Largest eigenvalues of sample covariance matrix for p-variate time series of length n with heavy-tails

Richard A. Davis

Department of Statistics

Columbia University

New York, USA

Abstract: We consider the joint limit distribution of the k largest eigenvalues of a sample covariance matrix based on a p-variate time series of length n under various scenarios when the dimension p goes to infinity with n. In the first case, the component series' represent independent copies of a linear process whose noise have regularly varying tails with index $\alpha \in (0, 4)$. It is shown that a point process based on the eigenvalues of the sample covariance matrix converges in distribution to a Poisson point process with intensity measure depending on the tail index α and the sum of squares of the linear coefficients in the filter. Second, we consider the case when there is linear, as well as limited forms of nonlinear dependence, between the rows. In case of linear dependence, the limiting distribution of the eigenvalues is given via an explicit function of the coefficients in the linear filter. We also discuss the extension of these limiting results to nonlinear time series models including stochastic volatility and GARCH processes. (This is joint work with Thomas Mikosch, Oliver Pfaffel and Robert Stelzer.)

Key words and phrases: Random matrix theory, heavy-tailed distribution, random matrix with dependent entries, largest singular value, sample covariance matrix, largest eigenvalue, linear process, random coefficient model