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Probability distances to the exponential class provide insight into classifying X-ray astronomy data[†]

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SUMMARY

We propose a new methodology to measure deviations from the class of exponential random variables based on the estimation of various integral probability metrics. Specifically, we consider the problem of estimating the Wasserstein and Zolotarev metrics, as well as normalized versions of these distances, between a positive random variable and an exponential variable with the same mean. We obtain sharp asymptotic results related to the plug-in estimators of these metrics and compare them with the finite-sample distributions via simulations. The practical use of our proposal is illustrated analysing in depth a massive data set from the X-ray astronomy Chandra Orion Ultradeep Project. The proposed probability distances provide a striking amount of information on the nature of the photon emitting sources.

Keywords: Wasserstein distance, Zolotarev metric, plug-in estimator, asymptotic distribution, probability metrics

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