AISM (2008) 60:205–224
DOI 10.1007/s10463-006-0083-3

Saddlepoint approximations for multivariate *M*-estimates with applications to bootstrap accuracy

Chris Field · John Robinson · Elvezio Ronchetti

Received: 4 March 2005 / Published online: 18 October 2006

Abstract We obtain marginal tail area approximations for the one-dimensional test statistic based on the appropriate component of the *M*-estimate for both standardized and Studentized versions which are needed for tests and confidence intervals. The result is proved under conditions which allow the application to finite sample situations such as the bootstrap and involves a careful discretization with saddlepoints being used for each neighbourhood. These results are used to obtain second-order relative error results on the accuracy of the Studentized and the tilted bootstrap. The tail area approximations are applied to a Poisson regression model and shown to have very good accuracy.

Keywords Empirical saddlepoint · Relative errors · Studentized *M*-estimates · Tail area approximation · Tilted bootstrap