SCHOOL OF STUDIES IN STATISTICS,

VIKRAM UNVERSITY, UJJAIN

MA / M. SC. (STATISTICS)

SCHEME OF PAPERS FOR

CHOICE BASED CREDIT SYSTEM (CBCS)

SCHOOL OF STUDIES IN STATISTICS, VIKRAM UNVERSITY, UJJAIN

MA/M.Sc. (STATISTICS)

SEMESTER-I

SESSION: 2016-17

SCHEME OF PAPERS FOR CBCS

Total Credits 30

Paper Code	Course Name	Discipline	Maximum	Marks	Credit
			University Exam	CCE	
MST-C-101	Measure Theory and Probability	Core	40	10	6
MST-C-102	Distribution Theory-I	Core	40	10	6
MST-E-103	Any one from the list of discipline centric elective courses	Elective	40	10	6
MST-F-104	Any one from the list of foundation courses	Foundation	40	10	6
MST-P-105	Practical-I (practical based on MST-C-101 & MST-C-102)	-	50	-	3
MST-P-106	Practical-II (practical based on MST-E-103 & MST-F-104)	-	50	-	3

SEMESTER-II

SESSION: 2016-17

SCHEME OF PAPERS FOR CBCS

Total Credits 30

Paper Code	Course Name	Discipline	Maximum	Marks	Credit
			University Exam	CCE	
MST-C-201	Statistical Inference-I	Core	40	10	6
MST-C-202	Distribution Theory-II	Core	40	10	6
MST-C-203	Sampling Techniques	Core	40	10	6
MST-E-204	Any one from the list of discipline centric elective courses	Elective	40	10	6
MST-P-205	Practical-I (practical based on MST-C-201 & MST-C-202)	-	50	-	3
MST-P-206	Practical-II (practical based on MST-C-203 & MST-E-204)	-	50	-	3

SCHOOL OF STUDIES IN STATISTICS, VIKRAM UNVERSITY, UJJAIN

MA/M.Sc. (STATISTICS)

SEMESTER-III

SESSION: 2017-18

SCHEME OF PAPERS FOR CBCS

Total Credits 30

Paper Code	Course Name	Discipline	Maximum	Marks	Credit
			University Exam	CCE	
MST-C-301	Statistical Inference-II	Core	40	10	6
MST-C-302	Multivariate Analysis	Core	40	10	6
MST-C-303	Operation Research	Core	40	10	6
MST-E-304	Any one from the list of discipline centric elective courses	Elective	40	10	6
MST-P-305	Practical-I (practical based on MST-C-301 & MST-C-302)	-	50	-	3
MST-P-306	Practical-II (practical based on MST-C-303 & MST-E-304)	-	50	-	3

SEMESTER-IV

SESSION: 2017-18

SCHEME OF PAPERS FOR CBCS

Total Credits 30

Paper Code	Course Name	Discipline	Maximum	Marks	Credit
			University Exam	CCE	
MST-C-401	Linear Models and Design of Experiment	Core	40	10	6
MST-C-402	Econometrics	Core	40	10	6
MST-E-403	Any one from the list of discipline centric elective courses	Elective	40	10	6
MST-E-404	Any one from the list of open elective courses	Elective	40	10	6
MST-P-405	Practical-I (practical based on MST-C-201 & MST-C-202)	-	50	-	3
MST-P-406	Practical-II (practical based on MST-C-203 & MST-E-204)	-	50	-	3

SCHOOL OF STUDIES IN STATISTICS,

VIKRAM UNIVERSITY, UJJAIN

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

SCHEME OF EXAMINATION FOR

CHOICE BASED CREDIT SYSTEM (CBCS)

