SAINT LOUIS UNIVERSITY

COLLEGE FOR PUBLIC HEALTH AND SOCIAL JUSTICE

BST 6200

Spatial Statistics and Disease Mapping

Spring 2020

Syllabus

3:45 pm - 5:00 pm MW
Salus Center 1417

Instructor

Steven E. Rigdon
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481 Salus
314-977-8127
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Office Hours

2:40 – 3:40 MW in 481 Salus Center
10:00 – 10:50 TR in Tegeler Hall (Room TBA)
or by appointment

v. 1/13/20 Disclaimer: The instructor reserves the right to modify the syllabus as needed during the semester. Any changes will be announced in class and on Blackboard.

Course Overview

Introduction: This course covers models for spatial data, that is, data that are geographically coded. Specific attention is given to disease rates which may vary across regions.

Purpose: Students should learn to apply the appropriate statistical method to data sets that include geographic information.

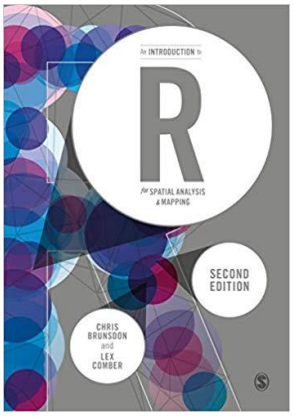
Course Description

Course Format: Lectures, class discussions, student presentations

Description in Banner: Statistical methods for disease data that include geographic information. Methods include spatial scan statistics, kriging, measures of autocorrelation, Moran's I, regression with exposure data and covariates. Disease maps and relative risk estimation. Mapping and geographic information systems. Bayesian methods of estimation for conditional autoregressive models.

Prerequisite: Although BST 5230 is stated in the catalog as a prerequisite, we will cover enough about Bayesian statistics to make the second half of the course understandable. Some of the Bayesian material will be presented in on-line videos. Students should have had a thorough introductory course on probability and statistics, such as BST 4100 or 5020.

Textbooks:

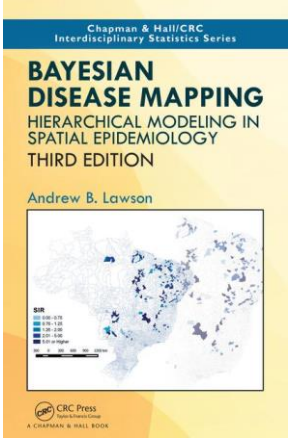


Introduction to R for Spatial Analysis and Mapping, Second Edition

by Chris Brundson and Lex Comber, 2019, Published by Sage,

ISBN 978-1526428509 REQUIRED

Web site: https://bookdown.org/lexcomber/brunsdoncomber2e/



Bayesian Disease Mapping: Hierarchical Modeling in Spatial Epidemiology, Third Edition

by Andrew Lawson, 2018, Published by CRC

ISBN 978-138-57542-4 REQUIRED

Web sites:

http://people.musc.edu/~abl6/

https://github.com/Andrew9Lawson

Course Learning Objectives:

Course Learning Objective	Program Learning Outcomes	Assessment of Learning Objectives
1. Design data collection strategies for studies that involve spatial data	**MS-BSTHA 1: DESIGN** Students should be able to design experiments or data collection strategies to answer research questions in public health. **PhD Biostatistics 1:** Design research studies to address problems in biomedical and public health fields.	Homework and exams
2. Identify and fit the appropriate model for spatial data.	**MPH-BST 1:** Analyze data with complex statistical models. **MS-BSTHA 3 ANALYSIS:** Students will develop statistical models for data and make inferences to answer research questions in public health. **PhD Domain 2 Analytical Skills:** Plan, design and conduct research studies. Interpret the results using inferential statistical methods and methods of qualitative data analysis.	Homework and exams
3. Use appropriate software to analyze spatial data.	**MPH-BST 5:** Manage and process data using a variety of software packages. **MS-BSTHA 2 DATA AND COMPUTING:** Students will use the appropriate software to manage and analyze data.	Homework, exams, and project
4. Communicate results of study involving spatial data.	**MPH-BST 4:** Create statistical reports and presentations using appropriate graphical and numerical summaries and narrative explanation. **MS-BSTHA COMMUNICATION** Students will describe the process of data collection, and convey the results of statistical analysis, both orally and in writing.	Project

Grading Determination and Policy

Grades are based on two exams, a midterm and a final, along with four homework assignments and one project. The project involves finding and analyzing areal spatial data using the CAR models described in the Lawson book. PhD students should identify a potential journal for their research project and write the paper using the guidelines of that journal.

Item	Points	Pct. Of Final Grade
Exam 1	50	20 %
Homework (4 @ 10)	40	16 %
Project on Disease Mapping (written and oral)	100	40 %
Final Exam	60	24 %
TOTAL	250	100 %

Grading Policy: According to University and CPHSJ policy, the final grades that are allowed are: A, A- B+, B, B-, C+, C, C-, F, and FQ.

