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# VARIABLILITY IN ADAPTIVE DESIGNS FOR ESTIMATION OF SUCCESS PROBABILITIES

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Three adaptive allocation rules for use when estimating the difference in success probabilities are proposed and studied via simulation. The rules are motivated by the need for randomization and reduction of experimenter bias, and they are adaptive in that the decision about which population to sample at each stage can depend on data collected up to that stage. The empirical mean square errors for these rules and two non-adaptive rules are compared. For moderate total sample sizes and moderate values of the success probabilities, it is shown that "adapting" substantially increases the mean square error over that of the simple totally randomized allocation rule which allocates at each stage to each population with probability 0.5. However, with total sample sizes of 100 and upward, adaptive rules do just as well as the totally randomized rule for moderate success probabilities, and do much better for more extreme values of the success probabilities.

**1. Introduction.** Suppose we have two Bernoulli populations, A and B, with respective success probabilities, $p_A$ and $p_B$, and failure probabilities $q_A = 1 - p_A$ and $q_B = 1 - p_B$. The setting could be clinical, with two treatment populations with cure rates equal to the success probabilities, or industrial with two brands of a component with failure rates equal to the success probabilities. In the clinical application, methods of allocating patients to treatments to lower the selection bias, the effect of trends in the data, and the number of patients on the inferior treatment have been proposed. These methods are typically adaptive in that decisions about future allocations depend on past observations. An excellent overview of such methods can be found in Rosenberger (1996).

While many adaptive designs have been suggested and studied in the clinical setting, few have been studied in the industrial setting. The goal of this work is to look at several adaptive allocations where the purpose of experimentation is the estimation of the difference, $p_A - p_B$, and the primary allocation goal is to minimize the variance of the estimator when a fixed total number of observations can be taken. Secondary

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