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EDITORS' INTRODUCTION: SPECIAL ISSUE ON EMPIRICAL LIKELIHOOD AND RELATED METHODS

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Generalized method of moments (GMM) has been the workhorse for estimation and inference in models specified by moment restrictions for much of the last two or more decades. Suitably formulated GMM delivers semi-parametrically efficient estimators in both unconditional and conditional moment condition scenarios. The most popular method for estimation is two-step (2S) GMM estimation, which has the virtue of computational simplicity. However, a lack of accord for 2SGMM between large sample analysis and finite sample performance has become increasingly apparent. In particular, a number of studies have concluded that 2SGMM may be severely biased.

Empirical likelihood (EL) and related estimators represent an alternative class of procedures for estimation and inference in moment condition models. A particular feature of EL is that it may be given a nonparametric maximum likelihood (ML) interpretation. In a correctly specified parametric environment, of course, ML is asymptotically efficient, and inference methods based on ML also display optimality properties. Indeed, EL shares the semiparametric efficiency properties of 2SGMM and other GMM procedures. Likewise, bias-corrected EL has a higher order optimality property. Such limited evidence as there is seems to confirm the empirical superiority of EL and related methods over 2SGMM.

We express our appreciation to all contributors and to the Editorial Board of *Econometric Theory* for the opportunity to publish this Special Issue. We are particularly grateful to the referees for their assistance in the review process without which this Special Issue would not have been possible. The referees will be included in the general list of referees for *Econometric Theory* that appears regularly on the journal website. Address correspondence to Yuichi Kitamura, Cowles Foundation for Research in Economics, Yale University, 30 Hillhouse Avenue, New Haven, CT 06511; e-mail: yuichi.kitamura@yale.edu.

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The collection of papers that appear in this Special Issue of *Econometric Theory* on Empirical Likelihood and Related Methods addresses a number of topics of current research interest. The papers published here cannot be gathered easily under any one heading. Consequently, the papers in this Special Issue are ordered to reflect rather broad subject headings as far as possible rather than any particular individual intellectual merit of the papers. Briefly, the topics examined may be summarized as follows: Confidence interval estimation is addressed in two of the papers. Estimation subject to moment conditions with nonparametric components and with nonsmooth unconditional moment indicators are analyzed in a further two papers. Inference methods for stratified samples are the subject of another paper, with nonnested tests for competing conditional moment restrictions models proposed in the remaining paper.

The first three papers of this Special Issue concern particular estimation issues for moment condition models. The focus of the paper by Taisuke Otsu is a general estimation method for conditional moment restriction models with unknown functions allowing for both endogenous and exogenous variable arguments in the nonparametric component. Conditional EL forms the basis for estimation extended by the method of sieves so as to enable the inclusion of nonparametric components. Consistency and a convergence rate are obtained, respectively, for the parametric and nonparametric components. The sieve conditional EL estimator for the parametric component is asymptotically first-order equivalent to the optimal sieve minimum distance estimator and is thus asymptotic normally distributed and achieves the semiparametric efficiency lower bound. To illustrate, the paper analyzes a partially linear regression model with nonparametric endogeneity and heteroskedasticity. Gautam Tripathi considers the practically important situation where, rather than being a random sample, data are collected using a stratified sampling scheme, inducing a difference between the distribution of observations and that of the target population. Subsequent inference may potentially be distorted if this difference is not incorporated. This paper provides efficient inferential tools based on EL for models specified by unconditional moment restrictions appropriate for data obtained using stratified sampling that avoid a complete description of the distribution of the target population. The approach is sufficiently general to permit stratification by response variables, exogenous variables, or a subset of these variables. Closed-form expressions for the asymptotic variances of estimators are provided that allow standard errors to be easily estimated. Paulo Parente and Richard Smith develop asymptotic theory for the generalized empirical likelihood (GEL) estimators in nonsmooth moment condition models. Nonsmoothness is an important feature of certain econometric models frequently used in applications. For example, models with quantile restrictions are conveniently represented by moment conditions in terms of indicator functions, which are discontinuous. The Parente-Smith paper derives large sample properties of GEL for nonsmooth models under weak and general assumptions. Moreover, it proposes an inference framework that applies to a wide range of specification testing problems as well as parametric hypothesis testing. It has been recognized that

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estimating the asymptotic variance in nonsmooth models is often difficult, making inference in those models a difficult matter. The GEL-based testing framework of Parente and Smith has an important advantage of not requiring an estimator for the asymptotic variance. Simulations are used to demonstrate the efficacy of their procedure in a quantile IV setup.

Taisuke Otsu and Yoon-Jae Whang formulate nonnested tests for competing models, expressed in the form of conditional moment restrictions. By exploiting the requisite implied conditional probabilities based on conditional EL, moment-encompassing, Cox-type, and efficient score encompassing nonnested tests are formulated. Although there is an equivalence under the null hypothesis and local alternatives with some existing nonnested tests, this is not the case under the alternative. Consequently, there are significant differences in global power properties between the nonnested tests proposed in this paper and unconditional moment-based tests. The tests in general therefore will have nontrivial power against nonnested alternatives undetectable by unconditional moment-based tests. A number of simulation experiments confirm that these nonnested tests are superior to some existing tests in terms of size-corrected power.

The final two papers in this Special Issue address issues concerning confidence interval estimation. Ngai Hang Chan, Liang Peng, and Dabao Zhang consider a time series nonparametric regression model with heteroskedasticity of unknown form. Their paper proposes an EL-based method to obtain confidence intervals for the conditional variance function of the regression model. Their approach nicely blends EL and nonparametric techniques recently developed for this class of models. Interestingly, it successfully combines a bias reduction technique for nonparametric conditional variance estimation and the empirical likelihood ratio method, so that the resulting confidence interval enjoys the merits of the two methodologies. It also broadens the scope of applications of the empirical likelihood ratio test. The simulation results in the paper show that the EL-based confidence intervals with the bias reduction technique work quite well and decidedly outperform existing methods. Anouar El Ghouch, Ingrid Van Keilegom, and Ian McKeague study interval estimation of functionals of the survival distribution of a weakly dependent time series, allowing a general censoring scheme. Their paper proposes confidence intervals based on a Wald-type statistic, EL, and the blockwise empirical likelihood. It first develops an asymptotic approximation result for a general integral functional of the Kaplan-Meier distribution estimator for beta-mixing processes. This is a new result and potentially useful in its own right. Then, building on this result, the asymptotic validity of the confidence intervals is established. Their confidence intervals utilize a data blocking technique, thus one needs to choose block-length to implement them. Their paper addresses this important issue by proposing a data-driven block length selection method. Simulations confirm that the confidence interval based on the blockwise empirical likelihood performs well in finite samples.

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