SVA GOVERNMENT COLLEGE (M) : SRIKALAHASTI

DEPARTMENT OF STATISTICS

Course 1: Descriptive Statistics and Probability

1. Students will gain an understanding of the broad scope of statistics in various fields including science, business, and social sciences, while also recognizing its limitations such as the assumptions underlying statistical methods and the potential for misinterpretation of results.

2. Students will be proficient in identifying and distinguishing between different types of data, including nominal, ordinal, interval, and ratio data, enabling them to select appropriate statistical methods for analysis and interpretation.

3. Students should be able to create and interpret graphical representations of data, including histograms, box plots, scatterplots, and bar charts, to visually summarize and communicate patterns and trends in data.

4. Students should be able to comprehend and apply various measures of central tendency (mean, median, mode) and dispersion (standard deviation, variance) to summarize and describe data sets effectively.

5. Students should understand fundamental concepts of probability theory, including sample spaces, events, probability distributions, and basic rules of probability (addition rule, multiplication rule, conditional probability).

6. Students will comprehend the concept of a single random variable as a function that assigns a numerical value to each outcome of a random experiment.

7. Gain knowledge about the properties of random variables, including expected value, variance, and standard deviation, and their roles in describing the central tendency and variability of random phenomena.

8. Students will understand bivariate random variables as pairs of random variables that are jointly distributed, and their significance in analysing relationships between two random phenomena.

9. Gain knowledge about properties such as covariance, correlation coefficient, and conditional distributions, and how they characterize the relationship between two random variables.

Course 2: Mathematical Expectation and Probability Distributions

1. Students will comprehend the concept of mathematical expectation as a measure of central tendency in probability theory, representing the average value of a random variable.

2. Students will achieve proficiency in applying properties of mathematical expectation, including linearity, additivity, and the law of iterated expectation, to analyze and solve problems in diverse statistical and probabilistic contexts.

3. Students will develop a deep understanding of moment generating functions, cumulant generating functions, characteristic functions, and probability generating functions as mathematical tools used to characterize the probability distribution of random variables.

4. Students will gain proficiency in applying MGFs, CGFs, characteristic functions, and probability generating functions to derive moments, cumulants, moments of derivatives, and probability distributions of random variables in diverse statistical and probabilistic contexts.

5. Learn about various discrete probability distributions such as the binomial, Poisson, negative binomial, geometric, and hypergeometric distributions, and understand their properties, applications, and limitations.

6. Gain knowledge about continuous probability distributions such as the uniform, exponential, and normal distributions, and understand their properties, including probability density functions, cumulative distribution functions, and applications in modeling continuous random phenomena.

7. Learn about different types of probability distributions for single random variables, including discrete distributions such as the binomial, Poisson, and negative binomial distributions, as well as continuous distributions such as the uniform, exponential, and normal distributions.

Course 3: Statistical Methods and Exact Sampling Distributions

1. Students will learn about curve fitting as a statistical technique used to find the best-fitting curve or function that describes the relationship between variables. They will be introduced to methods such as least squares regression for fitting curves to data.

2. Students will comprehend the concept of correlation as a statistical measure that describes the relationship between two variables. They will learn to interpret correlation coefficients and understand their significance in analysing associations between variables.

3. Students will learn about properties of correlation coefficients, including range (-1 to 1), direction (positive or negative), and strength (weak, moderate, strong). They will understand how these properties quantify the degree and direction of linear relationships between variables.

4. Students will grasp the concept of regression analysis as a statistical method used to model and analyse the relationship between a dependent variable and one or more independent variables. They will learn about simple linear regression and multiple linear regression models.

5. Students will learn about properties of regression models, including the regression equation, coefficients, residuals, and goodness-of-fit measures (such as R-squared). They will understand how these properties assess the adequacy of the regression model in explaining variability in the dependent variable.

6. Students will comprehend the theory of attributes as a branch of statistics that deals with qualitative (categorical) data and variables. They will learn about concepts such as frequency distributions, proportions, and measures of association for attribute data. They will understand how to analyze and interpret categorical data and draw meaningful conclusions from attribute data analysis.

7. Students will learn about exact sampling distributions such as the t-distribution, F-distribution, and chi-square distribution, which are used in hypothesis testing and confidence interval estimation. They will understand the properties and characteristics of these distributions.

Course 4: Statistical Inference

1. Students will learn about the properties of good estimators, including unbiasedness, efficiency, consistency, and sufficiency, and understand their significance in selecting appropriate estimation methods.

2. Students will comprehend various estimation methods, including maximum likelihood estimation (MLE) and moments method, as techniques used to estimate population parameters based on sample data.

3. Students will comprehend the concept of hypothesis testing and its role in statistical inference and they will understand the basic elements of hypothesis testing, including null and alternative hypotheses, test statistics, critical regions, and Type I and Type II errors.

4. Students will understand how to use the Neyman-Pearson Lemma to construct the critical region (rejection region) for a hypothesis test and they will learn how to calculate the likelihood ratio and determine the critical region that maximizes the power of the test while controlling the Type I error rate at a specified level.

5. Students will learn about the Z-test, which is commonly used large sample tests for testing of difference of population means, standard deviations and proportions and they will understand how to calculate test statistics and p-values for Z-tests and interpret the results in hypothesis testing.

