Lecture 2
Hypothesis in Quantitative Research

Undergraduate Course

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What's a Hypothesis?

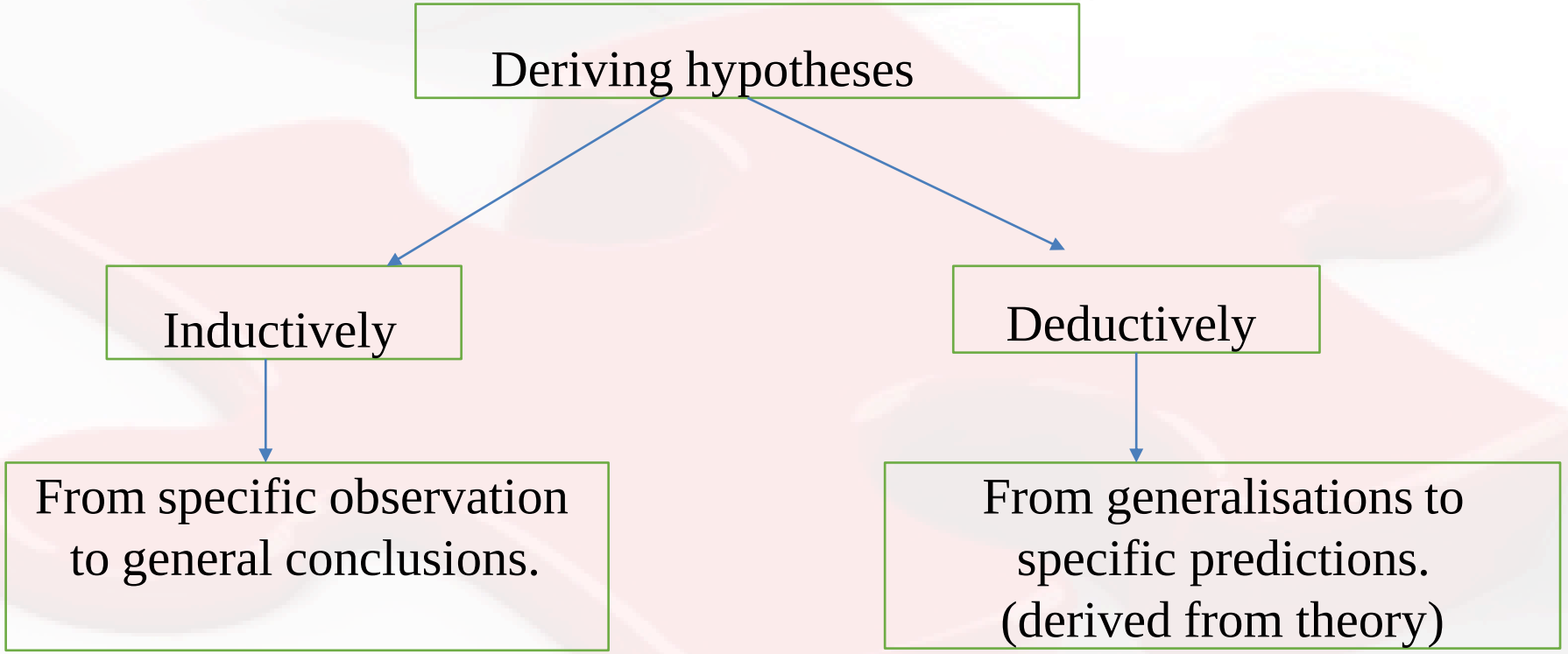
A research hypothesis is a clear, testable, and falsifiable statement or prediction that proposes a relationship between two or more variables in a study. It serves as a guiding framework for research, providing a specific direction for investigation and enabling researchers to test whether their assumptions about the phenomena under study hold true (Creswell & Creswell, 2018).

- It is a prediction the researcher makes about the expected outcomes of relationships among variables (a tentative answer to the research question).
- It represents the researcher's expectations about the relationship between variables within the question.
- Hypotheses suggest a relationship between two or more variables:
  - A variable that the researcher observes
  - A variable that the researcher controls

Purposes of the hypothesis in quantitative research

- It guides the research process
- It integrates information from experience, related research, and theory.
- It permits researchers to validate or fail theory, thus extending knowledge.
- It is a testable prediction, allowing researchers to use statistical methods to determine whether the predicted relationship or effect exists.
- It supports theory development and validation
- It provides the researcher with a relational statement that is directly testable (the RQ is not testable).
- It enhances precision and replicability

Suggestions for deriving hypotheses



Inductively, the researcher observes behaviour, notices trends (probable relationships), and hypothesizes an explanation for the observed behaviour.

