SAMPLE SYLLABUS (January 24, 2018)

STA 539 Applied Bayesian Methods - Summer Session

Instructor	Dr. Thomas Short
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Office hours	TBD
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Course meeting day and time	TBD
Course website	d2l.wcupa.edu

Course description

3 credits.
Review of conditional probability and Bayes' Theorem, conditional distributions and conditional expectations, and likelihood functions; Prior and posterior distributions; Conjugate priors; Credible intervals; Bayes' factors; Bayesian estimation in linear models; Predictive analysis; Markov Chain Monte Carlo methods. Use of appropriate technology. Prerequisites: STA 506; STA 511.

Materials

+ Access to the R statistical programming environment (https://www.r-project.org/).
+ See accompanying for potentially helpful references.

Programmatic Student Learning Objectives (PSLOs)

After completing the Graduate Program in Applied Statistics, students will have:

1. Demonstrated an understanding of probability and statistical inference, including the fundamental laws of classical probability, discrete and continuous random variables, expectation theory, maximum likelihood methods, hypothesis testing, power, and bivariate and multivariate distribution theory.
2. Demonstrated the ability to apply the elementary methods of statistical analysis, namely those based on classical linear models, categorical methods, and non-parametric ideas to perform data analysis for the purposes of statistical inference.
3. Demonstrated proficiency in the effective use of computers for research data management and for analysis of data with standard statistical software packages, particularly SAS.
4. Learned to develop and critically assess design of experimental studies and the collection of data.
5. Applied one or more methods of statistical inference to a particular area of interest, particularly the program in the elective concentration.
6. Gained practical experience in statistical consulting and communicating with non-statisticians, culminating with interaction with research workers at a local company as part of the internship practicum.

Course Student Learning Outcomes (CSLOs)
1. Compute conditional probabilities using Bayes' Theorem. [PSLO1]
2. Compute conditional distributions using Bayes' Theorem, demonstrate understanding of prior and posterior distributions, and compute conditional expectations using conditional distributions. [PSLO1, PSLO2]
3. Apply methods for conjugate priors to perform Bayesian analyses for one proportion and for one mean. [PSLO2, PSLO3]
4. Fit a simple linear regression model using Bayesian methods. [PSLO2, PSLO3]
5. Report and interpret credible intervals for estimating one proportion and one mean. [PSLO3, PSLO5]
6. Report and interpret Bayes' factors for testing one proportion and one mean. [PSLO3, PSLO5]
7. Compute and interpret a predictive distribution, and use the predictive distribution to generate predictions. [PSLO3, PSLO5]
8. Utilize simulation-based methods such as Markov Chain Monte Carlo to estimate conditional distributions. [PSLO3, PSLO5]
9. Apply Bayesian methods to a data analysis problem, and present the results in written and oral form. [PSLO5, PSLO6]

Evaluation & Grading

Assessment	CSLOs assessed	Weight
Homework	1-8	TBD
Exams	1-4	TBD
Data analysis project	9	TBD

A letter grade will be assigned based on performance in the course, according to the following scale:

Grade	Quality points	Percentage equivalents	Interpretation
A	4.00	93% - 100%	Superior graduate attainment
A-	3.67	90% - 93%	
B+	3.33	87% - 90%	Satisfactory graduate attainment
B	3.00	83% - 87%	
B-	2.67	80% - 83%	
C+	2.33	77% - 80%	Attainment below graduate expectations
C	2.00	73% - 77%	
C-	1.67	70% - 73%	
F	0	< 70%	Failure

D grades are not used. Refer to the *WCU Graduate Catalog* for description of NG (No Grade), W, and other grades.

Course outline (5-week summer schedule)

Meeting	Topics	CSLOs
1	Conditional probability and Bayes' Theorem; conditional distributions and conditional expectation.	1, 2
2	Likelihood functions; prior and posterior distributions	2
3	Conjugate prior distributions in the beta-binomial and normal-normal cases.	3
4	Bayesian inference for simple linear regression	4
5	Midsemester exam	1-4
6	Bayesian estimation and credible intervals	5
7	Bayesian hypothesis testing and Bayes' factors	6
8	Predictive distributions; Markov Chain Monte Carlo.	7, 8
9	Overflow	
9	Project presentations	9

Instructor's attendance policy

Attendance is an expected part of class. In the event that you miss a class you should contact either myself or another student to determine what was missed. It is your responsibility to make up all missed classwork.

ACADEMIC & PERSONAL INTEGRITY

It is the responsibility of each student to adhere to the university's standards for academic integrity. Violations of academic integrity include any act that violates the rights of another student in academic work, that involves misrepresentation of your own work, or that disrupts the instruction of the course. Other violations include (but are not limited to): cheating on assignments or examinations; plagiarizing, which means copying any part of another's work and/or using ideas of another and presenting them as one's own without giving proper credit to the source; selling, purchasing, or exchanging of term papers; falsifying of information; and using your own work from one class to fulfill the assignment for another class without significant modification. Proof of academic misconduct can result in the automatic failure and removal from this course. For questions regarding Academic Integrity, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to the Department Graduate Handbook, the Graduate Catalog, the *Ram's Eye View*, and the University website at www.wcupa.edu.

STUDENTS WITH DISABILITIES

If you have a disability that requires accommodations under the Americans with Disabilities Act (ADA), please present your letter of accommodations and meet with me as soon as possible so that I can support your success in an informed manner. Accommodations cannot be granted retroactively. If you would like to know more about West Chester University's Services for Students with Disabilities (OSSD), please visit them at 223 Lawrence Center. The OSSD hours of Operation are Monday – Friday, 8:30 a.m. – 4:30 p.m. Their phone number is 610-436-2564, their fax number is 610-436-2600, their email address is ossd@wcupa.edu, and their website is at www.wcupa.edu/ussss/ossd.

REPORTING INCIDENTS OF SEXUAL VIOLENCE
West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator, Ms. Lynn Klingensmith. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University protection of minors policy. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at the webpage for the Office of Social Equity at http://www.wcupa.edu/_admin/social.equity/.

EXCUSED ABSENCES POLICY
Students are advised to carefully read and comply with the excused absences policy, including absences for University-sanctioned events, contained in the *WCU Graduate Catalog*. In particular, please note that the "responsibility for meeting academic requirements rests with the student," that this policy does not excuse students from completing required academic work, and that professors can require a "fair alternative" to attendance on those days that students must be absent from class in order to participate in a University-sanctioned event.

EMERGENCY PREPAREDNESS
All students are encouraged to sign up for the University's free WCU ALERT service, which delivers official WCU emergency text messages directly to your cell phone. For more information, visit www.wcupa.edu/wcualert. To report an emergency, call the Department of Public Safety at 610-436-3311.

ELECTRONIC MAIL POLICY
It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.

Course bibliography

Albert, J. (2009) *Bayesian Computation with R*, Springer.

Coghlan, A. "Using R for Bayesian Statistics," http://a-little-book-of-r-for-bayesian-statistics.readthedocs.io/en/latest/index.html, accessed January 18, 2017.

Cowles, M. K. (2013) *Applied Bayesian Statistics With R and OpenBUGS Examples*, Springer.

Gelman, A., Carlin, J., Stern, H., Dunson, D., Vehtari, A., and Rubin, D. (2013) *Bayesian Data Analysis* (3rd ed.), CRC Press.

Hoff, P. D. (2009) *A First Course in Bayesian Statistical Methods*, Springer.

Kruschke, J. (2015) *Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan* (2nd ed.), Academic Press.

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