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Statistics of return intervals in long-term correlated records

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We consider long-term correlated data with several distribution densities (Gaussian, exponential, power law, and log-normal) and various correlation exponents γ ($0 < \gamma < 1$), and study the statistics of the return intervals r_j between events above some threshold q. We show that irrespective of the distribution, the return intervals are long-term correlated in the same way as the original record, but with additional uncorrelated noise. The distribution $P_q(r)$ of the return intervals is characterized at large scales by a stretched exponential with exponent γ, and at short scales by a power law with exponent $\gamma - 1$. We discuss in detail the occurrence of finite size effects for large threshold values for all considered distributions. We show that finite-size effects are most pronounced in exponentially distributed data sets where they can even mask the stretched exponential behavior in records of up to 10^6 data points. In order to quantify the clustering of extreme events due to the long-term correlations in the return intervals, we study the conditional distribution function $P_q(r|r_0)$ and the related moments. We find pronounced memory effects, irrespective of the original distribution.