

Mathematical Modelling Analysis

on

Persistence and Extinction of Family Names

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ABSTRACT FOR SEMINAR CONTRIBUTION

Personal name generally consists of family and given names. The former is hereditary from parent to children in most countries around world. The latter is given to children by parent and in general not hereditary. Family members usually have the common family name.

We consider in this work how the number of people in a family line with the same family name increases or decreases by chance from a probabilistic viewpoint: The number of children born from a couple could be regarded as stochastic event. Theoretical arguments about this problem were first given by H.W. Watson and followed by F. Galton in the end of the last century (Watson and Galton, 1874; Galton, 1891). Their mathematical modelling is with the stochastic process called *the Galton-Watson branching process*. Galton and Watson considered the probability for the extinction of family lines or family names (Watson and Galton, 1874; Galton, 1891). The same problem was reconsidered by A. J. Lotka in 1931 (Lotka, 1931). Lotka estimated the probability for the extinction of family name in the United States, using a statistical data of 1920.

In this work, for the mathematical modellings with the Galton-Watson branching process, we assume that the *successor*, regardless of sex, inherits the considered family name, and we mathematically discuss some problems about the persistence and the extinction of family names, and consider the probability distribution of the number of successors, taking account of the birth rate and the sex ratio of successors, the succession rate of family name. With our mathematical models, we discuss the effect of those rates for family name succession on its persistence. Moreover, we consider the case when the succession rate of family name depends on the sex of successor.

To try to give some perspectives with respect to the persistence of the present Japanese family names, we estimate the probability of extinction of family name, making use of some statistical data and the theoretical results by mathematical modelling with branching process. As a result, the probability of extinction of family name in Japan is smaller than 1 and the probability with which family name persists is not zero at present. With some mathematical results by the modelling analyses, we consider the effect of sex ratio and unmarried ratio of the present successors on the probability for the ultimate extinc-

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tion of family name. When a family name is succeeded from a father to his sons, if the male ratio in the children is higher, the probability of extinction of the family name is smaller. As the unmarried ratio gets higher, the probability is higher.

In the present Japan, we can find so many family names. We analyzed the characteristic natures of the frequency distribution of Japanese family names, using the data of family names by Meiji Life Insurance Company, and found a rank-size relation called Zipf's law for the frequency distribution of family names. With our framework of mathematical modelling, we will try to discuss some nature of the rank-size relation following Zipf's law, too.

REFERENCES

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