

T. Y. B. Sc. (Statistics)
(Effective from June - 2003)

The following are 3-Credit course papers for the T.Y.B.Sc. (Statistics) Each theory paper examination will be of 3 hours duration and will be of 80 marks. The practical course examination will be in two sitting and each of 3 hours' duration.

S-301: REAL ANALYSIS
(Total Marks: 80, Duration: 3 hours)

Unit 1:

Real numbers and Basic topology of real line sets : Index sets, Finite sets, Countable and Uncountable sets. De Morgan's laws, Fields and ordered structure, Completeness. Archimedean properties. Representation of real number on real line. Neighborhood and limit points. Open and closed sets (the related results should be discussed without proof.

Unit 2:

Real Sequences: Sequences, Convergence of sequences, Limit points of a sequence- Bolzano Weirstrass theorem. Limit superior and limit inferior, Convergent and non- convergent sequences. Algebra of sequences. Cauchy's first theorem on limits (only statement) and application. Monotonic sequence, Subsequence.

Unit 3:

Tests of Convergence of Series: necessary condition for convergence. Positive term series, geometric series, comparison of series. Comparison test , Cauchy's root test, D' Almbert's ratio test, Raabe's test, Logarithmic test, Integral test and gauss's test for convergence of series, convergence of series of arbitrary terms.

Unit 4:

Functions: Continuous functions, algrbra of continous functions Limits, Uniform continuity, Differentiability, Maxima and minima of functions.

Unit 5:

Some results on functions ; Durbox's theorem, Roles theorem, Lagrange's theorem, Mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Maclaurin's theorem, Generalized mean value theorem, Taylor's infinite series, Maclaurin's infinite series.

**statement of theorems and their applications.*

Unit 6:

Uniform Convergence: Uniform convergence of sequence of functions, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation.

Power Series: Definition and Convergence, Abel's theorem. Differentiation under the integral sign. Leibnitz's rule.

Reference:

1. Principle of Real Analysis (S.C.Malik) : Chapter 1 through 6.
2. Mathematical Analysis (S.C.Malik) : Chapter 13 : Sections 1,2, 3 (Theorems without proof). Sections 4.3 and 4.4. Chapter 14 :Sections 1,2,2.1 and 4.
3. Advance Calculus (John M.H.Olmsted). Chapter 9: pp 930,931, Chapter 13: pp 1301-1311 (Except 1303)

S-302: Probability and Distribution theory
(Effective from June - 2003)
(Total Marks: 80, Duration: 3 hours)

Unit 1:

Probability: Probability of union of n -events, Bool's inequality, Bonferroni's inequality, Convergence in Probability and Convergence in Distribution. Chebyshev's inequality and generalized form Weak law of large numbers, General Statement of the Central limit theorem (CLTs): Linderberge and Leavy from Liapunov's form (without proof), Applications of CLTs.

Unit 2:

Power Series Distributions (PSD): Definition, p.g.f and m.g.f of PSD, the Recurrence relation between the moments and central moments recurrence relation of p.s.d.. The result of known discrete distributions as particular cases. Truncated binomial distribution truncated at $x = 0$ and truncated Poisson distribution truncated at $x = 0$, their mean and variance.

Unit 3:

Continuous distributions Log-normal distribution, Cauchy distribution, Laplace distribution. Moments and their relations. Incomplete Gamma And beta distribution as tail probabilities of Poisson and binomial distributions. Truncated normal distribution truncated to the left. Pareto, Weillbul, logistic distributions their mean and variance.

Unit 4:

Sampling distributions: Distributions of one and two random. Variables: Distribution function and change of variable technique, M.G.F. and its properties, characteristics function and its properties. Distributions of sample mean and sample variance of normal distribution and their independence. The Chi- square, Student's t and F distributions.

Unit 5:

Multivariate distributions: Definitions. Concept of marginal and conditional distributions. Bivariate normal as special case of multivariate Normal distribution. Distribution of sample correlation coefficient when $\rho = 0$. Partial and multiple correlation and regression for three variables. Fisher's z -transformation and its uses.

Unit 6:

Order statistics: Definition, Distribution of r^{th} order statistic and joint Distribution of r^{th} and s^{th} order statistics, Distribution of the sample range and sample median (for continuous distributions only)

Scope of syllabus:

- 1: Fundamentals of Mathematical Statistics by V. K. Kapoor and S.C.Gupta.
- 2: Introduction to Mathematical Statistics by Hogg and Craig .
- 3: An out line of statistical theory: Vol.: I by Goon , Gupta and Dasgupta.

S:303 ESTIMATION AND TESTING OF HYPOTHESIS
(Effective from June - 2003)
(Total Marks: 80, Duration: 3 Hours)

UNIT 1: Point Estimation I:

Parameter space, Sample space. The problem of point estimation. *Properties of good estimator*: Unbiasedness, Consistency and Efficiency. Minimum Variance Unbiased estimators.(MVUE). Uniqueness property Of MVUE. Minimum mean square error estimators, Rao – Cramer inequality, Fisher's information. Minimum variance bound unbiased estimators.(MVBUE).

Unit 2: Point estimation II.