A	4.000	High achievement and intellectual initiative.
A-	3.700	Approaching high achievement.
B+	3.300	Slightly higher than above average achievement.
B	3.000	Above average achievement.
B-	2.700	Approaching above average achievement.
C+	2.300	Slightly higher than average achievement.
C	2.000	Average achievement.
C-	1.700	Below average achievement. Grade may not fulfill "C or better" course requirements.
F	0.000	Failure
FQ	0.000	"given to those students who had ceased attending a course and as a result earned a failing grade"

CPHSJ graduate students must receive a minimum grade of a "B-" or better in all core and required courses in the program, and a minimum grade of "C" or better in all electives.

Late Policy:

Homework should be turned in at the end of the class on the due date. After that it is considered late. One point (out of ten) will be deducted for each day the assignment is late, including the first day. If you are unable to attend class, you can scan and send the assignment via email by the due date and time. The same policy applies to homework submitted by email. Exceptions can be made if there are extenuating circumstances. Contact me as soon as possible in these cases.

Assignment/Exam Conflicts:

If you know you must miss a scheduled exam, let me know as soon as possible so we can reschedule. This applies to the two in-term exams and the final exam.

Feedback on Assignments:

Timely feedback on assignments is needed in order to ensure that students are aware of their progress. Typically, feedback will be provided within two weeks after the due date. In the rare event that these deadlines cannot be met, students should be informed of the delay and the extra time needed in providing feedback.

Policies

Academic Integrity Expectations and Policy:

Academic integrity is honest, truthful and responsible conduct in all academic endeavors. The mission of Saint Louis University is "the pursuit of truth for the greater glory of God and for the service of humanity." Accordingly, all acts of falsehood demean and compromise the corporate endeavors of teaching, research, health care, and community service through which SLU fulfills its mission. The University strives to prepare students for lives of personal and professional integrity, and therefore regards all breaches of academic integrity as matters of serious concern. The full University-level Academic Integrity Policy can be found on the Provost's Office website at: https://www.slu.edu/provost/policies/academic-and-course/policy_academic-integrity_6-26-2015.pdf.

Additionally, each SLU College, School, and Center has adopted its own academic integrity policies, available on their respective websites. All SLU students are expected to know and abide by these policies, which detail definitions of violations, processes for reporting violations, sanctions, and appeals. Please direct questions about any facet of academic integrity to your faculty, the chair of the department of your academic program, or the Dean/Director of the College, School or Center in which your program is housed. https://sites.google.com/a/slu.edu/my-cphsj/home/masters

Policy on Style for Citation and Plagiarism:

Please refer to the Google site for academic resources at https://sites.google.com/a/slu.edu/my-cphsj/home/masters for the policy on style and plagiarism.

Student Success Center:

In recognition that people learn in a variety of ways and that learning is influenced by multiple factors (e.g., prior experience, study skills, learning disability), resources to support student success are available on campus. The Student Success Center assists students with academic related services, and is located in the Busch Student Center (Suite, 331) and the School of Nursing (Suite, 114). Students who think they might benefit from these resources can find out more about:

- Course-level support (e.g., faculty member, departmental resources, etc.) by asking your course instructor.
- University-level support (e.g., tutoring services, university writing services, disability services, and student/academic coaching) by visiting the Student Success Center or by going to https://www.slu.edu/life-at-slu/student-success-center/.

Disability Accommodations:

Students with a documented disability who wish to request academic accommodations must formally register their disability with the University. Once successfully registered, students also must notify their

course instructor that they wish to use their approved accommodations in the course.

Please contact Disability Services to schedule an appointment to discuss accommodation requests and eligibility requirements. Most students on the St. Louis campus will contact Disability Services, located in the Student Success Center and available by email at Disability_services@slu.edu or by phone at 314.977.3484. Once approved, information about a student's eligibility for academic accommodations will be shared with course instructors by email from Disability Services and within the instructor's official course roster. Students who do not have a documented disability but who think they may have one also are encouraged to contact to Disability Services. Confidentiality will be observed in all inquiries.

Title IX:

Saint Louis University and its faculty are committed to supporting our students and seeking an environment that is free of bias, discrimination, and harassment. If you have encountered any form of sexual misconduct (e.g., sexual assault, sexual harassment, stalking, domestic or dating violence), we encourage you to report this to the University. If you speak with a faculty member about an incident that involves a Title IX matter, **that faculty member must notify SLU's Title IX coordinator (or that person's equivalent on your campus) and share the basic facts of your experience**. This is true even if you ask the faculty member not to disclose the incident. The Title IX contact will then be available to assist you in understanding all of your options and in connecting you with all possible resources on and off campus.

