



YOGI VEMANA UNIVERSITY : KADAPA

APPROVED SYLLABUS BY BOS (Effect from 2015 – 2016)
M. Sc., Statistics (Computer Applications) -Choice Based Credit System

I Semester

Code	Title of the Paper	No of Credits	Hours per week	Max.Marks:100		Exam time (hrs)
				Internal	External	
15151	Probability and Distributions	4	4	25	75	3
15152	Estimation Theory	4	4	25	75	3
15153	Sampling	4	4	25	75	3
15154	C – Programming	4	4	25	75	3
15151P	Practical I:	4	8	100		3
15152P	Practical II:	4	8	100		3

II Semester

				Max.Marks :100		
25151	Multivariate Analysis	4	4	25	75	3
25152	Testing of Hypothesis	4	4	25	75	3
25153	Stochastic Processes	4	4	25	75	3
25154	Design of Experiments	4	4	25	75	3
25151P	Practical: III	4	8	100		3
25152P	Practical: IV	4	8	100		3
Non-core-1	To be selected from other departments	3	3	25	75	3

III Semester

				Max.Marks :100		
35151	Operations Research I	4	4	25	75	3
35152	Computer - Intensive Statistical Methods	4	4	25	75	3
35153	Knowledge Discovery And Data Mining	4	4	25	75	3
35154	Time Series Analysis	4	4	25	75	3
35151P	Practical: V	3	8	75		3
35152P	Practical : VI	3	8	75		3
Non-core-2	To be selected from other departments	3	3	25	75	3

IV Semester: Theory

				Max.Marks :100		
45151	Operations Research II	4	4	25	75	3
45152	Econometrics	4	4	25	75	3
45153	Computer Programming - c++	4	4	25	75	3
45154	Actuarial Statistics	4	4	25	75	3
45151P	Practical: VII	3	8	75		
45152P	Practical : VIII	3	8	75		
45153P	Project	4		100		
Total for core papers		96	128	2400		
Total for Non-core papers		6	6	200		
Grand Total		104	136	2600		

YOGI VEMANA UNIVERSITY : KADAPA
M.Sc STATISTICS (Computer Applications)
(with effect from 2015-16 batch)

I SEMESTER

PAPER 15151 - PROBABILITY AND DISTRIBUTIONS

UNIT- I

Classes of sets, field, sigma field, minimal sigma field, Borel field. Limit of a sequence of sets. Measure on field, extension of measure to sigma field, Lebesgue measure, Lebesgue-Stieltjes measures, Measurable functions, Borel function, induced sigma field.

UNIT- II

Random variable, convergence of random variables- convergence in probability, almost surely, in the rth mean and in distribution their relationships. Characteristic function, properties, inversion theorem, continuity theorem, Central Limit Theorem, Lindberg-Levy, Liapunoff forms.

UNIT- III

Mathematical expectation, Moments of random variable, conditional expectation, problem of moments. Basic Markov's, Chebycheff's, Holder's, Minkovski's and Jensen's inequalities. Law of large numbers. Chebycheff's and Kinchin's forms of WLLN, Kolmogrov's SLLN. Convergence theorems relating to $X_n + Y_n$, $X_n Y_n$ and X_n / Y_n Where $X_n \rightarrow X$ and $Y_n \rightarrow C$. Weibull and Laplace distributions, their m.g.f., c.f. and other properties. Compound distributions – Poisson-Binomial. Sampling distributions .

UNIT- IV

Non-central chi-square, Non-central t and Non-central F distributions and their properties. Distribution of quadratic forms under normality and related distributions. Multivariate normal, bi-variate as a particular case, moments, c.f., conditional and marginal distributions. Distributions of order statistics from rectangular, exponential and normal distributions. Empirical distribution function, distribution of correlation coefficient, partial and multiple correlations, derivation formulae and inter relationships.

Text Books:

Bhat.B.R. . Modern probability theory. Wiley Eastern Ltd.

Rohatgi, V.K.(1984) . An introduction to Probability and Mathematical Statistics . Wiley Eastern

Goon, A.M., Gupta, M.K., Das Gupta, B.An outline of statistical theory, Vol. I. The World Press Pvt. Ltd., Kolkata.

