



## **Syllabus**

For B.Sc 3<sup>rd</sup> Semester Courses in Statistics  
(June 2018 onwards)

### **Contents:**

- Theory Syllabus for Courses:
  - SSTA0301 – Probability & Sampling Distributions (A)
  - SSTA0302 – Sampling Techniques
  - SSTA0303 – Operations Research
  
- Practical Course Syllabus for: SSTA03PR
- Evaluation and Assessment guidelines.

**S.Y. B.Sc Statistics**

**Course: SSTA0301**

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

**Course 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**

**Course Outcomes:** On completion of the course the learner should be able to:

1. Derive important statistical functions of variables, namely, moment generating function, cumulant generating function, joint probability mass functions, marginal densities, conditional distributions (expectation and variance).
2. Possess deeper understanding of the properties and uses of various discrete distributions (Uniform, Bernoulli, Binomial, Poisson, Geometric, Negative Binomial) in terms of skewness and kurtosis; understand the relationships between the various distributions.
3. Have a deeper understanding of the properties, uses and applications of normal distribution; know the central limit theorem and its applications.

**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**

**Normal Distribution:** (15 L)

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

**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. Normal Distribution.

**Evaluation (Theory):**

Total marks per course - 100.

CIA- 40 marks

CIA 1: Written test -20 marks

CIA 2: Written test -20 marks

End Semester Examination – 60 marks

One question from each unit for 20 marks, with internal choice.

Total marks per question with choice – 25 to 30

**Evaluation of SSTA03PR (0301)**

Total marks - 50.

Group Project – 15 marks

Journal – 5 marks.

End Semester Practical Examination – 30 marks.

**Grid Template - End Semester Examination (Theory)**

Q. No	Knowledge (Definition, Descriptive Notes, Theoretical Proofs)	Understanding & Application (Illustration/Numerical Problems)	Marks
1.	15	05	20
2.	15	05	20
3.	15	05	20
<b>Total</b>	45	15	60
<b>Weightage (%)</b>	75%	25%	100%

**S.Y. B.Sc. Statistics**

**Course: SSTA0302**

**Title: Sampling Techniques**

**Course Objectives:**

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

**Number of lectures: 45**

**Course Outcomes:**

On completion of the course the learner should be able to:

1. Use the sampling methods available to estimate parameters of the population.
2. Prove (by derivation) the various properties of the estimators in each sampling scheme.
3. Compare estimators of a population parameter with a view to select an appropriate one.

**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 Ratio and Regression Estimators under SRSWOR:**

**(15L)**

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)

**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.

**Topics for 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.

**Evaluation (Theory):**

Total marks per course - 100.

CIA- 40 marks

CIA 1: Written test -20 marks

CIA 2: Written test -20 marks

End Semester Examination – 60 marks

One question from each unit for 20 marks, with internal choice.

Total marks per question with choice – 25 to 30

**Evaluation of SSTA03PR (0302)**

Total marks - 50.

Group Project – 15 marks

Journal – 5 marks.

End Semester Practical Examination – 30 marks.

**Grid Template - End Semester Examination (Theory)**

Q. No	Knowledge (Definitions, Descriptive Notes, Theoretical Proofs)	Understanding & Application (Illustration/Numerical Problems)	Marks
1.	15	05	20
2.	15	05	20
3.	15	05	20
<b>Total</b>	45	15	60
<b>weightage (%)</b>	75%	25%	100%

**S.Y. B.Sc. Statistics**  
**Title: Operations Research**

**Course: SSTA0303**

**Course 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**

**Course Outcomes:**

On completion of the course the learner should be able to:

1. Understand the concepts of 'operations research'.
2. Understand the concept of formulating real life situations into mathematical models
3. Use techniques for solving linear programming problems (Graphical and Simplex).
4. Use techniques to solve transportation and assignment problems.
5. Know the techniques of 'decision making' in various scenarios in the field of operations research.

**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.

**Topics for Practicals**

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

**Evaluation (Theory):**

Total marks per course - 100.  
CIA- 40 marks  
CIA 1: Written test -20 marks  
CIA 2: Written test -20 marks  
End Semester Examination – 60 marks  
One question from each unit for 20 marks, with internal choice.  
Total marks per question with choice – 25 to 30

**Evaluation of SSTA03PR (0303)**

Total marks - 50.  
Group Project – 15 marks  
Journal – 5 marks.  
End Semester Practical Examination – 30 marks.

**Grid Template - End Semester Examination (Theory)**

Q. No	Knowledge (Definitions, Descriptive Notes, Theoretical Proofs)	Understanding & Application (Illustration/Numerical Problems)	Marks
1.	15	05	20
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