NEW COURSE FORM

1. General Information

a. Submitted by the College of: Public Health Today's Date: 16 April 2012

b. Department/Division: Biostatistics

c. Contact person name: Richard Kryscio Email: kryscio@email.uky.edu Phone: 257-4064

d. Requested Effective Date: ☐ Semester following approval OR X☐ Specific Term/Year[1] Fall 2013

2. Designation and Description of Proposed Course

a. Prefix and Number: BST 682

b. Full Title: Generalized Linear Models

c. Transcript Title (if full title is more than 40 characters): _____

d. To be Cross-Listed[2] with (Prefix and Number): _____

e. Courses must be described by at least one of the meeting patterns below. Include number of actual contact hours[3] for each meeting pattern type.

45 (3 per week) Lecture _____ Laboratory[1] _____ Recitation _____ Discussion _____ Indep. Study

_____ Clinical _____ Colloquium _____ Practicum _____ Research _____ Residency

_____ Seminar _____ Studio _____ Other – Please explain:

f. Identify a grading System: X☐ Letter (A, B, C, etc.) ☐ Pass/Fail

g. Number of credits: 3

h. Is this course repeatable for additional credit? YES ☐ NO X☐

If YES: Maximum number of credit hours: _____

If YES: Will this course allow multiple registrations during the same semester? YES ☐ NO ☐

i. Course Description for Bulletin:

This course, the second in a two-semester sequence in regression modeling, covers regression models for outcomes which are not normally distributed, such as binary and count data. The course will cover the generalized linear model framework, multivariate maximum likelihood theory, logistic regression, Poisson regression, and nominal and ordinal logistic regression models, as well as approached for building and checking these models. The course will include the use of computing tools to apply these models to real data.

j. Prerequisites, if any: BST 675, BST 681.

k. Will this course be offered through Distance Learning? YES[4] ☐ NO X☐

l. Supplementary teaching component, if any: ☐ Community-Based Experience ☐ Service Learning ☐ Both

3. Will this course be taught off campus? YES ☐ NO X☐

NEW COURSE FORM

4. Frequency of Course Offering

a. Course will be offered (check all that apply): ☐ Fall X☐ Spring ☐ Summer

b. Will the course be offered every year? YES X☐ NO ☐

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[1]Courses are typically made effective for the semester following approval. No course will be made effective until all approvals are received

[2]The chair of the cross-listing department must sign off on the Signature Routing Log.

[3]In general, undergraduate courses are developed on the principle that one semester hour of credit represents one hour of classroom meeting per week for a semester, exclusive of any laboratory meeting. Laboratory meeting, generally, represents at least two hours per week for a semester for one credit hour. (from *SR 5.2.1*)

[4]You must *also* submit the Distance Learning Form in order for the proposed course to be considered DL delivery.

If NO, explain: _____

5. Are facilities and personnel necessary for the proposed new course available? YES X☐ NO ☐

If NO, explain: _____

6. What enrollment (per section per semester) may reasonably be expected? 5

7. Anticipated Student Demand

a. Will this course serve students primarily within the degree program? YES X☐ NO ☐

b. Will it be of interest to a significant number of students outside the degree program? YES ☐ NOX ☐

If YES, explain: _____

8. Check the category most applicable to this course:

X☐ Traditional – Offered in Corresponding Departments at Universities Elsewhere

☐ Relatively New – Now Being Widely Established

☐ Not Yet Found in Many (or Any) Other Universities

9. Course Relationship to Program(s)

a. Is this course part of a proposed new program? YES ☐ NO X☐

If YES, name the proposed new program: _____

b. Will this course be a new requirement[5] for ANY program? YESX ☐ NO ☐

If YES[5], list affected programs: Ph.D. program in Epidemiology and Biostatistics

10. Information to be Placed on Syllabus

a. Is the course 400G or 500? *YES* ☐ *NO X*☐

If YES, the *differentiation for undergraduate students must be included* in the information required in ***10.b.*** You must include: (i) identification of additional assignments by the graduate students; and /or (ii) Establishment of different grading criteria in the course for graduate students. (See *SR 3.1.4.*)

b. X ☐ The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500 level grading differentiation if applicable, from ***10.a*** above) are attached. *NO* ☐

[5]In order to change a program, a program change form must also be submitted.

Signature Routing Log

To Be Added by Academic Affairs prior to submission to HCCC

Generalized Linear Models

University of Kentucky
BST 682, Spring 2014
Credit: 3.0

Lecture: 3:30 p.m - 4:45 p.m., Tuesdays and Thursdays
Room ???, Multidisciplinary Science Building (MDS ???)