References :

Billingsley, P.(1986) . Probability and Measure. Wiley

Kingman, J.F.C., and Taylor, S.J. (1966) . Introduction to Measure and Probability. Cambridge University Press.

David, H.A. . Order Statistics

Feller, W. . Introduction to Probability Theory And Its Applications, Vol. II

Cramer, H. (1946). Mathematical Methods of Statistics. Princeton

Morrison, D. F.(1976). Multivariate Statistical Methods. 2nd ed., McGraw Hill

Mardia

Anderson, T.W. (1983) . An Introduction to Multivariate Statistical Analysis. 2nd ed., Wiley.

Jhonson, R. and Wichern (1992). Applied Multivariate Statistical Analysis. 3rd ed., Prentice Hall.

PAPER 15152 - ESTIMATION THEORY

UNIT- I

Point estimation. Concepts of unbiasedness, consistency, minimum variance unbiased estimation. Information in a sample, Cramer-Rao inequality, efficiency of an estimator, Chapman-Robin's inequality and Bhattacharya bounds, definition of CAN estimator.

UNIT- II

Concept of sufficiency, single parameter and several parameter cases. Fisher-Neyman Factorization theorem, minimal-sufficient statistic, exponential families and Pitman families. Invariance property of sufficiency under 1-1 transformation of sample space and parameter space. Distributions admitting sufficient statistics, Rao-Blackwell theorem, completeness, Lehman-Scheffe theorem, joint sufficiency (regular case).

UNIT- III

Method of maximum likelihood, CAN estimatos for one-parameter Cramer family. Cramer-Huzurbazar theorem, solution of likelihood equations, method of scoring. Connection between MLEs and efficient estimators, MLEs and sufficient estimators.

UNIT- IV

Censored and truncated distributions. Type I and Type II censoring for normal and exponential distributions and their MLEs. Interval estimation. confidence intervals using pivots, shortest expected length confidence intervals.

Text Books

Goon, A.M., Gupta, M.K., Das Gupta, B. An Outline of Statistical Theory. Vol. II, The World Press PVT. Ltd., Kolkata.
Rohatgi, V. (1998). An Introduction to Probability and Mathematical Statistics. Wiley Eastern Ltd., New Delhi. Kale, B.K. (1999). A First Course on Parametric Inference. Narosa Publishing House.

References

Lehmann, E.L.(1986). Theory of Point Estimation.
Rao, C.R. (1973). Linear Statistical Inference.
Dudewicz, E.J. and Misra, S.N(1988) . Modern Mathematical Statistics. Student's Edition, Wiley. Lawless, J.F., Statistical Models and Methods for Lifetime Data. John Wiley & Sons.

PAPER 15153 – SAMPLING

UNIT- I

Selection with varying probabilities, PPS sampling, Horvitz and Thomson estimator, Yates' and Grundy's estimator, Midzuno-Sen sampling scheme. Systematic sampling. Estimation of population mean and its variance, Methods for populations with linear trend. Yates correction, modified systematic sampling, balanced systematic sampling, centrally located sampling, circular systematic sampling.

UNIT- II

Cluster sampling. Estimation of population mean and its variance, efficiency of cluster sampling, determination of optimal cluster size, estimation of proportion, cluster sampling with varying sizes. Two-stage sampling . Two-stage sampling with equal first stage UNIT----s. Estimation of mean and its variance. Optimum allocation. Three–stage sampling with equal probabilities. Two-stage pps sampling.

UNIT- III

Ratio estimation: Introduction. Bias and mean square error, estimation of variance, confidence interval, comparisons with mean per UNIT---- estimator, ratio estimator in stratified random sampling. Difference estimator and regression estimator: Introduction. Difference estimator, difference estimator in stratified sampling. Regression estimator, comparison of regression estimator with mean per UNIT---- estimator and ratio estimator. Regression estimator in stratified sampling.

