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THE HONG KONG UNIVERSITY OF SCIENCE TECHNOLOGY

Department of Mathematics

MATHEMATICS COLLOQUIUM

Regression Analysis of Reciprocity in Directed Networks

By

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Abstract

Reciprocity--the tendency of individuals to form mutual ties--is a fundamental structural feature of many directed networks. Despite its ubiquity, reciprocity remains insufficiently integrated into statistical network models, particularly in relation to covariate information. In this paper, we introduce the R2-Model, a novel and flexible framework that explicitly models reciprocity while incorporating covariate effects. Built upon a generalized p1 model, our framework accommodates both network sparsity and node heterogeneity, offering the most comprehensive parametrization of reciprocity to date--capturing not only its baseline level but also how it systematically varies with observed covariates. To address the challenges posed by high dimensionality and nuisance parameters, we develop a conditional likelihood estimator that isolates and consistently estimates the reciprocity effects. We establish its theoretical guarantees, including consistency, asymptotic normality, and minimax optimality under broad sparsity regimes. Extensive simulations and real-world applications demonstrate the R2-Model's flexibility, interpretability, and strong finite-sample performance, highlighting its practical utility for uncovering covariate-driven patterns of reciprocity in directed networks.

Bio: Prof. Leng is Chair Professor of Statistics and Machine Learning in the Department of Applied Mathematics at the Hong Kong Polytechnic University. He earned a bachelor's degree in Mathematics from the University of Science and Technology of China and a Ph.D. in Statistics from the University of Wisconsin–Madison. Prof. Leng is a Fellow of the Institute of Mathematical Statistics and an Elected Member of the International Statistical Institute.

Date : 27 March 2026 (Friday)
Time : 3:00pm - 4:00pm
Venue : Lecture Theatre F (Lift 25/26)

All Are Welcome!