

### ***Before You Watch***

In this topic you'll be introduced to some of the basic concepts of statistics, in particular random variables, variation and sampling. It doesn't build on ideas discussed in any of the previous videos, so feel free to watch this one straight away.

### ***The Video Content***

This video discusses the concepts of random variables, variation and sampling.

They say a statistician is someone who can have their head in the oven and their feet in ice and on average they are comfortable. However, the key to statistics is not simply to consider averages but to understand variation. We better understand variation by sampling.

Variation is all about us:

- Consider the bottles of 600mL soft drink you buy. The variation may be small but some will be a little fuller than others.
- Consider the lifetimes of a particular brand of lithium battery, or a light globe, or the composition and taste of two pizzas of the same type, bought from the same location. Or even the pull-off force of connector rods in an engine... in each scenario the items are constructed the same way from the same set of ingredients; however, the end result varies.

The amount of variation is important to quantify and minimise.

Whether it is volume in a bottle, battery lifetimes or connector rod strength, the amount or size of each of these measures will vary depending upon which bottle, battery or connector rod we happen to observe.

Consider testing 3 batteries to exhaustion to measure their lifetimes. With a precise enough measuring instrument, we will always identify varying times to battery failure.

Since the lifetimes (measured in hours, for example) exhibit variability, we consider 'battery lifetime' (which is our measure of interest) to be a *random variable*.

Using notation, the random variable, denoted by  $X$ , may be considered as assuming values according to the following model:

$$X = \mu + E$$

where  $\mu$  is a constant and  $E$  is a random disturbance.

So, what does this mean?

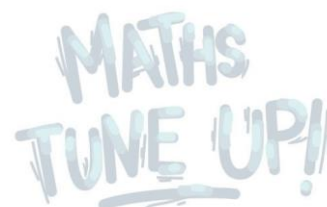
The constant, as the name suggests, remains the same with every measurement. However, small changes in the manufacturing process, the environment, test equipment and so on result in varying values for  $E$  and hence varying values for  $X$ , which is the real capacity of the battery.

As we consider more and more batteries we build up a picture of how the variable is distributed. We see how there is variability in  $X$ . We often need to describe, quantify and ultimately reduce variability.

However, we know that we cannot test all batteries to exhaustion or there would be none to sell. We wish to have an understanding of the variable (lifetime) including the size of variation without testing all items. This is where sampling comes into use.

Sampling is the process of taking a subset of items from a larger group (referred to as a population) in order to infer characteristics about that population.

There are many aspects of sampling that need to be considered... but as this is just a brief introduction to statistics, more about sampling is a topic for another day!



## *Now What?*

Now you should be familiar with the fundamental ideas involved in statistics. You can continue to develop your knowledge of statistics through the Other Links below. Alternatively, take a look at some of the other videos available, such as [Introduction to Algebra](#) or [Introduction to Calculus](#).

## *But When Am I Going To Use This?*

Statistics is essential in the study of systems of situations where there is an unpredictable random element. This includes a huge number of situations, such as any system that involves living things, which always have a degree of unpredictability. In fact, any studies that involve people involve statistics: for example, medical processes, education and economics. Other areas statistics can be applied to include quality control, stars, nature, or how wear and tear affects machinery.

## *Other Links*

**Maths is Fun** provides an index of a range of topics covering probability and statistics. Select the 'Probability and Statistics Index' at the top of the page, then choose the area you wish to explore.

- <http://www.mathsisfun.com/data/index.html>

The **Khan Academy** has a comprehensive set of video tutorials covering a large range of mathematical and other concepts, as well as questions to test your knowledge. This content provides a good explanation of how probability and statistics are linked, and allows you to investigate more complex statistical concepts.

- <https://www.khanacademy.org/math/probability>

