STAT150
BUSINESS STATISTCS

STAT150 – Business Statistics

Topics Covered

Introduction to Statistics – Objective and Scope
Summarizing and Displaying Data
Introduction to Distribution
Proportions
Means
Hypothesis Test for Population Mean
Comparing Population Means
Simple Linear Regression
Categorical Data Analysis
Excel Formulas
Formula Summary & Cheat Sheet for Exam

Objectives and Scope of Statistical Studies

> Statistics is the science of learning from data, involving collecting, presenting, analyzing and interpreting data.

Objectives

- **Primary Objective:** Obtain information about a target population using a sample
- **Target Population:** Comprises all relevant subjects of interest
- **Sample:** A manageable subset, selected to make the study feasible. A sample answers questions about a target population.

Scope of Statistical Study

Follows the structure:

- **S**tudy Design
- **A**nalysis of Data
- **I**nterpretation of Results
- **D**ata moving forward

Study Design:

- Formulate the **question** of interest
  - What? Who? Why?
- Specify the **target population**
  - Who/What? Where? When?
- Determine the measurements to be collected (the **variables**)
- Define the **method** of data collection
  - How? When? Where?

Populations and Samples

- Target Population should be well defined
- Sample should be representative of the target population (not biased) and large enough to give accurate information about the population
- Ideally the observations should be independent of each other.

Selecting a Sample

- Only a **representative sample** should be used to make inferences about the target population.
- This is unbiased and large enough to give accurate information about the population
- One way to ensure that a sample is representative of the target population is to obtain a random sample
- A **simple random sample** is where each member of the population has the same chance of being selected

A Representative Sample:

Given the difficulty in obtaining a simple random sample, researchers must ensure they obtain a representative sample where the characteristics represent those of the target population without bias.

Types of Studies

Classifier:

1. Deductive vs Inductive (evidence based)
2. Qualitative vs Quantitative (nature of evidence)
3. Observational vs Experimental (interaction with variables)

- Deductive (non-empirical)→speculative
- Inductive (empirical)→involves collecting data and facts
  - Qualitative (unstructured)
  - Quantitative (structured)
    - Observational: No intervention by the investigator
    - Experimental: Control over the determinant

Variables:

- Measurements are taken on subjects in a study according to the variables of interest
- These measurements vary from one subject to another (possible predictors)
- Collecting data is the process of collecting values of the variables
- Values that differ randomly between subjects are called random variables
- Variables = quantifiable measures
- Values = quantities of variables
- Identifier Variables = Categorical variables with the purpose of assigning a unique identifier code to each individual in the data set (eg: phone number).

In any study, variables take on specific roles and these roles are classified as:

Where the predictor is affecting variables and the outcome is the affected variables.

Bias: Sample Size

Bias is any systematic error which results in an incorrect estimate of a parameter or an incorrect association between variables in study.

Selection Bias
Any systematic differences occurring in the way that subjects are selected for a study. Distorts representative quality.

Measurement Bias:
Systematic differences in the measurement of variables (methodology distorts sample data)

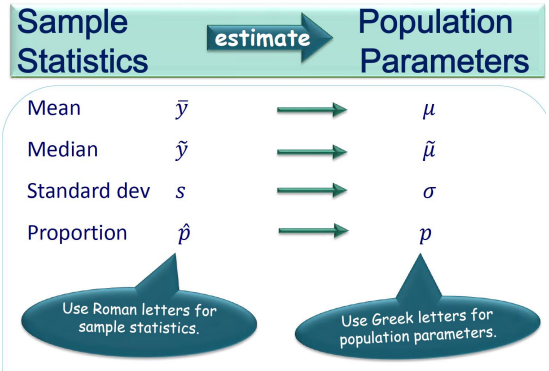
Response Bias:
Occurs when the response rate to a survey is to low. Should be at least 75%. The participation of sample distorts representative quality.

Confounding:
A confounder is a variable that distorts (increases or decreases) the apparent effect of one variable (determinant) on another (outcome). As such the correlation is confused as causation due to a third variable.

Eg: Suggested 4 hours of watching TV associated with heart disease. However, likely those aren't exercising enough which causes the risk.

