

## Nonparametric Copula Approximations

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**Abstract :** Copulas are currently utilized in finance, reliability theory, machine learning, signal processing, geodesy, hydrology and biostatistics, among several other fields of scientific investigation. It follows from Sklar's theorem that the joint distribution function of a multidimensional random vector can be expressed in terms of its associated copula and marginals. Since marginal distributions can easily be determined by making use of a variety of techniques, we address the problem of securing the distribution of the copula. This will be done by using several approaches. For example, we will obtain bivariate least-squares approximations of the empirical copulas, modify the kernel density estimation technique and propose a criterion for selecting appropriate bandwidths, differentiate linearized empirical copulas, secure Bernstein polynomial approximations of suitable degrees, and apply a corollary to Sklar's result. Illustrative examples involving actual observations will be presented. The proposed methodologies will as well be applied to a sample generated from a known copula distribution in order to validate their effectiveness.

**Keywords :** copulas, Bernstein polynomial approximation, least-squares polynomial approximation, kernel density estimation, density approximation

**Conference Title :** ICSEM 2025 : International Conference on Statistics, Econometrics and Mathematics

**Conference Location :** Bangkok, Thailand

**Conference Dates :** August 19-20, 2025