Program Specific Outcomes(PSOs) and Course Outcomes (COs) 2019-20

Department of Statistics

Programme: B. Sc. Statistics

PSO No.	Program Specific Outcomes(PSOs) **Upon completion of this programme the student will be able to**
PSO1	**Academic competence:** (i) Recall summary statistics for quantitative and qualitative data, basic concepts of probability, infinite series, concepts of financial mathematics for actuarial statistics. (ii) Understand concept of correlation and regression, multiple regression, probability distributions and their characteristic properties, some standard discrete and continuous probability models, theory of inference.
PSO2	**Personal and Professional Competence:** (i) Simulate various probability distributions using various random number generation procedures. (ii) Apply the statistical techniques that involve exploratory and confirmatory data analysis to the real life data collected through sample surveys, and prepare project reports.
PSO3	**Research Competence** (i) Plan statistical designing of experiments ,learn its applications and analysis, learn modelling and analysis of time series data ,forecasting of time series, create life tables and decide life insurance policy premiums , learn modelling of different probability distributions , use of R-software for statistical analysis.
PSO4	**Entrepreneurial and Social competence:** (i) Learn and apply stochastic processes, concept of regression, optimization techniques , survival analysis, reliability theory in real life situations.

B. Sc. Semester I		
Title of the Course and Course Code	**Descriptive Statistics**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concepts of statistical population and sample.	1
CO2	Articulate the data and its type and summarize information in the data using different summary measures.	2
CO3	Apply methods and procedures of summarizing information in real life situations in various fields.	3
CO4	Analyze the bivariate quantitative data.	4
CO5	Judge and make comparisons through the exploratory data analysis and summary measures.	5
CO6	Organize and summarize the information by suitable presentations and computations.	6
Title of the Course and Course Code	**Probability Theory**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe random and non-random experiments.	1
CO2	Articulate sample space for a certain random experiment and identify events and their types.	2
CO3	Illustrate different real life situations to find probability of different types of events, the theorems of probability.	3
CO4	Explain definition of independence of events to determine whether an assumption of independence is justifiable.	4
CO5	Justify random variable(s) of interest in a given scenario and find the probability distribution.	5
CO6	Formulate different discrete probability distributions based on finite sample space.	6
Title of the Course and Course Code	**Statistics Practical**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall various graphical and diagrammatic techniques and interpret.	1

CO2	Compute various measures of central tendency, dispersion, skewness and kurtosis.	2
CO3	Calculate and determine correlation coefficient of bivariate data.	3
CO4	Analyze the data using R- Software.	4
CO5	Evaluate probabilities of univariate distributions.	5
CO6	Develop summary statistics of output generated by R-Software.	6
	B.Sc. Semester II	
Title of the Course and Course Code	**Basic Applied Statistics**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall concept of bivariate and multivariate data, correlation, Karl Pearson's correlation coefficient and its interpretation.	1
CO2	Explain simple, multiple regression models, fitting of second degree and exponential curves, computation of price, quantity indices and study of qualitative data.	2
CO3	Apply appropriate statistical models to data generated in day to day life by using R software and calculate various price and quantity indices and Yule's coefficient of association.	3
CO4	Identify the situations for simple linear and multiple linear regression models.	4
CO5	Compare fitted models on the basis of residual analysis and coefficient of determination.	5
CO6	Formulate the real-life situations in terms of regression analysis.	6
Title of the Course and Course Code	**Probability Distributions**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concepts of discrete random variables.	1
CO2	Extend the concept of discrete probability distributions to continuous probability distributions.	2
CO3	Apply discrete distribution to real life situations.	3
CO4	Identify different discrete probability distributions.	4
CO5	Compare and illustrate the concept of two dimensional discrete random variables, bivariate and continuous probability distributions.	5
CO6	Build the interrelations between the probability distributions.	6
Title of the Course and Course Code	**Practical – II**	**Number of Credits : 02**

