

BIOSTATISTICS

Unit 1

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Lecture 3

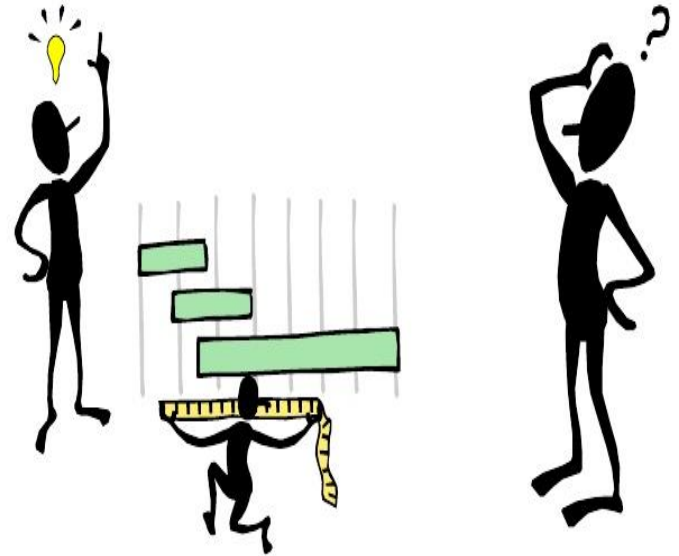
Types of Variables in Statistics



Variables

1. A variable is a characteristic of interest that can have different values, and you measure, record, and analyze.
2. A quantitative variable can be measured in some way.
3. A qualitative variable is characterized by its inability to be measured but it can be sorted into categories.

What is a Variable?

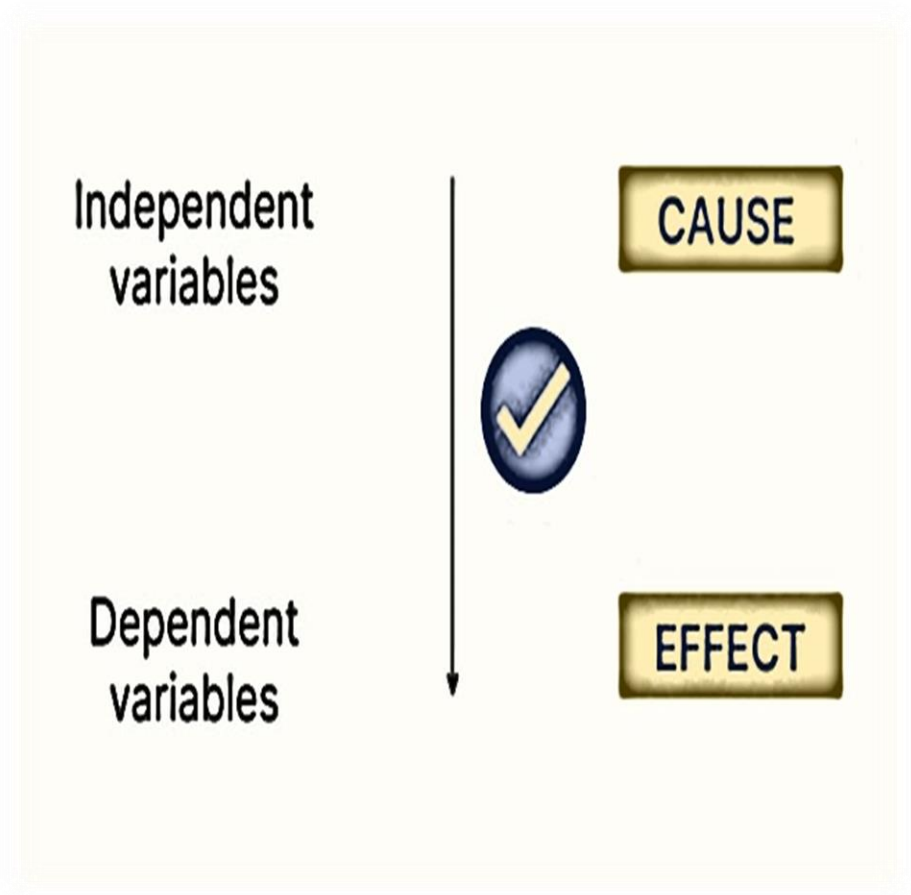


Types of Variables

Independent variable —
the presumed cause (of
a dependent variable)

