

Analysis of Population Decline Using Stable Population Model and Sensitivity Analysis -Prospects for Theory Construction Considering Migration between Regions-

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In this paper, we introduce a generalized Leslie matrix with migration and aim to construct a mathematical model that analyzes the effects of birth, death, and internal migration on population decline by sensitivity analysis. Sensitivity analysis is a method of numerically calculating the partial derivative coefficient of parameters such as birth rate, mortality rate, and migration rate for each age concerning the intrinsic rate of natural increase in a stable population model. Parameters with high values indicate that they have a substantial contribution to population decline, and thus are considered useful for quantitative evaluation of priority issues. This method is not only used in demography but also in conservation ecology. It has also been a guide for endangered species protection activities. The tendency to fall below replacement-level fertility, which has continued for more than 45 years, can assume to be a stable population model that is heading toward population decline, depending on the age of the population. Therefore, while citing the analysis of Leslie matrices using values of all Japan, we will discuss the effects of population decline due to differences in births and migration between regions, together with the model construction that we aim to.

Keywords: Declining birth rate, Leslie matrix, Data analysis, Markovian process