# Importance of Experiments

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WHAT'S COVERED

In this lesson, we'll discuss the importance of experiments. By the end of the lesson, you will be able to identify independent and dependent variables. This lesson covers:



## 1. What Is Statistics?

The focus of the field of statistics is studying data and information while determining how to interpret this information in useful ways. The primary goal of statistics is to collect reliable information and interpret it to learn more about the world around us and the people and things in it. Statistical methods are often applied to questions about nature and society to learn more about them and can also be applied in many different situations and contexts.

You may encounter statistics everywhere: in the media, perhaps in your job, at the doctor's office, etc. Knowing statistics is important when looking at an exam grade to understand how well you did relative to the rest of the class. It is also important when your doctor prescribes a medication and explains that the drug has a 5% chance of a specific side effect.

Knowing more about statistics and how they are created and analyzed can allow you a greater understanding of these situations and provide a greater ability to interpret the significance of the statistics that you come across.

## 2. The Experimental Method

The many methods of gathering information and statistics include:

- Observational methods: Watching something and getting a sense for how it changes.

- Experimental methods: An experiment is devised.

The experimental method is a very important approach to gathering information and statistics. It involves conducting experiments to learn more about the cause behind something, or how one thing might impact something else. Certain aspects involved in an experiment are changed to see the effect.

**IN CONTEXT**

While you could disclose information simply by observation, using the experimental method is beneficial because it permits us to establish whether there is a cause-and-effect relationship between two things. Take a look at these examples of situations that benefit from using the experimental method:

- You would expect that the more time you spend studying, the better your grades are likely to be. The experimental method allows you to track that to see if you are right. Record how much time you spend studying, then record the grades that you get and see if you can determine any kind of cause-and-effect relationship between the two.
- You would expect that the fewer calories you consume, the more weight you will likely lose. You would engage in the experimental method by tracking those calories and tracking the weight.
- You would expect that the slower you drive, the better gas mileage you're going to get. How will we engage in the experimental method with that? You would simply track how fast you drive and then track what kind of gas mileage you received.

By using the experimental approach with these scenarios, you would have the ability to determine whether one element of each pair is causing the other element.

The elements that are being changed or observed are called variables. The **explanatory variable** is the element that the experimenter changes. The **response variable** is the element that is observed that may be changing in response to the explanatory variable.

The idea here is that the experimenter will keep careful records and measurements as the experimenters make changes to the explanatory variable, and observe how the response variable responds or fails to respond.

TERMS TO KNOW

**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 independent variable.

# 3. Eight Steps of the Experimental Method

The experimental method has eight steps. You are going to go through these eight steps using the example of taking a specific medication to reduce the symptoms of a cold.

Maybe you've had a cold for a while, and you're trying to figure out what medication is going to help you feel better. By using the experimental method, you could figure out a methodical way of tracking these results.

STEP BY STEP

**Step 1:** Choose two things that you think might have a cause-and-effect relationship, where one might be causing the other. In this case, you're choosing a specific medication. You think it has a cause-and-effect relationship because if you take that medication, it will make you feel better or relieve the symptoms of your cold.

THINK ABOUT IT

In this experiment, which is your explanatory variable, and which is your response variable?

The explanatory variable, the element that is changed, in this case, would be taking the medication. The response variable, the element that is observed, would be how well you feel concerning the symptoms of your cold.

**Step 2:** Guess as to how these elements might have a cause-and-effect relationship. If you take the medicine twice a day, you would imagine that it's probably going to make you feel better shortly after taking it.

**Step 3:** Predict what you think will happen if changes are made to one thing, and how that will affect the other thing based upon your guess. Your prediction is, if I take this medication, I will feel better.

**Step 4:** Test your experiment with a prediction by trying to determine if, in fact, the things we are looking at share the cause-and-effect relationship that was predicted.

THINK ABOUT IT

How will you do that?

Make changes to one element that may be affecting the other element. Then observe what happens to the other element after the changes in the first element are made.

Perhaps you're taking the medication for a few days and you don't notice feeling any better, so you stop taking it. You record what happens then. If you feel the same or better, the medication wasn't doing much good. If you feel worse, the medication probably was helping your symptoms.

**Step 5:** Analyze the results of the test to determine what the results tell you about the cause-and-effect relationship between the two variables. The experimenter will analyze the information from Step 4 and use

statistical tests to determine whether changes in the explanatory variable are, in fact, causing the changes observed in the response variable.

DID YOU KNOW

The two variables would have a cause-and-effect relationship if changes to the explanatory variable affected the response variable, where the explanatory variable is the cause and the response variable is the effect.

**Step 6:** Conclude whether or not the tests showed that the prediction was correct. In this case, conclude whether or not taking the medication made you feel better. While a conclusion may or may not indicate a cause-and-effect relationship between two things, the results are not absolute. If the environment or things being tested were to change, then the results may no longer be valid, and new tests should be conducted. In a case like this, maybe you were taking more than one medication for the cold. Maybe the second medication was the one affecting it, and not necessarily the first one, or the one you were testing.

**Step 7:** Revise your guess if the prediction was wrong and start from Step 2. Or, if the prediction looks plausible, start testing again from Step 4 to verify your results. In general, it is a good idea to conduct multiple tests, as doing so helps to confirm the prediction when multiple tests show similar results.

**Step 8:** Once satisfied, report the findings so others can review and possibly test it themselves.

# 4. Examples

Take a look at other examples besides the medication and the cold symptoms. Say you're interested in getting to work a little bit earlier than you have been. You've been running late, and your boss is kind of frowning at you every time you walk in the door 5 minutes late.

To change that, you're interested in setting your alarm clock a little bit earlier to see if that makes a difference in terms of when you arrive at work. In a case like this, by setting the alarm clock just a few minutes earlier every day, you can determine whether or not you would get to work earlier as a result.

| Method | Example |
|---|---|
| Experimental Method | Make incremental changes to the alarm clock and record when you get to work. |
| Observational Method | Try to get up earlier and then notice if the boss stops yelling at you for being late. |

Here, it would be important to use the experimental method rather than an observational one, as you would be able to determine just how much earlier you had to get up in order to get to work earlier, rather than simply noticing a trend or maybe getting to work early by chance. The experimental method helps us realize if there is a strong cause-and-effect relationship between two things, whereas just observing still leaves room for speculation on whether or not two things do have a cause-and-effect relationship.

Sometimes we come across explanations of experiments that have already been done, such as studies conducted on new over-the-counter drugs or surveys regarding how many people consider a particular politician trustworthy. It can be useful in better understanding the experiment and its results if you can recognize the explanatory and response variables.

So let's take a look at a couple of different examples here to see if we can identify explanatory and response variables.

TRY IT

Suppose a television commercial says taking a particular vitamin will assist with weight loss.

**What is the explanatory variable?** +

Taking the vitamin is your explanatory variable.

**What is the response variable?** +

Your weight, whether or not you lose any, is the response variable.

TRY IT

Consider television viewing and the relationship it has with a person's grades.

**What is the explanatory variable?** +

The explanatory variable would be how many hours of television somebody watches.

**What is the response variable?** +

The response variable would be his or her grade or grade point average.

## SUMMARY

In this lesson, you learned the field of **statistics** focuses on studying data and information and interpreting this information in useful ways. **The experimental method** provides a source for your data and is beneficial because it helps identify cause-and-effect relationships. You learned how to identify independent and dependent variables. You also learned about the **eight steps of the experimental method** and went through several different **examples** talking about how one variable affects another.

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## TERMS TO KNOW

**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 independent variable.