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Extensions of saddlepoint-based bootstrap inference

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Abstract We propose two substantive extensions to the saddlepoint-based bootstrap (SPBB) methodology, whereby inference in parametric models is made through a monotone quadratic estimating equation (QEE). These are motivated through the first-order moving average model, where SPBB application is complicated by the fact that the usual estimators, method of moments (MOME), least squares, and maximum likelihood (MLE), all have mixed distributions and tend to be roots of high-order polynomials that violate the monotonicity requirement. A unifying perspective is provided by demonstrating that these estimators can all be cast as roots of appropriate QEEs. The first extension consists of two double saddlepoint-based Monte Carlo algorithms for approximating the Jacobian term appearing in the approximated density function of estimators derived from a non-monotone QEE. The second extension considers inference under QEEs from exponential power families. The methods are demonstrated for the MLE under a Gaussian distribution, and the MOME under a joint Laplace distribution for the process.