Applications of Kaniadakis functions beyond statistical mechanics

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This talk focuses on applications of the Kaniadakis κ-deformed exponential and logarithmic functions in three different problems. First, we show that a pair of nonlinear transforms based on the κ-exponential and the κ-logarithmic functions are useful tools in Gaussian process regression for non-Gaussian data. This novel transformation has advantages compared to the Box-Cox transform which is a standard statistical tool for normalizing skewed data. For illustration, the new transform is applied to a censored autoregressive model for the simulation of precipitation time series. Second, we highlight the connection between the heavy-tailed κ-Weibull distribution and weakest-link scaling theory in the case of non-independent links. In light of this analogy, the κ-Weibull is suitable for modeling the mechanical strength distribution of non-homogeneous brittle materials. We provide statistical analysis of various datasets that illustrate the usefulness of the κ-Weibull distribution. Finally, we comment on the potential use of the novel κ-lognormal probability distribution as a model for the permeability of random porous media. In summary, κ-deformations allow modifying the tails of classical distribution models (e.g., Weibull, lognormal) and provide new directions of research in the analysis of skewed space-time datasets.

References

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