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Decision Theory with a State of Mind Represented by an Element of a Hilbert Space: The Ellsberg Paradox *

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Abstract

In this paper, we propose an interpretation of the Hilbert space method used in quantum theory in the context of decision making under uncertainty. For a clear comparison we will stay as close as possible to the framework of SEU suggested by Savage (1954). We will use the Ellsberg (1961) paradox to illustrate the potential of our approach to deal with well-known paradoxes of decision theory.

Keywords: Decision theory, uncertainty, Ellsberg paradox, quantum theory, Hilbert space

JEL Classification codes: C00, C44, D03, D81

1 Introduction

Subjective Expected Utility (SEU) theory (or *Bayesian decision theory*) in the spirit of Savage (1954) has become the almost uncontested paradigm for decision theory in Economics and Statistics.

In Economics a *decision problem* is described by a set of *states of the world* $\omega \in \Omega$, a set of *outcomes* (or *consequences*) $o \in O$ and a set of *actions* $a \in A$. States in Ω are assumed to be mutually exclusive and to be observed perfectly after realizations. For a set of states $\Omega := \{\omega_1, \omega_2\}$, e.g., state ω_1 could mean "it rains"' and state ω_2 "'it does not rain". Outcomes in O are the ultimate objects which a decision maker values, e.g., sums of money, consumption bundles, work conditions, etc. In this sense, these sets contain semantic information.

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