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THE EFFECT OF TIME DELAY AND PERIODICITY ON SOME POPULATION MODELS

In this talk, I would like to introduce three topics from my recent research on the global dynamics of some population models. The effect of time delay and periodicity for the models will be discussed.

1. Global stability of logistic equations with multiple delays

We study stability property for logistic difference equations which model a dynamics of a single population with non-overlapping generation. For the case that the growth rate is depend on a past generation, $3/2$ type stability condition is known as a sharp global stability condition of the model. However, if the growth rate of the population depends on "multiple" past generations, we show that the " $3/2$ type condition" can be relaxed and there exists a several global stability conditions depend on the effect of each generation. Some examples are presented.

2. Global dynamics for SEIRS epidemic model in a periodic environment

To account for the effect of periodicity due to seasonality in disease transmission dynamics, we study a periodic SEIRS (Susceptible-Exposure-Infective-Recover-Susceptible) epidemic models. It is shown that the global dynamics is determined by the basic reproduction number which is defined through the spectral radius of a linear integral operator. Our results essentially improve the results in Zhang and Teng (2007) and suggested that the eradication policy on the basis of the basic reproduction number of the time-averaged system may overestimate the infectious risk of the periodic disease.

3. Dynamics of viral infection models with immune response and three kinds of time delay

In this section, we study effect of three kinds of time delays on virus dynamics. At first, to account for the time lag between the time target cells are contacted by the virus particles and the time new virus are produced from infected cells, we consider a viral infection model with two time delays. By constructing Lyapunov functions, we show that the global dynamics of the models is fully determined. Next, we incorporate the immune response for the model and, in this case, the global dynamics is also fully determined.

However, if there exists a time lag due to a delayed immune response, we can see that there exists a periodic solution by a numerical study. Delayed immune response only causes the existence of periodic solution, while latency period and virus production period does not change the dynamics dramatically.