)

S.STA.1.02 – Statistical Methods (A)

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

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

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.**

Number of lectures: 45

Unit – 1

Data: Types , Collection and Management. (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.

Unit 2

Presentation of Data. (15 L)

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.

Unit 3

Measures of Central Tendency or Location. (15 L)

Arithmetic mean and its properties (simple and weighted), Combined mean. Geometric mean and Harmonic 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. and H.M.

Requisites of a good average.

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

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 Puplications. 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 (6th edition) John Wiley & Sons.
9. Allan Bluman (2009) Introductory Statistics. A step by step approach (7th edition). McGraw-Hill
10. www.actuaries.org.uk
11. www.actuariesindia.org
12. 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.

Learning Objectives:

To study

1. Concept of probability
2. Probability distribution
3. Testing of hypotheses.

Number of lectures: 45

Unit 1 (15 L)

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

Discrete Random variable: (15 L)

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 their relationship (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

Standard Discrete Probability Distributions: (15 L)

Degenerate distribution, Bernoulli distribution, Binomial Distribution, Poisson

Distribution, Hypergeometric Distribution. Uniform Distribution Derivation of mean, & variance, Calculation of Expected frequencies.

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

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 (6th edition) John Wiley & Sons.
11. Allan Bluman (2009) Introductory Statistics. A step by step approach (7th edition). McGraw-Hill
12. www.actuaries.org.uk
13. www.actuariesindia.org
14. www.soa.org

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



St. Xavier's College – Autonomous Mumbai

F.Y.B.Sc

Syllabus For 2nd Semester Courses in Statistics (June 2015 onwards)

Contents:

Theory Syllabus for Courses:

S.STA.2.01 – Descriptive Statistics (B).

S.STA.2.02 – Statistical Methods (B).

Practical Course Syllabus for: S.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.Sc
(STATISTICS)

SEMESTER 2

COURSE : S.STA.2.01

DESCRIPTIVE STATISTICS (B)

[45 LECTURES]

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

Unit –4 : Absolute and Relative Measures of Dispersion. (15 Lectures)

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 (with proof). Measures of Skewness and Kurtosis
Box-Whisker Plot.

Unit-5 : Analysis of Bivariate Data. (15 Lectures)

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-6 : Index Numbers. (15 Lectures)

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.

List of Practicals:

6. Measures of Dispersion.
7. Skewness and Kurtosis.
8. Correlation Analysis
9. Regression Analysis.
10. Curve fitting by the Method of Least Squares.
11. Index Numbers.

REFERENCES:

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 Puplications. 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 (6th edition) John Wiley & Sons.
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F.Y.B.Sc. STATISTICS

COURSE : S.STA.2.02

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. Expection 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.

(15 L) 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.

6. Continuous Random Variables.
7. Uniform, Exponential Distributions.
8. Normal Distribution
9. Testing of Hypotheses
10. Estimation
11. 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
18. Theory and Problems of Statistics : Spiegel M.R. – Schaums Publishing Series, Tata Mcgraw - Hill. First edition
19. Probability and Statistical Inference : Hogg R.V, Tanis E.P. – Macmillan Publishing Co. Inc.
20. Fundamentals of Mathematical Statistics : S. C. Gupta, V.K.Kapoor – Sultan Chand & Sons. Eleventh edition.
21. Statistical Methods : S.P. Gupta – Sultan Chand & Sons. Thirty third edition.
22. Fundamentals of Statistics , Volume II, - Goon A.M., Gupta M.K., Dasgupta B. – The World Press Pvt. Ltd, Calcutta. Fifth edition.
23. Richard. I. Levin, David .S. Rubin: Statistics for Management Fifth edition
24. Prem . S. Mann (2007) . Introductory Statistics (6th edition) John Wiley & Sons.

25. Allan Bluman (2009) Introductory Statistics. A step by step approach (7th edition).
McGraw-Hill
26. www.actuaries.org.uk
27. www.actuariesindia.org
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St. Xavier's College – Autonomous Mumbai

Syllabus For 3rd Semester Courses in STATISTICS (June 2015 onwards)

Contents:

Theory Syllabus for Courses:

- S.STA.3.01 - Probability and Sampling Distributions (A)
- S.STA.3.02 - Sampling Techniques
- S.STA.3.03 - Operations Research.

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

S.Y.B.Sc. STATISTICS

COURSE : S.STA.3.01

Title: Probability and Sampling distributions (A)

Learning Objectives :

- 1) To understand the patterns in the data of large populations.
- 2) To obtain the central location and dispersion of the data.
- 3) To know the relationship between various distributions.

Number of lectures : 45

Unit 1

Univariate and Bivariate random variables (Discrete and Continuous) (15 L)

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

Standard Univariate Discrete Probability Distributions: (15 L)

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

S. Y. B. Sc. STATISTICS
3.02
Title: Sampling Techniques

Course : S. STA.

Learning Objectives :

1. To understand various sampling techniques.
2. To apply these techniques in real life situation.
3. Comparison of sampling techniques.

Number of lectures: 45

Unit 1

Concepts of sample survey

(15 L)

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

Census and Sample Surveys

Sampling and Non sampling errors.

Concepts of Probability and non-probability sampling.

