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Abstract

Estimating Differential Entropy Using Recursive Copula Splitting †

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We present a new method for estimating the Shannon differential entropy of multidimensional random variables using independent samples. The method is based on decomposing the distribution into a product of the marginal distributions and the joint dependency, also known as the copula. The entropy of marginals is estimated using one-dimensional methods. The entropy of the copula, which always has a compact support, is estimated recursively by splitting the data along statistically dependent dimensions. The method can be applied both for distributions with compact and non-compact supports, which is imperative when the support is not known or of mixed type (in different dimensions). At high dimensions (larger than 20), numerical examples demonstrate that our method is not only more accurate, but also significantly more efficient than existing approaches. We apply the new method to estimate the entropy of several statistical physics model showing out of equilibrium dynamics. The models show a phase transition in which the structure become hyper-uniform. We show that the phase transition can be detected by studying the entropy of particle configurations.