What is Statistics?

Chapter 1

Learning Objectives

LO1-1 Explain why knowledge of statistics is important

LO1-2 Define statistics and provide an example of how statistics is applied

LO1-3 Differentiate between descriptive and inferential statistics

LO1-4 Classify variables as qualitative or quantitative, and discrete or continuous

LO1-5 Distinguish between nominal, ordinal, interval, and ratio levels of measurement

LO1-6 List the values associated with the practice of statistics

Why Study Statistics

- Data are collected everywhere and require statistical knowledge to make the information useful
- Statistical techniques are used to make professional and personal decisions
- A knowledge of statistics is needed to understand the world and be conversant in your career
- In summary, statistics will help you make more effective personal and professional decisions

What is Meant by Statistics

- What is statistics?
- It's more than presenting numerical facts

STATISTICS The science of collecting, organizing, presenting, analyzing, and interpreting data to assist in making more effective decisions.

Example: The inflation rate for the calendar year was 0.7%. By applying statistics we could compare this year's inflation rate to past observations of inflation. Is it higher, lower, or about the same. Is there a trend of increasing or decreasing inflation?

Types of Statistics

- There are two types of statistics, descriptive and inferential
- Descriptive statistics can be used to organize data into a meaningful form
- You can summarize data and provide information that is easy to understand

DESCRIPTIVE STATISTICS Methods of organizing, summarizing, and presenting data in an informative way.

- Example: There are a total of 46,837 miles of interstate highways in the U.S. The interstate system represents 1% of the nations roads but carries more than 20% of the traffic. Texas has the most interstate highways and Alaska doesn't have any.

Types of Statistics

- Inferential statistics can be used to estimate properties of a population
- You can make decisions based on a limited set of data

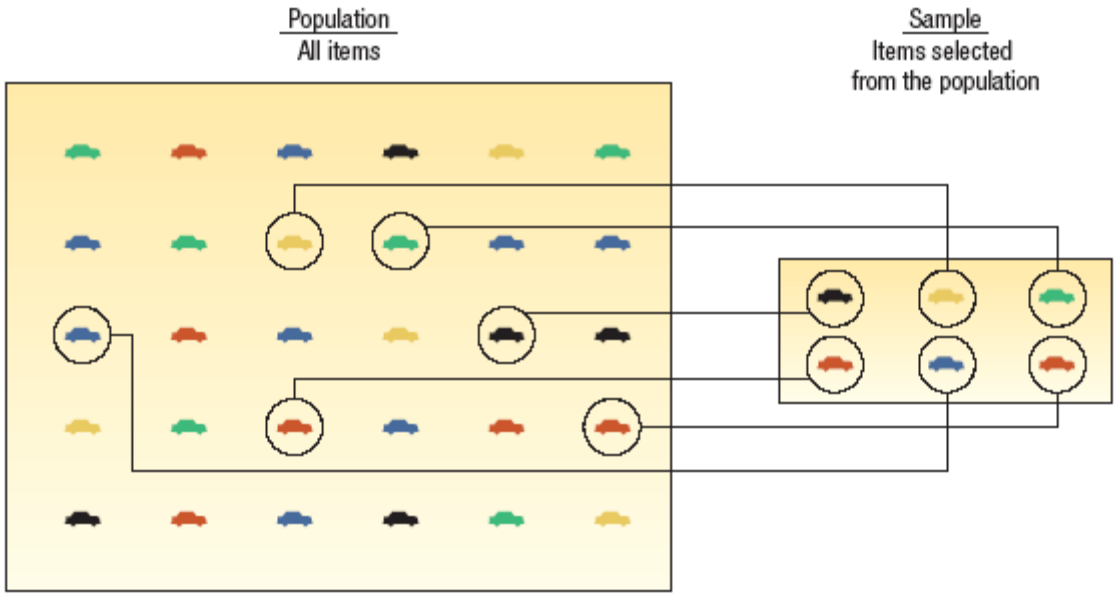
INFERENTIAL STATISTICS The methods used to estimate a property of a population on the basis of a sample.

- Example: TV networks constantly monitor the popularity of their programs by hiring Nielsen to sample the preferences of TV viewers. For example, NCIS was the most watched show during the week of March 13-19, 2017. A total of 14.16 million viewers watched this show.

Types of Statistics

POPULATION The entire set of individuals or objects of interest or the measurements obtained from all individuals or objects of interest.

SAMPLE A portion, or part, of the population of interest.



