SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U.COLLEGE OF SCIENCES
DEPARTMENT OF STATISTICS
(Syllabus common for SV University College and affiliated by SVU Area)
(Revised Scheme of Instruction and Examination, Syllabus etc., with effect from the Academic Years 2016-17 for I and II Semesters and 2017-18 for III and IV Semesters)
M.Sc. APPLIED STATISTICS
SCHEME OF INSTRUCTION AND EXAMINATION
I SEMESTER

Sl. No.	Course Code	Component of Study	Title of the Course	Contact Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total Marks
1	APST - 101	Core	Linear Algebra	6	4	20	80	100
2	APST - 102	Core	Probability Theory	6	4	20	80	100
3	APST - 103	Core	Distribution Theory	6	4	20	80	100
4	APST - 104	Core	Practical-I (75 Practical + 25 Record)	6	4	-	-	100
5	APST - 105	Compulsory Foundation (Related to Subject)	Statistical Computing	6	4	20	80	100
6	APST - 106	Elective Foundation	Human Values and Professional Ethics-I	6	4	20	80	100
			Total	36	24			600

II SEMESTER

Sl. No.	Course Code	Component of Study	Title of the Course	Contact Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total Marks
1	APST - 201	Core	Statistical Inference	6	4	20	80	100
2	APST - 202	Core	Multivariate Analysis	6	4	20	80	100
3	APST - 203	Core	(a) Linear Models and Applied Regression Analysis (b) Stochastic Processes (c) Mathematical Analysis	6	4	20	80	100
4	APST - 204	Core	Practical-II(75 Practical +15 Viva- voce + 10 Record)	6	4	-	-	100
5	APST - 205	Compulsory Foundation (Related to Subject)	Sampling Techniques	6	4	20	80	100
6	APST - 206	Elective Foundation	Human Values and Professional Ethics-II	6	4	20	80	100
Total				36	24			600

III SEMESTER

Sl. No.	Course Code	Components of Study	Title of the Course	Contact Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total Marks
1	APST - 301	Core	Applied Econometrics	6	4	20	80	100
2	APST - 302	Core	Experimental Designs and Applications	6	4	20	80	100
3	APST -303	Core	Applied Operations Research	6	4	20	80	100
4	APST -304	Core	Practical-III (75 Practical +25 Record)	6	4	-	-	100
5	APST - 305	Generic Elective* (Related to Subject)	(a) Advanced Bio-Statistics	6	4	20	80	100
			(b) Computer Programming and Data Analysis	6	4	20	80	100
			(c) Data Mining and Information Security					
6	APST - 306	Open Elective (For other Department)	(a) Statistics for Biological and Earth Sciences (b) Statistics for Social and Behavioral Sciences	6	4	20	80	100
	Total			**36**	**24**			**600**

* Among the Generic Electives the student shall choose two

Sl. No.	Course Code	Components of Study	Title of the Course	Contact Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total Marks
1	APST - 401	Core	Applied Forecasting Methods	6	4	20	80	100
2	APST - 402	Core	Applied Demography and Official Statistics	6	4	20	80	100
3	APST - 403	Core	Reliability and Survival Analysis	6	4	20	80	100
4	APST - 404	Core	Practical-IV (75 Practical + 15 Viva-voce + 10 Record)	6	4	-	-	100
5	APST - 405	Generic Elective* (Related to Subject)	(a) Statistical Quality Control	6	4	20	80	100
			(b) Statistics for Research, industry and Community Development	6	4	20	80	100
			(c)Actuarial Statistics					
6	APST - 406	Open Elective (For other Department)	(a) Statistics for Marketing Research	6	4	20	80	100
			(b) Statistical Analysis Using SPSS					
	Total			36	24			600

* Among the Generic Electives the student shall choose two

I SEMESTER

APST 101: LINEAR ALGEBRA

Unit-I: Algebra of matrices; Elementary transformations; Rank and Inverse of a matrix; Nullity; Partitioned matrices; Kronecker product; Generalized inverse of matrix; Moore-Penrose generalized inverse; Solutions of simultaneous equations.

Unit-II: Finite dimensional Vector Spaces; Vector Spaces and Subspaces; Linear dependence and independence; Basis and dimension of a vector space; Completion theorem; Inner product Spaces; Orthonormal basis and Gram-Schmidt orthogonalization process; Orthogonal projection of a vector.

Unit-III: Linear transformations and properties; Orthogonal and unitary transformations; Real quadratic forms; Reduction and classification of quadratic forms; Hermitian forms; Sylvesters law of inertia; Canonical reduction of quadratic form.

Unit-IV: Characteristic roots and vectors; Cayley – Hamilton theorem; Minimal polynomial; Similar matrices; Spectral decomposition of a real symmetric matrix; Reduction of a pair of real symmetric matrices; Hermitian matrices.

References:
1. Graybill, F.A. (1983). Matrices with applications in statistics, 2nd ed. Wadsworth, Belmont (California).
2. Rao, C. R. (1985). Linear statistical inference and its applications, Wiley Eastern Ltd., New Delhi.
3. Searle, S. R. (1982). Matrix Algebra useful for Statistics, John Wiley and Sons. Inc.
4. Bellman, R. (1970), Introduction to Matrix Analysis, 2nd ed. McGraw Hill, New York.
5. Campbell, H.G. (1980), Linear Algebra with Applications, 2nd Edition, Prentice-Hall, Englewood Cliffs (new Jersey), 1980.
6. Biswas, S. (1984), Topics in Algebra of Matrices, Academic Publications.
7. Hadley, G. (1987), Linear Algebra, Narosa Publishing House.
8. Halmos, P.R. (1958), Finite-dimensional Vector Spaces 2nd ed. D.Van Nostrand Company, Inc.
9. Hoffman, K. and Kunze, R, (1971). Linear Algebra, 2nd ed., Prentice Hall
10. Rao, A.R. and Bhimasankaram, P. (1992), Linear Algebra, Tata McGraw Hill Publishing Company Ltd.
11. Rao, C.R. and Mitra, S.K. (1971), Generalized Inverse of Matrices and its Applications, John Wiley and Sons, Inc.
12. Narayan, S. (1970), Theory of Matrices, S. Chand &Company, New Delhi.

APST 102: PROBABILITY THEORY

Unit-I: Classes of sets, fields, σ -fields, minimal σ -field, Borel σ – field in R^K, sequence of sets, limsup and liminf of a sequence of sets. Measure, Probability measure, properties of a measure, Caratheodory extension theorem (statement only), Lebesgue and Lebesgue-Stieltjes measures on R^K.

Unit-II: Measurable functions, Random variables, sequence of random variables, almost sure convergence, convergence in probability (and in measure). Integration of a measurable function with respect to a measure, Monotone convergence theorem, Fatou's lemma, Dominated convergence theorem.

Unit-III: Expectation of a random variable, inequalities on expectations, Markov, Holder, Jensen and Liapiunov inequalities. Borel- Cantelli - Lemma, Independence, Weak law and strong law of large numbers for iid sequences, Chebyshev's theorem, khinchine's theorem, Kolmogorov theorems (statements only).

Unit-IV: Convergence in distribution, theorem (statement only), CLT for a sequence of independent random variables under characteristic function, uniqueness theorem, CLT for iid random variables, Lindberg-Levy Central limit theorem; Liapounov theorem (statements only).

References :
1. Ash, Robert. (1972). Real Analysis and Probability. Academic Press.
2. Billingsley, P. (P. (1986) Probability and Measure. Wiley.
3. Dudley, R.M. (1989). Real Analysis and Probability, Wadsworth and Brooks/Cole.
4. Kingman, J F C and Taylor, S. J. (1966). Introduction to Measure and Probability. Cambridge University Press.
5. Loeve, M (1963), Probability theory
6. Bhatt B.R (1998), Modern Probability theory, Wiley Eastern
7. Mukhopadhyay, P.(2002), Mathematical Statistics, Books& Allied (p) Ltd., Kolkata.