Instructor: Patrick Breheny, Ph.D.
Office: Room 205D, Multidisciplinary Science Building
Phone: 218-2077
e-mail: patrick.breheny@uky.edu
Office hours: Whenever I'm in my office, or by appointment

Course description: This course, the second in a two-semester sequence in regression modeling, covers regression models for outcomes which are not normally distributed, such as binary and count data. The course will cover the generalized linear model framework, multivariate maximum likelihood theory, logistic regression, Poisson regression, and nominal and ordinal logistic regression models, as well as approaches for building and checking these models. The course will include the use of computing tools to apply these models to real data.

Course rationale: Regression models are ubiquitous in applied as well as methodological statistical research. Particularly in the health and social sciences, we are often interested in outcomes that do not follow a normal distribution, such as binary outcomes (survived/died, successful/unsuccessful therapy) and counts (number of infections/cases of cancer/complications at a hospital or in a county). Understanding the fundamentals of these models is critical for anyone in epidemiology or biostatistics. It is the purpose of this course – a core course in the PhD program for Epidemiology and Biostatistics – to provide that understanding.

Course objectives:

- To develop the mathematical tools necessary to describe generalized linear models and carry out inference concerning model parameters
- To provide experience fitting logistic and Poisson regression models to real data and familiarity with software required to do so
- To develop and reinforce techniques for successful modeling in practical research, including model checking and diagnostics, model selection, and the visualization and presentation of fitted models

Student learning outcomes:

- Understand the mathematical foundations of generalized linear model

- Understand the basics of multivariate likelihood theory
- Gain experience with fitting logistic and Poisson regression models to real data
- Gain experience with available software for fitting generalized linear models
- Develop techniques for model building, model selection, and diagnostics
- Able to present and describe the results of a fitted generalized linear model, including the construction of informative tables and figures

Text:

- DOBSON A.J. and BARNETT A.G. (2008) *An Introduction to Generalized Linear Models.* Third edition. CRC Press.

Prerequisites: BST 681.

Course website: The course notes, assignments, data sets, and other relevant materials will be made available on the course web site:
`http://web.as.uky.edu/statistics/users/pbreheny/682-S14/index.html`

Grading: Your grade will be based on a weighted average of homework (10%), two exams (20% each), and projects (50%). The grading scale is below:

A:	85-100
B:	70-85
C:	55-70
F:	0-55

Attendance: Regular attendance in this course is expected. No direct penalty will be applied for missing lectures. However, assignments and exams will be based entirely on lecture material, so skipping lectures will almost certainly hurt your grade (and, of course, your understanding of the material). If you miss a lecture, go over the online notes and come to see me if you have any questions.

Exams: The two midterm exams are of equal weight, and will be closed-book tests administered during class time. Exam dates are listed in the course schedule. If you cannot take the exams on these dates, let me know as soon as possible so that we may work out a makeup date/time. Note that there is no final exam.

Homework: There will be short weekly assignments in this course, to be distributed on Thursday and collected in class the following Thursday. No homework will be assigned on weeks in which there is an exam or in which a project is due. Thus, there will be frequent homework assignments at the beginning of this course, but fewer later in the course as we move into more comprehensive assignments involving projects and reports. Solutions will be posted the morning after the due date; beyond this point, late homework cannot be accepted. You may work with other students on the homework assignments, but all students

must write and turn in their own solutions.

Projects: There will be three projects in this course. For projects 1 and 2 (worth 15% each), I will supply the data set and define the questions of interest. There will also be a final project (worth 20%), for which you will acquire the data and define the questions of interest as well as carry out the analysis. For all three projects, you will write a report of your findings. You may discuss your analysis with other students, but each student's report must be written independently.

For the final project, you will also present your work to the class. We will discuss this in more detail later in the semester, but it is never too early to start thinking about your final project and what data you might wish to analyze.

Proofreading: If you see any typos in my notes, please tell me about them! Doing so will not only benefit you, but also your classmates and any future students of this course.

Electronic communication: I will occasionally send e-mails to the class (to the account listed for you in the campus directory), so please check that account regularly.

Academic honesty: Academic honesty is highly valued at the University of Kentucky. You must always submit work that represents your original words or ideas. If any words or ideas used in an assignment or project do not represent your original words or ideas, you must cite all relevant sources and make clear the extent to which such sources were used.

The University of Kentucky takes cheating on examinations very seriously, and has in place a number of rather severe academic sanctions, a summary of which can be found at `http://www.uky.edu/Ombud/acadoffenses/index.htm`

Complaints: Students with suggestions or complaints should see me first, and if we cannot come to an agreement, I will direct you to the head of the department.

