ST 440: Applied Bayesian Analysis

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Approval Path
1. Tue, 01 Mar 2016 23:44:58 GMT
   Spencer Muse (muse): Approved for 17ST UG Director of Curriculum
2. Wed, 02 Mar 2016 01:44:42 GMT
   Donald Martin (demarti4): Approved for 17ST GR Director of Curriculum
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5. Wed, 02 Mar 2016 14:39:02 GMT
   Cheryl Bowman-Medhin (clbowma2): Approved for COS CC Coordinator UG
6. Thu, 03 Mar 2016 13:44:04 GMT
   Cheryl Bowman-Medhin (clbowma2): Approved for COS CC Meeting UG
7. Tue, 20 Sep 2016 20:11:19 GMT
   Gregory Neyhart (Greg_Neyhart): Approved for COS CC Chair UG
8. Tue, 20 Sep 2016 22:23:32 GMT
   Jo-Ann Cohen (cohen): Approved for COS Dean UG
   Cheryl Bowman-Medhin (clbowma2): Approved for COS CC Coordinator GR
10. Wed, 21 Sep 2016 13:05:56 GMT
    Cheryl Bowman-Medhin (clbowma2): Approved for COS CC Meeting GR
11. Mon, 07 Nov 2016 00:51:58 GMT
   Alun Lloyd (alun_lloyd): Approved for COS CC Chair GR
12. Mon, 07 Nov 2016 04:31:15 GMT
   Alun Lloyd (alun_lloyd): Approved for COS Final Review GR
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   Alexandra Hergeth Huggins (aeherget): Approved for OUCC Review
15. Tue, 29 Nov 2016 15:18:53 GMT
   Alun Lloyd (alun_lloyd): Approved for allloyd
16. Tue, 29 Nov 2016 15:31:28 GMT
   Alexandra Hergeth Huggins (aeherget): Approved for UCCC Coordinator
17. Wed, 30 Nov 2016 19:12:14 GMT
   Li Marcus (lamarcus): Approved for UCCC Meeting
   Andrew Nowel (nowel): Approved for UCCC Chair
19. Tue, 06 Dec 2016 04:29:27 GMT
   Barbara Kirby (barbara_kirby): Approved for OUCC Final Signature
20. Tue, 06 Dec 2016 21:18:05 GMT
   Li Marcus (lamarcus): Approved for OUCC Final Review
   Dennis Boos (boos): Approved for boos
22. Thu, 19 Jan 2017 14:42:27 GMT
   Melissa Nosbisch (mlnosbis): Approved for ABGS Coordinator
   Dennis Boos (boos): Approved for boos
   Melissa Nosbisch (mlnosbis): Approved for ABGS Meeting

New Course Proposal

Date Submitted: Mon, 29 Feb 2016 20:44:05 GMT

Viewing: ST 440/ST 540 : Applied Bayesian Analysis

Changes proposed by: boos

Change Type
Major

Course Prefix
ST (Statistics)

Course Number
440

Dual-Level Course
Yes

Dual-Level Course Number:
540

Cross-listed Course
No

Title
Applied Bayesian Analysis

Abbreviated Title
Applied Bayesian Analysis

College
College of Sciences

Academic Org Code
Statistics (17ST)

CIP Discipline Specialty Number
27.0501

CIP Discipline Specialty Title
Statistics, General.

Term Offering
Spring Only

Year Offering
Offered Every Year

Effective Date
Spring 2017

Previously taught as Special Topics?
Yes

Number of Offerings within the past 5 years
2

<table>
<thead>
<tr>
<th>Course Prefix/Number</th>
<th>Semester/Term Offered</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST 495/ST 590</td>
<td>Spring 2015</td>
<td>17/42</td>
</tr>
<tr>
<td>ST 495/ST 590</td>
<td>Spring 2016</td>
<td>6/30</td>
</tr>
</tbody>
</table>

Course Delivery
Face-to-Face (On Campus)
Distance Education (DELTA)
Online (Internet)

Grading Method
Graded with S/U option

Credit Hours
3

Course Length
16 weeks

Contact Hours
(Per Week)

Component Type | Contact Hours
---|---
Lecture | 3

Course Attribute(s)

Course Is Repeatable for Credit

No

Instructor Name

Brian Reich

Instructor Title

Associate Professor

Grad Faculty Status

Full

Anticipated On-Campus Enrollment

Open when course_delivery = campus OR course_delivery = blended OR course_delivery = flip

<table>
<thead>
<tr>
<th>Enrollment Component</th>
<th>Per Semester</th>
<th>Per Section</th>
<th>Multiple Sections?</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Lecture | 40 | 40 | No | This 40 is the combination of 440 and 540. The undergraduate 440 will have less than 10 in most semesters.

DELTA/Online Enrollment:

Open when course_delivery = distance OR course_delivery = online OR course_delivery = remote

<table>
<thead>
<tr>
<th>Delivery Format</th>
<th>Per Semester</th>
<th>Per Section</th>
<th>Multiple Sections?</th>
<th>Comments</th>
</tr>
</thead>
</table>
| LEC | 15 | 15 | No | online format is for graduate ST 540

Course Prerequisites, Corequisites, and Restrictive Statement

ST 440: Prerequisite: ST 422 and ST 430
ST 540: Prerequisite: ST 512 or ST 514 or ST 515 or ST 517

Is the course required or an elective for a Curriculum?

