

Notes for Szymon Kozłowski "A degeneracy in DRW modelling of AGN light curves"

MALTE BRINCH

University of Copenhagen

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1. ARTICLE

The damped random walk (DRW) has been used to model AGN light curve variability. The process was introduced by Kelly 2009 and is also referred to as the CAR(1) or OU process, which has two model parameters the decorrelation timescale τ and the amplitude σ^2 . The idea is to test whether a non-DRW stochastic process be successfully and well modelled as DRW, and return correct variability parameters? Or will it rather return biased parameters, for example, longer time-scales for steeper SFs as in the SF analysis.

The covariance function tested is

$$cov(\Delta t) = \sigma_s^2 e^{-\left(\frac{|\Delta t|}{\tau}\right)^\beta}$$

The power β seems to weakly change from 1 to 1.2 for the brightest AGN leading to a bias for the parameters as β changes. The positive side is that modest deviations from the DRW model seem to be nearly unimportant for the estimated variability parameters and they weakly affect the correlations with the physical AGN parameters. The negative side is that typical AGN light curves are not good enough to notice the deviations from DRW and so one may misinterpret parameters. Because SFs or power spectral densities are a model-independent means of estimating the shape of the covariance function of the signal, one should rather estimate β this way, and then use it as input parameter in direct light-curve modelling to obtain correct model parameters. The process is generally good as structure functions for 9000 AGN have β near 1, just keep in mind some processes might not be DRW and give rise to other beta values.