UNIT- IV

Multi-phase sampling: Introduction. Double sampling for difference estimation, double sampling for ratio estimation, double sampling for regression estimator , optimum allocation varying probability sampling. Non-sampling errors. Sources and types of non-sampling errors, non-response errors, techniques for adjustment of non-response, Hansen and Harvitz technique, Deming's model.

Text Books

F.S.Chaudhary . Theory and Analysis of Sample Survey Designs, New Age International Publishers, Delhi.

Des Raj . Sampling Theory.

Cochran, W.G. Sampling Techniques.

Murthy, M.N. . Sampling Theory Techniques.

Parimal Mukhopadhyay. Theory and Methods of Survey Sampling. Prentice-Hall of India Pvt. Ltd., New Delhi.

Sukhatme, P.V. and Sukhatme, B.V. . Sampling Theory of Survey with Applications.

PAPER 15154 - C – PROGRAMMING

UNIT- I

Identifiers and key words, data types, constants, variables and arrays, declarations, expressions, statements, symbolic constants. Operators and expressions . Arithmetic, unary, relational and logical, assignment, conditional operators. Library functions.

UNIT- II

Data input and output. getchar, putchar functions, scanf, printf, gets, puts functions. Control statements. while, do-while, for nested loops, if-else, switch, break, continue, exit operator, goto statement. Functions. Definitions, accessing a function, passing arguments to a function, specifying argument types, function prototypes and recursion.

UNIT- III

Program structure. Storage classes, automatic, external and static variables. Arrays. Definition, processing an array, passing arrays to a function, multi-dimensional arrays, arrays and strings. Pointers. Fundamentals, pointer declarations, passing pointers to a function, pointers and multi-dimensional arrays, operations on pointers arrays of pointers, passing functions to other functions.

UNIT- IV

Structures and Unions. Definitions, processing, typedef, structures and pointers, passing structures to a function, self-referential structures. Data Files. Opening and closing a data file, creating, processing a data file, unformatted data files.

Text Books

Balaguruswamy, E. . Programming in C. Tata McGraw Hill.
Somasekharan, M.T. . Programming in C. Prentice Hall, India.
Brain, W., Karnighan and Dennis, M. Reitech. Prentice Hall India Ltd.
Byron, S.Gottfried. Programming with C. Tata McGraw Hill.
Kochan, S.G. . Programming in C.

Practical – I : Consisting of 24 practicals exercises covering at least 3 exercises from each unit of Paper I and Paper-II.

Practical – II : Consisting of 24 practicals exercises covering at least 3 exercises from each unit of Paper III and Paper-IV.

SEMESTER II

PAPER 25151 – MULTIVARIATE ANALYSIS

UNIT- I

Definition of Wishart matrix and its properties, Mahalanobis distance, null

2

distribution of Hotelling's T^2 statistic. Its Application . tests on mean vector for one and more multivariate normal populations , equality of the components of a mean vector in a multivariate population.

UNIT- II

Classification and discrimination procedures: Procedures for discriminating between two multivariate normal populations, sample discriminant function, tests associated with discriminant functions, probability of misclassification and their estimation. Classification into more than two multivariate populations. K-nearest neighbour classification.

UNIT- III

Principle components, dimension reduction. Canonical variables and canonical correlation. Definition, use, estimation and computation. Factor analysis: Orthogonal factor model, methods of estimating factor loadings – principle component method, principle factor method, iterated principle factor method. Maximum likelihood estimation. Factor rotation, orthogonal factor rotation – varimax, quartimax rotations, oblique rotation criteria for determining number of common factors. Factor scores.

UNIT- IV

Cluster analysis : Hierarchical clustering - single, complete and average linkage methods, centroid and Ward's methods. Non-hierarchical methods – K-means algorithm. Multi-dimensional scaling.

Note . Practical exercises must be based on statistical packages only.

Text Books .

Anderson, T.W. (1983) . An Introduction to Multivariate Statistical Analysis. 2nd ed., Wiley.

Seber, G.A.F. (1984). . Multivariate observations. Wiley.

Johnson, R. and Wichern (1992) . Applied Multivariate Statistical Analysis. Prentice-Hall, 3rd ed.

References.

Gin, N.C. (1977). Multivariate Statistical Inference. Academic Press.