Dependent variable —
the presumed effect (of
an independent
variable)

Example: Smoking is
independent variable →
Lung cancer is a
dependent variable



Independent and dependent variables

Level 1:
New medication



Blood pressure
lowers

Apply different levels of the
independent variable

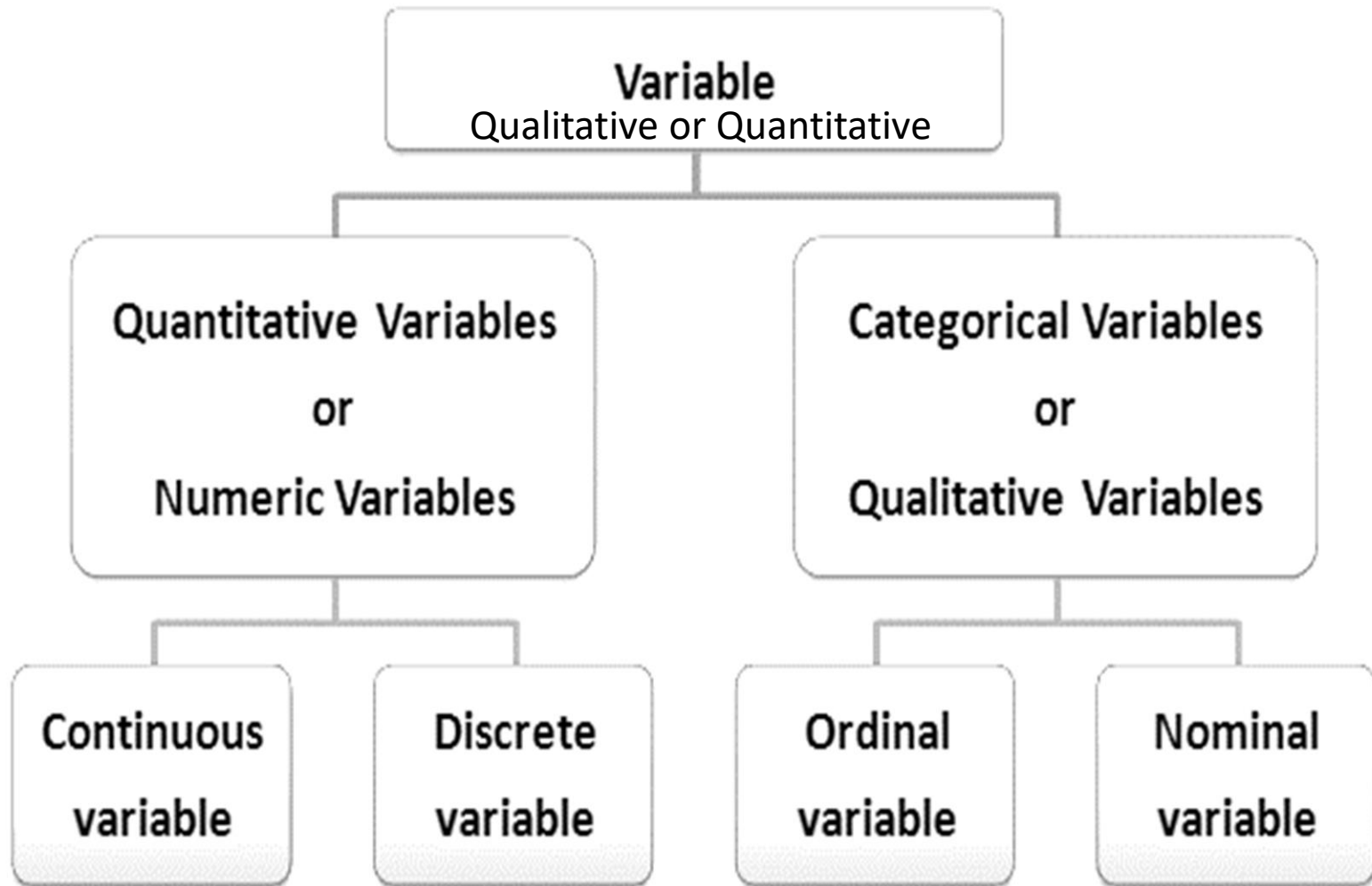
Measure the effect on the
dependent variable

