

1.1 Welcome to our complex world

What do we mean when we say something is complex? According to the Oxford dictionary, something that is complex “consists of many different and connected parts” and thus is “not easy to analyze or understand”.

Many situations and problems we face in the world today are complex: they are made up of many different and connected parts, and they are difficult to analyze or understand. Complex behavior that arises through the interaction of multiple variables over time has been called “natural” or “dynamic complexity”. These situations are often characterized by a lack of information and an incomplete understanding about how reality works. Situations of “dynamic complexity” are ones of constant change, where outcomes are difficult, if not impossible to predict.

We have all seen situations where something is increasing, decreasing, slowing after a period of strong growth or fluctuating and you are not too sure why. Maybe it’s the level of unemployment, or the crime rate in your city or the use of antibiotics. Or perhaps some actions have been taken to improve a situation or solve a problem but they have had no effect or, worse still they have had unintended consequences that have made things worse.

These are all manifestations of complexity as they are the result of a number of different, connected parts interacting over time. These six scenarios are the types of situations that we are going to learn to better understand in our class.

Complex situations arise through the interaction of a group or a system of variables. In our class we will use the word “variable” to refer to the parts or elements of a situation whose values can vary, increasing or decreasing over time. Variables can be tangible objects such as people, salaries and buildings and also intangible things such as worker morale, customer satisfaction, love or hate. A “system” is simply a group of interconnected variables.

As a task or situation includes more and more diverse and interconnected elements, it becomes more complex. As a general rule, the level of complexity in any situation, or problem or task increases as the number of interacting elements, the variety of the elements and as the strength of the interconnectedness between the elements increase.

Today some of the major and most urgent problems we face such as homelessness, drug addiction, poverty, disease, income inequalities, terrorism, decaying infrastructure and environmental threats involve so many interrelated and heterogeneous parts that they have been called “messes”, “swamps” or “wicked” problems.

While complex behavior does essentially arise through interactions, it is the nature of the variables and the relationships between them that makes these situations difficult to analyze or understand.

Let’s illustrate with a simple example. Imagine that you start a new company that sells an amazing, shiny new product. You engage in promotional activities to make your product known and generate sales. Proceeds from sales provide funds that you can invest in additional marketing and promotion which leads to new sales. Over time your sales grow. Four variables are necessary to explain this growth. Can you see how they form a loop? The sales you made yesterday, are fed back into the loop and will influence the sales we make today by financing new promotional activities. This is called feedback and here it is driving our growth in sales. The adaptation that feedback provokes makes things complex. We’ll look more closely at feedback in Chapter 2.

It may take time for potential customers to learn of your product offering and make their purchase decision. There are sometimes delays in the relationships between variables. We discuss delays at the start of our next chapter.

Of course, your competitors will begin to worry as your market share grows. When your market share reaches say 10%, they may develop a competing product or a more competitive product offer. It is not just your market share that gets them worried, but rather your level of market share. As their reactions differ depending on your level of market share, the relationship between these variables cannot be described by a simple, straight line. This relationship, just like many others in the world around us is non-linear. Levels and non-linear relationships make it sometimes difficult to link causes to effects, or effects to causes which also adds to the complexity and the unpredictability of the situation. We will see how some variables accumulate and how levels influence the relationships between variables in Chapter 3.

After a period of rapid growth, sales slow as competitive pressures are felt. Your activity looks a little like this chart that we saw a few minutes ago.

We can learn three things from this story:

1. The rapid growth and then slowdown in sales can be explained by six variables in interaction;
2. Interactions between variables, feedback loops, delays, levels and nonlinearities all contribute to creating the observed behavior over time;
3. Drawing the interaction of variables helps us see these interactions at work and better understand them.

We will learn more about the power of feedback, delays, levels and nonlinearities in the following chapters and we will learn different techniques to model complex situations.