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On the optimal strategy in a random game

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Abstract

Consider a two-person zero-sum game played on a random n by n matrix where the entries are iid normal random variables. Let Z be the number of rows in the support of the optimal strategy for player I given the realization of the matrix. (The optimal strategy is a.s. unique and Z a.s. coincides with the number of columns of the support of the optimal strategy for player II.) Faris an Maier (see the references) make simulations that suggest that as n gets large Z has a distribution close to binomial with parameters n and 1/2 and prove that $P(Z=n) < 2^{-(k-1)}$. In this paper a few more theoretically rigorous steps are taken towards the limiting distribution of Z: It is shown that there exists $a<1/2$ (indeed $a<0.4$) such that $P((1/2-a)n< Z <(1/2+a)n)$ tends to 1 as n increases. It is also shown that the expectation of Z is $(1/2+o(1))n$. We also prove that the value of the game with probability $1-o(1)$ is at most $Cn^{-1/2}$ for some finite C independent of n. The proof suggests that an upper bound is in fact given by $f(n)/n$, where $f(n)$ is any sequence tending to infinity as n increases, and it is pointed out that if this is true, then the variance of Z is $o(n^2)$ so that any $a>0$ will do in the bound on Z above.

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