

# Bivariate Statistical Analysis

## ► Difference Between Two Variable

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# Overview

- After Studying This Chapter, The Learner Should Be Able To:
- Understand How Research Contributes To Business Success.
- Know How To Define Business Research.
- Understand The Difference Between Basic And Applied Business Research.
- Understand How Research Activities Can Be Used To Address Business Decisions.
- Know When Business Research Should Be Conducted.



# Introduction

- Research Is Essential For Acquiring Knowledge, Exploring The Unexplored, And Seeking The Truth.
- The Word "Research" Denotes A Systematic, Patient Study To Establish Facts Or Principles.
- Research Involves Investigation, Recording, And Analysis Of Evidence To Gain Knowledge And Solve Problems.
- It May Lead To New Questions And Problems, Requiring Further Research.
- Knowledge About Research Methods Helps Professionals Solve Problems, Distinguish Good Research, Understand Multiple Influences, And Make Informed Decisions.
- It Enables Managers To Solve Minor Problems, Discriminate Between Good And Bad Research, Appreciate Various Influences, Take Calculated Risks, Prevent Vested Interests, Collaborate Effectively, And Combine Experience With Scientific Knowledge In Decision-making.



# The $\chi^2$ Test for Goodness-of-Fit

- A Chi-square ( $\chi^2$ ) Test Goodness Of Fit Is Statistical Test Used To Determine If Observed Data Matches The Expected Data Under A Specific Hypothesis.
- When Goodness Of Fit Is **High**, The Values Expected Based On The Model Are **Close To** The Observed Values.
- When Goodness Of Fit Is **Low**, The Values Expected Based On The Model Are **Far From** The Observed Values.

# How To Calculate The Test Statistic (Formula)

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

- $\chi^2$  is the chi-square test statistic
- $\sum$  is the summation operator (it means "take the sum of")
- $O$  is the observed frequency
- $E$  is the expected frequency



# What Are Null And Alternative Hypotheses

- Null And Alternative Hypotheses Are Used In Statistical Hypothesis Testing. The Null Hypothesis Of A Test Always Predicts No Effect Or No Relationship Between Variables.
- Null Hypothesis ( $H_0$ )  $\Rightarrow$  Observed = Expected
- While The Alternative Hypothesis States Your Research Prediction Of An Effect Or Relationship.
- Alternative Hypothesis ( $H_a$ )  $\Rightarrow$  Observed  $\neq$  Expected



# The T-Test For Comparing Two Means

- **A T-test Is A Statistical Hypothesis Test Used To Compare The Means.**
- **It Is Often Employed When You Want To Assess Whether A Sample From One Group Is Statistically Different From A Sample From Another Group.**



# Types

- There Are Different Types Of T-tests, But The Two Most Common Are:
  1. Independent Samples T-test
  2. Dependent Samples T-test



# Independent Samples T-test:

This Test Is Used When You Have Two Separate, Independent Groups.

To Compare The Means Of A Continuous Variable Between These Groups.



# Purpose And Data Requirement

- **Purpose:** The Independent Samples T-test, Also Known As A Two-sample T-test, Is Used To Compare The Means Of Two Independent And Unrelated Groups To Determine If There Is A Statistically Significant Difference Between Them.
- **Data Requirement:** You Need Two Separate Groups Of Data With No Direct Pairing Or Relationship Between The Data Points In The Two Groups.



# Paired Samples T-test

- A Paired Samples T-test, Also Known As A Dependent Samples T-test Or A Matched Pairs T-test
- Is A Statistical Hypothesis Test Used To Compare The Means Of Two Related Sets Of Data Points.
- A Significant Difference Between The Means Of These Paired Data Points.



# Paired Samples T-Test

- The Key Idea Behind The Paired Samples T-test Is That It Accounts For The Dependency Between The Data Points In The Two Groups
- Making It Particularly Useful When You Are Comparing Before-and-after Measurements, Or When The Data In The Two Groups Are Somehow Related Or Matched.



# What Is F-Test

- The F-test Is The Key Statistical Test For An ANOVA Model.
- The F-test Is A Statistical Tool
- The F-test Calculates F-statistic
- The F-statistic Can Be Obtained By Taking The Larger Sample Variance And Dividing By The Smaller Sample Variance



# Purpose Of F-Test

- Comparison Of Variances
- Analysis Of Variance (ANOVA)
- Quality Control
- Experimental Design
- etc...



# F-Test Calculation

- Null Hypothesis (H0): Two Groups Are Equal.
- Alternative Hypothesis (H1): Two Groups Are Not Equal.
- The F-statistic Is Calculated By Taking The Ratio Of The Variances Of The Two Groups.
- A Significance Level (Alpha) Is Chosen, Typically Set At 0.05.
- If The Calculated F-statistic Is Greater Than The Critical Value At The Chosen Significance Level, Then The Null Hypothesis Is Rejected, Indicating That The Variances Are Significantly Different.
- If The F-statistic Is Less Than The Critical Value, Then The Null Hypothesis Is Not Rejected, Indicating That The Variances Are Statistically Equal.



# Example To Illustrate The Concept Of F-test:



Comparing The  
Effectiveness Of Three  
Different Fertilizers On  
Plant Growth



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THANKS

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