



Multivariate SUN, SUNNY, and SUNSET distributions: Properties and applications

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The broad class of multivariate unified skew-normal (SUN) distributions has attracted sustained attention over the past two decades. In this talk, we provide an overview of its multiple origins, highlight its key properties, and describe its geometry under a parametrization with natural interpretability. We emphasize the issue of non-identifiability of the SUN distribution under permutations of its latent variables and propose several strategies to achieve identifiability, including identifiable sub-models such as the SUNNY class. This non-identifiability concern also arises in alternative parametrizations and extends to unified skew-elliptical (SUE) distributions, particularly the unified skew-t (SUT) family. An important feature of SUN distributions is their fundamental conjugacy property, which greatly facilitates Bayesian inference and computation. When used as priors for parameter vectors in general probit, tobit, and multinomial probit models, the resulting posteriors remain within the SUN family. We further discuss extensions of these results to the broader class of multivariate SUE distributions, ensuring conjugacy beyond fully observed, discretized, or censored multivariate normal models. Finally, we illustrate these properties with applications to multivariate SUT distributions and to the multivariate SUN with independent sets of latent variables (SUNSET) family.