Uncertainty and Risk Surrounding the Application of Social Models

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Abstract

Heather Douglas (2009) claims that when there are potential risks involved in the confirmation of a hypothesis, scientists should raise their evidential standards to ensure public safety. If Douglas is correct that scientists should consider the bad consequence associated with making erroneous claims, such that it requires scientists to raise their evidential standards in order to avoid causing negligent harm, then does it follow that scientists should likewise consider the potential benefits of accepting or rejecting a hypothesis? Suppose the hypothesis in question is in support of a social-good. In this case, should a scientist relax their evidential standards, since the acceptance of the hypothesis has positive consequences? This paper attempts to answer these questions in relation to the construction and application of mathematical models. I use Hong and Page's 'diversity trumps ability' model as a key example where academics have dropped their epistemic standards because the model's stated results support a social-good.

Introduction

In relation to Heather Douglas's work on inductive risk, I use Hong and Page's 'diversity trumps ability' result as a key example where academics have dropped their epistemic standards because the model's stated results support a social-good. As I argue, this has a consequence. The model also has an unstated result that "highest ability problem solvers cannot be diverse" (Hong and Page, 2004, 16389). This result can be utilized to support a socially pernicious notion that groups of best experts must not be diverse. I will argue that in dropping our epistemic standards in evaluating Hong and Page's model, we have no clear epistemic grounds to dismiss this socially pernicious result since, after all, the model itself has not changed. In other words, in dropping our evidential standards to support the 'diversity trumps ability' result, we make it difficult to reject the model's other result that experts must be uniform. I claim that this shows, more generally, that in dropping our epistemic standards, we undermine the conditions for rejecting research that supports social-ills on weak epistemic grounds.

This paper has two aspects of novelty. First, the paper attempts to answer the question of whether modelers should *lower* their epistemic standards when a model's results support a social good. Second, the paper explores whether inductive risk calculations can be applied to mathematical models more generally.

Inductive Risk

The concept of inductive risk was first expressed by Hempel (1965) and was later developed by Douglas (2009) and is the chance that one will be wrong when accepting or rejecting a scientific hypothesis. There are two ways in which scientists can go wrong when accepting or rejecting a hypothesis. The first type of error consists in concluding that there is a phenomenon or an effect when in fact there is none. This is called a type I error or a false positive result. The second type of error consists in discounting or missing an existing phenomenon or effect. This is called a type II error or a false negative result.

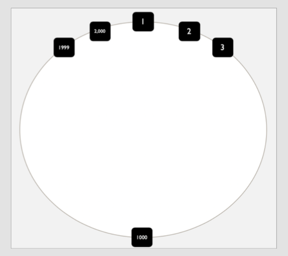
According to Douglas, the choice of a level of statistical significance requires scientists to consider which kind of error they are willing to tolerate, as changing the level of statistical significance changes the balance between false positives and negatives (Douglas, 2009).

In developing a standard for statistical significance, scientists must consider the consequences of false positive and false negative results. Considerations surrounding these consequences often include non-epistemic value judgements. This can be seen from a case in which it is uncertain whether a drug has a serious harmful side-effect. Acting as if there were no such side effect when there is one (type II error) would put the public at more risk than acting as if there were such a side effect when there is none (type I error).

The 'Diversity Trumps Ability' Model

In the model, the problem which the agents are trying to solve is represented by a circle of 2000 spots. Each spot on the circle can be considered a candidate answer to the problem. The agents move together along the circle and eventually land on a particular spot. There is a random integer assigned to each spot on the circle and this random integer is considered the epistemic payoff for landing on this particular spot in the circle.

The agents each have a ***heuristic*** that they use to move forward in the circle. A heuristic consists of an ordered list of non-repeating integers {*h1, h2, h3*}.



They measure the performance of an agent with a heuristic Φ by its *expected value.* Formally, for a starting point *v* and heuristic Φ, an agent's expected value E(V ; Φ) =

$$1/n \sum_{i=1}^{n} V\,((i))$$

It is assumed here that each point on the circle is equally likely to be the starting point. Thus, it follows that for each starting point *i* and agent's heuristic Φ, the average of the epistemic payoff values for all possible starting points is the agent's *expected value.* An agent A exhibits more expertise than an agent B if agent A's expected value is greater than agent B's expected value.

As mentioned, Hong and Page are interested in group performance. A group of agents is represented as an ordered list {a1, a2, … ai}. From a given starting point, the first agent takes the group to the highest spot it can using its heuristic. The second agent goes next and leads the group to the highest spot using its heuristic. After all agents have attempted to locate higher-value solutions, the first agent then searches again. The search finally stops when no agent can locate a higher value. The group's performance is the average score the group receives starting from all spots.

The Model's Results and Critiques

Results

Hong and Page's proof includes two important lemmas. The first lemma is that as the group size becomes large, the independently drawn collection of agents will find the optimal solution with probability one (2004, p. 16388). Given that agents drawn independently are unlikely to have common heuristics, it follows that as the group size increases, the probably that the group will get stuck on one non-optimal solution converges to zero. The second lemma is that as the pool of problem-solvers grows large, the best problem-solvers will become similar and in the limit, the highest-ability problem solvers cannot be diverse (Hong and Page, 2004). To get an intuitive sense of this result, consider a set of randomly selected numbers from 1 to 100, each representing a score on an exam. As the set of randomly selected numbers expands, the group of the 10 best scores will become more similar, ultimately including only numbers 91 to 100 in the limit. Subsequently, the group of experts drawn from a large pool of problem-solvers have similar heuristics and often do no better than single best problem solver—who, by assumption (b), cannot always find the optimal solution.

Critiques concerning the model's application

-Consider, first, Landemore's application of the 'diversity trumps ability' results to deliberative politics. The issue here is that a model characterized by agents finding a place along a circle of numbers cannot capture the complexities of individuals deliberating about policy issues in a meaningful way.

-One general issue is that the problem-solving context in the model does not address the fact that cognitive diversity in academic settings often introduces increased communication costs.

-As Grim et al. claim, genuine expertise seemingly requires being able to perform well on many problems of the same type, not just on a single problem. However, this important characteristic of expertise is not captured in the model.

The issue then is not the fact that the 'diversity trumps ability' model is idealized. Instead, the issue is that the model is highly idealized, such that, it is unclear how the model applies to the various problem-solving contexts it is meant to capture.

Inductive Risk and Mathematical Models

The main moral to be drawn from this section is that given the positive social implication of the 'diversity trumps ability' model, Hong and Page, as well as those who have utilized this model since its publication, have arguably adopted unusually low epistemic standards, given the model's positive social implications.

However, I claim that inductive risk calculations cannot be appropriately conducted for mathematical models like the 'diversity trumps ability' model. This is because, there is flexibility in what results can be derived from the model. This flexibility makes some risks unforeseeable—like the risk of concluding Hong and Page's model supports the socially pernicious result.

Conclusion

To conclude, I would like to reemphasize the aspects of novelty presented in this paper. The paper has shown that mathematical models generate inductive risks like those described by Heather Douglas. In the case of the 'diversity trumps ability' model, this resulted in modelers lowering their epistemic standards because the model supports a social-good. However, the paper also illustrates that inductive risk calculations are difficult to do for mathematical models. For instance, consider how mathematical models can be applied to multiple target systems or can generate such distinct results even when applied to a single target system. It is for this reason that the risks in generating and applying mathematical models are often unforeseeable.

Acknowledgements

I would like to thank my advisor Cailin O' Connor for her constant feedback and guidance. I would also like to thank James Weatherall and Patricia Marino for providing comments on this paper.