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Internal Quality Assurance Cell
Govt. Arts & Science College, Ratlam (M.P.)

The syllabus designed by Central Board of Studies Bhopal and Vikram University, Ujjain has been adopted for the session 2018-19 at all the levels of UG and PG programme respectively.

Principal

Govt. Arts and Science College
Ratlam (M.P.)

M.A./M.Sc. (STATISTICS)
SEMESTER-I
SESSION:2011-2012
Scheme of papers

S.No.	Title of the paper		University Exam	CCE
1:	**Paper-I**	Linear Algebra	40 Marks	10 Marks
2:	**Paper-II**	Distribution Theory-I	40 Marks	10 marks
3:	**Paper-III**	Sampling Techniques	40 Marks	10 Marks
4:	**Paper-IV**	Measure Theory and probability	40 Marks	10 Marks
5:	**Practical-I:** Based on Theory Papers I & II (40 Problems + 08 Record + 07 Viva Voce)		50 Marks	-
6:	**Practical-II:** Based on Theory Papers III & IV (40 Problems + 08 Record + 07 Viva Voce)		50 Marks	-
			Grand Total	300

M.A. / M.Sc. (STATISTICS)
SEMESTER-I
Paper-I; Linear Algebra

Unit - I: Vector space; linear dependence, basis and dimension of a vector space finite dimensional vector space, completion theorem, subspace.

Unit-2: Inner product spaces, orthogonal basis and Gram- Schmidt process of Orthogonalization, orthogonal projection of a vector, linear simultaneous equations-Cramer's rule.

Unit-3: Linear transformation and their properties, partitioned matrices, Idempotent matrices, Kronecker product, Hadamard product, Hermite canonical form, generalized inverse.

Unit-4: Bilinear forms, equivalence of bilinear forms, quadratic forms, reduction of quadratic forms, orthogonal reduction, index and signature of a quadratic form. 383
381   (367)

Unit-5: Eigen values, Eigen vectors and the characteristic equations of a matrix. Eigen value and Eigen vectors of a linear transformation. Cayley- Hamilton Theorem, minimal polynomial, multiplicity of Eigen values, Hermitian matrices.

Books:

1. Gray bill, F.A. (1983)   : Matrices with Application in Statistics. 2nd Ed. Wadsworth.

2. Searle, S.R. (1982)   : Matrix Algebra Useful for Statistics. John Wiley and Sons

3. Datta, K.B. (2006)   : Matrix and linear Algebra. Prentice Hall of India EE.Edn.

4. Biswas, S. (1984)   : Topics in Algebra of Matrices. Academic Publication.

5. Bellmen, R. (1970)   : Introduction to matrix Analysis. 2nd Edn. Mc Graw Hill

M.A. / M.Sc. (STATISTICS)
SEMESTER-I
Paper-II; Distribution Theory-I

Unit-I: Random Variable and its mathematical expectation, conditional expectation, joint, marginal and conditional p.m.fs. and p.d.fs.

Unit-2: Standard discrete distribution- the discrete uniform distribution, Binomial, Truncated Binomial, Hyper geometric, Poisson, Truncated Poisson, Geometric and Negative Binomial distribution.

Unit-3: Continuous distribution- continuous Uniform, Exponential, Gamma, Beta and Cauchy distribution.

Unit-4: Normal, Lognormal, Laplace, Pareto, Weibull, and Power series distribution.

Unit-5: Order Statistics- their distributions and properties, joint and marginal distribution of order statistics. Extreme values and their asymptotic distributions (statement only).

Books:

1. Dudewicz E.J. and Mishra S.N.(1988) : Modern Mathematical Statistic. Wiley International (student Edn.) .

2. Rohatgi V.K.(1988): : An Introduction to Probability Theory and Mathematical Statistics. Wiley Eastern

3. Mukhopadhyay P. (1996) : Mathematical statistics. New Central Book Agency

M. A. / M.Sc. (STATISTICS)

SEMESTER –I

PAPER –III: SAMPLING TECHNIQUES

Unit -1: Simple random sampling – definition, notations, properties of the estimates, variance of the estimates, f. p. c. , estimates of the standard error formula sample, confidence limits.(Art. 2.1 to 2.8 W.G.Cochran).