Kshirasagar, A.M. (1972). Multivariate Analysis. Marcel Dekker.

Morrison, D.F. (1976). Multivariate Statistical Methods. 2nd ed. McGraw Hill.

Muirhead, R.J. (1982). Aspects of Multivariate Statistical Theory. John Wiley.

Rao, C.R. (1973). Linear Statistical Inference and its Applications. 2nd ed., Wiley.

Sharma, S. (1996). Applied Multivariate Techniques. Wiley.

Srivastava, M.S. and Khatri, C.G. (1979). An Introduction to Multivariate Statistics. North Holland.

PAPER 25152 – TESTING OF HYPOTHESIS

UNIT- I

Neyman-Pearson theory. Lemma using critical functions. Uniformly most powerful tests, their relation with sufficient statistics,

UNIT- II

Monotone likelihood ratio and UMP tests for one-sided hypothesis, composite hypothesis. Unbiased tests, uniformly most powerful unbiased tests. Type-A and Type-A regions.

1

UNIT- III

Likelihood ratio criterion, its asymptotic distribution, one sample, two sample and k-sample problems. Linear hypothesis. Wald's SPRT. Proof that it terminates in a finite number of steps with probability 1. O.C and A.S.N. functions. Examples of binomial and normal cases for testing hypothesis on μ and σ^2

UNIT- IV

Notion of non-parametric test, different NP tests. Run test, sign test, Wilcoxon and Mann-Whitney test, Median test, derivations of the mean and variance of the above test statistics when null hypothesis is true. Chi-square test for goodness of fit, its asymptotic distribution, description of Kolmogorov-Smirnov test, tests involving rank correlation (Kendall's and Spearman's).

Text Books .

Rohatgi, V.K. . Statistical Inference, John Wiley and Sons.

Gibbons, J.D. . Non-parametric Inference, McGraw Hill

Wald. Sequential Analysis, John Wiley and Sons.

Goon, Gupta and Das Gupta . An Outline of Statistical Theory. Vol. 2, The World Press Pvt. Ltd., Kolkata.

References.

Lehmann, E.L. . Testing of Statistical Hypothesis. John Wiley and Sons.

Rao, C.R.. Linear Statistical Inference and its Applications. John Wiley and Sons.

Sidney Siegel . Non-parametric Statistics for the Behavioural Sciences.

PAPER 25153 – STOCHASTIC PROCESSES

UNIT- I

Introduction to stochastic processes(sps), classification of sps' according to state space and time domain. Countable state Markov Chains(MCs), Chapman-Kolmogorov equations, calculation of n-step transition probability and its limit. Classification of states, period of state, stationary distribution of MC.

UNIT- II

Random walk and gambler's ruin problem. Random walk in one and two dimensions. Gambler's ruin problem, probability of ultimate ruin, expected duration of the game. Discrete state space continuous time MC. Poisson process and its properties, birth process, death process, birth and death process.

UNIT- III

Weiner process as a limit of random walk, elementary properties of Weiner process. Branching process. G-W branching process, probability of ultimate extinction, distribution of population size.

UNIT- IV

Renewal Theory. Elementary renewal theorem and applications. Study of residual and excess life times and their distributions. Stationary process. Weakly stationary process and strongly stationary process.

Text Books.

Medhi, J. (1982). Stochastic Processes. Wiley Eastern.
Bhat, B.R.(2002). Stochastic Models- Analysis and Applications. New Age International, India.
Basu, A.K. . Introduction to Stochastic Process.
Srinivasan and Mehta. Stochastic Processes.

References.

Adke, S.R. and Manjunath, S.M. (1984). An introduction to Finite Markov Processes, Wiley Eastern.
Cinlar, E. (1975) . Introduction to Stochastic Processes. Prentice-Hall.
Feller, W. (1968). Introduction to Probability and Applications. Vol. I, Wiley Eastern.
Hoel, P.G., Port, S.G. and Stone, C.J. (1972). Introduction to Stochastic Processes. Houghton Mifflin and Co.
Karlin, S. and Taylor, H.M. (1975) . A First Course in Stochastic Processes. Vol. I
Parzen, E. (1962). Stochastic Processes. Holden-Day.

