

# The sinh-arcsinhed logistic family of distributions: properties and inference

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**Abstract** The sinh-arcsinh transform is used to obtain a flexible four-parameter model that provides a natural framework with which to perform inference robust to wide-ranging departures from the logistic distribution. Its basic properties are established and its distribution and quantile functions, and properties related to them, shown to be highly tractable. Two important subfamilies are also explored. Maximum likelihood estimation is discussed, and reparametrisations designed to reduce the asymptotic correlations between the maximum likelihood estimates provided. A likelihood-ratio test for logisticness, which outperforms standard empirical distribution function based tests, follows naturally. The application of the proposed model and inferential methods is illustrated in an analysis of carbon fibre strength data. Multivariate extensions of the model are explored.

**Keywords** Copula ·  $L_U$  distribution · Quantile measures · Sinh-arcsinh transform · Skewness · Tailweight · Test for logisticness