
# SOME DEVELOPMENTS ON LATENT VARIABLE MODELS AND COMPUTING

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**Abstract:** Latent variable models have been playing a central role in psychometrics and related fields. In many modern applications, the inference based on latent variable models involves one or several of the following features: (1) the presence of many latent variables, (2) the observed and latent variables being continuous, discrete, or a combination of both, (3) constraints on parameters, and (4) penalties on parameters to impose model parsimony. The estimation often involves maximizing an objective function based on a marginal likelihood/pseudo-likelihood, possibly with constraints and/or penalties on parameters. Solving this optimization problem is highly non-trivial, due to the complexities brought by the features mentioned above. Although several efficient algorithms have been proposed, there lacks a unified computational framework that takes all these features into account. We fill the gap in this study. Specifically, we provide a unified formulation for the optimization problem and then propose a quasi-Newton stochastic proximal algorithm. Theoretical properties of the proposed algorithms are established. The computational efficiency and robustness are shown by simulation studies under various settings for latent variable model estimation. Moreover, for the analysis of intensive longitudinal data, I would introduce a latent Gaussian process modelling framework, which can be regarded as a semi-parametric extension of the classical latent curve models and falls under the framework of structural equation modelling. Procedures for parameter estimation and statistical inference are provided under an empirical Bayes framework and evaluated by simulation studies. We illustrate the use of the proposed model through the analysis of an ecological momentary assessment data set.