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A Subjective and Probabilistic Approach to Derivatives

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We propose a probabilistic framework for pricing derivatives, which acknowledges that information and beliefs are subjective. Market prices can be translated into implied probabilities. In particular, futures imply returns for these implied probability distributions. We argue that volatility is not risk, but uncertainty. Non-normal distributions combine the risk in the left tail with the opportunities in the right tail -- unifying the "risk premium" with the possible loss. Risk and reward must be part of the same picture and expected returns must include possible losses due to risks. We reinterpret the Black-Scholes pricing formulas as prices for maximum-entropy probability distributions, illuminating their importance from a new angle. Using these ideas we show how derivatives can be priced under "uncertain uncertainty" and how this creates a skew for the implied volatilities. We argue that the current standard approach based on stochastic modelling and risk-neutral pricing fails to account for subjectivity in markets and mistreats uncertainty as risk. Furthermore, it is founded on a questionable argument -- that uncertainty is eliminated at all cost.

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