SCHOOL OF STUDIES IN STATISTICS, VIKRAM UNIVERSITY, UJJAIN

M.A. /M.SC. (STATISTICS)
SEMESTER-I
SESSION: 2016-17
SCHEME OF EXAMINATION FOR CBCS

Paper Code	Course Name (Theory Papers / Practical)	Examination Scheme						
		Discipline	Duration (hrs)	Maximum Marks		Total Marks	Minimum Marks	
				University Exam	Internal (CCE)		University Exam	Internal (CCE)
MST-C-101	Measure Theory and Probability	Core	3	40	10	50	14	4
MST-C-102	Distribution Theory-I	Core	3	40	10	50	14	4
MST-E-103	Any one from the list of discipline centric elective courses	Elective	3	40	10	50	14	4
MST-F-104	Any one from the list of foundation courses	Foundation	3	40	10	50	14	4
MST-P-105	Practical-I (practical based on MST-C-101 & MST-C-102)	-	4	50	-	50	18	-
MST-P-106	Practical-II (practical based on MST-E-103 & MST-F-104)	-	4	50	-	50	18	-
Total				260	40	300	92	16

SCHOOL OF STUDIES IN STATISTICS, VIKRAM UNIVERSITY, UJJAIN

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

SEMESTER-II

SESSION: 2016-17

SCHEME OF EXAMINATION FOR CBCS

Paper Code	Course Name (Theory Papers / Practical)	Discipline	Duration (hrs)	Examination Scheme					
				Maximum Marks		Total Marks	Minimum Marks		
				University Exam	Internal (CCE)		University Exam	Internal (CCE)	
MST-C-201	Statistical Inference-I	Core	3	40	10	50	14	4	
MST-C-202	Distribution Theory-II	Core	3	40	10	50	14	4	
MST-C-203	Sampling Techniques	Core	3	40	10	50	14	4	
MST-E-204	Any one from the list of discipline centric elective courses	Elective	3	40	10	50	14	4	
MST-P-205	Practical-I (practical based on MST-C-201 & MST-C-202)	-	4	50	-	50	18	-	
MST-P-206	Practical-II (practical based on MST-C-203 & MST-E-204)	-	4	50	-	50	18	-	
Total				260	40	300	92	16	

SCHOOL OF STUDIES IN STATISTICS, VIKRAM UNVERSITY, UJJAIN

M.A. /M.Sc. (STATISTICS)
SEMESTER-III
SESSION: 2017-18
SCHEME OF EXAMINATION FOR CBCS

Paper Code	Course Name (Theory Papers / Practical)	Discipline	Duration (hrs)	Examination Scheme				
				Maximum Marks		Total Marks	Minimum Marks	
				University Exam	Internal (CCE)		University Exam	Internal (CCE)
MST-C-301	Statistical Inference-II	Core	3	40	10	50	14	4
MST-C-302	Multivariate Analysis	Core	3	40	10	50	14	4
MST-C-303	Operation Research	Core	3	40	10	50	14	4
MST-E-304	Any one from the list of discipline centric elective courses	Elective	3	40	10	50	14	4
MST-P-305	Practical-I (practical based on MST-C-301 & MST-C-302)	-	4	50	-	50	18	-
MST-P-306	Practical-II (practical based on MST-C-303 & MST-E-304)	-	4	50	-	50	18	-
Total				260	40	300	92	16

SCHOOL OF STUDIES IN STATISTICS, VIKRAM UNVERSITY, UJJAIN

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

SEMESTER-IV

SESSION: 2017-18

SCHEME OF EXAMINATION FOR CBCS

Paper Code	Course Name (Theory Papers / Practical)	Discipline	Duration (hrs)	Maximum Marks University Exam	Maximum Marks Internal (CCE)	Total Marks	Minimum Marks University Exam	Minimum Marks Internal (CCE)
MST-C-401	Linear Models and Design of Experiment	Core	3	40	10	50	14	4
MST-C-402	Econometrics	Core	3	40	10	50	14	4
MST-E-403	Any one from the list of discipline centric elective courses	Elective	3	40	10	50	14	4
MST-E-404	Any one from the list of open elective courses	Elective	3	40	10	50	14	4
MST-P-405	Practical-I (practical based on MST-C-201 & MST-C-202)	-	4	50	-	50	18	-
MST-P-406	Practical-II (practical based on MST-C-203 & MST-E-204)	-	4	50	-	50	18	-
Total				260	40	300	92	16

Core Papers (Credit : 6 Each) (All compulsory)

