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## Mānoa Seminar Series in Machine Learning

# A Discourse on Decision Theory

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In April 2010 I presented a seminar at the Santa Fe Institute, where I demonstrated that certain classic problems in economics can be resolved by methods that present an alternative to the dominant formalism of expected utilities in decision theory. Specifically, I noted that simple mathematical models of economic processes, such as the random walk or geometric Brownian motion, are non-ergodic. Because of the non-stationarity of the processes, observables cannot be assumed to be ergodic, and this leads to differences in important cases between time averages and ensemble averages. In the context of decision theory, time averages tend to indicate how an individual will fare over time, while expectation values may apply to collectives but are a priori meaningless for individuals. The effects of replacing expectation values by time averages are astounding — sensible falsifiable predictions for risk aversion, market stability, and economic inequality follow directly. My 2010 seminar led to a discourse with Murray Gell-Mann and Kenneth Arrow about the history and development of decision theory, where the first studies of stochastic systems were carried out in the 17th century, and its relation to the development of statistical mechanics where refined concepts were introduced in the 19th century. I will summarize our discourse and present my current understanding of the problems.