UP-AND-DOWN DESIGNS I: STATIONARY TREATMENT DISTRIBUTIONS

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Abstract

The primary objective of experiments motivating this work is to estimate the unknown amout μ of treatment that has a probability of response equal to a fixed value $\Gamma, 0 \leq \Gamma \leq 1$. We further assume that it is desirable to 'center' the distribution of treatments around the unknown quantile. This is accomplished by sequentially assigning treatment levels to subjects using *up-and-down rules*, that is, rules by which the treatment used in the next trial is restricted to be one level higher, one level lower, or the same as it is for the current trial. We describe two such rules that asymptotically result in a unimodal distribution of treatment assignments with mode as close to μ as is possible given the discreteness of the treatment levels permitted. Responses are assumed to follow an extreme value function and a logistic function to illustrate how a parametric stationary treatment distribution can be determined by pairing a response function model with an up-and-down design. The designs are shown to be robust with respect to the form of the response function.