CGS Agenda Item: 22-03
Effective Spring 2023

Eastern Illinois University

New/Revised Course Proposal Format

(Approved by CAA on 4/3/14 and CGS on 4/15/14, Effective Fall 2014)

Banner/Catalog Information (Coversheet)

1. **__X__New Course or _____Revision of Existing Course**
2. **Course prefix and number:** __MAT 5150_____
3. **Short title:** __Bayesian Statistics_____
4. **Long title:** _Bayesian Statistics_____
5. **Hours per week:** _4__ Class _0__ Lab _4__ Credit
6. **Terms:** ___ Fall ___ Spring ___ Summer _X__ On demand
7. **Initial term**: ___ Fall _X__ Spring ___ Summer Year: _2023_____
8. **Catalog course description:** Introduction to the concepts of Bayesian statistics including Bayes' rule, prior and posterior distributions, conjugacy, Bayesian point estimates and intervals, Markov Chain Monte Carlo, and hierarchical models.
9. **Course attributes:**

   General education component: ___N/A_____

   ___ Cultural diversity ___ Honors ___ Writing centered ___ Writing intensive ___Writing active
10. **Instructional delivery**
    Type of Course:

    _X__ Lecture ___ Lab ___ Lecture/lab combined ___ Independent study/research

    ___ Internship ___ Performance ___ Practicum/clinical ___ Other, specify: _____

    Mode(s) of Delivery:

    _X__ Face to Face _X__ Online ___ Study Abroad

    ___ Hybrid, specify approximate amount of on-line and face-to-face instruction_____
11. Course(s) to be deleted from the catalog once this course is approved.
    _____N/A_____
12. **Equivalent course(s):** ___None_____

    a. Are students allowed to take equivalent course(s) for credit? ___ Yes _X__ No
13. **Prerequisite(s): ___CSM 2170, MAT 3701_____**

    a. Can prerequisite be taken concurrently? ___ Yes __X_ No

    b. Minimum grade required for the prerequisite course(s)? _C__

    c. Use Banner coding to enforce prerequisite course(s)? _X__ Yes ___ No

d. Who may waive prerequisite(s)?

___ No one _X__ Chair _X__ Instructor ___ Advisor ___ Other (specify)

14. Co-requisite(s): __N/A_____

15. Enrollment restrictions

a. Degrees, colleges, majors, levels, classes which may take the course: _all_____

b. Degrees, colleges, majors, levels, classes which may not take the course: _Everyone else_____

16. Repeat status: _X__ May not be repeated ___ May be repeated once with credit

17. Enter the limit, if any, on hours which may be applied to a major or minor: ___

18. Grading methods: _X__ Standard ___ CR/NC __ Audit ___ ABC/NC

19. Special grading provisions:

___ Grade for course will not count in a student's grade point average.

___ Grade for course will not count in hours toward graduation.

___ Grade for course will be removed from GPA if student already has credit for or is registered in: _____

___ Credit hours for course will be removed from student's hours toward graduation if student already has credit for or is registered in: _____

20. Additional costs to students:
Supplemental Materials or Software___N/A_____

Course Fee _X__No ___Yes, Explain if yes_____

21. Community college transfer:

___ A community college course may be judged equivalent.

_X__ A community college may not be judged equivalent.

Note: Upper division credit (3000+) will not be granted for a community college course, even if the content is judged to be equivalent.

Rationale, Justifications, and Assurances (Part I)

1. ___Course is required for the major(s) of _____
   __Course is required for the minor(s) of _____
   ___Course is required for the certificate program(s) of _____
   _X__ Course is used as an elective
2. **Rationale for proposal**: EIU does not presently offer a class which covers Bayesian statistical methods. This course would be part of the rotation of graduate mathematics courses needed for the requirements in the MA Mathematics degree. This course is also accessible to upper-level undergraduate students and could be taken as an elective by students majoring in Mathematics or Computer Science.
3. **Justifications for (answer N/A if not applicable)**
   Similarity to other courses: N/A
   Prerequisites: Students should have experience with coding (CSM 2170) and undergraduate probability and statistics (MAT 3701) before enrolling in this course.
   Co-requisites: N/A
   Enrollment restrictions: N/A
   Writing active, intensive, centered: N/A
4. **General education assurances (answer N/A if not applicable)**
   General education component: N/A
   Curriculum: N/A
   Instruction: N/A
   Assessment: N/A
5. **Online/Hybrid delivery justification & assurances (answer N/A if not applicable)**
   Online or hybrid delivery justification: Due to the anticipated demand for the course by students in the online MA Mathematics program, this course will be offered online. The online format provides flexibility for undergraduate students who wish to take it as an elective for Mathematics or Computer Science majors.
   Instruction: Online delivery of the class will be facilitated through the EIU Learning Management System. Materials will include professor-recorded videos, notes, discussions and other components. Faculty teaching the class online will have the appropriate OCDi training.
   Integrity: The EIU LMS allows for exams to be proctored, for example using Respondus. Assignments can be checked for integrity using available tools.

