Ognjanović, Zoran; **Rašković, Miodrag**; **Marković, Zoran**
Probability logics. Probability-based formalization of uncertain reasoning. (English)
Zbl 1371.03001
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In this monograph, three professors from Belgrade (Serbia) report on their studies of probability logics over the last decades and on how their work fits in the wider picture. Chapter 5 and Chapter 6 are authored by some of their students.

This monograph has seven main chapters and a short appendix which provides a brief introduction to general notions in mathematical logic (syntax, semantics, completeness, probabilities, etc.).

Chapter 1 is a brief introduction to the rest of the book which sets out main areas of research; among them are: probabilistic consequence relations, soundness, completeness, decidability and complexity.

Chapter 2 surveys the developing relationship between mathematical logic and probability theory. At first, the pre-Leibniz era is discussed. Next, contributions by Leibniz and Jacob Bernoulli are covered. Then, the 18th century protagonists: de Moivre, Bayes and Lambert are paid homage. Most space is devoted to thinkers in the 19th and 20th century. Since the authors cover a great number of authors in the last two centuries, every modern contributor receives less attention.

Chapter 3 introduces the logic LPP_2 which enriches the standard propositional logic with probabilistic operators of the form $P_{\geq s}$ with the intended interpretation that the formula following the operator has probability at least $s \in \mathbb{Q}$. Logics introduced in later chapters are modifications of this base logic. After specifying syntax and semantics an infinitary axiomatisation is provided, compactness is proved, soundness and completeness results are given. Furthermore, it is shown that the logic is decidable and that a satisfiability problem is NP-complete. The last part of the chapter contains a heuristic approach to the satisfiability problem.

In Chapter 4, various logics for nesting probabilistic operators are introduced. Although, nesting is not allowed in LPP_2 many of the proof techniques for establishing soundness and completeness applied in Chapter 3 can also be applied for logics with nested probabilistic operators. The chapter also delineates (dis-)similarities of probabilistic logics and modal logics.

Chapter 5 describes a number of logics which extend those logics introduced in the previous two chapters. Novel are the types of probability operators (conditional probabilities and qualitative probabilities) the ranges of the probability functions (finite, non-Archimedean and unordered). Axiomatisations, soundness, completeness and complexity results are presented.

Chapter 6 provides applications of probabilistic logics to non-monotonic reasoning (System P), a logic for reasoning about evidence and a formalisation of some human thinking in $L_{\mathbb{Q}_p}$.

Chapter 7 is a continuation of the second chapter, it relates the contents of this monograph to related works published since the mid-1980's. The related work is put under five headings: completeness, modal logics, temporal probability logics, applications of probability logics and books on probability logics.

Reviewer: Jürgen Landes (München)

MSC:

03-02	Research exposition (monographs, survey articles) pertaining to mathematical logic and foundations
03B48	Probability and inductive logic
60A05	Axioms; other general questions in probability
68T37	Reasoning under uncertainty in the context of artificial intelligence

Cited in **1** Review
Cited in **5** Documents

Keywords:

probability logics; uncertain reasoning; completeness; soundness; axiomatisation