Relationship, Correlation, & Causation

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Topics

• Relationship
• Correlation
• Causation
Relationship

Definition

The way in which two or more people or things are connected, or the state of being connected.

Oxford Dictionary

Example

• Classroom teaching involves a personal relationship between teacher and pupil.

• The study will assess the relationship between unemployment and political attitudes
Quantitative Research

Research Question

Central focus of the research.

Hypothesis

“Testable” statement that can be supported or rejected by an analysis of the data

Independent Variable/Dependent Variable

Elements of data set.

IV – The variable expected to account for (the cause of) the dependent variable.

DV – The variable to be explained (the effect)
Quantitative Research

Research Question

• Did implementation of the Leader in Me program make a significant difference in student achievement as measured by scores on the Criterion Referenced Competency Test (CRCT)?

Hypotheses

• H₀: The Leader in Me program integration does not increase student achievement on the Criterion Referenced Competency Test.
• H₁: The Leader in Me program integration increases student achievement on the Criterion Referenced Competency Test.

Independent Variable/Dependent Variable

IV – Leader in Me Program
DV – Student achievement as measured by scores on the CRCT

Caracelo, 2016
Definition

“A measure of association used to determine the existence and strength of the relationship between interval-ratio variables.”

(Frankfort-Nachmias & Leon-Guerrero, 2018, p. 435)
Interval-Ratio Variables

Definition

“Measurements for all cases are expressed in the same units and equally spaced. Interval-ratio values can be rank-ordered”

Example

- Age
- Income
- SAT scores

(Frankfort-Nachmias & Leon-Guerrero, 2018, p. 11)
Existence and Strength

Existence
• Is there a relationship between the two variables?

Strength
• How strong is the relationship?
• Is the relationship positive or negative?
Testing for the Relationship or Association

Pearson’s $r$
Spearman’s Rank Correlation ($\rho$)
Kendall’s Tau Rank Correlation ($\tau$)
Chi-Squared ($X^2$)
Pearson’s $r$

Measuring the strength of association between 2 continuous variables

Assumptions: Normal distribution, linearity, homoscedasticity

Example: Is there a statistically significant relationship between age, as measured in years, and height, as measured in inches?

Unique Features: Useful when you have multiple variables to examine at one time.
Spearman’s Rank Correlation ($\rho$)

Measuring the strength of association between 2 ordinal variables

**Assumptions:** Non-parametric test, so no assumptions about the data

**Example:** Is there a statistically significant relationship between participants’ responses to two Likert scales questions?

**Unique Features:** Use when you have data that can be arranged in rank order.
Kendall’s Tau Rank Correlation ($\tau$)

Measuring the strength of association between 2 ordinal variables

**Assumptions:** Non-parametric test, so no assumptions about the data

**Example:** Is there a statistically significant difference between the rankings of 12 candidates for a position by 2 interviewers?

**Unique Features:** Use when you have simple, ranked data.
Chi-Squared \((X^2)\)

Measuring the strength of association between 2 categorical variables

**Assumptions:** Non-parametric test, so no assumptions about the data

**Example:** Do the men's voting preferences differ significantly from the women's preferences?

**Unique Features:** Use when you are exploring the difference between what you expect you will see and what the data actually shows.
Testing Results: Types of Correlation

**Positive**: As one variable increases, so does the other.

**Negative**: As one variable increases, the other decreases.

**None**: There is no apparent relationship between the variables.
Testing Results: Correlation Coefficient

Range: -1.0 to +1.0

-1.0  Perfect negative correlation

+1.0  Perfect positive correlation

0 (or close to it)  No correlation
Testing Results: Correlation Coefficient

-0.3 to 0.3  Weak correlation
-0.5 to -0.3 or 0.3 to 0.5  Moderate correlation
-0.9 to -0.5 or 0.5 to 0.9  Strong correlation
-1.0 to -0.9 or 0.9 to 1.0  Very strong correlation

Cohen (1992)
Testing Results: Square of the Coefficient \( (r^2) \)

**Description:** Percent of variation in one variable as it is related to the variation in the other variable.

**Calculating:** Square the \( r \) value and express as percent (ignore decimal point)

**Example:** \( r = .7 \quad r^2 = .49 \quad 49\% \) of the variance is related
Spurious Correlations

Definition

“Based on false reasoning or information that is not true, and therefore not to be trusted.”

(Cambridge Dictionary)
Correlation Examples
Correlation Examples
Correlation Examples
Causation

Definition

When one variable actually causes the changes in another variable. This can only occur when there is a true experimental study with a randomized sample and a control group.
Experimental Study

Definition

All variables must be held constant except for the variable that is being tested in order to identify the effect of that specific variable.
Sample Selection

Definition

The participants in the study are selected based on common characteristics, such as age, education, and level of congruence with the topic of the study. This minimizes confounding variables.

Example

The participants in a study on the effects of an anti-depression medication are all college students at selective colleges between the ages of 19 and 21 who display moderate to severe depression as measured on a common rating scale administered to all of the students.
Random Sample

Definition

Every participant identified as being eligible for the study has an equal chance of being in the experimental group or the control group.

Example

The participants in the study are numbered 1-100. A random number generator is used to place the participants into 2 groups. One group becomes the control group, the other is the experimental group.
Control Group

Definition

The control group in a study involving medicine (or trial) receives a placebo. This is a pill or other form of medication that is designed to look exactly like the real medication. In a blind study, the control group would not know which drug they were receiving. In a double blind study, the participants would not know which drug they were receiving, nor would the doctors and/or nurses dispensing the medication.
Experimental Group

Definition

The experimental group in a study involving medicine (or trial) receives the actual medication. In a blind study, the experimental group would not know which drug they were receiving. In a double blind study, the participants would not know which drug they were receiving, nor would the doctors and/or nurses dispensing the medication.
Caution

Correlation is not causality
Questions?
References

Thank you!

Casanova says:
“See you next time!”

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