Introduction to Simple Random Sampling(Use of Lottery Method, Random numbers and Pseudo random numbers), Stratified Random Sampling, Systematic Sampling, Cluster Sampling, Two Stage Sampling
NSSO, CSO and their functions

Unit 2

Simple Random Sampling (with and without replacement): (15L)

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 3

Stratified Random Sampling

(15L)

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)

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

List of Recommended References books:

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

List of Practicals:

1. Simple Random Sampling for variables.
2. Simple Random Sampling for attributes.
3. Estimation of sample size in SRS.
4. Confidence limits in SRS.
5. Ratio and Regression methods of Estimation.
6. Stratified Random Sampling.

S.Y.B.Sc. STATISTICS
Title: Operations Research

COURSE : S.STA.3.03

LEARNING OBJECTIVES :

- 1) **To learn mathematical formulation of real life situations.**
- 2) **To study methods to solve the formulated problems.**
- 3) **To learn the applications of Operations Research in industry.**

Number of lectures: 45

Unit 1

Linear Programming Problem (L.P.P.) : (15 L)

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

Concept of Duality & its economic interpretation

Unit 2

Transportation Model (15 L)

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

Initial Basic Feasible Solution using

(i) North-West Corner rule.

(ii) Matrix Minima Method.

(iii) Vogel's Approximation Method.

MODI Method for optimality.

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

Unbalanced Transportation problem.

Assignment model

Definition, Mathematical formulation. Solution by Hungarian Method.

Unbalanced Assignment problems.

Problems involving Maximization & prohibited assignments.

Unit 3

Decision Theory. (15 L)

Decision making under uncertainty Laplace criterion, Maximax (Minimin) criterion, Maximin (Minimax) criterion, Hurwicz α criterion, Minimax Regret criterion.

Decision making under risk: Expected Monetary value criterion, Expected Opportunity Loss Criterion, EPPL, EVPI. Decision trees (with posterior probabilities).

List of Recommended Reference books:

1. Operations Research : Kantiswaroop, P.K. Gupta and Manmohan, 4th edition, Sultan Chand & Sons.
2. Operations Research : S. D. Sharma, 11th edition, Kedarnath, Ramnath & Co. .
3. Operations Research : H.A. Taha, 6th edition, Prentice Hall of India.
4. Operations Research: V.K. Kapoor, 7th edition, Sultan Chand & Sons.

List of Practicals.

1. L.P.P..
2. Transportation Problem.
3. Assignment Problem.
4. Decision Theory.



St. Xavier's College – Autonomous Mumbai

Syllabus For 4th Semester Courses in **STATISTICS** (June 2015 onwards)

Contents:

Theory Syllabus for Courses:

S.STA.4.01 - Probability and Sampling Distributions (B)

S.STA.4.02 – Analysis of variance & Design of Experiment

S.STA.4.03 – Industrial Statistics

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

S.Y.B.Sc
(STATISTICS)

SEMESTER 4

COURSE : S.STA.4.01

PROBABILITY & SAMPLING DISTRIBUTIONS (B) [45
LECTURES]

LEARNING OBJECTIVE :

- 4) **To understand the patterns in the data of large populations.**
- 5) **To obtain the central location and dispersion of the data.**
- 6) **To know the relationship between various distributions.**

Unit 1

Transformation of random variables. (15 L)

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 L)

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 independence of attributes (2x2 and r x c contingency tables without derivation of the test statistic), Yate's correction. Test for Goodness of Fit.

Unit 3

t-distribution : (15L)

Definition of Student's t-statistic. Derivation of its density function. Moments . Asymptotic property (without proof).

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.

F-distribution :

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

List of Recommended Reference books

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

List of Practicals

1. Normal Distribution.
2. Chi-Square Distribution.
3. t-Distribution.
4. F-Distribution.

S.Y.B.Sc
(STATISTICS)

SEMESTER 4

COURSE : S.STA.4.02.

Analysis of Variance & Design of Experiments

[45

LECTURES]

LEARNING OBJECTIVES :

- 7) **To introduce and apply the techniques and methodology available for designing and analysis of experiments.**
- 8) **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, 3rd edition, Sultan Chand & Sons.
2. Designs and Analysis of Experiments : M. N. Das and N.C. Giri 2nd edition, Wiley Eastern Ltd.
3. Designs and Analysis of Experiments : D.C. Montgomery, 6th edition, Wiley Eastern Ltd.
4. Applied Multivariate Analysis and Experimental Designs: N. Krishnan Namboodiri, Lewis F. Carter. Hubert M. Blalock. JR., 1st edition, McGraw –Hill, Inc.
5. Experimental Designs : William G. Cochran, Gertrude M. Cox, 2nd edition, Bombay, Asia Publishing House.
6. The Design of Experiments : Sir Ronald A. Fisher, 9th edition, Collier Macmillan Publishers.

S.Y.B.Sc
(STATISTICS)

SEMESTER 4

COURSE : S.STA.4.03

INDUSTRIAL STATISTICS.

[45 LECTURES

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LEARNING OBJECTIVES :

- 1) To learn the applications of operations research in industry.**
- 2) To plan and schedule projects.**
- 3) To study quality control methods in industrie**

Unit 1.

Statistical Quality Control

(15L)

Introduction, Assignable causes, Chance causes, Process control, Product control, Shewhart's control charts, 3σ Limits.

X and R, p, c, np charts, their uses, p-chart with variable sample size, Problems involving setting up standards for future use. Process capability.

Unit 2

Acceptance Sampling

(15L)

Introduction to Lot Acceptance Sampling Plans by Attributes. Consumers Risk, Producers Risk. Single and Double Sampling Plans : OC function and OC curves, AQL, LTPD, ASN, ATI, AOQ. Concept of 6σ limits.

Unit 3.