Stratified random sampling - description, notations, properties of the estimates, estimated variance and confidence limits, optimum allocation, relative precision of stratified random sampling and simple random sampling.(Art.5.1 to 5.6, Cochran)

Unit -2: Stratified random sampling - estimation of sample size with continuous data, stratified sampling for proportions, gains in precision in stratified sampling for proportions, estimation of sample size with proportions.(Art.5.9 to 5.12, Cochran)

Ratio estimators – methods of estimation, the ratio estimator, approximate variance of the ratio estimate, estimation of the variance from a sample, confidence limits, comparison of the ratio estimate with mean per unit, conditions under which the ratio estimator is BLUE, bias of the ratio estimate, accuracy of the formulas for the variance and estimated variance, ratio estimates in stratified random sampling.(Art. 6.1 to 6.10, Cochran.)

Unit -3: Regression estimators – the linear regression estimate, regression estimate with pre-assigned b, regression estimate when b is computed from the sample , sample estimate of variance, large sample comparison with the ratio estimate and the mean per unit, accuracy of the large sample formula for $V(\bar{y}_{lr})$ and $v(\bar{y}_{lr})$, bias of the linear regression estimate , the linear regression estimator under a linear regression model, regression estimates in stratified sampling.(Art.7.1 to 7.9, Cochran).

Systematic sampling – description, relation to cluster sampling , variance of the estimated mean, comparison of systematic with stratified random sampling, populations in " random" order, Populations with linear trend, method of populations with linear trends, population with periodic variation. (Art. 8.1 to8.8, Cochron)

Unit -4: Single stage cluster sampling : cluster of equal sizes – reasons for cluster sampling , comparisons of precision made from survey data, variance in terms of intracluster correlation. Variance functions, cost function, cluster sampling for proportions. (Art. 9.1 to 9.7, Cochron). Cluster of unequal sizes – cluster units of unequal sizes, sampling with probability proportional to size, selection with unequal probabilities with replacement. Optimum measure of size, relative accuracies of three techniques, sampling with unequal probabilities without replacement.The Horvitz – Thomson estimator. (Art. 9A.1 to 9A.7, Cochron).

Unit -5: Subsampling with units of equal size : two – stage sampling , finding means and variance in two – stage sampling , variance of the estimated mean in two – stage sampling, sample estimation of the variance. Estimation of proportions, optimum sampling and subsampling fractions. (Art. 10.1 to 10.6, Cochron). Subsampling with units of unequal size – introduction, sampling methods when n=1 and n>1, two useful results. Unit selected with equal probabilities: unbiased estimator and ratio to size estimate(Art. 11.1 to 11.8, Cochron).
Double sampling - description of the technique, double sampling for stratification, optimum allocation, estimated variance in double sampling for stratification (Art. 12.1 to 12.4, Cochron).

BOOKS:

1. Cochran, W.G.   : Sampling Techniques. Wiley Eastern

2. Singh, D. and Choudhary, F. S.   : Theory and Analysis of Sample Survey Design Wiley Eastern

3. Sukhatme, P. V., Sukhatme, B. V., Sukhatme, S. and Asok, C.   : Sampling Theory of Surveys with Application. Indian Society of Agricultural Statistics, New Delhi, India

4. Murthy, M. N.   : Sampling Theory and Method. Statistical Publishing Society, Calcutta.

M.A. / M.Sc. (STATISTICS)
SEMESTER-I
Paper-IV; Measure Theory and Probability

Unit - I: Classes of sets, fields, Sigma fields, minimal Sigma- field, limit superior and limit inferior of a sequence. Measure, probability measure, properties of measure.

Unit-2: Lebesgue and Lebesgue- stieltjes measures. Measureable functions, random variable, sequence of random variables, almost sure convergence, convergence in probability (and in measure)

Unit-3: Integration of a measurable function with respect to a measure, monotone convergence theorem.

Unit-4: Borel- Cantelli lemma, independence, Weak and Strong law of large number for i.i.d. sequences. Definition and example of Markov dependence.

Unit-5: Convergence in distribution, characteristics function, uniqueness theorem. Statement of Levy's continuity theorem. Central limit theorem for a sequence of independent variables under Lindeberg's condition, Central limit theorem for i.i.d. random variables.

