Experiments

Colby Community College

Definition

In an **experiment**, we apply some treatment and then proceed to observe its effects on the individuals.

Definition

In an **experiment**, we apply some treatment and then proceed to observe its effects on the individuals.

Definition

The individuals in an experiment are called **subjects** or **patients**.

Definition

In an **experiment**, we apply some treatment and then proceed to observe its effects on the individuals.

Definition

The individuals in an experiment are called **subjects** or **patients**.

Definition

A **Placebo** is a treatment that has no medicinal effect. (Such as a sugar pill or saline injection.)

Definition

In an **experiment**, we apply some treatment and then proceed to observe its effects on the individuals.

Definition

The individuals in an experiment are called **subjects** or **patients**.

Definition

A **Placebo** is a treatment that has no medicinal effect. (Such as a sugar pill or saline injection.)

Definition

The group that receives a placebo is called the **control group**.

Definition

In an **experiment**, we apply some treatment and then proceed to observe its effects on the individuals.

Definition

The individuals in an experiment are called **subjects** or **patients**.

Definition

A **Placebo** is a treatment that has no medicinal effect. (Such as a sugar pill or saline injection.)

Definition

The group that receives a placebo is called the **control group**.

Definition

The group that receives a treatment is called the **treatment group**.

Definition

As researchers assign treatments to cases, they do their best to **control** any differences in the groups.

Definition

As researchers assign treatments to cases, they do their best to **control** any differences in the groups.

Example 1

Consider an experiment that wants to test a new drug in pill form.

Definition

As researchers assign treatments to cases, they do their best to **control** any differences in the groups.

Example 1

Consider an experiment that wants to test a new drug in pill form.

Some patients may take their pills with only a sip of water and some may take their pills with an entire glass.

Definition

As researchers assign treatments to cases, they do their best to **control** any differences in the groups.

Example 1

Consider an experiment that wants to test a new drug in pill form.

Some patients may take their pills with only a sip of water and some may take their pills with an entire glass.

To control for the effect of water consumption, the researchers ask all subjects take the treatment pill with a 12oz glass of water.

Definition

As researchers assign treatments to cases, they do their best to **control** any differences in the groups.

Example 1

Consider an experiment that wants to test a new drug in pill form.

Some patients may take their pills with only a sip of water and some may take their pills with an entire glass.

To control for the effect of water consumption, the researchers ask all subjects take the treatment pill with a 12oz glass of water.

The treatment drug may have a different reaction to full versus empty stomachs.

Definition

As researchers assign treatments to cases, they do their best to **control** any differences in the groups.

Example 1

Consider an experiment that wants to test a new drug in pill form.

Some patients may take their pills with only a sip of water and some may take their pills with an entire glass.

To control for the effect of water consumption, the researchers ask all subjects take the treatment pill with a 12oz glass of water.

The treatment drug may have a different reaction to full versus empty stomachs.

To control for food consumption, researchers ask all subjects to take the treatment pill immediately after a meal.

A **negative control** is a control group that receives a treatment that is expected to not have a noticeable effect.

Definition

A **negative control** is a control group that receives a treatment that is expected to not have a noticeable effect.

Note

Placebos like sugar pills and saline injections are common examples.

Definition

A **negative control** is a control group that receives a treatment that is expected to not have a noticeable effect.

Note

Placebos like sugar pills and saline injections are common examples.

Example 2

Researchers want to study the effects of caffeine on blood pressure.

The researchers split their sample into four groups:

Definition

A **negative control** is a control group that receives a treatment that is expected to not have a noticeable effect.

Note

Placebos like sugar pills and saline injections are common examples.

Example 2

Researchers want to study the effects of caffeine on blood pressure.

The researchers split their sample into four groups:

Treatment Group: This group drinks two cups of coffee.

Definition

A **negative control** is a control group that receives a treatment that is expected to not have a noticeable effect.

Note

Placebos like sugar pills and saline injections are common examples.

Example 2

Researchers want to study the effects of caffeine on blood pressure.

The researchers split their sample into four groups:

Treatment Group: This group drinks two cups of coffee.

Negative Control: This group drinks two cups of decaf coffee.

