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Urban chaos and replacement dynamics in nature and society

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(Submitted on 5 Jun 2011)

Many growing phenomena in both nature and society can be predicted with sigmoid function. The growth curve of the level of urbanization is a typical S-shaped one, and can be described by using logistic function. The logistic model implies a replacement process, and the logistic substitution suggests non-linear dynamical behaviors such as bifurcation and chaos. Using mathematical transform and numerical computation, we can demonstrate that the 1-dimensional map comes from a 2-dimensional two-group interaction map. By analogy with urbanization, a general theory of replacement dynamics is presented in this paper, and the replacement process can be simulated with the 2-dimansional map. If the rate of replacement is too high, periodic oscillations and chaos will arise, and the system maybe breaks down. The replacement theory can be used to interpret various complex interaction and conversion in physical and human systems. The replacement dynamics provides a new way of looking at Volterra-Lotka's predator-prey interaction, man-land relation, and dynastic changes resulting from peasant uprising, and so on.

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