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**A logic with approximate conditional probabilities that can model default reasoning.** (English) [Zbl 1184.68520](#)

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**Summary:** The paper presents the proof-theoretical approach to a probabilistic logic which allows expressions about (approximate) conditional probabilities. The logic enriches propositional calculus with probabilistic operators which are applied to propositional formulas:  $CP_{\geq s}(\alpha, \beta)$ ,  $CP_{\leq s}(\alpha, \beta)$  and  $CP_{\approx s}(\alpha, \beta)$ , with the intended meaning “the conditional probability of  $\alpha$  given  $\beta$  is at least  $s$ ”, “at most  $s$ ” and “approximately  $s$ ”, respectively. Possible-world semantics with a finitely additive probability measure on sets of worlds is defined and the corresponding strong completeness theorem is proved for a rather simple set of axioms. This is achieved at the price of allowing infinitary rules of inference. One of these rules enables us to syntactically define the range of the probability function. This range is chosen to be the unit interval of a recursive non-Archimedean field, making it possible to express statements about approximate probabilities. Formulas of the form  $CP_{\approx 1}(\alpha, \beta)$  may be used to model defaults. The decidability of the logic is proved.

**MSC:**

[68T37](#) Reasoning under uncertainty in the context of artificial intelligence  
[03B48](#) Probability and inductive logic  
[03B60](#) Other nonclassical logic  
[68T27](#) Logic in artificial intelligence

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**Keywords:**

probabilistic logic; conditional probability; approximate probability; non-standard analysis; strong completeness; decidability; default reasoning

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**References:**

- [1] Adams, E.W., The logic of conditional, (1975), Reidel Dordrecht
- [2] N. Alechina, Logic with probabilistic operators, in: Proceedings of the ACCOLADE'94, 1995, pp. 121-138.
- [3] Benferhat, S.; Dubois, D.; Prade, H., Nonmonotonic reasoning, conditional objects and possibility theory, *Artificial intelligence*, 92, 259-276, (1997) · [Zbl 1017.68539](#)
- [4] Benferhat, S.; Saffiotti, A.; Smets, P., Belief functions and default reasoning, *Artificial intelligence*, 122, 1-69, (2000) · [Zbl 0948.68112](#)
- [5] Biazzo, V.; Gilio, A.; Lukasiewicz, T.; Sanfilippo, G., Probabilistic logic under coherence, model-theoretic probabilistic logic, and default reasoning in system  $\text{\textit{P}}$ , *Journal of applied non-classical logics*, 12, 2, 189-213, (2002) · [Zbl 1038.03023](#)
- [6] Biazzo, V.; Gilio, A.; Lukasiewicz, T.; Sanfilippo, G., Probabilistic logic under coherence: complexity and algorithms, *Annals of mathematics and artificial intelligence*, 45, 1-2, 35-81, (2005) · [Zbl 1083.03027](#)
- [7] Doršoutević, R.; Rašković, M.; Ognjanović, Z., Completeness theorem for propositional probabilistic models whose measures have only finite ranges, *Archive for mathematical logic*, 43, 557-563, (2004) · [Zbl 1057.03028](#)
- [8] Fagin, R.; Halpern, J., Reasoning about knowledge and probability, *Journal of the ACM*, 41, 2, 340-367, (1994) · [Zbl 0806.68098](#)
- [9] Fagin, R.; Halpern, J.; Megiddo, N., A logic for reasoning about probabilities, *Information and computation*, 87, 1-2, 78-128, (1990) · [Zbl 0811.03014](#)
- [10] T. Flaminio, F. Montagna, A logical and algebraic treatment of conditional probability, in: L.A. Zadeh, (Ed.), Proceedings of IPMU'04, 2004, pp. 493-500.
- [11] Friedman, N.; Halpern, J., Plausibility measures and default reasoning, *Journal of the ACM*, 48, 6, 648-685, (2001) · [Zbl 1127.68438](#)
- [12] Gillett, P.R.; Scherl, R.B.; Shafer, G., A probabilistic logic based on the acceptability of gambles, *International journal of approximate reasoning*, 44, 3, 281-300, (2007) · [Zbl 1115.68148](#)
- [13] Gilio, A., Probabilistic reasoning under coherence in system  $\text{\textit{P}}$ , *Annals of mathematics and artificial intelligence*, 34,

