Calculation models, fact or fiction

Allan Tarp, consultant at the MATHeCADEMY.net, letter to the editor, April 2020.

Wars are too important to leave to generals, French Prime Minister Clemenceau said. Similarly, it can be said that calculation models are too important to leave to mathematicians.

Calculation models are used in many places, e.g. in epidemics. As quantitative narratives, calculation models are related to qualitative narratives. The former gives us a number-language to describe quantities, the latter gives us a word-language to describe qualities. And both languages have a language about the language, a grammar. The word-language is taught before its grammar, the number-language after its grammar with fatal consequences in the form of deficient learning and application.

Qualitative stories come in two forms, fact and fiction, reports and novels. Similarly, with quantitative calculation models. Two examples will show the difference.

When I save 2$ daily for 30 days, the calculation model y = k*x says that y = 2*30 = 60, i.e. I have saved 60$. Here, the calculation model is a fact model, since both figures are actual. A fact model can also be called a 'when-so model'. Fact models are used to predict what will happen in the future.

If I save 2$ on rainy days for 30 days, the calculation model will give different results depending on how many rainy days I assume there will be. Here, the calculation model is a fiction model, as it includes a fictional number based on an assumption. A fiction model can also be called an 'if-then model'. So, a fiction model cannot predict, but can set up different scenarios.

Fact models are used in science to predict e.g. full moon; as well as in economics to predict purchase expenses, debts at constant interest rates etc.

Fiction models are used when choice or chance is involved. Neither populations nor share prices may be predicted.

Human-to-human infection can be described with both fact and fiction models.

If 1 infected person infects 2 people the first week, each infecting 2 people the next week, 2*2*2 = 8 people will be infected in the third week. This type of growth is called an exponential doubling growth with a doubling factor or a basic reproduction number 2, which corresponds to a growth rate of 100%.

A typical basic reproduction number for Ebola and Sars is 2 and 4 respectively. But otherwise, it depends on how many are gathered and for how long, so halving of group size and meeting time will both halve the basic reproduction number.

The value 1 means the same number of newly infected each week; and the value 1/2 means a halving of the number of newly infected. And a zero value means that the infection has disappeared.

The infection pressure will decrease, but how and depending on what? Here, the fact model becomes a fiction model.

The standard model assumes that the doubling number decreases evenly with increasing levels of infection. The model must therefore use figures for the starting value and maximum size of the flock, as well as for the starting value of the basic reproduction number.

These three figures can be found when you have three measurements. Unfortunately, however, reliable numbers are difficult to obtain in infection measurements, making the standard model unreliable. And besides, it's the number of beds you want to calculate.

An alternative model could therefore be used, which assumes instead that the doubling figure will fall evenly over time. Such a model can be set up on a spreadsheet in five minutes or ten minutes at maximum.

The model includes two politically chosen numbers, a starting number for the doubling number, and an end time when the doubling number has fallen to zero, so the epidemic is over. For example, you can choose to start with the doubling number 4 and with an epidemic length of 10 double-weeks, assuming that you typically stay in bed two weeks.

This time-based epidemic model shows that the number of beds is growing from 1 to its maximum 1189 after 8 periods, and that throughout the epidemic period 4635 beds have been needed. Whether this is enough to ensure herd immunity, another model must decide.

The model also shows great sensitivity to changes in the politically chosen figures. If the doubling number changes by 1%, the two bed numbers will change by about 8%. Therefore, excessive changes must be avoided in the two factors that determine the doubling number, group size and meeting time.

Instead, you could start by halving both factors instead of complete shutting down. The measured bed numbers would then show whether further changes to one or both factors are needed. Or how long the epidemic will last with the chosen doubling number.

Against this background, it may be surprising if a state opts for zeroing instead of a percentage reduction. And if a state uses the experts' standard model and fails to use the alternative model itself. As was the case in Denmark in March 2020.

After all, both models are fiction models based on assumptions. The scientific principle of simplicity, known as Occam's razor, should then be used. And without credible infection numbers, the flock-based standard model is deficient. And inflexible, because you can't change how the doubling rate falls.

Conversely, the time-based model is based on credible bed numbers, and here the formula for the doubling number can be quickly changed.

So why rely blindly on an unreliable model?

Because the war against the virus is left to the generals. Or, more accurately, because mathematics has a monopoly on calculations.

And mathematics is controlled hard by the ‘set-matics’ of the universities, who demand that concepts be explained as examples of the more abstract set concept, and not by the concrete examples from which they were originally abstracted.

The core concept of the number-language is the calculation of which there are two kinds, fact calculations and fiction calculations. A fact calculations as '2+3 = ?' can be calculated immediately. A fiction calculations as '2+u = ?' cannot be calculated until the unknown number is known. Fiction calculations are therefore expressed in scenarios with tables that may be drawn as curves. Fiction calculations are also called functions.

One would expect the school to explain the function concept with examples: a function is, for example, the calculation 2+u, but not 2+3. But set-matics will do it differently.

It uses only top-down definitions: A function is an example of a subset in a set product where first-component identity implies second-component identity. Which just put into Latin the banality that one measurement can of course only produce one measurement result.

At the same time, it silences the term calculation model and speaks only of mathematical models, which are all of the same type. Consequently, it is considered pointless to distinguish between fact and fiction models.

Finally, it demands that a calculation’s sensitivity number be referred to as the differential quotient of a function.

However, modern society relies on science that again relies on formulas and fact models. There is therefore an external pressure for high school reforms: Models must to enter the mathematics classroom, both on a daily basis and for oral presentations, where formulas are, not proved, but applied to build models to be explained and defended against opponents.

This concurs with the Learning Framework 2030, in which OECD recommends individual learning paths.

Therefore, as in the North American Highschool, all secondary education should be integrated in one four-year high school supporting the self-identity work of teenagers with self-chosen academic and practical half-yearly blocks allowing the students to choose freely between acquiring quantitative competence through theory-based set-matics or reality-based calculation modelling.

Of course, a language must be learned before its grammar. This applies to both languages. And everyone has the right to both a word- and a number-language. And to know the difference between fact and fiction.

For more details, please see the compendium “Math Modelling and Models”, http://mathecademy.net/math-modeling-models/