Statistics

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Chapter Goals

After completing this chapter, you should be able to:

- Explain how decisions are often based on incomplete information
- Explain key definitions:
  - ♦Population vs. Sample
  - ♦ Parameter vs. Statistic
  - ♦ Descriptive vs. Inferential Statistics
- Explain the difference between Descriptive and Inferential statistics

Dealing with Uncertainty

Everyday decisions are based on incomplete Information.

Consider:

- Will the job market be strong when I graduate?
- Will the price of Yahoo stock be higher in six months than it is now?
- Will interest rates remain low for the rest of the year if the federal budget deficit is as high as predicted?

What is Statistics ??

Numbers and data are used to assist decision making.

Statistics is a tool to help process, summarize, analyze, and interpret numerical data.

Key Definitions

- A **population** is the collection of all items of interest or under investigation

  N represents the population size

- A **sample** is an observed subset of the population

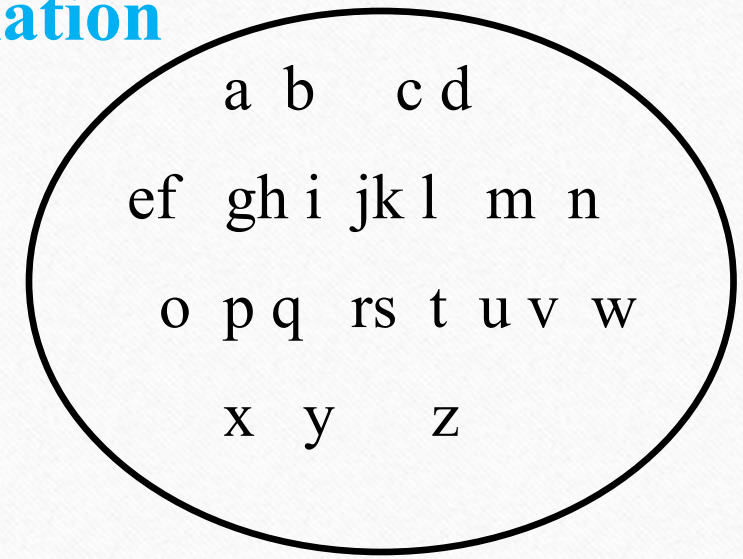
  n represents the sample size

- A **parameter** is a specific characteristic of a population

- A **statistic** is a specific characteristic of a sample

Population vs. Sample

Population



Values calculated using population data are called **Parameters**

Sample

Values computed from sample data are called **Statistics**

Examples of Populations

- Names of all registered voters in the United States
- Incomes of all families living in Daytona Beach (City in Florida)
- Annual returns of all stocks traded on the New York Stock Exchange
- Grade point averages of all the students in your university

Random Sampling

Simple Random Sampling is a procedure in which

- each member of the population is chosen strictly by chance,
- each member of the population is equally likely to be chosen,
- every possible sample of n objects is equally likely to be chosen

The resulting sample is called a **Random Sample**.

Parameter and Statistic

- In a study of household incomes in a small town of **1000 households**, one might conceivably obtain the income of every household.
- However, it is probably very expensive and time consuming to do this.
- Therefore, a better approach might be to obtain the data from a portion of the households (let's say **125 households**).

Parameter and Statistic

- In this scenario, the incomes of the 1000 households are referred to as the population and the incomes of the randomly selected 125 households are referred to as a sample.
- In this household incomes example, is the **average (mean)** income of all 1000 households a parameter or statistic? Is the average (mean) income of the 125 households a parameter or a statistic?

Parameter and Statistic

- In this household incomes example, is the average (mean) income of all 1000 households a parameter or statistic? Is the average (mean) income of the 125 households a parameter or a statistic?
- Solution: The average (or mean) of the 1000 households is a **parameter**, whereas the average (mean) income of the 125 households is a **statistic**.

Descriptive and Inferential Statistics

Two branches of Statistics:

1) **Descriptive statistics**

- Graphical and Numerical procedures to summarize and process data

2) **Inferential statistics**

- Using data to make Predictions, Forecasts and Estimates to assist Decision Making

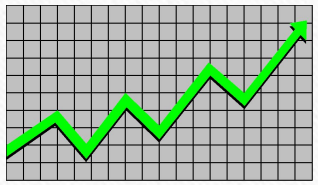
Descriptive Statistics

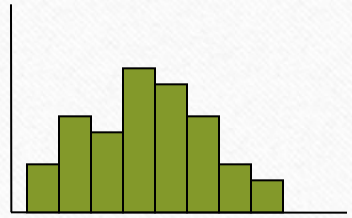
- **Collect data**

  e.g., Survey

- **Present data**

  e.g., Tables and graphs





- **Summarize data**

  e.g., Sample mean = $\frac{\sum X_i}{n}$

Inferential Statistics

- **Estimation**

  e.g., Estimate the population mean weight using the sample mean weight

- **Hypothesis Testing**

  e.g., Test the claim that the population mean weight is 140 pounds

Numeric Examples of Statistics

Example 1: Village Food Consumption

Data: The weekly food consumption (in kg) for 10 households is: 25, 30, 22, 28, 30, 26, 35, 29, 30, 31.