Interaction: The EIU LMS allows for submitted homework and posts to discussion boards. The professor can give feedback and interact with students via these methods, online office hours, and online class meetings if and when necessary. The discussion board tools also allow students to interact between themselves in an online class. The professor can create videos with instructions and demonstrations for students to view.

Model Syllabus (Part II)

Please include the following information:

1. Course number and title
2. Catalog description
3. Learning objectives.
4. Course materials.
5. Weekly outline of content.
6. Assignments and evaluation, including weights for final course grade.
7. Grading scale.
8. Correlation of learning objectives to assignments and evaluation.

1. MAT 5150: Bayesian Statistics

2. Description: Introduction to the concepts of Bayesian statistics including Bayes' rule, prior and posterior distributions, conjugacy, Bayesian point estimates and intervals, Markov Chain Monte Carlo, hierarchical models.

3. **Learning Objectives:** Students will be able to –

- Compare frequentist and Bayesian statistical methods (2)
- Explain the elements of the Bayesian inference formula (1, 2, 3)
- Construct Bayesian models for data analysis (1, 2, 3)
- Implement Bayesian analytic methods (1, 2, 4)
- Interpret Bayesian model output (1, 2, 3)
- Evaluate goodness of model fit and compare different model fits (1, 2)
- Understand Bayesian methods used in contemporary problems (1, 3)

4. Course materials: Computer with Internet connection, camera, microphone; textbook

Possible textbooks appropriate for the course:

- *A Student's Guide to Bayesian Statistics* (Ben Lambert). Sage: 2018.
- *Bayesian Computation with R*, 2nd edition (Jim Albert). Springer: 2009.
- *A First Course in Bayesian Statistical Methods* (Peter D. Hoff). Springer: 2009.

5. Weekly outline of content

Week 1: Introduction to Statistical Software
Week 2: Introduction to Bayesian Thinking
Week 3: Likelihoods, Priors, and Posteriors
Week 4: Single-Parameter Models
Week 5: Probability Distributions
Week 6: Conjugate Priors
Week 7: Multiparameter Models
Week 8: Introduction to Computational Bayes
Week 9: Markov Chain Monte Carlo Methods
Week 10: Metropolis-Hastings Algorithm
Week 11: Gibbs Sampling
Week 12: Hamiltonian Monte Carlo
Week 13: Hierarchical Models
Week 14: Model Comparison
Week 15: Data Analysis Project
Week 16: Final

6. Assignment and evaluation

- Homework: 40%
- Projects: 20%
- Quizzes/Tests/Final: 40%

7. Grading Scale

A: 90 – 100 (Excellent)
B: 80 – 89 (Good)
C: 70 – 79 (Average)
D: 60 – 69 (Poor but passed)
F: 0 – 59 (Failed)

8. Correlation of learning objectives to Assignments and Evaluation

Learning Objectives	Homework (40%)	Projects (20%)	Quizzes/Tests/Final (40%)
Compare frequentist and Bayesian statistical methods (2)	✓		✓
Explain the elements of the Bayesian inference formula (1, 2, 3)	✓		✓
Construct Bayesian models for data analysis (1, 2, 3)	✓	✓	✓
Implement Bayesian analytic methods (1, 2, 4)	✓	✓	✓
Interpret Bayesian model output (1, 2, 3)	✓	✓	✓
Evaluate goodness of model fit and compare different model fits (1, 2)	✓	✓	✓
Understand Bayesian methods used in contemporary problems (1, 3)	✓	✓	✓

Date approved by the department or school: 12/6/21
Date approved by the college curriculum committee: 1/19/22
Date approved by the Honors Council *(if this is an honors course):*
Date approved by CAA: CGS: