SEMESTER- III								
S.no	Course	Code	Tittle of the course	H/W	C	SEE	IA	TOTAL Marks
01	CC	APST 301	Applied Econometrics	4	4	70	30	100
02		APST 302	A: Advanced Bio Statistics B: Theory of Point Estimation	4	3	50	25	75
03		APST 303	A. Reliability and Survival Analysis B: Statistical Testing in Data Analysis	4	3	50	25	75
04	P	APST 304	Practical – V (302 &303)	6	2	35	15	50
05	SOC	APST 305	A: Applied Operations Research B: Computer Programming C++	4	3	50	25	75
06		APST 306	A: LINEAR MODELS AND REGRESSION ANALYSIS B: Total Quality Management and Six sigma	4	3	50	25	75
07	P	APST 307	Practical – VI (305 and 306)	6	2	35	15	50
08	OOTC	APST 308	OOTC/Open ELECTIVE **A: Survival Analysis** **B: Statistics For Social and Behavioral Sciences**	4	2	70	30	100
*	Seminar/Tutorials/Remedial Classes and Quiz as part of Internal Assessment			4	0	0	0	0
			Total	36	22	340	160	500

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.

Subject Code	Subject Name	Credits Allotted		Total
APST-301	**APPLIED ECONOMETRICS**	Theory	Practical	4
		4	----	
Course Objective	1. To study about classical linear regression model and their estimation. 2. To discuss about Autocorrelation, different orders of Autocorrelation and their estimation procedures. 3. To explain different lag models and their estimate procedures. 4. To explain about simultaneous linear equations model and their different methods and estimation.			
Course Out comes	1. Students know about heteroscedasticity, multicollinearity and autocorrelation and their estimation procedures. 2. Students understood about different lag models and simultaneous linear equations model with their estimation methods.			

APST-302(A): Advanced Bio Statistics

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.

Subject Code	Subject Name	Credits Allotted		Total
APST 302(A)	**ADVANCED BIOSTATISTICS**	Theory	Practical	4
		4	----	
Course Objective	1. To discuss about Clinical trials and their statistical designs. 2. To know the Dose response relationships, their estimation, transformations. 3. To study Geno types and phenol types, Matrix operations to base mattings of single gen cross etc. 4. To estimate Gene frequency using different methods.			
Course Out comes	Students are familiar about Biological assay, their distribution and theorem, dose response relationships, basic concepts of biological assay, estimation methods of gene frequencies.			

APST-302(B): Theory of Point Estimation

Unit-I: Parametric models, likelihood function; examples from standard discrete and continuous models. Information in data. About the parameters as variation in likelihood function, concept of no information, sufficiency, Neyman factorizability criterion, likelihood equivalence. Fisher information for single and several parameters.

Unit-II: Minimal sufficient statistic, Exponential families and Pitman families.
Minimum Variance Unbiased Estimation, unbiasedness, locally unbiased estimators, minimum variance, locally minimum variance, mean squared error, Cramer-Rao lower bound approach.

Unit-III: Minimum variance unbiased estimators(MVUE), Rao-Blackwell theorem, completeness, Lehman-Scheffe theorem, necessary and sufficient condition for MVUE.

Unit-IV: Consistent estimation of real and vector valued parameter, invariance of consistent estimator under continuous transformation: Consistency of estimators by method of moments and method of percentiles, mean squared error criterion, Asymptotic relative efficiency. Consistent asymptotic normal (CAN) estimator.

Course Outcome

CO1: To apply various estimation and testing procedures to deal with real life problems.

CO2: To understand Fisher Information, Lower bounds to variance of estimators, MVUE and apply them in practical situations.