On completion of the course, the students will be able to:		Bloom's Cognitive level
CO1	Recall the concepts of bivariate, multivariate data, correlation, Karl Pearson's correlation coefficient and its interpretation.	1
CO2	Explain simple, multiple regression models, fitting of second degree and exponential curves.	2
CO3	Compute price, quantity indices and probabilities of discrete distributions.	3
CO4	Analyze different types of indices.	4
CO5	Compare fitted models based on residual analysis and coefficient of determination.	5
CO6	Construct cost of living index number for real life situations.	6
	B. Sc. Semester III	
Title of the Course and Course Code	**Sampling Techniques**	**Number of Credits : 02**
On completion of the course, the students will be able to :		**Bloom's Cognitive level**
CO1	Recall concepts of sample and population, various sampling methods	1
CO2	Explain simple random sampling for variables and attributes, need of construction of strata and allocation problems in stratified random sampling method, sampling and non-sampling errors, PPS sampling	2
CO3	Choose a sample of suitable size by using various sampling methods to collect data in day today life,	3
CO4	Calculate estimates of unbiased estimators and their standard errors in various sampling methods.	4
CO5	Compare simple random sampling, stratified random sampling and systematic sampling	5
CO6	Design a questionnaire to carry out sample survey	6
Title of the Course and Course Code	**Probability Theory and Distributions – II**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define continuous random variable , its probability density function and its characteristics such as expectation, variance and higher order moments.	1
CO2	Explain the theory and application of important continuous distributions such as uniform, normal, exponential and bivariate probability distributions.	2

CO3	Apply different methods to obtain probability distribution of transformation of random variables.	3
CO4	Analyze the real life situations of continuous probability distributions.	4
CO5	Make judgments / comparisons through normal probability and q-q plots for testing normality of data obtained in real life situations.	5
CO6	Constitute an appropriate statistical model in case of practical situations.	6
Title of the Course and Course Code	**Statistics Practical-III**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the commands of R software	1
CO2	Illustrate the random sampling procedures and fitting probability distributions to real life situations.	2
CO3	Apply the procedure of drawing random samples for continuous probability distributions.	3
CO4	Generate various probabilities of events using commands of R-software.	4
CO5	Justify cost and variance analysis for allocation of sample size on various strata	5
CO6	Plan statistical analysis of primary / secondary data using R	6
	B. Sc. Semester IV	
Title of the Course and Course Code	**Sampling Distributions**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall continuous random variable and its probability distribution	1
CO2	Develop the theory of sampling distribution of statistics.	2
CO3	Apply the derived probability distributions to real life situations.	3
CO4	Analyze the real life situations using derived probability distributions.	4
CO5	Justify the use of truncated normal distribution.	5
CO6	Synthesize an appropriate statistical model in case of real life situations.	6
Title of the Course and Course Code	**Statistical Methods – II**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concept of point estimation , unbiased estimator	1
CO2	Discuss and define the terms used in testing of hypotheses.	2
CO3	Compute probabilities of type I and type II error.	3

CO4	Identify the distributions of various test statistics.	4
CO5	Decide the appropriate hypotheses for testing the population parameters like mean , variance , correlation , proportion.	5
CO6	Construct the tests about various population parameters and test goodness of fit of probability distributions.	6
Title of the Course and Course Code	**Statistics Practical-IV**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the commands of R software.	1
CO2	Understand the procedure of point estimation and non-parametric tests.	2
CO3	Compute probabilities of events based on different probability distributions using command of R-software.	3
CO4	Analyze practical situations using statistical tests for various population parameters.	4
CO5	Test the goodness of fit for the distributions fitted to practical situations.	5
CO6	Construct confidence intervals for population parameters.	6
	B. Sc. Semester V	
Title of the Course and Course Code	**Distribution Theory**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define various continuous probability distributions and outline the properties of probability density functions, cumulative distribution functions.	1
CO2	Compute moment generating function, raw moments, central moments of different continuous probability distributions.	2
CO3	Demonstrate the significance of the distributions and identify the real life situations for probability distributions.	3
CO4	Analyze the relationship between different continuous distributions using the nature of the distributions.	4
CO5	Determine and develop problem-solving techniques needed to accurately calculate probabilities.	5
CO6	Devise the probability distributions to real life situations.	6
Title of the Course and Course Code	**Theory of Estimation**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**

