

Nonlinear parameter optimization and modeling in R:

A tutorial

John C. Nash
Retired professor
Telfer School of Management
University of Ottawa
nashjc@uottawa.ca

Description: Many statistical tasks use some form of optimization to fit or estimate parameters. **R** has many tools in this area, in fact so many that ordinary users can easily become confused and have difficulty selecting an appropriate approach to a given computation. In particular, an attempt will be made, via examples, to clarify where and why different methods may be suitably applied. The tutorial aims to illustrate some of the more common issues that arise:

- The importance of derivative information (gradient, Hessian, Jacobian) and its approximation;
- Understanding how to set up a problem and characterize it properly;
- Checking and testing functions and output;
- Constraints and how they may be incorporated;
- The question of starting values for parameters;
- Improving performance when time is important.

The tutorial will draw heavily on material used in the writing of the presenter's recently completed book "Nonlinear parameters optimization with R" (Wiley), but tutorial participants will not require access to the book. It is intended that participants should, at the end of the tutorial, be able to successfully set up and solve nonlinear modeling and related problems that are "not too nasty". They should also have acquired some knowledge helpful in recognizing some pathologies that prevent successful resolution of problems.

Audience: Participants are expected to have a working acquaintance with **R** so that they can prepare a function to, for example, compute residuals given data and a model expression. Some understanding of basic linear algebra and calculus will be a definite help to grasping how different methods work and how optima are characterized.

Format:

- an introduction to the types of problems and some relevant examples that lead to nonlinear parameter optimization
- a panoramic review of some of the tools in R for tackling such problems
- a presentation of selected approaches to some example problems, using these to illustrate some of the issues that arise and which may lead to lack of success in finding solutions
- opportunity to pose questions and obtain answers related to the topic.

Presenter: John Nash is a retired Professor, Telfer School of Management, University of Ottawa. Three algorithms from his book "Compact numerical methods for computers" are part of the R `optim()` function, but he has been working for several years with other R developers to provide improved tools, as well as providing better interfaces to existing tools and packages.. He is also continuing to assess how well different methods work in different situations in an attempt to provide guidance on their use.