Analysis of Censored Data
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Competing Risks In Bioassay : A Nonparametric Bayesian Approach*

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Abstract

We extend the well known bioassay formulation to allow two competing risks at each dose level / stress level. The non-parametric Bayesian analysis is based on two cumulative incidence functions. After suggesting a suitable prior distribution we derive the exact posterior means for any finite number of stress levels in case of competing risks bioassay. Incidentally, exact posterior means in the usual bioassay problem can also be given on the same lines without much difficulty. Sampling based approaches to approximate marginal posterior distributions and their interesting features are also illustrated. A useful modification in the prior distribution which treats the case of ordered cumulative incidence functions is presented. Illustrative examples are provided.

1 Introduction

Suppose $0 = s_0 < s_1 < \ldots < s_k < s_{k+1} = \infty$ are the k dose or stress levels in a bioassay problem. The potency p_i which is the probability of the desired response (death/ failure etc.) of the stimulus when the i-th dose level s_i is administered to the subject is given by $F(s_i)$, the value of the potency curve F at s_i. Here F is assumed to be an appropriate distribution function with $F(0) = 0$ and $F(\infty) = 1$. In many situations, the subject shows one of several possible responses or none at all. This situation may be observed when the stimulus or stress leads to death due to a particular risk out of several possible competing risks. In the usual analysis concerning accelerated testing the emphasis is on discovering a relationship between the stress levels and the probability of failure. If there are competing failure modes then there would be interest in estimating and comparing the probabilities of failure at

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