CO1	Describe various terms for point estimation, interval estimations to understand problem of statistical inference. List and study the properties of point estimators.	1
CO2	Explain the method to obtain estimators using maximum likelihood, method of moments, method of scoring and Fisher Information function.	2
CO3	Demonstrate different situations with random sample from the standard distributions to obtain appropriate estimators. Execute the method to construct confidence intervals.	3
CO4	Compare different estimators with random sample from the standard distributions with unknown parameters and examine the suitability of estimators.	4
CO5	Evaluate efficiency of estimators and justify the importance of Fisher information function.	5
CO6	Collect various situations to discuss about importance of an estimator of unknown parameter.	6
Title of the Course and Course Code	**Introduction to Regression Analysis**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concept of fitting of simple regression models.	1
CO2	Articulate the concept of Multicollinearity and ridge regression.	2
CO3	Compare residual diagnostics and apply corrective measures.	3
CO4	Analyse the multiple linear regression and logistic regression models.	4
CO5	Justify weighted least squares method.	5
CO6	Determine tests of hypothesis of model parameters, AIC and BIC criteria.	6
Title of the Course and Course Code	**Design of Experiments**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Identify relationships between cause and effect, planning and designing the experiments.	1
CO2	Outline interactions among causative factors through factorial designs.	2

CO3	Apply different experimental designs to real life situations.	3
CO4	Analyse collected information through the experiments planned according to different designs using ANOVA and ANCOVA techniques.	4
CO5	Validate the design employed in real life situations using residual analysis.	5
CO6	Design a lay out of different statistical designs.	6
Title of the Course and Course Code	**Actuarial Statistics**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concepts of financial mathematics and probability theory.	1
CO2	Explain terms used in insurance business and survival analysis.	2
CO3	Calculate actuarial present values and amount of premium for insurance policy.	3
CO4	Classify risks into pure and speculative risk.	4
CO5	Compare statistical distributions of life length random variable on the basis of survival curves and force of mortality curves.	5
CO6	Construct life tables for different age groups of people.	6
Title of the Course and Course Code	**Operations Research**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concept of linear programming.	1
CO2	Represent given situation into LPP and formulate the objective function , constraints and the network diagram.	2
CO3	Apply the techniques of solving LPP to obtain optimal solution.	3
CO4	Classify the solutions and interpret them according to the situations.	4
CO5	Evaluate the CPM and PERT networks and apply project crashing techniques.	5
CO6	Devise cost benefit analysis for different projects.	6

Title of the Course and Course Code	Statistics Practical-I	Number of Credits : 02
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the theory of continuous distributions.	1
CO2	Carry out model sampling from Cauchy and Laplace distributions. Also carry out fitting of lognormal distribution.	2
CO3	Apply the theory of confidence interval based on order statistics. Apply theory of continuous distributions to compute probability of various events.	3
CO4	Analyze the regression models.	4
CO5	Compare different distributions for real life situations.	5
CO6	Develop method to obtain MLE of location parameter of Cauchy distribution.	6
Title of the Course and Course Code	**Statistics Practical – II**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the principles of design of Experiments and planning of experiments.	1
CO2	Illustrate the layout of designs employed.	2
CO3	Apply parametric and non-parametric methods of analysis of variance.	3
CO4	Analyse various experimental designs.	4
CO5	Interpret the output of analysis of various statistical designs.	5
CO6	Hypothesize the objectives in the given practical situation to employ a specific experimental design.	6
Title of the Course and Course Code	**Statistics Practical – II**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concept of Linear Programming.	1