Books:

1. Billingsley P. (1986) : Probability and measure, Wiley International.
2. Kingman, JFC and : Introduction to measure and probability
   Taylor, S.J. (1986) Cambridge University, Press
3. Gupta, K.P : Measure Theory

M.A. /M.Sc. (STATISTICS)

SEMESTER-II

SESSION: 2012-13
Scheme of Papers

S.No.	Title of the Paper		University Exam	CCE
1.	Paper-I	Statistical Inference-I	40 Marks	10 Marks
2.	Paper-II	Real Analysis	40 Marks	10 Marks
3.	Paper-III	Distribution theory-II	40 Marks	10 Marks
4.	Paper-IV	Programming with C language	40 Marks	10 Marks
5.	Practical-I Based on Theory Paper I & II (35 Problems+08 Record+07 Viva Voce)		50 Marks	--
6.	Practical-II Based on Theory Paper III & IV (35 Problems+08 Record+07 Viva Voce)		50 Marks	--
			Grand Total	300 Marks

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M.A./M.Sc. (STATISTICS)
Semester II
Paper I: Statistical Inference – I

Unit 1: Point Estimation: Unbiasedness, Consistency, sufficient conditions for consistent estimators, Efficiency, most efficient estimators, minimum variance unbiased estimators, Sufficiency, factorization theorem (discrete case only), properties of sufficient estimators, Minimal sufficient statistic.

Unit 2: Cramer-Rao inequality, its alternative forms, conditions for the equality, Rao-Blackwell theorem, completeness, complete family of distributions, Lehman- Scheffe theorem.

Unit 3: Methods of estimation: Method of maximum likelihood, properties of maximum likelihood estimators (Statement only), Method of moments, properties of moment estimators. Interval Estimation: confidence interval and confidence limits, construction of confidence interval using pivots, shortest expected length confidence interval.

Unit 4: Testing of Hypothesis: Statistical hypothesis, simple and composite. Errors of first and second kind, critical region, level of significance, power of the test, most powerful test, uniformly most powerful (UMP) test, Neyman-Pearson lemma. Unbiased test and unbiased critical region.

Unit 5: Likelihood Ratio Test; properties of LR tests (No derivation), UMP tests for simple null hypothesis against one sided alternatives, exponential family of densities, UMP tests for one sided null against one sided alternatives in one parameter exponential family.

Books Recommended

1. An outline of Statistical theory, Vol.II – Goon, Gupta and Dasgupta
2. Fundamentals of Mathematical Statistics – S. C. Gupta and V. K. Kapoor
3. Theory of Point Estimation – E. L. Lehman
4. Testing of Statistical Hypothesis- E. L. Lehman
5. Linear Statistical Inference and its applications- C. R. Rao
6. Introduction to the theory of Statistics- M. A. Mood, F.A. Graybill and D. C. Boes
7. An Introduction to Probability Theory and Mathematical Statistics- V. K. Rohtagi

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M.Sc. / M.A. (STATISTICS)
SEMESTER –II
PAPER –II REAL ANALYSIS

Unit-1: Elements of set theory; introduction to real numbers, introduction to n-dimensional Euclidian space, open and closed intervals, compact sets, Bolgano -Weirstrass and Heine –Borel theorems .

Unit-2: Sequences and series; their convergence. Real valued functions, continuous functions, uniform continuity.

Unit-3: Sequences of functions, Uniform convergence. Power series and radius of convergence.

Unit-4: Differentiation, maxima –minima of functions; functions of several variables, constrained maxima- minima of functions.

Unit-5: Multiple integrals and their evaluation by repeated integration, change of variables in multiple integration, uniform convergence in improper integrals, differentiation under the sign of integral Leibnitz rule.

BOOKS:

1. Apostol, T.M. (1985)   : Mathematical Analysis Narosa.Indian Edn.
2. Rudin Walter (1976)   : Principles of Mathematical Analysis, McGraw Hills.
3. Mallik, S.C.   : Mathematical Analysis, Wiley Eastern Ltd.

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M.Sc. / M.A. (STATISTICS)
SEMESTER –II
PAPER –III. DISTRIBUTION THEORY II

Unit-1: Jointly distributed random variables , distribution function of joint distribution, marginal distributions ,conditional distributions and Independence of X and Y. Discrete and continuous two dimensional distributions, moments of conditional distributions.

Unit-2: Simple correlation and regression, non-linear regression, regression of the second kind, correlation index and correlation ratio, Bivariate normal distribution.

Unit-3: Sampling distribution of a function of random variables, case of discrete and continuous variables. Three basic sampling distributions – Chi square, t and F-distributions.