Methods of estimations: Method of moments, Method of maximum likelihood. Properties of maximum likelihood estimators. (without proof). *Sufficiency*: Fisher Neyman and Factorization theorem (for one parameter. Discrete distributions with proof and without proof for continuous case)

Unit:3 Interval Estimation.

Random Interval. Definition of confidence interval. Confidence interval for The parameters of Normal distribution, for the difference of means and for the ratio of variances of Normal distribution. Confidence interval for the Proportion p of Binomial distribution and for the difference of proportions of two independent binomial distributions. Confidence interval for correlation coefficient under bivariate normal distribution. Large sample Confidence interval.

Unit:4 Test of Hypotheses. I

Statistical hypotheses: Simple and composite hypotheses. Null and alternative hypotheses. Test of statistical hypotheses Critical region. Two kinds of errors. Level of significance. Power and power function of the test. Most powerful (MP) test and critical region. Neyman Pearson lemma. Critical region for simple hypotheses involving one parameter. Uniformly most powerful tests (UMPT) critical regions.

Unit:5 Test of Hypotheses. II.

Likelihood ratio test (LRT). Properties of LR test (without proof). Applications of LR test to test (i) mean and variance of normal distribution (ii) equality of means of two independent normal distributions.(iii) equality of variance of two independent normal distributions. (iv)equality of k normal means. (v)mean of an exponential distribution.

Unit:6 Sequential Tests:

Sequential probability ratio test (SPRT). Determination of stopping bounds a and b , OC and ASN function of SPRT. *Non parametric test*: one sample and two sample sign test. Wald Wolfwitz run test. Run test for randomness. Median test Mann Whitney Wilcoxon test.

Scope of syllabus:

- 1: Introduction to Mathematical Statistics by Hogg and Craig .
- 2: Statistical Inference (in Gujarati) by S.W. Dharmadhikari and G. C. Patel
- 3: Modern Mathematical statistics by Dudewitz and Misra.

S: 304 Sampling Technique, Analysis of Variance and Design of Experiments.

(Effective from June - 2003)

(Total marks: 80, Duration: 3 hours)

Unit:1

Simple random sampling: Advantages and uses of sample survey. Principal steps in sample survey. Selection of simple random sample with and without replacement. Estimation of means, totals and proportion. Estimation of standard error. Variance of sample estimates. Confidence limits.

Unit:2

Stratified sampling: Construction of strata and determination of number of strata. Estimation of mean and its variance. Optimum allocation. Relative precision of stratified sampling and simple random sampling. Estimation of sample size in stratified sampling for proportion. Gain in precision due to stratification.

Unit:3

Systematic sampling: Systematic sampling, estimation of its mean and variance. Comparison with simple random sampling and stratified sampling. Estimation of sample size for proportions and with continuous data in case of simple random sampling.

Unit:4

Linear Models and Analysis of Variance: Introduction to linear models and their types. Gauss – Markoff model. Linear estimation. The method of least squares. Gauss – Markoff theorem (without proof). Analysis of variance for one way and two way classifications with one observation and m observations per cell (for fixed effect model). Expected values of various sums of squares.

Unit:5

Design of experiments: Need of design of experiment. Principles of experimentation. Analysis of completely randomized design.(CRD), Randomized block design, (RBD) AND Latin square design,(LSD). Efficiency of designs. Missing data in RBD AND LSD (up to two missing values).

Unit:6

Factorial Experiments: Factorial Experiments up to four factors each at two levels. Concept of Confounding and their types. Confounding up to two interactions. Analysis of confounded factorial experiments.

Scope of syllabus:

1. Sample Survey Designs : (Daroga Singh and F.S.Chaudhari).
2. Fundamentals of Applied Statistics (S.C.Gupta and V.K.Kapoor)
3. Sampling Techniques (W.G.Cochran)

S-305: Industrial Statistics
(Effective from June - 2003)
(Total Marks: 80, Duration: 3 hours)

Unit: 1

Importance of Statistical Methods in Industrial research and practice: Introduction to ISO 9000. Determination of tolerance limits. General theory of control charts. Cause of variation in quality. Control limits, Summary of out of control criteria. \bar{X} , R, p, np and c charts. Control charts and Sampling plans: Control limits, Warning limits, Modified control limits, Specified probability limits, Specification limits, rejection limits, OC function of \bar{X} , R, p, np and c chart.

Unit: 2

Sampling plans for attributes : General notation of acceptance sampling plans. Concept consumer risk, producer risk. Single sampling plan, double sampling plan (DSP), and Multiple sampling plans as a generalization of DSP. Sequential sampling plan and their AQL, LTPD, AOQL and AOQ, OC, ASN and ATI functions. Comparison between the plans.

Unit: 3

Sampling Plans for Variables: Single sampling plan for mean (with known S.D.) seeking one way and two ways protection. Single sampling plan for variables. Sampling plan using mean and s.d. sequential sampling plan for normal mean (known s.d.)

Unit: 4

Index Number: Price relatives and quantity or volume relatives. Link and chain relatives, computation of index numbers, Laspeyre's, Paasche's, Marshal-Edgeworth's and Fisher's Index numbers, Chain base index numbers, consumer price index numbers. Tests for index numbers : Time and factor reversal tests.