CPM and PERT:

(15L)

Introduction, Basic concepts of network analysis

Definitions : Activity, Event, Dummy activity, Predecessor and successor activities and events.

Rules for drawing network, Fulkerson's Rule.

Bar Diagram (Gantt Chart) and Network Diagram. Slack time and Float times. Critical path

Method (CPM), Project evaluation review technique (PERT).

Project cost analysis, Updating, Resource Leveling, Resource Allocation

Topics for Practicals.

- 1. Statistical Quality Control.**
- 2. Acceptance Sampling.**
- 3. Network Analysis.**

List of Recommended Reference books

1. Statistical Quality Control : E.L.Grant., 2nd edition, McGraw-Hill Publishers.
2. Quality Control and Industrial Statistics : Duncan D.B. , 3rd edition, Taraporwala Sons & Co.
3. PERT and CPM Principles and Applications : Srinath, 2nd edition, East West Press Pvt Ltd.
4. Operations Research : Kantiswaroop, P.K. Gupta and Manmohan, 4th edition, Sultan Chand & Sons.
5. Operations Research : S. D. Sharma, 11th edition, Kedarnath, Ramnath & Co. .
6. Operations Research : H.A. Taha, 6th edition, Prentice Hall of India.
7. Operations Research: V.K. Kapoor, 7th edition, Sultan Chand & Sons.



St. Xavier's College – Autonomous Mumbai

T.Y.B.Sc

Syllabus For 5th Semester Courses in STATISTICS (June 2015 onwards)

Contents:

Theory Syllabus for Courses:

S.STA.5.01 – Probability Theory

S.STA.5.02 – Statistical Estimation

S.STA.5.03 – Applied Statistics (IA)

S.STA.5.04 - Applied Statistics (IIA)

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

T.Y. B.Sc. Statistics
S.STA.5.01

Course:

Title: Probability Theory

Learning Objectives :

9) To strengthen their concepts in mathematical statistics.

10) To prepare students to develop their own models.

Number of lectures: 60

Unit 1 **(15L)**

Probability(A)

Theorems on Probability of realization of (i) at least one. (ii) exactly m
(iii) atleast m events out of N events $A_1, A_2, A_3, \dots, A_N$.

Maxwell Boltzmann, Bose Einstein and Fermi Dirac statistics

Ordered samples and Runs.

Matching and guessing problems.

Unit 2 **(15L)**

Probability (B)

Conditional probability and application of Bayes' theorem

Urn Model probability

Chebychev's theorem, Chebychev's inequality.

Unit 3 **(15L)**

Generating Functions

Definitions of generating function and probability generating function. Expression for mean and variance in terms of generating functions. Definition of a convolution of two or more sequences. Generating function of a convolution. Generating functions of the standard discrete distributions. Relation between.

i) Bernoulli and Binomial distributions.

ii) Geometric and Negative Binomial distributions in terms of convolutions.

Generating function of compound distribution

Unit 4 **(15L)**

Order Statistics

Definition of the order statistics for a random sample of size n from a continuous distribution. Derivation of the distribution function and hence the probability density function of the n^{th} order statistic.

Joint p.d.f. of the i^{th} and j^{th} order statistics. Joint p.d.f. of all n order statistics. Correlations coefficient between the i^{th} and j^{th} order statistics of the uniform distribution.

Distribution of range and median (n odd) for the Uniform and Exponential distribution.

List Of Recommended Reference Books

1. Feller W. An Introduction to Probability Theory and its Applications. Vol I. Third edition.
2. Alexander M Mood , Franklin A Graybill , Duane C. Boes : Introduction to theory of statistics , Third edition , Mcgraw-Hill Series
3. Hogg R.V. and Craig A.T. : Introduction to Mathematical Statistics.
4. Hogg R.V. and Tanis E.A : Probability and Statistical Inference.
5. S. C Gupta & V K Kapoor : Fundamentals of mathematical statistics, Eleventh edition , Sultan Chand & Sons

Topics For Practicals

1. Probability.
2. Generating Function.
3. Order statistics.

Title: Statistical Estimation

Learning Objective :

To empower students with methods of estimation and inference in order to predict future trends on the basis of current data, with enhanced precision.

Number of lectures: 60

Unit 1. (15L)

Point Estimation

General problem of estimation. Definition of a statistic, estimator & estimate. Properties of a good estimator. Unbiasedness, Consistency, Efficient estimator. Minimum variance unbiased Estimator (MVUE). Relative efficiency, Uniqueness of MVUE if it exists.. Cramer-Rao inequality. Definition of an efficient estimator using CRLB. Definition of a sufficient statistic, Statement of Neyman's factorization theorem.

Unit 2. (15L)

Methods Of Estimation

Method of maximum likelihood estimation Properties of maximum likelihoods estimators
Method of moments.
Method of minimum chi-square. Method of modified minimum chi-square.

Unit 3 (15L)

Bayesian Estimation

Prior distribution. Posterior distribution. Loss function Risk function. Bayes' solution under squared error and Absolute error loss function.