Level 2:
Sugar pill placebo



No change in
blood pressure

Types of Variables



Qualitative variables

- Nominal

Example: Sex (M, F)

Exam result (P, F)

Blood Group (A,B, O or AB)

Color of Eyes (blue, green, brown, black)

Examples of Nominal Data



Qualitative variables

- **Ordinal**

Example:

Response to treatment

(poor, fair, good)

Severity of disease

(mild, moderate, severe)

Income status (low, middle,

high)

QUANTITATIVE (DISCRETE)

Example: The no. of family members

The no. of heart beats

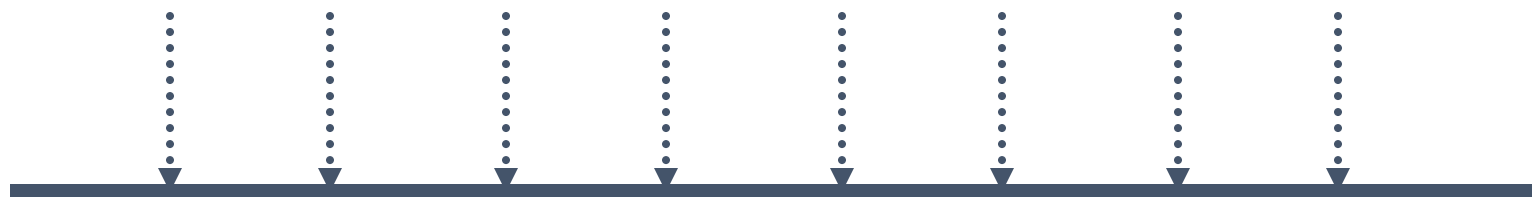
The no. of hospital admissions in a day

QUANTITATIVE (CONTINUOUS)

Example: Height, Weight, Age, BP, Serum

Cholesterol and BMI

Discrete data -- Gaps between possible values



Number of Children

**Continuous data -- *Theoretically,*
no gaps between possible values**



Hb

Continuous data can be transformed by classification into categories



Qualitative data

wt. (in Kg.) : under wt, normal & over wt.

Ht. (in cm.): short, medium & tall

Nominal Level of Measurement

- Categories that are distinct from each other such as gender, religion, marital status.
- Qualitative classification that have no quantitative value.
- Lowest level of measurement.
- Many characteristics can be measured on a nominal scale: race, marital status, and blood type.
- Appropriate statistics: mode, frequency
- We cannot use mean. It would be meaningless here.

Examples of Nominal Scales	
<p>What is your gender?</p> <p><input checked="" type="radio"/> M- Male</p> <p><input type="radio"/> F- Female</p>	<p>What is your hair colour?</p> <p><input checked="" type="radio"/> 1- Brown</p> <p><input type="radio"/> 2- Black</p> <p><input type="radio"/> 3- Blonde</p> <p><input type="radio"/> 4- Gray</p> <p><input type="radio"/> 5- Other</p>

Ordinal Level of Measurement

➤ The exact differences between the ranks cannot be specified. It indicates order rather than exact quantity.

➤ Involves using numbers to designate ordering on an attribute.

How do you feel today?

- 1 - Very Unhappy
- 2 - Unhappy
- 3 - OK
- 4 - Happy
- 5 - Very Happy

How satisfied are you with our service?

