KYBERNETIKA — VOLUME 44 (2008), NUMBER 5, PAGES 705-714

Kermack-McKendrick Epidemics Vaccinated

Jakub Staněk

Abstract: This paper proposes a deterministic model for the spread of an epidemic. We extend the classical Kermack–McKendrick model, so that a more general contact rate is chosen and a vaccination added. The model is governed by a differential equation (DE) for the time dynamics of the susceptibles, infectives and removals subpopulation.

We present some conditions on the existence and uniqueness of a solution to the nonlinear DE. The existence of limits and uniqueness of maximum of infected individuals are also discussed.

In the final part, simulations, numerical results and comparisons of the different vaccination strategies are presented.

Keywords: SIR epidemic models; vaccination; differential equation;

AMS Subject Classification: 92D25; 37N25;

References

[1] H. Amann: Ordinary Differential Equations: An Introduction to Nonlinear Analysis. Walter de Gruyter, Berlin – New York 1990.

[2] N. T. J. Bailey: The Mathematical Theory of Epidemics. Hafner Publishing Company, New York 1957.

[3] D. J. Daley and J. Gani: Epidemic Modelling: An Introduction. Cambridge University Press, Cambridge 1999.

[4] P. Greenwood, L. F. Gordillo, A. S. Marion, and A. Martin-Löf: Bimodal Epidemic Side Distributions for Near-Critical SIR with Vaccination. In preparation.

[5] J. Kalas and Z. Pospíšil: Spojité modely v biologii (Continuous Models in Biology). Masaryk University, Brno 2001.

[6] W. O. Kermack and A. G. McKendrick: A contribution to the mathematical theory of epidemics. Proc. Roy. Soc. London A 155 (1927), 700–721.

[7] J. Štěpán and D. Hlubinka: Kermack–McKendrick epidemic model revisited. Kybernetika 43 (2007), 395–414.

[8] J. Štěpán: Private communication.

[9] T. Wai-Yuan and W. Hulin: Deterministic and Stochastic Models of AIDS Epidemics and HIV Infections with Intervention. World Scientific, Singapore 2005.