PAPER 25154 – DESIGN OF EXPERIMENTS

UNIT- I

Principles of designs, analysis of variance and analysis of co-variance, fixed and random effect models. Contrasts. Model adequacy checking. Test for normality, test for equality of variances (Bartlett test, Modified Levene method)

UNIT- II

C.R.D., R.B.D., estimation of parametric functions and tests of hypothesis, comparison of their efficiencies. Missing plot techniques, testing the equality of subsets of block effects or treatment effects. Multiple comparisons tests . Tukey's , Fisher's Least Significant Difference (LSD) method, Duncan's multiple range test.

UNIT- III

L.S.D., orthogonality in L.S.D. Missing plot technique, Analysis of split plot design. Factorial designs. Analysis of 2 and 3 designs. Estimation of factorial effects, testing their significance. Total and partial confounding.

UNIT- IV

Youdin design, intra block analysis. B.I.B.D., P.B.I.B.D., their analysis, estimation of parameters, testing of hypothesis.

Text Books.

Das, M.N. and Giri, N.C.. Design and Analysis of Experiments. New Age International Pvt. Ltd.

Montgomery, D.C. . Design and Analysis of Experiments. John Wiley and Sons, New York.

References.

Cochran and Cox . Experimental Designs. Asia Publishing House, Bombay.

Kemp Thorne. Design and Analysis of Experiments, Wiley Eastern Pvt. Ltd., New Delhi.

Practical – I : Consisting of 24 practicals exercises covering at least 3 exercises from each unit of Paper I and Paper-II.

Practical – II : Consisting of 24 practicals exercises covering at least 3 exercises from each unit of Paper III and Paper-IV.

SEMESTER III

PAPER 35151 – OPERATIONS RESEARCH I

UNIT- I

Definition and scope of Operations Research (O.R). Phases in OR. Models and their solutions. Linear Programming (LP). Graphical, simplex, revised simplex methods. Duality and sensitivity analysis. Transportation and assignment problems.

UNIT- II

Sequencing and scheduling problems. 2-machine n-job and 3-machine n-job problems with identical machine sequence for all jobs, 2-job n-machine problem with different routings.

UNIT- III

Analytical structure of inventory problems, EOQ formula of Harris, its sensitivity analysis and extensions allowing quantity discounts and shortages. Multi-item inventory subject to constraints. Models with random demand, static risk model, P and Q systems with constant and random lead times. S-s policy for inventory and its derivation in the case of exponential demand, multi-echelon inventory models.

UNIT- IV

Queuing models : specifications and effectiveness measures. Steady state solutions of M/M/1 and M/M/C with associated distributions of queue length and waiting time. M/G/1 queue and Pollaczek –Kinchine result. Steady state solutions of M/E_k/1 and E_k/M/1 queues. Machine interference problem. Bulk queues (bulk arrival and bulk service), finite queues, queues in tandem, GI/G/1 queue and its solution, simulation of queues.

Text Books.

Kanti Swarup, Gupta, P.K. and Man Mohan (1985) . Operations Research, Sultan Chand and Sons.

Sharma, J.K. (2003). Operations Research Theory and Applications. Macmillan, India.

Sharma, S.D. . Operations Research. Kedarnath Ramnath Publishers, Meerut.

References.

Taha, H.A.(1982) .Operations Research: An Introduction. Macmillan.

Hillier, F.S. and Lieberman, G.J. . Introduction to Operations Research. Holden Dev.

Churchman, C.W., Ackoff, R.L., and Arnoff, E.L. (1957) . Introduction to Operations Research. John Wiley.

Gross, D. and Harris, C.M. (1974) . Fundamentals of Queuing Theory. John Wiley.

PAPER 35152 – COMPUTER-INTENSIVE STATISTICAL METHODS

UNIT- I

Stochastic simulation. generating random variables, simulating multivariate distributions, simulating stochastic processes such as simple queues.

UNIT- II

Variance reduction: importance sampling for integration, control variates and antithetic variables. Markov Chain Monte Carlo methods. Gibbs sampling for multivariate simulation, simulated annealing for optimization.

