



# St. Xavier's College – Autonomous Mumbai

## S.Y.B.Sc Syllabus For 3<sup>rd</sup> 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 Function, 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 : 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.

### **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.

**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, 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.

### **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  $\alpha$  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, 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.

**List of Practicals.**

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