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High-Dimensional Gaussian Graphical Model Selection: Tractable Graph Families

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We consider the problem of high-dimensional Gaussian graphical model selection. We identify a set of graphs for which an efficient estimation algorithm exists, and this algorithm is based on thresholding of empirical conditional covariances. Under a set of transparent conditions, we establish structural consistency (or sparsistency) for the proposed algorithm, when the number of samples n=omega(J_{min}^{-2} log p), where p is the number of variables and J_{min} is the minimum (absolute) edge potential of the graphical model. The sufficient conditions for sparsistency are based on the notion of walk-summability of the model and the presence of sparse local vertex separators in the underlying graph. We also derive novel non-asymptotic necessary conditions on the number of samples required for sparsistency.

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