國立高雄大學統計學研究所

114 學年度書報討論題目暨摘要登記表

Ensemble Strategies for Bayesian Network Structure Learning under Finite-Sample Settings

Ming-Ming Kuo (郭明明)

Abstract

Bayesian Network structure learning aims to recover the underlying dependency structure among variables from observational data. In finite-sample settings, however, structure estimation is often unstable, and different learning algorithms may result in noticeably different network structures due to their distinct assumptions and search mechanisms. Relying on a single structure learning algorithm may therefore lead to unreliable reconstruction of the true network structure. This study investigates the use of ensemble strategies for Bayesian Network structure learning under finite-sample conditions. A simulation framework is constructed by generating data from a predefined discrete Bayesian Network, followed by repeated resampling to reflect sampling variability. Five representative structure learning algorithms, including constraint-based, score-based, and hybrid methods, are applied to the sampled data. Their estimated structures are then integrated using several aggregation strategies, such as intersection, union, and majority voting, to produce ensemble graphs. To evaluate structural similarity between the estimated graphs and the true network, the Balanced Scoring Function (BSF) is employed as the primary performance metric, as it jointly accounts for correctly and incorrectly identified edges. Simulation results indicate that, across different sample sizes and threshold settings, the union-based aggregation strategy consistently achieves higher average BSF values than other ensemble strategies and individual algorithms.

Keywords：Bayesian Network, structure learning, ensemble strategies, finite-sample settings, Balanced Scoring Function

指導教授簽名：