UNIVERSITY OF LONDON

Probability and Statistics: To p, or not to p?

Module Leader: Dr James Abdey

1.4 Simplicity vs. complexity – the need for models

Is the real world:

(a) nice, simple and easy?

(b) big, horrible and complicated?

Answer (b)!

Although we care about the real world, seek to understand it and make decisions in reality, we have an inherent dislike of complexity. Indeed, in the social sciences the real world is a highly complex web of interdependencies between countless variables.

For example, in economics, what determines the economic performance of a country? From national income accounting in Economics 101 you might say consumption, investment, government spending and net exports, but what affects, say, consumption? Consumer confidence? Perhaps, but what drives consumer confidence? Consumers' incomes? Consumers' inflationary expectations? Fears of job insecurity? Perceived level of economic competency of the government. The weather? Etc.

So in order to make any sense of the real world, we will inevitably have to simplify reality. Our tool for achieving this is a **model**.

A model is a deliberate simplification of reality. A good model retains the most important features of reality and ignores less important details.

Immediately we see that we face a **trade-off** (an *opportunity cost* in Economics 101). The benefit of a model is that we simplify the complex real world. The cost of a model is that the consequence of this simplification of reality is a departure from reality. Broadly speaking, we would be happy if the benefit exceeded the cost, i.e. if the simplicity made it easier for us to understand and analyse the real world while incurring only a minimal departure from reality.

The London Underground map

The world-famous London Underground map is an excellent example of a model for getting from point A to point B. The map contains the most important pieces of information for reaching your intended destination:

- **distinct names and colours for each line**
- **the order of stations on each line**
- **the interchange stations between lines**

while less important details are ignored, such as:

- **the depth of each tunnel**
- **the exact distance between stations**
- **the non-linear nature of the tunnels under the ground**.

Of course, an engineer would likely need to know these 'less important details', but for a tourist visiting London such information is superfluous and the map is very much fit-for-purpose.

However, we said above that a model is a departure from reality, hence some caution should always be exercised when using a model. Blind belief in a model might be misleading. For example, the map above fails to accurately represent the precise geographic location of stations.

If we look at the geographically-accurate map we see the first map can be very misleading in terms of the true distance between stations – for example, the quickest route from Edgware Road to Marble Arch is to walk! Also, even line names can be a model – the Circle line (in yellow) is clearly not a true circle! Does it matter? Well, the Circle line forms a loop and it is an easy name to remember, so arguably here the simplification of the name outweighs the slight departure in reality from a true circle!

Our key takeaway is that models inevitably involve trade-offs. As we further simplify reality (a benefit), we further depart from reality (a cost). In order to determine whether or not a model is 'good', we must decide whether the benefit justifies the cost. **Resolving this benefit–cost trade-off is subjective** – further adding to life's complexities.