Sampling distributions arising from univariate normal distribution (sample mean, sample variance).

Unit-4: Non central Chi square, t and F distributions, their properties and applications.

Unit-5: Distributions arising from the bivariate normal (linear functions of two jointly distributed normal variables), sampling distribution of sample means, variances and covariances in bivariate normal situation, sampling distribution of 'r'.

BOOKS:

1. Goon, A.M., Gupta M.K. and Das Gupta, B. : An Outline of Statistical Theory Vol. I World Press Calcutta.

2. Mukhopadhyay, P. : Mathematical Statistics, Central Book Agency.

3. Gupta,S.C.,Kapur, V.K. : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

4. Agrawal, B.L. : Basic Statistics, New Age

M.A./M.Sc. (STATISTICS)
Semester II
Paper IV: Programming with C language

Unit 1: Introduction and importance of C language, sample C programs, basic structure of C programs. Character set, C tokens, Keywords and identifiers, Constants, Variables, Data types, declaration of variables, assigning values to variables.

Unit 2: Operators and Expression: Introduction, types of operators, arithmetic expressions, evaluation of expressions, mathematical functions. Managing input and output operators, reading and writing a character, formatted input and formatted output.

Unit 3: Decision making and branching: Introduction, decision making with IF statement, simple IF statement, the IF- ELSE statement, nesting of IF...ELSE statements, the ELSE IF ladder, switch statement. Looping, the WHILE statement, DO statement and the FOR statement.

Unit 4: Introduction to Arrays and Pointers, One and Two dimensional arrays, Initializing two-dimensional arrays, Multidimensional arrays. Understanding pointers, declaring and initializing pointers, pointer expression, pointer increments and scale factor, pointers and functions, pointers and structures.

Unit 5: User defined functions, need for user defined functions return value and their types, calling a function, category of functions, nesting of functions, Recursion, function with arrays, scope and lifetime of variables in function.

Book Recommended

1. Byron S Gottfried : Programming with C- Tata Mc-Graw Hill

2. Balagurusamy, E : Programming in ANSI C - Tata Mc-Graw Hill

3. Kantekar, Y: Let us 'C'

M.A./M.SC. (STATISTICS)

SEMESTER III

SESSION :2013-14

SCHEME OF PAPERS

S.No.	Title of Papers	University Exam	CCE
1	Paper-I Statistical Inference-II	40 Marks	10 Marks
2	Paper-II Multivariate Analysis	40 Marks	10 Marks
3	Paper-III Operation Research	40 Marks	10 Marks
4	Paper-IV Demography	40 Marks	10 Marks
5	Practical-I Based on theory papers I & II (40 Problems + 08 Records + 07 Viva Voce)	50 Marks	-
6	Practical-II Based on theory papers III & IV (40 Problems + 08 Records + 07 Viva Voce)	50 Marks	-
		GRAND TOTAL:	300

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Unit I: Elements of Decision Theory – Some basic concepts, loss function; risk function, Minimax approach, Bayes approach; Point estimation as a decision problem, Hypothesis testing as a decision problem, interval estimation as a decision problem, Bayes and minimax estimators, Admissibility of estimators.

Unit II: Sequential Analysis- Walds Sequential probability Ratio Test (SPRT), Determination of constants, Walds fundamental identity (no derivation), OC function of SPRT, ASN function of SPRT.

Unit III: Non-parametric methods- Parametric v/s non-parametric methods, Order statistics and their distribution. Ranks, Correlation between Ranks and variate values.Treatment of ties in ranks.

Unit IV: Tests for one sample problems –Run test, Kolmogorov- Smirnov test, Sign test, Wilcoxon signed rank test.

Unit V: Tests for two sample problems – Wald- Wolfwitz Run test, Kolmogorov –Smirnov test, Median test, Wilcoxon test, Mann –Whitney test U –test.

BOOKS RECOMMENDED:

1. An outline of statistical theory, Vol II - Goon,Gupta and Dasgupta.
2. An introduction to probability theory and mathematical statistics-V.K.Rohtagi
3. Introduction to the theory of Statistics-M.A.Mood , F.A.Graybill and D.C. Boes.
4. Mathematical Statistics-S.S.Wilks.
5. Sequential Analysis-A.Wald.
6. Non-parametric Statistical Inference-J.D.Gibbons.
7. Non-parametric statistics for Behavioural Sciences - S. Siegal.

