Correlation vs Cause-effect

Definitions

Correlation (co-relation) = a relationship or association between two variables

Cause-effect = one thing causes a reaction in another thing

What is correlation?

Research studies often look to see if there is a relationship between one action and another. There are three types of correlation: positive, negative and no correlation.

Positive correlation

As the value of one variable increases, the value of the other **also** increases. Figure 1 below shows that project completion is faster when more staff work on the project.

Example: Five ways to describe a positive correlation (health)

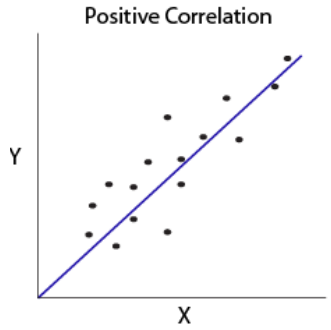

Fig. 1. Positive correlation

1. Higher education levels positively correlate with health status (see Fig. 1).
2. The higher the education level, the more positive the health outcomes (see Fig. 1).
3. As Figure 1 indicates, there is a strong positive correlation between education level and health status.
4. Lower education levels positively correlate with poor health, as Figure 1 clearly shows.
5. The lower the education level, the poorer the health (see Fig. 1).

Negative correlation

As the value of one variable **increases**, the value of the other **decreases.**

Example: Four ways to describe a negative correlation (health)

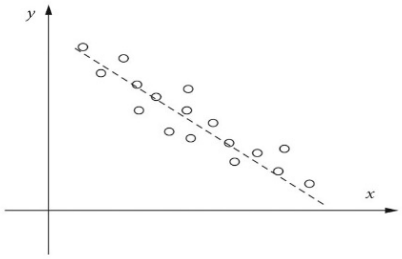

Fig. 2. Negative correlation

1. Figure 2 indicates a strong negative relationship/correlation between age and maximum heart rate.
2. The older the person, the lower their heart rate (see Fig. 2).
3. Figure 2 clearly shows that there is a negative correlation between age and maximum heart rate.
4. Age negatively correlates with heart rate, as Figure 2 illustrates.

No correlation

There is a possibility that we will *assume* a relationship between two variables based on previous observations. For example, some singers with relatively high BMI *appear* to be able to sing very loudly. We might think that a test could show a relationship between these two variables. After the test, we find however, that there is no clear relationship.

Example: Four ways to describe no correlation between weight and singing volume

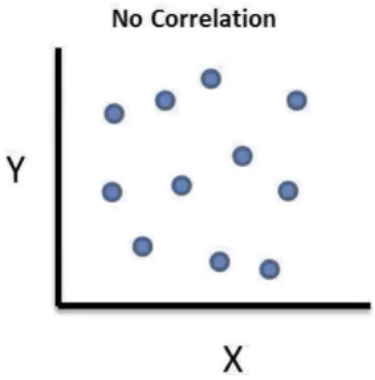

Fig. 3. No correlation

1. Figure 3 indicates that there is no correlation between a person's weight and the volume at which they can sing.
2. There is no association between weight and the volume at which a person can sing (see Fig. 2).
3. Figure 3 clearly shows no correlation between weight and singing volume.
4. As Figure 3 illustrates, no correlation can be found between weight and singing volume

False correlation

"There is a positive correlation between rainfall figures and petrol prices." Really?

Just because two variables increase in the same direction does not mean they have any possible relationship. For example, in 2022 the price of petrol increased at the same time as monthly rainfall figures. The two variables, however, have absolutely no logical connection. A false correlation has therefore been made between petrol pricing and rainfall figures.

What about cause-effect?

Some correlations can **also** be described as having a cause-effect relationship. For example, hot weather causes us to feel hot, that is, the hotter the temperature the hotter we feel.

Other correlations, however, cannot be proved to show cause and effect. For example, can we say that old age **causes** a lower heart rate? There may be other medical reasons that impact on heart rate *at any age*. Can we say that high levels of education **cause** good health? Other factors are more closely related, such as regular exercise *and* good food *and* no smoking *and many other factors.*

Can we say that more projects are completed more quickly **because** more staff are working on them? This is possible, but it **also** depends on effective management *and* teamwork *and many other factors.*

How do scientists prove a cause-effect relationship? They do this through blind control studies. For example, to prove that a drug has a specific effect on people, a study is performed where one group of participants is given the drug and another group with the same condition as the other group is given a placebo (e.g., a tablet with no active ingredients). Participants are 'blind' in that they do not know if they have received the drug or the placebo. Cause and effect is proved if the participants who took the drug had similar effects *that were not seen* in the participants who took the placebo.

Additional resources

- Australian Bureau of Statistics (ABS). (nd). Correlation and causation. *Statistical Language.* https://www.abs.gov.au/websitedbs/D3310114.nsf/home/statistical+language+-+correlation+and+causation, retrieved 7 September 2021.

Related help sheets

- Reading & writing critically