# A CLASS OF STOCHASTIC MODELS OF RESPONSE AFTER INFECTION IN THE ABSENCE OF DEFENSE MECHANISM

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## 1. Introduction

In experimental studies of quantal response to infection three factors of essential interest are (i) the microorganisms, henceforth called particles, (ii) the host, and (iii) the type of response. The particles are *self-reproducing* entities, usually bacteria or viruses, which are inoculated with differing intensities into groups of hosts, such as animals, egg membranes, or tissue cultures. The response which the particles elicit from the host during the course of time may be death, the development of a tumor or a local lesion, or some other detectable symptom. The phenomenon of particular interest here is observed in the following.

At time $t = 0$ a certain dose of a suspension of specified virulent particles is injected into each of $n$ experimental hosts. If $n(t)$ denotes the number of hosts not responding by time $t$, the plot against $t$ of either $n(t)$ itself or of the proportion $q(t) = n(t)/n$ is known as the time dependent response curve. If the response is the death of the host, the curve is also called the survival curve. As is well known, the response curves differ with the dose and with the type of particles injected. Generally, the larger the injected dose, the sooner the host responds, that is, the steeper is the decrease in $q(t)$. The purpose of the present paper is to examine a class of stochastic models for the time dependent response curves with the hope that some of these will be useful in certain situations to be discussed later. It is to be emphasized, however, that we will not concern ourselves here with those situations where the response causing agent is not a self-reproducing entity. The reader may find discussion of these elsewhere [7].

Most of the earlier mathematical models related to the time dependent response curves treat the case where the response is the death of the host, although this is by no means a restriction of their applicability to other cases. A brief reference to these is desirable here.

Wiggins [20] has studied a stochastic model of survival of an animal injected with a certain dose of virulent bacteria. He assumes that the body of the host is divided into three regions $R_1$, $R_2$, and $R_3$, with the following properties. If a bacterium enters $R_3$, it is rendered noninfectious, and nothing happens to the

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