	Recall the concepts of financial mathematics and probability theory.	
CO2	Articulate the linear programming problem, Transportation problem, Assignment problem. Explain the concept of survival function and its properties.	2
CO3	Apply the techniques to find optimal solution to all types of LPP. Calculate actuarial present values and amount of premium for insurance policy	3
CO4	Compare statistical distributions of life length random variable .	4
CO5	Determine and interpret the optimal solutions of all types of LPP	5
CO6	Construct life tables for various age groups of people.	6
Title of the Course and Course Code	**Data Analysis using C-programming**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Introduce the concept of algorithm and programming and define differentiate terminology of C programming.	1
CO2	Articulate the different situations where programming is helpful for analysing the statistical data.	2
CO3	Apply the method to write simple C programs and use them to analyse the statistical data.	3
CO4	Examine the de-bugging of the programs as and when required to run the program successfully.	4
CO5	Consider and justify the use of parametric or non-parametric tests.	5
CO6	Write simple programs in C for statistical data analysis.	6
Title of the Course and Course Code	**Data Analysis using R software**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the principles of designs of experiments and prepare layout of designs employed. Recall the theory of continuous probability	1

	distributions.	
CO2	Estimate confidence intervals for quantiles. Demonstrate the computation of probabilities of events.	2
CO3	Apply parametric and non-parametric methods of analysis of variance. Apply the pivotal quantity technique to obtain confidence interval. Compare residual diagnostics using R.	3
CO4	Analyze various experimental designs, regression models and continuous probability distributions using R.	4
CO5	Interpret the output of analysis of various statistical designs, the output of analysis of regression models and MLE using R.	5
CO6	Hypothesize the objectives in the given practical situation to imply a specific experimental design and distributions. Test the hypotheses related to parameters in the regression models using R.	6
B. Sc. SEM VI		
Title of the Course and Course Code	**Introduction to Stochastic Processes STS3601**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the concepts of stochastic processes in discrete time, especially concerning Markov chains and their classifications.	1
CO2	Give examples of different types of stochastic processes and classify the states space of Markov chain.	2
CO3	Demonstrate the computations of higher order probabilities of Markov chain using Kolmogorov's equations.	3
CO4	Differentiate the stochastic processes based on classification of state space and explain the concept of stationary distribution of irreducible and ergodic Markov chain.	4
CO5	Justify the stochastic simulation techniques.	5
CO6	Design and develop the theory of stochastic process and its applications.	6
Title of the Course and Course Code	**Testing of Hypotheses**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**

CO1	Describe the terms involved in the problem of testing of hypothesis to develop MP and UMP tests.	1
CO2	Compute Type I error and Type II error to understand the concept of MP and UMP tests.	2
CO3	Demonstrate MP test using NP Lemma and construction of LRT and SPRT	3
CO4	Explain the situations when UMP test exists	4
CO5	Justify the use of parametric or non-parametric tests.	5
CO6	Develop Likelihood Ratio Test and illustrate that MP test is special case of LRT.	6
Title of the Course and Course Code	**Reliability and Survival Analysis**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall various probability distributions and their properties.	1
CO2	Explain structural properties of coherent system.	2
CO3	Compute reliability of coherent system.	3
CO4	Explain the non-parametric estimation of survival function.	4
CO5	Evaluate the structure function using modular and pivotal decomposition.	5
CO6	Construct the reliability block diagrams and structure functions of coherent system using minimal path and cut sets.	6
Title of the Course and Course Code	**Applied Multivariate Analysis**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Memorize the properties of univariate normal distribution. Define bivariate and multivariate distributions.	1
CO2	Demonstrate the significance of the distributions and identify the real-life situations for bivariate and multivariate distributions.	2