APST 103: DISTRIBUTION THEORY

Unit-I: Brief review of basic distribution theory, joint, marginal and conditional p.m. functions and p.d. functions. Rectangular, lognormal, exponential, gamma, beta, Cauchy, Laplace and Weibull distributions. Functions of random variables and their distributions using Jacobian of transformations and other tools.

Unit-II: Sampling distributions: central Chi Square, t and F distributions and its properties, applications, relation between t and F, F and χ^2; Fisher's Z-distribution, fisher's Z-transformation. Non-central chi-square, t and F distributions and their properties.

Unit-III: Order statistics and their distributions, joint and marginal distributions of order statistics, distribution of range. Extreme values and their asymptotic distributions.

Unit-IV: Multiple and partial correlation coefficients, multiple linear regression, inter relationship among partial and multiple correlation and regression coefficients. Null distributions of simple, partial and multiple correlation coefficients. Compound binomial distribution and compound Poisson distribution.

References:
1. Dudewicz E.J and Mishra S.N (1988): Modern Mathematical Statistics, Wiley, International Students Edition.
2. Rohatgi V.K. (1984): An Introduction to probability theory and mathematical statistics.
3. Rao C.R (1973): Linear Statistical Inference and its Applications, 2/e, Wiley Eastern.
4. Pitman J. (1993): Probability, Narosa Publishing House.
5. Johnson, N.L and Kotz, S.M. (1972): Distributions in Statistics, Vol. I , II & III. Houghton and Miffin.
6. Yule, U and M.G. Kendall: An introduction to the theory of Statistics.
7. David H.A (1981): Order Statistics, II Edition, and John Wiley.
8. Feller W (1966): Introduction to probability theory and its applications, Vol. III, second edition. Wiley Eastern.
9. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics. Sulthan and Chand Company.
10. Mukhopadhyay, P(2002), Mathematical Statistics, Books and Allied (p) Ltd., Kolkata.

APST 104 : PRACTICAL-I

At least 20 practicals covering all papers relating to the subject in this semester must be carried out. (75 marks for practical examination + 25 marks for record in the semester)

APST 105: STATISTICAL COMPUTING

Unit-I: Programming in C: Identifiers and Key words, data types and their declaration. Data input and output, operators and expressions. Control statements, if, if-else, case, go to statements. Loops, while, do-while and for statements. One and two-dimensional arrays. Concept of structures, Unions and pointers. Simple programs.

Unit-II: Structure of C++ program, Concept of OOP, tokens, key words, data types, dynamic initialization, manipulators, operator overloading. Function prototyping, inline functions, friend function and virtual functions with examples. Data binding using class, creating objects, defining member functions with simple examples. The concept of inheritance and polymorphism. Dynamic memory allocation and processing of linked lists.

Unit-III: Review of Excel, sorting, filtering and construction of charts. Curve fitting and interpretation of the output. Statistical functions in Excel - Calculating theoretical probability using Binomial, Poisson and Normal distributions. Matrix operations- Transpose, Product and Inverse operations using Excel. Pivot tables and look up functions.

Unit-IV: Data bases using MS-Access – working with tables and forms. Various types of queries – make table, update, crosstab and delete quires and their SQL code. Creating reports using Access. Crystal reports tool - standard and cross tab reports using Access and Excel data. Group expert, sort expert, select expert and section expert. Running totals and formulas. Simple statistical charts like Bar graph and Pie Diagrams.

References:
1. Balaguruswamy, E (2007), Programming in ANSI C, 4E, Tata Publishing McGraw-Hill Publishing Ltd.
2. Balaguruswamy, E (1998), Object Oriented Programming with C++, Tata Publishing McGraw-Hill Publishing Ltd.
3. Ravi Chandran. D (2002), Programminig with C++, Tata Publishing McGraw-Hill Publishing Ltd.
4. Sarma K.V.S. (2010), Statistics Made Simple Do it Yourself on PC, Prentice Hall.

APST 106: HUMAN VALUES AND PROFESSIONAL ETHICS-I

UNIT-I: Definition and Nature of Ethics-Its relation to Religion ,Politics, Business, Legal ,Medical And Environment ,Need And Implementation Ethics-Goals-Ethical Values in Various Professions.

UNIT-II: Nature Of Values-Good and Bad, Ends and Means, Actual and Potential Values, Objectives and Subjective Values ,Analysis Of Basic Moral Concepts-rights, Ought, Duty, Obligation, Justice. Responsibility and Freedom .Good Behavior and Respect for Elders, Character and Conduct.

UNIT-III: Ahimsa (Non-Violence), Satya (Truth),Brahmacharya (Celibacy),Asteya (Non-possession) and APARIGRAHA (Non-stealing).Purusharthas (Cardinal virtues)-Dharma (Righteousness), Artha (Wealth), Kama(Fulfillment bodily desires).Moksha (Liberation)

UNIT-IV: Bhagavad Gita-(a) Niskama karma.(b).Buddhism-The four noble truths-Arya Astanga marga, (c) Jainisam- mahavratas and anuvratas. Values embedded in various religions, Religious tolerance, Gandhian ethics.

UNIT-V: Crime and Theories or punishment-(a) Reformative , Retributive and Deterrent ,(b) Views on manu and Yajnavalkya.

References:
1. R.Subramanian ,Professional Ethics, Oxford University Press.
2. Joha S Mackenjie:A Manual Of Ethics.
3. The Ethics of Management by Larue Tone Hosmer.Richard D.Irwin Lnc.
4. Management Ethics Integrity at Work by Joseph A.Petrick and John F.Quinn.Respons Books;New Delhi.
5. "Ethics in Management" By S.A.Sherlekar, Himalaya Publication House.
6. Harold H.Titus ; Ethics For Today.
7. Maitra,S.K;Hindu Ethics.
8. William Lilly;Introduction Ethics.
9. Sinha: A Manual of Ethics.
10. Manu:Manava Dharma Sastra or the Institute of Manu:Comparising the Indian Syasem of Duties :Raligious and civil (ed.) G.C.Halighton.

11. Susrpta samh ita: Tr.Kaviraj Kunjanlal , Kunjalal Brishagratha .Chowkarnaba Sanskrit series. Vol LII and III , Varanasi , Vol I 00, 16'20,21-32 and 74-77 only.
12. Caraka samhita :Tr.Dr.Ram karan sarma and vaidya bhagavan dash, Chowkarnaba Sanskrit series office. Varanasi I,11.111 Vol IPP 183-191.
13. Ethics, Theory and contemporary issues.Barbara mackinnon wadsworth / Thomsaon learning, 2001.
14. Analyzing moral.issues,Judith A.Boss.May Field Publishing Company-1999.
15. An introduction to applied ethics(ed.)John H.Piet and Ayodhya Prasad.cosmo publications.
16. Text book for intermediate first year ethics and human values. Board of intermediate education-Telugu-academy, Hyderabad.
17. I.C.Sharma ethics philosophy of india.Nagin & co julundhar.

SEMESTER – II

APST 201: STATISTICAL INFERENCE

Unit-I: Point estimation - Unbiasedness, Consistency, Efficiency and Sufficiency; Fisher-Neyman factorization theorem, complete sufficient statistics, minimum variance unbiased estimator (MVUE), Cramer - Rao inequality, Battacharayas inequality, Rao – Blackwell theorem. Exponential family, Maximum Likelihood estimation method, method of moments, method of minimum chi-squares and interval estimation.

Unit-II: Tests of hypothesis: Basic concepts, Most Powerful (MP) test, Neyman – Pearson Lemma, Consistency and Unbiased tests, Uniformly Most Powerful (UMP) test, UMP Unbiased tests, similar critical regions, Lehmann –Scheffe theorem, Likelihood Ratio Tests, Asymptotic Distribution of LR test, Bartlett's test for homogeneity of variances and Wald Test.