No

Catalog Description

Introduction to Bayesian concepts of statistical inference; Bayesian learning; Markov chain Monte Carlo methods using existing software (SAS and OpenBUGS); linear and hierarchical models; model selection and diagnostics.

Justification for new course:

The Bayesian approach to statistical analysis is becoming increasingly common across a wide variety of fields, and a new course is required to provide our students the background required to apply these methods in practice. The course is designed for: (1) master's students in statistics to prepare them to apply Bayesian methods in their future careers; (2) graduate students in departments other than statistics to provide them with the analytic tools needed to carry out their thesis work; and (3) advanced undergraduate statistics majors to prepare them for graduate coursework in statistics. Current Bayesian offerings (for example, ST 740) are designed primarily for Statistics PhD students, and this new class will shift the focus to benefit the three groups mentioned above. In particular, it will deemphasize theoretical issues in favor of practical aspects of Bayesian data analysis such as computing using R and hierarchical modeling.
Does this course have a fee?
No

Is this a GEP Course?
No

Consultation

Instructional Resources Statement
Dr. Brian Reich will teach ST 440/540 and the PhD level course ST 740 as part of his standard teaching obligation; thus no new resources are required.

Course Objectives/Goals
The goal of this course is to introduce Bayesian data analysis methods to students who do not have a theoretical background in statistics.

Student Learning Outcomes
Compute posteriors distributions for conjugate priors
Utilize various approaches for selecting prior distributions
Implement Markov chain Monte Carlo algorithms
Interpret output from software such as OpenBUGS and JAGS
Select appropriate statistical models and conduct goodness-of-fit diagnostics
Compare and contrast Bayesian versus frequentist methods
ST 540 Only: Demonstrate the ability to work with more theoretical aspects of selected topics via derivations, proofs, or other more advanced statistical techniques

Student Evaluation Methods

<table>
<thead>
<tr>
<th>Evaluation Method</th>
<th>Weighting/Points for Each</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
<td>ST 540 will have additional questions that address the additional learning outcomes for graduate students.</td>
</tr>
<tr>
<td>Midterm</td>
<td>30%</td>
<td>Closed book, closed notes. ST 540 students will have additional Exam questions that address the additional learning outcomes for graduate students.</td>
</tr>
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<td>Midterm</td>
<td>30%</td>
<td>Closed book, closed notes. ST 540 students will have additional Exam questions that address the additional learning outcomes for graduate students.</td>
</tr>
<tr>
<td>Project</td>
<td>30%</td>
<td>A detailed analysis of a data set.</td>
</tr>
</tbody>
</table>

Topical Outline/Course Schedule

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time Devoted to Each Topic</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Bayesian statistics</td>
<td>3 weeks</td>
<td>review of conditional probability and Bayes’ rule; priors and posteriors; Bayesian learning; summarizing the posterior distribution</td>
</tr>
<tr>
<td>Methods for selecting prior distributions</td>
<td>3 weeks</td>
<td>basic conjugacy relationships; uninformative priors; reference priors; eliciting expert opinion</td>
</tr>
<tr>
<td>Bayesian computing</td>
<td>3 weeks</td>
<td>introduction to R; Gibbs sampling; Metropolis sampling; Introduction to OpenBUGS and PROC MCMC; convergence diagnostics</td>
</tr>
</tbody>
</table>
Bayesian linear and hierarchical models 4 weeks Zellner's prior; connections with classical least squares; random effects
Model selection and adequacy concepts 1 week Bayes factors; DIC; residual analysis; sensitivity analysis; Bayesian p-values
Case studies 1 week Complete analysis of several complex datasets
Final exam 1 week final exam

Syllabus

Additional Documentation

Additional Comments

ST 440 and 540 will differ in the following way. 540 will have an additional learning outcome: Demonstrate the ability to work with more theoretical aspects of selected topics via derivations, proofs, or other more advanced statistical techniques. 540 students will have additional HW and Exam questions to evaluate this learning outcome. The projects for 540 students will be expected to be on more advanced topics and have more depth than those for 440.

Comment on anticipated impact of establishment of ST 440/540 on ST 740 (PhD-level course Bayesian Inference): ST 540 may take a few students from ST 740, but we hope that ST 540 will attract students who might not have taken ST 740.

minosbis 1/10/2017: Previous enrollment shows demand for the course. Though similar to ST 740, this course is available to non-ST and non-PhD students.

pjharrie 1/19/2017: there is a disconnect between the grading scheme - which states that grad students will have different tests and the statement in the additional comments which appears to be repeated from the other course proposals. So which is it?

ABGS Reviewer Comments:
-Do we want additional detail about the additional homework and additional exam questions for the 500-level? It seems that in the past we have asked for clearer articulation.

pjharrie 1/31/2017 I think the more clearly the differences between 400/500 levels are articulated, the better. So, I feel that the ABGS Reviewer comments should be addressed.

Course Reviewer Comments


Key: 9461