- 1 - Very Unsatisfied
- 2 - Somewhat Unsatisfied
- 3 - Neutral
- 4 - Somewhat Satisfied
- 5 - Very Satisfied

➤ Example: anxiety level: mild, moderate, severe. Statistics used involve frequency distributions and percentages.

➤ Appropriate statistics: same as those for nominal data, plus the median; but not the mean.

Interval level of Measurement

Interval scale : can be ranked in order and compared

Example: temperature

- Data is placed in meaningful intervals and order.
- Example: body temperature on the Celsius thermometer as in 36.2, 37.2 etc. means there is a difference of 1.0 degree in body temperature.
- No implication of ratio (30° C is not twice as hot as 15° C)

Interval level of Measurement

- They are real numbers and the difference between the ranks can be specified.
- Involves assigning numbers that indicate both the ordering and the distance between the values
- They are actual numbers on a scale of measurement.
- Appropriate statistics
 - same as for nominal
 - same as for ordinal plus,
 - the mean

Ratio level of Measurement

- Is the highest level of data measurement where data can be categorized, ranked and the difference between ranks can be specified.
- A zero point means that there is a total absence of the quantity being measured.
 - Age, weight, height, pulse rate
 - pulse rate of 120 is twice as fast as 60
 - person with weight of 80kg is twice as heavy as the one with weight of 40 kg.

Ratio level of Measurement

Question 3

Which age group do you fall into?

15 - 25 years

A

26 - 35 years

B

36 - 50 years

C

51 - 65 years

D

Greater than 66

E

- All scales, whether they measure weight in kilograms or pounds, start at 0. The 0 means something and is not arbitrary (SUBJECTIVE).

Levels of Measurement

- 1. Nominal:** Names, labels, or qualities. Cannot perform meaningful operations on this data. (*Type of car, Eye Color, Zip codes*)
- 2. Ordinal:** Data can be arranged in order, but differences are not meaningful. (*Hotel Ratings, poor/fair/good, low/medium/high*)
- 3. Interval:** Data can be ordered and differences can be calculated. There is no inherent zero. (*Temperature, Year of birth*)
- 4. Ratio:** There is an inherent zero. Data can be ordered, differences can be found, and a ratio can be formed so you can say one data value is a multiple of another. (*Height, weight, age*)



Airports	✗ international
	✗ national
	✗ regional



What Type of Data To collect?

- The goal of the researcher is to use the highest level of measurement possible.
- **Example: Two ways of asking about Smoking behavior. Which is better, A or B?**

(A) Do you smoke? Yes No

(B) How many cigarettes did you smoke in the last 3 days (72 hours)?

(A) Is nominal, so the best we can get from this data are frequencies.

(B) is ratio, so we can compute: mean, median, mode, frequencies.

