

Product-form estimators: exploiting independence to scale up Monte Carlo

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Abstract

We introduce a class of Monte Carlo estimators for product-form target distributions that aim to overcome the rapid growth of variance with dimension often observed for standard estimators. We identify them with a class of generalized U-Statistics, and thus establish their unbiasedness, consistency, and asymptotic normality. Moreover, we show that they achieve lower variances than their conventional counterparts given the same number of samples drawn from the target, investigate the gap in variance via several examples, and identify the situations in which the difference is most, and least, pronounced. We further study the estimators' computational cost and delineate the settings in which they are most efficient. We illustrate their utility beyond the setting of product-form distributions by detailing two simple extensions (one to targets that are mixtures of product-form distributions and another to targets that are absolutely continuous with respect to product-form distributions) and conclude by discussing further possible uses

This is joint work with Francesca Crucinio and Adam Johansen.

References

- [1] Kuntz, Juan, Francesca R. Crucinio, and Adam M. Johansen. "Product-form estimators: exploiting independence to scale up Monte Carlo." arXiv preprint arXiv:2102.11575 (2021).