Types of Variables

- There are two basic types of variables

QUALITATIVE VARIABLE An object or individual is observed and recorded as a non-numeric characteristic or attribute.

Examples: gender, beverage preference, eye color

QUANTITATIVE VARIABLE A variable that is reported numerically.

Examples: balance in your checking account, the number of gigabytes of data used on your cell phone plan last month, the number of people employed by a company

Types of Variables

- Quantitative variables can be discrete or continuous
- Discrete variables are typically the result of counting
  - Values have "gaps" between the values
  - Examples: the number of bedrooms in a house, the number of students in a statistics course
- Continuous variables are usually the result of measuring something
  - Can assume any value within a specific range
  - Examples: the air pressure in a tire, duration of flights from Orlando to San Diego

Types of Variables Summary

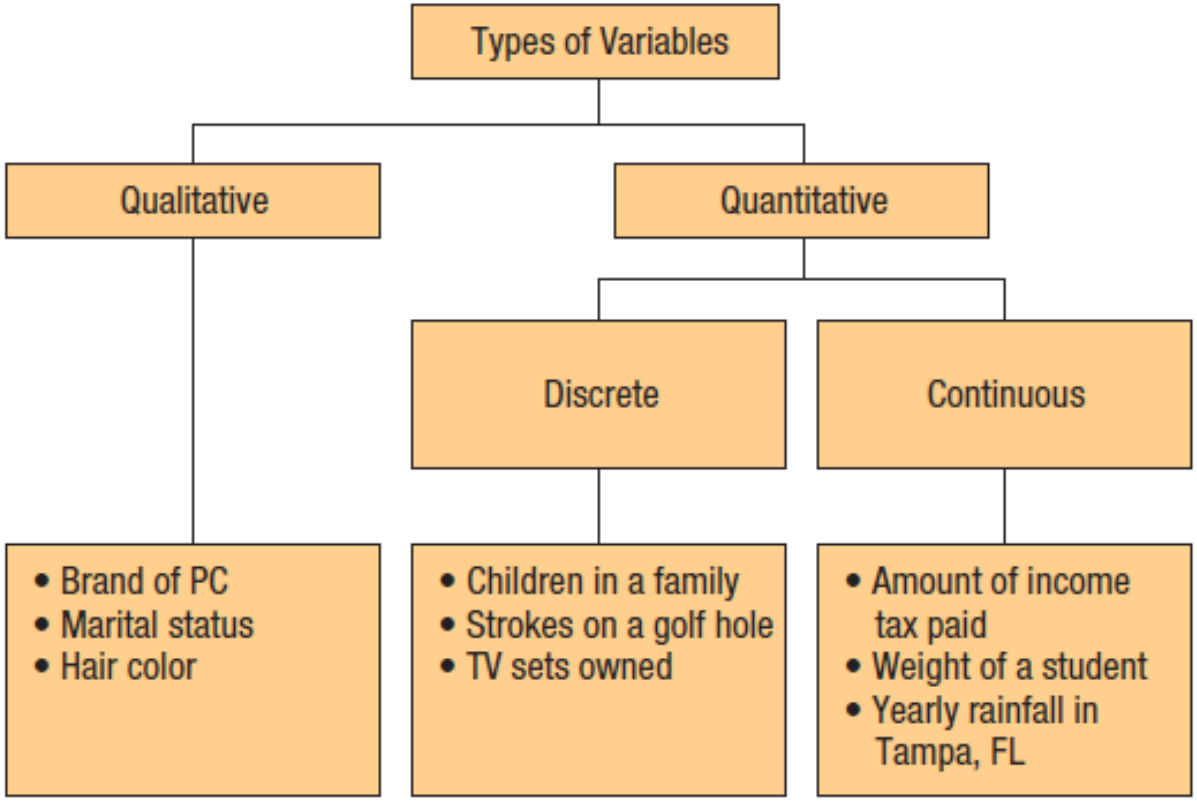


CHART 1–2 Summary of the Types of Variables

Levels of Measurement

- There are four levels of measurement
  - Nominal, ordinal, interval, and ratio
- The level of measurement determines the type of statistical analysis that can be performed
- Nominal is the lowest level of measurement

NOMINAL LEVEL OF MEASUREMENT Data recorded at the nominal level of measurement is represented as labels or names. They have no order. They can only be classified and counted.

