Statistics Paper-I
Methods of applied statistics
[CORE COURSE]

Semester II	Credits: 2	Subject Code: BS22005	Lectures : 40

Course Outcomes:
At the end of this course, the learner will be able to:
• Calculate and interpret the correlation between two variables.
• Represent graphically and calculate the simple linear regression and non-linear regression equations for a set of data. Interpret the results of bivariate regression and correlation analysis, for forecasting.
• Calculate multivariate regression for three variables. Interpret the results of multivariate regression for forecasting.
• Analyze the trend in time series and how to remove it.

Unit 1: Correlation (For ungrouped data)	10
• Concept of bivariate data, scatter diagram, its interpretation, concept of correlation, positive correlation, negative correlation, zero correlation. • Karl Pearson's coefficient of correlation, properties of correlation coefficient, Interpretation of correlation coefficient, coefficient of determination with interpretation. • Spearman's rank correlation coefficient (formula with and without ties). • Numerical problems.	

Unit 2: Regression (for ungrouped data)	12
• Concept of linear and nonlinear regression. Illustrations, appropriate situations for regression and correlation. • Linear regression: Fitting of both lines of regression using least square method. • Concept of regression coefficients. • Properties of regression coefficients : $b_{xy} \cdot b_{yx} = r^2$, $b_{xy} * b_{yx} \leq 1$, $b_{xy} = r(\sigma_x / \sigma_y)$ and $b_{yx} = r(\sigma_y / \sigma_x)$. • Nonlinear regression models: Second degree curve, exponential curves of the type $Y = ab^x$ and $Y = ax^b$. • Numerical problems related to real life situations.	

Unit 3: Multiple Regression and Multiple, partial Correlation (For TrivariateData)	10
• Concept of multiple regressions, Yule's Notations. • Fitting of multiple regression planes.[Derivation of equation to the plane of regression of X1on X2 and X3 is expected. Remaining two equations to be written analogously.] • Concept of partial regression coefficients, interpretations. • Concept of multiple correlation: Definition of multiple correlation coefficient and its formula.	

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Unit 4: Time series	08
- Meaning and utility - Components of time series - Additive and multiplicative models - Methods of estimating trend: moving average method, least squares method and exponential smoothing method (with graph and interpretation). - Numerical problems related to real life situations.	

Recommended Text Books:

- Gupta S. C. and Kapoor V. K. 1987, *Fundamentals of Applied Statistics (3rd Edition)* S. Chand and Sons, New Delhi.
- Kulkarni M.B., GhatpandeS.B.,Gore S.D. 1999, *Common Statistical Tests*, Satyajeet Prakashan, Pune
- Kulkarni M.B., Ghatpande S.B. 2007, Introduction to Discrete Probability and Probability Distributions SIPF Academy
- Sarma K.V.S. 2001 *Statistics Made Simple. Do it Yourself on P.C.* Prentice Hall

Reference Books:

- Box and Jenkin ,*Time Series Analysis*, 4th Edition , Wiley, 2008.
- Brockwell and Davis, *Time Series Methods,* Springer, 2006.
- Douglas C. Montgomery, Peck Elizabeth A. *Introduction to Linear Regression Analysis,* G. Geoffrey Vining, Wiley
- Gupta and Kapoor, *Fundamentals of Applied Statistics(3rd Edition),* S. Chand and Sons, New Delhi, 1987.

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Subject Expert (Outside SPPU)	Dr. Suresh Pathare		*Pathare* 21/7/20
V.C. Nominee(SPPU)	Dr. Mohan Kale	*MKale* 21/7/20	
Industry Expert	Dr. Saikat Roy		Saikat Roy 21/7/20
Alumni	Anuja	Anuja 21/7/20	

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Statistics Paper-II

Continuous probability distributions and testing of hypothesis

[CORE COURSE]

Semester II	Credits:2	Subject Code: BS22006	Lectures : 40

Course Outcomes:

At the end of this course, the learner will be able to: Apply the knowledge of standard continuous probability distributions to solve real life problems by calculating probabilities. • Apply the concepts and definitions related to testing of hypothesis. • Perform Test of Hypothesis for a population parameter for single sample and two sample cases. Understand the concept of p-values. • To generate model sample from given distributions. • Apply the knowledge of concepts of hypothesis testing, parametric and non-parametric tests in research methodology at higher level studies and applications.

