VERSITA

Acta Geophysica
vol. 61, no. 6, Dec. 2013, pp. 1351-1394
DOI: 10.2478/s11600-013-0154-9

Fitting and Goodness-of-Fit Test of Non-Truncated and Truncated Power-Law Distributions

Anna DELUCA and Álvaro CORRAL

Centre de Recerca Matemàtica, Edifici C, Bellaterra, Barcelona, Spain

Departament de Matemàtiques, Universitat Autònoma de Barcelona, Cerdanyola, Spain
e-mails: ADeluca@crm.cat, ACorral@crm.cat

Abstract

Recently, Clauset, Shalizi, and Newman have proposed a systematic method to find over which range (if any) a certain distribution behaves as a power law. However, their method has been found to fail, in the sense that true (simulated) power-law tails are not recognized as such in some instances, and then the power-law hypothesis is rejected. Moreover, the method does not work well when extended to power-law distributions with an upper truncation. We explain in detail a similar but alternative procedure, valid for truncated as well as for non-truncated power-law distributions, based in maximum likelihood estimation, the Kolmogorov–Smirnov goodness-of-fit test, and Monte Carlo simulations. An overview of the main concepts as well as a recipe for their practical implementation is provided. The performance of our method is put to test on several empirical data which were previously analyzed with less systematic approaches. We find the functioning of the method very satisfactory.

Key words: power-law distribution estimation, goodness-of-fit tests, binning, seismic-moment distribution, waiting-time distribution, tropical-cyclone energy.