Understanding Longitudinal Studies

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Learning Objectives

Define independent sampling unit (ISU).

Define unit of observation.

Define correlation.

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Learning Objectives

Define between- and within-independent sampling unit factors.

Define longitudinal studies.

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Learning Objectives

Define a longitudinal study.

Recognize an example of a longitudinal study.

Describe how longitudinal designs result in complex correlation between measurements.

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Each study can be described by its analytical units

An independent sampling unit (ISU) is statistically independent from any other unit.

In NIH sponsored research, the person is often the independent sampling unit.

Muller and Stewart, 2006

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Each study can be described by its analytical units

The unit of observation is the measurement of interest within the independent sampling unit.

Muller and Stewart, 2006

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Longitudinal studies are common in social and behavioral health research

A longitudinal study evaluates a research question by analyzing two or more measurements on the same independent sampling unit over time.

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Correlation measures the straight-line relationship between two variables

Correlation "indicates the strength and direction of the relationship between two random variables" (p. 127).

Rosner, 2010, p. 127

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Correlation ranges from -1 to 1

Correlation

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The sign of correlation indicates whether two variables are changing in the same direction

Negative correlation (between -1 and 0) indicates that two variables change in opposite directions.

Positive correlation (between 0 and 1) indicates that variables change in the same direction.

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Numbers further from zero represent stronger correlation

Correlation

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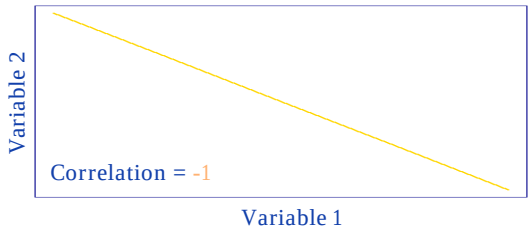
A correlation of -1 indicates that two variables change at constant rates in opposite directions

Perfect negative correlation



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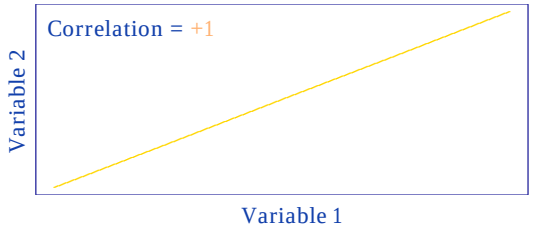
A correlation of +1 indicates that two variables change at constant rates in the same direction

Perfect positive correlation



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A correlation of 0 indicates that two variables are unrelated

Variables with correlation equal to zero have rates and directions of change that are uncorrelated, or unrelated.

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Variables that are independent always have correlation equal to zero

Mathematically, variables with correlation equal to zero are not necessarily independent.

For the purposes of this class, we focus on cases in which correlation of zero indicates that two variables are independent.

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Longitudinal sampling induces correlation between measurements

Measurements from the same person taken at two or more times will be correlated.

Longitudinal measurements are repeated measures that may have uneven spacing.

Rosner, 2010

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We discuss study designs in terms of 'factors'

A factor indicates a dimension of interest such as treatment versus no treatment, or time.

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Longitudinal studies involve within-independent sampling unit factors

Within-independent sampling unit factors are features with values which differ within each independent sampling unit.

Example:

Distance walked, with different values for each day, Monday through Friday

Bray and Maxwell, 1985
Doncaster and Davey, 2007

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Longitudinal studies may include between-independent sampling unit factors

Between-independent sampling unit factors take only one value for a single independent sampling unit. Different ISUs may have different values.

Example: Drug assignment in a randomized clinical trial

Bray and Maxwell, 1985
Doncaster and Davey, 2007

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We examine a longitudinal study of pain perceived after a root canal

Vignette

Researchers conducted a study to determine if dental patients who are instructed to use a sensory focus have a different pattern of long-term memory of pain than participants who did not.

Logan, Baron and Kohout, 1995

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We examine a longitudinal study of pain perceived after a root canal

Vignette, continued

Participants were selected and randomly assigned to either the intervention or non-intervention groups.

Logan, Baron and Kohout, 1995

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We examine a longitudinal study of pain perceived after a root canal

Vignette, continued

Participants in the intervention group listened to automated audio instructions to pay close attention only to the physical sensations in their mouth.

Logan, Baron and Kohout, 1995

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We examine a longitudinal study of pain perceived after a root canal

Vignette, continued

Participants in the no-intervention group listened to automated audio instruction on a neutral topic to control for media and attention effects.

Logan, Baron and Kohout, 1995

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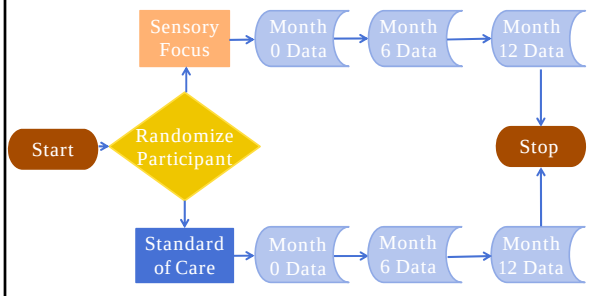
Observed pain after root canal was measured at 0, 6, and 12 months



Logan, Baron and Kohout, 1995

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The study assessed the impact of treatment on post-root canal pain

Null hypothesis:

Participants receiving the sensory focus training experience the same pattern of pain over time as participants not receiving sensory focus training.

Logan, Baron and Kohout, 1995

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The study assessed the impact of treatment on post-root canal pain

Independent sampling unit: Participant

Unit of Observation: Participant's perceived pain at a specific time

Logan, Baron and Kohout, 1995

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Measurements taken from a given participant at months 0, 6, and 12 were correlated

Within-independent sampling unit factor: Time, with measurements of perceived pain recorded for each person at month 0, 6, and 12

Logan, Baron and Kohout, 1995

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Outcomes were analyzed for each individual over a 12 month period

Between-independent sampling unit factor:
Treatment assignment to sensory focus training or no sensory focus training

Logan, Baron and Kohout, 1995

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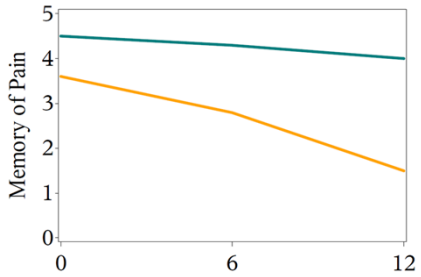
Pain recall over time differed by treatment group



Logan, Baron and Kohout, 1995

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REVIEW OF LEARNING OBJECTIVES

Define a longitudinal study

A longitudinal study aims to answer a research question by analyzing two or more measurements on the same independent sampling unit (often a research participant) over time.

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Define independent sampling unit

Observations from one independent sampling units are statistically independent of observations from any other distinct sampling unit.

Muller and Stewart, 2006

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Which measure indicates both the direction and strength of an association?

Amplitude

Correlation

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Explain how within- and between-independent sampling factors differ

Within-independent-sampling-unit factors occur within an independent sampling unit whereas between-independent-sampling-unit factors occur for each independent sampling unit as a whole.

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How do longitudinal designs result in correlation between measurements?

Two or more measurements from one person are not independent from one another.

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