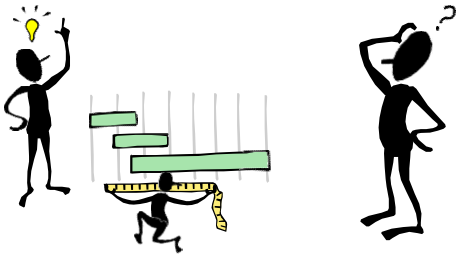
Lesson 3: Hypotheses in Research

What is a Research Hypothesis?



HYPOTHESIS - Definition

(a) A hypothesis (plural hypotheses) is ***the statement created by researchers when they speculate upon the outcome of a research or experiment.***

(b) This usually ***involves proposing a possible relationship between two variables***: the independent variable (what the researcher changes) and the dependent variable (what the research measures).

(c) In research, there is a standard that the hypothesis is written in two forms: the *null hypothesis, and the alternative hypothesis* (called the experimental hypothesis when the research method of investigation is an experiment).

(d) Every experimental research must have this statement at the core of its structure, as the final aim of any experiment.

(e) The ***predecessor to a hypothesis is a research problem***, usually framed as a question. It might ask what, or why, something is happening.

The Purpose of a Hypothesis

1. A hypothesis is used in an experiment ***to define the relationship between two variables (the Independent and Dependent variables).***
2. The purpose of a hypothesis is to *find the answer to a question*. A formalized hypothesis will force us to think about what results we should look for in an experiment.
3. A hypothesis should always:
   - Explain what you expect to happen.
   - Be clear and understandable.
   - Be **testable**.
   - Be **measurable**.
   - And **contain an independent and dependent** variable.

Types of Research Hypotheses

The six most common forms of hypotheses are:

1. Simple Hypothesis.
2. Complex Hypothesis.
3. Null Hypothesis *(Denoted by "H_O").*
4. Alternative Hypothesis *(Denoted by "H_1").*
5. Non-directional Hypothesis.
6. Directional Hypothesis.

1. A ***simple hypothesis*** is a ***prediction of the relationship between two variables***: the independent variable and the dependent variable.
   E.g.: Drinking sugary drinks daily leads to obesity.
2. A ***complex hypothesis*** examines the ***relationship between two or more independent variables and two or more dependent variables***.
   E.g.: Overweight adults who 1) value long life and 2) seek happiness are more likely than other adults to 1) lose their excess weight and 2) feel a more regular sense of joy.
3. The ***null hypothesis (H_0)*** states that there is ***no relationship between the two variables being studied*** (one variable does not affect the other). It states results are due to chance and are not significant in terms of supporting the idea being investigated.
   E.g.: There is no significant change in my health during the times when I drink green tea only or beer only.
4. This is where the ***alternative hypothesis (H_1)*** enters the scene. In an attempt to disprove a null hypothesis, researchers will seek to discover an alternative hypothesis.

- The ***alternative hypothesis*** states that ***there is a relationship between the two variables being studied*** (one variable has an effect on the other).
- It states that the results are not due to chance and that they are significant in terms of supporting the theory being investigated.

E.g.: My health improves during the times when I drink green tea only, as opposed to beer only.

5. ***Non-directional Hypothesis:*** A two-tailed non-directional hypothesis ***predicts that the independent variable will have an effect on the dependent variable, but the direction of the effect is not specified.***

E.g., there will be a difference in how many numbers are correctly recalled by children and adults.

6. ***Directional Hypothesis:*** A one-tailed directional hypothesis ***predicts the nature of the effect of the independent variable on the dependent variable.***

E.g.: adults will correctly recall more words than children.

CAN A HYPOTHESIS BE PROVEN?

- Upon analysis of the results, ***an alternative hypothesis can be rejected or supported***, but it can never be proven to be correct.
- In fact, ***a hypothesis is never proved***, and it ***'supported' or 'verified'***. This means that the research showed that the evidence supported the hypothesis and further research is built upon that.
- We must avoid any reference to results proving a theory as this implies 100% certainty, and there is always a chance that evidence may exist which could refute a theory.

