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How to construct the optimal Bayesian measurement in quantum statistical decision theory[1] FUYUHIKO TANAKA, Osaka Univ — Recently, much more attention has been paid to the study aiming at the application of fundamental properties in quantum theory to information processing and technology. In particular, modern statistical methods have been recognized in quantum state tomography (QST), where we have to estimate a density matrix (positive semidefinite matrix of trace one) representing a quantum system from finite data collected in a certain experiment. When the dimension of the density matrix gets large (from a few hundred to millions), it gets a nontrivial problem. While a specific measurement is often given and fixed in QST, we are also able to choose a measurement itself according to the purpose of QST by using qunatum statistical decision theory. Here we propose a practical method to find the best projective measurement in the Bayesian sense. We assume that a prior distribution (e.g., the uniform distribution) and a convex loss function (e.g., the squared error) are given. In many quantum experiments, these assumptions are not so restrictive. We show that the best projective measurement and the best statistical inference based on the measurement outcome exist and that they are obtained explicitly by using the Monte Carlo optimization.

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