
ROCHESTER INSTITUTE OF TECHNOLOGY

COLLEGE OF SCIENCE
SCHOOL OF MATHEMATICAL SCIENCES

COS-STAT-489 Special Topics: Bayesian Methods of Data Analysis

1.0 Course Information

a) Catalog Listing (click [HERE](#) for credit hour assignment guidance)

Course title (100 characters)	Special Topics: Bayesian Methods of Data Analysis
Transcript title (30 Characters)	Bayesian Inference
Credit hours	3
Prerequisite(s)**	COS-STAT-205 or COS-MATH-252
Co-requisite(s)	

b) Terms(s) offered (check at least one)

<input type="checkbox"/>	Fall
X	Spring
<input type="checkbox"/>	Summer
<input type="checkbox"/>	Other
X	Offered biennially

If "Other" is checked, explain:

c) Instructional Modes (click [HERE](#) for credit hour assignment guidance)

	Contact hours	Maximum students/section
Classroom	3	35
Lab		
Studio		
Other (specify, i.e. online, workshop seminar, etc.)		

2.0 Course Description (as it will appear in the bulletin)

COS-STAT-489

Bayesian Methods of Data Analysis

This course is an introduction to the principles and techniques of data analysis using Bayesian methods. Topics covered include parameter estimation, hypothesis testing and model selection, marginalization over nuisance parameters, and numerical methods.

Bayesian methods are compared and contrasted with classical frequentist techniques where appropriate. (COS-STAT-205 or COS-MATH-252) **Class 3, Credit 3 (S)**

3.0 Goal(s) of the Course

To provide an introduction to Bayesian methods at the undergraduate level; to enable students to apply Bayesian methods to computational data analysis; to contextualize students' existing knowledge of classical frequentist techniques in a Bayesian logical framework.

4.0 Intended course learning outcomes and associated assessment methods

Include as many course-specific outcomes as appropriate, one outcome and assessment method per row. Click [HERE](#) for guidance on developing course learning outcomes and associated assessment techniques.

Course Learning Outcome	Assessment Method
Construct posterior probability distributions from observed data	Homework, exams, project
Perform model comparisons using the Bayes factor	Homework, exams, project
Compare Bayesian results to their classical analogues	Homework, exams, project
Evaluate Bayesian quantities (plausible intervals, probabilities, Bayes factors) numerically	Homework, project

5.0 Topics (should be in an enumerated list or outline format)

1. Bayesian interpretation of probability
 1. Probability as extended logic
 2. Sum and product rules
 3. Bayes's theorem and conditional probabilities
2. Bayesian parameter estimation
 1. Calculation of posterior probabilities
 2. Marginalization over nuisance parameters
 3. Choice of prior probability distributions
 4. Point estimates and plausible intervals
3. Bayesian hypothesis testing
 1. Model comparison using the Bayes factor
 2. Bayesian decision theory
4. Numerical methods
 1. Markov chain Monte Carlo
 2. Gibbs sampler

6.0 Possible Resources (should be in an enumerated list or outline format)

1. Gelman, Carlin, Stern, Dunson, Vehtari, and Rubin, *Bayesian Data Analysis*, Chapman & Hall/CRC
2. Bolstad, *Introduction to Bayesian Statistics*, Wiley, Hoboken, NJ

3. Bolstad, *Understanding Computational Bayesian Statistics*, Wiley, Hoboken, NJ
4. Kruschke, *Doing Bayesian Data Analysis: A Tutorial with R, JAGS and Stan*, Academic Press
5. Sivia, *Data Analysis: A Bayesian Tutorial*, Oxford University Press
6. R (programming language) / Rstudio (integrated development environment)
7. Scientific Python (programming library) / Jupyter (notebook environment)

7.0 Program outcomes and/or goals supported by this course (if applicable, as an enumerated list)

N/A (elective course)

8.0 Administrative Information

a) Proposal and Approval

Course proposed by	John Whelan
Effective term	Spring, AY 16-17 (2165)
Required approval	Approval granted date
Academic Unit Curriculum Committee	
Department Chair/Director/Head	
College Curriculum Committee	
College Dean	

b) Special designations for undergraduate courses

The appropriate Appendix (A, B and/or C) must be completed for each designation requested. IF YOU ARE NOT SEEKING SPECIAL COURSE DESIGNATION, DELETE THE ATTACHED APPENDICES BEFORE PROCEEDING WITH REVIEW AND APPROVAL PROCESSES.

Check	Optional Designations	*** Approval date (by GEC, IWC or Honors)
	General Education	
	Writing Intensive	
	Honors	

c) This outline is for a...

<input checked="" type="checkbox"/>	New course
<input type="checkbox"/>	Revised course
<input type="checkbox"/>	Deactivated course

If revised course, check all that have changed

<input type="checkbox"/>	Course title	<input type="checkbox"/>	Mode of Delivery
<input type="checkbox"/>	Credit hour	<input type="checkbox"/>	Course Description
<input type="checkbox"/>	Prerequisites	<input type="checkbox"/>	Special Designation
<input type="checkbox"/>	Contact hour	<input type="checkbox"/>	
<input type="checkbox"/>	Other (explain briefly):		

d) Additional course information (check all that apply)

<input checked="" type="checkbox"/>	Schedule Final Exam
<input type="checkbox"/>	Repeatable for Credit How many times:
<input type="checkbox"/>	Allow Multiple Enrollments in a Term
<input type="checkbox"/>	Required course For which programs:
<input checked="" type="checkbox"/>	Program elective course For which programs: Applied statistics major & minor

e) Other relevant scheduling information

(e.g., special classroom, studio, or lab needs, special scheduling, media requirements)

9.0 Colleges may add additional information here if necessary

(e.g., information required by accrediting bodies)