- Examples: classifying M&M candies by color, identifying students at a football game by gender

Levels of Measurement

- The next level of measurement is the ordinal level
- The rankings are known but not the magnitude of differences between groups

ORDINAL LEVEL OF MEASUREMENT Data recorded at the ordinal level of measurement is based on a relative ranking or rating of items based on a defined attribute or qualitative variable. Variables based on this level of measurement are only ranked and counted.

- Examples: the list of top ten states for "best business climate", student ratings of professors

Levels of Measurement

- The next level of measurement is the interval level
- This data has all the characteristics of ordinal level data plus the differences between the values are meaningful
- There is no natural 0 point

INTERVAL LEVEL OF MEASUREMENT For data recorded at the interval level of measurement, the interval or the distance between values is meaningful. The interval level of measurement is based on a scale with a known unit of measurement.

- Examples: the Fahrenheit temperature scale, dress sizes

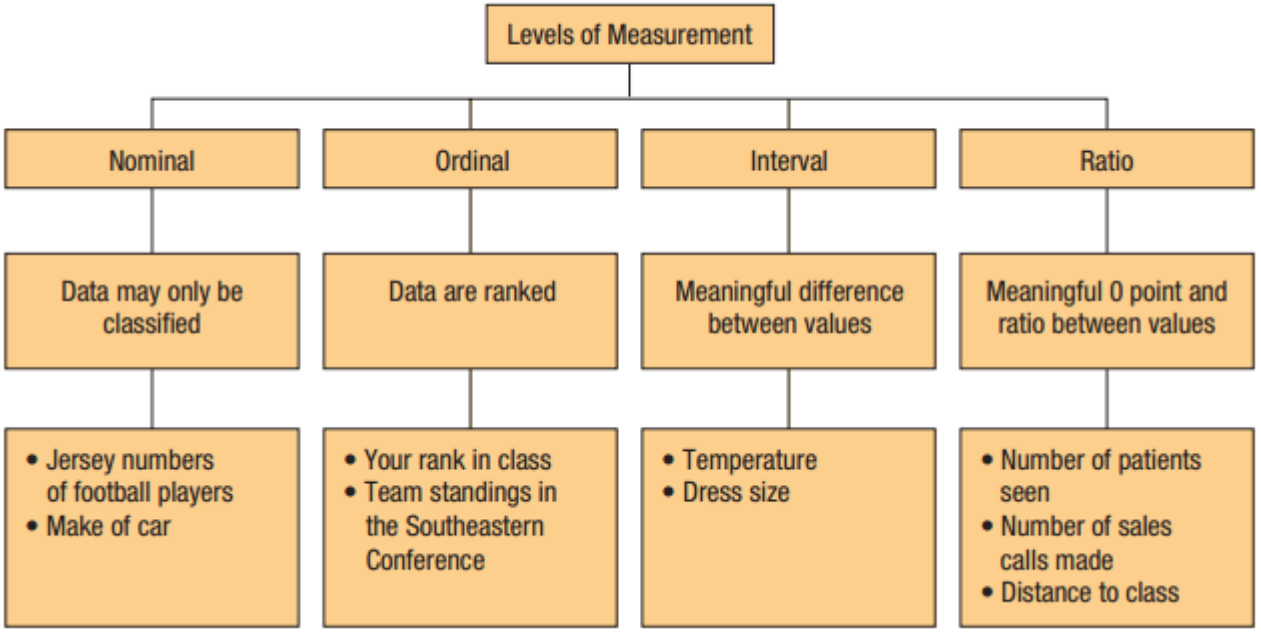
Levels of Measurement

- The highest level of measurement is the ratio level
- The data has all the characteristics of the interval scale and ratios between numbers are meaningful
- The 0 point represents the absence of the characteristic

RATIO LEVEL OF MEASUREMENT Data recorded at the ratio level of measurement are based on a scale with a known unit of measurement and a meaningful interpretation of zero on the scale.