For most students on the St. Louis campus, the appropriate contact is Anna R. Kratky (DuBourg Hall, room 36; anna.kratky@slu.edu; 314-977-3886). If you wish to speak with a confidential source, you may contact the counselors at the University Counseling Center at 314-977-TALK. To view SLU's sexual misconduct policy, and for resources, please visit the following web addresses: https://www.slu.edu/here4you and https://www.slu.edu/general-counsel.

University Writing Services:

We encourage you to take advantage of university writing services in the Student Success Center; getting feedback benefits writers at all skill levels. Trained writing consultants can help with writing projects, multimedia projects, and oral presentations. University Writing Services offers one-on-one consultations that address everything from brainstorming and developing ideas to crafting strong sentences and documenting sources. For more information, call the Student Success Center at 314-977-3484.

Basic Needs Security Syllabus Statement:

Students in personal or academic distress and/or who may be specifically experiencing challenges such as securing food or difficulty navigating campus resources, and who believe this may affect their performance in the course, are encouraged to contact the Dean of Students Office (deanofstudents@slu.edu or 314-977-9378) for support. Furthermore, please notify the instructor if you are comfortable in doing so, as this will enable them to assist you with finding the resources you may need.

Course Calendar (Subject to Revision)

Week	Dates	Monday	Book/ Chapter	Wednesday	Book/ Chapter
1	1/13/2020 1/15/2020	Introduction to course; Introduction to R and R Studio; R packages; Data types and structures in R	B/C Chapters 1 and 2	Scalars, vectors, and matrices; Data frames and tibbles; Plots in base R; ggplot; reading/writing data files	B/C Chapter 2
2	1/20/2020 1/22/2020	NO CLASS		Handling spatial data in R: sp and sf packages; Spatial data formats in R; Reading and writing spatial data; tmap package	B/C Chapter 3
3	1/27/2020 1/29/2020	Mapping spatial data attributes; Mapping points and attributes; Raster graphics; Descriptive statistics	B/C Chapter 3	Scripting and Writing Functions in R: Loops and conditionals; Functions; Spatial data structures; dplyr package	B/C Chapter 4
4	2/3/2020 2/5/2020	Using R as a GIS: Spatial intersection; Buffers; Merging spatial features; Creating distance attributes	B/C Chapter 5	Using Combining spatial datasets; Raster graphics; Converting Raster and vector graphics	B/C Chapter 5
5	2/10/2020 2/12/2020	Point Pattern Analysis Using R: Kernel density estimates; Second-order analysis; The *K* function	B/C Chapter 6	The *L* function; The *G* function; Marked point patterns; Interpolation; Nearest neighbor; Voronoi diagrams	B/C Chapter 6
6	2/17/2020 2/19/2020	Inverse distance weighting; Kriging	B/C Chapter 6	Kriging; Semivariogram	B/C Chapter 6
7	2/24/2020 2/26/2020	Review and Catch-up		Midterm Exam	
8	3/2/2020 3/4/2020	Spatial attribute analysis with R; Autocorrelation; PA lung cancer data; Queen and rook adjacency	B/C Chapter 7	Neighbor networks; Moran's *I*	B/C Chapter 7
	3/9/2020 3/11/2020	SPRING BREAK			
9	3/16/2020 3/18/2020	Conditional autoregressive model; Transition to Lawson book	B/C Chapter 7; Lawson Chapter 5	Bayesian Approach to Statistics: Bayes theorem; Discrete prior and posterior	Lawson Chapter 2; Online videos
10	3/23/2020 3/25/2020	Bayesian Approach to Statistics: Continuous prior and posterior; Conjugate priors	Lawson Chapter 2; Online videos	Markov chain Monte Carlo; Metropolis-Hastings algorithm; BUGS and nimble	Lawson Chapter 3; Online videos
11	3/30/2020 4/1/2020	Disease map reconstruction; relative risk estimation; random effects	Lawson Chapter 5	Conditional autoregressive (CAR) model; ICAR and PCAR models	Lawson Chapter 5
12	4/6/2020 4/8/2020	Disease cluster detection; Residuals	Lawson Chapter 6	Disease detection with discrete counts	Lawson Chapter 6
13	4/13/2020 4/15/2020	Regression and Ecological Analysis; Regression modeling	Lawson Chapter 7	Regression and Ecological Analysis; Examples	Lawson Chapter 7
14	4/20/2020 4/22/2020	Regression and Ecological Analysis; More examples	Lawson Chap. 7	Spatio-temporal modeling for count data	Lawson Chap. 12
15	4/27/2020 4/29/2020	Spatio-Temporal Modeling; Latent structure models; Student Presentations	Lawson Chap. 12	Student Presentations	
16	5/4/2020 5/6/2020	Student Presentations		FINAL EXAM Wednesday May 6, 2020, 4:00 – 5:50 pm	