Optimal measurement in the quantum statistical decision theory

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Abstract

Let $\rho_1, \rho_2, \ldots$ be normal states on a von Neumann algebra $\mathfrak{M}$ which can occur with some a priori probabilities $\pi = (\pi_1, \pi_2, \ldots)$. We want to find a measurement (POVM– positive operator valued measure) $M = (M_1, M_2, \ldots), M_i \in \mathfrak{M}$ which minimizes Bayes risk i.e.

$$r(M, \pi) = \sum_{i=1}^{\infty} \sum_{j=1}^{\infty} \pi_i L(i,j) \rho_i(M_j),$$

where L is a loss function.

We want to present some estimates of Bayes risk (e.g. Holevo–Curlander bounds, entropic bound [2]) for arbitrary von Neumann algebra $\mathfrak{M}$ and generalization of Holevo asymptotic theorem [1] for infinitely dimensional Hilbert space.

[1] Holevo A. S., *On Asymptotically Optimal Hypothesis Testing in Quantum Statistics*, Theory of Probability and its Applications **23**(2) (1978), 411–415.

[2] Wieczorek R., Podsędkowska H., *Entropic upper bound for Bayes risk in the quantum case*, Probability and Mathematical Statistics.