CO3: To understand consistency, sufficiency, unbiasedness, CAN and BAN estimators

References:

1. Casella G. and Berge R.L. (2002): Statistical Inference, 2nd Ed., Thomson- Duxbury, Singapore.
2. Kale B.K. and Muralidharan (2015): Parametric Inference, An Introduction, Alpha Science International Limited.
3. Kendall M.G. and Stuart A. (1968): The Advanced Theory of Statistics, Vol.II, Charles Griffin and Co.
4. Lehman E.L. (1986): Theory of Point Estimation, John Wiley.
5. Rao C.R. (1973): Linear Statistical Inference and Its Applications. Wiley Eastern.
6. Rohatgi V.K. and A.K.L. Salah (2001): An Introduction to Probability and Mathematical Statistics. Wiley Eastern.
7. Silvey S.D. (1970): Statistical Inference. Chapman and Hall.
8. Zacks S. (1981): Parametric Statistical Inference, Pergamon Press.

APST-303(A): Reliability 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

<table>
<tr><td>Subject Code</td><td>Subject Name</td><td colspan="2">Credits Allotted</td><td>Total</td></tr>
<tr><td rowspan="2">APST303(A)</td><td rowspan="2">RELIABILITY AND SURVIVAL ANALYSIS</td><td>Theory</td><td>Practical</td><td rowspan="2">4</td></tr>
<tr><td>4</td><td>----</td></tr>
<tr><td>Course Objective</td><td colspan="4">1. To discuss about reliability and their measures, analysis mixed configuration, series and parallel systems with examples.
2. To explain Redundancy for unit, element and stand by with simple applications.
3. To discuss Distributions for life testing and reliability estimation with their applications.
4. To understand Survival functions, survival distributions and fittings.</td></tr>
<tr><td>Course

Out comes</td><td colspan="4">Students learnt about and survival analysis with their related distributions, relationships, non-parametric methods for computing survival analysis.

.</td></tr>
</table>

APST-303(B): Statistical Testing in Data Analysis

Unit-I: Population and sample, parameter, statistic, estimator, statistical properties of estimators. Basic concepts concerning testing of hypotheses, procedure for hypothesis testing. Null hypothesis, alternate hypothesis, statistical test procedures, test statistic, two types of errors, level of significance, p-value, size and power of the test. One sided and two sided test

procedures. Parametric and nonparametric tests.

Unit-II: Assumptions, test procedures and examples - One sample Z test, hypothesis testing of means, hypothesis testing for differences between means under equal variance and unequal variances, paired t-test, tests for proportions. Sample size and its determination.

Unit-III: Hypothesis testing for comparing a variance to some hypothesized population variance, testing the equality of variances of two normal populations, hypothesis testing of correlation coefficients, confidence intervals.

Unit-IV: Non-parametric tests, sign test, Wilcoxon signed rank test, Wilcoxon rank sum test-Mann-Whitney test, Contingency tables - Chi-square test for independence of attributes, Principles of design of experiments, basic principle of ANOVA, ANOVA – CRD, RBD, LSD. Tukey multiple comparison test with equal sample sizes, Tukey-Kramer test with unequal sample sizes.

Course Outcomes:

CO1: Demonstrate their knowledge of the basics of inferential statistics by making valid generalizations from sample data

CO2: Perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases. Understand the concept of p-values.

CO3: Learn non-parametric test such as the Chi-Square test for Independence as well as Goodness of Fit.

CO4: Compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test.

References:

1. J.Medhi (1992): Statistical Methods : An Introductory Text, Wiley Eastern Limited.
2. Douglas A. Lind, William C. Marchal, Samuel A. Wathen (2012), “Basic Statistics for Business & Economics” McGraw-Hill Education

APST-304: Practical – V (APST 302 &APST 303)

APST-305(A): 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.

Subject Code	Subject Name	Credits Allotted		Total
APST-305(A)	**APPLIED OPERATIONS**	Theory	Practical	4
		4	----	

	RESEARCH			
Course Objective	1. To explain different queuing models like M/M/I, M/M/C, M/G/I and bulk queues etc. 2. To learn about Non-linear programming and integer programming and their related problems. 3. To discuss about Network flow charts, CPM and PERT, project management models. 4. To study about Game theory of 2×2, 2×m, m×n and non-zero sum games with their illustrations.			
Course Out comes	1. Students understood about Dual primal, Revised simplex methods. 2. Students gains the knowledge related to non-linear programming, integer programming, CPM, PERT and different models of games.			