UNIT-III

Bootstrap methods: re-sampling paradigms, bias and standard errors, confidence intervals, bootstrapping in regression.

UNIT- IV

Jackknife and cross-validation: jackknife in sample surveys, cross validation for tuning parameters.

Text Books.

Rubinstein (1981). Simulation and the Monte Carlo Method. Wiley.
Tanner, M.A. (1996). Tools for Statistical Inference. 3rd ed., Springer.
Efron, B. and Tibshirani, R.J. (1993). An introduction to Bootstrap. Chapman & Hall.
Shao, J. and Tu, D. (1995). The Jackknife and the Bootstrap. Springer Verlag.
Gnanadesikan, R. (1997). Methods for Statistical data Analysis of Multivariate Observations. 2nd ed., Wiley.

References.

Fishman, G.S. (1996). Monte Carlo . Concepts, Algorithms and Applications. Springer.
Belsley, D.A., Kuh, E., and Welsch, R.E.(1980). Regression Diagnostics. Wiley
McCullagh, P. and Nelder, J.A. (1999) . Generalized Linear Models. 3rd ed., Chapman and Hall.
Seber, G.A.F., and Wild, C.J.(1989).Non-linear Regression. Wiley.
McLachlan, G.J. and Krishnan, T.(1997). The EM algorithms and extensions. Wiley.
Simon off, J.S. (1996). Smoothing Methods.

PAPER 35153 – KNOWLEDGE DISCOVERY AND DATA MINING

UNIT-I: Review of classification methods from multivariate analysis; classification and decision trees. Clustering methods from both statistical and data mining viewpoints; vector quantization.

UNIT-II: Unsupervised learning from univariate and multivariate data; dimension reduction and feature selection.

UNIT-III: Supervised learning from moderate to high dimensional input spaces; regression trees.

UNIT-IV: Introduction to databases, including simple relational databases; data warehouses and introduction to online analytical data processing. Association rules and prediction; data attributes.

Text Books:

A.Berson and S.J. Smith (1997): Data Warehousing, Data Mining and OLAP. McGraw-Hill.

L.Breiman, J.H. Friedman, R.A. Olshen, and C.J.Stone (1984): Classification Regression Trees. Taylor Francis.

J.Han and M. Kamber (2006): Data Mining; Concepts and Techniques. 2nd Edition. Morgan Kaufmann.

T.M. Mitchell (2011): Machine Learning. Springer.

Reference Book:

B.D.Ripley (2008): Pattern Recognition and Neural Networks. Cambridge University Press.

PAPER 35154 – TIME SERIES ANALYSIS

UNIT- I

Time series as discrete parameter stochastic process. Auto covariance and auto-correlation function, their properties. Exploratory time series analysis. Tests for trend and seasonality. Exponential and moving average smoothing. Holt and Winters smoothing. Forecasting based on smoothing, adaptive smoothing

UNIT- II

Detailed study of the stationary processes: Moving Average (MA), Auto Regressive (AR), ARMA and AR Integrated MA (ARIMA) models.

UNIT- III

Box-Jenkins models: Discussion (without proof) of estimation of mean, auto covariance and auto-correlation functions under large sample theory. Choice of AR and MA periods. Estimation of ARIMA model parameters. Forecasting, residual analysis and diagnostic checking.

UNIT- IV

Spectral analysis of weakly stationary process. Periodogram and correlogram analyses. Computations based on Fourier transform.

Text Books.

Box, G.E.P. and Jenkins, G.M. (1976). Time Series Analysis – Forecasting and Control. Holden Day, San Francisco.

Anderson, T.W. (1971). The Statistical Analysis of Time Series. Wiley, N.Y.

Makridakis, Wheelwright and McGee. Forecasting. Methods and Applications. John Wiley & Sons.

Montgomery, D.C. and Johnson, L.A. (1977). Forecasting an Time Series Analysis. McGraw Hill.

References.

Fuller, W.A. (1976). Introduction to Statistical Time Series. John Wiley, N.Y.

Granger, C.W.J. and Newbold (1984). Forecasting Econometric Time Series. 3rd ed., Academic Press.

