Identifying a Reason for Performing an Experiment

by Sophia

≣ WHAT'S COVERED

In this lesson, you're going to learn about identifying a reason for performing an experiment. The experimental method involves creating a hypothesis. You will learn what a hypothesis is, and how it assists in establishing the cause-and-effect relationship between an explanatory variable and a response variable. This lesson will also talk about the difference between the null hypothesis and the alternative hypothesis, and why it's important to use both to come up with an educated guess about the relationship between the two variables in question. This lesson covers:

1. What Is a Hypothesis?
2. Null and Alternative Hypotheses

1. What Is a Hypothesis?

If you recall from the previous lesson, the experimental method consists of conducting experiments to understand the cause behind something and how one variable might affect another one. The variables in question are the explanatory variable and the response variable.

- Explanatory Variable: The quantity varied by the person conducting an experiment.
- Response Variable: The quantity whose change is observed as a result of varying the explanatory variable.

This is where the hypothesis comes in. Essentially an educated guess, a hypothesis establishes a parameter for the experimental method, outlining what you expect will happen if you change the explanatory variable, and how that would actually affect the response variable. It is an educated guess, not a random one.
When you hypothesize that a specific change in variable *a* causes a change in variable *b*, you base your educated guess on what you have observed. The experimental method allows you to set the parameters for the experiment and then go ahead and determine if there's any cause to support your hypothesis.

IN CONTEXT

To see how a hypothesis might work for making a prediction about the cause and effect that exists between a couple variables, let's assume that you have a particular person, Lars, who goes to the doctor because his blood pressure has been a little high. The doctor talks to Lars about how to manage that.

Lars starts exercising more regularly, and at a follow-up visit a month later, his blood pressure is relatively low. Lars hypothesizes that, since his blood pressure went down, the exercise led to that change. His hypothesis is an educated guess about the relationship between these two variables.

TRY IT

Suppose that gas is $1.50 a gallon, and people are buying large vehicles. Then gas prices go up to $3 a gallon, and you notice that people drive relatively smaller cars, and you are wondering why this would be.

What's a good hypothesis about the effect of rising gas prices on the kinds of cars people buy?   +

Your hypothesis could state simply that the gas price is what's causing this to happen. Gas prices became more expensive; therefore, it's more expensive to drive a large vehicle that gets lower gas mileage.

Your hypothesis states what you believe to be the case, but other explanations may exist. Perhaps rising insurance rates or decreased incomes have caused people to buy smaller vehicles.

Take a look at the relationship that exists between education and the income someone earns throughout the course of his or her career. If you have a college degree, it typically means your earnings will be higher over the course of a lifetime, but is getting the degree causing higher incomes, or could there possibly be something else going on here?

Your hypothesis might be simple: A college degree translates to higher earnings. Data would tend to back that up if you use the experimental method.

- Explanatory Variable: College degree.
- Response Variable: Higher earnings.

Then again, there could be other factors at play here as well. People that choose to get a college degree might be more driven in general. Therefore, they would typically do well in terms of their earnings, regardless of if they had the degree or not, relative to their peers.

There may be several explanations, but your hypothesis states what you believe to be the case. It is an educated guess based upon what the data is telling you.

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2. Null and Alternative Hypotheses

There are two types of hypotheses. One is a **null hypothesis**, which states that there's no relationship between the variables in question. The other, called the **alternative hypothesis**, states that there *is* a relationship between the explanatory variable and the response variable, and defines that relationship.

A null hypothesis essentially says that it's possible the explanatory variable is really just affecting the response variable by chance. In other words, there's no direct relationship. It just happens to be something that's occurring. It's not necessarily something that's causing the effect in the response variable.

The alternative hypothesis suggests that there actually is some cause-and-effect relationship going on between the explanatory variable and the response variable.

- Null Hypothesis: States that two variables are <u>not</u> related.
- Alternative Hypothesis: States that two variables <u>are</u> related, and how they are related.

> **IN CONTEXT**
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> Suppose you want to look at test scores and evaluate how well a given class might do on a particular exam. In particular, perhaps you are testing to see if there's a relationship between the amount of sleep a student gets and how well he or she performs on an exam.
>
> Your null hypothesis would be that sleep and student performance are not related. The alternative hypothesis, on the other hand, would be that perhaps increased amounts of sleep would lead to better student performance. You'd see if the relationship between sleep and student performance actually exists, and whether or not there's a cause-and-effect relationship that exists between the two.

⑦ **DID YOU KNOW**

You can never accept the alternative hypothesis. You can reject the null hypothesis, or you can fail to reject the null hypothesis. However, under no circumstance will you ever accept the alternative hypothesis because it might not always be true under all circumstances.

So, let's go through a couple of different examples of how we would actually look at a situation and identify what a null hypothesis is under those circumstances as well as what the alternative hypothesis would be.

✏ **TRY IT**

Scenario 1: Home Sale. Suppose you are in the real estate business, and you are in the process of selling a home. You are interested to see whether or not the value of the home you're selling is equal to that of a neighboring house.

What is your null hypothesis?   +

Your null hypothesis would assume that the houses are of equal value.

What is your alternative hypothesis?	+

Your alternative hypothesis would be that one of the homes has to be worth more or less than the other home.

⬛ TRY IT

Scenario 2: Retail Sale. Suppose a store is having a sale, and you are interested in the effect on customers.

What is your null hypothesis?	+

Your null hypothesis here is that the sale is not going to make one bit of difference with regard to bringing in additional customers.

What is your alternative hypothesis?	+

Your alternative hypothesis, in this case, would be the opposite of that: The sale could attract additional customers.

When you're looking at the difference between null and alternative hypotheses, the words often used to describe a null hypothesis are equal, less than or equal to, or greater than or equal to. In the alternative hypothesis, on the other hand, you see words such as unequal, less than, greater than, or different.

Null Hypothesis	Alternative Hypothesis
Equal	Unequal
Less than or equal to	Greater than (larger)
Greater than or equal to	Less than (smaller)
Same	Different

⭐ BIG IDEA

The idea here is that we have the complete opposite. If the null hypothesis states that something is equal, the alternative must state that it's unequal.

📄 TERMS TO KNOW

Null Hypothesis
  States that two variables are not related.

Alternative Hypothesis

States that two variables are related, and how they are related.

SUMMARY

In this lesson, you learned **what a hypothesis is**. A hypothesis is an educated guess, not simply a random statement. There are two types of hypotheses: **null and alternative**. It is important to use both, and they will be the opposite of each other.

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TERMS TO KNOW

Alternative Hypothesis
States that two variables are related, and how they are related.

Null Hypothesis
States that two variables are not related.