- Examples: wages, changes in stock prices, and height

Levels of Measurement Summary



Ethics and Statistics

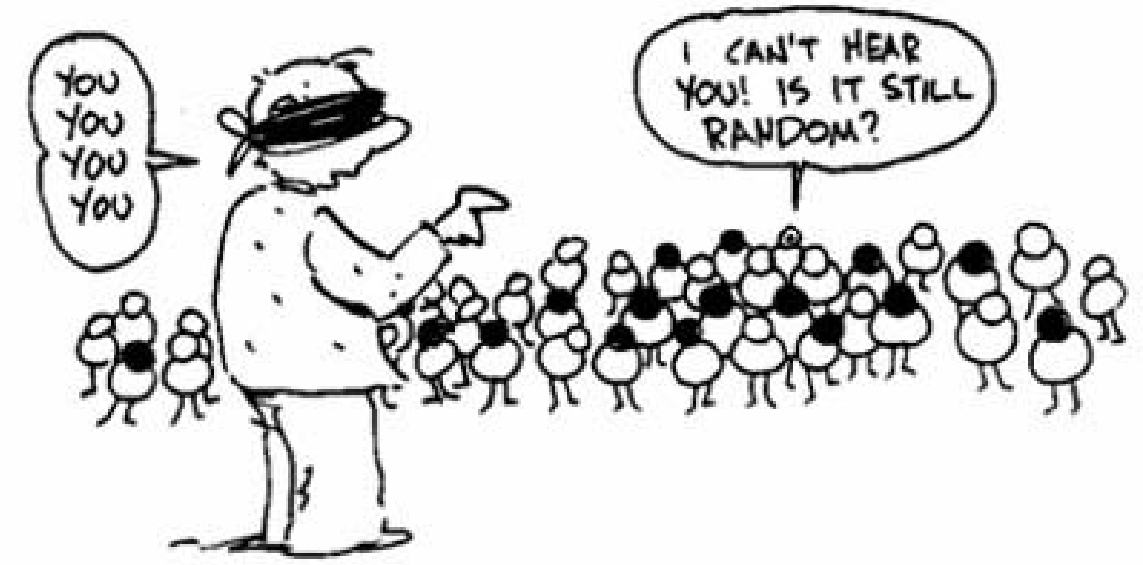
- Practice statistics with integrity and honesty when collecting, organizing, summarizing, analyzing, and interpreting numerical information
- Maintain an independent and principled point of view when analyzing and reporting finding and results
- Question reports that are based on data that
  - do not fairly represent the population
  - does not include all relevant statistics
  - introduces bias in an attempt to mislead or misrepresent

Sampling Methods

- **Type of Sampling Method**
  - Probability Sampling
    - Simple Random Sampling
    - Stratified Sampling
    - Cluster Sampling
    - Systematic Sampling
  - Nonprobability Sampling
    - Convenience Sampling

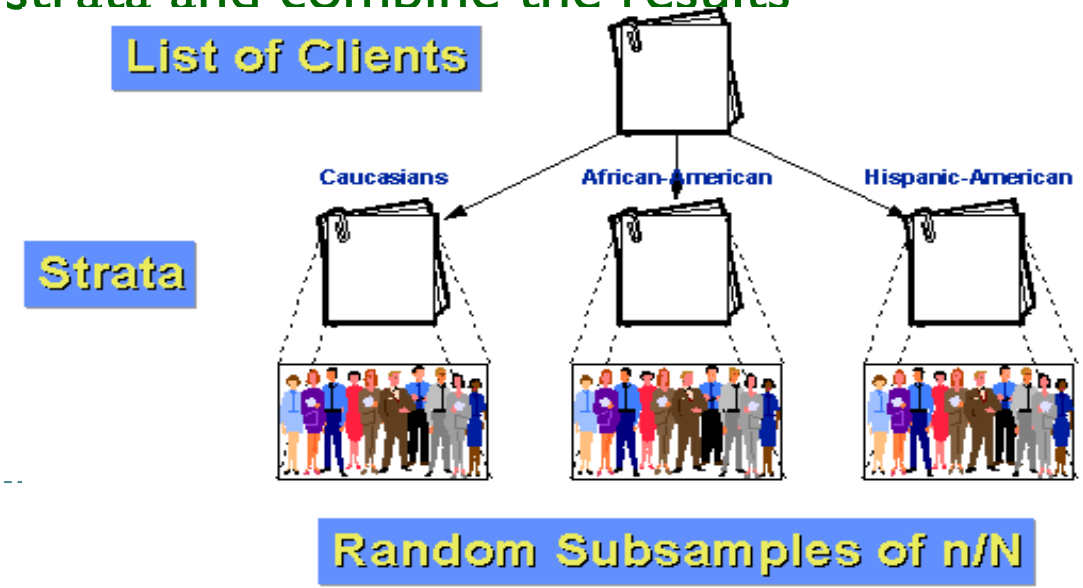
Sampling Methods

- **Probability Sampling**
  - Simple Random Sampling
    - every item from a frame has the same chance of selection as every other item.



