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Extreme value theory for dependent random variables with application to random graphs

Let $\mathbf{X}(n) = (X_1(n), \ldots, X_{d(n)}(n))$, $n \in \mathbb{N}$, be a sequence of random vectors. We prove that, under certain dependence conditions, the cdf of the maximum of $X_i(n)$, $1 \leq i \leq d(n)$, asymptotically equal to the cdf of the maximum of a random vector with the same but independent marginal distributions. Our result generalizes all known results about stationary and non-stationary sequences of random variables and implies novel results about random fields on integer lattices. Using our results on asymptotic independence, we prove that, in a binomial random graph, maximum number of cliques sharing one vertex after appropriate normalization converges to the standard Gumbel distribution and show that these techniques can be generalized to get similar results for arbitrary extensions. To prove our result on asymptotic independence, we obtain new lower and upper bounds on the probability that none of a given finite set of events occurs.

This is joint work with Mikhail Isaev, Rui Zhang, and Maxim Zhukovskii.