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Exploiting Asymptotic Structure for Efficient Rare-event Estimation for Sums of Random Variables

Abstract

We consider the problem of estimating the right-tail probability of a sum of random variables when the density of the sum is not known explicitly, but whose asymptotic behaviour is known. We embed this asymptotic structure into a simple importance sampling estimator, in which we consider the radial and angular components of the distribution separately. By design, this estimator has a bounded relative error when the marginal tails decay exponentially. Moreover, we present a procedure to obtain a 'good' approximation to the angular component as a mixture of Dirichlet distributions by using Bernstein polynomial approximation (cf. the Weierstrass approximation theorem). The estimator and procedure are applicable in both the heavy- and light-tailed settings, as well as for dependent and independent summands. We illustrate the approach with a series of examples.

This is joint work with Patrick Laub.