Engineering Statistics

Third Year

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Syllabus

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Chapter One:
Fundamentals (Introduction to Statistics)

1. Introduction
2. Descriptive and Inferential Statistics
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Chapter One
Fundamentals (Introduction to Statistics)

1. *Introduction*

❖ ***Statistics:*** Is the science the science of collecting, analyzing, presenting, and interpreting data, which often leads to the drawing of conclusions. For example :-

- ***Nearly one in seven U.S. families are struggling with bills from medical expenses even though they have health insurance. (Source: Psychology Today.)***
- ***Eating 10 grams of fiber a day reduces the risk of heart attack by 14%. (Source: Archives of Internal Medicine, Reader's Digest.)***
- ***Thirty minutes of exercise two or three times each week can raise HDLs by 10% to 15%. (Source: Prevention.)***
- ***About 15% of men in the United States are left-handed and 9% of women are left-handed. (Source: Scripps Survey Research Center.)***
- ***The median age of people who watch the Tonight Show with Jay Leno is 48.1. (Source: Nielsen Media Research.)***

❖ **Populations and the Samples:**

- **Populations**: is a total collection of elements, and it is often too large for us to examine each of its members due to the cost and time consuming, for this reason we deal with sampling.
- **Samples** is a subgroup of population elements; it must be representative to that population. To achieve that the sample must be chosen in a random manner.

2. Descriptive and Inferential Statistics

- **Descriptive statistics** consists of the collection, organization, summarization and presentation of data. For example the average age, income and other characteristics of the population.
- **Inferential statistics** consists of generalizing from samples to populations, performing estimations and hypothesis tests, determining relationships among variables, and making predictions.

3. Variables and Types of Data

❖ **Variable** is a characteristic or attribute that can assume different values such as compressive strength, tensile strength, water table level, specific gravity, etc. Variables can be classified as:

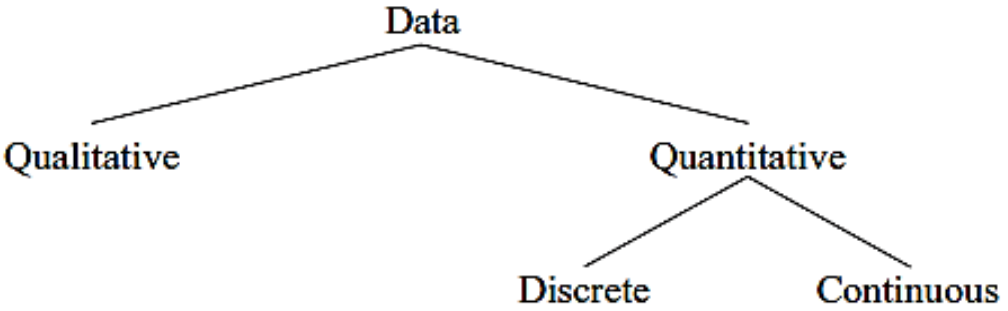
- **Qualitative variables** are variables that can be placed into distinct categories, according to some characteristic or attribute. For example, gender (male or female).

- **Quantitative variables** are numerical and can be ordered or ranked. For example, the variable *age* heights, weights, and body temperatures. Quantitative variables can be further classified into two groups:

✓ ***Discrete variables*** can be assigned values such as 0, 1, 2, 3 (integer values) and are said to be countable. For examples: the number of children in a family, the number of students in a classroom.

- ✓ **Continuous variables** can assume an infinite number of values between any two specific values. They are obtained by measuring. They often include fractions and decimals.

The classification of variables can be summarized as follows:



Statistically, variables can be divided into two types: ***independent*** and one ***dependent*** *variables.*

- The **independent variable** in an experimental study is the one that is being manipulated by the researcher.
- the **dependent variable is t**he resultant variable or the outcome variable.

$$Y = X^2 + 3 \qquad \sigma = \frac{p}{A}$$

dependent variable

independent variable

4. Data Collection and Sampling Techniques

❖ Data Collection

Data can be collected in a variety of ways. One of the most common methods is through the use of surveys:

- ***Telephone surveys***
- ***Mailed questionnaire***
- ***Personal interview surveys***

❖ Sampling Techniques

To obtain samples that are unbiased, i.e. that give each subject in the population an equally likely chance of being selected—statisticians use four basic methods:

1. **Random** Subjects are selected by random numbers.
2. **Systematic** Subjects are selected by using every k^{th} number after the first subject is randomly selected from 1 through *k.*
3. **Stratified** Subjects are selected by dividing up the population into groups (strata), and subjects are randomly selected within groups.
4. **Cluster** Subjects are selected by using an intact group that is representative of the population.

5. Observational and Experimental Studies

There are several different ways to classify statistical studies for example *observational studies* and *experimental studies.*

- **Observational study** observes what is happening or what has happened in the past and tries to draw conclusions based on these observations such as accidents rate with age, …
- **Experimental study,** the researcher manipulates one of the variables and tries to determine how the manipulation influences other variables.

Thank You

Any Questions?