Navigating uncertainty: Why we need decision theory during a pandemic

January 22 2021

Credit: Pixabay/CC0 Public Domain

During a pandemic, decisions have to be made under time pressure and amid scientific uncertainty, with potential disagreements among experts and models. With COVID-19, especially during the first wave, there was

uncertainty about the virus transmissibility, the disease severity, the future evolution of the pandemic and the effectiveness of the proposed policy interventions, such as wearing face masks or closing schools. Together with a group of epidemiologists and economists, including the Nobel Prize winner Lars Peter Hansen, Bocconi professors Massimo Marinacci, AXA-Bocconi Chair in Risk, and Valentina Bosetti investigated how modern decision theory can help policymakers navigate through the uncertainty that characterizes this pandemic and possible future ones.

More in detail, they interpret the problem of a policymaker taking policy decisions about the COVID emergency as happening in an environment characterized by three layers of uncertainty: uncertainty about models, across models, and within models. Uncertainty about models relates to the fact that models are, by design, simplifications of more complex phenomena, and hence are necessarily misspecified, at least to some extent. For instance, they might not include some variables that are instead important. Uncertainty across models encompasses both the proliferation of different models and the fact that the parameters of each single model are unknown. In the COVID-19 context, these parameters include the effective reproduction number (the now famous Rt index) and the disease latent period. Finally, uncertainty within models accounts for the fact that—apart from deterministic models, that however are often oversimplistic—even a fully specified model has uncertain outcomes. For example, when flipping coins or rolling dice, we have full knowledge of the probability model but still cannot anticipate the outcome, because the latter is random.

In front of this complexity, formal decision rules can be of great help. A formal decision problem consists of a set of actions, a set of consequences and a set of environment states, plus a function that associates a consequence to each action-state couple. In the case of COVID-19, the considered actions may be different durations of school

closures, while consequences include both the benefits of this kind of action (e.g. reducing infections, hospitalizations and deaths) and its costs (worse education for children, struggles for working parents, etc.) and also depend on the environment state (i.e. the pandemic and economic situation). A formal decision rule is then a function that associates the "best" action to the observed data.

"Various decision rules exist and picking the best one for a particular situation remains a non-trivial problem," says Professor Bosetti, "however this approach can help weed out bad solutions from the debate."

"Policymakers can check their decisions by asking whether they can be justified using a formal decision rule," explains Professor Marinacci. "Used this way, formal decision rules can help policymakers clarify the problem, test their intuition, and avoid reasoning mistakes that have been documented in psychological studies, like confirmation and optimism bias."

"In practical terms, ensuring that policy options are in line with formal decision rules could be achieved by including a decision analyst in the group of advisors. This would assist policymakers not only in accounting for all sources of uncertainty while taking decisions, but also in communicating this uncertainty transparently, either to the citizens, or to a potential investigating committee. Being open about the degree of uncertainty surrounding the scientific evidence used to guide policy choices is a valuable way of retaining public trust and avoiding that single self-described experts over-influence both citizens and policymakers."

More information: Loïc Berger et al, Rational policymaking during a pandemic, *Proceedings of the National Academy of Sciences* (2021). DOI: 10.1073/pnas.2012704118

Provided by Bocconi University