- However, the researcher should consult previous research.

Deductively, the researcher tests an existing theory, observes behaviour, and Supports/ rejects the theory.

Characteristics of a usable hypothesis

1. **Stating the expected/ proposed relationship between variables**. Example: Students who participate in weekly collaborative problem-solving activities in a high school mathematics class will achieve higher test scores on algebra assessments compared to students who do not participate in such activities.

2. **Must be testable** (variables must be measurable). Example: Students who receive 30 minutes of daily mindfulness training will report lower levels of test anxiety on a standardized anxiety scale compared to students who do not receive the training.

3**. Consistent with the existing literature**. Example: Students who engage in regular peer tutoring sessions will demonstrate higher reading comprehension scores on standardized tests. (This is consistent with prior studies showing peer interaction improves literacy outcomes).

4. **Simple, clear, concise and precise declarative statement**. Example: Increased physical activity during recess will improve students' attention spans in afternoon math classes.

Conceptual and Operational definitions

- Having established the hypothesis, researchers need to define the **operational terms**, such as measuring ‘physical activity’ as minutes of moderate-to-vigorous movement and ‘attention spans’ as scores on a standardised focus assessment administered after math lessons.
- **A conceptual definition** is a theoretical or abstract description of a concept or variable, explaining its meaning within a specific context or discipline. It provides a broad, theoretical understanding of the concept, often based on existing literature or theoretical frameworks, but it is not tied to specific measurement procedures like an operational definition (Babbie, 2016).
- **An operational definition** is a clear, specific, and measurable description of how a variable or concept will be observed, manipulated, or measured in a study. It defines the variable in terms of the procedures or operations used to quantify or assess it, ensuring that the concept is concrete and replicable for research purposes (Shadish et al., 2002).
- Operational definition refers to assigning meaning to a construct or variable by specifying the activities or 'operations’ (procedures, actions, or processes) by which it could be observed and measured (how the researcher is going to measure the variables).

- Operational definition **a specification of the activities of the researcher in measuring a variable or in manipulating it**.

Types of hypotheses

The Research hypothesis

- developed from observation, theory, and literature; e.g., vocabulary knowledge positively affects reading comprehension.

Directional hypothesis

- predicts the nature(direction) of the effect (higher, lower, positive, negative …); e.g., Increased study time will improve test scores."

Non-directional hypothesis

- the direction of the effect is not specified; e.g., There is a significant relationship between vocabulary knowledge and reading comprehension.

The Null hypothesis

- in the general population, no relationship or no significant difference exists between groups on a variable; e.g., There is no significant relationship between vocabulary knowledge and reading comprehension.
- it states results are due to chance and are not significant in terms of supporting the idea being investigated.

The Alternative hypothesis

- basing this prediction on prior literature and studies on the topic that suggest a potential outcome; e.g., There is a significant relationship between vocabulary knowledge and reading comprehension.
- it states that the results are not due to chance and that they are significant in terms of supporting the theory being investigated.

Null hypothesis

- One reason researchers test the H0 is because they think it is wrong.

In a courtroom, since the defendant is assumed to be innocent (this is the null hypothesis), the burden is on a prosecutor to conduct a trial to show evidence that the defendant is not innocent. Similarly, we assume the null hypothesis is true, placing the burden on the researcher to conduct a study to show evidence that the null hypothesis is unlikely to be true.

Testing the hypothesis

We use inferential statistics to test hypotheses. They use sample data to make generalisations, predictions, or inferences about a larger population, relying on probability theory and hypothesis testing to draw conclusions beyond the immediate data (e.g., t-tests, ANOVA, regression analysis) (Field, 2018). We use samples because we know how they are related to populations.

Steps to testing the hypothesis (Null Hypothesis)

- State, in operational terms, the relationship that should be observed if the research hypothesis is true.
- State the null hypothesis.
- Select a random sample from the population
- Select a research method that will enable the hypothesised relationship to be observed if it exists.
- Gather the empirical data and select and calculate appropriate descriptive statistics for these data.
- Conduct a statistical test: Calculate inferential statistics to determine the probability that your obtained results could have occurred by chance when the null hypothesis is true.
- If the probability of the observed findings being due to chance is very small (e.g., only 1 in 100 chances), you would have sufficient evidence to reject the null hypothesis.

Final Notes

- Although you may find support for a hypothesis, the hypothesis is not proven to be true. A hypothesis is never proved or disproved; it is only supported or not supported. Hypotheses are essentially probabilistic in nature.
- Empirical evidence can lead you to conclude that the explanation is probably true, or that it is reasonable to accept the hypothesis, but it never proves the hypothesis (Ary et al, 2014).