**Quantitative Methods - I**

**Apr 2025 Examination**

**PLEASE NOTE: This assignment is application based, you have to apply what you have learnt in this subject into real life scenario. You will find most of the information through internet search and the remaining from your common sense. None of the answers appear directly in the textbook chapters but are based on the content in the chapter**

**Q1. Propose a method to use Excel for solving a binomial distribution problem, and discuss the advantages and limitations of using Excel for such statistical analyses? Solve the below problem using excel or manual method.**

**A company manufactures light bulbs, and it is known that 5% of the light bulbs are defective. If a quality control inspector randomly selects 20 light bulbs from a production batch, what is the probability that exactly 2 of them are defective? (10 Marks)**

**Ans 1.**

### **Introduction**

In statistics, probability distributions help in predicting outcomes in various real-world scenarios. One such crucial distribution is the **binomial distribution**, which models the probability of a fixed number of successes in a given number of trials, provided the trials are independent and have the same probability of success. Businesses often use binomial distribution to analyze product defects, success rates in marketing campaigns, and risk assessment in investments.

Microsoft Excel, a widely available and user-friendly tool, offers built-in functions to calculate binomial probabilities efficiently. The **BINOM.DIST** function in Excel simplifies calculations, making it an excellent tool for statistical analyses. However, Excel also has

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**Q2. A cereal company claims that the average weight of its cereal boxes is 500 grams. A quality control manager doubts this claim and randomly selects a sample of 50 boxes. The sample has a mean weight of 495 grams and a standard deviation of 10 grams. Formulate the null hypothesis (H0) and the alternate hypothesis (H1). - Perform a statistical to determine if the mean weight of the cereal boxes is significantly different from 500 grams at a significance level of 0.05 (10 Marks)**

**Ans 2.**

### **Introduction**

Statistical hypothesis testing is a critical tool in quality control and decision-making, allowing businesses to validate claims about their products. In this scenario, a cereal company claims that the average weight of its cereal boxes is **500 grams**, but a **quality control manager** doubts this and decides to test the claim using a **sample of 50 boxes**. The sample has a **mean weight of 495 grams** and a **standard deviation of 10 grams**. To determine whether the company's claim is valid, a hypothesis test is conducted at a **significance level of 0.05 (5%)**.

This problem involves a **one-sample t-test**, as we are testing a sample mean against a known population mean. The test helps in assessing whether the difference between the sample

**Q3(A) Evaluate the importance of understanding the null and alternate hypotheses in the context of hypothesis testing and its impact on research outcomes?**

**State Null and Alternate Hypothesis for below scenarios**

**A health organization claims that the average sodium content in a specific brand of soup is at least 400 mg per serving. A nutritionist doubts this claim and wants to verify if the average sodium content is less than 400 mg. State Null and Alternate Hypothesis**

**A pharmaceutical company claims that their new drug reduces cholesterol by an average of 50 mg/dL. A medical researcher wants to verify if the average reduction is not equal to 50 mg/dL. (5 Marks)**

#### **Introduction**

Hypothesis testing is a fundamental aspect of statistical analysis in research. It enables researchers to make data-driven decisions by assessing whether an observed effect is statistically significant or simply due to chance. The **null hypothesis (**$H\_{0}$**)** represents the default assumption that there is no effect or no significant difference, while the **alternative hypothesis (**$H\_{1}$**)** suggests that there is an effect or a deviation from the assumed norm. Understanding these hypotheses is crucial in fields such as healthcare, business, and social

**Q3 (B) Given the following data points for variables X and Y:**

**X: 2, 4, 6, 8, 10**

**Y: 3, 5, 7, 9, 11**

**Calculate the Pearson correlation coefficient between X and Y. Given the following data points for variables X and Y:**

**X: 1, 2, 3, 4, 5**

**Y: 2, 4, 5, 4, 5**

**Determine the equation of the regression line (Y = a + bX)**

#### **Ans 3b.**

#### **Introduction**

In statistical analysis, correlation and regression are essential tools for understanding relationships between variables. **Pearson’s correlation coefficient** measures the strength and direction of a linear relationship between two variables, while **linear regression** provides a predictive equation that describes this relationship. In this section, we calculate the **Pearson correlation coefficient** and derive the **regression equation** for given datasets.