Conditional score residuals and diagnostic analysis of serial dependence in time series models

A seminar by Paolo Gorgi

Department of Econometrics and Data Science School of Business and Economics Vrije Universiteit Amsterdam

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Department of Statistical Sciences

This paper introduces conditional score residuals and it provides a general framework for the diagnostic analysis of time series models. Conditional score residuals encompass standard definitions of residuals that are typically used in time series models. ARMA residuals, squared residuals and Pearson residuals are special cases of conditional score residuals when the conditional distribution of the model belongs to the exponential family. Instead, conditional score residuals provide an alternative definition of residuals when the conditional distribution is not of the exponential type. A key feature of conditional score residuals is that they account for the shape of the conditional distribution. This feature leads to more reliable and powerful diagnostic tools for testing residual autocorrelation. Furthermore, they can also be employed in complex models where it may not be clear how to define residuals. The asymptotic properties of the empirical autocorrelation function of conditional score residuals are formally derived. The results yield a unified theory for the diagnostic analysis of a wide class of time series models. The practical relevance of the proposed framework is illustrated for heavy-tailed GARCH models. Monte Carlo and empirical results support the finding that conditional score residuals are more reliable in testing residual autocorrelation, when compared to squared residuals. Finally, it is shown how a diagnostic analysis can be designed for dynamic copula models.
Authors:
P. Gorgi, F. Blasques, and S.J. Koopman