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In this talk we propose a general framework for distribution-free nonparametric testing in multi-dimensions, based on a notion of multivariate ranks which are defined using some recent advances in the theory of measure transportation. Unlike other existing proposals in the literature, these multivariate ranks share a number of useful properties with the usual notion of one-dimensional ranks; most importantly, these ranks are distribution-free. This crucial observation allows us to design nonparametric tests which are based on statistics that are exactly distribution-free under the null hypothesis. We illustrate the applicability of this approach by constructing exact distribution-free tests for two classical nonparametric problems: (i) testing for mutual independence between random vectors, and, (ii) testing for the equality of multivariate distributions. In both these problems we derive the asymptotic null distribution of the proposed statistic. We further show that our tests are consistent against very general alternatives. Moreover, the proposed tests are tuning-free, computationally feasible and are well-defined under minimal assumptions on the underlying distributions (e.g., they do not need any moment assumptions). (Received August 16, 2019)