Universality in rank distributions due to multiplicative processes: from power laws to stretched exponentials

GERARDO NAUMIS, Depto. de Física-Química, Instituto de Física, UNAM, GERMINAL COCHO, Instituto de Física, SISTEMAS COMPLEJOS-FISICA-QUIMICA COLLABORATION — Although power laws have been used to fit rank distributions in many different contexts, they usually fail at the tails. Stretched exponentials and log-normal distributions have been used to solve the problem, but unfortunately they are not able to fit at the same time both ending tails. Here we show that many different data in rank laws, like in granular materials, codons, author impact in scientific journal, etc. are very well fitted by a beta-like function (a,b distribution). Since this distribution is indeed ubiquitous, it is reasonable to associate it to the product of correlated probability distributions. In particular, we have found that the macrostates of the product of discrete probability distributions imply stretched exponential-like frequency-rank functions, which qualitatively and quantitatively can be fitted with the a,b distribution in the limit of many random variables [1]. We prove this by transforming the problem into an algebraic one: finding the rank of successive products of a given set of numbers. [1] New J. Phys. 9 (2007) 286. (2007).

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