1. MST –C-101 : Measure Theory and Probability
2. MST –C-102 : Distribution Theory –I
3. MST –C-201 : Statistical Inference –I
4. MST –C-202 : Distribution Theory –II
5. MST –C-203 : Sampling Techniques
6. MST –C-301 : Statistical Inference –II
7. MST –C-302 : Multivariate Analysis
8. MST –C-303 : Operations Research
9. MST –C-401 : Linear Models and Design of Experiments
10. MST –C-402 : Econometrics

Discipline Centric Elective Papers (Credit: 6 each)

(Any one of these may be selected by a student in each semester)

1. Advance Operations Research
2. Demography
3. Mathematical Economics
4. Advance Design of Experiments
5. Statistical Quality Control and Reliability Theory
6. Linear Algebra
7. The calculus of finite Differences and numerical analysis

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Open elective Papers (Credit : 6 each)

(Any one of these may be selected by a student in fourth semester)

1. Programming with C language
2. Statistical data analysis using software packages
3. Actuarial Statistics
4. Bio - Statistics
5. Genetics
6. Any open elective paper of any other subject in UTD

Foundation course papers (credit:6 each)

(Any one of these may be selected by a student in first semester)

1. Statistical Methods
2. Research Methodology
3. Real Analysis

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Grades and Grade Points

% Marks	Letter Grade	Grade Point
90% and above	O(out standing)	10
75 % and less than 90%	A+(excellent)	9
60 % and less than 75%	A (very Good)	8
55% and less than 60%	B+ (Good)	7
50 % and less than 55%	B (above Average)	6
45 % and less than 50%	C (Average)	5
36% and less than 45%	P (Pass)	4
less than 36%	F (Fail)	0
absent	Ab	0

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

Measure Theory and Probability

MST-C-101 (Core Paper 1)

Unit-1: Classes of sets. Fields, Sigma fields, minimal sigma- field, limit superior and limit inferior of a sequence. Measure, properties of measure.

Unit-2: Lebesgue and Lebesgue- Stieltjes measure. Measurable 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 numbers 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 sequqnce 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

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

Distribution Theory-I

MST-C-102 (Core Paper 2)

Unit-1: 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 distributions.

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) : Morden Mathematical Statistics. 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

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

Statistical Inference-I

MST-C-201 (Core Paper 3)

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. .Method of moments 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, Error of first kind, critical region, level of significance, power of test, most powerful test, uniformly most powerful test (UMP) test, Neyman-Pearson lemma. Unbiased test and unbiased critical region.

Unit 5: Likelihood Ratio Test, Properties of LR tests (No Derivation) application of LR test criterion, UMP test 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)

DISTIBUTION THEORY II

MST-C-202 (Core Paper 4)

Unit-1: Jointly distributed random variables, distribution function of joint Distribution, marginal distribution, conditional distributions and Independence of X and Y. Discrete and continuous two dimensional distribution s, 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 distribution 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: Distribution arising from the bivariate normal (linear functions of two jointly distributed normal variables), sampling distribution of sample mean, variance and covariance in bivariate normal situation, sampling distribution of 'r'.

BOOKS

1. Goon, A.M., Gupta M.K.   : An Outline of Statistical Theory Vol.I

   and Das Gupta, B.   World Press Calcutta.

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

3. Gupta, S.C., Kapur, V.K.   : Fundamental of mathematical statistics,

   Sultan Chand and Sons

1. Agrawal, B.L.   : Basic Statistical, New Age.

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

SAMPLING TECHNIQUES

MST-C-203 (Core Paper 5)

Unit-1: Simple random Sampling- definition, notations, properties of the estimates, variance of the estimates, f.p.c., estimates of the standard error from sample, confidence limits.

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.

Unit-2: Stratified random sampling- estimation of sample size with continuous data, stratified sampling for proportions, gain in precision in Stratified sampling for proportions.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 estimators is BLUE, bias of the ratio estimate, ratio estimates in stratified random sampling.

Unit-3: 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, bias of the linear regression estimate, the linear regression estimator under a linear regression model, regression estimates in stratified sampling.

