THE SIMULATION OF STOCHASTIC EPIDEMICS IN TWO DIMENSIONS

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1. Introduction

The real purpose of epidemic theory is not to develop interesting and elegant mathematics, though this may be a delightful incidental byproduct, but is to facilitate the practical prevention or control of actual outbreaks of serious contagious disease. This purpose is still a long way from being achieved to any appreciable extent. The developed countries are today free from disasters of the magnitude of the Black Death in the 14th century when perhaps as much as 25 per cent of the population in Europe perished. Nevertheless, widespread epidemics on a massive scale are still common in Africa and the Far East. As the volume and speed of modern travel continue to increase there is an ever growing risk of the transmission of virulent infections to regions where natural immunity may be low though public health control is, for ordinary purposes, more or less adequate. Even within a developed country there are possible dangers from such factors as the appearance of new strains of infectious organisms resistant to standard drugs and antibiotics, or increases in the contact rate between individuals due to greater population densities or changes in social behavior. The current increase in venereal infections in many countries could be a case in point. It follows therefore that it is eminently worth considering in what directions research should proceed in order to have an improved chance of attaining its object.

As with applications to many other fields in biology and medicine, the attempt to develop mathematical theories of epidemics exhibits the usual conflict between insight and realism. Epidemic theory falls into two distinct, though complementary, parts. On the one hand, there is the study of small groups like individual families. From these it is possible, though not often done, to collect detailed data to which relatively realistic models can be fitted, yielding information about such biological or clinical entities as contact rate, length of latent and infectious periods and so forth. However, little can be deduced from this about the spread of infection through a community. The latter requires the special theory of large groups. This provides some insight into the behavior of population outbreaks, with regard to such features as threshold phenomena or the general graphical appearance of "epidemic curves." Unfortunately, even the