Unit 4. (15L)

Interval Estimation

Concept of confidence interval and confidence limits. Definition of pivotal quantity and its uses in obtaining confidence intervals

Derivation of $100(1-\alpha)\%$ equal tailed confidence intervals for

- (i) single population mean & proportion
- (ii) difference of two population means and proportions
- (iii) population variance
- (iv) ratio of population variances of normal distribution
(based on large and small samples)

Confidence intervals based on asymptotic properties of maximum likelihood estimators for Poisson and Exponential distribution

List Of Recommended Reference Books

1. Hogg R.V. and Craig A.T. : Introduction to Mathematical Statistics. (Macmillan Publishing Co.)
2. Hogg R.V. and Tanis E.A : Probability and Statistical Inference. (Macmillan Publishing Co)
3. Rohatgi V.K. : Statistical Inference. John Wiley
4. S C Gupta & V K Kapoor : Fundamentals of mathematical statistics, Eleventh edition , Sultan Chand & Sons
5. Alexander M Mood , Franklin A Graybill , Duane C. Boes : Introduction to theory of statistics , Third edition , Mcgraw-Hill Series
6. Parimal Mukhopadhyay : Mathematical Statistics, Second edition, Books and Allied (P) Ltd.

Topics For Practicals

1. Method of maximum likelihood estimation.
2. Method of Moments.
3. Method of modified minimum Chi-square.
4. Bayesian estimation.
5. Interval estimation.

Title: Applied Statistics (I A)

Learning Objective :
To apply Statistics to the Biological Sciences.

Number of lectures: 60

Unit 1. (15L)

Epidemic Methods

The features of an epidemic.

Definitions of various terms.

Definition of deterministic and stochastic models.

Deterministic models with and without removals (for 'a' introductions) along with threshold theorem. Carrier model. Host-vector model. Chain binomial models. Reed-Frost and Greenwood models. Distribution of individual chains and total number of cases. Maximum likelihood estimator of p and its asymptotic variance for the households of size upto 4.

Unit 2. (15L)

Bioassays

Meaning and scope of bioassays. Basic terms. Direct assays. Fieller's theorem. Indirect assays. Conditions of similarity monotony and linearity. Linearizing transformation for Parallel line and slope ratio assays.

Definitions – Symmetric and unsymmetric parallel line assays.

Symmetrical 2K-point parallel line assays ($k=2,3$), using orthogonal contrasts.

Quantal assays, ED50 and LD 50. Probit analysis.

Unit 3. (15L)

Clinical Trials – I

Introduction to clinical trials : The need and ethics of clinical trials.

Overview of phases (I – IV). Common terminology used in clinical trials.

Study protocol, case record/report form/blinding (single/double).

Randomized control (placebo/active control).

Study designs (parallel, cross over).

Type of trials : inferiority, superiority and equivalence. Multicentric trial.

Inclusion/exclusion criteria.

Estimation of sample size (for specified power) for the following cases

- i) Single population mean
- ii) Single population proportion
- iii) Difference of two population means
- iv) Difference of two population proportions

Unit 4.**Clinical Trials - II**

Statistical tools : Analysis of parallel design using analysis of variance.

Concepts of Odd's Ratio.

Statistics in Bioequivalence Studies: Introduction to Bioequivalence studies

Commonly used designs in BE studies.

Estimation of Pharmacokinetic Parametres :

Cmax, Tmax and Area Under Curve (AUC)

Analysis of Variance for parallel and non replicated cross over design.

Ratio Analysis.

90% Confidence Interval and Bioequivalence Criteria

List Of Recommended Reference Books

1. Bailey N.T.J. : The mathematical theory of Infectious Diseases, Second edition, Charles Griffin and Co. Ltd. London.
2. Das M.N. and Giri N.C. : Design and Analysis of Experiments. Second edition, Wiley Eastern .
3. Finney D.J. : Statistical methods in Biological Assays. First edition, Charles Griffin and Co. Ltd. London.
4. Sanford Boltan and Charles Bon : Pharmaceutical statistics, Fourth edition, Marcel Dekker Inc.
5. Zar Jerrold H. : Biostatistical Analysis , Fourth edition, Pearson's education.
6. Friedman L. M., Furburg. C., Demets D. L. : Fundamentals of clinical trials, First edition (1998) . Springer Verlag.
7. Fleiss J.L. : Design and Analysis of Clinical experiments, Second edition (1989), Wiley and Sons.
8. Glenwalker : Common Statistical Methods.
9. Shein-Chung-Chow : Design and analysis of Bioavailability and Bioequivalence studies, 3rd edition, Chapman & Hall / CRC BioStatistics series.
10. Daniel Wayne W : Biostatistics- A foundation for analysis in the health sciences 7th edition, Wiley Series in Probability and Statistics.

TOPICS FOR PRACTICALS

1. Epidemics
2. Bio Assays
3. Clinical Trials

Title: Applied Statistics (IIA)

Learning Objective :
To apply Statistics to the Insurance industry.

Number of lectures: 60

Unit 1. (15L)

Mortality Tables:

Various mortality functions. Probabilities of living and dying. The force of mortality. Estimation of μ_x from the mortality table. Laws of mortality: Gompertz's and Makeham's first law. Select and ultimate mortality table. Mortality table as a population model. Stationary population. Stable population Expectation of life and Average life at death. Central death rate.

Unit 2. (20L)

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.
- (iii) annuity with frequency different from that with which interest is convertible.

Redemption of Loan.

Unit 3 (10L)

Life Annuities:

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).

Unit 4

Assurance Benefits:

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
2. Annuities
3. Life annuities
4. Assurance benefits



St. Xavier's College – Autonomous Mumbai

T.Y.B.Sc

Syllabus For 6th Semester Courses in **STATISTICS** (June 2015 onwards)

Contents:

Theory Syllabus for Courses:

S.STA.6.01 – Probability Distributions and Stochastic Processes.

S.STA.6.02 – Statistical Inference.

