Stratified Multivariate Mann-Whitney Estimators for the Comparison Of Two Treatments with Randomization Based Covariance Adjustment*

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Methodology for the comparison of two randomly assigned treatments for strictly ordinal response variables has discussion in terms of multivariate Mann-Whitney estimators with stratification adjustment. Although such estimators can have direct computation by two-way analysis of variance for within stratum ridits (as ranks/(sample size) within each stratum), determination of a consistent estimator for their covariance matrix is through methods for multivariate U-statistics. The scope for these methods includes ways of managing randomly missing data and for invoking randomization based covariance adjustment for no differences between treatments for background or baseline covariables. The assessment of treatment differences can be through confidence intervals or statistical tests for the adjusted Mann-Whitney estimators in their own right or for their counterparts from linear logistic models. Three examples have illustrative results presented for the methods in this paper. The first example is a randomized clinical trial with four strata and a univariate ordinal response variable. The second example is a randomzed clinical trial with four strata, two covariables (as age and baseline) and four ordinal response variables. The third example is a randomzed two period crossover clinical trial with four strata, three covariables (as age, screening, first baseline) and three response variables (as first period response, second baseline, second period response). For each of these examples, the results from analyses with adjusted Mann-Whitney estimators are interpretable in terms of the probability of better outcomes for test treatment than the control treatment. When the distributions of each of the response variables for the two treatments have compatibility with the proportional hazards assumption, the interpretation of adjusted Mann-Whitney estimators can be through their hazard ratio counterparts as well.

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