Unit-III: Non – Parametric tests of significance; Sign Test, Wilcoxon-Mann-Whitney U-test, Run test, Kolmogorov-Simrnov one and two sample tests, Median test, Kendall's τ test. Concept of asymptotic relative efficiency, CAN, BAN, CAUN and BEST CAUN estimators, MLE in Pitman family and Double Exponential distribution, MLE in Censored Truncated distribution.

Unit-IV: Statistical decision theory – decision problems and two person games, problems of inference viewed as decision problems, non-randomized and randomized decision rules, Loss and Risk functions, admissibility, complete and essentially complete class, complete class theorem. Bayes principle, determination of Bayes rule Minimax principle, determination of minimax rule, minimax theorem. Minimax estimates of parameters of Binomial, Poisson and Normal distributions.

References:
1. Rohtagi, V.K (1988): An Introduction to Probability and Mathematical Statistics, Wiley Eastern
2. Rao C.R (1973), Linear Statistical Inference and its applications, (Revised Edition), Wiley Eastern
3. Lehmann, E.L (1986), Theory of point estimation, (Student Edition)
4. Lehmann, E.L (1986), Testing Statistical Hypothesis (Student Edition)
5. Gibbons, J.D (1985), Non-parametric statistical inference, 2nd Edition, Mercel Dacker Inc
6. Siegal Sidney (1987), Non-parametric Statistics for behavioral sciences, 3rd Edition, Springer Verlog
7. Kendal, M.G and Stuart, A (1968), The advanced theory of statistics, Vol-II, Chales Griffin and Co., London
8. Ferguson, T.S (1967), Mathematical Statistics – a decision theoretic approach, Academic Press
9. Goon, A.M, Gupta, M and Das Gupta, B (1980), An outline of statistical theory, Vol-II, World Press, Calcutta.

APST 202: MULTIVARIATE ANALYSIS

Unit-I: Multivariate normal distribution, marginal and conditional distributions, characteristics functions, Maximum likelihood estimators of parameters, distribution of sample mean vector and dispersion matrix, distribution of quadratic form in the exponent of the multivariate normal density.

Unit-II: Hotelling's T^2 and its applications – T^2 distribution, application of T^2 to single sample, two sample and multiple sample problems, optimum properties of T^2 test. Mahalobis D^2 statistic and its distribution, Multivariate Analysis of Variance (MANOVA) of one and two-way classified data.

Unit-III: Classification and discrimination: procedures for classification into two multivariate normal populations, Fisher's Discriminant function, classification into more than two multivariate normal populations, Wishart distribution and its properties, concept of sample generalized variance and its distribution.

Unit-IV: Principal Component Analysis – properties, method of extraction of principal components; Canonical variables and canonical correlations; Factor Analysis – mathematical model, estimation of factor loading, concept of factor rotation; Cluster Analysis – similarities and dissimilarities, Hierarchical clustering: single and complete linkage method.

References:
1. Anderson, T.W (1983), An introduction to Multivariate Statistical Analysis, Wiley, 2nd Edition.
2. Rao, C.R (1973), Linear Statistical Inference and its applications, 2nd edition, Wiley
3. Srivastava. M.S and Khatri, C.G (1979), An introduction to Multivariate Statistics, North Holland
4. Morrison,F(1985): Multivariate Statistical Methods, Mc Graw Hill Book Company.
5. Johnson A.R and Wishern, D.W (1996), Applied Multivariate Statistical Analysis, Prentice Hall of India
6. Sharma, S (1996), Applied Multivariate Techniques, Wiley
7. Krishisagar, A.M (1972), Multivariate Analysis, Marcel Dekker
8. K.C. Bhuyan(2005): Multivariate Analysis and its Applications, Central

APST 203(a): LINEAR MODELS AND APPLIED REGRESSION ANALYSIS

Unit-I: Two and Three variable Linear Regression models; General linear model: Assumptions; OLS estimation; BLUE; Tests of significance of individual regression coefficients; Testing the equality between two regressions coefficients; Test of significance of complete regression.

Unit-II: Criteria for model selection; Goodness of fit measures; R^2 and adjusted R^2 Criteria; C_p criterion; testing the general linear hypothesis; Chow test for Equality between sets of regression coefficients in two linear models; test for structural change; restricted least squares estimation; Generalized Mean Squared error criterion.

Unit-III: Non-normal disturbances and their consequences; test for normality; Jarque-Bera test; Shapiro-Wilk test, Minimum Absolute Deviation (MAD) estimation; Box-Cox transformations. Statistical analysis of residuals, OLS residuals, BLUS residual, Studentised residual, Predicted residual, tests against heteroscadasticity.

Unit-IV: Non-Linear regression; Non linear least squares estimation; Maximum Likehood estimation; Idea of computational methods; Gradient methods, Steepest descent method and Newton-raphson method; testing general Nonlinear hypothesis; Wald test, Lagrange multiplier test and likelihood ratio Test. Robust , probit, binomial logistic ,multiple logistic regression.

References:
1. Johnston, J (1984): Econometric Methods, III rd edition. MC Graw Hill.
2. Gujarathi, D (1979): Basic Econometrics, MC Graw Hill.
3. Judge, C.G., Griffiths, R.C.Hill, W.E ., Lutkephol, H and Lee, T.C (1985): The Theory and Practice of Econometrics, John Wiley and Sons.
4. Draper, N and Smith, B (1981): Applied Regression Analysis, Second Edition

APST 203(b): STOCHASTIC PROCESSES

Unit-I: Introduction to stochastic processes (sp's): classification of sp's according to state apace and time domain. Countable state Markov chains (MC's), Chapman – Kolmogorov equations, calculation of n – step transition probability and its limit. Stationary distribution, classification of states,, transient MC, random walk and gambler's ruin problem.

Unit-II: Discrete state space continuous time MC: Kolmogorov – Feller differential equations, Poisson process, birth and death process; Applications to queues and storage problems. Wiener process as a limit of random walk, first – passage time and other problems.

Unit-III: Renewal theory: Elementary renewal theorem and applications. Statement and uses of key renewal theorem, study of residual life time process: weakly stationary and strongly stationary process; Moving averages and auto regressive process.

Unit-IV: Branching process: Galton – Watson branching process, probability of ultimate extinction, distribution of population size. Martingale in discrete time, inequality, convergence and smoothing properties. Statistical inference in MC and Markov process.

References:
1. Adke, S.R and Manjunath, S.M (1984): An Introduction to Finite Markov Processes, Wiley Eastern.
2. Bhat, B.R (2000): stochastic Models: Analysis and Applications, New Age International, India.
3. Cinlar, E (1975): Introduction to Stochastic Processes, Prentice Hall.
4. Feller, W (1968): Introduction to Probability and its Applications, Vol. 1, Wiley Eastern.
5. Harris, T.E (1963): The Theory of Branching Processes, Springer – Verlag.
6. Hoel, P.G., Port, S.C and Stone, J.C (1972): Introduction to Stochastic Processes, Houghton Miffin & Co.
7. Jagers, P (1974): Branching Process with Biological Applications, Wiley.
8. Karlin, S and Taylor, H.M (1975): A First Course in Stochastic Processes, Vol. 1, and Academic Press.
9. Medhi, J (1982): Stochastic Processes, Wiley Eastern.
10. Parzen, E (1962): Stochastic Processes, Holden – Day.

APST 203(c): MATHEMATICAL ANALYSIS

Unit-I: Real numbers; Bounded and unbounded Sets; Supremum and Infimum; Completeness in R; Open and closed sets; Countable sets; Bolzano-weierstrass theorem; Heine-Borel theorem, Uniform continuity.