APST-305(B): Computer Programming C++

UNIT-I: Object oriented programming principles, Declaration of classes, array of classes, Pointer to classes, constructors such as void constructor, copy constructor, Destructor,

UNIT-II: Friend functions, inline functions, static class members, this pointer, Single, Multiple inheritances: 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, 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.

References

1. R.Decker and So Hirshfield (1998): The Object Concept: An Introduction to Computer Programming using C++; PWS Publishing.
2. S.B.Lippmann and J.Lajoie (1998): C++ Primer. Third edition. Addison- Wesley. P.Nauahton (1996).The Java Handbook. Tata McGraw-Hill
3. W.J. Savitch (2001): Problem Solving with C++The Object of Programming. Third Edition. Addison-Wesley Longman.
4. Deital&Deital: C++; Prentice-Hall Inc.
5. Sarang: Object Oriented programming with C++; Prentice-Hall Inc.
6. Balaguruswamy, E : Programming with C++; Tata McGraw-Hill.

<table>
<tr><td>Subject Code</td><td>Subject Name</td><td colspan="2">Credits Allotted</td><td>Total</td></tr>
<tr><td rowspan="2">APST-305(B)</td><td rowspan="2">COMPUTER PROGRAMMING – C++</td><td>Theory</td><td>Practical</td><td rowspan="2">4</td></tr>
<tr><td>4</td><td>----</td></tr>
<tr><td>Course Objective</td><td colspan="4">1. Understand principles of object-oriented programming, defining classes, Creating objects, initializing objects and destroying objects.
2. understand friend functions, inline functions, single and multiple inheritance,
Differenttypesofderivationandambiguityininheritance.
3.Understandvirtualbaseclassandcontainerclasses.Learntooverloadfunctionsandoperators.
4. Understand polymorphism, virtual functions, pure virtual functions, constructors and destructors under inheritance.
5. Understand templates, exception handling, use of datafiles.</td></tr>
<tr><td>Course Out comes</td><td colspan="4">1:Understand principles of object-oriented programming, classes, different types of constructors and destructors.
2:Understand friend functions, different types of inheritance and their use.
3:Understand function over loading and operator over loading, overloading of unary and bi-nary operators.
4:Understand the definitions of abstract base classes, similarities and differences of virtual functions, and their use in polymorphism.
5: Understand the utility of function templates and class templates, exception handling mechanisms and use of datafiles.</td></tr>
</table>

APST-306(A): LINEAR MODELS AND 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 Likehoodestimation; 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

Subject Code	Subject Name	Credits Allotted		Total
APST 306(A)	**Linear models and Regression Analysis**	Theory	Practical	4
		4	----	
Course Objective	1. To discuss about linear regression models and their assumptions. 2. To study about different criteria for model selection and their Goodness of fit measures. 3. To explain Non normal disturbances and their consequences and statistical analysis of residuals. 4. To discuss about Non-linear regression estimation methods.			
Course	1. Students learnt about different linear and non-linear regression			

Out comes	models and their appropriate computational procedures. 2. They know R^2, adjusted R^2 and C_p criteria for model selection.

APST-306(B): Total Quality Management and Six sigma

Unit I: Need for TQM, evolution of quality, Definition of quality, TQM philosophy – Contributions of Deming, Juran, Crosby, Taguchi and Ishikawa.

Unit II: Vision, Mission, Quality policy and objective, Planning and Organization for quality, Quality policy Deployment, Quality function deployment, Analysis of Quality Costs.

Unit III: Customer focus, Leadership and Top management commitment, Employee involvement – Empowerment and Team work, Supplier Quality Management, Continuous process improvement, Training, performance Measurement and customer satisfaction.