CO3	Relate multivariate normal distribution with Chi-square distribution. Sketch probability density curves for bivariate distribution.	3
CO4	Determine and develop problem-solving techniques needed to accurately calculate probabilities.	4
CO5	Apply discriminant analysis technique for solving appropriate real-world events.	5
CO6	Construct clusters for data generated in day today life using cluster analysis.	6
Title of the Course and Course Code	**Time Series Analysis**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the concept of time series and its components .	1
CO2	Explain basic models of time series and different methods of estimation of trend and seasonal variation.	2
CO3	Demonstrate exponential smoothing and autoregressive model fitting technique of time series analysis.	3
CO4	Analyze the real life time series and carry out residual analysis.	4
CO5	Determine an appropriate model to forecast future observations of the time series.	5
CO6	Prepare an appropriate time series model for the given data.	6
Title of the Course and Course Code	**Biostatistic**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall concepts of health, illness, disease and socially defined concept of sickness and define the phases of clinical trials.	1
CO2	Discuss the principles of epidemiology.	2
CO3	Demonstrate the types of study designs used in clinical trials and use of randomization and blinding.	3
CO4	Analyze 2 x 2 cross over design data.	4

CO5	Evaluate proportional odds ratio.	5
CO6	Write the objectives of clinical trials.	6
Title of the Course and Course Code	**Statistics Practical -I**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Introduce the concept parametric and non-parametric tests. Further also introduce concept of sequential tests. Introduce concept of Markov chain. Define the various terms involved in Markov chain. Evaluate transition probability matrix of Markov chain. Recall the method of evaluation of reliability of any system.	1
CO2	Demonstrate the various situations to compute probability of type-1 error, power of the test. Also demonstrate the MP tests and UMP tests.	2
CO3	Apply various parametric and non-parametric tests to real life data. Also apply MP and UMP tests. Compute reliability of coherent system.	3
CO4	Examine the suitability of tests. Verify the underlying conditions for applying the tests.	4
CO5	Consider and justify the use parametric or non-parametric tests. Also justify ergodicity of Markov chain. Determine minimal path and cut sets for coherent systems.	5
CO6	Develop the method to obtain the realization of Markov chain.	6
Title of the Course and Course Code	**Statistics Practical – II**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the techniques of smoothing, time series component estimation.	1
CO2	Compare various time series models fitted through the residual analysis, Identify the real-life situations for bivariate and multivariate distributions.	2
CO3	Use one sample test on mean vector in multivariate normal distribution.	3
CO4	Analyse different time series data.	4

CO5	Determine an appropriate model to forecast future observations of the time series.	5
CO6	Build an appropriate model of time series for the real life data.	6
Title of the Course and Course Code	**Statistics Practical – III**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the techniques of data presentation like tabulation, bargraph , pie chart , box plot .	1
CO2	Discuss different characteristics of the data	2
CO3	Apply different methods of collection of data	3
CO4	Analyze the data using statistical tools and R-software	4
CO5	Determine the hypotheses and validate using appropriate statistical tests	5
CO6	Prepare the project report and make the presentation.	6
Title of the Course and Course Code	**Elements of Statistical Computing and Data Mining**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concept of random numbers and interrelation among probability distributions	1
CO2	Compare the procedures of random number generation and describe the concept of classification.	2
CO3	Demonstrate different random samples generation procedures from probability distributions and apply binary classifier in real life situations.	3
CO4	Compare the random number generation procedures on the basis of entropy.	4

CO5	Estimate sensitivity, specificity and accuracy of a classifier	5
CO6	Create confusion matrix and ROC curve	6
Title of the Course and Course Code	**Statistical Computing using R software**	**Number of Credits : 02**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concept of testing of hypotheses, stochastic process and survival function	1
CO2	Compare different time series models observing residual plots and error measures using R.	2
CO3	Apply autoregressive modelling and exponential smoothing procedures for time series data using R. Apply Markov chain to study the behavior of the process.	3
CO4	Explain the non-parametric estimation of survival function using R.	4
CO5	Judge models of time series using different error measures and identify the different states of Markov chain.	5
CO6	Create an appropriate model for real life time series and realization of stochastic process.	6