Differences between measurements, true zero exists

Ratio Data

Quantitative Data

Differences between measurements but no true zero

Interval Data

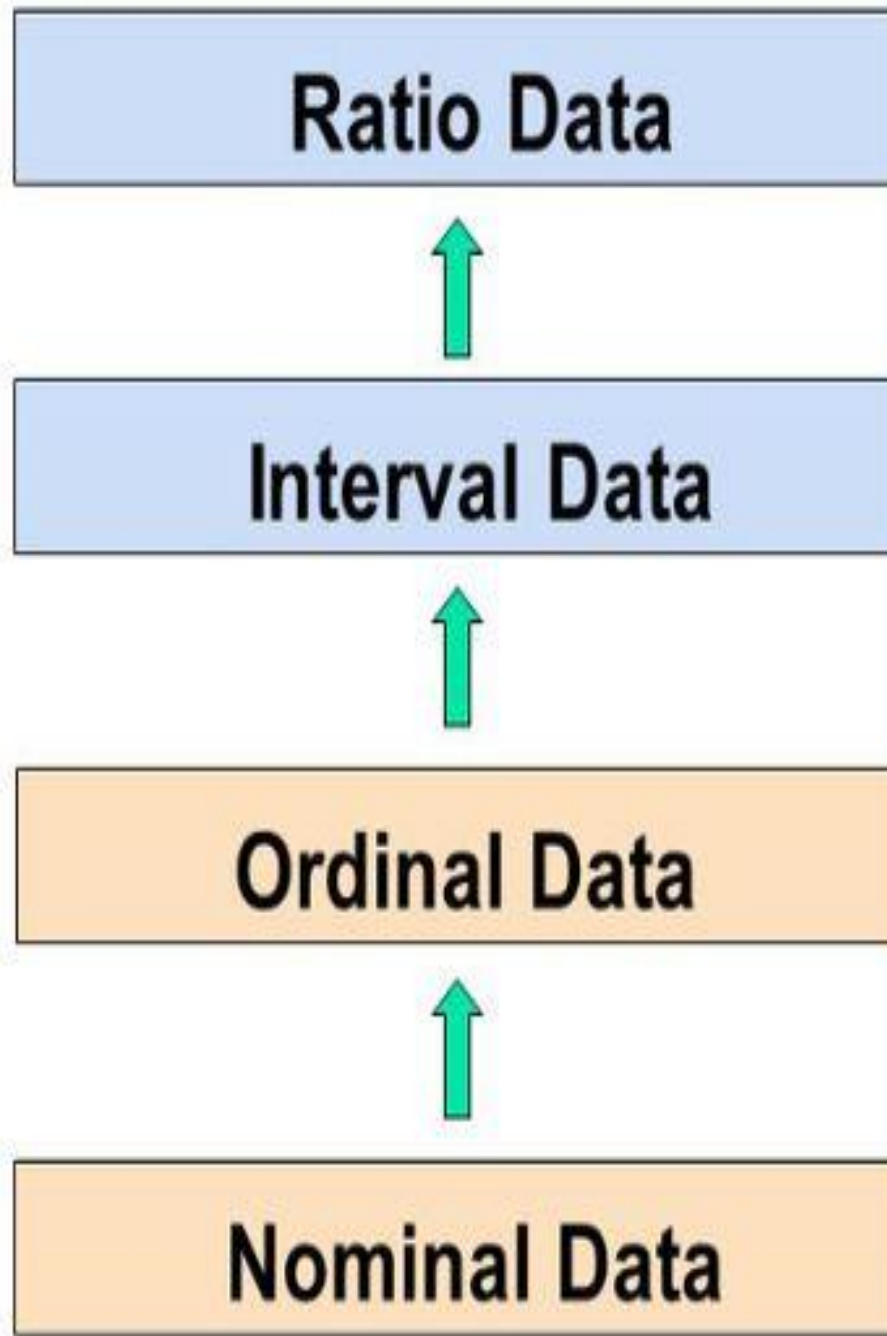
Ordered Categories (rankings, order, or scaling)

















