



Power-law intermittent ratio distributions in marine ecology

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In marine ecology and biogeochemical marine studies, one can find quite often some studies using ratio statistics between two quantities. There are two main instances where this happens: stoichiometry studies concerning nutrient concentrations in biogeochemical studies and sex ratio statistics in population dynamics studies. In the first case, one considers e.g. N/P ratio of nitrogen and phosphat concentration, to detect possible limitation nutrients for phytoplankton growth. The sex ratio statistics is the study of the ratio M/F of male to female concentration.

There are results concerning ratio statistics in the mathematical literature, and several theorem are known. For example, if the variables X and Y are Gaussian, the ratio $Z=X/Y$ is a Cauchy random variable with power-law tail and its variance does not exist. There are other results for more general cases and globally, the ratio Z is in many situations an intermittent random variable with a power-law tail of exponent 2 or 3.

In the light of these results, we consider some experimental ratio of nutrient concentrations or sex ratio of zooplankton. We show that these distributions have power-law tails. We also discuss the difference between the mean of X/Y and of Y/X . Finally we underline the fact that the ratio of the mean is not the mean of the ratio. Our general conclusion is that a random variable created as a ratio of two variables has a very peculiar statistical behaviour and can only be used in experimental studies with much caution.