**GGS 300: Quantitative Methods for Geographical Analysis**

**Course Syllabus, Fall 2021, 3 Credits**

**Instructor**: Dr. Edward Oughton

**Location**: Remote, 100% asynchronous

**Email**: eoughton@gmu.edu

**Web location**: Blackboard

**TA**: Amy Rose-Tejwani (arose20@gmu.edu)

**Pre-requisites**: 30 credits, including GGS 102 and 103 or permission from the instructor.

**Textbook**: Readings will be based on McGrew et al. (2014):

McGrew, Lembo, and Monroe. 2014. *An Introduction to Statistical Problem Solving in Geography* (Third Edition). Waveland Press, Inc., Illinois. ISBN: 1478611197

Make sure to get the Third Edition! Available at the GMU Bookstore or at www.waveland.com

## OVERVIEW & OBJECTIVES

GGS 300 introduces students to the use of statistical techniques and quantitative methods within the spatial sciences. The aim will be to enable you to think and engage critically with statistical data, given we encounter this type of information daily (e.g. in the media, workplace, on a smartphone etc.). The course focuses on the basic components of quantitative spatial research, such as (i) developing research questions, (ii) evaluating research questions via formal hypothesis testing, and (iii) interpreting the results of statistical tests (including the redevelopment of research questions).

Students will learn how to:

1. Conduct rigorous statistical analysis of data and information commonly encountered in spatial science using industry-standard statistical software.
2. Interpret statistical analysis techniques in geographic research and the broader scientific literature.
3. Think critically about the use and misuse of statistics!

## GGS COMPUTER LAB, ASSIGNMENTS, & EXPECTATIONS

GGS 300 Students have remote access to the GGS Virtual Computing Lab with the software required for this course (R Studio), although as the software is open source it is encouraged you download a version on your own machine (for ease). Lab assignments will be based on the lecture material and will be administered via Blackboard. Lab assignments will generally be set on Thursdays and will be due the following week prior to the start of the lecture (except when noted in the Course Schedule). Late

labs will be penalized 20% for each day late. Late submissions will only go unpenalized for the usual documented medical reasons or by previous agreement with the instructor.

Grading will be as follows:

| **GRADING** | | |
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| **Assessment** | **Points** | **%** (of final grade) |
| Lab Assignments (10) | 200 | 25% |
| Midterm Exam1 | 100 | 25% |
| Midterm Exam2 | 100 | 25% |
| Final Exam | 100 | 25% |

Grades will be based on the following cutoff values, although the instructor reserves the right to alter the values at the end of the course:

A (93%), A- (90%), B+ (87%), B (83%), B- (80%), C+ (77%), C (73%), C- (70%), D (60%)

The midterm exams will cover the first two parts of the course. The final exam will be semi-comprehensive, focusing on the final part of the course, but also covering key topics from throughout the entire semester. There will be ungraded quizzes during the semester. The quizzes will be used to evaluate how well the course information is being presented and retained; they also provide an opportunity to preview potential exam questions. Students will be expected to submit assignments online through Blackboard. Only Word document (.docx or .doc) or Adobe PDF (.pdf) file formats will be accepted.

**OPTIONAL TEXTS**

There are many open and free resources for learning statistics in R. An Introduction is available for free as a pdf from www.r-project.org in the Documentation/Manuals section, although this focuses more on just the statistical computing language. You should also examine the *Resources* section on the R Studio website, as this will be the piece of software, we use to run the R language in this module (www.rstudio.com) (RStudio is a Graphical User Interface for the R language). There are also several introductory statistics websites that are very good and may help you considerably in your understanding by providing a different perspective. Two that are recommended are Statistics at Square 1 and Simple R: Using R for Introductory Statistics.

Further readings, if any, will be announced in class or by e-mail.

## COURSE RESOURCES

Content for GGS300 will be available on Blackboard, otherwise known as myMason. You will need to have access to a computer with a stable Internet connection capable of streaming video. It is also useful to have a web camera with a microphone for any additional Zoom sessions.

## OFFICE HOURS AND INSTRUCTOR INTERACTION

There are currently no set office hours, so instructor interaction is by appointment. When emailing, a timely response is expected Monday-Thursday. Please ensure your email questions are succinct. Phrasing questions to enable the instructor to make a swift response is likely to increase the efficiency of an answer. Regular Q&A sessions will be held via Zoom to help with any queries participants may have.

## ACADEMIC INTEGRITY

GMU has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to always follow are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged, with the expectation that all aspects of the class will be conducted with civility and tolerance for differing ideas, perspectives, and traditions.

## GMU EMAIL ACCOUNTS

Students must use their MasonLive email account to receive important University information, including messages related to this class. See http://masonlive.gmu.edu for more information. Please do not email the instructor from a non-GMU email account.

## DIVERSITY

GMU promotes a living and learning environment for outstanding growth and productivity among its students, faculty, and staff. Through its curriculum, programs, policies, procedures, services, and resources, Mason strives to maintain a quality environment for work, study, and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds, and practices can be voiced, heard, and respected.

The reflection of Mason's commitment to diversity and inclusion goes beyond policies and procedures to focus on behavior at the individual, group, and organizational level. The implementation of this commitment to diversity and inclusion is found in all settings, including individual work units and groups, student organizations and groups, and classroom settings; it is also found with the delivery of services and activities, including, but not limited to, curriculum, teaching, events, advising, research, service, and community outreach.