S.STA.6.03 – Applied Statistics (I B)

S.STA.6.04 - Applied Statistics (II B)

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

T.Y.B.Sc
(STATISTICS)

SEMESTER 6

COURSE : S.STA.6.01

PROBABILITY DISTRIBUTIONS AND STOCHASTIC PROCESSES

[60
LECTURES]

LEARNING OBJECTIVES :

- 11) To strengthen their concepts in mathematical statistics.**
- 12) To prepare students to develop stochastic and queueing models.**

UNIT 1 BIVARIATE DISTRIBUTIONS :

i) Definition and properties of Moment Generating Function of two random variables of continuous and discrete type. Necessary and sufficient condition for independence of two random variables.

ii) Trinomial distribution:

Definition of joint probability distribution (X,Y). Joint moment generating function, moments μ_{rs} where $r = 0,1,2$ and $s = 0,1,2$

Marginal & conditional distributions. Their Means & Variances.

Correlation coefficient between the random variables.
Distribution of the Sum X+Y.

iii) Multinomial distribution:

Definition of joint probability distribution with parameters $(n, p_1, p_2, \dots, p_{k-1})$ where $p_1 + p_2 + \dots + p_{k-1} + p_k = 1$.

Other properties (Concept only)

UNIT 2 BIVARIATE NORMAL DISTRIBUTIONS :

Definition of joint probability distribution (X,Y). Joint moment generating function, moments μ_{rs} where $r = 0,1,2$ and $s = 0,1,2$

Marginal & conditional distributions. Their Means & Variances.

Correlation coefficient between the random variables. Condition for the independence of X and Y.
Distribution of $aX+bY$, where a and b are constants.

SIGNIFICANCE OF CORRELATION COEFFICIENT :

Distribution of sample correlation coefficient when $\rho = 0$. Testing the significance of a correlation coefficient.

Fisher's z – transformation. tests for

i) $H_0 : \rho = \rho_0$ and ii) $H_0 : \rho_1 = \rho_2$. Confidence interval for ρ .

UNIT 3 STOCHASTIC PROCESSES :

Definition of stochastic process. Postulates and difference differential equations for the i) Poisson process ii) Pure birth process iii) Yule's process iv) Pure death process v) **Poisson type of death process** vi) **Yule's type / Linear Markovian death process** vii) Birth and death process viii)

Linear growth model.

Derivation of $P_n(t)$, mean and variance wherever applicable.

UNIT 4 QUEUEING THEORY

Basic elements of the Queueing model. Roles of the Poisson and Exponential distributions.

Derivation of Steady state probabilities for the birth and death process.

Steady state probabilities and the various average characteristics for the following models

i) (M/M/1) : (GD/ ∞ / ∞) ii) (M/M/1) : (GD/ N / ∞)

iii) (M/M/c) : (GD/ ∞ / ∞) iv) (M/M/c) : (GD/ N / ∞)

v) (M/M/c) : (GD/ N / N) $c < N$ vi) (M/M/ ∞) : (GD/ ∞ / ∞)

Derivation of the waiting time distribution for the (M/M/1):(FCFS/ ∞/∞) model

TOPICS FOR PRACTICALS:

| Ser. No. | Topic |
|----------|---|
| 1. | Trinomial & Multinomial distributions |
| 2. | Bivariate Normal distribution |
| 3. | Significance of correlation coefficient |
| 4. | Stochastic processes |
| 5. | Queueing theory |

REFERENCES:

1. Feller W: An introduction to probability theory and its applications, Volume:1, Third edition, Wiley Eastern Limited.
2. Robert V. Hogg & Allen T. Craig: Introduction to Mathematical Statistics, Fifth edition, Pearson Education Pvt Ltd.
3. Alexander M Mood, Franklin A Graybill, Duane C. Boes: Introduction to the theory of statistics, Third edition , McGraw- Hill Series .
4. Hogg R. V. and Tanis E.A. Probability and Statistical Inference Fourth edition McMillan Publishing Company
5. S C Gupta & V K Kapoor: Fundamentals of Mathematical statistics, eleventh edition, Sultan Chand & Sons.
6. Taha H.A. Operations Research Mcmillan Publishing Co.
7. Kantiswaroop , P.K Gupta and Manmohan, Fourth edition, Sultan Chand & Sons.
8. Vohra N.D. Quantitative Techniques in Management Third edition McGraw Hill Companies
9. J Medhi: Stochastic Processes, Second edition, Wiley Eastern Ltd.
10. Biswas S. Topics in Statistical Methodology Wiley Eastern Ltd.
11. J. N. Kapur, H. C. Saxena Mathematical Statistics Fifteenth edition S. Chand and Company

T.Y.B.Sc

(STATISTICS)

SEMESTER 6

COURSE : S.STA.6.02

STATISTICAL INFERENCE

[60 LECTURES]

LEARNING OBJECTIVE : To empower students to validate assumptions made on population parameters.