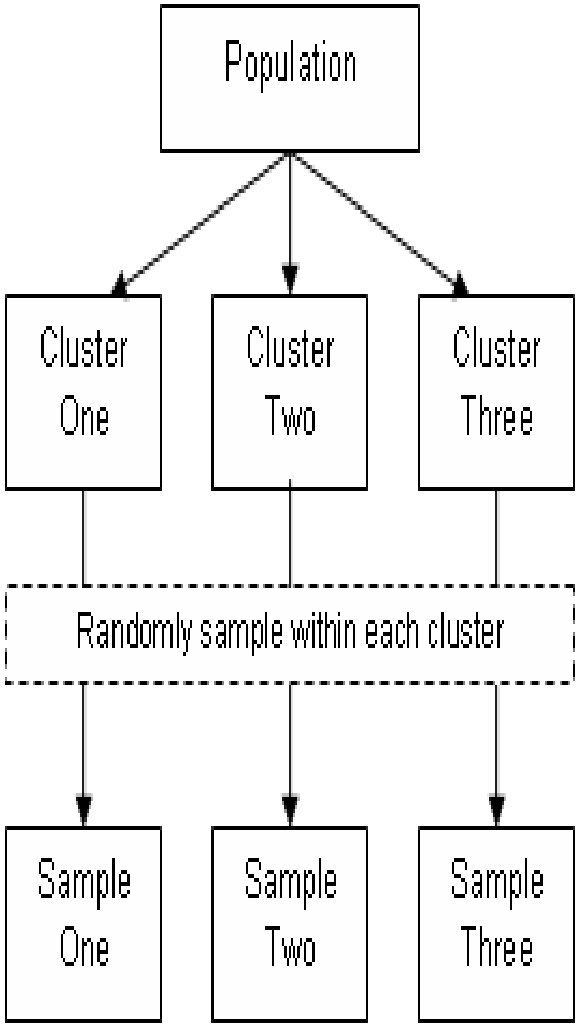
Sampling Methods

- **Probability Sampling**
  - Stratified Sampling
    - Subdivide the N items in the frame into separate subpopulations (strata). A stratum is defined by some common characteristic, e.g.: gender or year in school. Conduct simple random sampling within each strata and combine the results



Sampling Methods

- **Probability Sampling**
  - Cluster Sampling
    - Divide the N items in the frame into clusters that contain several items. Clusters are often naturally occurring designations, such as counties, election districts, city blocks, households, or sales territories. Then take a random sample of one or more clusters and study all items in each selected cluster.

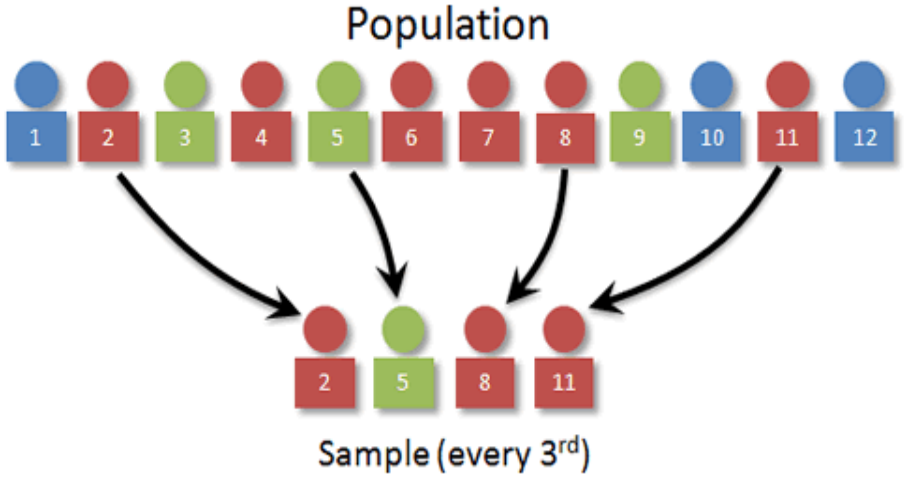


Sampling Methods

- **Probability Sampling**
  - Systematic Sampling
    - Partitioned the N items in the frame into n groups of k items, where

$$k = \frac{N}{n}$$

and round *k* to the nearest integer.



    - Then choose the first item to be selected at random from the first *k* items in the frame. Then, select the remaining items by taking every *k*th item thereafter.

Sampling Methods

- **Nonprobability Sampling**
  - Convenience/Accidental Sampling
    - Items selected are easy, inexpensive, or convenient to sample. For example, if you were sampling tires stacked in a warehouse, it would be much more convenient to sample tires at the top of a stack than tires at the bottom of a stack.