Statistical complexity of kappa distribution

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The statistical complexity measures represent an interplay between order and disorder levels of a complex system. In the past, different definitions of statistical complexity were introduced, but there is not a general agreement about which one is preferable [1-3], since it has still not been accepted what a set of basic properties is that a complexity measure should satisfy.

In this work we provide a general treatment of the statistical complexity measures starting from a set of ineluctable properties, which are stated as axioms. These axioms state that the statistical complexity measure of a discrete system is a non-negative composition of a strongly pseudo-additive entropy [4-5], which serves as a measure of disorder, and of a generalized certainty measure [6], which serves as a measure of an order. In addition, the statistical complexity measure has to be non-negative, decomposable, equal to zero, in the case of a simple system, and to preserve consistency of discrete and continuous cases.

We derived the unique class of statistical complexity measures which satisfy the aforementioned axioms and includes some of the previously considered measures as special cases. Unlike the majority of the previously proposed measures, it has a finite and non-vanishing limit when a discrete system tends to a continuous one, so that the corresponding differential statistical complexity can be defined, being invariant under rescaling, translation and replication. We derive the analytic expression for the statistical complexity of a multivariate kappa distribution and we analyze its extensivity.

References

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