**New Course Request** **Indiana University** Indianapolis Campus

Check Appropriate Boxes: Undergraduate credit ☐ Graduate credit XX ☐ Professional credit ☐

1. School/Division Science, Biostatistics 2. Academic Subject Code BIOS
3. Course Number S587 (must be cleared with University Enrollment Services) 4. Instructor Lang Li
5. Course Title Nonlinear Mixed Models

   Recommended Abbreviation (Optional) _____
   (Limited to 32 Characters including spaces)
6. First time this course is to be offered (Semester/Year): Fall 2009
7. Credit Hours: Fixed at 3.0 or Variable from _____ to _____
8. Is this course to be graded S-F (only)? Yes ____ No X
9. Is variable title approval being requested? Yes ____ No X
10. Course description (not to exceed 50 words) for Bulletin publication: P: Undergraduate statistics course and familiarity with statistical inference. This course will develop the student's ability to understand the pharmacokinetic/ pharmacodynamic model, fit the nonlinear mixed model through the required software package, conduct the diagnosis of model fitting, perform the hypothesis tests, and provide the interpretation of the data.
11. Lecture Contact Hours: Fixed at 3 or Variable from _____ to _____
12. Non-Lecture Contact Hours: Fixed at _____ or Variable from _____ to _____
13. Estimated enrollment: 5-10 / TBD of which 100 percent are expected to be graduate students.
14. Frequency of scheduling: ~~new program~~ Will this course be required for majors? elective
15. Justification for new course: course for new biostatistics Ph.D. program.
16. Are the necessary reading materials currently available in the appropriate library? Yes
17. Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.
18. If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant.
19. A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by: _____ Date 3/17/09
Department Chairman/Division Director

Approved by: _____ Date 4/17/2009
Dean

_____ Date _____
Dean of Graduate School (when required)

_____ Date _____
Chancellor/Vice-President

_____ Date _____
University Enrollment Services

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.

UPS 724

University Enrollment Services Final—White; Chancellor/Vice-President—Blue; School/Division—Yellow; Department/Division—Pink; University Enrollment Services Advance—White

**BIOS S587 (3 cr.)**
**Nonlinear Mixed Models**

**Syllabus**

## A. Instructors:

Lang Li, PhD, Associate Professor
Changyu Shen, PhD, Assistant Professor

**Contact information:**

Lang Li, PhD
Division of Biostatistics
Indiana University School of Medicine
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Indianapolis, IN 46202

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## B. Course Description and Rationale:

Nonlinear mixed models are heavily utilized in drug development. Population pharmacokinetics/pharmacodynamics models are the most important applications. Because this topic has a heavy interdisciplinary flavor, it requires a mixed content that has pharmacology background, statistical theory, and computational implementations. The course's primary audiences include are graduate students in biostatistics, pharmacology, bioinformatics and researchers from pharmaceutical industry.

The most important feature of the course is the intended balance among pharmacology background, statistical theory and software implementation. At the end of this course, we expect that the students can understand the pharmacokinetics/pharmacodynamics model, fit the nonlinear mixed model through the required software package, conduct the diagnosis of model fitting, perform the hypothesis tests, and provide the interpretation of the data. The course is part of the Biostatistics PhD curriculum.

## C. Prerequisites:

Students are assumed to have completed an undergraduate level statistics course and are familiar with the basic concepts of statistical inference. Students who are uncertain about their levels of preparation are encouraged to contact the instructors.

## D. Course Description for Bulletin:

P: Undergraduate statistics course and familiarity with statistical inference. This course will develop the student's ability to understand the pharmacokinetic/pharmacodynamic model, fit the nonlinear mixed model through the required software package, conduct the diagnosis of model fitting, perform the hypothesis tests, and provide the interpretation of the data.

## E. Educational Objectives:

Students will receive a balanced training in pharmacology background, statistical theory and software implementation. By participating in the course, they will acquire hands on experience for implementing nonlinear model fitting. We will assess students' achievement towards these objectives by homework exercises and in-class or take home examinations.

## F. Course Content:

1. Week 1 and 2
   - Drug absorption, distribution, and eliminations distribution concepts
   - Noncompartment model, one-compartment model, and two compartment models.
2. Weeks 3
   - Introduction to NONMEM: data input and PK model definitions.
3. Weeks 4-5:
   - Pharmacodynamic model definitions
   - In-vitro pharmacokinetics parameters
4. Weeks 6-9: Nonlinear Models
   - Nonlinear model specifications, objective functions, and parameter estimations.
   - Nonlinear model objective function optimization methods.
   - The inference and diagnose of nonlinear models.
   - NONMEM implementation of nonlinear models.
5. Weeks 10-14: Nonlinear Mixed Models
   - Linear mixed model: model specification and inferences
   - Nonlinear mixed model: a two-stage approach
   - Nonlinear mixed model: a first order approximation approach
   - Nonlinear mixed model: a conditional first order approaximation approach.
   - NONMEM implementation of nonlinear mixed models.
   -

## G. Required and Recommended Texts:

The course will use the following textbook:

- Davidian and Giltianan (1995). Nonlinear models for repeated measurement data, New York: Chapman & Hall
- Batts and Watts (1988) Nonlinear regression analysis and its applications. New York: Wiley.
- Rowland and Tozer (1995) Clinical Pharmacokinetics Concepts and Applications, third edition. Lippincott Williams & Wilkins.

But we will not necessarily follow the order of the original chapters in the book.

We will supplement the textbook with instructors' own lecture notes.

## H. Evaluation and Grading:

Student's performance will be evaluated through homework exercises and in-class/take home exams. The homework assignment will account for 40% of the course grade. Two exams will each contribute 30% to the overall course score, which ranges from 0 to 100. Letter grades for the course are assigned using the following scale: A: 90-100; B: 80-89; C: 70-79; D: 60-69; F: less than 60. Within each letter grade, "+" and "-"will be assigned if the numeric score is in the top and bottom quintiles, respectively.

**I. Bibliography:**
N/A

**J. Cheating and Plagiarism:**
Academic misconduct will *not* be tolerated and all cases will be reported. Examine the IU Code of Student Rights, Responsibilities, and Conduct at http://www.iupui.edu/code and in particular examine the rules regarding academic misconduct at http://www.iupui.edu/code/#P2_G. Violations of these rules will result in a grade of "F" (or 0%) for the assignment in question, and may result in an "F" for the course or even expulsion from the university (see http://life.iupui.edu/rights/undergrad/sanctions.html).

**K. Americans with Disabilities Act**
If you need any special accommodations due to a disability, please contact Adaptive Educational Services at (317)-274-3241. Joseph T. Taylor Hall (UC), Room 137.