

# All Models Are Wrong

JUNE 21, 2017

GEORGE BOX & JORGE BORGES

## All models are wrong.

Yep. It's the truth. However, there is another part to that statement:

## All models are wrong, some are useful.

Those words come from the British statistician, George Box. In a groundbreaking 1976 paper, Box revealed the fallacy of our desire to categorize and organize the world. We create models (a term with many applications), once to confuse them for reality.

Box also stated: *Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful.*

## What Exactly Is A Model?

First, we should understand precisely what a model is. The dictionary definition states a model is 'a representation, generally in miniature, to show the construction or appearance of something' or 'a simplified description, especially a mathematical one, of a system or process, to assist calculations and predictions.' For our purposes here, we are better served by the second definition. A model is a simplification, which fosters understanding.

Think of an architectural model. These are typically a small scale model of a building, made before it's built. Its purpose is to show what the building will look like and to help people working on the project to develop a clear picture of the overall feel. In the iconic scene from *Zoolander*, Derek (played by Ben Stiller) looks at the architectural model of his proposed 'school for kids who can't read good' and shouts "What is this? A center for ants??" That scene illustrates the wrong way to understand models: Too literally.

## Why We Use Models- And Why They Work

"Scientists generally agree that no theory is 100 percent correct. Thus, the real test of knowledge is not truth, but utility. Science gives us power. The more useful that power, the better the science."

— Yuval Noah Harari

Time-tested models allow us to understand how things work in the real world. And understanding how things work prepares us to make better decisions without expending too much mental energy in the process.

Instead of relying on fickle and specialized facts, we can learn versatile concepts. No single model is universally applicable – we find exceptions for nearly everything. Even hardcore physics has not been totally solved.

"The basic trouble, you see, is that people think that "right" and "wrong" are absolute; that everything that isn't perfectly and completely right is totally and equally wrong."

— Isaac Asimov

Take a look at almost any comment section on the internet and you are guaranteed to find at least one pedant raging about a minor perceived inaccuracy, throwing out the good with the bad. While ignorance and misinformation are certainly not laudable, neither is an obsession with perfection.

Like heuristics<sup>1</sup>, models work as a consequence of the fact they are usually helpful in most situations, not because they are always helpful in a small number of situations.

Models can assist us in making predictions and forecasting the future. Forecasts are never guaranteed, yet they provide us with a degree of preparedness and comprehension of the future. For example, a weather forecast which claims it will rain today may get that wrong. Still, it's correct often enough to enable us to plan appropriately and bring an umbrella.

Sure, all of them can be improved. But the only way that can happen is if we try them out, educate ourselves and collectively refine them.

*"The world doesn't have the luxury of waiting for complete answers before it takes action."*

— Daniel Gilbert

Your kitchen knives are not as sharp as they could be. Does that matter as long as they still cut vegetables? Your bed is not as comfortable as it could be. Does that matter if you can still get a good night's sleep in it? Your internet is not as fast as it could be. Does that matter as long as you can load this article? Arguably not. Our world runs on the functional, not the perfect. This is what a model is – a functional tool. A tool which maybe could be a bit sharper or easier to use, but still does the job.

The statistician **David Hand** made the following statement in 2014:

*In general, when building statistical models, we must not forget that the aim is to understand something about the real world. Or predict, choose an action, make a decision, summarize evidence, and so on, but always about the real world, not an abstract mathematical world: our models are not the reality.*

For example, in 1960, Georg Rasch said the following:

*When you construct a model you leave out all the details which you, with the knowledge at your disposal, consider inessential... Models should not be true, but it is important that they are applicable, and whether they are applicable for any given purpose must, of course, be investigated. This also means that a model is never accepted finally, only on trial.*

### **Imagine a world where physics like precision is prized over usefulness**

We would lack medical care because a medicine or procedure can never be perfect. In a world like this, we would possess little scientific knowledge, because research can never be 100% accurate. We would have no art because a work can never be completed. We would have no technology because there are always little flaws which can be ironed out.

*"A model is a simplification or approximation of reality and hence will not reflect all of reality ... While a model can never be "truth," a model might be ranked from very useful, to useful, to somewhat useful to, finally, essentially useless."*

— Ken Burnham and David Anderson

In short, we would have nothing. Everything around us is imperfect and uncertain. Some things are more imperfect than others, but issues are always there. Over time, incremental improvements happen through unending experimentation and research.

---

<sup>1</sup> Any approach to problem solving, learning, or discovery that employs a practical method not guaranteed to be optimal or perfect, but sufficient for the immediate goals.

### **The Map is Not the Territory**

As we know, the map is not the territory. A map can be seen as a symbol or index of a place, not an icon. When we look at a map of Paris, we know it is a representation of the actual city. There are bound to be flaws; streets which have been renamed, demolished buildings, perhaps a new Metro line. Even so, the map will help us find our way. It is far more useful to have a map showing the way from Notre Dame to Gare du Nord (a tool) than to know how many meters they are apart (a piece of trivia.)

Someone who has spent a lot of time studying a map will be able to use it with greater ease, just like a mental model. Someone who lives in Paris will find the map easier to understand than a tourist, just as someone who uses a mental model in their day to day life will apply it better than a novice. As long as there are no major errors, we can consider the map useful, even if it is by no means a reflection of reality.

Physical maps generally become more accurate as time passes. Not long ago, they often included countries which didn't exist, omitted some which did, portrayed the world as flat or fudged distances. Nowadays, our maps have come a long way.

The same goes for mental models – they are always evolving, being revised – never really achieving perfection. Certainly, over time, the best models are revised only slightly, but we must never consider our knowledge “set”.

### **Another factor to consider in using models is to take into account what they're used for**

Many models are based upon scientific and mathematical concepts. A person who works in those areas will obviously need a deeper understanding of it than someone who want to learn to think better when making investment decisions. They will need a different map and a more detailed one showing elements which the rest of us have no need for.

### **How Do We Know If A Model Is Useful?**

When looking at any model, it is helpful to ask some of the following questions:

- **How long has this model been around?** As a general rule, models which have been around for a long time will have been subjected to a great deal of scrutiny. Time is an excellent curator, trimming away inefficient ideas. A model, which is new, may not be particularly refined or versatile. Many of our models originate from Ancient Greece and Rome, meaning they have to be functional to have survived this long.
- **Is it a representation of reality?** In other words, does it reflect the real world? Or is it based on abstractions?
- **Does this model apply to multiple areas?** The more elastic a model is, the more valuable it is to learn about. (Of course, be careful not to apply the model where it doesn't belong).
- **How did this model originate?** Many mental models arise from scientific or mathematical concepts. The more fundamental the domain, the more likely the model is to be true and lasting.

When using any model, we must avoid becoming too rigid. There are exceptions to all of them, and situations in which they are not applicable. It pays to have many of them in your toolbox. If you only have one or two, you're likely to attempt to use them in places that don't make sense. If you've absorbed them only lightly, you will not be able to use them when the time is at hand.

If on the other hand, you have a toolbox full of them and they're sunk in deep, you're more likely to pull out the best ones for the job exactly when they are needed.

Too many people are caught up wasting time on physics-like precision in areas of practical life that do not have such precision available. A better approach is to ask “Is it useful?” and, if yes, “To what extent?”

Models are a way of thinking about the world that prepares us to make good decisions in the first place.

Box, George. "All Models Are Wrong." Farnam Street. June 21, 2017. Accessed June 21, 2017. <https://www.farnamstreetblog.com/2017/06/all-models-are-wrong/>. Adapted for the use of Human Geographic study.