Probabilistic Reasoning in the Sciences

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Abstract

Report on the Conference on Probabilistic Reasoning in the Sciences which took place at the Marche Polytechnic University in Ancona, Italy. 29-31 August 2024.

Keywords

Probabilistic reasoning; Science; Methodology.

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The *Conference on Probabilistic Reasoning in the Sciences* took place at the *Marche Polytechnic University* in Ancona, Italy, from August 29th to 31st 2024. It was hosted by the *Center for Philosophy, Science, and Policy (CPSP)* and organized by Michał Sikorski, Alexander Gebharter, and Barbara Osimani. The main objective of the conference was to bring together philosophers of science and philosophers interested in using probabilistic tools in science. Probabilistic reasoning was discussed from both a foundational and a practical perspective.

The event had more than 30 participants, most of whom were based in Europe, with some attending from overseas. The conference was kicked off by welcoming words from Abele Donati,

the director of the *Department of Biomedical Sciences and Public Health*, and Stefano Staffolani, the dean of the *Economics Faculty*. There were six plenary lectures and 24 contributed papers. The plenary lectures were given by Saana Jukola (University of Twente), David Papineau (King's College London), Jan-Willem Romeijn (University of Groningen), Elliott Sober (University of Wisconsin), Jan Sprenger (University of Turin), and Katya Tentori (University of Trento).

Saana Jukola's talk "Evidence, Uncertainty, and Public Health Policies" investigated the question of how epistemic risk could and should be addressed in scientific reasoning and evidence-based policy. Based on cases from nutrition science and public health policy she argued that institutions rather than individuals should be responsible for such risks and that the collective responsibility literature might be useful to shed further light on these issues.

David Papineau's talk entitled "Causal Inference and the Metaphysics of Causation" explored the metaphysics of causal inference. He outlined a reductionist probabilistic account of causation as a metaphysical basis for causal inference. He then discussed how this theory naturally explains single-case causation, causal asymmetry, and the relation between causation and rational action. Finally, he compared his account with "interventionist" approaches to causation.

Jan-Willem Romeijn, in his talk "Statistical Evidence", argued that statistical methods are inevitably relative. Bayesian inference relies on the choice of a prior, while frequentist statistical methods—referred to here as "Bernoullian"—depend on the structure of the sample space, which exposes them to violations of the likelihood principle. In the second part of the talk, he discussed what

this means for the epistemic authority of statistical science. He offered a conception of evidence that is both relativized and objective, combining insights from logical empiricism and pragmatism. Finally, he argued that this conception of relativized objectivity can counter post-truth views on statistics.

Elliott Sober's talk "Darwin, Common Ancestry, and the Law of Likelihood" focused on Darwin's views concerning common ancestry and the Law of Likelihood. Darwin argued that if two species share a trait T, this is evidence for common ancestry. He also believed that adaptive similarities provide only weak evidence for common ancestry, whereas neutral and deleterious similarities offer stronger evidence. Sober evaluated both claims using the Law of Likelihood. In addition, he described how Darwin tested hypotheses about natural selection by inferring the characteristics of ancestors from the observed traits of present-day organisms.

Jan Sprenger's talk "Counterfactual and Probabilistic Reasoning" addressed a gap in the counterfactual reasoning literature concerning the relationship between causal and semantic approaches. He sketched a unified picture based on a "division of labor" between the truth and assertion conditions of counterfactuals, where assertion conditions correspond to truth in all relevant worlds within a given context. Finally, he argued that this framework brings the semantic analysis of counterfactuals closer to their use in scientific reasoning, particularly in relation to the *do*-operator in causal Bayes nets.

In her talk "Promoting a Culture of Uncertainty to Reduce Biases in Medical Reasoning" Katya Tentori (University of Trento) argued that the misunderstanding and misuse of scientific evidence are often rooted in a small number of probabilistic fallacies. She

highlighted that both scientists and the general population frequently struggle to draw accurate conclusions from statistical evidence, as exemplified by misunderstandings of vaccine efficacy results reported during the COVID-19 pandemic. Her main conclusion emphasized that enhancing probabilistic knowledge is essential for the more effective use of scientific evidence.

The conference featured a Best Paper Award for students and PhD candidates. All submissions were evaluated by an expert panel consisting of Serena Doria, Hykel Hosni, and Jan Sprenger. The prize was awarded to Giacomo Molinari (University of Bristol, UK) for his paper "Disagreement over Imprecise Evidence" in which he argues that scarcity and ambiguity warrant different doxastic responses, develops deference principles for scarce and ambiguous evidence, and applies the resulting account to situations of peer disagreement.

We would like to thank the plenary speakers, the members of the best paper award expert panel, and all speakers and participants for making this event a success and are looking forward to possible future instalments. Finally, we would like to take this opportunity to invite submissions to a topical collection in Synthese devoted to the topic of the conference. Details and the call for papers can

be found at .

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