M.A./ M.Sc. (STATISTICS)
SEMESTER III
Paper II: MULTIVARIATE ANALYSIS

Unit I: The multivariate normal distribution, the distribution of linear combination of normally distributed variates; Independence of variates, marginal distribution, The multiple correlation coefficient, Some formulas for practical correlations, The Characteristic function.

Unit II: Estimation of the mean vector and the covariance matrix: The maximum likelihood estimates of the mean vector and the covariance matrix, The distribution of the sample mean vector; The Generalized T^2- statistics: Derivation of the T^2- statistics as a function of the likelihood ratio criterion.

Unit III: The distribution of T^2, uses of T^2- statistics, Mahalnobis D^2 – statistics, its distribution and uses, Wishart distribution, Its derivation and properties.

Unit IV: Definition of Principal components in the population, Maximum likelihood estimates of the principal components and their variances, Canonical correlation and variates in the population.

Unit V: The problem of classification, Standards of good classification, Procedures of classification into one of the two populations with known probability distributions, Classification into one of the two known multivariate normal populations, Classification into one of the two multivariate normal populations when the parameters are estimated.

BOOKS RECOMMENDED:

1. T. W. Anderson : An introduction to Multivariate Statistical Analysis, Wiley Eastern, Pvt. Ltd.
2. Kshirsagar : Multivariate Analysis.
3. Khatri, C.G : Multivariate Analysis.
4. S.N.Roy : Some Aspects of Multivariate Analysis.

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Unit I: Definition and Scope of O.R., Phases of O.R., Linear Programming: Graphical solution of two variable problems, Formation of linear programming (LPP), Slack and Surplus variables, Standard and Matrix forms of LPP. Important definitions, assumptions of LPP, simplex method of solution.

Unit II: Two- phase simplex method, Big-M method, problem of degeneracy. Special cases: Alternative solutions, unbounded solutions and non–existing solutions. Duality in LPP. Duality theorems: Fundamental duality theorem and existence theorems.

Unit III: Assignment problem: Fundamental theorems, Hungarian method for assignment problems, unbiased assignment problems. Travelling salesmen problem. Transportation problem, method for initial basic feasible solution, method for optimal solution, degeneracy in transportation problems.

Unit IV: Theory of games: Basic definitions minimax (maximin) criterion, saddle point, optimal strategies and the value of the game, solution of games with saddle point, minimax – maximin principle for mixed stratigy games, 2 x 2 games without saddle point, principle of dominance graphical method for 2 x n games.

Unit V: Job Sequencing: Terminology and notations, processing n jobs through 2 machines, processing two jobs through m machines and n jobs through m machines. Project Management by PERT – CPM: Basic steps in PERT / CPM techniques, Rules for drawing network diagram, time estimates and critical path in network analysis. Project evaluation and review technique (PERT): Optimistic, most likely, pessimistic and expected time (PERT).

BOOKS RECOMMENDED:

1. Sharma, S. D. – Operation Research, Kedarnath Ramnath & Co.
2. Kantiswaroop, Gupta P. K & Singh M. -Operation Research, Sultan chand & Sons.
3. Gass, S. I. - Linear Programing, 3/e, Mc Graw – Hill Kogakusha, Tokyo (1969).
4. Hadley, G. - Linear Programing, Addison Wesley, Reading Mass Massachusetts (1962).
5. Vohra, N. D. – Quantitative Techniques in Management, Tata Mc Graw Hill Pulo Co. New Delhi.
6. Makinsey, J.C.C. – Introduction to game theory, Mc Graw – Hill.

M.A./M.SC. (STATISTICS)
SEMESTER III
Paper-IV: Demography

Unit I: Census and vital statistics data, vital rates and ratio, standardization of rates , Measurement of moratlity; Standard death rates, Neo- natal, peri-natal and infant mortality rates, causes of death rates, Construction of life table and their uses, Abrideged life tables.

Unit II: Measures of fertility; period and cohort measures, use of birth order statistics, Child-woman ratio, standard fertility rates, Gross and Net reproduction rates, length of generation, Stationary and stable population, Probability models for times for first birth.

Unit III: Population estimation, Logistic curve, fitting of Logistic curve by method of Perl, Reed and Rhode, Makehan's graduation formula and its fitting.

Unit IV: Population projection and their matrix presentation, method of solution. Migration and distribution of population. Different methods of estimation of migration.

