Kojevnikov, Denis; Marmer, Vadim; Song, Kyungchul
Limit theorems for network dependent random variables. (English) Zbl 1471.62536
J. Econom. 222, No. 2, 882-908 (2021).

Summary: This paper is concerned with cross-sectional dependence arising because observations are interconnected through an observed network. Following [P. Doukhan and S. Louhichi, Stochastic Processes Appl. 84, No. 2, 313–342 (1999; Zbl 0996.60020)], we measure the strength of dependence by covariances of nonlinearly transformed variables. We provide a law of large numbers and central limit theorem for network dependent variables. We also provide a method of calculating standard errors robust to general forms of network dependence. For that purpose, we rely on a network heteroskedasticity and autocorrelation consistent (HAC) variance estimator, and show its consistency. The results rely on conditions characterized by tradeoffs between the rate of decay of dependence across a network and network’s denseness. Our approach can accommodate data generated by network formation models, random fields on graphs, conditional dependency graphs, and large functional-causal systems of equations.

MSC:
62P20 Applications of statistics to economics
60F05 Central limit and other weak theorems
62M30 Inference from spatial processes
91D30 Social networks; opinion dynamics

Keywords:
network dependence; random fields; central limit theorem; networks; law of large numbers; cross-sectional dependence; spatial processes

Software:
PMTK

Full Text: DOI arXiv

References:
[1] Andrews, D. W.K., Heteroskedasticity and autocorrelation consistent covariance matrix estimation, Econometrica, 59, 3, 817-858 (1991) · Zbl 0732.62052
[2] Aronow, P.; Samii, C., Estimating average causal effects under general interference, with application to a social network experiment, Ann. Appl. Stat., 11, 4, 1912-1947 (2017) · Zbl 1383.62329
[3] Baladi, P.; Rinott, Y., On normal approximations of distributions in terms of dependency graphs, Ann. Probab., 17, 1646-1650 (1989) · Zbl 0691.60020
[4] Birkel, T., On the convergence rate in the central limit theorem for associated processes, Ann. Probab., 16, 1685-1698 (1988) · Zbl 0658.60039
[5] Bläsius, T.; Friedrich, T.; Krohmer, A., Cliques in hyperbolic random graphs, Algorithmica, 80, 2324-2344 (2018) · Zbl 1391.05234
[6] Blume, L. E.; Brock, W. A.; Durlauf, S. N.; Jayaraman, R., Linear social interactions models, J. Political Econ., 123, 444-496 (2015)
[7] Borg, I.; Groenen, P. J.F., Modern Multidimensional Scaling (2005), Springer Verlag: Springer Verlag New York · Zbl 1085.62079
[8] Boucher, V.; Mourifie, I., My friend far, far away: A random field approach to exponential random graph models, Econom. J., 20, S14-S46 (2017)
[9] Chen, L. H.Y.; Goldstein, L.; Shao, Q.-M., Normal Approximation by Stein’s Method (2011), Springer-Verlag: Springer-Verlag New York, USA · Zbl 1213.62027
[10] Chen, L. H.Y.; Shao, Q.-M., Normal approximation under local dependence, Ann. Probab., 32, 1985-2028 (2004) · Zbl 1048.60020
[11] Chung, F.; Lu, L., The diameter of sparse random graphs, Adv. Appl. Math., 26, 257-279 (2001) · Zbl 0977.05127
[12] Comets, F.; Janžura, M., A central limit theorem for conditionally centered random fields with an application to markov

Edited by FIZ Karlsruhe, the European Mathematical Society and the Heidelberg Academy of Sciences and Humanities
© 2022 FIZ Karlsruhe GmbH
[48] Stein, C., Approximate computation of expectations, Lect. Notes-Monogr. Ser., vol. 7, i-164 (1986) · Zbl 0721.60016

[49] Wendland, H., Scattered data approximation, (Cambridge Monographs on Applied and Computational Mathematics (2004), Cambridge University Press)

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.