

Transition between Poisson and non-Poisson fluctuations in sales numbers

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Individual sales activities in convenience stores are analyzed based on detail point-of-sales data [1]. From theoretical viewpoint it is expected that sales numbers of each item follows a Poisson distribution, and we expect that the standard deviation of sales number fluctuation is equal to the square root of the mean value of the sales number. This law actually holds generally for most of items but only for the cases that both time and space scales are small enough. In the case that the mean value of sales number is larger than a certain value there holds another fluctuation law, that is, the standard deviation is proportional to the mean value, implying that the fluctuation is much larger than the case of Poisson process.

We introduce a simple model to understand this fluctuation law taking into account the fluctuation of number of customers. It is shown both theoretically and by data analysis that the above non-Poisson law holds generally for large mean values.

We also pay attention to some exceptional cases that the Poisson law breaks down even in small space and time, and we clarify the reason of deviation.

[1]G. Fukunaga, H. Takayasu, M. Takayasu, PLoS ONE, **11** e0157653, (2016).