

# What is Probability?

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## Abstract

Probabilities may be subjective or objective; we are concerned with both kinds of probability, and the relationship between them. The fundamental theory of objective probability is quantum mechanics: it is argued that neither Bohr's Copenhagen interpretation, nor the pilot-wave theory, nor stochastic state-reduction theories, give a satisfactory answer to the question of what objective probabilities are in quantum mechanics, or why they should satisfy the Born rule; nor do they give any reason why subjective probabilities should track objective ones. But it is shown that if probability only arises with decoherence, then they must be given by the Born rule. That further, on the Everett interpretation, we have a clear statement of what probabilities are, in terms of purely categorical physical properties; and finally, along lines laid out by Deutsch and Wallace, that there is a clear basis in the axioms of decision theory as to why subjective probabilities should track these objective ones. These results hinge critically on the absence of hidden-variables or any other mechanism (such as state-reduction) from the physical interpretation of the theory. The account of probability has traditionally been considered the principal weakness of the Everett interpretation; on the contrary it emerges as one of its principal strengths.

**Keywords:** Probability, Born rule, Everett, many-worlds, quantum mechanics, Gleason's theorem, principal-principle, subjective probability, decision theory.

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