Dr. Saeed Alghamdi
Room 542
Statistics Department
Faculty of Sciences
King Abdulaziz University
web sit
www.kau.edu.sa/saalghamdy

Elementary Statistics
A Step by Step Approach
Sixth Edition

by
Allan G. Bluman
http://www.mhhe.com/math/stat/blumanbrief

SLIDES PREPARED
BY
LLOYD R. JAISINGH
MOREHEAD STATE UNIVERSITY
MOREHEAD KY

Updated by
Dr. Saeed Alghamdi
King Abdulaziz University

Chapter 1

1-1

The Nature of Probability and Statistics

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Objectives

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□ Demonstrate knowledge of statistical terms.

□ Differentiate between the two branches of statistics.

□ Identify types of data.

□ Identify the measurement level for each variable.

□ Identify the four basic sampling techniques.

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Objectives

□ Explain the difference between an observational and an experimental study.

□ Explain how statistics can be used and misused.

□ Explain the importance of computers and calculators in statistics.

Dr. Saeed Alghamdi, Statistics Department, Faculty of Sciences, King Abdulaziz University

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Introduction

□ *Statistics* is the science of conducting studies to collect, organize, summarize, analyze, and draw conclusions from data.

□ *Probability* is the chance of an event occurring.

□ *Probability* deals more with creating models and theoretical data while *statistics* deals more with applying models and real data.

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Introduction

□ A *population* consists of all subjects that are being studied.

□ A *sample* is a group of subjects selected from a population.

□ Data are the values that variables can assume.

□ Each value in the data set is called a *data value* or a *datum*.

□ A *data set* is a collection of data values.

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Introduction

□ In order to gain knowledge about events, statisticians collect information for variables that describe the events.

□ A *variable* is a characteristic or attribute that can assume different values.

□ *Random variables* have values that are determined by chance.

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Descriptive and Inferential Statistics

□ *Descriptive statistics* consists of the collection, organization, summarization, and presentation of data.

□ *Inferential statistics* consists of generalizing from samples to populations, performing estimations hypothesis testing, determining relationships among variables, and making predictions.

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Variables and Types of Data

□ *Qualitative variables* can be placed into distinct categories according to some characteristic or attribute, e.g., flight classes, departments, gender, ….

□ *Quantitative or scale variables* are numerical in nature and can be ordered or ranked, e.g., number of passengers, cargo weights, age, ….

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Variables and Types of Data (cont'd.)

Qualitative variables can be further classified
into two groups.

□ _Nominal_—classifies data into categories that
can not be ordered or ranked, e.g., gender,
departments, eye color, ….

□ _Ordinal_—classifies data into categories that
can be ranked, e.g., flight classes, ranking,
grade letters, ….

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Variables and Types of Data (cont'd.)

Quantitative or scale variables can be further
classified into two groups.

□ _Discrete variables_ assume values that can
be counted, e.g., number of passengers,
number of students in Stat 110, ….

□ _Continuous variables_ can assume all values
between any two specific values, e.g.,
heights, weights, ….

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Variables and Types of Data (cont'd.)

Also, Quantitative or scale variables can be
further classified into two groups.

□ _Interval_—ranks data, and precise differences
between units of measure do exist; however,
there is no meaningful zero, e.g., IQ tests,
temperature, ….

□ _Ratio_—possesses all the characteristics of
interval measurement, and there exists a true
zero, e.g., time, heights, weights, ….

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Data Collection

□ *Surveys* are the most common method of collecting data. Three methods of surveying are

  ◘ Telephone surveys

  ◘ Mailed questionnaire surveys
  ◘ Personal interviews

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Sampling Techniques

□ *Random samples* are selected using chance methods or random methods.

□ Researchers obtain *systematic samples* by numbering each subject of the populations and then selecting every k^{th} number.

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Sampling Techniques

□ Researchers select *stratified samples* by dividing the population into groups called strata according to some characteristic that is important to the study, then sampling from each group or strata.

□ Researchers select *cluster samples* by intact groups called clusters. Thus, dividing the population into groups and then taking samples of the groups.

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Observational and Experimental Studies

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□ In an *observational study*, the researcher merely observes what is happening or what has happened in the past and tries to draw conclusions based on these observations.

□ In an *experimental study*, the researcher manipulates one of the variables and tries to determine how the manipulation influences other variables.
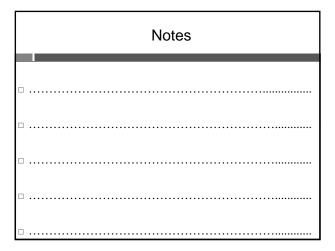
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Observational and Experimental Studies

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□ In a true experimental study, the subjects should be assigned to groups randomly. If this is not possible and a researcher uses intact groups, then he is performing a *quasi-experimental study*.

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Observational and Experimental Studies

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Statistical studies usually include one or more independent variables and one dependent variable.

□ The *independent variable or explanatory variable* is the one that is being manipulated by the researcher.

□ The *dependent variable or outcome variable* is the resultant variable.

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Observational and Experimental Studies

- A *confounding variable* is the variable that influences the dependent or outcome variable but cannot be separated from the independent variable.
- Example, subjects on exercise program may improve their diet and perhaps that improve their health in other ways not due to exercise alone. Then diet becomes confounding variable.

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Uses and Misuses of Statistics

- *Suspect Samples:* Sometimes researchers use very small samples to obtain information or wrong way of selecting a sample such as bias sample selection or volunteer samples
- *Ambiguous Averages*: measures that are loosely called averages are the mean, median, mode and midrange. People can select the one that support their arguments.

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Uses and Misuses of Statistics

- *Changing the Subject*: The choice of values that represent the same data, as numbers and percentages.
- *Detached Statistics*: it is the one in which no comparison is made. For example, one may say that "Our cookies has one-third fewer calories" Here, fewer than what?

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Uses and Misuses of Statistics

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- *Implied Connections*: Usage of words such as may, suggest or some that imply connections but there is no guarantee. So be careful when you draw conclusions.
- *Misleading Graphs*: if graphs are drawn inappropriately, they can misrepresent the data and lead to false conclusions.
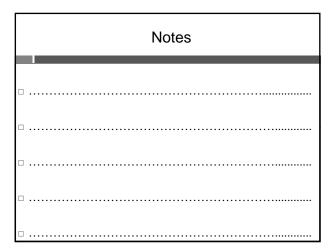
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Uses and Misuses of Statistics

1-22

- *Faulty Survey Questions*: You should be sure that the questions are properly written since the way questions are phrased can influence the way people answer them.

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Statistical Packages

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- Excel, SPSS, MINITAB, SAS and the TI-83 graphing calculator can be used to perform statistical computations.
- Students should realize that the computer and calculator merely give numerical answers and save time and effort of doing calculations by hand.

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