**ABG 250: Mathematical Modeling in Biological Systems (4).**
**WINTER 2013**

**Information for course: ABG 250-001, CRN 40066**

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| **Lecture:** | Mon: | 9:00-10:50 AM | 1135 Meyer |
| | Wed: | 9:00-10:50 AM | 1135 Meyer |

**Instructors:** J. G. Fadel, 2115 Meyer, jgfadel@ucdavis.edu
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**Course Description:**
All aspects of model development and evaluation including sensitivity analyses using R. Four principle modeling methodologies included: algebraic functions of biological processes, physiological-based compartmental models, linear programming and meta-analysis. Fundamental background and understanding of mathematical modeling principles in biological systems.

**Prerequisites:** Graduate standing; MAT 16A, 16B or equivalent required; MAT 16C or equivalent recommended; STA 100 or equivalent required; more than one course in statistics recommended; ABI 102 or BIS 102 recommended or equivalent course in biochemistry.

**Hardware and Software:** Students are expected to have their own laptops or access to a computer and they are expected to have access to Microsoft Office, R Studio, and R. The open source software R and R-studio can be download from the web at http://www.r-project.org/ and http://www.rstudio.org/. You will need Adobe Acrobat Reader (the latest version) and Flash Player installed on your computer. Most computers have both of these installed. Material for this course will be posted as both pdf and as a web link in case some have Adobe Acrobat installed but not the Flash Player.

**Tentative Grading:**

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| Homework: | 75% |
| Term Project Report | 25% |

**Summary of Course Contents:**
1. Introduction to course; course goals and overview; introduction to R; Parameter estimation; linear regression.
2. Matrix algebra, summation notation, expectations
3. Principles of Mathematical Modeling; definition and classification; levels of organization; mechanistic modeling; growth model; static versus dynamic solutions; numerical vs. analytical integration.
4. Overview of R; How does R work? Introduction to some packages; Pharmacokinetics (Compartmental Analysis); Introduction to pharmacokinetics; Compartmental analysis.
5. Tracer Methods for in vivo Kinetics; Introduction to tracers.
6. Parameter Estimation; Nonlinear parameter estimation; Iterative solutions using an optimizer.
7. Model Optimization; Linear Programming; Overview of linear programming; Language of linear programming; Assumptions; Graphical solution.
8. Sensitivity Analysis and Model Evaluation.
9. Mixed Model Analysis.
10. Meta-Analysis; Assumptions; Numerical example; Sources of variation.
11. Data analyses vs. Predictions; Review of Mathematical models in Animal Science and their use.