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TIME-VARYING EPIDEMIC TRANSMISSION IN HETEROGENEOUS NETWORKS

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Classic epidemiological models are generally based on two assumptions: first, the mass-mixing, which means all the individuals have a uniform contact pattern, and second, that the parameters - such as the transmission rate - are constant in time. Of course, while these assumptions may simplify the analysis, it can be useful to formulate models with a more realistic approach. Simple models could be refined, starting from two observations.

First of all, a person would transmit or contract the disease from their own neighbourhood of individuals which they have contact relationships with. Moreover, spreading also depends of connections between individuals. Therefore, it is reasonable to replace the assumption of the mass-mixing with heterogeneous networks, that specify who is connected to whom and in which way [1]. In this context, each person is a node and the degree k of a node is defined as the number of neighbourhood of an individual.

Regarding the second assumption, an other consideration that we make is about the parameters. A more reasonable approach should take into account seasonality of the disease; the basic idea is taking parameters which depends on a switching signal. In particular, the most common approach is consider a time-varying transmission rate [2]. For simplicity, it has been considered the transmission rate as a piece-wise constant function, subject to a switching rule.

I will talk about SIS, SIR, SIRS and SEIR models with network contact patterns and time-varying transmission rates. The behaviour of these models is analysed, discussing the existence of the endemic equilibrium and developing stability criteria using the method of Lyapunov functions.

References

[1] Keeling, M. J., Eames, K. T. (2005). *Networks and epidemic models*. Journal of The Royal Society Interface, 2(4), 295-307.

[2] Liu, X., Stechlinski, P. (2017). *Infectious disease Modeling: a Hybrid Systems Approach*. Springer.

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