- Unit 1** **TESTING OF HYPOTHESIS:** (15L)
Statistical hypothesis. Problem of testing of hypothesis. Definitions and illustrations of i) Simple hypothesis ii) Composite hypothesis iii) Null Hypothesis iv) Alternative Hypothesis v) Test of hypothesis vi) Critical region vii) Type I and Type II errors viii) Level of significance ix) p-value x) size of the test xi) Power of the test xii) Power function of a test xiii) Power curve.
Definition of most powerful test of size α for a simple hypothesis against a simple alternative hypothesis. Neyman – Pearson fundamental lemma. Definition of uniformly most powerful (UMP) test. Construction of UMP test for one tailed alternative hypothesis.
- Unit 2** **LIKELIHOOD RATIO TEST:** (15L)
Likelihood ratio principle. Definition of the test statistic and its asymptotic distribution (statement only) Derivation of the test procedure for testing a composite hypothesis against a composite alternative hypothesis for the parameters μ and σ^2 of Normal distribution.
- Unit 3** **NON PARAMETRIC TESTS:** (15L)
Need for non parametric tests. Distinction between a parametric and a non parametric test .Concept of a distribution free statistic. Confidence interval for a quantile. Single sample and double sample nonparametric tests. i) Sign test ii) Wilcoxon’s signed rank test.iii) Median test iv) Mann – Whitney – Wilcoxon test.v) Run test. Assumptions, justification of the test procedure, critical regions for one tailed and two tailed test procedures. Calculation of exact probabilities of the test statistic for small samples. Problems with no ties.
- Unit4** **SEQUENTIAL PROBABILITY RATIO TEST:** (15L)
Sequential probability ratio test procedures for testing a simple null hypothesis against a simple alternative hypothesis. Its comparison with fixed sample size. Neyman- Pearson test procedure. Definition of Wald’s SPRT of strength (α, β) . Problems based on standard distributions such as Bernoulli , Poisson, Normal, Exponential . Graphical and tabular procedures for

carrying out the tests. O.C function and A.S.N function and their respective curves.

TOPICS FOR PRACTICALS:

- Testing of Hypotheses.
- Likelihood Ratio Tests.
- Non Parametric Tests.
- Sequential Probability Ratio Test.

REFERENCES:

1. Hogg R.V. and Craig A.T: Introduction to Mathematical Statistics Fourth edition London Macmillan Co. Ltd.
2. Hogg R.V. and Tanis E.A.: Probability and Statistical Inference. Third edition Delhi Pearson Education.
3. Daniel W.W. : Applied Non Parametric Statistics First edition Boston-Houghton Mifflin Company
4. Sidney Siegal, N. John Castelian Jr. Nonparametric Statistics For Behavioral Sciences , Second edition McGraw Hill International editions
5. Wald A.: Sequential Analysis First edition New York John Wiley & Sons
6. Biswas S.: Topics in Statistical Methodology. First edition New Delhi Wiley eastern Ltd.
7. Gupta S.C. and Kapoor V.K.: Fundamentals of Mathematical Statistics Tenth edition New Delhi S. Chand & Company Ltd.

T.Y.B.Sc (STATISTICS)

SEMESTER 6

COURSE : S.STA.6.03

APPLIED STATISTICS (I B)

[60 LECTURES]

LEARNING OBJECTIVE : To orient students on various applications of Statistics in industry.

Unit 1 INVENTORY CONTROL :

15L

Deterministic Models:

Single item static EOQ models for i) Constant rate of demand with instantaneous replenishment, with and without shortages.

ii) Constant rate of demand with uniform rate of replenishment, with and

without shortages. iii) Constant rate of demand with instantaneous replenishment without shortages, with at most two price breaks.

| | | |
|---------------|--|------------|
| Unit 2 | <u>INVENTORY CONTROL :</u> <u>Probabilistic models. :</u> Single period with i) Instantaneous demand (discrete and continuous) without setup cost. ii) Uniform demand (discrete and continuous) without set up cost. | <i>15L</i> |
| Unit 3 | <u>REPLACEMENT THEORY:</u> Replacement of items that deteriorate with time and the value of money: i) remains constant ii) changes with time (weighted average of costs method). Replacement of items that fail completely. Individual replacement and Group replacement policies. | <i>15L</i> |
| Unit 4 | <u>GAME THEORY :</u> 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. <u>SIMULATION:</u> 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 Queueing models. | <i>15L</i> |

TOPICS FOR PRACTICALS:

- Deterministic inventory models.
- Probabilistic inventory models.
- Replacement Theory.
- Game Theory.
- Simulation.

REFERENCES:

1. Sharma J. K. : Operations Research Theory and Application, Third edition, Macmillan India Ltd.
2. Sharma S.D. : Operations Research. Eleventh edition, Kedarnath, Ramnath & Co.
3. Kantiswaroop , P.K Gupta and Manmohan, Fourth edition, Sultan Chand & Sons.
4. V.K. Kapoor. Operations Research.-Techniques for Management. Seventh edition, Sultan Chand & Sons Educational Publishers New Delhi.
5. Taha H.A. Operations Research, Sixth edition, Prentice Hall of India Pvt Ltd.
6. Vohra N.D. Quantitative Techniques in Management Third edition McGraw Hill Companies
7. Bannerjee B. Operation Research Techniques, Second edition, Mumbai Business Books.
8. Bronson R. Operations Research , Shaum's Outline series

T.Y.B.Sc
(STATISTICS)

SEMESTER 6

COURSE : S.STA.6.04

APPLIED STATISTICS (II B)

[60 LECTURES]

LEARNING OBJECTIVE : To enable students to develop the technique of model building

- | | | |
|---------------|---|-----|
| Unit 1 | <p><u>MULTIPLE LINEAR REGRESSION – I :</u></p> <p>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 multiple correlation, partial correlation, R^2 and adjusted R^2. Properties of multiple and partial correlation coefficients. Testing the significance of multiple and partial correlation coefficients. 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</p> | 15L |
| Unit 2 | <p><u>MULTIPLE LINEAR REGRESSION – II :</u></p> <p><u>Autocorrelation:</u> Concept, Detection using i) Run Test ii) Durbin Watson Test, Consequences of using OLS estimators in presence of autocorrelation, Generalized least square (GLS) method. <u>Heteroscedasticity:</u> Concept, Detection using i) Spearman's rank</p> | 15L |

correlation test ii) Breusch – Pagan – Godfrey Test. Consequences of using OLS estimators in presence of heteroscedasticity Weighted least square (WLS) estimators

Multicollinearity: Concept, Detection using R square & t ratios, simple correlation coefficients, Variance Inflation Factor (VIF) Consequences of using OLS estimators in presence of multi collinearity.

