CrossMark

Depth-based runs tests for bivariate central symmetry

**Rainer Dyckerhoff · Christophe Ley ·
Davy Paindaveine**

Abstract McWilliams (J Am Stat Assoc 85:1130–1133, 1990) introduced a non-parametric procedure based on runs for the problem of testing univariate symmetry about the origin (equivalently, about an arbitrary specified center). His procedure first reorders the observations according to their absolute values, then rejects the null when the number of runs in the resulting series of signs is too small. This test is universally consistent and enjoys good robustness properties, but is unfortunately limited to the univariate setup. In this paper, we extend McWilliams' procedure into tests of bivariate central symmetry. The proposed tests first reorder the observations according to their statistical depth in a symmetrized version of the sample, then reject the null when an original concept of simplicial runs is too small. Our tests are affine invariant and have good robustness properties. In particular, they do not require any finite moment assumption. We derive their limiting null distribution, which establishes their asymptotic distribution freeness. We study their finite-sample properties through Monte Carlo experiments and conclude with some final comments.