1. School/Division: Science, Biostatistics

2. Academic Subject Code: BIOS

3. Course Number: 8621 (must be cleared with University Enrollment Services)

4. Instructor: J. Harezlak

5. Course Title: Advanced Statistical Computing

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: STAT 52100; experience with R/Splus programming. This course covers selected computational techniques useful in advanced statistical applications and statistical research, such as methods for solving linear equations, numerical optimization, numerical integration, Bayesian methods, bootstrap methods, and stochastic search algorithms.

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 of which 100 percent are expected to be graduate students.

14. Frequency of scheduling: New Program
Will this course be required for majors? Yes __

15. Justification for new course: Required 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: Berti Barta

Date: 3/17/09

Department Chairman/Division Director

Dean of Graduate School (when required)

Approved by: Dean M. Murphy

Date: 4/17/2009

Chancellor/Vice-President

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.
BIOS S621 (3 cr.)
Advanced Statistical Computing

Syllabus

A. Instructors
   Jaroslaw Harezlak, PhD, Assistant Professor
   Samiran Ghosh, PhD, Assistant Professor
   Xiaochun Li, PhD, Associate Professor

Contact information:
   Jaroslaw Harezlak, PhD
   Division of Biostatistics
   Indiana University School of Medicine
   410 West 10th Street, Suite 3000
   Indianapolis, IN 46202
   Office: (317) 274-2682
   Email: harezlak@iupui.edu

B. Course description:
   This course will cover selected computational techniques useful in advanced statistical
   applications and statistical research. Topics to be covered include methods for solving linear
   equations, numerical optimization, numerical integration, Bayesian methods, bootstrap
   methods and stochastic search algorithms. The course is part of the Biostatistics Ph.D.
   curriculum.

C. Prerequisites:
   STAT 52100; experience with R/Splus programming

D. Course Description for Bulletin:
   P: STAT 52100; experience with R/Splus programming. This course covers selected
   computational techniques useful in advanced statistical applications and statistical research,
   such as methods for solving linear equations, numerical optimization, numerical integration,
   Bayesian methods, bootstrap methods, and stochastic search algorithms.

E. Educational objectives:
   During the course students will:
   1. develop computational skills required in modern statistical modeling
   2. acquire knowledge necessary to implement new statistical methods

F. Meeting times:
   Lectures twice per week

G. Course outline:


Lectures 13-14 Linear and quadratic programming.

Lectures 15-16. EM and related algorithms.


Lectures 20-22. Basic simulation methods. Generating uniform pseudo-random numbers, transformation methods, accept-reject methods, importance sampling, control variates, antithetic sampling.

Lecture 23. Numerical integration via importance sampling in Bayesian applications.


Lectures 26-28. Bootstrap methods. Resampling methods for variance estimation, bias reduction, hypothesis testing, and confidence intervals; iterated bootstrap; use of control variates, importance sampling and antithetic sampling to improve efficiency.

Lectures 29-30. Stochastic search algorithms

H. Textbooks
  Required and Recommended: None--Lecture notes will be available on course web page

Supplemental references:

I. Evaluation and Grading: Students will be evaluated based on their performance on the homework assignments (60%), and take home final exam (40%). 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.

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](http://www.iupui.edu/code) and in particular examine the rules regarding academic misconduct at [http://www.iupui.edu/code/#P2_G](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](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.