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MATHEMATICAL MODELS IN ECOLOGY

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ABSTRACT

Mathematical modelling is the process of translating the real word problem into the mathematical problem, solving mathematical problem to get some useful results, and then these results are interpreted in the language of real world. Modelling consists of writing in mathematical terms what is first expressed in words, using variables where necessary. Mathematical models are used in the natural sciences , engineering as well as in the social sciences. Statisticians, operations research analysts, and economists use mathematical models hugely. A model may help to explain a system and to study the effects of different components, and to make predictions about the problem. In this paper we shall discuss about the mathematical modelling and its use in ecology.

Keywords: *Mathematical Modelling, Infected, Susceptible*.

I. INTRODUCTION

Mathematical Models are idealized abstraction that represents situations, activities, processes, etc. by means of mathematical techniques. It may not be possible to translate a real problem into mathematical problem in its generality. The real world system is to be first idealized or simplified and then represented using mathematical notations. Sometimes the idealization or simplifications are so drastic that real problem is approximated by another problem and then mathematical representation may be given.

II. EPIDEMIC MODEL

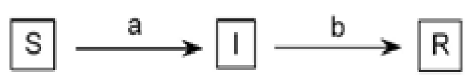
An epidemic model is simplified means of describing the transmission of communicable disease through individuals. Modelling of infectious diseases is a tool with the help of which we study the features of the spreading disease, and then predict the future course and to find the proper solution of the epidemic. There are two types of epidemic models: stochastic and deterministic. Stochastic models are used in small populations and deterministic models are used in those areas where the population is large. Moreover the real world is nonlinear; fitting the components together is a much harder puzzle Here in this paper I shall discuss few simple epidemic models.

SIR Epidemic

- In SIR model we use the three compartments: susceptible S(t); infected I(t);and removed R(t).
- S(t) represents the number of individuals not yet infected with the disease at time t.
- I (t) represent the number of individuals who have been infected with the particular disease and they are spreading the disease to those who are in susceptible category.
- R (t) is used to those who have been infected and then recover their disease either due to immune or death. Individuals in this category are not supposed to be infected again.

SIR Equations

- Becoming infected depends on contact between Susceptible and Infected *(aSI)*
- Recovery is at a constant rate, proportional to number of Infected *(b).*



$$\begin{aligned}\frac{dS}{dt} &= -aSI\\ \frac{dI}{dt} &= aSI - bI\\ \frac{dR}{dt} &= bI\end{aligned}$$

SIS Epidemic

You get sick, then recover, but without immunity. For example the common cold. To get SIS equation we remove the equation representing the recovered population from the SIR model and adding those removed from the infected population into the susceptible population gives the following equations:

$$\boxed{S} \underset{b}{\overset{a}{\rightleftarrows}} \boxed{I}$$

$$\begin{aligned}\frac{dS}{dt} &= bI - aSI\\ \frac{dI}{dt} &= aSI - bI\end{aligned}$$

SI Epidemic

Some epidemic are non recoverable. So if an individual comes in contact with the infected forever in the infected category and remove from the subsection category. Here r is the growth rate of susceptible individuals which is assumed to be constant.

$$\frac{ds}{dt} = r - aSI$$

Susceptible →→Infected

$$\frac{dI}{dt} = aSI$$

III. CONCLUSION

These are the few basic epidemic models discussed here. There are many more models to discuss about the epidemiology. The extensive study of epidemic is important to learn about how disease spread and how to control the spread of disease. Networks are of fundamental importance in studying the spread of disease. One can make the models more perfectly by taking another variable also which affects the individuals to reach at the equilibrium point. So the proper research is necessary.

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