Unit 3 **TIME SERIES:** 15L

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

Unit 4 **RELIABILITY:** 15L

Concept of reliability, Hazard-rate.
Failure time distributions :i) Exponential ii) Gamma iii) Weibull iv) Gumbel. Definitions of increasing (decreasing) failure rate.
System Reliability Reliability of i)series ii) parallel system of independent components having exponential life distributions.
Mean Time to Failure of a system (MTTF).

TOPICS FOR PRACTICALS:

- Multiple regression model.
- Autocorrelation, Heteroscedasticity, Multicollinearity.
- Time series..
- Reliability.

REFERENCES:

4. S.C.G upta , V.K.Kapoor : Fundamentals of Applied Statistics, Third edition, Sultan Chand & Sons.

5. Barlow R.E. and Prochan Frank.: Statistical Theory of Reliability and Life Testing, First edition, John Wiley & Sons
6. Mann N.R., Schafer R.E., Singapurwalla N.D. : Methods for Statistical Analysis of Reliability and Life Data., First edition, Wiley International
7. Damodar Gujrathi : Basic Econometrics, Second edition McGraw-Hill Companies.
8. S.M.Ross: Probability Models & Applications.
9. A.M.Goon, M.K.Gupta, B.Dasgupta: Fundamentals of Statistics, Vol Two, Fifth Revised edition, The World Press Pvt Ltd.



St. Xavier's College – Autonomous
Mumbai
SYBSc

Syllabus for Scientific Communication Skills (Statistics)
3rd Semester
(June 2011 onwards)

Contents:

Syllabus for Courses: SSTA03SCS

Learning Objectives:

The course enables students to:

1. Be knowledgeable of various aspects of scientific communication.
2. Convey the importance of scientific communication and its various modes like precis, journal paper and scientific presentation.
3. Introduce students to the historical and philosophical aspects of science so that they can critically reflect on the topic to be communicated, and overcome objections, tackle reviews etc.

Number of lectures: 12 Lectures

| | Sessions | Plan | Tutor |
|-----------|---|--|--|
| 1. | Introduction | Relevance of Communication Skills (CS), Overview of course Emphasize various aspects of CS Listening, Reading, Comprehension, Summarization, Group Discussion, Speaking | SXC dept faculty/ invitee |
| 2 | Listening, Reading and Comprehension Aim: To teach students to write without reproducing all that was said ad-verbatim | a) Talk for 10-15 minutes by teacher on any topic. Students don't take notes. At the end of 10 minutes, students given time to write what they recall and understand. b) Students should read the photocopies of 2-3 pages of matter provided for 10 minutes. Then through memory write what they recall and understand. c) Show a 10-15 min film clip. Students to be asked to write what they recalled and understood after the clip. d) Random selections of student writings to be read out in class and discussed | SXC dept faculty / invitee Matter used for the exercise could be decided by each dept Chiefly Memory- based |
| 3 | Comprehension & Writing a summary | a) Staff member to give input for 10 -15 minutes on how to write a summary/précis. b) Groups of 3-4 students to be given a chapter from a book/science article/science magazine/journal. c) Convert the given material into a small report. | SXC dept Faculty / invitee Shift from memory – based |

| | | | |
|---|--|--|-------------------------------------|
| | | <p>d] Groups of 3-4 students with each individual of a group having a different type of material. Individual student completes his summary and then exchanges his material with next person in the group. All in one group separately write 3 different summaries. Then they compare each summary with group members and finalize a new consensus summary.</p> <p>Whole class – All groups could be given the same set of 3 articles</p> <p>OR</p> <p>2 different sets of 3 articles could be prepared and distributed randomly.</p> | to understanding –dependent writing |
| 4 | Reading a simple research paper | <p>a] Why and How to read a paper?</p> <p>b] Explain the general format of a paper i.e. Introduction, Method, Results & Discussion, Conclusion.</p> <p>c] What to look for while summarizing a paper / How to select salient features in a paper.</p> <p>d] Students given a Paper / Article to read and understand.</p> <p>e] Students to summarize/ pointwise listing of key features.</p> | SXC dept faculty/invitee |
| 5 | Writing an Abstract | <p>a] Staff to explain the structure of an abstract and the points to remember while writing an abstract</p> <p>b] Recognize good and bad abstracts based on the above information- students to be provided with good & bad abstract samples in sets of 3. Groups + Individual work in group + Sharing of conclusions in group + Teacher conducting general discussion on the positives and negatives of each abstract</p> <p>c] Make a summary of the paper read in the previous session and it could be converted into an abstract.</p> <p>d] Compare and understand the difference between summary and abstract</p> | SXC dept faculty/invitee |
| | | | |

| | | | |
|---|----------------------------------|---|---|
| 6 | Evaluation & Feedback | <p>Evaluation Options:</p> <p>a) Provide a scientific paper and ask for an abstract to be written</p> <p>b) Give article and let the salient features be written in abstract format</p> <p>c) Provide a 3 - 4 page article from a Research journal/ Science magazine and students will write a 1-page summary of it.</p> <p>d) Any other approach could be suggested for example: Recognize good and bad abstracts and write a report/news article/abstract</p> <p>Feedback : A questionnaire will have to be prepared and circulated before the start of the evaluation / after they complete the evaluation</p> | <p>SXC Dept faculty</p> <p>A questionnaire to be created by coordinators of the course.</p> |
|---|----------------------------------|---|---|

References:

Selected Reads from the following:

1. Laudan: From theory to research traditions.
2. Thomas Kuhn on Scientific Revolutions.
3. Rationalism vs Empiricism, Realism, Idealism and other topics using the Stanford Encyclopaedia of Philosophy.
4. Positivism and Pauperian logic vs Logical Positivism vs Hermeneutics.
5. Rosenberg on Explanation, Causation and Laws.
6. Review of select scientific papers and manual of style for citations.



