Feng, Long; Jiang, Tiefeng; Liu, Binghui; Xiong, Wei
Max-sum tests for cross-sectional independence of high-dimensional panel data. (English)
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Summary: We consider a testing problem for cross-sectional independence for high-dimensional panel data, where the number of cross-sectional units is potentially much larger than the number of observations. The cross-sectional independence is described through linear regression models. We study three tests named the sum, the max and the max-sum tests, where the latter two are new. The sum test is initially proposed by T. S. Breusch and A. R. Pagan [Rev. Econ. Stud. 47, 239–253 (1980; Zbl 0465.62107)]. We design the max and sum tests for sparse and nonsparse correlation coefficients of random errors between the linear regression models, respectively. And the max-sum test is devised to compromise both situations on the correlation coefficients. Indeed, our simulation shows that the max-sum test outperforms the previous two tests. This makes the max-sum test very useful in practice where sparsity or not for a set of numbers is usually vague. Toward the theoretical analysis of the three tests, we have settled two conjectures regarding the sum of squares of sample correlation coefficients asked by M. H. Pesaran, “General diagnostic test for cross section dependence in panels”, IZA Discussion Paper No. 1240 (2004)]. In addition, we establish the asymptotic theory for maxima of sample correlation coefficients appeared in the linear regression model for panel data, which is also the first successful attempt to our knowledge. To study the max-sum test, we create a novel method to show asymptotic independence between maxima and sums of dependent random variables. We expect the method itself is useful for other problems of this nature. Finally, an extensive simulation study as well as a case study are carried out. They demonstrate advantages of our proposed methods in terms of both empirical powers and robustness for correlation coefficients of residuals regardless of sparsity or not.

MSC:
62H15 Hypothesis testing in multivariate analysis
62F05 Asymptotic properties of parametric tests

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asymptotic independence; asymptotic normality; cross-sectional independence; extreme-value distribution; high-dimensional data; hypothesis tests; max-sum test; panel data models

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References:
[1] BALTAGI, B. H. (2013). Econometric Analysis of Panel Data, 5 ed. Wiley, New York.
[2] BALTAGI, B. H., KAO, C. and PENG, B. (2016). Testing cross-sectional correlation in large panel data models with serial correlation. Econometrics 4 1-24.
[3] BEAULIEU, M.-C., DUFOUR, J.-M. and KHALAF, L. (2007). Multivariate tests of mean-variance efficiency with possibly non-Gaussian errors: An exact simulation-based approach. J. Bus. Econom. Statist. 25 398-410. doi:10.1198/073500106000000468
[4] BREUSCH, T. S. and PAGAN, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. Rev. Econ. Stud. 47 239-253. doi:10.2307/2297111
[5] Cai, T., Fan, J. and Jiang, T. (2013). Distributions of angles in random packing on spheres. J. Mach. Learn. Res. 14 1837-1864. doi:10.1111/j.1287.1329.2012.01535.x
[6] Cai, T. and Liu, W. (2011). Adaptive thresholding for sparse covariance matrix estimation. J. Amer. Statist. Assoc. 106 672-684. doi:10.1198/jasa.2011.tm1060
[7] Cai, T., Liu, W. and Xia, Y. (2013). Two-sample covariance matrix testing and support recovery in high-dimensional and sparse settings. J. Amer. Statist. Assoc. 108 265-277. doi:10.1080/01621459.2012.758041
[8] Cai, T. T., Li, W. and Xia, Y. (2014). Two-sample test of high dimensional means under dependence. J. R. Stat. Soc. Ser. B. Stat. Methodol. 76 349-372. doi:10.1111/rssb.12034
[9] Cai, T. T. and Zhang, A. (2016). Inference for high-dimensional differential correlation matrices. J. Multivariate Anal. 143 107-126. doi:10.1016/j.jmva.2015.08.019
Zheng, S., Bai, Z. and Yao, J. (2015). Substitution principle for CLT of linear spectral statistics of high-dimensional sample covariance matrices with applications to hypothesis testing. *Ann. Statist.* 43 546-591 · Zbl 1312.62074 · doi:10.1214/14-AOS1292

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