PROBLEMS IN CONTAGION

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1. Introduction

The purpose of this paper is to present some actual problems involving contagion together with a review of recent work on the subject. Attention is focused on two avenues of investigation which have been followed in England and the United States for the past four or five years. This is not meant to be a comprehensive review, since the results given are selected primarily from applications of stochastic process techniques to accident and epidemic studies.

In studying contagion, we first consider the idea of the "risk" of occurrence of one of a class of events. We assume that if one situation has more risk than a second, then the former would be expected to have more occurrences of the type of events in question than the latter. We do not try to define risk in general terms; however, by observing the number and times of occurrences of events, we can define various specific risk measures. The word "proneness" is usually used in connection with an individual and may be interpreted as the risk associated with an individual in a particular situation. Sometimes one speaks of an underlying proneness, independent of situation, which is supposed to exist in each person. This notion will not concern us at this time, and we constrain our viewpoint to the one which involves both the individual and the situation. When risk is measured for an individual we have a measure of proneness.

Suppose a process is such that proneness depends upon the number of events previously incurred by a person. Then we say there is *individual contagion* in the process. Perhaps the first event serves as a reminder and reduces risks of future events. This would be called *negative contagion*. If, on the other hand, an event were to change a person somehow, so that he became more susceptible to future events, *positive contagion* would exist. When a person's proneness depends on the events which have occurred to others in his environment we say there is *between individual contagion* with positive and negative connotations as just given.

In order to fix ideas somewhat, a few illustrations of situations involving contagion will be given. Of particular interest are cases in which contagion is observed in connection with epidemics and the spread of disease. Some of these situations have recently been brought to the attention of the author by members of the Commission on Respiratory Diseases of the Armed Forces Epidemiological Board.

2. Some problems involving contagion

2.1. *Living conditions.* Presently under investigation at two United States Air Force bases is the epidemiology of upper respiratory diseases. These are contagious diseases which present a serious problem to the armed forces because of the great amount of time lost due to them. It has been noticed in some preliminary work that