# Hypothesis testing



A **hypothesis** is a statement or conjecture whose truth has yet to be proven or disproven. Examples of hypotheses:

- More than half the population is satisfied with EU membership
- Drinking fizzy drinks causes tooth decay
- The age at marriage has increased over the past 20 years.

**Null hypothesis**

The statement being tested in a test of significance is called the **null hypothesis**. The test of significance is designed to assess the strength of the evidence against the null hypothesis. Usually the null hypothesis is a statement of 'no effect' or 'no difference.'

We abbreviate 'null hypothesis' as $H_0$.

However, in statistics, it is essential that our attitude is one of skepticism. Until we are convinced otherwise, we accept $H_0$. In other words, we cling to the idea that there is no change, no improvement, no deterioration, no effect.

In a courtroom, the null hypothesis is that the defendant did *not* commit a crime.

A verdict of guilty means we reject the null hypothesis, that is to say, the defendant committed a crime.

However, a verdict of not guilty does not mean the defendant did not commit a crime, but simply that the case has not been proven.

Applying this logic to hypothesis testing, we either reject $H_0$ or fail to reject $H_0$.

The reasoning behind hypothesis testing is that we usually prefer to think about getting things right rather than getting them wrong.

In testing a hypothesis, data may be given or collected.

**Procedure for carrying out a hypothesis test**

The procedure for carrying out a hypothesis test will involve the following steps:

1. Write down $H_0$, the null hypothesis, and $H_A$, the alternative hypothesis.
2. Write down or calculate the sample proportion, $\hat{p}$.
3. Find the 95% margin of error.
4. Write down the 95% confidence interval for $p$, using

   $$\hat{p} - 1{\cdot}96\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \leq p \leq \hat{p} + 1{\cdot}96\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}.$$

   In addition, we can illustrate the confidence interval with a diagram.
5. **(i)** If the value of the population proportion stated is within the confidence interval, we fail to reject $H_0$.

   **(ii)** If the value of the population proportion is outside the confidence interval, reject the null hypothesis, $H_0$.
6. State your conclusion in words.