6. Students will understand the different variants of the t-test, including the independent samples t-test, paired samples t-test, and one-sample t-test, and how to apply them in hypothesis testing.

7. Students will understand the F-test, a small sample test commonly used in analysis of variance (ANOVA) to compare variances or test the equality of means across multiple groups.

8. Students will understand the different variants of the chi-square test, including the chi-square test of independence and the chi-square test of goodness of fit, and how to apply them in hypothesis testing.

9. Students will comprehend the principles of non-parametric tests, which are statistical tests that do not rely on the assumption of specific population distributions and they will understand the advantages and limitations of non-parametric tests compared to parametric tests.

Course 5: SAMPLING THEORY and DESIGN OF EXPERIMENTS

1. Students will understand the advantages and disadvantages of sample survey over census. They will understand factors that contribute to sampling error, such as sample size, sampling design, and sampling method, and learn techniques for estimating and minimizing sampling error and also they will understand different types of non-sampling errors, including coverage error, non-response error, measurement error, and processing error, and learn techniques for identifying and reducing non-sampling errors.

2. Students will comprehend the principles of different sampling methods, including Simple Random Sampling, Stratified Random Sampling and Systematic Sampling and also they will understand the advantages, disadvantages, and applicability of each sampling method in various contexts.

3. They will understand that Simple Random Sampling is often preferred when resources are limited or the population is homogeneous, while stratified sampling is preferred when there are known differences within the population, and systematic sampling is preferred when the population is ordered or structured.

4. Students will comprehend the principles of Analysis of Variance (ANOVA), a statistical technique used to compare means across multiple groups and they will understand the underlying assumptions of ANOVA, including independence, normality, and homogeneity of variances, and how to assess these assumptions.

5. Students will learn about one-way ANOVA, which is used to compare means across two or more independent groups and they will understand how to formulate hypotheses, calculate the F-statistic, and interpret the results of one-way ANOVA tests and also students will understand two-way ANOVA, which extends the one-way ANOVA to examine the effects of two categorical variables (factors) simultaneously.

6. Students will comprehend the fundamental principles of experimental design, including randomization, replication, and local control and they will understand the importance of experimental design in ensuring valid and reliable conclusions from experiments.

7. Students will learn about CRD (where treatments are randomly assigned to experimental units without any restrictions), students will understand RBD, where experimental units are grouped into blocks based on known sources of variation, and treatments are randomly assigned within blocks and students will learn about LSD, which extends RBD to incorporate two sources of variation (rows and columns) in the experimental layout.

8. Students will understand factorial experiments, which involve simultaneously varying two or more factors (independent variables) to study their main effects and interactions and they will learn how to design and analyse factorial experiments, including identifying factors and levels, constructing factorial layouts, and interpreting main effects and interaction effects.

9. Students will learn to interpret the results of experiments conducted using CRD, RBD, LSD, and factorial designs, including understanding treatment effects, main effects, and interaction effects and also they will learn how to draw valid conclusions and make inferences based on experimental findings, considering the design and analysis methods used.

Course 6: Statistical Quality Control and Reliability

1. Students will comprehend the principles of Statistical Quality Control (SQC), including the use of statistical methods to monitor and improve the quality of products and processes in industry and they will understand the importance of SQC in ensuring consistency, reliability, and customer satisfaction.

2. Students will understand how control charts help identify common cause variation (inherent to the process) and special cause variation (resulting from external factors or process changes) and they will learn to distinguish between random fluctuations and assignable causes of variation and take appropriate corrective actions to maintain process stability and consistency.

3. Students will learn to use control charts as a key tool in SQC for monitoring process variation and detecting deviations from the desired quality standards and they will understand the different types of control charts and their applications in monitoring variables data (e.g., X-bar and R charts) and attribute data (e.g., p-chart, np-chart, and c-chart).

4. Students will comprehend the principles of acceptance sampling, a statistical technique used to make decisions about whether to accept or reject a batch ofproducts or materials based on inspection of a sample and they will understand the role of acceptance sampling in quality control and its applications in various industries, including manufacturing, healthcare, and service sectors.

5. Students will learn to construct single sampling plans, which involve inspecting a single sample from a batch and making a decision based on predetermined acceptance criteria (e.g., acceptance number, sample size, and sampling plan level) and they will understand how to calculate sampling parameters such as

Acceptance Quality Limit (AQL), Lot Tolerance Percent Defective (LTPD), and Operating Characteristic (OC) curves for single sampling plans.

6. Students will learn to construct double sampling plans, which involve inspecting an initial sample and, if necessary, a second sample based on the results of the first sample.

7. Students will comprehend the concept of reliability, which refers to the probability that a system or component will perform its intended function without failure for a specified period under stated conditions and they will understand the importance of reliability in various fields such as engineering, manufacturing, healthcare, and telecommunications.

8. Students will learn about different measures of reliability, including the probability of survival (reliability function), the probability of failure (failure rate or hazard rate), mean time to failure (MTTF), and mean time between failures (MTBF) and they will understand how these measures quantify the reliability of systems and components over time and under different operating conditions.

9. Students will understand the concept of the lack of memoryless property, which states that the future behaviour of a stochastic process or system depends on its current state and is not independent of past events and they will learn about stochastic processes that exhibit memoryless property (e.g., exponential