Title: New classification features for X-ray astronomy data

Abstract: The classification of the X-ray sources into classes is an essential task in astronomy. Typically, one of the classes corresponds to extragalactic radiation, whose photon emission behaviour is well characterized by a homogeneous Poisson process. We propose to use normalized versions of the Wasserstein and Zolotarev distances, two integral probability metrics, to quantify the deviation of the distribution of photon interarrival times to the exponential class. Our main motivation is the analysis of a massive dataset from X-ray astronomy obtained by the Chandra Orion Ultradeep Project (COUP). This project yielded a large catalog of 1616 X-ray cosmic sources in the Orion Nebula region, with their series of photon arrival times and associated energies.
We consider the plug-in estimators of these metrics and analyze their large sample behavior with a Monte Carlo study.
We estimate these metrics for each of the large collection of COUP sources from three different classes. We conclude that our proposal provides a striking amount of information on the nature of the photon emitting sources. Further, these variables have the ability to identify outliers, including X-ray sources wrongly catalogued before. As an appealing conclusion, we show that some outliers, previously classified as extragalactic emissions, have a much higher probability of being young stars in Orion Nebula.

This is a joint work with Amparo Baíllo (Departamento de Matemáticas, Universidad Autónoma de Madrid) and Konstantin Getman (Department of Astronomy and Astrophysics, Pennsylvania State University).