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SHAPE MODELLING WITH FAMILY OF PEARSON DISTRIBUTIONS

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The choice of the best-suited statistical distribution for data modelling is not a trivial issue. Unless a sound theoretical background exists for selecting a particular distribution, one will usually resort to testing various candidates and select a distribution based on its fit to the observed data. While this is a legitimate strategy, it is more objective and efficient to define a sufficiently general family that can be used for this purpose. This approach has a long tradition in statistics, and resulted in various families of distributions, most notably Pearsons. The Pearson distributions are widely used family of distributions to approximate empirical data, with a wide diversity of distribution shapes. The variety of shapes offered by this family includes unimodal, bimodal, U-shaped, J-shaped and monotone probability distribution functions, which may be symmetric and asymmetric, concave and convex, with smooth, abrupt, truncated, long, medium or short tails. On one hand, the ability of Pearson distributions to take this great diversity of shapes is responsible for wide application in actual modelling of measurements, and, on the other hand, the estimation of the distribution parameters requires only first four central moments calculated from the measurements minimizing the error propagation. The basic properties of the family members are discussed and numerical procedures for determining appropriate parameters using maximum likelihood estimation and method of moments are introduced. As an illustration of the distribution family and methods, a practical implementation is applied to data sets of electric field of Langmuir waves measured by WIND satellite yielding to a new insight in a long-lasting problem in beam-plasma interaction mechanisms.