Unit: 5

Demand Analysis: Theory and analysis of consumer's demand : Law of demand , price elasticity of demand , estimation of demand curves ; forms of demand functions, Engle's curves, income elasticity of demand.

Unit: 6

Input-output analysis: The transformation system. Leontief's open system, Walras-Leontief closed system. Leontief's dynamic system. Dynamic solution for two industries.

Scope of syllabus:

1. Applied Statistics (Mukhopadhyaya P. 1999)
2. Statistical Quality controls (Grant. E.L.)
3. Statistical Quality controls (Ekambaram).
4. Fundamentals of Applied Statistics (S.C.Gupta and V.K.Kapoor)

S-306: Programming with FORTRAN 77 or 90
(Effective from June - 2003)
(Total Marks: 80, Duration: 3 hours)

Introduction to FORTRAN 77 or 90, FORTRAN characters codes, constant, variables, names; arithmetic, logical and relational operators, expression: Arithmetic, character, relational and logical expressions, rules for writing arithmetic expression.

Statement: Specification Data, parameter, Format, one dimensional Array statements, Assignment statements Arithmetic statements , Control statements : DO loops, Do-continue, IF- Blocks, unconditional GOTO label And computed GOTO statements, STOP, RETURNS and END statements I/O statements : Format free Read, Write and Print Statements , Simple Formats, OPEN and CLOSE statements. Built-in-functions: Name of Generic and non Generic functions. Flow chart, Body of the program, compiling and running of the programs.

Towards Better Programming

Real, Integer, Double Precision, Complex and logical variables, Common Statements, Common Blocks, Blocks Data Equivalence, Two dimensional and multidimensional arrays.

Multi-branch transfer of control : Logical and Arithmetic, IF, Computed GOTO, assigned GOTO Nested and implied DO loops, Counting Loppes, Simple and nested Blocks:

IF- THEN

IF- THEN-ENDIF

IF- THEN-ELSE-ENDIF

IF- THEN-ELSEIF-ENDIF

DO-WHILE

Format refinements:

Design of modular programs: User defined functions, Functions- Sub-programs, Subroutine- Subprograms. Programs using subprograms : Square root subroutines, Matrix inversion, subprograms for computing mean , variance and covariance for n pairs of observations, main programs for computing correlation and regression lines using subprograms.

Scope of syllabus:

Reddy. R.N. and Ziegler. C.A.: FORTRAN 77

Rajaraman : Computer programming in FORTRAN 77

Practicals S – 307 (Manual)
(Effective from June - 2003)
(Total marks :80, Duration: 3 hours)
Matrix Theory and Theory of Testing of Hypothesis

Inversion of a 5 x 5 matrix by Doo-little and partitioning method.

1. Evaluation of determination of a 5x5 matrix by partitioning method and by Laplace method.
2. Solution of non-homogenous linear equation using i) and ii) and problems of I/O analysis.
3. Given observation to compute CR and powers of a test for Binomial , Poisson, Normal and Exponential distribution.
4. Sequential Probability Ratio test (SPRT)
5. Sign test , Median test, Run test, Wilcoxon test and Mann- Whitney Wilcoxon test.
6. Construction of confidence interval.

Sampling Plans:

1. O.C., ATI, AOQL for Single sampling plan.
2. O.C., ATI, AOQL for Double sampling plan.
3. Sequential sampling plan for attributes
4. Sampling plan for variables.

Practicals on Index numbers.

Practicals S – 308 (Using FORTRAN 77/90)
(Effective from June - 2003)
(Total marks :80, Duration: 3 hours)
Fitting of Distribution

1. Truncated Binomial , Truncated Poisson, Truncated at zero.
2. Truncated Normal (truncated left) distribution
3. Lognormal, Pareto , Weibul and Logistic distributions

Multiple correlation and regression.

1. To compute multiple and partial correlation coefficient and testing their significance
2. Test the homogeneity of correlation coefficient by Z- transformation
3. Multiple linear regression and testing regression coefficient.

Methods of Estimation

1. Estimation of parametric functions of Truncated Binomial, Truncated Poisson, and Truncated Negative Binomial by the method of moment.
2. Estimation of parametric functions of Truncated Binomial, Truncated Poisson, and Truncated Negative Binomial by the maximum likelihood.

Practicals S – 309 (Using MS EXCEL)
(Effective from June - 2003)
(Total marks :80, Duration: 3 hours)

Generating random samples:

Generating random samples from:

i) Uniform ii) Exponential iii) Normal iv) Binomial v) Poisson populations.

Analysis of variance (ANOVA)

1. Test of homogeneity of variance in K-populations
2. ANOVA for one and two way classifications.
3. Analysis of CRD.
4. Analysis of RBD
5. Analysis of LSD.
6. Missing plot techniques (up to 2) in RBD and LSD.
7. Analysis of factorial experiments (up to 2^3) Yate's method
8. Analysis of confounded factorial experiment (2^4 experiment with confounding up to 2 independent interactions)

Control Charts

1. Construction of X and R charts.
2. Construction of p,np and c charts.