KLE Society's

Raja Lakhamagouda Science Institute (Autonomous), Belagavi

DEPARTMENT OF STATISTICS

III SEMESTER

Course Title: Distribution Theory

COURSE CODE: 21ST301 CREDITS: 4

COURSE OUTCOMES

After the completion of this course, the student would be able to:

CO1: Understand the axiomatic formulation of modern probability theory and think of random variables as an intrinsic need for the analysis of random phenomena.

CO2: To fit probability distributions such as Negative binomial, Normal, to carry out large sample and small sample tests of significance.

CO3: Find sampling distributions of functions of random variables and explore their applications.

CO4: Able to learn different mathematical model and their application in simulation.

UNIT 1: Distribution of Random Variables (Two-dimensional) 15 Hrs

Two dimensional random variables: Joint distribution, Marginal distribution and Conditional distributions of random variables, conditional expectation, covariance, correlation and moments. Distribution of functions of random variables using m.g.f. and distribution function. Transformation of variable technique (one and two variables). Chebyshev's in equality-proof and its use in approximating probabilities; Statements of Weak Lawof Large Numbers; Convergence in law and Central Limit theorems – De-Moivre. (Some simple examples)

UNIT 2: Probability Distributions-II 12 Hrs

Continuous distributions: Uniform, Gamma, Exponential, Beta (type 1 and type 2), Cauchy, Weibull– definition through probability density function, mean, variance, moments, m.g.f., other properties and applications. Bivariate normal distribution-definition through probability density function, marginal and conditional distribution.

UNIT 3: Sampling Distributions 16 Hrs

Definitions of random sample, parameter and statistic, sampling distribution of sample mean, standard error of sample mean, sampling distribution of sample variance, standard error of sample variance. Exact sampling distributions: Chi square distribution- mean, variance, moments, mode, additive property. Student's and Fisher's t-distribution- mean, variance, moments and limiting form of t distribution. Snedecor's F-distribution: mean, variance and mode. Distribution of 1/F. Relationship between t, F and $\chi 2$ distributions.

UNIT 4: Simulation 13 Hrs

Introduction to simulation. Generation of random observations from Uniform, Exponential, Normal, Biomial, Poisson distributions using R-codes.

STATISTICS PRACTICAL III SEMESTER

Course Title: Statistics Practical III

COURSE CODE: 21ST302 CREDITS: 2

COURSE OUTCOMES:

After the completion of this course, the student would be able to:
CO1: Practical's on probability distribution used to describes the likelihood of obtaining the possible values that a random variable can assume.
CO2: Probability distributions help to forecast power failures and network outages.
CO3: Practical's on continuous distribution used if the variable can assume an infinite number of values between any two values.
CO4: Probability distribution used widely in the study of large sample theory where normality is involved

1. Demonstration of R functions for calculus, distribution of random variables, probability distributions, sampling distribution simulation.

2. Numerical differentiation and integration.

3. Bivariate Probability Distributions-Marginal and Conditional distributions.

4. Bivariate Probability Distributions-Conditional Mean, Conditional Variance, Correlation.

5. Applications of Chebyshev's in equality (For standard distributions such as Normal, Exponential, Gamma).
6. Applications of discrete probability distributions-Negative–Binomial, Geometric, Hyper geometric and discrete uniform, multinomial distributions.

7. Applications of continuous probability distributions- Exponential, Gamma, Cauchy, Weibull distributions.

8. Fitting of discrete and continuous distributions.

9. Generating random sample from discrete distributions.

10. Generating random sample from continuous distributions.

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Raja Lakhamagouda Science Institute (Autonomous), Belagavi

DEPARTMENT OF STATISTICS

III SEMESTER

Course Title: Statistical Inference-I

COURSE CODE: 21ST401 CREDITS: 4

COURSE OUTCOMES:

After the completion of this course, the student would be able to:
CO1: Carryout statistical analysis by identifying families of distributions and the use of order statistics.
CO2: To find estimators using different methods of estimation and compare estimators.
CO3: To carry out statistical inference using different tests of hypotheses under different scenarios.
CO4: Generate random variables and use this generated random variable for illustration of concepts studied in this course.

UNIT-1: Point Estimation-I **16 Hrs**

Families of distributions-location and scale families. Single parameter exponential family. Concept of order statistics, Distribution of maximum and minimum order statistics (with proof) and rth order statistic (without proof). Concepts of estimator and estimate. Criteria for estimators: Unbiasedness, Consistency. Invariance property of consistent estimators. Efficiency and relative efficiency. Mean squared error as a Criterion for comparing estimators. Sufficient statistics. Statement of Neyman-Factorization theorem.

UNIT-2: Point Estimation-II **12 Hrs**

Fisher in formation function. Statement of Cramer–Rao inequality and its applications. Minimum Variance Unbiased Estimator and Minimum Variance Bound Estimator. Maximum likelihood and method of moment estimation; Properties of MLE and moment estimators and examples. Method of Scoring.

UNIT-3: Testing of Hypotheses **18 Hrs**

Statistical hypotheses-null and alternative, Simple and composite hypotheses. Type-I and Type-II errors, test functions. Randomized and non-randomized tests. Size, level of significance, Power function, power of tests. Critical region, p- value and its interpretation. Most Powerful (MP) and UMP test. Statement of Neyman-Pearson Lemma and its applications. Likelihood ratio tests. Large and small samples tests of significance. Tests for single mean, equality of two means, single variance and equality of two variances for normal populations. Tests for proportions.

UNIT-4: Interval Estimation **10 Hrs**

Confidence interval, confidence coefficient, shortest confidence interval. Methods of constructing confidence intervals using pivotal quantities. Construction of confidence intervals for mean, difference of two means, variance and ratio of variances, proportions, difference of two proportions and correlation coefficient.

STATISTICS PRACTICAL IV SEMESTER

Course Title: Statistics Practical IV

COURSE CODE: 21ST402 CREDITS: 2

COURSE OUTCOMES:

After the completion of this course, the student would be able to:

CO1: Practical's on statistical inference consists in the use of statistics to draw conclusions about some unknown aspect of a population based on a random sample from that population.

CO2: Practical's on point estimation methods which consist of assigning a value to each unknown parameter.

CO3: Regression models are the most commonly used method in medicine and the biological sciences to describe the relationship between an outcome variable and one or more exposure variables.

CO4: Statistical inference is used to examine gene expression data across biological replicates to isolate significant changes, beyond what would be expected by random chance.

1. Demonstration of R-functions for estimation and testing of hypotheses.
2. Point estimation of parameters and obtaining estimate of standard errors and mean square error.
3. Computing maximum likelihood estimates.
4. Computing moment estimates.
5. Interval estimation: Construction of confidence interval (large and small samples)
6. Evaluation of Probabilities of Type–I and Type–II errors and power of tests.
7. Small sample tests: Tests for mean, equality of means under normality when variance is(i)known(ii) unknown, P-values.
8. Small sample tests: single proportion and equality of two proportions, variance and equality of two variances under normality. P-values for the above tests.
9. Large sample tests: Tests for mean, equality of means when variance is (i) known (ii) unknown, under normality, variance and equality of two variances under normality. P-values for the above tests.
10. MP and UMP tests for parameters of binomial, Poisson distributions, normal and Exponential (scale parameter only) distributions and power curve