

AN EFFICIENT AND ROBUST TEST FOR A CHANGE-POINT IN CORRELATION

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Workshop “Methods and Challenges in Financial Risk Management” 2012

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Abstract

For a bivariate time series $((X_i, Y_i))_{i=1, \dots, n}$ we want to detect whether the correlation between X_i and Y_i stays constant for all $i = 1, \dots, n$. We propose a nonparametric change-point test statistic based on Kendall’s tau and derive its asymptotic distribution under the null hypothesis of no change. The asymptotic distribution depends on the long run variance of Kendall’s tau, for which we propose an estimator and show its consistency.

Kendall’s tau possesses a high efficiency at the normal distribution, as compared to the normal maximum likelihood estimator, Pearson’s moment correlation coefficient. Contrary to Pearson’s correlation coefficient, it has excellent robustness properties and shows no loss in efficiency at heavy-tailed distributions.

We assume the data $((X_i, Y_i))_{i=1, \dots, n}$ to be stationary and P -near epoch dependent on an absolutely regular process. The P -near epoch dependence condition constitutes a generalization of the usually considered L_p -near epoch dependence, $p \geq 1$, that does not require the existence of any moments. It is therefore very well suited for our objective to efficiently detect changes in correlation for arbitrarily heavy-tailed data.

As two important theoretical contributions we prove two functional limit theorems for P -near epoch dependent processes, a U -statistic invariance principle and a bivariate empirical process invariance principle. We investigate the test numerically and compare it to previous proposals.

Preprint: <http://arxiv.org/abs/1203.4871v1>