

# Estimation of Large Network Formation Games\*

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(Preliminary and Incomplete)

## Abstract

This paper develops estimation methods for network formation models using observed data from a single large network. We characterize network formation as a simultaneous-move game with incomplete information, where we allow for utility externalities from indirect friends such as friends-of-friends and friends-in-common. As a consequence the expected utility can be nonlinear in the link choices of an agent. In a network with  $n$  members each individual faces a discrete choice problem with  $2^{n-1}$  overlapping alternatives, which is difficult to solve without simplification. We propose a novel method that uses the Legendre transform to express the expected utility as a linear function of the individual link choices. This allows us to derive a closed-form expression for the conditional choice probability (CCP). The closed-form CCP is that for an agent who myopically chooses to establish links or not to the other members of the network. The dependence between the agent's choices is captured by a 'sufficient statistic' for this dependence. Using this CCP we propose a two-step estimation procedure that requires few assumptions on equilibrium selection, is simple to compute, and provides asymptotically valid estimators for the parameters. The main issue is to show that the asymptotic distribution of the estimator is not dominated by the dependence

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