SEQUENTIAL DESIGNS FOR BINARY RANDOM VARIABLES

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Let $X(n)$, $n \geq 1$, be a sequence of treatments for which the outcomes are binary random variables, $Y(n)$, $n \geq 1$. We take the treatment space to be a finite set of K points: $\Omega_X = \{x_1 < \cdots < x_K\}$. Let the probability of response vary with some stimulus x. Designs are presented for two scenarios. First assume that $P\{Y(n) = 1|x\}$ increases with x, as is the case when Y is toxicity and x is dose. For this scenario, the goal is to estimate the dose μ for which $P\{Y(n) = 1|\mu\} = \Gamma$, where Γ is prespecified. Another objective is to avoid treatment at highly toxic dosages. In the second scenario $Y(n)$ indicates success, and we assume that the response function $P\{Y(n) = 1|x\}$ is a unimodal function of x. This is the case when too little and too much treatment are both bad and the goal is to estimate the dose μ with the maximum success probability. In this scenario it is desirable to avoid treatments with high risk of failure. For these scenarios, we describe up-and-down designs and designs based on urn models that cause treatments to cluster around, or converge to, the unknown target μ. These designs are characterized using Markov chains and branching processes. Of note, they make no parametric assumptions about the response function.