Unit IV : SIX SIGMA AND PDSA: An overview of six sigma methodology, DMAIC,DFSS and lean six sigma; product / process understanding : SIPOC, VSM, FMEA ; The Seven QC Tools of Quality, New Seven management tools, Bench Marking, JIT, POKA YOKE, 5S, KAIZEN, Quality circles.

Reference

1. Narayana V. and Sreenivasan, N.S.(1996): "Quality Management – Concepts and Tasks", New Age International.

2. Zeiri(1991): "Total Quality Management for Engineers", Wood Head Publishers.

3. Juran J.M and Frank M.Gryna Jr.(1982): "Quality Planning and Analysis", TMH, India.

4. Brain Rethery(1993): ISO 9000, Productivity and Quality Publishing Pvt.Ltd.

5. D. Mills(1993): Quality Auditing, Chapman and Hall.

APST-307: Practical – VI (APST 305 and APST 306)

APST-308: OOTC/ OPEN ELECTIVE

APST 308 (A) : SURVIVAL ANALYSIS

UNIT – I: Functions of Survival Time – Definition, Relationship of Survival Functions; Nonparametric Methods of Estimating Survival Functions: Product-Limit Estimate of Survival Function – Kaplan-Meier Estimator of Survival Function.

UNIT – II: Nonparametric Methods for Comparing Two Survival Distributions – Gehan's Generalized Wilcoxon Test, Cox - Mantel test, Logrank Test, Peto and Peto's Generalized Wilcoxon Test, Cox's F-test and Mantel-Haenszel Test.

UNIT – III: Parametric Methods for Comparing Two Survival Distributions: Exponential, Weibull and Gamma distributions only. Nonparametric and Parametric Methods for Identifications of Prognostic Factor Relating to Survival Time, Cox Proportional Hazard (PH) Model for Survival Data.

UNIT – IV: Analytical Estimation Procedures for Survival Distributions: Exponential, Weibull, Log-Normal and Gamma distributions only.Graphical Methods for Survival Distributions Fitting: Probability Plotting, Hazard Plotting Methods, Tests of Goodness-of-Fit, A Regression Method for Fitting Survival Distribution.

REFERENCES:

1. Elisa T.Lee (1992): Statistical Methods for Survival Data Analysis, John Wiley Sons.
2. Miller, R.G. (1981): Survival Analysis, New York, John Wiley & Sons, Inc.
3. Cross A.J. and Clark V.A. (1975): Survival Distribution, Reliability Applications in the Biomedical Sciences, John Wiley and Sons.

4. Elandt Johnson, R.C., Johnson N.L. (1999): Survival Models and Data Analysis, New York, John Wiley & Sons, Inc.
5. Collett, D. (1994), Modeling Survival Data in Medical Research, London: Chapman & Hall.
6. Cox, D. R. and Oakes, D. (1984), Analysis of Survival Data, London: Chapman & Hall.
7. Lawless, J. F. (1982), Survival Models and Methods for Lifetime Data, New York: John Wiley & Sons, Inc.

APST 308 (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 $\bar{R}^2$statistics; Multiple Range tests: l.s.d. 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.

<table>
<tr><td>Subject Code</td><td>Subject Name</td><td colspan="2">Credits Allotted</td><td>Total</td></tr>
<tr><td rowspan="2">APST 308 (b)</td><td rowspan="2">Statistics for social and behavioral sciences</td><td>Theory</td><td>Practical</td><td rowspan="2">4</td></tr>
<tr><td>4</td><td>----</td></tr>
<tr><td>Course Objective</td><td colspan="4">1. To learn about Basic statistics measures with examples.
2. To discuss important concepts, probability distributions like Binomial, Poisson and Normal properties and applications.
3. To explain Parametric and non-parametric test and discussed with illustrations.
4. To discuss advanced statistical tools with examples.</td></tr>
<tr><td>Course
Out comes</td><td colspan="4">1. Students learnt about Graphs, measures of averages, measures of dispersion etc.
2. Students understood about basic probability and important distributions with workout examples.
3. Students applied t, F, χ^2, ANOVA and ANCOVA and non-parametric tests and discussed with examples.
4. Students used Advanced statistics tools with illustrations.</td></tr>
</table>

