

# Stochastic multiplicative population growth predicts and interprets Taylor's power law of fluctuation scaling

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Taylor's law (TL) asserts that the variance of the density (individuals per area or volume) of a set of comparable populations is a power-law function of the mean density of those populations. Despite the empirical confirmation of TL in hundreds of species, there is little consensus about why TL is so widely observed and how its estimated parameters should be interpreted. Here, we report that the Lewontin-Cohen (henceforth LC) model of stochastic population dynamics, which has been widely discussed and applied, leads to a spatial TL in the limit of large time and provides an explicit, exact interpretation of its parameters. The exponent of TL exceeds 2 if and only if the LC model is supercritical (growing on average), equals 2 if and only if the LC model is deterministic, and is less than 2 if and only if the LC model is subcritical (declining on average). TL and the LC model describe the spatial variability and the temporal dynamics of populations of trees on long-term plots censused over 75 years at the Black Rock Forest, Cornwall, NY, USA.