Unit-II: Sequences: convergence of sequences; limits, inferior and superior; Cauchy sequences; Sandwich theorem; uniform convergence of sequences. Series: convergence of series; comparison tests for series. uniform convergence of series, Power series.

Unit-I11: Reimann Integration; mean value theorems of integral calculus; concepts of Reimann-Stieltjes integral and Improper integrals; Double and Triple integrals; Gamma and Beta integrals.

Unit-IV: Review of complex number systems, analytic functions and their properties, complex integration, Cauchy's theorem, integral formula, Taylor's and Laurant's series, singularities, residues, Cauchy residue theorem.

References

1. Malik,S.C. (1985), Mathematical Analysis (Second Edition); New Age International Pvt. Limited, New Delhi.
2. Apostol, T. M. (1985), Mathematical Analysis, Narosa Publishers, New Delhi.
3. Narayan, S.(1985) , A course of Mathematical Analysis, S.Chand & Company, New Delhi.
4. Royden, H.L.(1988), Real Analysis, 3rd Edition, MacMillan, New York.
5. Rudin Walter (1976), Principles of Mathematical Analysis, 3rd Edition, McGraw Hill, New York.
6. Chaudhary B (1983): The elements of complex analysis, Wiley Eastern.
7. Curtiss J.H (1978): Introduction to the functions of complex variables, Marcel Dekker.

APST 204: PRACTICAL –II

At least 20 practicals covering all papers relating to the subject in this semester must be carried out. (75 marks for practical examination + 15 marks for viva-voce + 10 marks for record in the semester)

APST 205: SAMPLING TECHNIQUES

Unit-I: Review of basic concepts of sampling theory such as sampling design, sampling scheme, sampling strategy etc., Sampling with varying probability with and without replacement, PPS WR/WOR methods – Lahiri's sample scheme, Hansen – Hurwitz, Des Raj estimators for a general sample size and Murthy estimator for a sample of size 2, Symmentrized Des Raj estimator.

Unit-II: Hurwitz – Thompson estimator (HTE) of a finite population total / mean, expression for V(HTE) and its unbiased estimator. IPPS scheme of a sampling due to Midzuno – Sen and JNK Rao (sample size 2 only). Rao – Hartley-Cochran sampling scheme for a sample of size n with random grouping.

Unit-III: Ratio and Regression methods of estimation, Two stage sampling, Multi stage sampling, Cluster sampling. Resampling methods and its applications.

Unit-IV: Double sampling for difference, ratio, regression and PPS estimators; Large scale sample surveys, Errors in surveys, A mathematical model for errors of measurement, Sampling and Non-sampling errors, Sources and types of non-sampling errors, Remedies for non-sampling errors.

References:

1. Chaudhuri. A and Mukerji. R (1988): Randomized Response Theory and Techniques, New Yory, Marcel Dekker Inc.
2. Cochran W.G (1988): Sampling Techniques III Edition (1977) Wiley.
3. Des Raj and Chandak (1988): Sampling Theory. Narosa.
4. Murthy M.N (1977): Sampling Theory and Methods. Statistical Publishing Society.
5. Sukhatme et al (1984): Sampling Theory of Surveys with Applications. Iowa State University Press & IARS
6. Sing D and Chudary F.S (1986): Theory and Analysis of Sample Survey Designs. New Age International Publishers.
7. Hedayat A.S and Sinha B.K. (1991): Design and Inference in Finite Population Sampling. Wiley.
8. Mukhopadhyay P(1996): Inferential problems in Survey Sampling. New Age International.

9. Wolter K.M (1985): Introduction to Variance Estimator. Springer. Verlag.
10. Hansen M.M and Hurwitz W.M and Mandow W.G (1954): Sample Survey Methods and Theory, Vol. I and Methods and Applications Vol. II, John Wiley and Sons.
11. Philli. I. Good (2013):Introduction to statistics through resampling methods and R, 2nd edition.

APST 206: HUMAN VALUES AND PROFESSIONAL ETHICS-II

UNIT-I:Value Education –Definition-Relevance to present day-Concept of Human Values-self introduction-self-esteem-family values-Components , Structure and responsibilities of family-Neutralization of anger-Adjustability-Threats of family life –Status of women in family and society – Caring for need elderly –Time allotment for sharing ideas and concerns.

UNIT-II: Medical ethics-Views if charaka, Sushruta and Hippocratus on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia ,ethical obligation to animals, ethical issues in relation to health care professional patients. Social justice in health care , human cloning , problems of abortion .Ethical issues ingenetic engineering and ethics issues raised by new biological technology of knowledge.

UNIT-III: Business ethics – Ethical standards of business-immoral and illegal practices and their solutions. Characteristics of ethical problems in management, ethical theories causes of unethical behavior , ethical abuses and work ethics.

UNIT-IV: Environmental Ethics- Ethical Theory , man And Nature- Ecological Crisis , Pest Control , Pollution and Waste , Climate Change, Energy and Population, Justice and Environmental Health.

UNIT-V: Social ethics – Organ trade. Human trafficking, Human rights violation and social disparities, Feminist ethics. Surrogacy / pregnancy, Ethics of media-Impact of newspapers, Television , Movies and Internet.

References:
1. Joha S Mackenjie:A Manual Of Ethics.
2. The Ethics of Management by Larue Tone Hosmer.Richard D.Irwin Lnc.
3. Management Ethics Integrity at Work by Joseph A.Petrick and John F.Quinn.Respons Books;New Delhi.
4. "Ethics in Management" By S.A.Sherlekar, Himalaya Publication House.
5. Harold H.Titus ; Ethics For Today.
6. Maitra,S.K;Hindu Ethics.
7. William Lilly;Introducation Ethics.
8. Sinha: A Manual of Ethics.
9. Manu:Manava Dharma Sastra or the Institute of Manu:Comparising the Indian Syastem of Duties :Raligious and civil (ed.) G.C.Halighton.
10. Susrpta samh ita: Tr.Kaviraj Kunjanlal , Kunjalal Brishagratha .Chowkarnaba Sanskrit series. Vol LII and III , Varanasi , Vol I 00, 16'20,21-32 and 74-77 only.
11. Caraka samhita :Tr.Dr.Ram karan sarma and vaidya bhagavan dash, Chowkarnaba Sanskrit series office. Varanasi I,11.111 Vol IPP 183-191.
12. Ethics, Theory and contemporary issues.Barbara mackinnon wadsworth / Thomsaon learning, 2001.
13. Analyzing moral.issues,Judith A.Boss.May Field Publishing Company-1999.

14. An introduction to applied ethics(ed.)John H.Piet and Ayodhya Prasad.cosmo publications.
15. Text book for intermediate first year ethics and human values. Board of intermediate education-Telugu-academy, Hyderabad.
16. I.C.Sharma ethics philosophy of india.Nagin & co julundhar.
17. I.C.Sharma ethics philosophy of india.Nagin & co julundhra.

SEMESTER – III

APST 301: APPLIED ECONOMETRICS

Unit-I: Quick review of inference in classical linear regression model; Estimation and tests of significance of linear and compound growth rates; Incremental analysis; Testing the function form of regression; choosing between linear and log-linear regression models; Likelihood Ratio, Wald and Lagrange Multiplier tests.

Unit-II: Multicollinearity; Sources, consequences and detection of Multicollinearityl Farrar-Glauber test; remedial measures; Heteroscedasticity: Sources and consequences; Tests for Heteroscedasticity; Glejser's test, Goldfield-Quandt test and Breusch-Pagan-Godfrey test; Estimation of parameters under Heteroscedasticity;

Unit-III: Autocorrelation; sources and consequences; first order autoregressive scheme; tests for autocorrelation Durbin-Watson test; Remedies; Estimation of parameters under Autocorrelation; Stochastic Regressors; Errors in variables linear model, IV and ML methods of estimation.