SEMESTER- IV								
S.no	Course	Code	Tittle of the course	H/W	C	SEE	IA	TOTAL Marks
01	OOSDC	APST 401	A:APPLIED FORECASTING METHODS B: STATISTICAL CONCEPTS USING Python	4	4	50	25	75
02	PW	APST 402	A: STATISTICAL ANALYSIS USING **R** B: APPLIED DEMOGRAPHY	4	4	50	25	75

			AND OFFICIAL STATISTICS					
03		APST 403	Practical – VII (401 and 402)	6	2	35	15	50
04	Project	404	Project Work – Orientation classes	14	12	65	35	100
		Conducting Classes for Competitive, Communications Skill UGC/CSIR and NET/SLET examinations		12	--	--	--	--
			Total	36	20	200	100	300
			Total Semester	144	84	1220	580	1800

APST-401(A): 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 p arameter 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.

Subject Code	Subject Name	Credits Allotted		Total
APST401	**APPLIED FORECASTING METHODS**	Theory	Practical	4
		4	----	
Course Objective	1. To fitgrowth curves, measurement of cyclical and irregular component with simple examples. 2. To discuss Single, Double, Triple, adoptive exponential smoothing models and its importance. 3. To explain Auto correlation functions and their properties. 4. To discuss about Box Jenkins time series models and their estimation of parameters, fitting and diagnostic checking.			
Course Out comes	1. Students understood Time series analysis with some important growth models and their fitting 2. Students forecasting using regression, non-linear regression techniques, single, double, triple and adoptive exponential smoothing models. 3. Students obtained knowledge on AR, MA, ARMA, ARIMA, models fitting, diagnostic checking, etc.			

APST-401(B): STATISTICAL CONCEPTS USING **Python**

UNIT – I:Introduction to Python:

Introduction to Python Language,Strengths and Weaknesses, IDLE, Dynamic Types, Naming Conventions, String Values, String Operations, String Slices, String Operators, Numeric Data Types, Conversions, Control Flow and Syntax, Indenting, The if Statement, Relational Operators, Logical Operators, True or False, Bit Wise Operators, The while Loop, break and

continue, The for Loop, Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries, Copying Collections, In Functions.

UNIT –II :Object and Classes : Classes in Python, Principles of Object Orientation, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes.

UNIT –III : Functions and Modules : Introduction, Defining Your Own Functions, Parameters, Function Documentation, Keyword and Optional Parameters, Passing Collections to a Function, Variable Number of Arguments, Scope, Functions - "First Class Citizens", Passing Functions to a Function, Mapping Functions in a Dictionary, Lambda, Modules, Standard Modules – sys, Standard Modules – math,Standard Modules – time,The dir Function**.**

UNIT –IV : Statistical concepts in python: python programming basics, data manipulations with NumPy and Pandas, descriptive statistics, probability and hypothesis testing, data visualization and advanced topics such as regression analysis, experimental design using python libraries to analyze and interpret data and Bayesian statistics.

Books for Study:

1. Dive into Python, Mike
2. Learning Python, 4th Edition by Mark Lutz
3. Programming Python, 4th Edition by Mark Lutz

Course Outcomes:

1: Able to understand the concept of Python Programming.
2: Expertise in Object and Classes.
3: To be able to explore Functions and Modules learning.
4: Able to understand the concept of I/O and Error Handling In Python.

APST 402(A): STATISTICAL ANALYSIS USING **R**

UNIT-I: Familiarizing with R environment, Using R console as a calculator, R atomic types, methods of creating vectors, combining vectors and repeating vectors, different ways of subsetting vectors using indexing, names and logicals. Arithmetic and logical operations. Using

character vectors for text data, manipulating text using strsplit(), paste(), cat(), grep(), gsub() functions; handling factor data. Working with dates.

