7 SIGNIFICANCE TESTS

7.01 Hypotheses

Today is going to be a very labor-intensive day because I have to shoot *all* the videos for this final module. But although today will be a heavy day, tomorrow I will pack my bags and leave on a 10 days scuba-diving holiday! Wiehaa! Well, let's be a bit more cautious. I'm not *completely* sure that I will leave tomorrow. My flight might be delayed. I might oversleep and miss the flight. Or I might get sick as a result of which I won't be able to dive. In other words, I expect to leave tomorrow, but I am not completely sure yet. It is likely, but not one hundred percent certain.

When researchers have expectations about the parameters they are interested in, we talk about **statistical hypotheses**. This video is about such hypotheses – they form the main ingredients of the method of **significance testing**. So, a statistical hypothesis is nothing more than an expectation about a population. Usually a hypothesis is formulated as a claim that a population parameter takes a particular value or falls within a specific range of values. Such a claim is based on previous studies and theory. On the basis of information from a sample we assess if a hypothesis makes sense or not. This is what we call a significance test. It's just a method for using sample data to test hypotheses that are formulated in advance.

The significance test is, just like the confidence interval, a method of **inferential statistics**. We use, after all, sample data to draw inferences about population parameters. In this module we'll look at **null-hypothesis testing**, where each significance test is based on two hypotheses: the **null hypothesis** and the **alternative hypothesis**. The null hypothesis is symbolized by 'H-zero' and the alternative hypothesis by 'H-a'. The null hypothesis claims that the parameter you're interested in takes a specific value. It usually represents the situation when there is no relation between variables or no difference between groups. It is the hypothesis that will be rejected if the data in your sample suggest that it is a highly unlikely expectation. The alternative hypothesis claims that the parameter you're interested in falls within an alternative range of values. The null hypothesis and the alternative hypothesis are always mutually exclusive.

If you do a significance test, you assume that the null hypothesis is true unless your data provide strong evidence against it. Think about a courtroom trial. The point of departure is that the accused is innocent. The prosecutor tries to convince the jury or the judge that the accused is guilty. The burden of proof to convince jury or judge is on the prosecutor. The defendant is found guilty only if the prosecutor comes with strong evidence against the defendant's presumed innocence. This is exactly what happens in a significance test. The point of departure that the accused is innocent is analogous to the null hypothesis. And the expectation that the defendant is guilty is the equivalent of the alternative hypothesis.

Let me give you an example. In the actual research practice, your expectation about the parameter you're interested in forms your alternative hypothesis. The null hypothesis then is the opposite. But it has to be a single value, not a range of values. You assume that the null hypothesis is true unless your data provide strong evidence against it. Suppose you have good reasons to believe that less than 3 percent of all Americans have scuba-diving experience. What are your null and alternative hypothesis? Well, your expectation is the alternative hypothesis. We write that as follows: 'H-a' colon, Pi is smaller than 0.03. Your null hypothesis is the opposite, but it has to be expressed as a single value. That means that 'H-zero' is: Pi is equal to 0.03. Or suppose you are interested in the maximum depth a scuba diver has ever reached. You have good reasons to expect that the mean maximum depth American divers have ever reached is *not* 25 meters. Your alternative hypothesis now is Mu does not equal 25. The null hypothesis thus is: Mu equals 25.

That's it. Pretty easy, right? Well… sometimes it seems more easy than it actually is. Always remember this: While doing a significance test you always assume that the null hypothesis is true. If you find enough support for your alternative hypothesis you reject the null hypothesis and if you don't find enough proof you don't reject it. But failing to reject your null hypothesis *doesn't* mean that the null hypothesis is true! Compare it, once more, to the courtroom trial. During a trial it is assumed that the defendant is innocent. If there is enough proof that he or she is guilty, there will be a conviction. However, if there is not enough proof, the defendant will not be convicted. But that doesn't mean that you can conclude that he or she is innocent!