A sample size needs to be sufficiently large to give an accurate representation of the target population. Accuracy of a sample for determining a population characteristic depends on 2 factors:

- *Sample Size* (n) used for the study
- *Variability* (spread) of the measurements



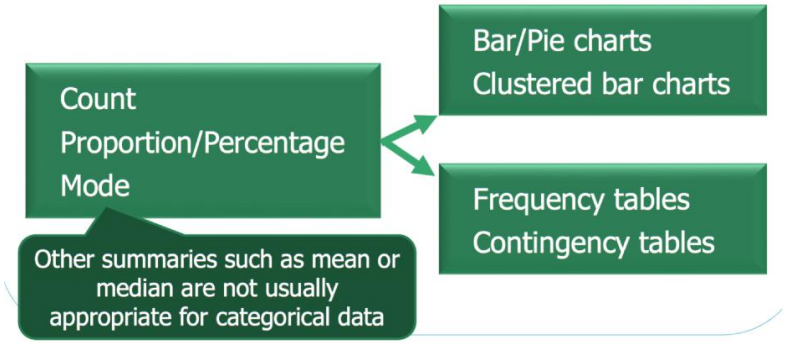
Data Classification

Categorical Variables

Variables for which each observation falls into 1 of a number of groups. If there are 2 groups, variable may be referred to as binary or dichotomous.

-Nominal Variables have no inherent ordering
-Ordinal Variables are grouped with ordering

Summarizing a Categorical Variable



Graphs need:

-A title
-A clearly labelled axes -An explanatory comment
-To be clear and uncluttered

1. Frequency Tables
Records the counts for each of the categories of the variable. The table should show the sample size and also:

- Variable name
- Name of each category
- The count, proportion and percentage of observations in each category

Bar Charts:
Obeys the area principle, giving an accurate visual impression of the distribution of a categorical variable, showing the counts for each category. Should have small spaces between bars to indicate that these are freestanding bars that could be rearranged into any order. Variable name is often a subtitle for horizontal axis (y=frequency)

Pie Charts:
Shows how a whole group breaks into several categories (proportion). However sometimes patterns that are easy to see in bar charts are often difficult to discern in corresponding pie charts.

2. Contingency Tables

When the interest is whether responses on 1 variable are associated with another variable. Table explores 2 categorical variables.

	Should live odds be illegal?		
Are you less than 30 years old?	No	Yes	Grand Total
No	4	5	9
Yes	4	1	5
Grand Total	8	6	14

- **Conditional Distribution:** Distribution of 1 variable satisfies a condition on another
- **Marginal Distribution:** Found in the margins of the table
- **Independent:** Distribution of 1 variable is the same for all categories of another variable (no association between these variables)

A **clustered bar chart** would clearly show the information on a contingency table for 2 variables.

Summarizing and Graphing Numerical Data

Measured variables:

-Discrete Variables take whole values
-Continuous Variables assume any value usually within a certain range

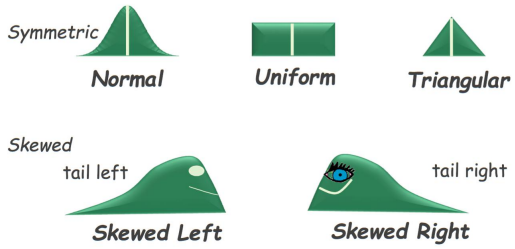
1. Histograms:

Provides a good visual representation of the data when we only have 1 numerical variable.

- Create a frequency table
  - Specify the bin (range of possible values split into intervals called bins over which the frequencies are displayed)
  - Eg: 20+ to 25
- Whilst gaps separate the categories in bar charts, gaps here importantly indicate a region where there are no values, describing the distribution.
- The vertical axis shows the number of cases falling in each bin.

Distributions:

Describes the shape, centre and spread of the data's histogram. Focus on the presence or absence of symmetry, modes and gaps or outliers.



Modes also describe the shape of the distribution and is the peak in the histogram:

-Uniform: No mode
-Unimodal: 1 main hump
-Bimodal: 2 humps→indication of 2 groups in the data
-Multimodal: 3 or more humps

Centre, Spread and Shape of a Histogram

A **measure of centre** shows the middle of the data

- **Median:** Measure of the centre of a set of numerical data (the middle value or average of middle 2 values in a even sample size). Divides distribution into 2 equal parts. The median is not as sensitive to outliers and is a more robust measure of centre, better used for skewed distributions.
- **Mean:** Centre of gravity and the point of balance of the data

Sample statistics (whilst values vary, they are known) estimate population parameters (fixed values that are often unknown).

If the distribution is skewed, the mean will be pulled towards the side with the longer tail. As the median isn't affect by unusual observations or the shape of the distribution, if the distribution is skewed, report the median and if unimodal or symmetric, report the mean. Eg: the mean would be larger if rightly skewed.