

Unit 1 : Section 1

What is Statistics?

What is Statistics?

Statistics is both the art and science of learning from data.

That is, statistics deals with data in an intelligent and informative manner which provides us insight into the true nature regarding the issue under investigation.

At its essence, statistics seeks relevant data in order to acquire knowledge and attain understanding.

Lesson 1 :

What is Statistics?

The field of statistics is concerned with all aspects of data.

Including its
collection,
organization,
presentation,
description,
and
interpretation.

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The process of collecting data is one of the most crucial components of statistics. A great deal of consideration must be dedicated to determine exactly what data is relevant to the issue under investigation and precisely how should that data be collected. The quality and reliability of any statistical analysis is directly related to the quality and reliability of the data.

Lesson 1 :

What is Statistics?

The field of statistics is concerned with all aspects of data.

Including its
collection,
organization,
presentation,
description,
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interpretation.

The organization of data enables it to be used in an efficient and effective manner.

Organized data can be accessed, identified, utilized, and understood much more easily.

Lesson 1 :

What is Statistics?

The field of statistics is concerned with all aspects of data.

Including its collection, organization, **presentation**, description, and interpretation.

Presenting data accurately and effectively is absolutely essential in any statistical analysis.

Clearly communicating the results of a statistical study is crucial to the proper comprehension of the issue under investigation.

Lesson 1 :

What is Statistics?

The field of statistics is concerned with all aspects of data.

Including its collection, organization, **presentation**, **description**, and interpretation.

Describing data involves the objective communication of statistical results in the context of the issue under investigation.

Descriptions report results that can be directly derived from the data.

Lesson 1 :

What is Statistics?

The field of statistics is concerned with all aspects of data.

Including its collection, organization, presentation, description, and **interpretation**.

Interpreting data involves the subjective communication of statistical results in the context of the issue under investigation.

Interpretations offer explanations of and provide meaning for results that can be deduced from the data.

Lesson 1 :

What is data?

Data is information that has been collected and recorded.

This information supplies the underlying support and evidence for which all statistical results and conclusions are derived.

Information (or data) comes in many forms and is obtained in many ways.

Lesson 1 :

Lesson 2 :

Types of Data

Types of Data

It is important to know the type of data you are dealing with in order to know what type of statistical analysis technique to apply.

Specific statistical analysis techniques only work with particular types of data.

Lesson 2 :

Types of Data

For instance,

with non-numerical data, such as students' political party affiliation, calculating the percentage of students who are either democrat or republican is an appropriate statistic to analyze.

Lesson 2 :

Types of Data

For instance,

with numerical data, such as the age of students, calculating the average age of students is a reasonable statistic to analyze.

Lesson 2 :

Types of Data

Data can be classified into two basic types: qualitative or quantitative.

Qualitative data is categorial in nature.

In essence, qualitative data represents information regarding a quality or attribute; not a quantity.

Quantitative data is numerical in nature.

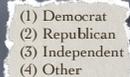
In essence, quantitative data represents information regarding a quantity or amount; not a quality.

Lesson 2 :

Types of Data

For instance,

the political party affiliation of students



the colors of M&Ms in a bag of Milk Chocolate Plain M&Ms



the zip code that a household resides in



would be classified as qualitative data

Lesson 2 :

Types of Data

For instance,

the age of Sierra College Elementary Statistics students

Q4. What is your age?

the number of M&Ms in a bag of Milk Chocolate Plain M&Ms



the total annual household income (in dollars)



would be classified as quantitative data

Lesson 2 :

Types of Data

Quantitative data can be further classified as either discrete or continuous.

Discrete data can take on only separate values with no intermediate values.

In general, discrete data denote counts (how many) and are represented by whole numbers only (0, 1, 2, 3, ...).

Continuous data can take on any value over a certain interval.

In general, continuous data denote measurements (how much) and are represented by any real number (0, 1, $2\frac{1}{2}$, 3.14, ...).