Systematic sampling- description, related to cluster sampling, variance of the estimated mean, comparison of systematic with stratified random sampling, populations in "random" order. Population with linear trend, population with periodic variation.

Unit-4: Single stage cluster sampling: cluster of equal sizes- reasons for cluster sampling, variance in terms of intra cluster correlation. Sampling with probability proportional to size, selection with unequal probabilities with replacement. Sampling with unequal probability without replacement. The Horvitz Thomson estimator.

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.

Double sampling- Description of the technique, double sampling for stratification, optimum allocation, estimated variance in double sampling for stratification.

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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.

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M.A./ M.Sc. (Statistics)

Statistical Inference -II

MST-C 301 (Core Paper 6)

Unit I: Elements of Decision Theroy – 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, 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 . Distribution of number of runs.

Unit IV : Test 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

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M.A./ M.Sc. (Statistics)

Multivariate Analysis

MST-C 302 (Core Paper 7)

Unit I : The multivariate normal distribution , the distribution of linear combination of normally distributed variants; Independence of variates , marginal distribution , The multiple correlation coefficient , Some formulas for practical correlations , The characteristics 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 T^2 –statistics as a function of the ;likelihood ratio criterion.

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

Unit IV : Definition of Principal componetns 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 : Multivatirate Analysis
3. Khatri, C.G. : Multivatirate Analysis
4. S.N. Roy : Some Aspects of Multivariate Analysis

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OPERATIONS RESEARCH

MST-C 303 (Core Paper 8)

Unit I : Definition and scope of O.R.., Linear Programming ; Graphical solution of two variable problems, Formation of Linear programming (LPP), Slack and Surplus variables , statndard and Matrix forms of LPP , Important definitions, assumption 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 intial 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-maximum principle for mixed stratigy game, 2x2 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 evalution and review technique (PERT): Optiministics , 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 and sons
3. Gass , S. I. – Linear Programming , 3/e Mc Graw – Hill Kogakusha , Tokyo (1969)
4. Hardly, G. – Linear Programming , Addison Wesley , Reading Mass Masachusetts (1962)
5. Vohra , N.D. – Quantitative Techniques in Management , Tata Mc Grew Hil Pub. Co. New Delhi.
6. Makinsey , J.C.C.- Introduction to game theory , Mc Grew Hil

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M. A/ M. Sc. (Statistics)

Linear Model and Design of Experiments

MST –C-401 (Core Paper 9)

Unit I: The General linear model ,Normal equations and least square 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 principles 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:

1. Kshirsagar, A.M.(1983) : A course in linear models.
2. Rao, C.R.(1973) : Linear Statistical Inference and its application. Wiley Eastern.
3. Gupta, S.C. and Kapoor, V.K.(2011): Fundamental of Applied statistics, Sultan Chand & Sons.
4. Das,M.N. and N.C. Giri, Design and Analysis of experiments; Wiley Eastern.
5. Federer, W.T. ; Experimental Design, Theory and Applications, Oxford & IBH.
6. Cochran, W.G.and G.M. Cox , Experimental Design, Wiley Eastern.
7. Kemptharne, O. The Design and Analysis of Experiments, Wiley Eastern.
8. Chakrabarti, M.C., Mathematics of Design and Analysis of Experiments, Asia, Publishing Co.

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M. A/ M. Sc. (Statistics)

Econometrics

MST-C-402 (Core Paper 10)

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 principal 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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Advance Operations Research
(Discipline Centric Elective Paper 1)

Unit 1: Basic idea of dual simplex method , Integer linear programming : definition , importance and need of integer programming , Gomory's cutting plan method , geometrical interpretation of Gomory's cutting plane method , Branch and Brown method.

Unit 1I: Non linear programming problems- definition, practical situation, formulation of non linear programming problem, general non linear programming problem. Canonical form of non linear problem, graphical solution and verification of Kuhn –tucker conditions. Quadratic programming-definition, Kuhn – tucker conditions, general quadratic programming problem, Wolfe's method.