Unit V: Poisson process, linear birth and death process, Birth , death and migration model, Extinction of population.

References:

1. Techniques of Population Analysis- Barclay, C.W.
2. Introduction to Demography- Spieglaman.
3. Applied Mathematical Demography- Keyfitj, N.
4. An Introduction to the Study of Population –Misra, B. D.
5. Technical Demography- Ramkumar, R.
6. Stichastic Process in Demography and its Applications- S. Biswas.

M.A/M.Sc (STATISTICS)

SEMESTER-IV

SESSION: 2013-2014

Scheme of Papers

COMPULSARY THEORY PAPERS

S.No.	Tittle of the paper	University Exam	CCE
1:	Paper-i Linear Model and Design of Experiments	40 Marks	10 Marks
2:	Paper-II Statistical Quality Control and Reliability theory	40 Marks	10 Marks

OPTIONAL THEORY PAPERS (ANY TWO)

S.No.	Tittle of the paper		University Exam	CCE
3:	Paper-III	Mathematical Economics	40 Marks	10 Marks
4:	Paper-IV	Econometrics	40 Marks	10 Marks
5:	Paper-V	Advance operations research	40 Marks	10 Marks
6:	Paper-VI	Research Methodology	40 Marks	10 Marks
7:	Paper-VII	Advanced Design of Experiments	40 Marks	10 Marks
8:	Paper-VIII	Acturial statistics	40 Marks	10 Marks
	Practical-I: Based on Paper-I (40 Problems+08 Records +07 Viva Voce)		50 Marks	
	Practical-II Based on Paper-II,and any two optional papers (40 Problems+08 Records +07 Viva Voce)		50 Marks	
	PROJECT WORK		50 Marks	
			Grand Total	350

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SEMESTER-IV

Paper I: Linear Model and Design of Experiments

Unit I The General linear model , Normal equation and least squares estimates , Estamability of a linear parametric function , Definition of a BLUE , The Guass- Markoff theorm , Variance and covariance of BLUES , Estimation space , Error space.

Unit II Analysis of variance with one-way, two-way and three- way classifications. Analysis of covariance.

Unit III Fundamental priniciples of experimental design. Completely randomized , randomized blocks and Latin square design. Missing plot technique in RBD and LSD.

Unit IV Simple factorial experiments. Total and partial confounding in factorial experiments , 3^2 factorial experiments.

Unit V Split plot Design , Balanced and Partially Balanced Incomplete Block Design . Lattice Design . Youden's Square and Cross Over designs. .

Books Recommended:

Kshirsagar , A.M. (1983) : A course in linear models. ·

Rao, C.R. (1973) : Linear Statistical Inference and its application. Wiley Eastern..

Gupta , S.C. and Kapoor, V.K. (2011) : Fundamentals of Applied statistics , Sultan Chand & Sons.

Das , M.N. and N.C. Giri , Design and analysis of of experiments; Wiley Eastern.

Federer , W.T. ; Experimental Design , Theory and Applications , Oxford & IBH.

Cochran , W.G. and G.M. Cox , Experimental Design , Wiley Eastern.

Kemptharne, O. The Design and Analysis of Experiments , Wiley Eastern.

Chakrabarti , M.C. , Mathematics of Design and Analysis of Experiments, Asia, Publishing Co.

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M.A/ M.Sc (STATISTICS)

SEMESTER – IV

PAPER – II : Statistical Quality Control and Reliability Theory.

Unit – I The general theory of control charts, control charts for variables and attributes including fraction defective (when sample sizes vary) . Applications of the theory of runs and related patterns.

Unit – II OC and ARL of control charts, CUSUM charts for Binomial, Poisson and Normal distributions and derivations of d and θ for V – mask of these distributions. General notion of acceptance sampling plans. Properties and determination of parameters of single and double attributes sampling plans for LTPD, AOQL and AQL requirements.

Unit – III Sequential sampling plans for attributes. Sampling inspection by variables Single Sampling Plan with known and unknown process standard deviation when the lot quality is described by the process mean (specifications being given).

Unit – IV Problems in life testing. Hazard rate , Reliability, Failure modals. Exponential failure modal with one and two parameters. Properties of exponential distribution. Estimation of mean life with complete samples.

Unit – V Introduction of series and parallel systems. Reliability of series system with identical components. Reliability of parallel system with identical components. Reliability of series and parallel system.