Lesson 2 :

Types of Data

For instance,

the number of units a student is enrolled in this semester

Q6. How many units are you enrolled in this semester?

the number of M&Ms in a bag of Milk Chocolate Plain M&Ms



the total number of TV's in a household



would be classified as discrete data

Lesson 2 :

Types of Data

For instance,

the age of Sierra College Elementary Statistics students

Q4. What is your age?

the weight (in ounces) of a bag of Milk Chocolate Plain M&Ms



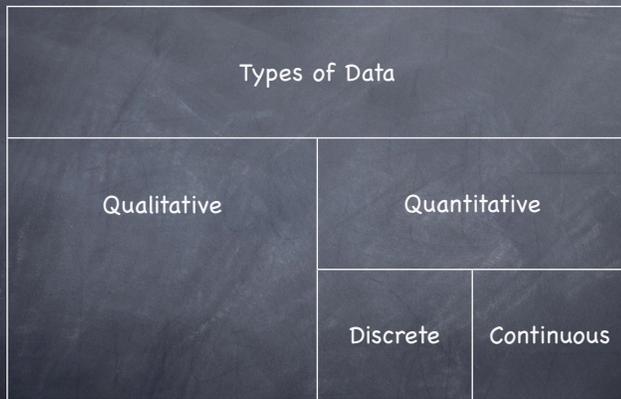
the total annual household income (in dollars)



would be classified as continuous data

Lesson 2 :

Types of Data



Lesson 2 :

Example 1

One of the questions on the Sierra College Elementary Statistics Student Survey asked

Q1. What is your gender? (1) Male (2) Female

Classify as to the type of data for this particular data item.

Lesson 2 : Types of Data

Example 1

Q1. What is your gender? (1) Male (2) Female

A student's gender is **qualitative** data since the data values "Male" and "Female" are categorical in nature.

Lesson 2 : Types of Data

Example 2

One of the questions on the Sierra College Elementary Statistics Student Survey asked

Q3. How would you rate your ability as a mathematics student? (1) Below Average (2) Just Average (3) Above Average

Classify as to the type of data for this particular data item.

Lesson 2 : Types of Data

Example 2

Q3. How would you rate your ability as a mathematics student? (1) Below Average (2) Just Average (3) Above Average

A student's rating of their mathematics ability is **qualitative** data since the data values "Below Average", "Just Average", and "Above Average" are categorical in nature.

Lesson 2 : Types of Data

Example 3

One of the questions on the Sierra College Elementary Statistics Student Survey asked

Q5. What is your college GPA? _____

Classify as to the type of data for this particular data item.

Lesson 2 : Types of Data

Example 3

Q5. What is your college GPA? _____

A student's college GPA is **quantitative** data of the **continuous** type since the data values are numerical in nature and can take on any value over a certain interval.

Lesson 2 : Types of Data

Example 4

One of the questions on the Sierra College Elementary Statistics Student Survey asked

Q7. How many courses are you enrolled in this semester? _____

Classify as to the type of data for this particular data item.

Lesson 2 : Types of Data

Example 4

Q7. How many courses are you enrolled in this semester? _____

The number of courses a student is enrolled in this semester is **quantitative** data of the **discrete** type since the data values are numerical in nature and can take on only separate values with no intermediate values.

Lesson 2 : Types of Data

Lesson 3 :

Levels of Measurement

Levels of Measurement

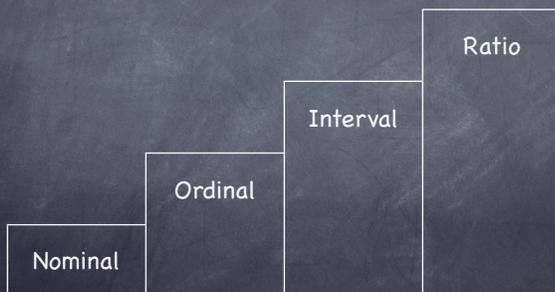
Data can be classified not only by its type (describing the underlying nature of the data item), but also by its level of measurement (describing how much information the data item contains).

Some data items contain a small amount of information, and some data items contain a lot. Yet, others contain a moderate amount of information.

