Engineering statistics   Lecture One
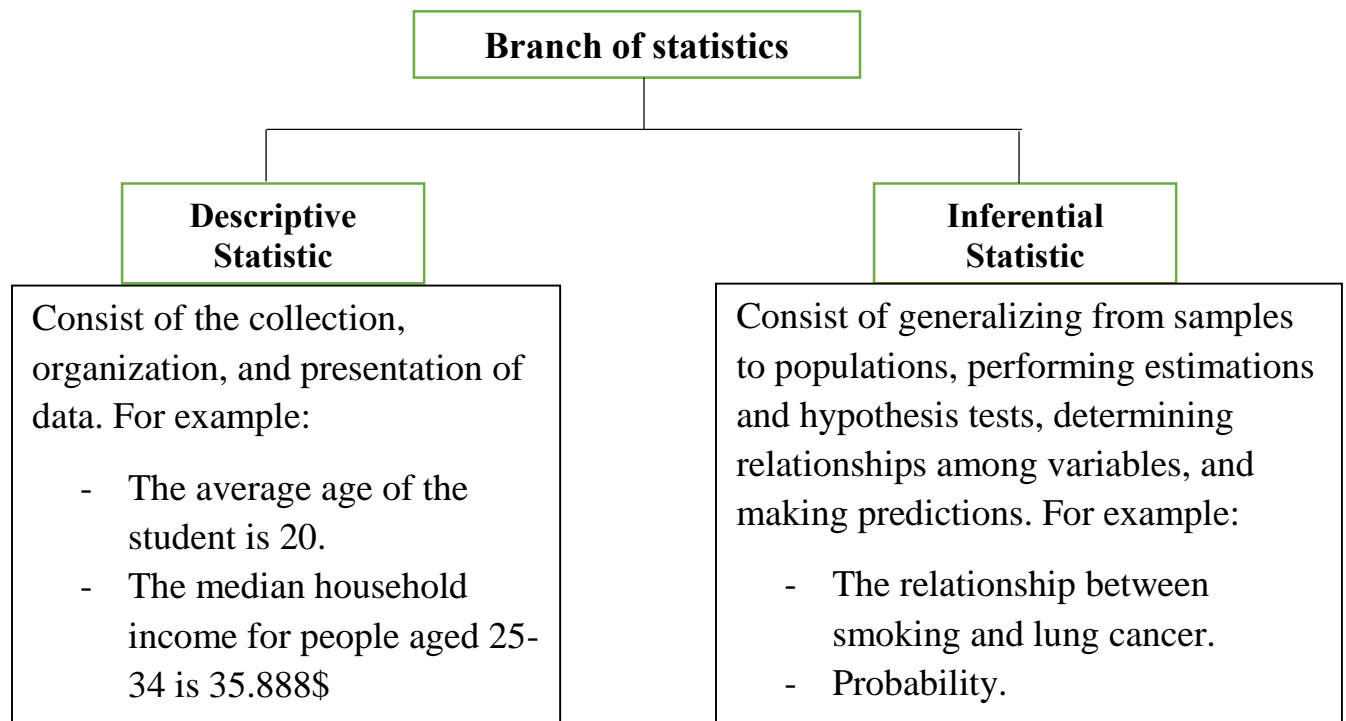
1.1 Statistics: is the science of conducting studies to

- ✓ organize
- ✓ collect
- ✓ summarize
- ✓ present
- ✓ and analyze data

❖ To obtain appropriate conclusions and decisions.

1.2 Branch of statistics

Branch of statistics	
Descriptive Statistic	**Inferential Statistic**
Consist of the collection, organization, and presentation of data. For example: - The average age of the student is 20. - The median household income for people aged 25-34 is 35.888$	Consist of generalizing from samples to populations, performing estimations and hypothesis tests, determining relationships among variables, and making predictions. For example: - The relationship between smoking and lung cancer. - Probability.

Example 1.1: A researcher asked 80 students about their weight. As a result of this information, the average weight of students was 59 kg. Which branch of statistics was used in this study?

a) Observational

b) Experimental

c) Inferential

d) Descriptive

Solution: d

Example 1.2: There is a relationship between IQ and the final score student. The branch of statistics is:

a) Observational

b) Experimental
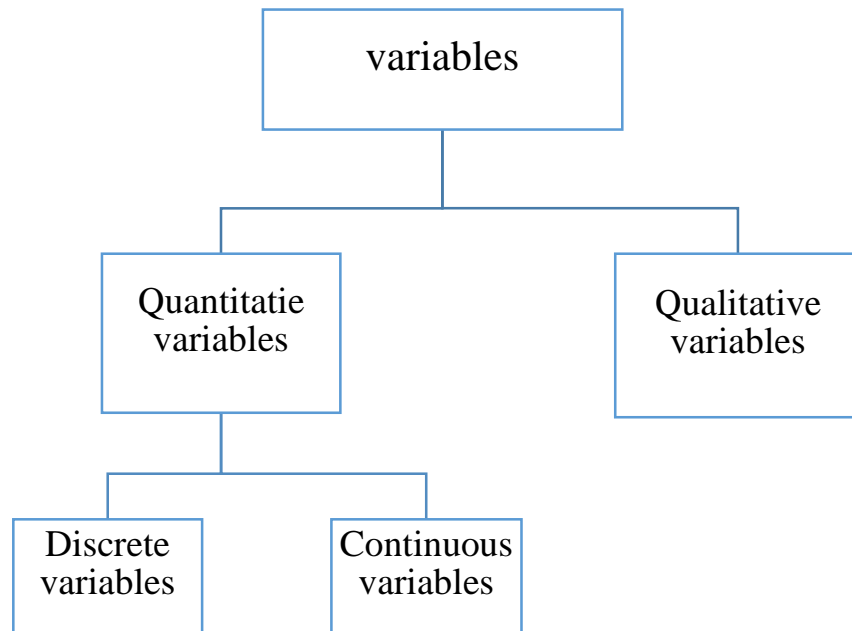
c) Inferential

d) Descriptive

Solution: c

H.W 1.1: Determine whether Descriptive or Inferential were used:

a. The average jackpot for the top five lottery winners was 367.6$ million.

