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cumulative frequency distribution, The relative frequency distribution, The percentage frequency distribution; Graphic and diagrammatic representation: Bar chart, Pie chart, Histograms, Frequency curves and Histograms; Histograms by Hand: Stem-and-leaf.

### **Measure of Central Tendency**

Introduction; Types of Averages: Mean: Arithmetic mean, Geometric mean, Harmonic mean, Trimmed mean and Winsorized mean; Quintiles: Median, Quartiles, Deciles, Percentiles; The mode; Box plot and detailed box plot; Empirical relation between Mean, Median and Mode; The cumulative distribution function: Finding the percentile ranking for a given number, Finding the percentile for a given percentage; Summary measures and type of data.

### **Measures of Dispersion, Skewness and Kurtosis**

Absolute and relative measure of dispersion; Different measures of dispersion: The Range, Quartile deviation, Mean deviation, Variance and standard deviation: Definition and interpretation of variance and standard deviation, Computation of variance and standard deviation, Step deviation method or coding method, Coefficient of variation, Standardized variable, Properties of standard deviation and variance; Skewness: Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness; Kurtosis.

### **Index Numbers**

Index Numbers, Un-weighted index numbers; Simple aggregative index; Weighted indexes; Laspeyre's price index, Paasche's price index, Marshal- Edgeworth price index; Fisher's ideal index; Consumer Price Index (CPI), Producer Price Index (PPI), CPI versus GDP Deflator; Issues in constructing and using index numbers; Application of index numbers to business and economics.

### **Recommended Books:**

- Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., & Cochran, J. J. (2014). Essentials of statistics for business and economics. Cengage Learning.
- Anderson, D. R., Williams, T. A., & Sweeney, D. J. (2011). Statistics for Business and Economics. 12th. Cengage Learning.
- Lind, Douglas A., Marshal, William G. and Mason, Robert D., (2015) Statistical Techniques in Business and Economics (16th edition). Boston: McGraw Hill, 2003.

**Code: STAT-102**

**Title: Probability and Probability Distributions**

**Credit Hours: 03**

**Prerequisite: Elementary Statistics**

### **Objectives:**

This course is designed to equip students with higher statistical tools and their application in economic analysis.

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## **Course Contents**

### **Probability**

A survey of probability concepts: Classical probability, Empirical concept, Subjective probability; Some rules of probability: Rules of addition, Rules of multiplication; Tree diagrams; Conditional Probability, Bayes Theorem; Counting rules: The multiplication formula, The permutation formula, The combination formula.

### **Random Variables and Probability Distribution**

Random variables, Discrete random variable, Continuous random variable, Discrete probability distribution; The mean, variance and standard deviation of a probability distribution; Binomial probability distribution, and its computation. Cumulative probability distributions, Properties of Binomial probability distribution. Poisson Probability Distribution, Hypergeometric

### **Probability Distribution**

The normal probability distribution: Properties of normal distribution, Applications of the standard normal distribution, Areas under the normal curve, Finding areas under the normal curve; The normal approximation of the binomial; Continuity correction factor.

### **Survey Sampling and Sampling Distributions**

Sampling the population, Advantages of sampling, Representative samples, Sample design and sample survey, Sampling frame, Probability and non-probability sampling, Sampling with and without replacement, Sampling and non-sampling error, sampling bias; Probability sampling and non-probability sampling methods; Sampling distribution of the mean; The central limit theorem; Sampling distribution of differences between means; Sampling distribution of sample proportion; Sampling distribution of differences between proportions.

### **Estimation and Confidence Intervals**

Point estimates and confidence intervals; Estimation by confidence interval: Confidence interval estimate of a population mean (Known Variance), Confidence interval estimate of a population mean (Unknown Variance) Confidence interval for differences of means, Confidence interval for differences of means; Confidence interval for population proportion, Confidence interval for differences between proportions; One sided confidence interval; Sample size for estimating population mean.

### **Hypothesis Testing**

One sample test of hypothesis; One Sample; One tail and two tails tests of significance; Testing for a population mean with a known population standard deviation: Two-tailed test, one-tailed test; P-Value in hypothesis testing; Testing for a population mean: Large sample, Population standard deviation unknown; Testing hypotheses about population proportion when sample size is large; Type II error.

Testing of two Sample Hypothesis: Population means, Population proportions; comparing populations with small samples.

### **Chi Square Applications**

Introduction; Goodness-of-fit test: Equal expected frequencies; Goodness-of-fit test: Unequal

expected frequencies; Limitations of Chi square; Using the goodness-of-fit test to test for normality; Contingency Table Analysis.

### **Analysis of Variance**

Introduction, The F distribution; Comparing two population variances; ANOVA assumptions; ANOVA test; Inferences about pairs of treatment means; Two-way analysis of variance.

### **Recommended Books:**

- Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., & Cochran, J. J. (2014). Essentials of statistics for business and economics. Cengage Learning.
- Anderson, D. R., Williams, T. A., & Sweeney, D. J. (2011). Statistics for Business and Economics. 12th. Cengage Learning.
- Lind, Douglas A., Marshal, William G. and Mason, Robert D., (2015) Statistical Techniques in Business and Economics (16th edition). Boston: McGraw Hill, 2003.

**Code: MATH-111**

**Title: Calculus-I**

**Credit Hours: 03**

**Prerequisite: Mathematics at Secondary Level**

### **Objectives:**

To prepare the students with the essential tools of algebra/calculus to apply the concepts and the techniques in Economics

### **Course Contents**

#### **Preliminaries**

Real-number system, introduction to sets, set operations, functions, types of functions.: quadratic, polynomial, power, exponential, logarithmic; Graphs of functions, sequences and series: convergence, algebraic properties and applications; continuous functions: characterizations, properties with respect to various operations and applications; differentiable functions: characterizations, properties with respect to various operations and applications; Economic applications of functions

#### **Matrices**

The Role of Linear Algebra; Definitions of the key terms; Matrices and Vectors; Vectors as Special Matrices; Addition and Subtraction of Matrices; Scalar Multiplication; Multiplication of Matrices; Commutative, Associative, and Distributive Laws in Matrix Algebra; Identity Matrix and Null Matrix; Scalar Matrix; Diagonal Matrix; Idempotent Matrix; Symmetric Matrix; Transpose of a Matrix and its properties; Inverse of a Matrix and its properties; Inverse Matrix and Solution of Linear-Equation System; Determinants-Definition and