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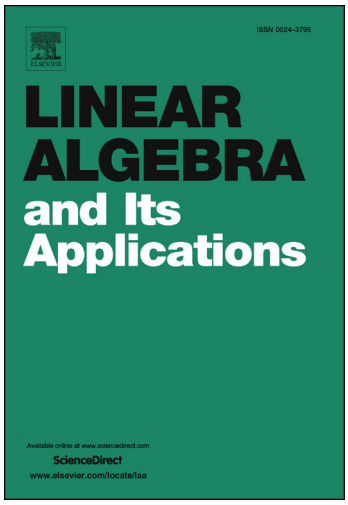

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A Recursive Three-Stage Least Squares Method for Large-Scale Systems of Simultaneous Equations

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Abstract

A new numerical method is proposed that uses the QR decomposition (and its variants) to derive recursively the three-stage least squares (3SLS) estimator of large-scale simultaneous equations models (SEM). The 3SLS estimator is obtained sequentially, once the underlying model is modified, by adding or deleting rows of data. A new theoretical pseudo SEM is developed which has a non positive definite dispersion matrix and is proved to yield the 3SLS estimator that would be derived if the modified SEM was estimated afresh. In addition, the computation of the iterative 3SLS estimator of the updated observations SEM is considered. The new recursive method utilizes efficiently previous computations, exploits sparsity in the pseudo SEM and uses as main computational tool orthogonal and hyperbolic matrix factorizations. This allows the estimation of large-scale SEMs which previously could have been considered computationally infeasible to tackle. Numerical trials have confirmed the effectiveness of the new estimation procedures. The new method is illustrated through a macroeconomic application[†].

Keywords: updating, QR decomposition, high dimensional data, matrix algebra

MSC: 15A23;15B10;62L12

1. Introduction

The simultaneous equations model (SEM) is a system of structural equations where some of the response variables also reappear in the system as explanatory variables. Let the SEM in compact form be

$$\operatorname{vec}(\boldsymbol{Y}) = (\boldsymbol{I}_G \otimes \boldsymbol{W})\,\boldsymbol{S}\boldsymbol{\delta} + \operatorname{vec}(\boldsymbol{E}),\ \operatorname{vec}(\boldsymbol{E}) \sim (\boldsymbol{0}, \boldsymbol{\Sigma} \otimes \boldsymbol{I}_M), \tag{1.1}$$

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[†]The computational aspects of the strategies are included as a supplementary material (Appendix).