Definition

A **negative control** is a control group that receives a treatment that is expected to not have a noticeable effect.

Note

Placebos like sugar pills and saline injections are common examples.

Example 2

Researchers want to study the effects of caffeine on blood pressure.

The researchers split their sample into four groups:

Treatment Group: This group drinks two cups of coffee.

Negative Control: This group drinks two cups of decaf coffee.

Negative Control: This group drinks two cups of water.

Definition

A **negative control** is a control group that receives a treatment that is expected to not have a noticeable effect.

Note

Placebos like sugar pills and saline injections are common examples.

Example 2

Researchers want to study the effects of caffeine on blood pressure.

The researchers split their sample into four groups:

Treatment Group: This group drinks two cups of coffee.

Negative Control: This group drinks two cups of decaf coffee.

Negative Control: This group drinks two cups of water.

Negative Control: This group drinks nothing.

Definition

A **negative control** is a control group that receives a treatment that is expected to not have a noticeable effect.

Note

Placebos like sugar pills and saline injections are common examples.

Example 2

Researchers want to study the effects of caffeine on blood pressure.

The researchers split their sample into four groups:

Treatment Group: This group drinks two cups of coffee.

Negative Control: This group drinks two cups of decaf coffee.

Negative Control: This group drinks two cups of water.

Negative Control: This group drinks nothing.

Afterwards the blood pressure of each subject is measured.

A **positive control** is a sample group that receives a known treatment and is expected to change the subjects in a predictable way.

Definition

A **positive control** is a sample group that receives a known treatment and is expected to change the subjects in a predictable way.

Example 3

It's unlikely, but the blood pressure machine used in Example 2 may be faulty or miscalibrated.

Definition

A **positive control** is a sample group that receives a known treatment and is expected to change the subjects in a predictable way.

Example 3

It's unlikely, but the blood pressure machine used in Example 2 may be faulty or miscalibrated.

The researchers could add a fifth group who drinks nothing, but their blood pressure is measured using a completely independent second machine.

Definition

A **positive control** is a sample group that receives a known treatment and is expected to change the subjects in a predictable way.

Example 3

It's unlikely, but the blood pressure machine used in Example 2 may be faulty or miscalibrated.

The researchers could add a fifth group who drinks nothing, but their blood pressure is measured using a completely independent second machine.

Example 4

A researcher swabs an existing colony of bacteria and wipes it on a growth plate.

Example 5

An experiment of a new acne treatment randomly assigns 300 patients into the following groups:

Treatment Group: Receives the treatment being tested.

Negative Control: Receives a placebo treatment.

Positive Control: Receives a commercially available medication.

Example 5

An experiment of a new acne treatment randomly assigns 300 patients into the following groups:

Treatment Group: Receives the treatment being tested.

Negative Control: Receives a placebo treatment.

Positive Control: Receives a commercially available medication.

Note

The negative control is used to show that any positive effects of the new treatment aren't caused by some confounding variable.

The positive control is used to detect any problems with the new treatment or how it is administered.

Example 5

An experiment of a new acne treatment randomly assigns 300 patients into the following groups:

Treatment Group: Receives the treatment being tested.

Negative Control: Receives a placebo treatment.

Positive Control: Receives a commercially available medication.

Note

The negative control is used to show that any positive effects of the new treatment aren't caused by some confounding variable.

The positive control is used to detect any problems with the new treatment or how it is administered.

Note

A positive control can also be used to benchmark the results of the new treatment against existing treatments.

Some times researchers will suspect that variables, other than the treatment, will influence the result.

Note

Some times researchers will suspect that variables, other than the treatment, will influence the result.

Definition

Researchers can first group individuals based on a suspected confounding variable into **blocks** and then randomize the cases within each block to the treatment groups. This is called **blocking**.

Note

Some times researchers will suspect that variables, other than the treatment, will influence the result.

Definition

Researchers can first group individuals based on a suspected confounding variable into **blocks** and then randomize the cases within each block to the treatment groups. This is called **blocking**.

Example 6

If researchers are looking into the effect of a drug on heart attack patients, they might split all the patients into high-risk and low-risk blocks. Then half of each block is assigned to the treatment group and half to the control group.