UNIT – II: Creating Matrices, getting values in and out of matrices, performing matrix calculations; Working with multidimensional Arrays; creating data frames, getting values in and out of data frames, adding rows to data frame, adding variables to data frame; creating lists, extracting components from a list, changing values of components of lists. Getting data into and out of R - reading data in CSV files, EXCEL files, SPSS files and working with other data types. Getting data out of R – working with write.csv() and write.table() functions.

UNIT – III: Writing Scripts and functions in R. Control statements in R – conditional control using if, if-else, looping control using for, while, repeat; transfer of control using break and next. Manipulating and processing data - creating subsets of data, use of merge() function, sorting and ordering of data. Group manipulation using apply family of functions - apply, sapply, lapply, tapply. Base graphics. Use of high-level plotting functions for creating histograms, scatter plots, box-whiskers plot, bar plot, dot plot, Q-Q plot and curves. Controlling plot options using low-level plotting functions - Adding lines, segments, points, polygon, grid to the plotting region; Add text using legend, text, mtext; and Modify/add axes, Putting multiple plots on a single page

UNIT – IV: Statistics and probability distributions – Descriptive statistics, normal, binomial, Poisson and other distributions. Summary statistics, hypothesis testing - one and two-sample Student's t-tests, Wilcoxon U-test, paired t-test, paired U-test, correlation and covariance, correlation tests, tests for association- Chi-squared test and goodness-of- fit tests. Formula notation, one-way and two-way ANOVA and post-hoc testing, graphical summary of ANOVA and post-hoc testing, extracting means and summary statistics, regression analysis (simple and multiple)

References:

1. Mark Gardener(2012), Beginning R - The Statistical Programming Language, Wiley India Pvt Ltd.
2. Andrie de Vries and JorisMeys(2015), R Programming for Dummies, Wiley India Pvt Ltd.
3. Jared P. Lander(2014), R For Everyone - Advanced Analytics and Graphics, Pearson Education Inc.

Course Outcomes:

1: Understand the atomic types of R, different methos of creating and filtering of vectors,manipulationoftextdata,factor data and dates.
2: Understandhowtocreate,subsetandmodifydatastructureslikematrices, arrays,dataframesandlists.Understandhowtoreaddataintoandoutof R.
3: Understand the control statements of R, writing functions and scripts in R and debuggingfeatures ofR.Understandtheuseofapply familyoffunctions.
4: Understandtheusethehigh-levelplottingfunctionsinRtocreategraphsin baseRandthe low-levelplottingfunctionstocustomizethe graphs.
5: Understandtheuseofbuilt-infunctionstoperformhypothesestesting, correlationandregressionanalysis,andANOVA.

Course objectives:

1: Able to create and manipulate vectors,matrices,arrays,data frames and lists. Should beabletoworkwithcharacterdata,factordataanddates.
2: Abletowritescriptsandfunctioninrandreaddatafrom.csvfiles,EXCELfiles andSPSSfiles.
3: Abletodistinguishbetweenhigh-levelandlow-levelplottingfunctionsavailable inbaseR.
4: Abletousebuilt-infunctionstoanswerquestionsrelatingtoprobability distributions,parametricandnonparametrichypothesistesting,correlationand regressionanalysis,andone-wayandtwo-wayANOVA.

APST 402(B): 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.

Subject Code	Subject Name	Credits Allotted	Total

ST -402(b)	**Demography and official statistics**	Theory	Practical	4
		4	----	
Course Objective	1. To study about demography and their importance, different reproduction. 2. To explain population Genetics, CSO, NSSO and their scope and contents in population census in India. 3. To describe about Official Statistics and their related topics. 4. To have knowledge about Official Statistics			
Course Out comes	5. Students know the growth rates, life tables, GRR, NRR and growth models. 6. Students understood about gene frequencies, genotypes, phenotypes etc. 7. Students learnt about population census methods, organizations in India and their functions.			

APST-403: Practical – VII (APST-401 and APST-402)

APST-404: Student project

65 Marks for project thesis, 25 for project Viva Voce and 10 marks for Project presentation.