5-34, (2002) · [Zbl 1014.68165](#)

- [14] Goldszmidt, M.; Pearl, J., Qualitative probabilities for default reasoning, belief revision and causal modeling, *Artificial intelligence*, 84, 57-112, (1996)
- [15] Hoover, D.N., Probability logic, *Annals of mathematical logic*, 14, 287-313, (1978) · [Zbl 0394.03033](#)
- [16] Keisler, J., *Elementary calculus, An infinitesimal approach*, (1986), Prindle, Weber & Schmidt Boston, MA
- [17] Kraus, S.; Lehmann, D.; Magidor, M., Nonmonotonic reasoning, preferential models and cumulative logics, *Artificial intelligence*, 44, 167-207, (1990) · [Zbl 0782.03012](#)
- [18] Lehmann, D.; Magidor, M., What does a conditional knowledge base entail?, *Artificial intelligence*, 55, 1-60, (1992) · [Zbl 0762.68057](#)
- [19] Lukasiewicz, T., Probabilistic default reasoning with conditional constraints, *Annals of mathematics and artificial intelligence*, 34, 35-88, (2002) · [Zbl 1002.68175](#)
- [20] Lukasiewicz, T., Nonmonotonic probabilistic logics under variable-strength inheritance with overriding: complexity, algorithms, and implementation, *International journal of approximate reasoning*, 44, 3, 301-321, (2007) · [Zbl 1118.68167](#)
- [21] Marchioni, E.; Godo, L., A logic for reasoning about coherent conditional probability: a modal fuzzy logic approach, (), 213-225 · [Zbl 1111.68683](#)
- [22] Marković, Z.; Ognjanović, Z.; Rašković, M., A probabilistic extension of intuitionistic logic, *Mathematical logic quarterly*, 49, 415-424, (2003) · [Zbl 1022.03011](#)
- [23] Nilsson, N., Probabilistic logic artificial intelligence, 28, 71-87, (1986) · [Zbl 0589.03007](#)
- [24] Ognjanović, Z.; Rašković, M., Some probability logics with new types of probability operators, *Journal of logic and computation*, 9, 2, 181-195, (1999) · [Zbl 0941.03022](#)
- [25] Ognjanović, Z.; Rašković, M., Some first-order probability logics, *Theoretical computer science*, 247, 1-2, 191-212, (2000) · [Zbl 0954.03024](#)
- [26] Z. Ognjanović, T. Timotijević, A. Stanojević, Database of papers about probability logics, Mathematical Institute Belgrade. <<http://problog.mi.sanu.ac.yu/>> 2005.
- [27] Rašković, M., Classical logic with some probability operators, *Publications de l'institut mathématique, nouvelle Série, beograd*, 53, 67, 1-3, (1993) · [Zbl 0799.03018](#)
- [28] M. Rašković, Z. Ognjanović, Z. Marković, A probabilistic approach to default reasoning, in: *Proceedings of the NMR'04, 2004*, pp. 335-341.
- [29] Rašković, M.; Ognjanović, Z.; Marković, Z., A logic with conditional probabilities, (), 226-238 · [Zbl 1111.68688](#)
- [30] Robinson, A., *Non-standard analysis*, (1966), North-Holland Amsterdam · [Zbl 0151.00803](#)
- [31] Satoh, K., A probabilistic interpretation for lazy nonmonotonic reasoning, *Proceedings of the 8th American conference on artificial intelligence*, 659-664, (1990)
- [32] van der Hoeck, W., Some consideration on the logics  $\text{FD}$ , *Journal of applied non-classical logics*, 7, 3, 287-307, (1997) · [Zbl 0885.03022](#)
- [33] N. Wilson, A logic of extended probability, in: *First International Symposium on Imprecise Probabilities and their Applications, 1999, Ghent, Belgium*.

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