BOOKS RECOMMENDED

1. Statistical Quality Control, Grant, E.L. and Leavenworth, R.S.
2. Quality Control, Industrial Statistics, Duncan, A. J.
3. Sampling Inspection by variables, Bowker , A.E And Goode, H.P.
4. The Statistical Basis of Acceptance sampling , Ekambran , S.K.
5. Introduction to statistical quality control , Montgomery, D.C.
6. Life Testing and Reliability, Sinha, S. K. And Kale.

M.A./M.Sc. (STATISTICS)

SEMESTER-IV

Paper –III: Mathematical Economics

UNIT-I Supply and Demand Function, Elasticity of Supply and Demand, graphical method of determination of elasticity of demand.

Unit-II Theory of consumer behavior, utility function, marginal utility and indifference curve, maximization of utility function, Liontief inter industry model.

Unit-III National Income, Pareto's and lognormal distributions. Concentration curve, Gini's concentration ratio.

Unit-IV Production function, elasticity of substitution, Cobb – Douglas production function, marginal rate of substitution, C.E.S. production function. Theory of growth ; multiplier accelerator model of Harrod-Domar, Phillips and Samuelson–Hicks.

Unit-V Perfect and imperfect competitions, , monopoly, average and marginal revenue, profit maximization, application of monopoly, Duopoly and oligopoly, Cournot and Collusion solution.

Books Recommended :

1: Mathematical Economics , Allen, R.G.D.

2. Micro–Economics Theory (A mathematical approach) , Henderson , R.E. and Quandt , J.M.

3. Theory of Linear Economics Model, Gale, D.

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M.A./M.Sc. (STATISTICS)

SEMESTER-IV

Paper –IV: Econometrics

Unit I Nature and scope of Econometrics . Linear model (Two variable case)

Unit II General linear model, Estimation under exact linear restrictions , multicollinearity, Specification error.

Unit III Heteroscedastic disturbances, Stochastic regressors , errors in variables .

Unit IV Auto- correlation, test of Auto – Correlation . Use of prinicipal components , canonical correlations in econometrics .

Unit V Simultaneous linear equation model, identification problem , restriction on structural parameters, rank and order conditions . Restrictions on variances and co-variances.

Books Recommended :

1. Econometrics method, Johnston, J.

2. An introduction to Econometrics, Klien , R.R.

3. Econometric Theory, Goldberget, A.S.

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M.A/ M.Sc (STATISTICS)

SEMESTER –IV

Paper –V: Advance Operations Research.

Unit I : Basic idea of dual simplex method , Integer linear programming : definition , importance and need of integer programming , Gomory's cutting plane method, geometrical interpretation of Gomory's cutting plane method .Branch and Brown method.

Unit II : Non linear programming problems – definition , practical situation, formulation of non linear programming problems , general non- linear programming problem. Canonical form of non- linear programming problem , graphical solution and verification of Kuhn- tucker conditions. Quadratic programming – Definition , Kuhn – tucker conditions , general quardratic programming problem , Wolfe's method.

Unit III : Inventory management – preliminaries , concept of EOQ , deterministic elemrntary static demand , inventory models 1(a), (b) , and (c) . Dynamic or fluctuating demand models IV and V , probabilistic inventory model VI(a) and (b) , Instaneous demand , no setup cost model.

Unit IV: Replacement : Replacement problems of items that deteriorate, replacement of items that fail completely , individual replacement policy, Mortality theorem, group replacement of items that fails completely, group replacement policy , Recruitment and promotion problem, equipment renewal problem.

Unit V: Waiting line model- Queuing system, transient and steady states, traffic intensity, probability distribution in queuing system, solution of queuing models (M/M/1):(∞/FCFS),Erlang model, (M/M/1): (N/FCFS), (M/M/S): (∞/FCFS): (M/ E_R /1): (∞/FCFS).

Book Recommended:

1. Sharma , S.D.- Operation Research, Kedarnath Ramnath & Co.

2. Kantiswaroop , Gupta ,P.K and Singh M- Operation Research , Sultan Chand and sons

3. Hadley ,G.- Non-Linear and dynamic programming ,Addision Wesley.

4. Kleinrock, L.-Queuing System , Vol. , John Wiley

5. Gross , D. and Harris , C.M. – Fundamental of queuing theory.

6. Churchman , C.W. , Ackoff and Arnoff, E.L.- Introduction to Operation Research, Wiley NY(1957)

M.A/M.Sc(STATISTICS)

SEMESTER-IV

Paper –VI : Research Methodology

Unit-1   Nature and Scope of Research Methodology. Problem Formulation and Statement of Research Objectives.

