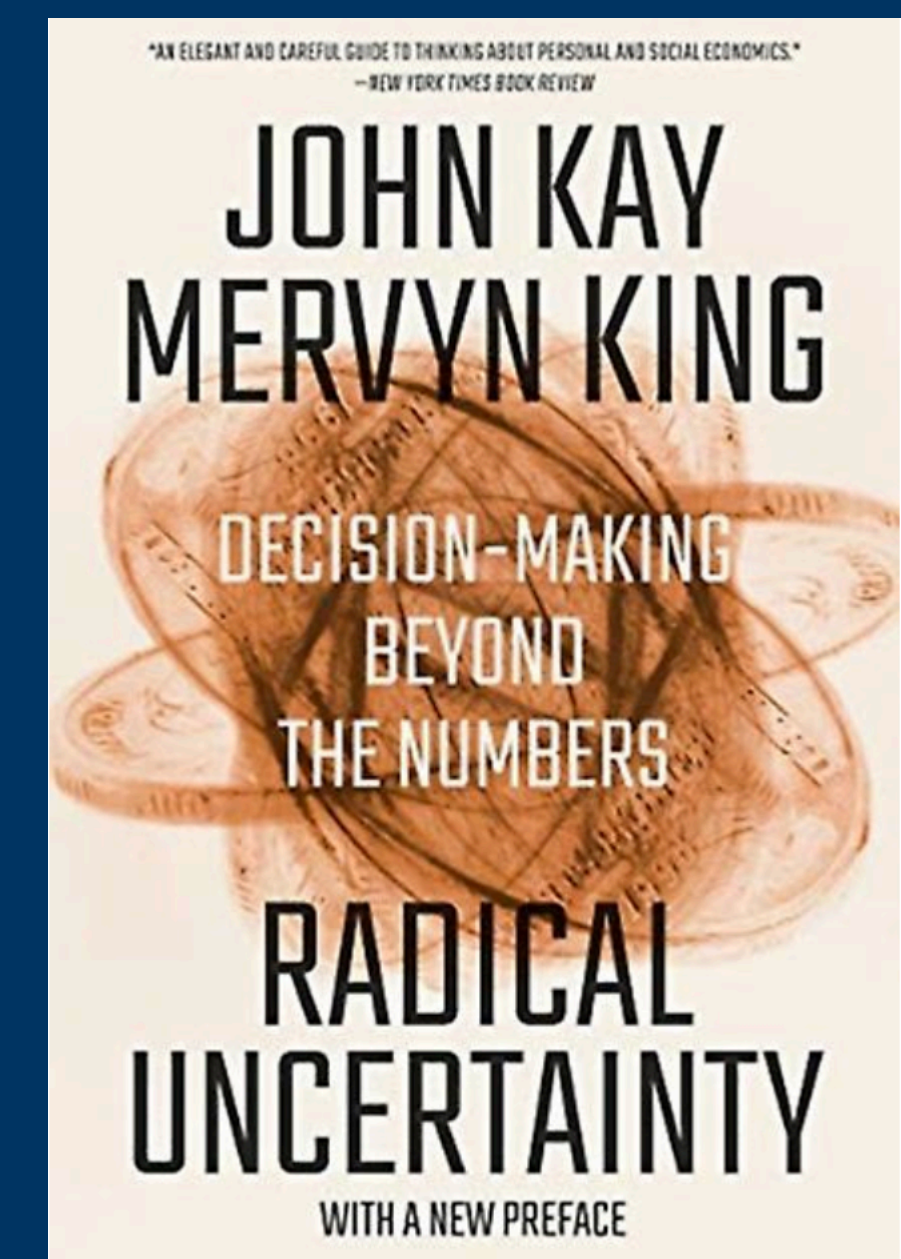


Radical Uncertainty in Decision Theory

Discussion starting from “Radical Uncertainty: Decision-Making Beyond the Numbers”

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What is radical uncertainty

- Events are divided in puzzles and mysteries
 - Puzzles are resolvable, typical of small worlds, probability can be successfully applied
 - Radical uncertainty is the uncertainty of mysteries, real world problems where probability is not enough or cannot be applied (cfr. Knight: *risk vs uncertainty*).
- Reflexivity is a key aspect of radical uncertainty: “belief influence behaviour”
 - Cfr Goodhard’s law “When a measure becomes a target, it ceases to be a good measure”
- Radical uncertainty can have many dimensions: ignorance, ambiguity, vagueness → another taxonomy

Models (small worlds) vs real world

- Decision theory is good in solving puzzles using models (small worlds)
- The results on models cannot be directly applied to real world
- “The claim of the modern science of decision theory is that most mysteries can be reduced to puzzles by the application of probabilistic reasoning. Such reasoning can provide solution to puzzles, but not to mysteries. How to think about and cope with mysteries is the essence of managing life in the real world”
- Decision theory is about puzzles not mysteries.
 - “there is no general theory of how best to make decisions”
 - “Creativity is inseparable from uncertainty. By nature, creativity cannot be formalized”

