

A flexible system for fitting non-linear models with latent random variables

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Hierarchical models have gained widespread use in applied statistics. Examples include mixed model regression and state-space models. The likelihood function is obtained by integrating the joint likelihood over the latent random variables. Within the Gaussian/linear world this integral can be solved analytically, but for nonlinear models it must be approximated numerically. We will present an algorithm based on the Laplace approximation and a technique from computer science known as 'automatic differentiation'. The algorithm has been implemented as part of the software package AD Model Builder. This software offers great flexibility in model formulation, and hides the technical details of computation. Several examples will be presented showing the ease by which maximum likelihood estimates may be calculated.