Optimal Adaptive SMART Designs with Binary Outcomes

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Abstract

In a sequential multiple-assignment randomized trial (SMART), a sequence of treatments is given to a patient over multiple stages. In each of the stages, randomization may be done to allocate patients to the different treatment groups that have been considered for the SMART. In spite of SMART designs getting popular among clinicians/clinical researchers, the methodologies for the adaptive randomization at different stages of a SMART are still few and not sophisticated enough to deal with the complexity of optimal allocation of treatments at each and every stage of the trial. Lack of optimal allocation methodologies can raise serious concerns about SMART designs from an ethical point of view. In this work, we have developed an optimal adaptive allocation procedure to minimize the expected number of treatment failures for a SMART which has a binary primary outcome. Issues related to optimal adaptive allocations are explored theoretically along with detailed supporting simulations. The applicability of the proposed methodology is also demonstrated using a recently conducted SMART study named M-Bridge for developing an universal and resource-efficient dynamic treatment regimes (DTRs) for incoming first-year college students as a bridge to desirable treatments to address alcohol-related risks for those students.

STANDBY REDUNDANCY ALLOCATION FOR SERIES AND PARALLEL SYSTEMS

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The allocation of redundant components to a system is an efficient technique to improve the lifetime of a system. In this paper, we study the problem of two standby redundancy allocations for series and parallel systems, consisting of n-component ($n \geq 2$), in the sense of various stochastic orderings. It is assumed that components and redundancies follow a general lifetime distribution. For the case of allocating two redundancies to a series (parallel) system, we show that allocating the relatively stronger redundancy to the weaker component and the weaker redundancy to the stronger components can result in a system lifetime that is longer (shorter) in terms of the usual stochastic order. Moreover, various results associated with the hazard rate and reversed hazard rate orders are established. The outcomes of various papers are strengthened and generalized through our results. In addition, some applications are provided to illustrate our findings.

NONPARAMETRIC METHOD OF MULTIPLE STRUCTURAL BREAK DETECTION IN TIME SERIES

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Structural breaks have gained much popularity in the recent statistics literature due to its applicability in diverse fields starting from hydrology, climate research, cryptography, to medicine research and finance. The general problem of structural break detection concerns the inference of a change in distributional characteristics for a set of time-ordered observations. This paper develops a novel methodology for detecting structural breaks in time series data using a non parametric regression setup with possibly unknown drift and diffusion function. The proposed test statistic is based on the kernel estimate directly, and hence it facilitates easy computation and gives better small sample performance than traditionally existing methods. The procedure can be shown to work well for a wide range of dependence structure in the covariates present in the regression model, including the presence of structural breaks in themselves. Simulation studies suggest that the test is capable of detecting accurate breaks even in presence of non stationarity, heavy tailedness and other contamination. As an exemplary application the test is applied to Bitcoin returns of past 4 years and relevant breaks were detected.