Ordinal Data

Qualitative Data

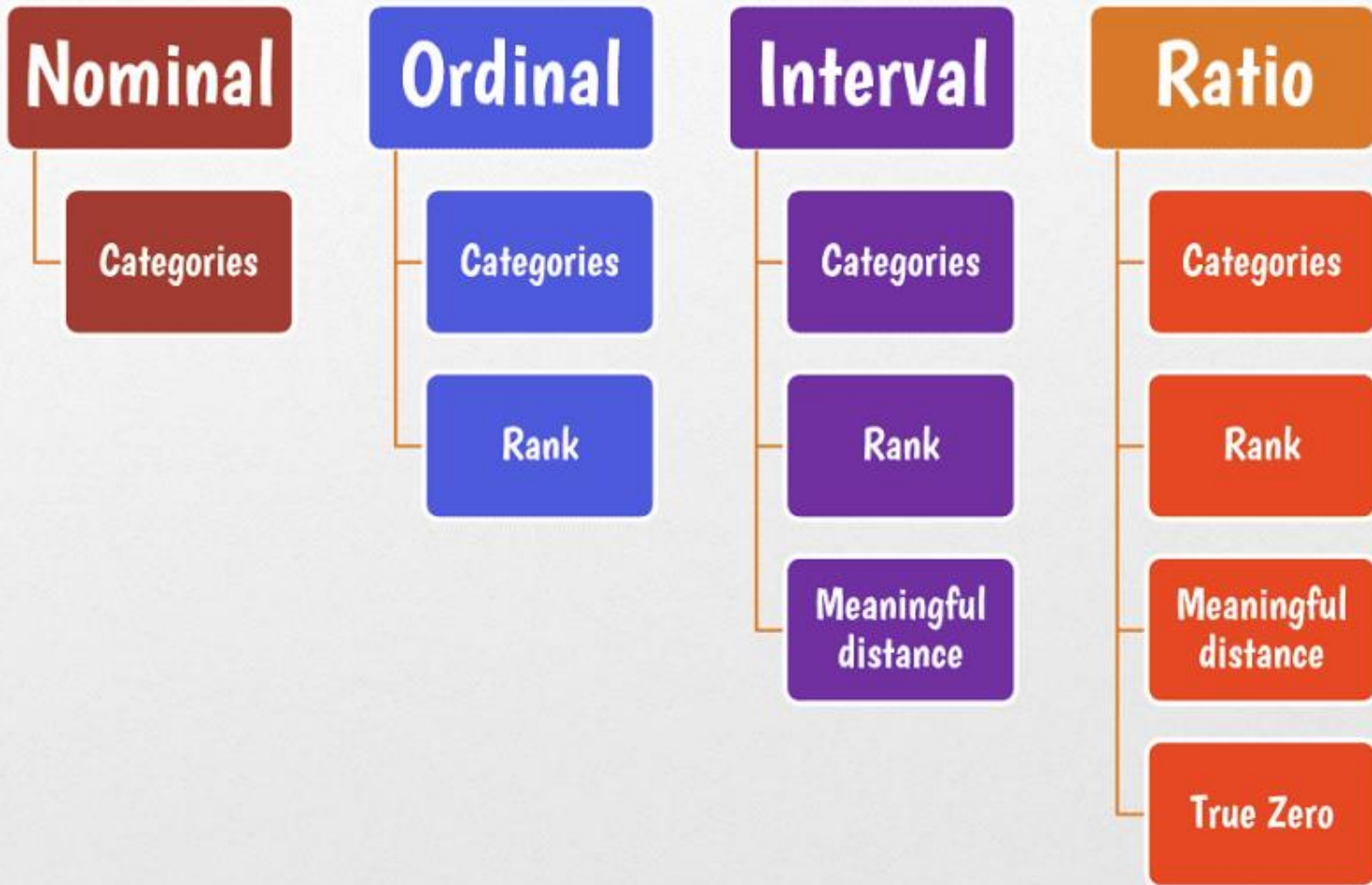
Categories (no ordering or direction)

Nominal Data



	Category Names	Meaningful Order	Equal Distance	True Zero & Ratios
Nominal				
Ordinal				
Interval				
Ratio				

MEASUREMENT SCALES



Provides:	Nominal	Ordinal	Interval	Ratio
The “order” of values is known		✓	✓	✓
“Counts,” aka “Frequency of Distribution”	✓	✓	✓	✓
Mode	✓	✓	✓	✓
Median		✓	✓	✓
Mean			✓	✓
Can quantify the difference between each value			✓	✓
Can add or subtract values			✓	✓
Can multiple and divide values				✓
Has “true zero”				✓

Example

- “100 meter race” where three runners are participating from three different governates from Jordan. Each runner is assigned a number (displayed in uniform) to differentiate from each other.
 - The number displayed in the uniform to identify runners is an example of nominal scale.
 - Once the race is over, the winner is declared along with the declaration of first runner up and second runner up based on the criteria that who reaches the destination first, second and last. The rank order of runners such as “second runner up as 3”, “first runner up as 2” and the “winner as 1” is an example of ordinal scale.
 - The time spent by each runner in completing the race is an example of ratio scale.