Unit 1II: Inventory management, preliminaries, .concept of EOQ, deterministic elementary 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 1V: 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 , requirement and promotion problems, equipments 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)

BOOKS RECOMMENDED:

1. Sharma, S.D.- Operation Research , Kedarnath Ramnath & Co.
2. Kantiswaroop , Gupta P.K. & Singh M.- Operation research, sultan chand and sons
3. Hadley,G – Non- linear and dynamic programming , Addison 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)

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DEMOGRAPHY

(Discipline Centric Elective Paper 2)

Unit I : Census and Vital statistics data , vital rates and ratio, standardization of rates, Measurement of mortality; 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 – women ratio , standard fertility rates , Gross and Net reproduction rates, length of generation , stationary and stable population, Probability models for times for the first birth.

Unit III : Population estimation, Logistic curve , fitting of Logistic curve by method of Pear , 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 method 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

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M. A/ M. Sc. (Statistics)

Mathematical Economics

(Discipline Centric Elective Paper 3)

Unit- I: Supply and Demand Function, Elasticity of Supply and Demand, graphical method

Of determination of elasticity of demand.

Unit-II: Theory of consumer behaviour, 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.Sc. /M.A. (STATISTICS)

Advanced Design of Experiments

(Discipline Centric Elective Paper 4)

Unit-1 Finite group and finite field, Finite geometry and Euclidean construction of complete set of MOLS, lattice design and their analysis, Constructions 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 optimally criteria and their interpretation, A, D , E optimal design.

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 Willey and Sons(Asia)
2. R.H. Myers & D.C. Montegomery : Response surface methology, John Willey and Sons
3. J.Fox(1993) : Quality through designs- McGrawhill

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M. A/ M. Sc. (Statistics)

Statistical Quality Control and Reliability.

(Discipline Centric Elective Paper 5)

Unit I: The general theory of control charts, control chart 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 (spefication being given).

Unit IV: Problems in life testing. Hazard rate, Reliability, Failure models. Exponential failure models 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.

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

Paper- I: Linear Algebra

(Discipline Centric Elective Paper 6)

Unit-1: Vector Space: linear dependence, basis and dimension of a vector space finite dimensional vector space.

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.

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

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

The Calculus of Finite Differences and Numerical Analysis

(Discipline Centric Elective Paper 7)

Unit-I: Forward difference operator Δ, The shift operator E, Properties of operators Δ and E, Fundamental theorem of finite differences, Relation between E and d, where $D = d/d_x$, Missing terms(equal intervals), Factorial notation, Assumptions of interpolation, Uses of interpolation, Gregory Newton's forward and backward interpolation Formulae for equal intervals.

Unit-II: Divided differences Δ, Divided difference table, Theorems on divided differences, Newton's divided difference formula, Lagrange's interpolation formula, Central difference interpolation: Central difference operators δ, ∇ σ, and μ, Gauss forward and backward interpolation, starlings formula, Bessel formula, Laplace -Everett formula.

Unit-III: Numerical differentiation, Numerical quadrature: A general quadrature formula for equidistant ordinates, The Trapezoidal rule, Simpson's one –third rule, Simpson's three-eights rule, Weddle's rule, Euler- Maclaurin summation formula, Newton-cotes formula, Gauss formula for numerical integration.

Unit-IV: Summation of series; summation by parts, Difference equation: solution of simple difference equation, first order homogeneous linear equations, Higher order homogenous linear equations, reduction of a non-homogeneous equation to a homogeneous equation, non- homogeneous linear equations, method of evaluating $\frac{1}{f(E)}\phi(x)$, first order non-homogeneous linear equation, first order homogeneous linear equation with rational coefficient, higher order homogeneous linear equation with constant coefficients, first order linear equation with variable coefficient , equation homogeneous in $u(x)$.

Unit-V: Transcendental and polynomial equations: Direct methods, Iterative methods, Initial approximation, Bisection method, Iteration method based on first degree equation, Scant method, Newton- Raphson method , Rate of convergence of scant method , Newton- Raphson method, Iteration method, Efficiency of a method; Polynomial equation, Brige- Vieta method, Ordinary differential

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equations: Euler method, Taylor series method, Runge- Kutta first and second order methods.