Priestley, M.B. (1981). Spectral Analysis and Time Series. Griffin, London.

Kendall, S.M. and Ord, J.K. (1990). Time Series Analysis. 3rd ed., Edward.

Kendall, M.G. and Stuart, A. (1966). The Advanced Theory of Statistics. Vol.3, Charles Griffin, London

Blooinfield, P.(1976). Fourier Analysis of Time Series-An Introduction, Wiley.

Granger, C.W.J. and Hatanka, M.(1964). Spectral Analysis of Economic Time Series. Princeton Univ. Press, N.Y.

Koopmans, L.H.(1974). The Spectral Analysis of Time Series. Academic Press.

Practical – I: Consisting of 24 practicals exercises covering at least 3 exercises from each unit of Paper I and Paper-II.

Practical – II: Consisting of 24 practicals exercises covering at least 3 exercises from each unit of Paper III and Paper-IV.

SEMESTER IV

PAPER 45151- OPERATIONS RESEARCH II

UNIT- I

Decision Theory: Decision theory approach, decision theory under uncertainty, under risk, posterior probabilities and Bayesian analysis, decision tree analysis, decision making with utilities.

UNIT- II

Game theory: two-person games, pure and mixed strategies, existence of solution and uniqueness of value in zero-sum games, finding solutions in 2×2 , $2 \times m$ and $m \times n$ games. Dynamic programming.

UNIT- III

Integer programming: Branch and Bound algorithm and cutting plane algorithm. Multi-criterion and goal programming. Replacement problems: block and age replacement policies, replacement of items with long life.

UNIT- IV

Project management: CPM, PERT, probability of project completion, crashing. Information theory: Communication process, entropy, channel capacity, efficiency, redundancy. Shannon-Fano encoding procedures. Non-linear programming: Kuhn-Tucker conditions, Wolfe and Beale's algorithms for solving quadratic programming problems.

Text Books.

Kanti Swarup, Gupta, P.K. and Man Mohan (1985) . Operations Research, Sultan Chand and Sons.
Sharma, J.K. (2003). Operations Research Theory and Applications. Macmillan, India.
Sharma, S.D. . Operations Research. Kedarnath Ramnath Publishers, Meerut

References.

Taha, H.A.(1982) .Operations Research-An Introduction. Macmillan.
Hillier, F.S. and Lieberman, G.J. . Introduction to Operations Research. Holden Dev.
Churchman, C.W., Ackoff, R.L., and Arnoff, E.L. (1957) . Introduction to Operations Research. John Wiley.
Gross, D. and Harris, C.M. (1974) . Fundamentals of Queuing Theory. John Wiley.

PAPER 45152 – ECONOMETRICS

UNIT- I

Nature and scope of econometrics. General Linear Model. assumptions, OLS method of estimation, tests of hypothesis, confidence intervals, prediction, estimation subject to linear restrictions, maximum likelihood estimation.

UNIT- II

Tests of structural change: dummy variables and seasonal adjustments, equality of two regression equations, specification errors. Estimation methods.

UNIT- III

Generalized least squares: Aitken estimators. Heteroscedasticity. Goldfeld-Quandt test, Park test, weighted least square method of estimation. Auto-correlation. detection by Durbin-Watson statistic, estimation methods. Cochran, Orcutt and Durbin's. SUR system of equations.

UNIT- IV

Lagged variables: distributed lag models- Koyck approach, adaptive expectations model, stock adjustments models, Almon's approach. Errors in variables. Simultaneous equation models: structural form, reduced form and recursive form. Identification problem, order and rank conditions. Methods of estimation. 1LS, 2SLS, IV, LIML and 3SLS.

Text Books.

Gujarathi, D.(1979). Basic Econometrics, McGraw Hill.

Johnston, J.(1984). Econometric Methods. 3rd ed., McGraw Hill.

Koutsoyiannis, A.(1979). Theory of Econometrics. Macmillan Press.

Theil, H.(1982). Introduction to the Theory and Practice of Econometrics. John Wiley.
References.

