# Accepted Manuscript


An efficient algorithm for sparse inverse covariance matrix estimation based on dual formulation

Peili Li, Yunhai Xiao

PII: S0167-9473(18)30177-4
DOI: https://doi.org/10.1016/j.csda.2018.07.011
Reference: COMSTA 6655

To appear in: *Computational Statistics and Data Analysis*

Received date : 8 December 2017
Revised date : 31 May 2018
Accepted date : 21 July 2018

Please cite this article as: Li P., Xiao Y., An efficient algorithm for sparse inverse covariance matrix estimation based on dual formulation. *Computational Statistics and Data Analysis* (2018), https://doi.org/10.1016/j.csda.2018.07.011

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

*Manuscript
Click here to view linked References

# An Efficient Algorithm for Sparse Inverse Covariance Matrix Estimation Based on Dual Formulation

Peili Li*†  Yunhai Xiao‡

May 31, 2018

**Abstract**

Estimating large and sparse inverse covariance matrix plays a fundamental role in modern multivariate analysis, because the zero entries capture the conditional independence between pairs of variables given all other variables. This estimation task can be realized by penalizing the maximum likelihood estimation with an adaptive group lasso penalty imposed directly on the the elements of the inverse, which allows the estimated to have a blockwise sparse structure that is particularly useful in some applications. In the paper, we are particularly interested in studying the implementation of optimization algorithms for minimizing a class of log-determinant model. This considered minimization model, one the one hand, contains a large number of popular sparse models as special cases, but on the other hand, it poses more challenges especially in high-dimensional situations. Instead of targeting the challenging optimization problem directly, we employ the symmetric Gauss-Seidel (sGS) iteration based alternating direction method of multipliers (ADMM) to tackle the 3-block nonsmooth dual program. By choosing an appropriate proximal term, it was shown that the implemented sGS-ADMM is equivalent to the 2-block ADMM, so its convergence is followed directly from some existing theoretical results. Numerical experiments on synthetic data and real data sets, including the performance comparisons with the directly extended ADMM, demonstrate that the implemented algorithm is effective in estimating large and sparse inverse covariance matrices.

**Key words.** Inverse covariance matrix, non-smooth convex minimization, Lagrangian dual, alternating direction method of multipliers, symmetric Gauss-Seidel iteration.

## 1. Introduction

With the rapid development of science and technology, large and high dimensional data are routinely collected in a wide variety of scientific investigations. Estimating large covariance and inverse covariance matrices has always been an important part of modern multivariate analysis, which frequently appears in many fields, such as economics, finance, biology, social networks, speech recognition, health sciences and many others (ref. [5, 13, 25, 56]).

### 1.1. Problem's General Descriptions

Let $\mathcal{S}^p$, $\mathcal{S}^p_+$, and $\mathcal{S}^p_{++}$ be the sets of all $p \times p$ symmetric, positive semi-definite, and positive definite matrices, respectively. Let $\xi_i$ be a $p$-dimensional random vector following a multivariate Gaussian distribution

*School of Mathematics and Statistics, Wuhan University, Wuhan 430072, China (Email: lipeili@whu.edu.cn).
†School of Mathematics and Statistics, Henan University, Kaifeng 475000, China.
‡Institute of Applied Mathematics, School of Mathematics and Statistics, Henan University, Kaifeng 475000, China (Email: yhxiao@henu.edu.cn).

Download English Version:

https://daneshyari.com/en/article/6868573

Download Persian Version:

https://daneshyari.com/article/6868573

Daneshyari.com