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# Abstract

The congestion and depopulation are serious problems in the modern Japanese society. A specific area develops greatly, and why does not another area do it? The evolution of the population seems to change with time due to various factors such as economy, environment, and policy, etc. The mechanisms of population dynamics have been studied in demographic and economic contexts, and there are international comparisons. The advantage of these studies is to be able to argue about concrete factors on the basis of geographical and social conditions. However, it is difficult to show a unified view, because individual circumstances in each country are different. Now, therefore, the present conditions have many hypotheses, but there is little inspection. In this study, we treat these factors as stochastic variables and discuss the perspective of population dynamics by statistical-mechanical approach.

The purpose of this study is twofold. First, we explain the perspective of the population distribution. We have investigated the cumulative population distribution of (all) municipalities and prefectures, and they seem not to have changed so much in these 26 years. This appears similar to (1) the double Pareto distribution, which is closely matched to the head of a log-normal distribution, and the tail of a power law distribution or (2) the single power law distribution. Second, we investigate the origin of the distribution by using simple stochastic models (Random Multiplicative Process (RMP) and Preferential Urn Model (PUM)). These stochastic models can generate a power law distribution. We found the parametric control methods of these models. Using this controllability, we explained the origin of the cumulative population distributions. In these models, randomness plays an important role in generating a power law distribution. In the RMP, we assume the growth rate and unexpected comings and goings of each area are uniform. This means all areas are equality. In the PUM, we assume each area has different attractiveness and people move depending on them. This means people can move freely anywhere. In other words, discrepancy in population inter-areas naturally arises in the society where free growth and movement were guaranteed. It is very interesting to be able to reproduce the population distribution by such simple mechanisms.

This controllability of RMP and PUM can be applied to a power law distribution in various other fields related to complex systems and social networks.