Apte, P.G. (1990). Text Book of Econometrics. Tata McGraw Hill.

Cramer, J.S. (1971). Empirical Econometrics. North Holland.

Intrilligator, M.D.(1980). Econometric Models-Techniques and Applications. Prentice Hall of India.

Klien, L.R. (1962). An Introduction to Econometrics. Prentice Hall of India.

Mallinvald, E (1966). Statistical Methods of Econometrics. North Holland.

Srivastava, V.K. and Gile, D.A.E. (1987). Seemingly Unrelated Regression Equation Models. Marcel and Dekker.

Walters, A. (1970). An Introduction to Econometrics. McMillan & co.

PAPER 45153 - COMPUTER PROGRAMMING - C++

UNIT- I

Object oriented programming principles, declaration of classes, array of classes, pointer to classes, constructors and destructors.

UNIT- II

Friend functions, inline function, static class members, this pointer. Single, multiple inheritance. Types of derivation such as public, private, protected inheritance and member access controls, ambiguity in inheritance.

UNIT- III

Virtual base class, container classes. Function overloading. Operator Overloading. overloading of assignment, binary and unary operators.

UNIT- IV

Polymorphism, early binding, virtual functions, late binding, pure virtual functions, abstract base classes, constructor under inheritance, destructor under inheritance, virtual destructors.

Templates and exception handling. Data file operations, structures and file operations, classes and file operations.

Text Books.

Deital & Deital . C++. Prentice-Hall Inc.

Sinan Si Alhir . UML. Orielly.

Sarang . Object Oriented Programming with C++. Prentice-Hall.

Balaguruswamy, E. . Programming in C++. Tata McGraw Hill.

References.

Decker, R. and Hirshifield, S. (1998). The Object Concept. An Introduction to Computer Programming using C++. PWS Publishing.

Lippmann, S.B. and Lajoie, J. (1998). C++ Primer. 3rd ed. Addison-Wesley.

Nauhaton, P.(1996). The Java Handbook. Tata McGraw Hill.

Sawitch, W.J. (2001). Problem Solving with C++ . The Object of Programming. 3rd ed. Addison-Wesley, Longman.

PAPER 45154 – ACTUARIAL STATISTICS

UNIT- I

Theory of interest rates: rate of interest, nominal rate of interest. Accumulation factors. Force of interest, present values, Stoodley formula for the force of interest, present value of cash flows, valuing cash flows. Basic compound interest function, equations of values and yield on transaction-annuities certain, present values and accumulation, concepts of different annuities, continuously payable annuities, varying annuities.

UNIT- II

Utility theory, insurance and utility theory, models for individual claims and their sums, approximations for the distribution of the sum. Application to insurance. Survival function, time until death for a person age x , curate future life time, force of mortality. Life table and its relation with survival function, examples, the deterministic survivorship group, recursion formulas, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

UNIT- III

Life insurance: insurance payable at the moment of death and at the end of the year of death-level benefit insurance, endowment insurance, deferred insurance and varying benefit insurance. Life annuities. single payment, continuous life annuities, discrete life annuities, life annuities with monthly payments, recursions, complete annuities-immediate and apportionable annuities-due.

UNIT-IV

Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions, evaluation for special mortality laws. Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrements, central force assumptions for multiple decrements. Uniform distribution assumption for multiple decrements.

Text Books.

Bowers, N.L., Gerber, H.U., Hickman, J.C, Jones, D.A., and Nesbitt, C.J. (1986) . Actuarial Mathematics. Society of Actuaries, Ithaca, Illinois, U.S.A. 2nd ed. (1997) CH. 1,2,3,4,5,9 & 10.
McCutcheon, J.J. and Scott, W.F. . An Introduction to Mathematics of Finance. Butter Worth & Heinemann.

References.

Spurgeon, E.T. (1972). Life Contingencies. Cambridge University press.
Nall, A. (1977). Life Contingencies. Heinemann.

Practical – I : Consisting of 24 practicals exercises covering at least 3 exercises from each unit of Paper I and Paper-II.

Practical – II : Consisting of 24 practicals exercises covering at least 3 exercises from each unit of Paper III and Paper-IV.