Task: Calculate the mean, median, and mode of the data.

Mean:

Mean = (25 + 30 + 22 + 28 + 30 + 26 + 35 + 29 + 30 + 31) / 10 = 286 / 10 = 28.6 kg

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Median:

Arrange the data in ascending order: 22, 25, 26, 28, 29, 30, 30, 30, 31, 35.

Median is the average of the 5th and 6th values: Median = (29 + 30) / 2 = 29.5 kg

Mode:

The most frequent value is 30 kg (appears 3 times).

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Example 2: Farmer's Planting Decision (Probability)

Data: The farmer has data from the last 10 years showing that in 6 out of 10 years, it rained within the first two weeks of April.

Task: Calculate the probability that it will rain in the first two weeks of April this year.

Probability Calculation:

Probability (Rain) = Number of years it rained / Total number of years = 6 / 10 = 0.6 or 60%

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Example 3: School Test Scores

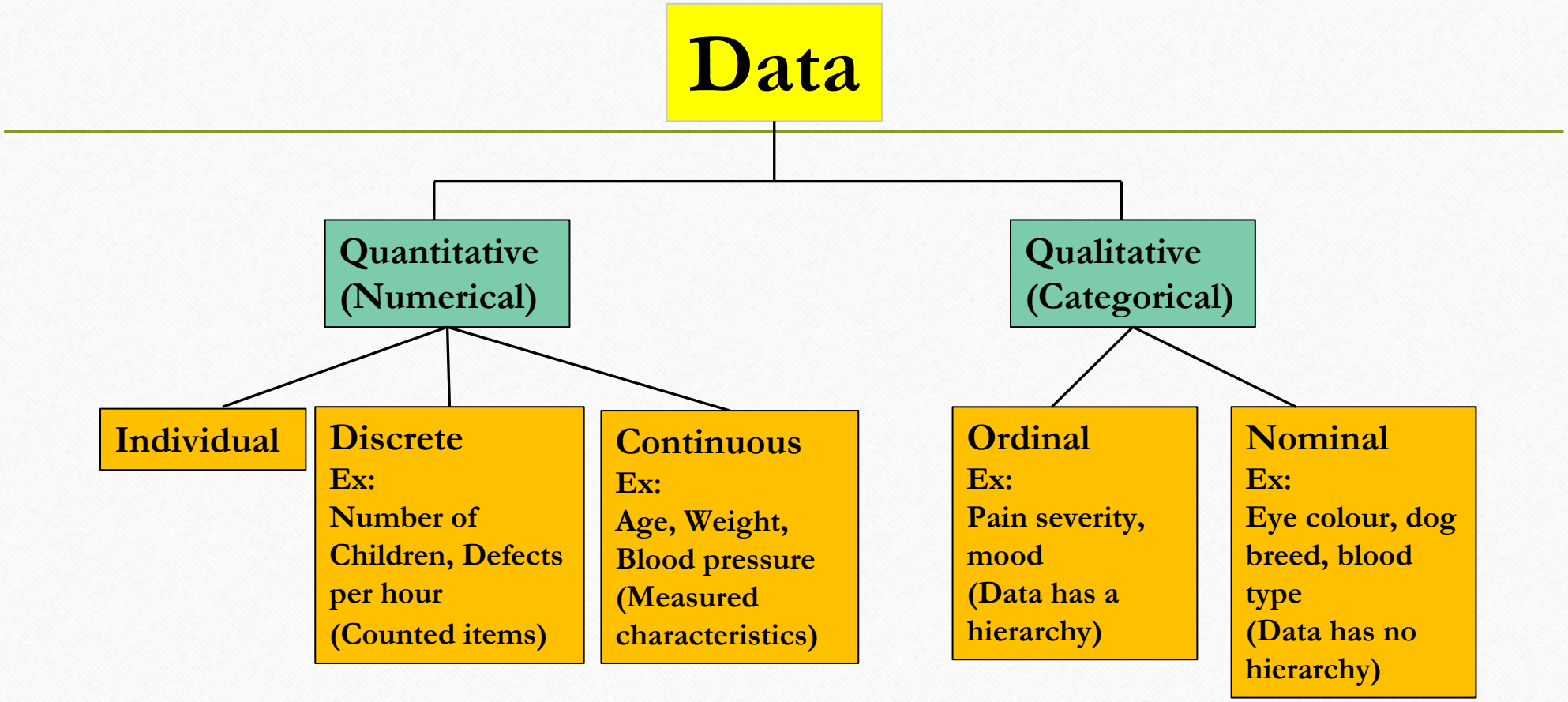
Data: Test scores of 20 students: 55, 60, 65, 70, 75, 80, 85, 55, 60, 65, 70, 75, 80, 85, 55, 60, 65, 70, 75, 80.

Task: Create a frequency distribution table and draw a histogram.

Frequency distribution is:

Interval	Frequency
55-59	3
60-64	3
65-69	3
70-74	3
75-79	3
80-85	5

Types of Data



Presentation of Data