Unit-IV: Finite distributed lag models; Almon's Polynomial approach; Infinite distributed lag models; Geometric lag model; Koyck's approach; IV method; simultaneous linear equations models; Problem of identification; Indirect least squares, LIML, Two stage least squares; three stage least squares and FIML estimation methods.

References:
1. Johnston, J (1984): Econometric Methods, III rd edition , MC Graw Hill.
2. Judge, C.G., Griffths, and Hill, R.C. et al (1985): Theory and Practice of Econometrics, John Wiley.
3. Gujarathi, D. (1979): Basic Econometrics, Mc Graw hill.
4. Intrilligator, M.D (1980): Econometric Models, Techniques and Applications, Prentice Hall.

APST 302: EXPERIMENTAL DESIGNS AND APPLICATIONS

Unit-I: Standard linear model, BLUE, Gauss-Markoff theorem, ANOVA for one way, two way and three way classifications (with equal number of replications per cell). Multiple Range Tests-LSD test, Student-Newman-Keuls test; Duncan's Multiple Range test, Tukey's test; Multiple F-tests, Scheffe's test; Tukey's Gap, Straggler and Variance test;

Unit-II: Transformation of data; Square Root, Arc Sine and Logarithmic transformations; Test for additively of data. Latin squares, Orthogonal Latin Squares and their construction, Missing Plot Technique for Latin Square Design, Graeco and Hyper Graeco Latin Square Designs.

Unit-III: Factorial experiments; analysis of 2^n, 3^2 and 3^3 factorial designs in randomized blocks. Concept of complete and partial confounding. Confounding in 2^n, 3^2 and 3^3 factorial designs and their analysis.

Unit-IV: Fractional factorial designs, design resolution, alias pattern, construction of half and one-fourth fractions of 2^n designs and analysis. Response surface designs- first and second order rotatable designs and central composite designs. Concept of orthogonal arrays and linear graphs with applications to process control.

References:
1. Montgomery, D.C (1976), Design and Analysis of Experiments, John Wiley and Sons
2. Chakraborthy, M.C (1962), Mathematics of Design and Analysis of experiments, Asia Publishing House, Bombay.
3. Kempthorne, O (1965), Design and Analysis of Experiments, Wiley Eastern
4. Das, M.N and N.C. Giri (1979), Design and Analysis of Experiments, Wiley Eastern
5. Federer, w.T (1963), Experimental Design, Theory and Application, MacMillian Company, New York
6. Joshi, D.D (1987), Linear Estimation and Design of Experiments, Wiley Eastern
7. Winner, B.J (1971), Statistical Principles in Experimental Design, 2nd edition, Mc Graw Hill, Inc
8. Pearce, S.C (1984), Design of Experiments, Wiley

APST 303: APPLIED OPERATIONS RESEARCH

Unit-I: Definition and scope of Operations research; phases in Operations Research; models and their solutions (Review of Linear Programming). Definition of Dual-Primal, Relationships- Dual Simplex Sensitivity or Post Optimal Analysis, Revised Simplex method.

Unit-I1: Non-linear programming - Kuhn Tucker conditions. Wolfe's algorithm for solving quadratic programming problems. Integer programming – Branch and bound algorithm and cutting plane algorithm.

Unit-III: Flows in networks max-flow-min-cut theorem. Project Management; PERT and CPM probability of project completion, PERT – crashing. Decision making in the face of competition, two-person games, pure and mixed strategies, existence of solution and uniqueness of value in zero- sum games, finding solution in 2x2, and 2xm, and mxn games.

Unit-IV: Queuing models-specifications and effectiveness measures. Steady state solutions of M/M/1 and M/M/c models with associated distributions of queue length and waiting time. M/G/1 Queue and Pollazcek Khinchine result. Steady-state solutions of M/Ek/1 and Ek/M/1 queues. Bulk queues.

References:
1. Taha H.A (1982) Operational Research: An Introduction; Macmillan.
2. Hiller F. Sand Leiberman G.J. (1962) Introduction to Operations Research; Holden Day
3. Kanti Swarup; Gupta P.K and Singh M.M (1985) Operations Research; Sultan Chand.
4. Philips D.T, Ravindran A and Solberg J Operations Research, Principles and Practice.
5. Curchman C.W; Ackoff R.L and Arnoff E.L(1957) introduction to Operations Research; John Wiley
6. Hadley G (1964) Non-Linear and Dynamic programming Addison Weslay.
7. Mckinsey J.C.C(1952) Introduction to the theory of games Mc Graw Hill.P.K.Gupta; D.S.Hira Operations Research S.CHand.

APST 304 : PRACTICAL-III
At least 20 practicals covering all papers relating to the subject in this semester must be carried out. (75 marks for practical examination + 25 marks for record in the semester)

APST 305 (a): ADVANCED BIOSTATISTICS

Unit-I: Structure of Biological assay, Direct assays, Potency ratio, Feller's theorem and its generalization. Quantitative dose-response relationships, Linear dose-response regression, Parallel line bioassay, Slope Ratio Bioassay, Quantal responses, estimation of median effective dose, Transformations: Probit and Logit transformations.

Unit-II:: Basic Biological concepts: Gene, Chromosomes, Alleles, Concepts of Geno types and Phenotypes, Family studies, Basic mating from single gene cross, Matrix approach to basic matings of single gene cross, Checker board method, Mendal's law of heredity: Geneotypes and Pheno type ratios, Branching system method.

Unit-III: Types of matings, Random Mating, Concept of Gene pool, Gene frequency, Hardy–Weinberg law of equilibrium, Calculation of Gene frequencies, Genotypic frequency, Generation matrix approach to inbreeding, Estimation of Gene frequencies in ABO blood group system, Maximum Likelihood Method, Minimum Chi-Square method, Genetic parameters; Heritability Coefficients, Genetic Correlations, Repeatability, selection index; Inbreeding coefficient.

Unit-IV: Statistical Methods in Clinical Trials- phase I, II, III and IV trails. Statistical design for clinical trials- fixed sample trials. Simple randomized design, stratified randomized design, crossover and sequential designs – open and close sequential design. Dynamic randomization, Permuted block randomization; Single, double and triple blinding methods.

References:
1. D.J. Finney (1971): Statistical Methods in Biological Assay, Charles Griffen and Company, London.
2. D.J. Finney (1971): Probit Analysis, 3rd Edition, S.Chand and Company Ltd, New Delhi.
3. William D. Stansfield. (1969): Theory and Problems of Genetics, Schaum's Outline Series, MC Graw Hill, New York.
4. Oscar Kempthorne (1973): An Introduction to Genetic Statistics, Jagmohan Book agency, New Delhi.
5. J.P. Jain (1992): Statistical Techniques in Quantitative Genetics, 2nd Edition, Hindustan Publishing House, New Delhi.
6. Basu, S. B. (1996), Quantitative Genitics Research Technique, Kalyani Publishers, New Delhi.
7. Elisa T. Lee &John Wenyu Wang (2003): Statistical methods for Survival Data analysis, 3rd Edition, John Wiley
8. Jerrold H. Zar (1999): Biostatistical Analysis, 4th edition, Pearson.
9. Armitage, P, Berry G and Mathews J.N.S. (2002): Statistical Methods in Medical Research, 4/e, Blockwell Scientific Publications.
10. Rastogi. V.B. (2006), Fundamental of Biostatistics. ANE Books, India.

APST 305(b): COMPUTER PROGRAMMING AND DATA ANALYSIS

Unit-I: Essentials of R-language – Expressions and objects, assignments, creating vectors, vectorized arithmetic, creating matrices, operations on matrices, lists, data frame creation, indexing, sorting and conditional selection with examples. Programming using conditional statements and loops, data editor, reading data from text files.

Unit-II: Obtaining summary statistics, generating tables, bar plots, pie charts, box plots, histograms. Random sampling from discrete and continuous distributions, plotting density and cumulative density curves, Q-Q plots with suitable examples.

