Two-Sample Rank-Sum Test under Order Restricted Randomized Designs

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Abstract: A new nonparametric test is proposed based on order restricted randomized design (ORRD) for the location shift between two populations. The ORRD is similar to a ranked set sample and exploits the use of the subjective information on experimental units. Under the ORRD, sets of experimental units are recruited from a population along with subjective information that they may have. This subjective information is then used to create artificial covariates through judgment ranking of the experimental units. These artificial covariates with a proper randomization scheme induce a positive correlation structure among within-set response measurements. This positive correlation structure then acts as a variance reduction technique in the inference of a contrast parameter in an ORRD.

Based on the ORRD, a rank-sum test is developed. It is shown that the asymptotic null distribution of the proposed test is distribution-free even if the ranking information is not perfect. The point and interval estimates for the location shift parameter are developed. An optimal design is constructed by maximizing the asymptotic Pittman efficacy of the test. It is shown that the test outperforms its competitors even under imperfect ranking information. The use of the proposed test is illustrated in a data set from a clinical trial study.