How to Write a Good H_O and H_1 Hypothesis

1. A hypothesis often follows a basic format of **"If** {this happens} **then {this will happen}."**
2. One way to structure your hypothesis is to ***describe what will happen to the dependent variable*** if you make changes to the independent variable.

The basic format might be:

"If *{these changes are made to a certain independent variable}*, then we will observe *{a change in a specific dependent variable}.*"

Some examples on the next slide:

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Examples:

- **If** 3rd years and 4th years ***(this is the IV)*** complete the same programming assignment, **then** the 4th years will have **more answers correct**, ***(this is the DV)*** **because** they have studied programming for one year longer than the 3rd years.
- **If dry bread and moist bread** ***(this is the IV)*** are left in bags for two weeks, **then** the moist bread will grow mold more ***(this is the DV)*** quickly than the dry bread, **because** mold is a living organism, and organisms need water to survive.
- **If** some students **eat breakfast before school and others do not**, ***(this is the IV)*** **then** the ones who do eat breakfast will have **better grades** ***(this is the DV)*** in their morning classes, **because** their brains have more energy to think.

- **IF**…tells the readers what will be changed. This is the *manipulated* (independent) *variable* in the investigation.
- **THEN**… tells the reader what will happen because of the change (manipulated variable) described in the If… statement. This is the *responding* (dependent) *variable* in the investigation.
- **BECAUSE**… tells the reader how you know this will occur. It should be based on something you have experienced, or perhaps something you infer.

Formulating The "Alternative" Hypothesis (H_1)

- An alternative hypothesis ($\mathbf{H_1}$) is **a statement that directly contradicts a null hypothesis** by stating that that the actual value of a population parameter ***is less than, greater than, or not equal to*** the value stated in the null hypothesis.
- The alternative hypothesis states what we think is wrong about the null hypothesis.
- Formula Review: $\mathbf{H_0}$ and $\mathbf{H_1}$ are contradictory. Therefore:

If H_0 has:	equal (=)	greater than or equal to (≥)	less than or equal to (≤)
then H_1 has:	not equal (≠) or greater than (>) or less than (<)	less than (<)	greater than (>)

Examples:

1. In a population of fish, approximately 42% are female. A test is conducted to see if, in fact, the proportion is less. **State the null and alternative hypotheses**.

   Answer:

   $H_0: p=0.42$

   $H_1: p<0.42$

2. We want to test whether the mean height of third years is 173 cm . **State the null and alternative hypotheses.**

   Answer:

   $H_0: \mu=173$

   $H_1: \mu\neq173$

3. About 40% of people pass the Kenyan driving test on the first try. In your research, you want to test if more than 40% pass on the first try. **State the null and alternative hypotheses**.

   Answer:

   $H_0: p=0.40$

   $H_1: p>0.40$

4. We have a medicine that is being manufactured and each pill is supposed to have 14 milligrams of the active ingredient. **What are our null and alternative hypotheses**?

   Answer:

   $H_0: \mu=14$

   $H_1: \mu\neq14$

For each of the following statements, determine whether the statement is a null hypothesis or an alternative hypothesis.

(a) The mean IQ of all students at a certain high school is larger than 100.

(b) The probability of rolling a 6 with a particular six-sided die is 1/6.

(c) The probability of rolling a 6 with a particular six-sided die is not equal to 1/6.

(a) The mean IQ of all students at a certain high school is larger than 100.
Answer: Alternative Hypothesis

(b) The probability of rolling a 6 with a particular six-sided die is 1/6.
Answer: Null hypothesis

(c) The probability of rolling a 6 with a particular six-sided die is not equal to 1/6.
Answer: Alternative Hypothesis

A research hypothesis, which stands the test of time, eventually becomes a theory, such as Einstein's General Relativity. Even then, as with Newton's Laws, they can still be falsified or adapted.