Unit-2   Value and cost of Information- Bayesian Decision Theory, Organization structure of Research ; Research Process, Research Design; Exploratory, Descriptive and Experimental Research.

Unit-3   Different methods of data collection- Observational, survey (interview) methods, Questionnaire Design , Schedule and Case Study Method, Attitude measurement techniques; Motivational Research techniques.

Unit-4   Administration of surveys, Sample design ; selecting an Appropriate Statistical Technique. Tabulation and presentation of data; Writing report of Investigation.

Unit-5   Advanced Techniques for data analysis – ANOVA, Discriminant Analysis, Factor Analysis, Multidimensional scaling and clustering methods.

Books Recommended:

1. Gupta, S.P.- Statistical Methods, Sultan Chand,New Dehli.

2. Kothari,C.R.-Reasearch Methodology, Wishwa Prakashan.

3. Shennoy and Pant, Statistical Methods in Business and Social Sciences

4. Dwivedi, R.S.- Research Methods in Behovioural Science ,Macmillan.

5. Salking Neil,Exploring Research , Third Edition, Prentice Hall (1977)

6. Bennet, Roger – Management Research ILO (1983)

M.A/M.Sc (STATISTICS)

SEMESTER-IV

Paper –VII: Advanced Design of Expeiments

Unit-1 Finite group and finite field, Finite geometry and Euclidean construction of complete set of MOLS, Lattice designs and their analysis, Construction of BIBD'S using MOLS, Finite geometry and difference method of loss, Inter and intra block analysis of BIBD.

Unit-2 Two associate PBIB design association scheme and intra block analysis, Group divisible designs. Dual and linked block designs, Resolvable and affine resolvable design, General row-column designs, Connectedness and intra block analysis.

Unit-3 Fractional factorial design orthogonal and balance arrays and their connections with confounded and fractional factorial Response Surface designs- orthogonally, rotatability and blocking, Construction and analysis.

Unit-4 Optimum design- Various optimality criteria and their interpretations, A, D, E Optimal designs.

Unit-5 Optimality of BIBD, Repeated measurement designs (First order residual effects and its analysis.)

Books Recommended:

1. D.C.Montegomery : Design and Analysis of experiments,

   5th Edn. (2001)- John Wiley & Sons(Asia)

2. R.H.Myers & D.C.Montegomery : Response surface methology, John Wiley & Sons.

3 J.Fox (1993) : Quality through designs - McGraw Hill

M.A/M.Sc(STATISTICS)

SEMESTER-IV

Paper VIII: Actuarial Statistics

Unit-1 Mortality: Mortality experience, Mortality Table, Graph of Force of Mortality table as a population model, Expectation of life, Stationary funds.

Unit-2 Annuities: Pure endowments, Annuities, Accumulation, Assurance, Varying annuities of Assurance, Continuous annuities family income benefits.

Unit-3 Policy Values: Nature of resave, Prospective and retrospective reserves fractional premiums, Fractional durations modified reserves, Continuous reserves, Industrial assurance, Children's deferred assurance, Joint life and last survivorship.

Unit-4 Contingent functions: Contingent probabilities, contingent assurance, Reversionary annuities, Multiple decrement table, Force of decrement, Construction of decrement table.

Unit-5 Pension Funds : Capital fund on retirement & death, Widow's pension, Sickness benefits, Benefits dependent of marriage.

Books Recommended:

1. Neil A (1977) : Life contingencies Heinemann London.
2. Wing G : Institutional of Actuaries text book part-II (Second Edn.).

   Charis & Edwin Layton, London.

3. Donald D.W.A : Compound interest and annuities, Heinewan, London.
4. Jordan, C.W.Jr. : Life Contingencies Chicago Society of Acturies.
5. Spurgeon, E.T. : Life Contingencies, Cambridge University Press.
6. Freeman H : Finite Difference for actuarial students, Cambridge University Press
7. Benjamin & Pollard J.H.(1980) : Analysis mortality and other actuarial statistics, Heinemann, London.

8. Elandt – Johnson R.L.

Johnson N.L. (1980) : Survival models and data analysis, John Wiley.