Disabilities: If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, submit to me a Letter of Accommodation from the Disability Resource Center (`www.uky.edu/TLC/grants/uk_ed/services/drc.html`). If you have not already done so, please register with the Disability Resource Center for coordination of campus disability services available to students with disabilities.

Religious observances: If a religious observance prevents you from taking an exam or finishing an assignment or project, please let me know in advance so that we can make arrangements for you to make up the work.

Inclement weather: The University of Kentucky has a detailed policy for decisions to close in inclement weather. The snow policy is described in detail at `http://www.uky.edu/MicroLabs/documents/temp/policies-weather.htm` or you can call (859) 257-5684.

I look forward to getting to know you, and I hope that we have a great semester together!

Course schedule:

1-10 Introduction; generalized linear model framework
1-15 Exponential families; maximum likelihood estimation
1-17 Weighted least squares
1-22 Weighted least squares (cont'd)
1-24 GLM model fitting & the iteratively reweighted least squares algorithm
1-29 GLM model fitting & the iteratively reweighted least squares algorithm (cont'd)
1-31 Asymptotic multivariate maximum likelihood theory
2-5 Asymptotic multivariate maximum likelihood theory (cont'd)
2-7 Logit functions and the logistic regression model
2-12 Logistic regression: Estimation and inference for probabilities and odds ratios
2-14 Logistic regression and case-control studies
2-19 **Exam I**
2-21 Wald vs. likelihood ratio approaches to inference
2-26 Logistic regression: Residuals and diagnostics
2-28 Logistic regression model selection
3-5 Logistic regression model selection (cont'd)
3-7 Logistic regression: Case study
3-12 No class (spring break)
3-14 No class (spring break)
3-19 Logistic regression: Case study (cont'd)
3-21 **Exam II**
3-26 The Poisson regression model, estimation, and inference
3-28 Poisson regression: Model building, diagnostics, offsets; **Project 1 due**
4-2 Overdispersion: Quasi-likelihood and negative binomial models
4-4 Log-linear models for categorical data
4-9 Poisson regression: Case study
4-11 Poisson regression: Case study (cont'd)
4-16 Multinomial regression
4-18 Multinomial regression: Case study; **Project 2 due**
4-23 The proportional odds model
4-25 Proportional odds modeling: Case study
5-2 **Final projects due**

PhD program competency attainment for BST 682 – Generalized Linear Models

Key:

Competency level	Number	Description
Unaware	0	No information or skill in this area
Aware	1	Able to identify the concept or skill but with limited ability to perform or apply it independently
Knowledgeable	2	Able to apply and describe the concept or skill
Proficient	3	Able to synthesize, critique, or teach the concept or skill

Biostatistics competencies attained:

Competency	Level attained
Understand the interface between biostatistics and epidemiology	1
Demonstrate advanced proficiency to apply concepts and methods from these disciplines jointly	1
Demonstrate the ability to review and critically evaluate the literature in a substantive area of research, be able to identify gaps in knowledge and be able to formulate original research hypotheses or statements	1
Evaluate the strengths and limitations of epidemiologic reports	1
Draw appropriate inferences from data	2
Communicate research results orally and in writing to lay and professional audiences	2
Demonstrate an understanding of concepts of probability and statistical inference as they apply to problems in public health	2
Demonstrate proficiency in using computing tools commonly encountered in epidemiology and biostatistics	2
Understand the principles of epidemiologic study design and be able to calculate the appropriate epidemiologic measures for most typical designs	1
Become proficient at and be able to evaluate the strengths and limitations of advanced designs including multivariate linear models, generalized linear models, longitudinal models, mixed effects models, and survival models both parametric and nonparametric	2
Understand the principles of chronic and infectious disease epidemiology	0
Demonstrate an understanding of research methods used in epidemiology and biostatistics	1
Demonstrate knowledge of the public health system in the commonwealth and the country	0

PLS 640 Advanced Topics in Plant Propagation

PLS 641 Plant Water Relations

PLS 643 Advanced Greenhouse Crop Production

PhD in Epidemiology/Biostatistics and the following related courses:

BST 639, Drop, Computing Tools for the Biomedical Sciences

BST 760, Drop, Advanced Regression

BST 701, Change, Bayesian Modeling in Biostatistics

BST 740, Change, Spatial Statistics

BST 762, Change, Longitudinal Data Analysis

BST 764, Change, Applied Statistical Modeling for Medicine and Public Health

BST 766, Change, Analysis of Temporal Data in Public Health

BST 681, New, Linear Regression

BST 682, New, Generalized Linear Models

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