Books:

1. Jain,M.K., Iyengan,S.R.K. and Jain, R.K.(1993): Numerical Methods for Scientific and Engineering Computation. Third Edition, New Age International(P) Limited.
2. Saxena,H.C.(1976): The calculus of finite differences and Numerical Analysis. S. Chand & Company Ltd.
3. Sastry,S.S.(1994): Introductory methods of Numerical Analysis. Pretice-Hall of India Private Limited, New Delhi.
4. Rajaraman, V.(1997): Computer oriented numerical methods, Third Edition, Prentice- Hall of India Private Limited, New Delhi.
5. Gupta, S.C. and Kapoor, V.K. (2014): Fundamental of mathematical Statistics, Sultan Chand and Sons, New Delhi.

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M.A./M.Sc.(STATISTICS)
Programming with C language
(Open elective paper 1)

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 Expressions: Introduction, types of operators, arithmetic expressions, evaluations of expressions, mathematical functions. Managing input and output operators, reading and writing a character, formatted input and formatted output.

Unit 3: Decisions 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 increaments 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.

Books Recommended:
1. Byron s Gottfried: Programming with C- Tata Mc- Graw Hill.
2. Balagurusamy, E. PRO Programming IN ansic- Tata Mc- Graw Hill.
3. Kaneekar, Y: let us 'c'

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

Statistical data analysis using software packages

(Open elective paper 2)

UNIT I: Use of Software packages for: Summarization and tabulation of data; Descriptive statistics; Graphical representation of data, Exploratory data analysis.

UNIT II: Fitting and testing the goodness of fit of discrete and continuous probability distributions; Testing of hypothesis based on large sample test statistics; Testing of hypothesis using chi-square, t and F statistics.

UNIT III: Concept of analysis of variance and covariance of data for single factor, multi-factor, one-way and multi-classified experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.

UNIT IV: Analysis of mixed models; Estimation of variance components; Testing the significance of contrasts; Correlation and regression including multiple regression.

UNIT V: Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Time series data; Spatial analysis; Neural networks.

Suggested Readings

Anderson CW & Loynes RM. 1987. The Teaching of Practical Statistics. John Wiley.

Atkinson AC. 1985. Plots Transformations and Regression. Oxford University Press.

Chambers JM, Cleveland WS, Kleiner B & Tukey PA. 1983. Graphical Methods for Data Analysis. Wadsworth, Belmount, California.

Chatfield C & Collins AJ. 1980. Introduction to Multivariate Analysis. Chapman & Hall.

Chatfield C. 1983. Statistics for Technology. 3rd Ed. Chapman & Hall.

Chatfield C. 1995. Problem Solving: A Statistician's Guide. Chapman & Hall.

Cleveland WS. 1985. The Elements of Graphing Data. Wadsworth, Belmont, California.

Ehrenberg ASC. 1982. A Primer in Data Reduction. John Wiley.

Erickson BH & Nosanchuk TA. 1992. Understanding Data. 2nd Ed. Open University Press, Milton Keynes.

Snell EJ & Simpson HR. 1991. Applied Statistics: A Handbook of GENSTAT Analyses.

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Actuarial Statistics

(Open elective paper 3)

Unit-1: Mortality: Mortality experience, Mortality table, Graph of L, 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 reserve 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, London.
3. Donald D. W. A: Compound interest and annuities, Heinewan, London.
4. Jordan, C.W. Jr : Life contingencies, Chicago society of actuaries.
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 other4 actuarial statistics, Heinemann, London.
8. Elandt-Johnson of R.L., Johnson. N. L. (1980): Survival models and data analysis, John Wiley.

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

BIO-STATISTICS

(Open elective paper 4)

UNIT I: Concept of survival data, definition and associated probability density function, survival function, hazard function, Censoring in survival time.

UNIT II: Estimation of survival function by life table analysis, Kaplan and Meirer Method.

UNIT III: Survival and failure time distributions: family of exponential and Weibul models.

UNIT IV: Analytical and graphical method for choosing best fitted distribution, Parametric and non-parametric tests for comparison of survival functions.