Unit-III: Data Analysis Pak in Excel, descriptive statistics, tests of hypothesis, ANOVA, Correlation and Regression, Random Number Generation from different distributions, Binomial, Poisson, Uniform, Normal and from discrete distributions with given mean and variance. Forecasting Using Excel – Moving Averages and Exponential Smoothing, Use of functions, Linest, Logest, Forecast , Growth, Trend for trend analysis. The use of solver for optimization – Application to LPP.

Unit-IV: Data handling using SPSS: Opening Excel files in SPSS. Merging of files, selection of records, recoding. Analysis tools, descriptive statistics, cross tabs (with stress on procedures and syntax). Post-hoc analysis for multiple comparisons using Tukey's test, Duncan's Multiple Range Test, Dunnet's test and Scheffe's test with interpretation. Selection of variables in Multiple Linear Regression – stepwise procedures and analysis of residuals. Procedure for Binary Logistic regression, Factor analysis, Linear Discriminant analysis and Cluster analysis.

References:
1. Introductory Statistics with R by Peter Dalgaard, Springer, 2nd editions, 2008
2. The R book by Micheal J. Crawley, John Wiley and Sons, Ltd, 2007
3. Sarma, K.V.S (2010), Statistics Made Simple, Do it Yourself on PC, Prentice Hall of India.
4. Johnson and Wichern, Multivariate Analysis, Prentice Hall

APST 305 (c): DATA MINING AND INFORMATION SECURITY

UNIT-I: Data warehousing components: Introduction, Access tools, Data Marts, Data Mining data warehousing, Industry, Methodology. Classical Techniques, Statistics, Neighborhoods, clustering, The classics, Nearest Neighbor, Tree Network and Rules, Neural Network – Rule Induction.

UNIT-II: Basic Data Mining Taks, classification, regression, time series analysis, prediction, clustering, summarization, association rules, sequence discovery. Data mining versus knowledge discovery in data bases. The development of data mining issues. Data mining metrics, social implications of data mining, data mining from a data base perspective. Exploratory Data Analysis.

UNIT-III: Security Trends-The OSI architecture-Security Attacks-Security Services –Security Mechanisms- A Model for Network Security Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques Transportation Techniques, Rotor Machines –Steganography. Public-Key Encryption and Hash Functions Introduction to Number Theory Prime Numbers – Fermat's and Euler's Theorems, Testing for Primality – The Chinese Remainder Theorem, Discrete Logarithms.

UNIT-IV: Public-key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm, Digital Signatures and Authentication Protocols: Digital Signatures, Authentication Protocols-Digital Signature Standard Authentication Applications : Kerberos-X.509 Authentication Service, Public Key Infrastructure .

References:
1. Margaret H. Dunham (2006), Data Mining – Introductory and Advanced Topics, Pearson Education.
2. Tukey, (1997), Exploratory Data Analysis
3. Cleveland, (1993), Visualizing Data

4. Tufte, (1983), Visual Display of Quantitative Information Anything on statistics by Jacob Cohen or Paul Meehl.
5. Cryptography and Network Security Principles and Practices – Fourth Edition –By William Stallings- Pearson Prentice Hall Publishers.

APST 306 (a): STATISTICS FOR BIOLOGICAL AND EARTH SCIENCES

Unit - I: Statistical measures: Statistical diagrams and graphs; Frequency distributions; Measures of central tendency: Arithmetic mean, Median and Mode; Measures of variation: Range, Quartile Deviation, Mean Deviation, Standard deviation, Coefficient of variation; Karl Pearson's coefficient of Skewness.

Unit- II : Random Variable and Probability Distributions: Definition of Probability, Additive and Multiplicative laws of probability (statements only), Random variable, Binomial, Poisson, Normal and Exponential distributions (properties and applications), Curve Fitting: Principle of least squares; Fitting of a straight line, Exponential curve and Power curve; Correlation and Regression Analysis: Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient; Simple linear regression; Multiple and Partial correlation coefficients; Multiple linear regression; Yules coefficient of Association.

Unit –III: Tests of Significance: Basic concepts; Z- test for proportions and means; Applications of t, χ^2 and F tests; Paired t-test; Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) techniques for one way and two way classifications (single observation per cell), Confidence limits.

Unit- IV: Special Statistical Tools: Experimental designs CRD, RBD and LSD and their analysis; concept of critical difference; Duncan's Multiple range test; Elements of Principal components Analysis, Factor Analysis; Cluster Analysis and Discriminant analysis; Hotelling's T^2 and Mahalanobis D^2 statistics; Multivariate Analysis of Variance (MANOVA); Canonical correlations; Concept of Probit analysis.

References:
1. Bailey, N.T.J.(1959), Statistical Methods in Biology, The English Universities Press Ltd.,
2. Pillai, S.K., and Sinha, H.C.(1968), Statistical Methods for Biological workers, Ram Prasad and sons, Agra.
3. Basu, S.P.(1996), Quantitative Genetics Research techniques, Kalyani publishers, New Delhi.
4. Misra, B.N., and Misra, M.K.(1998), Introductory Practical Biostatistics, Naya Prakash, Kolkata.
5. Johnson, R.A., and Wichern, D.W.(2001), Applied Multivariate Statistical Analysia, Third edition, Prentice Hall of India, New Delhi.
6. Federer, W.T.(1969), Experimental Designs and its appliucations.

APST 306 (b): STATISTICS FOR SOCIAL AND BEHAVIOURAL SCIENCES

Unit- I: Statistical Measures: Measures of central tendency: Arithmetic Mean, Median and Mode; Measures of Variation: Range, Quartile Deviation, Standard Deviation, Coefficient of Variation, Measures of Skewness.

Unit- II: Probability and Distributions: Concept of Probability, Laws of Probability (statements only); Random Variable; Probability Distributions: Binomial, Poisson and Normal distributions (properties and applications).

Unit- III: Tests of Significance: Basic concepts; Random sampling techniques; Standard error of statistic; Large sample tests for proportions and means; Small sample tests: Applications of t, χ^2 and F tests; Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) techniques for one way and two way classifications (single observation per cell); Nonparametric tests: Wilcoxon Signed Rank test, Median test and Mann-Whitney U-test.

Unit- IV: Special statistical tools: Computation of Linear and Compound Growth rates and their tests of significance; Chow test for Structural change; Granger Causality test; Stepwise regression; R^2 and $\overline{R}^2$ statistics; Multiple Range tests: LSD. test and Duncan's test: ANOVA for Ranked data; Krushkal-wallis test, Friedman test; Elements of Factor analysis and Discriminant analysis.

References

1. Gupta, S.C.(1997), Fundamentals of Statistics, Himalayan Publishers, Mumbai.
2. Kshirasagar, A.M. (1972), Multivariate Analysis, Marcel Decker, New York.
3. Gujarati, D.(1995), Basic Econometrics, Mc Graw Hill.
4. Ferguson, C.A.(1971), Statistical Analysis in Psychology and Education, McGraw Hill.
5. Johnson, R.A., and Wichern, D.W. (2001), Applied Multivariate Statistical Analysis, Third Edition, Prentice-Hall of India (p) Ltd.,. New Delhi.

SEMESTER – IV

APST 401: APPLIED FORECASTING METHODS

Unit-I: Need and uses of forecasting, classification and characteristics of forecasts, forecasting based on regression techniques: simple and multiple linear regression and non-linear regression techniques, moving averages smoothing methods: simple and double, multi average methods; explanatory version time series forecasting, test for trend seasonality.

Unit-II: Exponential smoothing methods: trend adjusted exponential smoothing, double and triple exponential smoothing, winten's method, Chow's adaptive control methods, brown's one parameter adaptive method: Box-Jenkins three parameter smoothing, Harrison's Harmonic smoothing methods, tracking signal.