Acknowledging that the attainment of diversity and inclusion are dynamic and continuous processes, Mason seeks to continuously improve its environment. To this end, the University promotes continuous monitoring and self-assessment regarding diversity. The aim is to incorporate diversity and inclusion within the philosophies and actions of the individual, group and organization, and to make improvements as needed.

In this regard, should you have any comments or feedback that you wish to raise about GSS300, please do let the instructor know as your feedback is incredibly valuable.

**OFFICE OF DISABILITY SERVICES**

If you are a student with a disability and you need academic accommodations, please contact the instructor and the Office of Disability Services (ODS) at 993-2474, http://ods.gmu.edu. All academic accommodations must be arranged through the ODS.

**STUDENTS AS SCHOLARS**

Students as Scholars is GMU's award-winning initiative to give students the opportunity to conduct undergraduate research. If you are interested in conducting research or simply learning more about the program, check out oscar.gmu.edu or stop by the Office of Student Scholarship, Creative Activities, and Research to learn about the many programs available to GMU students.

**GMU RESOURCES**

The Writing Center: https://writingcenter.gmu.edu

University Libraries, Ask a Librarian: https://library.gmu.edu/ask

Counseling and Psychological Services: https://caps.gmu.edu

University Catalog: https://catalog.gmu.edu

University Policies: https://universitypolicy.gmu.edu

| Week | Lecture/Lab Topic | Coursework |
|---|---|---|
| **Unit 1: Data, descriptive statistics, and probability** | | |
| Week 1: Jan 25th | Introduction to quantitative methods<br>Course overview<br>Statistics<br>Graphical data display<br>Lab: Installing R | **Read** McGrew Chapter 1 |
| Week 2: Feb 1st | Data basics and geographic data<br>Statistics in geoinformation science<br>Dimensions of data<br>Levels of measurement<br>Characteristics of a data set<br>Lab 1: Basic R and plotting | **Read** McGrew Chapter 2<br>**Homework 1** |
| Week 3: Feb 8th | Descriptive statistics<br>Concepts of descriptive statistics<br>Measures of central tendency<br>Measures of dispersion<br>Measures of shape<br>Lab 2: Descriptive statistics | **Read** McGrew Chapter 3<br>**Homework 2** |
| Week 4: Feb 15th | Descriptive spatial statistics<br>Concepts of descriptive spatial statistics<br>Spatial measures of central tendency<br>Spatial measures of dispersion<br>Lab 3: Descriptive spatial statistics | **Read** McGrew Chapter 4<br>**Homework 3** |
| Week 5: Feb 22nd | Probability<br>Basic probability<br>Binomial distribution<br>Poisson distribution<br>Normal distribution<br>Probability mapping<br>Lab 4: Probability | **Read** McGrew Chapter 5, 6<br>**Homework 4** |
| **Unit 2: Sampling and inferential tests of difference** | | |
| Week 6: Mar 1st | Data sampling<br>Sampling<br>Sampling design | **Read** McGrew Chapter 7<br>**Midterm 1** |
| Week 7: Mar 8th | Estimation in sampling<br>Concepts in estimation<br>Central limit theorem<br>Confidence intervals<br>Sample size estimation<br>Lab 5: Sampling | **Read** McGrew Chapter 8<br>**Homework 5** |
| Week 8: Mar 15th | Inferential statistics and hypothesis testing<br>Hypothesis testing<br>One sample tests<br>Issues in inferential testing<br>Lab 6: One sample tests | **Read** McGrew Chapter 9<br>**Homework 6** |
| Week 9: Mar 22nd | Inferential statistics: Two sample tests<br>Concepts of two sample tests<br>Two independent sample tests<br>Matched pair tests | **Read** McGrew Chapter 10<br>**Homework 7** |

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| | Lab 7: Two sample tests | |
| Week 10: Mar 29th | Analysis of variance: Multiple sample tests<br>Concepts of three or more samples<br>Analysis of variance<br>Kruskal-Wallis<br>Lab 8: Multiple sample tests | **Read** McGrew Chapter 11<br>**Homework 8** |
| **Unit 3: Inferential tests of relationships** | | |
| Week 11: April 5th | Categorical difference tests<br>Goodness-of-fit<br>Contingency analysis | **Read** Chapter 12<br>**Midterm 2** |
| Week 12: April 12th | Inferential spatial statistics<br>Concepts of inferential spatial statistics<br>Point pattern analysis<br>Area pattern analysis<br>Lab 9: Inferential spatial statistics | **Read** McGrew Chapters 13, 14, 15<br>**Homework 9** |
| Week 13: April 19th | Correlation<br>The nature of correlation<br>Correlation tests<br>Lab 10: Correlation and categorical difference | **Read** McGrew Chapter 16<br>**Homework 10** |
| Week 14: April 26th | Regression<br>Simple linear regression<br>Bivariate regression analysis<br>Residual analysis<br>Multivariate regression<br>Geographically weighted regression<br>Lab 11: Regression | **Read** McGrew Chapter 17, 18<br>**Homework 11** |
| Finals Week | Final exam | **Final exam:**<br>To be confirmed |

**Note:** The GGS 300 course schedule is tentative and is subject to revision by the instructor