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# ENM 207

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## Lecture 1

### Introduction

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## Outline

- Why we need to statistics?
  - Uncertainty and variation
  - Population and Sample
  - Relationship between Probability and Statistics
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## Statistics-Why do we need statistics?

- Statistics teach how to make intelligent or rational judgments in the presence of uncertainty and variation
- Real world →uncertainty and variation
  - Future customer demand, number of defects on a product, number of customers in a bank, etc.
- Statistics help us:
  - to see what really causes significant changes
    - A different tool, a different method, etc.
  - to make the RIGHT decision

## Uncertainty and variation

- Any process or product has a type of variability associated with it
- Life of a component
- Number of customers in a bank
- Customer demands for a product
- Number of defects on a circuit board
- Variability is the result of changes in the conditions under which observations are made.
- In a manufacturing context, these changes may be differences in
  - specimens of material
  - operators
  - process variables (temperature, pressure, holding time)
  - environmental factors (humidity)

## Uncertainty and variation

- Variation can be seen in every area where we have a form of quantitative measurement

### Statistics offers methods for

- analyzing the results of experiments after they have been carried out
- how experiments can be performed in an efficient manner to mitigate the effect of variation.

**Using statistical methods we have a better chance of making correct decisions.**

## Populations and Samples

- Engineers and scientists are constantly exposed to collections of **data**, both in their professional practices and in everyday activities.
- The statistics discipline provides methods for organizing and summarizing data, and for drawing conclusions based on **information** contained in the data.

## Population

- A population is a **collection of objects or elements**.
- If the elements can be well defined and placed in a frame (or listed onto a frame from which the sample can be drawn),
  - then the population is concrete and existing
  - otherwise, it is hypothetical or conceptual.

## Population

- Concrete populations
  - Students in Gazi University in 2005
  - All households in the city of Ankara.
- Conceptual population
  - Starting salaries of next year's graduates from Dept. of Ind. Eng. in Gazi University

## Sample

- When desired information is available for all objects in the population, we have what is called a **census**.
- **Time, money, and other scarce resource constraints** usually make a census impractical or infeasible.
- For example, if you want to distribute a survey considering all students in GU,
  - to determine how and why students choose their disciplines

it is impractical to apply survey all of them, because it is time consuming i.e., expensive.

## Sample

- This is why we can use a representative **sample** from population.
- **Sample** is a subset of the population which is selected in some prescribed manner.
- We can use
  - A sample of screws from a particular production
    - to investigate whether the screws are conforming to specifications or not
  - A sample of students
    - to evaluate the quality of education in a college
  - Etc.

## Branches of Statistics

- **Descriptive statistics**

- comprises of all methods that organize and summarize data
- It is subdivided into 2 categories
  - Pictorial and Tabular (Stem and Leaf, Histogram, Boxplots)
  - Numerical (Quantitative) measures of location, variability, skewness, kurtosis.

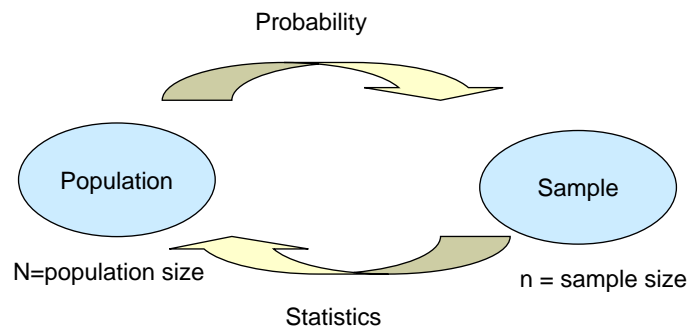
- **Inferential or inductive statistics**

- comprises of all techniques for generalizing from a sample to a population
  - Point estimations
  - Confidence intervals
  - Hypothesis Tests

## Inferential Statistics

- Most applications of statistics in modern engineering, science and management involve inference and decision making.
- The objective of decision maker is to use the information in the sample to draw a conclusion about population from which the sample was drawn.
- For example,
  - to draw an inference about capability of the manufacturing process that is producing the power supplies
    - collect sample data on the output voltage of a power supply
    - use this sample information.

## Relationship between Probability – Statistics



## Probability and Statistics

- Probability is about uncertainty and variation
- The field of probability and statistics consists of methods for
  - describing and modeling uncertainty,
  - making decision when uncertainty is present.
- Probability theory provides tools to formalize uncertainty about events
- Statistics applies these tools towards a better understanding of the data and making decisions under uncertainty.

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## References

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  - Dengiz, B., (2004),
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    - *Probability & Statistics in Engineering & Management Science*
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