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R-Estimation in Semiparametric Dynamic Location-Scale Models

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Abstract

We propose rank-based estimation (R-estimators) as an alternative to Gaussian quasi-likelihood and standard semi-parametric estimation in time series models, where conditional location and/or scale depend on a Euclidean parameter of interest, while the unspecified innovation density is a nuisance. We show how to construct R-estimators achieving semiparametric efficiency at some predetermined reference density while preserving root-n consistency and asymptotic normality irrespective of the actual density. Contrary to the standard semiparametric estimators, our R-estimators neither require tangent space calculations nor innovation density estimation. Numerical examples illustrate their good performances on simulated and real data.

Keywords: Conditional heteroskedasticity, Distribution-freeness, Discretely observed Lévy processes, Forecasting, R-estimation, Realized volatility, Skew-t family.

JEL classification: C13, C14, C22

1. Introduction

1.1. Gaussian dynamic location-scale models

Dynamic location-scale processes are essential tools in time series econometrics, and have motivated the study of increasingly diverse and sophisticated classes of discrete- and continuous-time models such as ARCH, AR-ARCH or AR-LARCH models, AR conditional duration models, or discretely observed diffusions with jumps. While the probabilistic properties of those models have been studied extensively and in great details, their statistical analysis is less exhaustive, and still presents several challenges; see, for instance, Drost et al. (1997), Aït-Sahalia (2006), Fernandes et al. (2007), Zhao (2008), Bibby et al. (2010), and references therein.

Among those challenges is the specification of underlying densities. All models considered in the literature involve some unobserved driving noise, the density of which is often specified to be Gaussian. Although Gaussian assumptions are unrealistic in most applications, an all too common belief is that violating them is essentially harmless, and that Gaussian Quasi-Likelihood (QL) inference methods remain safe and valid as soon as finite second-order moments exist.[1] In particular, QL estimators erroneously are surmised to be

[1] Actually, second-order moments are not sufficient, and root-n consistency and asymptotic normality of QL estimators, essentially, require finite *fourth* order moments; see Gouriéroux et al. (1984), Bollerslev and Wooldridge (1992), Hall and Yao (2003), Peng and Yao (2003).