**THEORY 2**

**Define: -**

**Correlation vs. Covariance**

**Correlation: - Correlation** is a measure that quantifies the strength and direction of a linear relationship between two variables.

**Types: -** i) Positive, ii) Negative and iii) No correlation

1. **Positive Correlation:** Two variables change in the same direction; as one increase, the other also tends to increases, and vice- versa.

**Example: -** Height and Weight in people tend to be positively correlated.

**II.** **Negative Correlation:** Two variables change in opposite direction; as one variable increase, the other tends to decrease.

**Example: -** The price of a product and its demand are often negatively correlated.

**III.** **No (or Zero) Correlation:** There is no discernible relationship or association between the variables. Changes in one variable do not have a predictable effect on the other.

**Example: -** Shoe size and intelligence are an example of variables with no correlation.

**Covariance: -** Covariance is a measure that quantifies the joint variability of two random variables, indicating whether they tend to move in the same direction (positive covariance) or in opposite directions (negative covariance).

**Types: -** i) Positive Covariance, ii) Negative Covariance and iii) Near- Zero Covariance

1. **Positive Covariance:** A positive covariance indicates a direct relationship, where two variables tend to move in the same direction.

If one variable increase, the other also tends to increase.

If one variable decrease, the other also tends to decrease.

**For example:** A positive covariance exists between the amount of time a student studies and their exam score. As study hours go up, exam scores tend to rise.

1. **Negative Covariance:** A negative covariance indicates an inverse relationship, where the two variables and move in opposite directions.

If one variable increases, the other tends to decrease.

**For example:** There is a negative covariance between the temperature and sales of winter coats. As the temperature rises, coat sales tend to fall.

1. **Zero Covariance:**  A covariance of zero indicates that there is no linear relationship between the two variables.

**Null and Alternative Hypothesis: -**

**Null Hypothesis (H0): -** Null Hypothesis represents a default position, often suggesting no effect or difference, against which researchers compare their experimental results. The Null Hypothesis, often denoted as H0 asserts a default assumption in statistical analysis. It posits no significant difference or effect, serving as a baseline for comparison in hypothesis testing.

**Mean1= Mean2**

The variables are independent (i.e. not related), There is not significant difference.

**Alternative Hypothesis: -** An Alternative Hypothesis is a claim or a complement to the null hypothesis. If the null hypothesis predicts a statement to be true, the Alternative Hypothesis predicts it to be false. Let's say the null hypothesis states there is no difference between height and shoe size then the alternative hypothesis will oppose the claim by stating that there is a relation.

**Mean1! = Mean2**

The variables are dependent (i.e. related), There is significant difference.

**p-value** **and** **significance** **level: -**

**p-value:** - The p-value, or probability value, is a statistical measure used in hypothesis testing to assess the strength of evidence against a null hypothesis. It represents the probability of obtaining results as extreme as, or more extreme than, the observed results under the assumption that the null hypothesis is true.

**Significance Level: -** The significance level is the limit we set to decide if a result is real or just luck.  
It shows how much error we are willing to accept in a test.  
Usually, it is 0.05, meaning a 5% chance of being wrong.  
It helps us know when to reject the null hypothesis.

**Notes: -**

* If the p-value is greater than significance value, then we fail to reject null hypothesis and there is no significant difference. (p-value > Alpha)
* If the p-value is less than significance value, then we reject null hypothesis and there is a significant difference. (p-value < Alpha)