Why study probability? If you're watching this clip, it is probably because you have already registered for this class and therefore are already somewhat convinced that the subject is useful. Nevertheless, let me add some more perspective. Until quite recently, scientific literacy meant calculus, some physics, and some chemistry. With the more recent addition of familiarity with computers and computation, this was all you needed to know in order to make sense of the world.

But these days, there's not much you can understand about what is going on around you if you do not understand the uncertainty attached to pretty much every phenomenon. In fact, I predict that for most of you in your careers, you're more likely to have to deal with uncertainty, for example, analyzing noisy data, rather than having to calculate integrals. Probability is now a central component of scientific literacy.

What is it that has changed and caused this shift? I can think of two main factors. As science and engineering move forward, we end up dealing with more and more complex systems. And in a complex system, we cannot expect to have a perfect model of each component or to know the exact state of every piece of the system. So uncertainty is now at the foreground and needs to be modeled.

The second factor is that we live in an information society. Data and information play an increasingly central role, both in our individual lives and in the economy as a whole. Now, data and information are only useful because they can tell us something we did not know. Their reason for existence is to reduce uncertainty. But if your goal is to reduce uncertainty, to fight it, you'd better understand its nature. You'd better have the tools to describe it and analyze it.

And this is why probability theory and its children-- statistics and inference-- is a must. If these arguments sound a bit too abstract, just think of any scientific field, and you quickly realize that maybe, other than the motion of the planets, everything else involves uncertainty and calls for probabilistic models. Think of physics.

Quantum mechanics has taught us that nature is inherently uncertain. Think of biological evolution. It progresses through the accumulation of many random effects, like mutations, within an uncertain environment. Think also of the haystack of biological data that we are accumulating and that needs to be sifted using statistical tools in order to make progress in the biomedical sciences.

Think of communications and signal processing. These fields are almost by definition a fight against noise, an effort to clean signals from the noise that nature has added. Think of management. Customer demand is random, and you want to be able to model it and predict it. Think of finance. Markets are uncertain, and whoever has the best methods to analyze financial data has an advantage.

Think of transportation systems. Random disruptions due to weather or accidents are a major concern. Think of trends in social networks, which spread like epidemics but in ways that are hard to predict.

I could go on and on, giving you many more examples. But the message is hopefully clear. Most phenomena of interest involve significant randomness. And the only reason we collect and manipulate data is because we want to fight this randomness as much as we can. And the first step in fighting an enemy like randomness is to study and understand your enemy.