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A Quantum Martingale Convergence Theorem

It is well-known in quantum information theory that a positive operator valued measure (POVM) is the most general kind of quantum measurement. A quantum probability is a normalised POVM, namely a function on certain subsets of a (locally compact and Hausdorff) sample space that satisfies the formal requirements for a probability and whose values are positive operators acting on a complex Hilbert space. A quantum random variable is an operator valued function which is measurable with respect to a quantum probability. In this talk, we will discuss a quantum analogue of the Lebesgue dominated convergence theorem and use it to prove a quantum martingale convergence theorem (MCT). In contrast with the classical MCT, the quantum MCT exhibits non-classical behaviour; even though the limit of the martingale exists and is unique, it is not explicitly identifiable. Fortunately, a partial classification of the limit is possible through a study of the space of all quantum random variables having quantum expectation zero. Based on joint work with Kyler Johnson.