

**STAT 8230 — Applied Nonlinear Regression
Course Syllabus***

Instructor: Dan Hall

Office Hours: T,Th: 11:00am–noon, and by appointment

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Lecture Hours: T,Th: 9:30–10:45 (2nd period), Room 102, Aderhold Hall

Prerequisite: STAT 6220, STAT 6320, or STAT 6420

- A note about the required background for the course: We are studying nonlinear regression here. So, you really need to understand linear regression pretty well first to be ready to tackle the extension to the nonlinear case. In addition, it is crucial that you have some knowledge of linear algebra (vectors and matrices and how to manipulate them) and calculus. If you feel that you may not have the appropriate background for the course, talk to me and I can advise. It may be better for you to drop the course rather than just cross your fingers and hope that you can get by on your innate intelligence.

Reserved Texts:

†Bates, D.M. and Watts, D.G. (1988). *Nonlinear Regression Analysis and its Applications*. Wiley.

Seber, G.A.F. and Wild, C.J. (1989). *Nonlinear Regression*. Wiley.

Pinheiro, J.C. and Bates, D.M. (2000). *Mixed-effects Models in S and S-PLUS*. Springer.

Ratkowsky, D.A. (1983). *Nonlinear Regression Modelling: A Unified Practical Approach*. Marcel Dekker.

Ratkowsky, D.A. (1990). *Handbook of Nonlinear Regression Models*. Marcel Dekker.

Venables, W.N., and Ripley, B.D. (1999). *Modern Applied Statistics with S-PLUS, Third Edition*. Springer.

* Note that the course syllabus is a general plan for the course; deviations from the syllabus may be necessary and will be announced by the instructor.

† The book we will follow most closely.

Some comments about textbooks:

The required textbook for this course in the past was the one by Bates and Watts which is on reserve. Several years ago this book became very expensive because it became a “print on demand” book from the publisher. At that time I decided to no longer require it. More recently, the Bates and Watts book has become available in paperback at a much more affordable price. Still, I’ve learned that the course seems to proceed fine without a required textbook, so I’ve decided to keep it that way. Much of the content of Bates and Watts’ book is covered in my notes, so you won’t be missing too much by not owning it. But that said, it is a good book and you wouldn’t be making a mistake to buy it for reference both during this course and later.

I also recommend the book by Seber and Wild. This book is also available in paperback, but it is still quite expensive. It’s a more comprehensive and broadly useful reference; not only for nonlinear regression, but also more generally on methods of statistical estimation and inference, computational methods, etc. On the down side, it is a bit more advanced than is suitable for this course, and it doesn’t have exercises. Therefore, it’s not the ideal course textbook, which is why it’s not required. We will not follow it closely, but we will draw from it fairly heavily, and it is an excellent reference to have on your shelf (actually any book by Seber is probably worth owning — his books are uniformly excellent).

When we get into the material on nonlinear mixed-effects models we will draw on the Pinheiro and Bates book heavily. This is an extremely useful book for learning about nonlinear (and linear) mixed effect models and how to apply them to real problems. It integrates the nlme software thoroughly into the presentation, so it provides a very useful tutorial for that software. I highly recommend this book as well, but like the others, it is not required.

Finally, there is a short book on nonlinear regression that emphasizes practical aspects and the use of the R software package (Ritz, C. and Streibig, J.C. (2008), *Nonlinear Regression with R*, Springer). This book is not comprehensive enough for our purposes, but it is worth knowing about because of its coverage of the R package and because it is a free internet resource (find it at <http://www.springerlink.com/content/w8vv3g>).

Evaluation:

Grades will be based on (5 or 6) homeworks (60%), a midterm (20%) and a final (20%). The exams will probably be take home exams. You are encouraged to work together on homeworks, but of course not on exams.

Attendance:

You are graduate students. I expect you to be mature enough to come to class regularly without me formally *requiring* it or taking attendance. If you have to miss class for one reason or another, you need not inform me, but of course you are still responsible for the material you missed in class, including any announcements regarding course business. Missing one or two classes during a term is no big deal, but regularly skipping class is one of the surest ways to convince your professors that you are not serious about graduate school.

Course Topics:

- Review of linear regression.
- Fixed-effects nonlinear models (NLMs).
- Nonlinear Least-squares.
- Computational methods and other practical considerations.
- Extended NLMs and maximum likelihood estimation.
- Important classes of NLMs: Growth Models; Compartmental Models.
- Nonlinear mixed-effects models (NLMMs).
- Methods of estimation and inference in NLMMs.
- Software for NLMs and NLMMs.

Computing:

I will maintain a web site for the course at <http://www.stat.uga.edu/~dhall/STAT8230.html>. There I will post a copy of this syllabus, lecture notes, homework assignments, etc. In addition, I'd like to be able to contact you via e-mail. Please give me your e-mail addresses and get in the habit of checking your e-mail regularly, if you don't do so already.

I will arrange for all of you to have accounts made in the Statistics Department's computer lab (room 307, Statistics Building). This lab has a cluster of 30 PCs running Windows with several useful software packages including SAS, R and S-PLUS. There are many software packages that fit NLMs, but we will rely mainly on R software packages and, to a lesser extent SAS. R is a free clone of S-PLUS and almost everything that runs in S-PLUS will also run on R with little or no modification. We will use the nlme library (aka "package" in R terminology) extensively, which runs on both platforms and contains functions such as gls and nlme, which fit nonlinear regression models and nonlinear mixed-effect regression models, respectively. Information about R, including R downloads and R package downloads, can be found at <http://cran.r-project.org/>.

Help and information on the nlme library of software can be obtained through the S-PLUS and R help screens and in the nlme.pdf file, which can be found at <http://cran.r-project.org/web/packages/nlme/index.html> on the CRAN (Comprehensive R Archive Network) website. A good general reference on S-PLUS and R is the book by Venables and Ripley on reserve, although there are many other books on these packages that might be helpful. Complete SAS documentation is available online at <http://support.sas.com/documentation/cdl/en/statug/63347/HTML/default/viewer.htm>.

Academic Honesty:

All academic work must meet the standards contained in the UGA Academic Honesty policy, "A Culture of Honesty". Students are responsible for informing themselves about those standards before performing any academic work. The link to more detailed information about academic honesty can be found at: <http://www.uga.edu/ovpi/honesty/acadhon.htm>