On the role of models

- Models are fiction, they build a separate world (such as Fortnite or Games of Thrones do)
- In small worlds, we use deduction and induction, **in real world we use abduction**
 - Abduction: finding the best explanation from the information that is known
 - “Listening to evidence, hearing pros and cons, inviting challenges to the prevailing narrative, and finally reaching a considered decision”
 - “**Models are small-world analogies which help us towards the key characteristics of larger worlds**”

Artificial Intelligence

- A similar dichotomy to small/real world, can be applied to artificial/natural intelligence
- **AI can be successfully applied to small worlds.** It is generally based on induction and deduction
- On the other hand, Human Intelligence works better in the real world and also uses abduction
 - “Human intelligence and artificial intelligence are different, and **the latter enhances rather than replaces the former**”
- AI can be successfully applied to small worlds, for instance in diagnosis

Computer and doctors

- “Computers and the algorithms they [doctors] use can effect large improvements in medical care.
- Billions of people seek treatment every year and the training base on which artificial intelligence can learn is huge. And as with the machine that plays chess or Go, **the progress of patients provides feedback on how well the program is performing**, although such feedback is never as rapid or as clear as in these games.
- A computer can maintain and search the entire corpus of medical knowledge better and more quickly than the most distinguished of medical academics. **The power of these methods will improve and speed up the process of diagnosis and may even displace the doctor in many well-defined ‘small world’ problems.”**

Artificial Intelligence

- This is opposite to Kahneman view, who sees in **AI the possibility to eliminate biases and noise at the basis of our decisions:**
 - “He looks forward to the day when artificial intelligence will eliminate our natural stupidity: *‘it’s very difficult to imagine that with sufficient data there will remain things that only humans can do’*.”
 - As a result he suggests that it would be a good idea to *‘replace humans by algorithms wherever possible’* (Kahneman, 2017)”
- “**Artificial intelligence** offers the prospect of ever faster ways to solve complex puzzles, but it **will not resolve mysteries**”

Decision Support Systems

- DSS must support the human decision, not substitute it
 - “The human brain is not a computer implementing an axiomatic decision-making process, and as a result is a better decision-maker in many complex situations”
 - “a small-world model value lies in framing a problem to provide insights into the large-world problem facing the policy-maker and not in the pretense that it can provide precise quantitative guidance.
 - You cannot derive probability or a forecast or a policy recommendation from a model; the probability is meaningful, the forecast accurate or the policy recommendation well founded only within the context of the model”

Decision Support Systems

- Hence, DSS must support the use of human abduction and use themselves induction and deduction in modeling the situation, for instance by means of ML algorithms or mathematical deductions.
- Can we use some form of abduction, even partial or weak, in ML/DSS?
 - Causal reasoning
 - Belief revision
 - Formal abduction

Trustworthiness and Explainability

- Support humans means tell them the truth. Trustworthiness is a more important quality than explainability
 - “Good judgment and good explanations are not the same”
- We are not always able to explain our decision, even if they will prove to be correct.
 - So why should AI be able?
 - If AI is not supposed to be autonomous in taking a decision, but it is somehow trustable, then a **human decision maker can take advice from explainable and not explainable AI.**
- Trustworthiness implies to not hide uncertainty.
 - **ML must be given the possibility to abstain** when taking a decision is too risky and/or not supported by enough evidence. This is akin to what rational humans should do in presence of ignorance:
 - “rational individuals governed by reason and logic avoid giving answers to such questions in real life if they do not know the answer”.

Narratives

- DSS must help to build a narrative. That is to answer: “What is going on here?”
 - This is the most important question a decision-maker must have in mind
 - She can gather different kinds of evidence, opinions with probabilities and then take a decision.
- BTW, this approach works better than the approach in which someone different from the decision-maker summarizes the different points of views and probabilities: again, do not hide uncertainty
 - “In the ordinary business of life, where we are constantly confronted with unique situations, we need a pluralism of approaches and models”
 - “Making decision about an uncertain future is often a group activity”

Narratives

- Some pointers
 - Collective intelligence, group decision making
 - Data Perspectivism
 - <https://www.epistemic-ai.eu/> (a model is substituted by a set of models)

Data and Narrative

- Data and narrative should be both taken into account.
- Data are not enough
 - “bare statistical evidence in the absence of a narrative is never enough”
 - “Statistical reasoning has its place but only when integrated into an overall narrative or best explanation. Radical uncertainty means that it is rarely possible to know the complete set of possible explanations”.
- A narrative should be trustable hence coherent and consistent.
- However, both data and narrative should be challenged, and a decision maker should be open to other narratives.

Big Data

- “..while data are essential, it is necessary to be careful in making inferences, and especially causal inferences, about the world based on data alone. The availability of now are called ‘big data’ – the very large databases permitted by the power of modern computers- increases these dangers”
- “Never rely on data without asking ‘what is the source of this information’”?

Computers don't

- “Computers don't do narratives. They don't do emotions, and yet we have learnt that lack of emotional depth makes it impossible or difficult to make decisions even on trivial matters in a large world. Computers don't do empathy, and we have learnt from studies of high-functioning autistics that people who lack insight into the feelings of others can do very well the sorts of things that computers, or Max Planck (who was not at all autistic), can do very well, but that they struggle with activities which are part of most people's everyday lives and the working lives of almost everyone who is successful in organisations”