Statement of Purpose

Applicant: Chieh Chen
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Columbia University Economics Ph.D.

Dear Members of the Admissions Committee,

I am writing to express my interest in pursuing a Ph.D. in Economics at Columbia University. In 2018, I started my economics journey at National Taiwan University (NTU). My keen interest in statistics and econometrics led me to start pursuing a minor in mathematics during the following year. This passion for quantitative analysis prompted me to engage in graduate-level courses across both departments. I'm proud to have received four Dean's List awards (top 5%) during my undergraduate studies along with a minor in mathematics, and I am well-positioned to graduate from my master's program with the highest GPA in my graduating class.

My passion lies in expressing social phenomena using the language of mathematics, and it was during my academic journey that I discovered my specialization in the econometrics, social networks, and Bayesian statistical modelling.

My journey in this field began as a research assistant to Professor Ming-Jen Lin. We worked with Taiwanese health insurance data to investigate intergenerational health transmission. I was involved in reconstructing family trees using household registry information, devising and performing hypothesis testing, and running structural estimation. Working with this large data set made me think deeply about how health issues spread through social networks like family structures, socio-economic strata, and geographic locations. As I gained *hands-on experience in the workflow of empirical studies*, my interest shifted towards the theoretical and econometric aspects of estimating social-interaction effects.

Subsequently, I dived into the world of SAR (spatial auto-regressive) models and started RA work with Professor Hon-Ho Kwok on estimating these models. My responsibilities primarily involved implementing the estimation process. This collaboration culminated in my **bachelor's thesis**, where I focused on estimating SAR models using non-linear least squares (NLS). In past literatures, instrument variable and maximum likelihood methods are used to estimate the SAR model, but not NLS. I demonstrated NLS's consistency and asymptotic normality and validated these results through extensive numerical simulations. I also proposed a feasible two-step estimation procedure to achieve optimal asymptotic efficiency, which is shown to be as efficient asymptotically as the most efficient instrument variable method in the literature. Since the most efficient instrument can only be approximated in practice, the NLS method provides a feasible possibility to obtain optimal efficiency with straightforward numerical optimization without additional distributional assumptions needed by maximum likelihood.

This journey inspired me to tackle the challenge of dealing with unknown networks. Learning about Bayesian methods from Professor Chih-Sheng Hsieh, I realized that a Bayesian approach is more suitable for estimating unknown networks. My current **master's thesis** revolves around establishing a Bayesian framework for estimating SAR models with unknown networks. Standard high dimensional methods are often involved in unknown network estimation by imposing arbitrary restrictions to entries to the adjacency matrix, however, in many applications, we have a good prior knowledge on the characteristics of adjacency ma-

trix. This prior knowledge can be incorporated in the estimation process through Bayesian priors on the adjacency matrix itself, which should improve finite sample performance while preserving frequentist asymptotic properties such as consistency. I've developed preliminary methods for sampling from random matrices and conducting statistical inference using Gibbs sampling and Markov Chain Monte Carlo (MCMC) with the help of computing cluster resources at NTU. In the upcoming semester, I plan to delve into the asymptotic properties and the decision-theoretic foundation of this proposed estimation method

Working with unknown networks naturally piqued my interest in network formation processes and their causal mechanisms. In addition to the econometric insights I gained from Professors Hon-Ho Kwok and Chih-Sheng Hsieh, I delved into causal inference in econometrics under the guidance of Professor Yu-Chang Chen in the course Econometrics Theory II. I found that these methods share similarities with concepts explored in the literature of network formation. Moreover, I believe that integrating causal inference methods into spatial econometrics holds significant theoretical and practical relevance. This integration is an area I plan to explore further once I am admitted to a Ph.D. program.

Looking forward, my strong determination is to continue my journey in econometrics. I aim to explore statistical and econometric methods related to social networks, encompassing theoretic, practical, and computational aspects, maintaining the trajectory established during my undergraduate studies. As understanding social phenomena within the framework of social networks are becoming increasingly prominent in our interconnected world, pursuing a Ph.D. in Economics is the perfect opportunity for me to satisfy my passion and interest in unraveling the complexity of social interactions.

Columbia University is a perfect fit for my academic journey due to several key factors. The research by econometricians such as Prof. Jushan Bai and Prof. Serena Ng aligns with my interest in high-dimensional methods and in autoregressive models, offering potential research opportunities. Furthermore, Prof. Pietro Tebaldi's work in networks and industrial organization match directly with my research interest. The strong community in microeconomics and econometrics at the university positions me at the forefront of research. All of these elements make Columbia University the ideal destination for my academic journey.

Thank you for considering my application.

Sincerely,
Jesse Chieh Chen 陳 捷