Unit-III: Auto regressive series, yules series, markoff series, deseasonalisting and detrending an observed time series, auto-covariance, Auto Correlation Function(ACF),Partial Auto Correlation Function(PACF) and their properties, conditions for stationary and invertibility. Period gram and correlogram analysis.

Unit-IV: Box-Jenkin's time series methods: Moving average , Autoregressive , ARMA and AR integrated MA (ARIMA) models, estimation of ARIMA model parameters, forecasting with ARIMA models, Diagnostic checking of the model: Analysis of residuals, forecasting using transfer function model, concept of Kalmon's Filters relation for outline.

References:

1. Thomopouls, N.T (1980): Applied Forecasting Methods. Engle Wood Cliffs, N.J, Prentice Hall.
2. Wheel Wishart, S.C; and S. Makridaks (1980): Forecasting Methods for Management . III edition, New York. John Wiley.
3. Sullivan, William G. and Wayne Claycambe. W (1977): Fundamentals of Forecasting. Prentice Hall. Virginia.

4. Gupta. S.C and V.K. Kapoor (1995): Fundamentals of Applied Statistics, Sulthan & Chand Sons. New Delhi.
5. Bovas, Abraham and Johannes Ledolter (1983): Statistical Methods for Forecasting, John Wiley & Sons. New York.
6. Box, G.E.P and Jenkkins, G.M (1976): Time Series Analysis Forecasting and Control, Holden Day, San Francisco.
7. Anderson, T.W (1971): The Statistical Analysis of Time Series, John Wiley, New York.
8. Markidakis, S Steven C. Wheel Wright and Victor E. Mcgee (1983): Forecasting: Methods and Applications, 2nd Edition, New York, John Wiley & Sons.

APST 402: APPLIED DEMOGRAPHY AND OFFICIAL STATISTICS

Unit-I: Indian and International Statistical Systems, Functions of CSO and NSSO; Organization of large scale sample surveys; Data dissemination systems. Non-Governmental statistical organizations, Methods of conducting population census and Economic census in India. Indian population census.
Unit-II: Official Statistics and their limitations; Methods of collection of official statistics; System of collection of Agricultural Statistics, Crop forecasting and estimation; Agricultural census in India defects; Statistics related to Forests, Fisheries; Trade, Labour, Finance, Price and Industries; CMI, SSMI and ASI publications.
Unit-III: Definition, Scope and limitations of demographic analysis; Sources of Demographic data in India; Mortality measures, Construction of life tables; Abridged life tables; Measures of fertility and Reproduction.
Unit-IV: Methods for population projection, Use of Leslie matrix, Stable and Stationary populations; Lokta's model; Models for population growth and their fitting; Stochastic models for population growth; Concept of Migration and Urbanization, Chandrasekhar nand Demings method, Stochastic model for Birth and Deaths.
References:
1. B.N. Gupta (1994), Statistics, Sathiya Bhawan, Agra.
2. B.L. Aggarwal (1994), Basic Statistics, general edition, Wiley eastern, New Delhi.
3. Asthana, B.N.(1970), Indian official Statistics.
4. S. Biswas (1988), Stochastic Process in Demography and Applications, Wiley Eastern, New Delhi.
5. K.B. Pathak and F. Ram (1992), Techniques of Demographic Analysis, Himalayan Publishing House, Bombay.

APST 403: RELIABILITY THEORY AND SURVIVAL ANALYSIS

Unit-I: Reliability: Concept and Measures of Reliability, bath tub curve, Reliability and failure density in terms of hazard rate; Hazard models, System Reliability Models: Reliability of Series and parallel systems, Mixed configuration models, Non-series-parallel systems; r-out of n- systems, Fault tree analysis.
Unit-II: Reliability improvement methods: Redundancy, element, unit and stand by redundancies; Maintainability and availability; Reliability allocation; Life testing and Reliability estimation; Exponential failure model, Normal, Gamma and weibull distributions and their applications in reliability estimation.

Unit-III: Functions of Survival time: Definitions, Relationships of Survival Functions; Non-parametric Methods of Estimating Survival Functions: Kaplan Meier Product limit Estimate; Non-parametric methods for comparing two survival distributions: Gehan's generalized wilcoxon test, Cox-Mantel test, log rank test, Peto and peto's generalized wilcoxon test, Cox's F test and Mantel-Haenszel test.

Unit-IV: Graphical Methods for survival distributions fitting: Probability plotting, hazard plotting methods, testing of goodness of fit; Analytical Estimation Procedures for Survival distributions: Exponential, Weibull, Lognormal and Gamma Distributions only; Regression method for fitting Survival distributions; Parametric methods for comparing two survival distributions: Exponential, Weibull and Gamma Distributions only; Non-parametric and Parametric methods for identification of Prognostic factor relating survival time.

References :

1. L.S. Srinath (1998): Reliability Engineering, Applied East west Press PVT Ltd.,   New Delhi.
2. E. Balaguruswamy (1984): Reliability Engineering, Tata MC Graw Hill publishing company, New Delhi.
3. S.K. Sinha and B.K. Kale (1980): Life Testing and reliability Estimation, Wiley Eastern Ltd, New Delhi.
4. S.K. Sinha (1986): Reliability and Life Testing, Wiley Eastern Ltd, New Delhi.
5. Elisa T.Lee (1992), Statistical methods for survival data analysis, John Wiley sons.
6. Miller, R.G (1981), Survival Analysis, John Wiley
7. Cross A.J and Clark, V.A (1975), Survival distribution, reliability applications in the biomedical sciences, John Wiley and sons.
8. Elandt Johnson, R.E., Johnson, N.L.,(1999), Survival Models and Data Analysis, John Wiley and sons

APST 404 :PRACTICALS –IV

At least 20 practicals covering all papers relating to the subject in this semester must be carried out. (75 marks for practical examination + 15 marks for viva-voce + 10 marks for record in the semester)

APST 405 (a): STATISTICAL QUALITY CONTROL

Unit-I: Basic concepts of quality, causes of variation, principle of Shewart's control chart, control charts for attributes and variables. Control limits and probability limits. Process monitoring and control, process capability, modified control chart. Capability indices C_p, C_{pk}, and C_{pm}. Concept of Six sigma and its relationship with process capability.

Unit-II: The OC and ARL of Shewart's control charts. Control by gauging, Moving Average and Exponentially Weighted Moving Average charts. CUSUM charts using V-mask and decision interval methods. Multivariate control charts – Control Ellipsoid, Hotelling's T^2 chart.

Unit-III: Acceptance sampling plans for attribute inspection – Type-A and Type-B OC curves. Single, double and sequential sampling plans and their properties. Sampling plans with rectifying inspection-concept of AOQ, AOQL. Construction of Dodge CSP-1, CSP-2 and Multi level plans and their properties. Chain sampling and its applications. Design of Skip lot sampling plan and its ASN.

Unit-IV: Total Quality Management - Quality as a corporate strategy, six magnificent tools of process control, quality planning, costs of quality, analysis of quality costs, Zero Defects programme, quality circles, ISO 9000 and its modifications. Taguchi's contributions to Quality Engineering.

References:
1. Montgomery D.C (2009), Introduction to Statistical Quality Control, 6/e, John Wiley and Sons, New York.
2. Edward G. Schilling, Dean V. Neubauer, (2009), Acceptance sampling in quality control Second Edition, Taylor & Francis.
3. Mittage, H.J and Rinne, H (1993): Statistical Methods of Quality Assurance, Chapmann Hall, London, UK.
4. Ott. E.R (1975), Process Quality Control, Mc Graw Hill
5. Phadke, M.S (1989), Quality Engineering through Robust Design, Prentice Hall
6. Duncan, A.J (1974), Quality Control and Industrial Statistics, 3rd Ed., New York, Irwin.
7. Philip J. Ross (1989), Taguchi techniques for quality engineering, McGraw Hill

APST 405 (b): STATISTICS FOR RESEARCH, INDUSTRY AND COMMUNITY DEVELOPMENT

UNIT- I: Response Surface Designs: First and Second order Response Surface models; Rotatable designs; concept of connected design; outliers and Winsorized t - statistic; Stepwise regression; Specification of Random coefficients Regression model; Specification of variance components model; MINQUE Theory; Non parametric regression, the partially linear regression model.