Lesson 3 :

Levels of Measurement

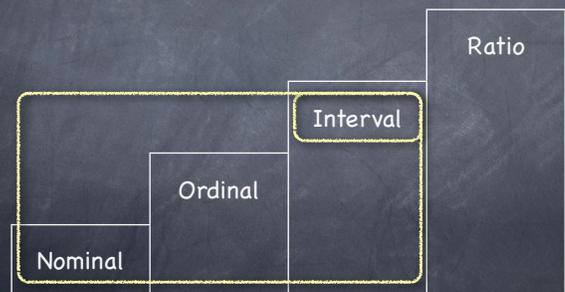
There are four **levels of measurement** in Statistics.



Lesson 3 :

Levels of Measurement

Each successive higher level contains the information from the preceding levels.



Lesson 3 :

Levels of Measurement

Nominal Level

is characterized by data that consists of names, labels, or categories only.

Nominal data cannot be arranged in a natural ordering scheme.

Levels of Measurement

Nominal Level

For instance,

the political party affiliation of students

- (1) Democrat
- (2) Republican
- (3) Independent
- (4) Other

the colors of M&Ms in a bag of Milk Chocolate Plain M&Ms



would be classified at the nominal level

Lesson 3 :

Lesson 3 :

Levels of Measurement

Ordinal Level

involves data that may be arranged in some natural order, but differences between data values either cannot be determined or are meaningless.

Lesson 3 :

Levels of Measurement

Ordinal Level

For instance,

star ratings for movie reviews



consumer satisfaction ratings



would be classified at the ordinal level

Lesson 3 :

Levels of Measurement

Interval Level

involves data where differences between data values can be determined and are meaningful.

However, there is no inherent zero starting point (where zero indicates that none of the quantity is present). At the interval level, zero does not indicate zero. Zero indicates something else.

Lesson 3 :

Levels of Measurement

Interval Level

For instance,

a city's elevation (in feet)



water temperature (in °C)



would be classified at the interval level

Lesson 3 :

Levels of Measurement

Ratio Level

involves data with an inherent zero starting point (where zero indicates that none of the quantity is present).

At the ratio level, both differences between data values and ratios of data values are meaningful.

Lesson 3 :

Levels of Measurement

Ratio Level

For instance,

the age of Sierra College Elementary Statistics students

Q4. What is your age?

the number of M&Ms in a bag of Milk Chocolate Plain M&Ms



would be classified at the ratio level

Lesson 3 :

Example 1

One of the questions on the Sierra College Elementary Statistics Student Survey asked

Q1. What is your gender? (1) Male
(2) Female

Determine the level of measurement for this particular data item.

Lesson 3 : Levels of Measurement

Example 1

Q1. What is your gender? (1) Male
(2) Female

A student's gender falls at the **nominal** level of measurement since the data values "male" and "female" are names only.

Lesson 3 : Levels of Measurement

Example 2

One of the questions on the Sierra College Elementary Statistics Student Survey asked

Q3. How would you rate your ability as a mathematics student? (1) Below Average
(2) Just Average
(3) Above Average

Determine the level of measurement for this particular data item.

Lesson 3 : Levels of Measurement

Example 2

Q3. How would you rate your ability as a mathematics student? (1) Below Average
(2) Just Average
(3) Above Average

A student's rating of their mathematics ability reaches the **ordinal** level of measurement since the data values "Below Average", "Just Average", and "Above Average" can be arranged in a natural order.

Lesson 3 : Levels of Measurement

Example 3

One of the questions on the Sierra College Elementary Statistics Student Survey asked

Q5. What is your college GPA? _____

Determine the level of measurement for this particular data item.

Lesson 3 : Levels of Measurement

Example 3

Q5. What is your college GPA? _____

A student's college GPA reaches the **interval** level of measurement since a college GPA of 0 refers to a letter grade of "F" rather than no GPA at all.

Lesson 3 : Levels of Measurement

Example 4

One of the questions on the Sierra College Elementary Statistics Student Survey asked

Q7. How many courses are you enrolled in this semester? _____

Determine the level of measurement for this particular data item.

