Syllabus
For B.A. 6th Semester Courses in Statistics
(June 2019 onwards)

Contents:

T.Y. B.A. Course: ASTA0601
Title: Probability & Sampling Distributions (B)

Course 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.

Number of lectures: 45

Course Outcomes (COs):

1) Students are knowledgeable of the Properties and Uses of various continuous distributions (Rectangular, Exponential, Laplace, Gamma & Beta)
2) Students are aware of transformation of continuous (1D & 2D) random variables using Jacobian.
3) Students are knowledgeable of the Properties and Uses of various continuous distributions (Chi-Square, t and F- distribution)

Unit 1 **(15 lectures)**

Standard Univariate Continuous Probability Distributions:

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)

Transformation of random variables

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

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. Moment. 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.

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. Rectangular and Exponential distribution.
2. Chi-square distribution
3. t – distribution
4. F 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 ASTA06PR (0601)

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

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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
Total	45	15	60
Weightage (%)	75%	25%	100%

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T.Y.B.A. COURSE:ASTA0602

Analysis of Variance & Design of Experiments

Course 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.

Number of lectures: 45

Course Outcomes (COs):

1) Students have an understanding of Analysis of Variance (One way & Two way)
2) Students are aware of the principles of Design of Experiments and how they are incorporated into various basic designs namely Completely Randomized design (CRD), Randomized Block design (RBD) and Latin Square design (LSD)
3) Students are able to derive proofs of theorems pertaining to properties of estimators used in the above mentioned designs.
4) Students are aware of handling the above designs in case of missing observations.
5) Students are introduced into the construction and procedure of factorial experiments (2^2 & 2^3)

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.

List Of Recommended Reference Books :-

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 Publisher

Topics for Practical :-

1) One Way ANOVA / CRD.
2) Two Way ANOVA / RBD.
3) LSD.
4) Missing Plot Technique.
5) Factorial Experiment.

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 ASTA05PR (0501)

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

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Grid Template - End Semester Examination (Theory)

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Weightage (%)	75%	25%	100%

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T.Y. B.A. COURSE: ASTA0603
Applied Statistics (B)

Course 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.

Number of lectures: 45

Course Outcomes (COs):

1) Students are knowledgeable of the fitting of a multiple linear regression model with two independent variables.
2) Students are aware of techniques of decision making in various scenarios in the field of OR. (Techniques in the topics of Decision Theory and Game Theory)
3) Students are familiar with the concept of Simulation and are able to apply its techniques to Inventory and queuing models.

Unit 1. DECISION THEORY: (15 lectures)

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, 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 2. SIMULATION: (15 lectures)

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.

Unit 3. MULTIPLE LINEAR REGRESSION: **(15 lectures)**

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.

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.
5) Damodar Gujrathi: Basic Econometrics, Second edition McGraw-Hill Companies.
6) Vohra N.D. Quantitative Techniques in Management Third edition McGraw Hill Co.

Topics for Practical

1) Decision Theory.
2) Game theory.
3) Game theory.
4) Multiple Linear regression.

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 ASTA05PR (0501)
Total marks - 50.
Group Project – 15 marks
Journal – 5 marks.
End Semester Practical Examination – 30 marks.

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Grid Template - End Semester Examination (Theory)

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