UNIT-II: Simulation: Scope and limitations; Simulation models; Generation of RandomNumbers; Monte-Carlo simulation; Simulation of Queueing, Inventory Systems; Networks and Job sequencing.Data Envelopment Analysis (DEA): Non parametric approach to productive efficiency; Input, output correspondences for Frontier production function; Mathematical Programming for productive efficiency: Farrell and Timmer approaches with reference to Cobb-Douglas production function.

UNIT-III: Demand Analysis: Laws of Demand and Supply; price and partial elasticities of demand; Pigous method for Time Series and Family Budget data; Engel's curve; Pareto law of Income distribution;Production Functions: Basic concepts; Isoquants; Cobb-Douglas, CES and Translog Production functions and their properties and estimation; Tools for Data Mining.

UNIT-IV: Social Surveys for Community Development: Objects, Types of Social Survey; Steps in social survey; Gallop polls; Prephology, Data collection; Kinds of measurement; Scaling methods: Thurstone, Likert and Guttman methods; Concepts of Validity and Reliability; Methods of calculating reliability coefficients; Test Reliability; ANOVA for Ranked data: Kruskal-Wallis and Friedman tests; Elements of cluster analysis, Factor analysis., path coefficient analysis and Discriminant analysis.

References:

1. Das, M.N. and Giri, N.C. (1979), Design and Analysis for Experiments, Wiley Eastern (P) Ltd., New Delhi.
2. Montgomery, C.D. (1976), Design and Analysis of Experiments, Wiley & Sons, New York.
3. Johnston, J., and Dinardo, J. (1997), Econometric Methods, Fourth Edition, Mc Graw-Hill International Editions, New York.
4. Judge., C.G., et.al (1985), Theory and Practice of Econometrics, John Wiley.
5. Taha, H.A. (1992), Operations Research, An Introduction, Fourth Edition,

APST405 (c): ACTUARIAL STATISTICS

Unit I : Basic deterministic model: Cash flows, discount function, interest and discount rates, balances and reserves, internal rate of return, The life table: Basic definitions, probabilities, construction of life tables, life expectancy, Life annuities: Introduction, calculating annuity premium, interest and survivorship discount function, guaranteed payments, deferred annuities.

Unit II : Life insurance: Introduction, calculation of life insurance premiums, types of life insurance, combined benefits, insurances viewed as annuities, Insurance and annuity reserves: The general pattern reserves, recursion, detailed analysis of an insurance, bases for reserves, non forfeiture values, policies involving a return of the reserve, premium difference and paid-up formula.

Unit III : Fractional durations: Life annuities paid monthly, immediate annuities, fractional period premium and reserves, reserves at fractional durations, Continuous payments: Continuous annuities, force of discount, force of mortality, Insurance payable at the moment of death, premiums and reserves. The general insurance – annuity identity, Select morality: Select an ultimate tables, Changed in formulas.

Unit IV : Multiple life contracts: Joint life status, joint annuities and insurances, last survivor annuities and insurances, moment of death insurances. The general two life annuity and insurance contracts, contingent insurances

Reference :
1. Neill, A. (1977) Life contingencies, Heinemann, London.
2. Newton L. Bowers, Jr, Hans U. Gerber, James C. Hickmann, Donald A. Jones and Cecil J. Nesbitt (1997) Actuarial Mathematics, The Society of Actuaries.
3. King, G. Institute of Actuaries Text Book. Part 11, Second edition, Charles and Edwin Layton, London.
4. Donald D.W.A. (1970) Compound Interest and Annuities, Heinemann, London.
5. Jordan, C.W. Jr. (1967) Life Contingencies, Second edition, Chicago Society of Actuaries.
6. Hooker, P.F. and Longley Cook, L.W. (1953) Life and other Contingencies, Volume I and Volume II (1957) Cambridge University Press.
7. Spurgeon, E.T. (1972), Life Contingencies, Third edition, Cambridge University Press.

APST 406 (a) : STATISTICS FOR MARKETING RESEARCH

UNIT-I: RESEARCH METHODOLOGY: Types of Research; Hypotheses; Research Design; Collection of Data; Marketing Surveys; Sampling Techniques; Research Tools: Scaling Techniques; Problems in Marketing Research; Case study Method; Preparation of Research Report.

UNIT-II: STATISTICS FOR MARKETING: Statistical Measures: Mean, Median and Mode; Standard Deviation and Coefficient of Variation; Correlation and Regression analysis; Multiple correlation and Regression; Coefficient of Association; Linear and Compound growth rates.

UNIT-III: MARKETING INFERENTIAL TECHNIQUES: Elements of probability; Concepts of Binomial, Poisson and Normal distributions; Tests of Significance: z, t, χ^2 and F tests, ANOVA Technique; Non parametric Tests; Components of Experimental Designs: CRD, RBD and LSD.

UNIT-IV: ADVANCED STATISTICS FOR MARKETING: Basic Time Series and Forecasting Methods; Determination of Trend; Process and Product control; control charts $\overline{X}$, R, p, np and c-charts; Operation Research Techniques: Linear Programming Problem-Graphical Method, concept of PERT, CPM; Concepts of Multivariate Statistical Techniques: Factor Analysis, Discriminant Analysis, Cluster Analysis, Computer Applications to Marketing Research.

References:
1. Azel and Sounderpandian, Complete Business Statistics, TMH.
2. JK Sharma, Business Statistics, Pearson.
3. RS Bhardwaj, Mathematics for Economics and Business, EB.
4. RP Hooda, Statistics for Business and Economics, McMillan.
5. GC Beri, Business Statistics, TMH.
6. Glynn Davis and BrankoPecar, Business Statistics using Excel, Oxford University press, 2010.
7. J.K. Sharma, Fundamentals of Business Statistics, 2nd Edition, Vikas Publication, 2014.
8. SC Gupta, Fundamentals of Statistics, Himalaya Publications, 2013.
9. N.D. Vohra, Business Statistics, Tata McGraw Hill, 2013.
10. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons Publishers, New Delhi.
11. S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons Publishers, New Delhi.
12. R. Pannerselvam, Research Methodology, Published by PHI Learning Private Limited, New Delhi.
13. Donald R Cooper and Pamela S Schnidler, Business Research Methods, Nineth Edition, Tata Mc Graw Hill Publishing Company Limited, New Delhi

APST 406(b) : STATISTICAL ANALYSIS USING SPSS

Unit-I
Introduction to SPSS, Different Menu's in SPSS, creating a data file, opening excel files,variables and labels,selecting casesby filtering,recoding of data, merging of files,

Unit-II
Sorting of Cases and Variable, SPSS Output and its transfer to excel and word.Analysis categorical data-Scales of Measurements, Data reliability-test rest method, Cronbach's alpha.

Unit-III
Analysis tools – frequency tables, descriptive, cross tabulations, chi square tests. Compare-Means, ANOVA, Independent Sample t-test, Paired Sample t-test, One-way ANOVA.

Unit-IV
General Linear Model-Univariate, Multivariate, Repeated Measures.Correlation – Simple and Partial, Multiple Linear Regression-Selection variables into the model-Stepwise Multiple Linear Regression.

References:
1. Statistics Made Simple-Do it Yourself on PC by K.V.S. Sarma
2. A Handbook of Statistical Analyses using SPSS-Sabine Landau and Brian S. Everitt
3. SPSS for Beginners -Vijay Gupta

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