集団内での情報流布に関する個体群ダイナミクスモデル
A population dynamics model for the information spread in a community

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In this talk, we are going to construct a mathematical model to describe the temporal variation of the frequency of accepters for a matter which is spreading over a community. Our mathematical model is a population dynamics model taking account of the heterogeneity in the individuality that characterizes the easiness/hardness to accept the matter. For example, the matter may be the custom to wear a mask or to pay by a credit card. It may be a mode about the clothes, or a fake news. In history, we may consider the spread of an innovation or the penetration of a novel appliance as the example. These can be regarded in general as the spread of an information over the community. In sociological science, such process of the spread of an information was theoretically discussed in some contexts, in which Mark Granovetter's works are well-known [1, 2, 3]. The simple model used by Granovetter was sometimes called *threshold model* today.

In our work, we shall construct and analyze the following new population dynamics model of difference equation, of which a special case may be regarded as corresponding to the Granovetter's threshold model, and especially discuss how the heterogeneity about the individuality in the community could affect the spread of an information over the community:

$$P_{t+1} = \left[1 + \gamma b\{\varphi_0 - P_t + (1 - \varphi_0)F(\alpha P_t)\}\right] P_t,$$

where P_t means the frequency of accepters at time-step t (e.g., in the unit of day) about an information in the considered community. φ_0 is the initial frequency of accepters. Parameters γ and b are positive constants, which respectively mean the probability to make the decision to make the decision to accept or deny the information and the likeliness to get the chance to do it. The value αP_t with a positive constant α is the strength of the social effect of accepter's frequency on the decision-making. The function F defines the frequency distribution of threshold with respect to the decision-making in the community, that reflects the heterogeneity of individuality about the decision-making. Following the idea of Granovetter's threshold model, the rule of decision-making is assumed to be governed by the following rule: the decision-making is possible for the individual with the threshold ξ only if $\xi \leq \alpha P$, while it is not available if $\xi > \alpha P$, where the threshold ξ characterizes the individuality according to the decision-making about whether he/she could accept the information arrived at him/her. The value of $F(x)$ gives the frequency of members who have the threshold less than x in the community.

References

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