Unit 1: Standard Continuous Probability Distributions	**10**
• Uniform Distribution: statement of p.d.f., mean, variance, nature of probability curve. Theorem (without proof): The distribution function of any continuous r.v. if it is invertible follows $U(0, 1)$ distribution • Exponential Distribution: statement of p.d.f. of the form, • $f(x) = (1/\theta) e(-x/\theta)$, mean, variance, nature of probability curve, lack of memory property.(with proof) • Parato distribution: Form of p.d.f. $f(x) = \alpha / x(\alpha+1); x \geq 1, \alpha > 0$. Mean, variance, symmetry, applications • Normal Distribution: statement of p.d.f., identification of parameters, nature of probability density curve, standard normal distribution, symmetry, distribution of $aX+b$, $aX+bY+c$ where X and Y are independent normal variables, computations of probabilities using normal probability table, normal approximation to binomial and Poisson distribution, central limit theorem (statement only), normal probability plot. Box Muller transformation. • Numerical problems related to real life situations.	

| **Unit 2: Concepts and definitions related to testing of hypothesis**	**4**
• Concepts and definitions related to testing of hypothesis • Definitions: population, statistic, SRSWR, SRSWOR, random sample from a probability distribution, parameter, statistic, standard error of estimator. • Concept of null hypothesis and alternative hypothesis, critical region, level of significance, type I and type II error, one sided and two side dtests, p-value.	

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Unit 3: Parametric and Non-parametric Tests	20

- Large Sample Tests
  - Ho: $\mu = \mu o$ Vs H1: $\mu \neq \mu o$ (two sided tests)
    Ho: $\mu1 = \mu2$ Vs H1: $\mu1 \neq \mu2$ (two sided tests)
  - Ho: $P = Po$ Vs H1: $P \neq Po$ (sided and two sided
    tests)Ho: $P1 = P2$ Vs H1: $P1 \neq P2$ (two sided tests)
  - Test based on F- distribution: F-test for testing significance of equality of two population variances.
- Tests based on t –distribution: Ho: $\mu1 = \mu2$ Vs H1: $\mu1 \neq \mu2$, $\mu1 < \mu2$, $\mu1 > \mu2$ (One sided and two sided tests), Paired t-test.
- Tests based on Chi square distribution
- Chi-square test for goodness of fit
- Test for independence of attributes (mxn and 2x2)
- Kolmogorov - Smirnov test
- Run test for testing randomness of the sample and sign test for testing symmetry of the sample
- Numerical problems related to real life situations.

Unit 4: Simulation	06

- Introduction, concept of simulation, random numbers, pseudo random numbers, Advantages, Disadvantages of Simulation. Applications
- Methods of simulation, Linear congruential generator and simulation from continuous Uniform, Exponential and Normal Distribution.
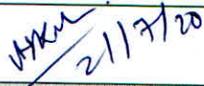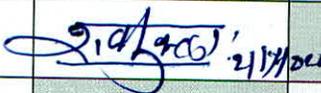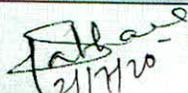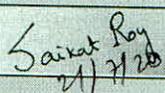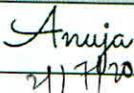
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- Sarma K.V.S. 2001 *Statistics Made Simple. Do it Yourself* on P.C. Prentice Hall

Reference Books:

- Agarwal B. L., *Programmed Statistics*, New Age International Publishers.
- Freund J.E., *Modern Elementary Statistics*,,Pearson Publication, 2005.
- Ghatpande S.B., Gore S.D., Kulkarni M.B., *Common Statistical Tests* Satyajeet Prakashan, 1999.
- Law A. M. and Kelton W.D., *Simulation Modeling and Analysis*, Tata McGraw Hill, 2007.
- Medhi J., *Statistical Methods (An Introductory Text)*, New AgeInternational1992.
- Mukhopadhyay P., *Mathematical Statistics (3rdEdition)*,Books And Allied (P),Ltd., 2015.
- Trivedi K.S., Probability, Statistics, *Design of Experiments and Queuing Theory with Applications of Computer Science*, Prentice Hall of India, New Delhi, 2001.

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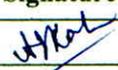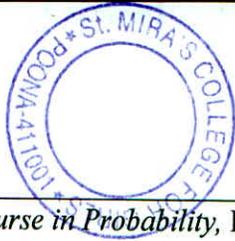
- Ross Sheldon, *A First course in Probability,* Pearson Education Inc.

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