

论文

贝叶斯推理的逻辑与认知问题

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摘要:

贝叶斯主义的复兴出现在统计推理领域,贝叶斯方法成功避免了经典统计推理中的主观因素问题以及先验回避问题,凸显了自身的归纳特性,因而是推理方法的革命。尽管目前贝叶斯主义风行,但它仍存在主观性、简单性与旧证据问题等难题,这也为其进一步发展留下了宽广空间。认知心理学近来对贝叶斯推理研究的发展,为贝叶斯推理研究的认知转向提供了契机,同时为这种方法的发展提供了可能的进路:探索频率主义与贝叶斯主义整合的可能性;在外延性归纳逻辑中引入内涵因素,尝试外延性与非外延性因素的融合。

关键词: 统计推理 贝叶斯推理 逻辑 困境 认知转向

Logic and Cognitive Problems of Bayesian Reasoning

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Abstract:

Bayesianism has already gained a prominent role as a theory of probability interpretation. Its reasoning models are known as Bayesian inference. Keynes' formal induction system has made it evolved into a new era: Bayesian inference has got an extensive use in statistics, economics, psychology and artificial intelligence, and its application domain is still expanding. This is a revolution of reasoning method because Bayesian method has eliminated the problems caused by ignore-to-prior and subjective issues in classical statistic inference. Bayesian inference resolved the problem of deciding test statistic in classical statistic inference and avoided the difficulty of using stopping rule. Bayesianism replaces confidence interval by credible interval in order to obtain the prediction of the true value of a parameter. It also employs prior information through Bayes theorem on conditional probability. Though Bayesianism is very popular nowadays, several challenges have been raised, especially on its subjectivity, simplicity and on the problem of old-evidence. Therefore, there are a lot of issues need to be studied in the future. The criticism of subjectivity of Bayesianism is focused on a prior-constraint, and the question on simplicity of Bayesianism is echoed by the inconsistency between probability axiom and the simplicity postulate. Forster and Sober remarked that the simplicity postulate is "an ad hoc method;" Howson argued that it should not be taken as an essential guideline. Additionally, an old-evidence in the Bayesian framework could not serve as affirming the current hypothesis, which contradicts with our instinct. Howson insightfully revealed that "evidence support" mechanism actually contains a ternary relation between data e, hypothesis h and background knowledge k, and the problem of old-evidence only become evident when e is decided as evidence and e is included in k. These challenges have shown that the further improvement and development were needed in Bayesian inference. Recent developments in the research of Bayesian inference in the field of cognitive psychology have invoked a possible cognitive turn in the research of Bayesian inference, and they also provide various possible approaches for the development of Bayesian inference: to explore the possibility of the integration between Frequentism and Bayesianism|to bring the intentional factor in the extensional inductive logic, with an attempt to combine extensionality and non-extensionality. Gigerenzer and Hoffrage has already offered a Bayesian model with frequency representation of information|Kahneman and Tversky proposed a non-extension logic theory, the support theory for subjective probability. This seems to be a prospective path for inductive logic that worth further exploring.

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