UNIT V: Concomitant variables in lifetime distribution models, Cox-proportional hazard models, Cox-proportional hazard models with time dependent covariates.

Suggested Readings

Anderson B. 1990. Methodological Errors in Medical Research.

Blackwell. Armitage P & Berry G. 1987. Statistical Methods in Medical Research.

Blackwell. Collett D. 2003. Modeling Survival Data in Medical Research.

Chapman & Hall. Cox DR & Oakes D. 1984. Analysis of Survival Data.

Chapman & Hall. Elandt-Johnson RC & Johnson NL. 1980. Survival Models and Data Analysis. John Wiley.

Everitt BS & Dunn G. 1998. Statistical Analysis of Medical Data. Arnold.

Hosmer DW, Lemeshow S & May S. 2008. Applied Survival Analysis: Regression Modeling of Time-to-Event Data. 2nd Ed. John Wiley.

Klein JP & Moeschberger ML. 2003. Survival Analysis: Techniques for Censored and Truncated Data. 2nd Ed. Springer.

Kleinbaum DG & Klein M. 2002. Logistic Regression. Springer.

Kleinbaum DG & Klein M. 2005. Survival Analysis. A Self Learning Text. 2nd Ed. Springer.

Lee ET & Wang JW. 2003. Statistical Methods for Survival Data Analysis. John Wiley.

Therneau TM & Grambsch PM. 2000. Modeling Survival Data: Extending the Cox Model. Springer.

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

GENETICS

(Open elective paper 5)

UNIT I:Physical basis of inheritance. Analysis of segregation, detection and estimation of linkage for qualitative characters. Amount of information about linkage, combined estimation, disturbed segregation.

UNIT II :Gene and genotypic frequencies, Random mating and Hardy -Weinberg law, Application and extension of the equilibrium law, Fisher's fundamental theorem of natural selection. Disequilibrium due to linkage for two pairs of genes, sex-linked genes, Theory of path coefficients.

UNIT III :Concepts of inbreeding, Regular system of inbreeding. Forces affecting gene frequency - selection, mutation and migration, equilibrium between forces in large populations, Random genetic drift, Effect of finite population size.

UNIT IV: Polygenic system for quantitative characters, concepts of breeding value and dominance deviation. Genetic variance and its partitioning, Effect of inbreeding on quantitative characters, Multiple allelism in continuous variation, Sex-linked genes, Maternal effects - estimation of their contribution.

UNIT V: Correlations between relatives, Heritability, Repeatability and Genetic correlation. Response due to selection, Selection index and its applications in plants and animals improvement programmes, Correlated response to selection. Restricted selection index. Variance component approach and linear regression approach for the analysis of GE interactions. Measurement of stability and adaptability for genotypes. Concepts of general and specific combining ability. Diallel and partial diallel crosses - construction and analysis.

Suggested Readings:

Bailey NTJ. 1961. The Mathematical Theory of Genetic Linkage. Clarendon Press.

Balding DJ, Bishop M & Cannings C. 2001. Hand Book of Statistical Genetics. John Wiley.

Crow JF & Kimura M. 1970. An Introduction of Population Genetics Theory. Harper & Row.

Dahlberg G. 1948. Mathematical Methods for Population Genetics. Inter Science Publ.

East EM & Jones DF. 1919. Inbreeding and Outbreeding. J B Lippincott.

Ewens WJ. 1979. Mathematics of Population Genetics. Springer.

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Falconer DS. 1985. Introduction to Quantitative Genetics. ELBL.

Fisher RA. 1949. The Theory of Inbreeding. Oliver & Boyd.

Fisher RA. 1950. Statistical Methods for Research Workers. Oliver & Boyd.

Fisher RA. 1958. The Genetical Theory of Natural Selection. Dover Publ.

Kempthorne O. 1957. An Introduction to Genetic Statistics. The Iowa State Univ. Press.

Lerner IM. 1950. Population Genetics and Animal Improvement. Cambridge Univ. Press.

Lerner IM. 1954. Genetic Homeostasis. Oliver & Boyd.

Lerner IM. 1958. The Genetic Theory of Selection. John Wiley.

