

# HOMework 2

## A Bayesian test for periodic signals in red noise

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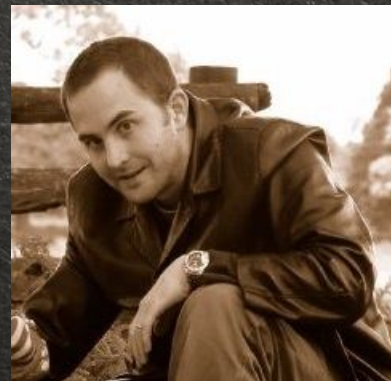
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### ABSTRACT

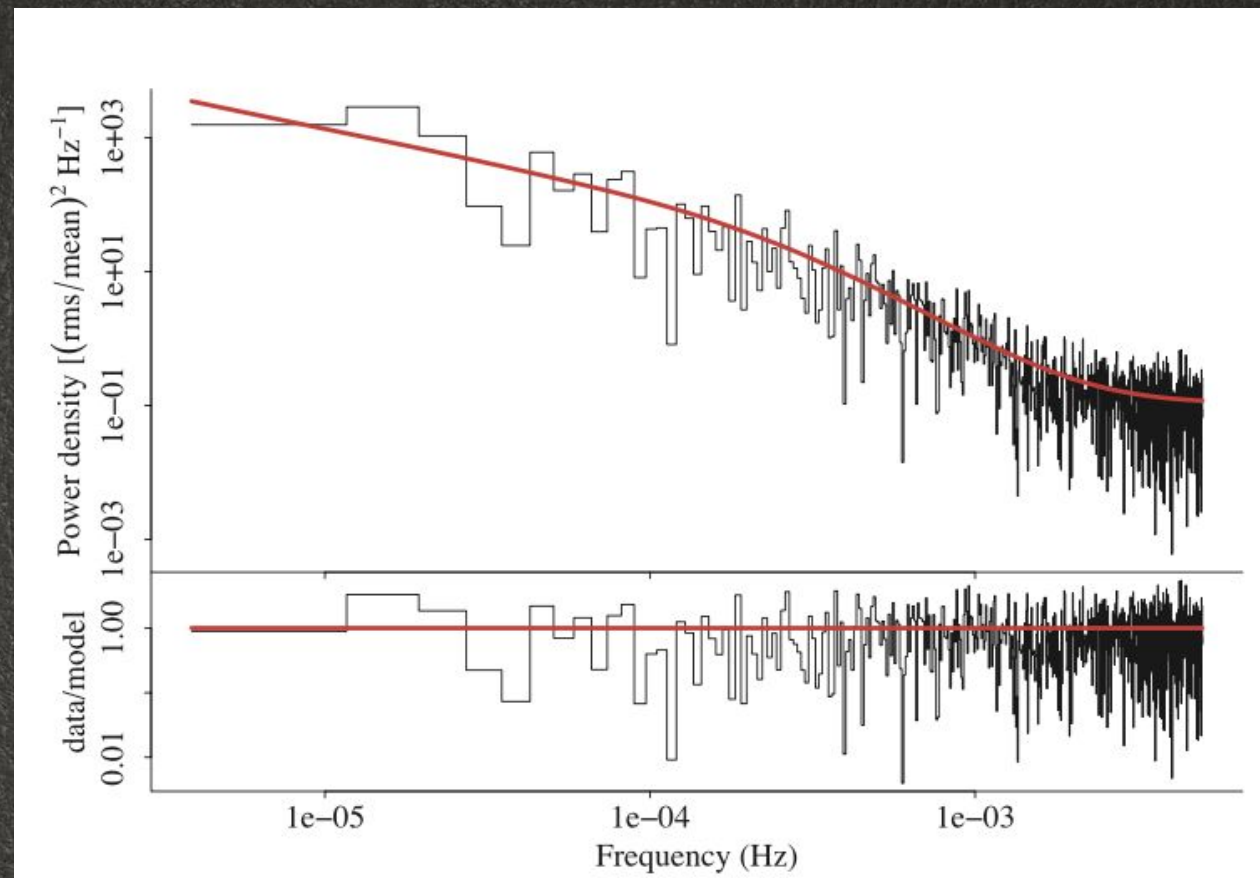
Many astrophysical sources, especially compact accreting sources, show strong, random brightness fluctuations with broad power spectra in addition to periodic or quasi-periodic oscillations (QPOs) that have narrower spectra. The random nature of the dominant source of variance greatly complicates the process of searching for possible weak periodic signals. We have addressed this problem using the tools of Bayesian statistics; in particular, using Markov Chain Monte Carlo techniques to approximate the posterior distribution of model parameters, and posterior predictive model checking to assess model fits and search for periodogram outliers that may represent periodic signals. The methods developed are applied to two example data sets, both long *XMM-Newton* observations of highly variable Seyfert 1 galaxies: RE J1034 + 396 and Mrk 766. In both cases, a bend (or break) in the power spectrum is evident. In the case of RE J1034 + 396, the previously reported QPO is found but with somewhat weaker statistical significance than reported in previous analyses. The difference is due partly to the improved continuum modelling, better treatment of nuisance parameters and partly to different data selection methods.

**Key words:** methods: data analysis – methods: statistical – galaxies: Seyfert – X-rays: general.

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- How to deal with a “coloured” noise in spectral analysis.