Example 7

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42

Example 7

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42

Split into blocks

Low-risk patients

1	2	3	5	7	11	12
13	14	15	16	17	18	20
24	25	26	27	31	34	36
39	41	42				

High-risk patients

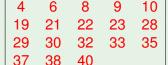| 4	6	8	9	10
19	21	22	23	28
29	30	32	33	35
37	38	40		

Example 7

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42

Split into blocks

Low-risk patients

1	2	3	5	7	11	12
13	14	15	16	17	18	20
24	25	26	27	31	34	36
39	41	42				

High-risk patients

4	6	8	9	10
19	21	22	23	28
29	30	32	33	35
37	38	40		

↓ Randomly split each block in half ↓

Control group

| 2 | 5 | 7 | 12 | 13 | 17 |
| 18 | 20 | 25 | 36 | 39 | 42 |

| 4 | 6 | 19 | 28 | 30 | 32 |
| 35 | 38 | 40 | | | |

Treatment group

| 1 | 3 | 11 | 14 | 15 | 16 |
| 24 | 26 | 27 | 31 | 34 | 41 |

| 8 | 9 | 10 | 21 | 22 | 23 |
| 29 | 33 | 37 | | | |

Experimental Design

A good experiment is built on four principles.

Controlling	Researchers do their best to control for differences in the treatment and control groups.
Randomization	Sampling and assignment into treatment and/or control groups are done randomly.
Replication	A sufficiently large sample is used.
Blocking	Researchers suspect that variables other than the treatment may influence the response.

Experimental Design

A good experiment is built on four principles.

Controlling	Researchers do their best to control for differences in the treatment and control groups.
Randomization	Sampling and assignment into treatment and/or control groups are done randomly.
Replication	A sufficiently large sample is used.
Blocking	Researchers suspect that variables other than the treatment may influence the response.

Note

While blocking is a slightly more advanced topic, the statistical methods we discuss in this course can be extended to analyze such experiments.

Note

Ethics in human experimentation is a very complicated topic, and there are multiple viewpoints on the use of placebos.

Note

Ethics in human experimentation is a very complicated topic, and there are multiple viewpoints on the use of placebos.

Example 8

Suppose researchers want to test the effectiveness of a new treatment for cervical cancer. They decided to use a control group that receives no treatment.

Is this ethical?

Note

Ethics in human experimentation is a very complicated topic, and there are multiple viewpoints on the use of placebos.

Example 8

Suppose researchers want to test the effectiveness of a new treatment for cervical cancer. They decided to use a control group that receives no treatment.

Is this ethical?

No, there are existing, effective treatments for cervical cancer. It is unethical to withhold all treatment from a patient.

Note

Ethics in human experimentation is a very complicated topic, and there are multiple viewpoints on the use of placebos.

Example 8

Suppose researchers want to test the effectiveness of a new treatment for cervical cancer. They decided to use a control group that receives no treatment.

Is this ethical?

No, there are existing, effective treatments for cervical cancer. It is unethical to withhold all treatment from a patient.

Note

If there is no known effective treatment, then having a control group that receives no treatment may be ethical.

Example 9

If researchers want to study the effectiveness of a new surgical procedure, they may need to perform a sham surgery on the control group patients.

Example 9

If researchers want to study the effectiveness of a new surgical procedure, they may need to perform a sham surgery on the control group patients.

Is it ethical to use a sham surgery?

Example 9

If researchers want to study the effectiveness of a new surgical procedure, they may need to perform a sham surgery on the control group patients.

Is it ethical to use a sham surgery?

It's complicated. Surgery always carries the risk of infection and complication. But at the same time, you don't want to promote a new, costly surgery if it doesn't have proven benefit for the patient.

Example 9

If researchers want to study the effectiveness of a new surgical procedure, they may need to perform a sham surgery on the control group patients.

Is it ethical to use a sham surgery?

It's complicated. Surgery always carries the risk of infection and complication. But at the same time, you don't want to promote a new, costly surgery if it doesn't have proven benefit for the patient.

Note

In practice, research groups are responsible to review boards which must weigh the ethical concerns of an experiment before any patients are treated.