Li CC. 1982. Population Genetics. The University of Chicago Press.

Mather K & Jinks JL. 1977. Introduction to Biometrical Genetics. Chapman & Hall.

Mather K & Jinks JL. 1982. Biometrical Genetics. Chapman & Hall.

Mather K. 1949. Biometrical Genetics. Methuen.

Mather K. 1951. The Measurement of Linkage in Heredity. Methuen.

Narain P. 1990. Statistical Genetics. Wiley Eastern.

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

STATISTICAL METHODS

(Foundation course Paper 1)

UNIT I: Descriptive statistics: probability distributions: Discrete probability distributions ~ Bernoulli, Binomial, Poisson, Negative-binomial, Geometric and Hyper Geometric, uniform, multinomial ~ Properties of these distributions and real life examples. Continuous probability distributions ~ rectangular, exponential, Cauchy, normal, gamma, beta of two kinds, Weibull, lognormal, logistic, Pareto. Properties of these distributions. Probability distributions of functions of random variables.

UNIT II: Concepts of compound, truncated and mixture distributions (definitions and examples). Pearsonian curves and its various types. Sampling distributions of sample mean and sample variance from Normal population, central and non–central chi-Square, t and F distributions, their properties and inter relationships.

UNIT III: Concepts of random vectors, moments and their distributions. Bivariate Normal distribution - marginal and conditional distributions. Distribution of quadratic forms. Cochran theorem. Correlation, rank correlation, correlation ratio and intra-class correlation. Regression analysis, partial and multiple correlation and regression.

UNIT IV: Sampling distribution of correlation coefficient, regression coefficient, correlation ratio, intra class correlation coefficient. Categorical data analysis - loglinear models, Association between attributes. Variance Stabilizing Transformations.

UNIT V: Order statistics, distribution of r-th order statistics, joint distribution of several order statistics and their functions, marginal distributions of order statistics, distribution of range, median, etc.

Suggested Readings

Agresti A. 2002. Categorical Data Analysis. 2nd Ed. John Wiley.

Arnold BC, Balakrishnan N & Nagaraja HN. 1992. A First Course in Order Statistics. John Wiley. David HA & Nagaraja HN. 2003. Order Statistics. 3rd Ed. John Wiley.

Dudewicz EJ & Mishra SN. 1988. Modern Mathematical Statistics. John Wiley.

Huber PJ. 1981. Robust Statistics. John Wiley.

Johnson NL, Kotz S & Balakrishnan N. 2000. Continuous Univariate Distributions. John Wiley.
Johnson NL, Kotz S & Balakrishnan N. 2000. Discrete Univariate Distributions. John Wiley.

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Marek F. 1963. Probability Theory and Mathematical Statistics. John Wiley.

Rao CR. 1965. Linear Statistical Inference and its Applications. John Wiley.

Rohatgi VK & Saleh AK Md. E. 2005. An Introduction to Probability and Statistics. 2nd Ed. John Wiley.

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M. A/ M. Sc. (Statistics)

Research Methodology

(Foundation course Paper 2)

Unit I: Nature and scope of research methodology. Problem Formulation and Statement of Research objectives.

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

Unit III: Different methods of data collection- Observational, survey(interview) methods, Questionnaire design, Schedule and case study Method, Attitude measurement techniques; Motivational Research techniques.

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

Unit V: 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 Delhi.
2. Kothari. C. R.- Research Methodology, Wishwa Prakashan.
3. Shennoy and Pant, Statistical methods in Business and social sciences.
4. Dwivedi, R.S.,- Research methods in Behavioural Science, Macmillan.
5. Salking Neil, Exploring Research, Third Edition, Prentice Hall (1977).
6. Bennet, Roger- Management Research ILO(1983)

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

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

Unit- 3: Sequence 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, and differentiation under the sign of integral Leibnitz rule.

BOOKS:

2. Apostol,T.M.(1985)   : Mathematical Analysis Narosa. Indian Edn.

3. Rudin Waiter (1976)   : Principles of Mathematical Analysis, McGraw Hills.

4. Mallik, S.C.   : Mathematical Analysis, Wiley Eastern Ltd.

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