Lesson 3 : Levels of Measurement

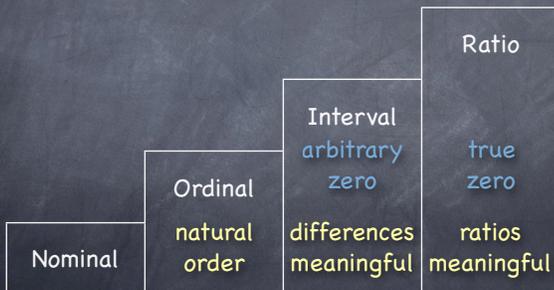
Example 4

Q7. How many courses are you enrolled in this semester? _____

The number of courses a student was enrolled in that semester reaches the **ratio** level of measurement since a 0 would indicate that the student was enrolled in zero courses that semester.

Lesson 3 : Levels of Measurement

Levels of Measurement



Lesson 3 :

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Your solutions should be clear, complete, and sufficiently detailed in order to demonstrate your understanding and communicate your reasoning and method of solving the problem.

Exercise 1

Classify as to the type of data and determine the level of measurement for each of the data items collected in the Movie Database Sample.

- (a) Movie Title
- (b) Genre
- (c) MPAA Rating
- (d) Year Released
- (e) Running Time
- (f) Worldwide Gross
- (g) Oscar Nominations

Exercise 2

Classify as to the type of data and determine the level of measurement for the particular data item :
The size of a drink (Short, Tall, Grande, or Venti) ordered at Starbucks.

Exercise 3

Classify as to the type of data and determine the level of measurement for the particular data item :
The amount of caffeine (in mg) in a drink ordered at Starbucks.

Exercise 4

Classify as to the type of data and determine the level of measurement for the particular data item :
The number of Starbucks drinks a person orders in a week.

Your solutions should be clear, complete, and sufficiently detailed in order to demonstrate your understanding and communicate your reasoning and method of solving the problem.

Exercise 1

Classify as to the type of data and determine the level of measurement for each of the data items collected in the Movie Database Sample.

(a) Movie Title

Since a movie's title indicates its name only, it is classified as qualitative data at the nominal level of measurement.

(b) Genre

Since a movie's genre indicates its category only, it is classified as qualitative data at the nominal level of measurement.

(c) MPAA Rating

Since the MPAA ratings follow a hierarchal classification, it is classified as qualitative data at the ordinal level of measurement.

(d) Year Released

Since the year is a whole number only with an arbitrary zero, it is classified as quantitative data of the discrete type at the interval level of measurement.

(e) Running Time

Since running time is a measurement with a true zero, it is classified as quantitative data of the continuous type at the ratio level of measurement.

(f) Worldwide Gross

Since worldwide gross is a measurement with a true zero, it is classified as quantitative data of the continuous type at the ratio level of measurement.

(g) Oscar Nominations

Since Oscar nominations are a count with a true zero, it is classified as quantitative data of the discrete type at the ratio level of measurement.

Exercise 2

Classify as to the type of data and determine the level of measurement for the particular data item :
The size of a drink (Short, Tall, Grande, or Venti) ordered at Starbucks.

The size of a drink ordered at Starbucks is qualitative data that reaches the ordinal level of measurement because Short, Tall, Grande, or Venti is categorical in nature and may be arranged in some natural order.

Exercise 3

Classify as to the type of data and determine the level of measurement for the particular data item :
The amount of caffeine (in mg) in a drink ordered at Starbucks.

The amount of caffeine (in mg) in a drink ordered at Starbucks is quantitative data of the continuous type that reaches the ratio level of measurement because the amount of caffeine is numerical data that can take on intermediate values over a certain interval with a true zero.

Exercise 4

Classify as to the type of data and determine the level of measurement for the particular data item :
The number of Starbucks drinks a person orders in a week.

The number of Starbucks drinks a person orders in a week is quantitative data of the discrete type that reaches the ratio level of measurement because the number of drinks ordered in a week is numerical data that can take on only separate values with no intermediate values and has a true zero.