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# Probability Interference in Expected Utility Theory*

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Working paper
Comments welcome

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**Abstract**

Allais (1952) was one of the first to propose an outcome dependent probability weighting function to characterize probability distortions that explain violations of the linear probability model for expected utility theory (EUT). Quantum probability theory (QPT) extends the probability distortion paradigm with state dependent preferences, and non-Kolmogorov quantum probability measures, over a complex valued Hilbert space. Key innovations in QPT include representing vectors in Hilbert space as (mental) states, and a wave function comprised of a normalized linear combination of states. Born rule treats the real valued squared amplitude of the wave function as the associated probability often accompanied by a trigonometric probability interference factor addend. In this paper, we prove that the Born rule innovation of QPT which resolve, *inter alia*, violations of Savage's sure thing principle, conjunction and disjunction fallacies, preference reversal, etc, can also be obtained by replacing EUT's transitivity axiom with a weak harmonic transitivity (WHT) axiom in classic Kolmogorov probability space. The WHT axiom supports an abstract harmonic probability weighting function (HPWF) that mimics random fields driven by mental states, and it admits a harmonic addend akin to the trigonometric probability interference factor in QPT. By imposing suitable moment conditions on the underlying objective probability distribution, we derive a complex valued HPWF that satisfies Born rule. We calibrate the HPWF to a recent QPT probability measure derived from evaluation of state representation of binary choice, estimate it with harmonic regression, and show how heteroskedasticity correction has debiasing effects.

*Keywords*: transitivity axiom, harmonic analysis, abstract probability weighting function, quantum probability

*JEL Classification*: C02, D81

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