b. A study done by the American Academy of Neurology suggests that older people who had a high caloric diet more than doubled their risk of memory loss.

c. In 2011, 79% of U.S. adults used the Internet.

d. In 2011, there were 34 deaths from the avian flu.

1.3 Statistical Terms

1.3.1 Variables: is a characteristic that can assume different values and is symbolized by the symbol y or any other symbol (x or z). For example temperature, weight, height, gender, age, and nationality.

❖ **Types of variables**

```
                    ┌─────────────┐
                    │  variables  │
                    └─────────────┘
                          │
             ┌────────────┴────────────┐
     ┌───────────────┐         ┌───────────────┐
     │ Quantitatie   │         │ Qualitative   │
     │ variables     │         │ variables     │
     └───────────────┘         └───────────────┘
             │
     ┌───────┴────────┐
┌──────────┐   ┌──────────────┐
│ Discrete │   │ Continuous   │
│ variables│   │ variables    │
└──────────┘   └──────────────┘
```

❖ Qualitative variables: are variables that have distinct <u>categories</u>, according to some characteristic or attribute. For example: Gender, Marital status, Color…etc.

❖ Quantitative variables: are variables that can be <u>counted or measured</u>. For example: Age, Height, Weight, ….etc

    ➢ Quantitative variables can be either discrete or continuous.

    • A continuous variable: assume an infinite number of values between any two specific values. For example: Height, Wight, Time …etc.

    • A discrete variable: assume values that can be counted. For example:

    ✓ Number of children in a family

    ✓ Number of student in classroom

H.W 1.2: Classify each variable as a discrete variable or a continuous variable:

a. The highest wind speed of a hurricane.

b. The weight of baggage on an airplane.

c. The number of pages in a statistics book.

1.3.2 Data: is the values that the variables can assume

1.3.3 Population: consists of all subjects (human or otherwise) that are studied.

1.3.4 Sample: I a subset of population (is a group selected from a population).

> **For example:**
>
> In order to study the response times for emergency 988 calls in Jeddah 50 calls are selected randomly over a six month period and the response times are recorded.
>
> **Population: all calls 988.**
>
> **Sample: 50 calls**

1.4 Statistical Notations

If the variable y represents

y = {20, 14, 33, 5}

Then $y_1 = 20, y_2 = 14, y_3 = 33, y_4 = 5$

1. The sum of the values of the variable $\sum_{i=1}^{n} y_i$

Where $\sum$ is an upper case Greek sigma. The subscript i is the index of summation and the 1 and n that appear respectively below and above the symbol $\sum$ designate the range of the summation.

$\sum_{i=1}^{n} y_i = y_1 + y_2 + y_3 + y_4$

2. $\sum_{i=1}^{n} y_i^2 = y_1^2 + y_2^2 + y_3^2 + y_4^2$

3. $(\sum_{i=1}^{n} y_i)^2 = (y_1 + y_2 + y_3 + y_4)^2$

4. $\sum_{i=1}^{n} x_i * y_i = x_1 * y_1 + x_2 * y_2 + x_3 * y_3 + x_4 * y_4$

5. $(\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i) = (x_1 + x + x_3 + x_4)(y_1 + y_2 + y_3 + y_4)$

6. $\sum c = nc$

7. $\sum_{i=1}^{n} cy_i = c\sum_{i=1}^{n} y_i$. Where c= constant number

Example 1.3 **If you know that the values of the variables x and y are as follows:**

x= (2, 6, 3, 1)

y= (3, 9, 6, 2) find

a) $\sum_{i=1}^{n} x * y_i^2$

b) $\sum_{i=1}^{n} (y_i - 3)$

c) $\sum_{i=1}^{n} y_i - 3$

Solution:

a) $\sum_{i=1}^{n} x * y_i^2 = x_1 * y_1^2 + x_2 * y_2^2 + x_3 * y_3^2 + x_4 * y_4^2$

$$= 2*3^2 + 6*9^2 + 3*6^2 + 1*2^2$$

$$= 616$$

b) $\sum_{i=1}^{n} (y_i - 3) = \sum_{i=1}^{n} y_i - \sum 3$

$$= y_1 + y_2 + y_3 + y_4 - 4*3$$

$$= 8$$

c) $\sum_{i=1}^{n} y_i - 3 = y_1 + y_2 + y_3 + y_4 - 3$

$$= 17$$

H.W 1.3: If you know that the values of the variables x and y are as follows:

x= (2, 6, 3, 1)

y= (3, 9, 6, 2) **find**

a) $\sum_{i=1}^{n}(x_i * y_i)^2$

b) $\sum_{i=1}^{n} (y_i - 5) (x_i\text{-}3)$

c) $\sum_{i=1}^{n} y_i \{ (\sum_{i=1}^{n} y_i)^2 \}/ \text{ n}$

d) $3 \sum_{i=1}^{n} y_i - \sum_{i=2}^{n} x_i$