Title: Foundations and Interpretation of Quantum Theory - Lecture 6 (Part 2 of 2)

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Abstract: After a review of the axiomatic formulation of quantum theory, the generalized operational structure of the theory will be introduced (including POVM measurements, sequential measurements, and CP maps). There will be an introduction to the orthodox (sometimes called Copenhagen) interpretation of quantum mechanics and the historical problems/issues/debates regarding that interpretation, in particular, the measurement problem and the EPR paradox, and a discussion of contemporary views on these topics. The majority of the course lectures will consist of guest lectures from international experts covering the various approaches to the interpretation of quantum theory (in particular, many-worlds, de Broglie-Bohm, consistent/decoherent histories, and statistical/epistemic interpretations, as time permits) and fundamental properties and tests of quantum theory (such as entanglement and experimental tests of Bell inequalities, contextuality, macroscopic quantum phenomena, and the problem of quantum gravity, as time permits).

Evidential Probability

(Classical [Bayesian] Probability)

- Probability = inverse of how many possible events there are.
- Principle of Indifference: if there is no reason to choose between N events, assign equal probabilities to them.
  - More sophisticated: If there is a transitive symmetry group on events, assign equal probabilities.

Evidential Probability

(Subjective Bayesian Probability)

- Probability = a quantitative way of describing your beliefs.
- Those beliefs can be actualized in betting scenarios.
- "[My] probability of a coin coming up heads is 1/2 because I believe heads is just as plausible as tails. I would accept any odds better than 1:1 in betting on this event."

"...my objection to current statistical theory is not so much to the way it is used as to the fact that it limits its scope at the outset in such a way that it cannot state the questions asked, or the answers to them, within the language that it provides for itself, and must either appeal to a feature of ordinary language that it has declared to be meaningless, or else produce arguments within its own language that will ntot bear inspection." Jeffreys, preface

-H. Jeffreys

Evidential Probability

(Objective Bayesian Probability)

- Objective Bayesian Probability: probability is about your beliefs, but if you are rational and utility-maximizing (i.e., you think logically about how to achieve the best outcome) then your [probabilistic] beliefs are constrained to be coherent with each other, in exactly the same way that logic constrains your [logical, true/false] beliefs to be consistent.

Evidential Probability

(Pignistic [Bayesian] Probability)

- Pignistic [Bayesian] Probability: probability is about your beliefs as evinced by your actions. (see Savage's "On the elicitation of personal probabilities"). This view (the right one!) has strong connections to decision theory, operationalism, and predictive inference.