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Asymptotics for the Tukey depth process, with an application to a multivariate trimmed mean

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We describe the asymptotic behaviour of the empirical Tukey depth process. It is seen that the latter may not converge weakly, even though its marginals always do. Closed subsets of the index set where weak convergence does occur are identified and a necessary and a sufficient condition for the asymptotic normality of the marginals is given. As an application, asymptotic normality of a Tukey depth-based multivariate trimmed mean is obtained for smooth distributions.

Keywords: Brownian bridge; empirical process; multidimensional trimmed mean; Tukey depth