St. Xavier's College – Autonomous
Mumbai
SYBSc

Syllabus for Scientific Communication Skills (Statistics)

4th Semester

(June 2011 onwards)

Contents:

Syllabus for Courses: SSTA04SCS

Learning objectives:

The course enables students to understand:

1. The development and communication of science as a team activity.
2. Scientific communication as a vehicle of dissemination of rational thinking

Number of lectures: 12 Lectures

| Sr. No. | Sessions | Plan | Tutor |
|----------------|---|---|---|
| 1. | Recap of semester 3 & Types and Structure of Scientific Writings | a) Explain the various types of scientific writings: Papers, Reviews, Short communications, Articles for newspapers, Popular science writing, Chapters in textbook, etc. b) Discuss in detail the structure of science paper using different journals in your subject c) Exercise: Students to be given papers to work on in group and asked to list all points discussed in (b) | Faculty member of the Dept/ an invited expert. |
| 2 | Writing: The 'How to of writing' | a) Teacher input on the rules for: Text, figures, graphs, tables, etc. Example - Punctuation, Location Legends, Details etc b) How to write a title? How to write an introduction? Example - Give photocopies of a paper (excluding the title and introduction) Ask students to: <ul style="list-style-type: none"> • Formulate the title of the paper • Prepare an introduction i.e. list the points they would like to cover in the introduction. c) How to write a bibliography? Teacher input regarding different styles of reference writing and the variation for books, journals etc. | Faculty member of the Dept/ an invited expert. The Matter used for the exercise could be decided by the Dept/ expert |

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| | | <p>Example - Students to write names of 5 text books/ reference books they normally use as if they were writing for the bibliography of their paper. Get 4 – 5 science magazines, let students pick an article in each and write it as a reference</p> <p>d) How to gather information?</p> <ul style="list-style-type: none"> • Literature survey from magazines, journals (letters/short communication/ abstracts/ articles/reviews) • What are good journals/authentic sites? • Search engines <p>Example – As Homework - Give a topic (maybe their assignment topic), Student collects information...Number of references in each of the following categories: Books, Papers, Reviews...</p> | |
| 3. | Writing | <p>a) 10 – 15 minutes staff input on how to write a paper/article.</p> <p>b) Groups of 3 – 4 students given papers maybe in study pack/asked to get papers in previous session and asked to read them.</p> <p>c) Create a new paper using the reference papers provided/ collected for their project etc:</p> <ul style="list-style-type: none"> • Start with creating a title. • Write an introduction of 2 pages • Group presentation <p>d) Writing the result. Teacher provides data/student project data.</p> <p>e) Students complete paper and submit to the teacher</p> | |
| 4. | Writing a simple research paper/article | <p>a) Teacher discusses all positives and negatives of all submitted papers.</p> | SXC Department faculty/Invitee. |

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| | | <p>b) Student revise papers keeping in mind the suggestions of the teacher.</p> <p>c) Teacher explains how to make PPT of the paper, (how many slides/what to write on ppt/what to say verbally, time per slide etc)</p> | Students given 2 weeks to get their revised papers and the corresponding ppt ready. |
| 5. | PPT Presentation | Practice presentation by 4 – 5 students, randomly selected; evaluation and discussion of positives and negatives | SXC Department Faculty/Invitee (Could be a short session of 45 minutes) |
| 6. | Evaluation & Feedback | <p>Evaluation:</p> <ul style="list-style-type: none"> • A fifteen minute presentation by each group. • Ten minutes for Q & A. <p>Feedback: A questionnaire will have to be prepared and circulated before the start of the evaluation/after they complete the evaluation.</p> | <p>SXC Department Faculty</p> <p>Presentations will have to be spread over 2 weeks.</p> <p>A questionnaire to be created by coordinators of the course.</p> |
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Course Outcomes

1. Students are familiarised with scientific method and have gained competence in using online scientific resources. (Relevant papers from research databases like Science Direct and JSTOR)
2. Students have gained competence in using offline scientific resources like Journal of Indian Statistical Association (JISA), Journal of Statistical Theory & Applications (JSTA) etc.
3. Students have developed insights on various analytical techniques that the scientific method relies on, most critically, deductive reasoning and inductive logic.
4. Students have enhanced their skills for developing concept notes and writing research papers using appropriate methods of referencing.

References:

Selected Reads from the following:

1. Thomas Kuhn on Scientific Revolutions,
2. Rationalism vs Empiricism, Realism, Idealism and other topics using the Stanford Encyclopaedia of Philosophy.
3. Positivism and Pauperian logic vs Logical Positivism vs Hermeneutics.
4. Rosenberg on Explanation, Causation and Laws.
5. Review of select scientific papers and manual of style for citations.

