Setting Up an Experiment

by Sophia

WHAT'S COVERED

There are two different types of hypotheses: null hypothesis and alternative hypothesis. The idea behind these hypotheses is to set up a test, or an experiment, using the experimental method. This lesson is going to talk about setting up an experiment. It will cover:

1. Hypotheses and Variables
2. Random Selection
3. Control Variables
4. Importance of Replication

1. Hypotheses and Variables

Once you develop the hypotheses and make a prediction based on the alternate hypothesis, the next step in the process is to test the prediction. You're going to basically determine whether or not the hypothesis will be rejected or not. The results that you come up with from the experiment will fail or reject the null hypothesis.

In order to test this hypothesis, you need to start gathering accurate data. From this data, you're going to largely be able to determine whether or not a cause-and-effect relationship will exist between the two variables in question.

You're going to conduct an experiment. You're going to see how long it takes to have a pizza delivered. Say your null hypothesis is that you believe the average pizza delivery is going to take less than 40 minutes. The alternative hypothesis is you're going to test the concept that it's possible that it actually takes more than 40 minutes.

- Null Hypothesis: The average delivery time is 40 minutes or less.
- Alternative Hypothesis: The average delivery time is greater than 40 minutes.

In other words, the hypothesis, in this case, would be the average delivery arrives equal to 40 minutes or less than 40 minutes, whereas the alternative would simply be stating that you're going to test whether or not it actually arrives in greater than 40 minutes.

How would you actually go about testing this hypothesis? How would you actually go ahead and look at data in order to determine this?

The explanatory variable in this case is essentially what you are altering in order to see how the response variable changes.

Apply this to an experiment with regard to pizza delivery time. The response variable might be how long it takes a customer to get their pizza. The explanatory variable might be any variety of different factors. For this experiment, you will choose one in particular: how many delivery drivers happen to be working at one particular point in time.

- Explanatory Variable: How many drivers are working.
- Response Variable: How long it takes a customer to get their pizza.

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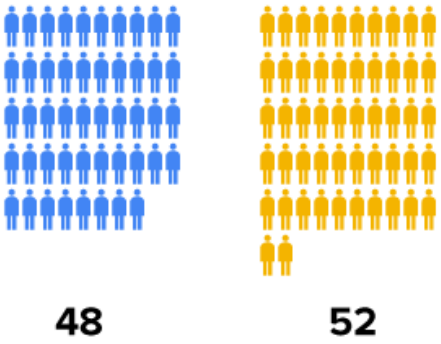
2. Random Selection

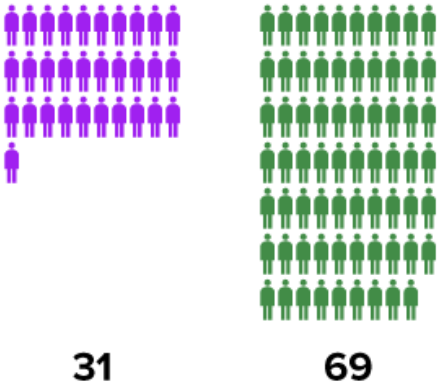
Take a look at another simple experiment. You're going to randomly pick 100 people and ask them to perform one of two specific tasks. The first one is you're going to take them to a basketball court, put them at the free throw line, hand them a basketball, and ask them to make 10 free throws. The second one would be you're going to sit them down at a desk and give them a quiz and ask them to name all 50 state capitals in the United States.

You're going to have it randomly set up who's selected for which task. If you randomly select the people, you're in all likelihood going to wind up with roughly a 50/50 break, meaning 50 people are going to be doing one task, and 50 people are going to be doing another one.



It won't necessarily be the people that are good at one or good at the other one. It's just going to be 50 random people. That'll give you a better sense in terms of the larger group and how good they happen to be at one task or the other.

You might have a different situation where you allow people to choose which half they want to do. What's going to happen is you're going to wind up with two distinct situations. If you pick randomly, you're going to wind up with relatively close to a 50/50 split. If you allow people to do what's called self-select, you're going to wind up with a vastly different number.



This is why you want to use random assignment—in order to better mimic what the overall group that you're drawing from looks like. In this case, it might just be American people. You're trying to get a sense of whether or not you can actually replicate that experiment over again.

3. Control Variables

Once you have groups with an experiment that have been randomly chosen, you need to make sure that one group does not get manipulated.

What is meant by manipulating? Manipulated means there's something that can alter that group in order to affect the outcome or the response variable.

A **control variable** is a variable that stays the same throughout. A control group is a group you control everything within and make sure that the variables they're exposed to are not going to be different throughout the course of the experiment. The idea here is to make sure you're not influencing the response variable.

If you control for other variables, those who conduct the experiment are going to make sure that only the explanatory variable is the one influencing a response variable and no other variables are. Now, there might be more than one explanatory variable that could affect that response variable. The idea of a control group is to try to eliminate that. You're not considering any other explanatory variables other than the one you're looking at.

IN CONTEXT

Pharmaceutical companies will do trial runs on new experimental medicines on a periodic basis. What they will do is often break people into a control group and a test group.

The control group will basically have everything remain the same except they are not getting the drug in question. They're getting what's called a placebo. The test group is the one actually receiving the drug.

The idea behind using the experimental method in a case like this is to see what effect the actual drug has on the conditions of an underlying medical problem.

Say you are a botanist growing different plants under different conditions, and you wanted to try out a new type of fertilizer. How would you prove that the fertilizer has any impact on plant growth?

What you could do is get two groups of plants that are about the same size and species. You would give one group of plants fertilizer in the water. The other group would just get water with no fertilizer added. Both groups would get the same amount of water at the same time of day at the same rate. After a period of time, this would show if the plants grew better under certain conditions like having fertilizer.

THINK ABOUT IT

What if another variable influences this? How do you take that into account?

Another variable in this situation could be sunlight. If some plants had more than others, this could affect growth rate. To avoid this, you would want to try to keep that third variable, sunlight, the same throughout the experiment. You would put all the plants together in the same location where they're going to be subject to the same amount of sunlight per day.

TERM TO KNOW

Control Variable

A variable that stays the same throughout an experiment.

4. Importance of Replication

Now you've set up an experiment. You know how important random assignment is. You know how important a control or control group is. Now you need to understand the concept of replication.

The reason you conduct multiple tests, or replicate the test, is to make sure that they're repeatable. One experimenter could run the test with a group, and somebody else should be able to replicate the same experiment using a completely different set of people or things.

You want to see if the tests are going to show similar results. If the test wound up showing very different results, something might be wrong with the experiment. You might need to go back and reevaluate the design of how you actually came up with the experiment to begin with.

BIG IDEA

Replicating an experiment provides some validity behind why the experiment is actually done.

SUMMARY

In this lesson, you learned that your experiment begins with identifying your **hypotheses and variables**. It is important to use **random selection** when creating groups because it gives you a more accurate representation of the whole. Having **control variables** is also important because it limits what is being tested to just the variables in your hypotheses. Don't forget the **importance of replication**. You want to make sure your experiment is repeatable.

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TERMS TO KNOW

Control Variable

A variable that stays the same throughout an experiment.