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On Low-Dimensional Projections of High-Dimensional Distributions

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Let P be a probability distribution on q-dimensional space. The so-called Diaconis-Freedman effect means that for a fixed dimension $d << q$, most d-dimensional projections of P look like a scale mixture of spherically symmetric Gaussian distributions. The present paper provides necessary and sufficient conditions for this phenomenon in a suitable asymptotic framework with increasing dimension q. It turns out, that the conditions formulated by Diaconis and Freedman (1984) are not only sufficient but necessary as well. Moreover, letting $\hat{P}$ be the empirical distribution of n independent random vectors with distribution P, we investigate the behavior of the empirical process $\sqrt{n}(\hat{P} - P)$ under random projections, conditional on $\hat{P}$.

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