

Generalized Skew-Symmetric Circular and Toroidal Distributions

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Abstract:

Existing circular and toroidal distributions are mostly symmetric, however, many data sets possess asymmetric patterns. Due to the increasing need for asymmetric distributions in recent times, driven by complex modern datasets, a new approach is introduced to generate skewed distributions from symmetric distributions, for modelling both circular and toroidal skewed data. This new family of asymmetric distributions, called generalized skew-symmetric distributions, includes some well-known distributions as special cases, such as the circular models of Umbach and Jammalamadaka [Stat. Prob. Lett. 79 (2009) 659-663] and Abe and Pewsey [Stat. Pap. 52 (2011) 683-707] and the toroidal model of Ameijeiras-Alonso and Ley [Biostatistics (2019), in press]. General properties of the new models are studied, and we see that the proposed distributions are able to provide wider ranges of skewness as their competitors. To illustrate the practical implementation and usefulness of our new general skewing approach, we compare our models to competitors from the literature on several real data sets.

Keywords: Circular distributions, Sine-skewed distributions, Skew-symmetric distributions, Toroidal distributions, Trigonometric moments.