

# GEOG 4185

## STATISTICAL RESEARCH METHODS IN GEOGRAPHY

Spring, 2021 ▪ Tuesday/Thursday 12:30 – 1:50 PM ▪ ENV 340

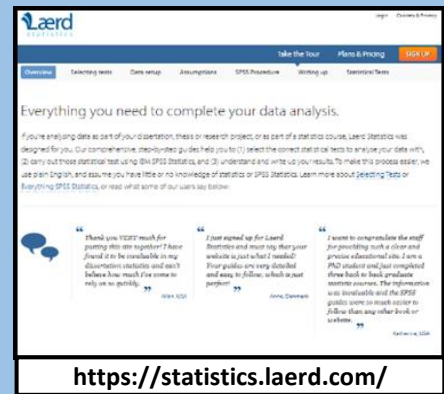
### Why should you take this course?

- Geographic research is inherently diverse, which in turn means that *researchers across geography need a broad tool kit* to address the range of problems to be solved.
- Another key point: geographic research can be done poorly. If this happens, this bad research reflects poorly on all geographers. *Geographers need to be properly educated* to avoid this.
- Given the above, *everyone in the geography community needs to understand the basic types of questions* that can be addressed through statistical analysis, and the range of *statistical options that we can draw on* that match the issues geographers commonly encounter.
- You will find these needs addressed here.

**Instructor:** Dr. Murray D. Rice  
**Office:** ENV 310G  
**Telephone:** (940) 565-3861  
**E-Mail:** [rice@unt.edu](mailto:rice@unt.edu)  
**Office Hours:** Thu, 10:00 am – 12:00 pm

### What you'll need for this course:

- The online course text (we'll discuss in class)



- Weekly ability to access the course website for resources posted there
- Time management skills
- Willingness to work & learn



**Class Web Site:**  
<http://www.murrayrice.com/geog-4185.html>

## What should you be able to do by the end of this course?

- Define and understand key terminology related to statistical research in geography, including “statistics”, “data”, “research”, “sample”, “population”, and others
- Explain the meaning of “probability” as the concept that is the foundation for statistical research
- Define the term “statistical test”
- Explain the need for both parametric and non-parametric statistical tests
- Ability to correctly define and use a null hypothesis and an alternative hypothesis for a statistical test
- Fully and logically document the results of a statistical test
- Master the range of possible tests of difference that can be used in statistical research
- Define the need for categorical tests
- Master the application of the Chi-Square test
- Define the terms “correlation” and “regression” and correctly demarcate the distinction between the two terms
- Account for the need for both parametric and non-parametric regression
- Explain the need for spatial statistics
- Assess the roles played by point and area-based spatial statistics
- Ability to use spatial statistics in an applied setting

# How can you succeed in this course?

In addition to the many grade-earning opportunities that await you this semester, your success in this class will be determined by **how well you manage your time** and **how engaged you are with the class** activities.

More specifically:



**Show up to class, and be on time** If you get to class within 10 minutes of the class start time, you'll avoid being considered late. Even more importantly, you will miss little to none of the great subject matter we're exploring in class that day. I always look forward to seeing you in class! However, if something like a family emergency or a lost dog prevent you from attending, if possible, please send me an email ahead of time so I know not to expect you that day.



**Know the class schedule** Half of the problems people have in busy classes like this one come from not realizing what's coming up. Please track what's happening in each week of classes beforehand. Knowing what is due in class and what is expected that week will help you get the most out of your education investment. One more hint: looking ahead through the entire semester's schedule can help you identify weeks that are really heavy. This gives you a chance to get an early start on work for those tough weeks. Use the grade breakdown to the right to help you prioritize what is important.

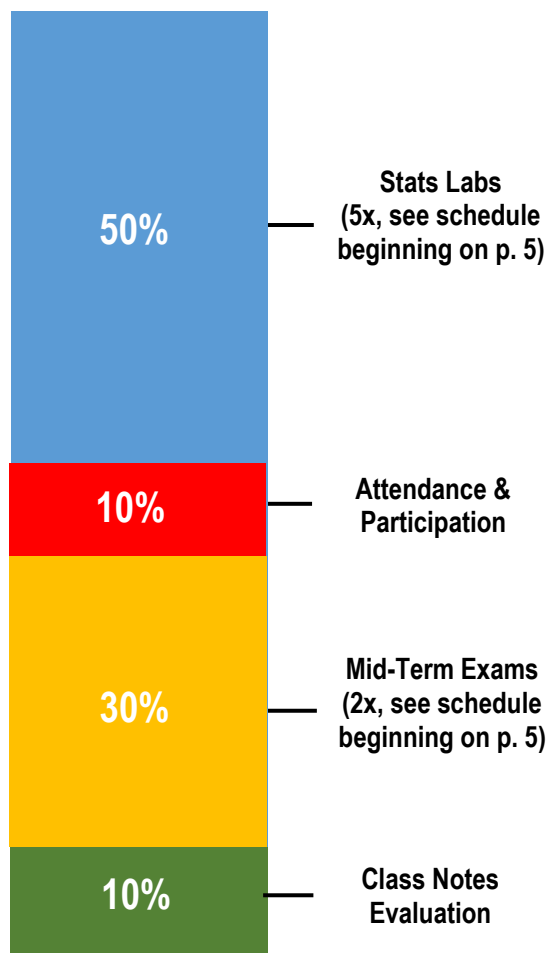


**Do the weekly reading** Each class will typically involve some sort of reading beforehand that will often relate to something we will do in class that day. I will always assume you have done that reading and are ready to use that knowledge in class.



**Contact me when problems come up** I want to hear from you when you have questions or issues with class. I especially want to talk with you if you feel like you're getting behind and things are falling out of control. You can succeed in this class! I am here to help.

## Course Grades Overview



\* All students have the option of turning in a term paper (or thesis methods draft) in lieu of the final. The term paper (or thesis methods draft) must have a substantial statistics component to qualify

**It is not essential to pass any particular exam, lab, or project to pass the course, but relative success in each will impact your final grade**



**Accommodation for Students with Disabilities:** The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with an accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the Office of Disability Accommodation website at <http://www.unt.edu/oda>. You may also contact them by phone at 940.565.4323.

**Course Text:** The required textbook for this course is the online statistics reading and SPSS tutorial source, <https://statistics.laerd.com/>. Laerd has very reasonable subscription packages available for 1, 3, and 6 month terms (for example, a 6 month subscription to the site currently costs \$12.95). Other secondary readings and resources are also required and listed by week in the schedule portion of this syllabus. Details on access to all readings will be announced in class. The course's "Further Reading" page gives a good start on accessing a wide variety of resources related to the course (see <http://www.murrayrice.com/srmg-further-reading>).

**Late Policy:** Anything handed in late will be subject to an immediate 10% penalty. Late work will not be accepted after graded work has been handed back to the class. Graded work is usually returned to the class one week after the due date. I will grant exceptions to the above if you provide documentation substantiating a valid personal emergency.

- *Please note:* it is your responsibility to come to me if a personal emergency prevents you from handing in an exercise on time.

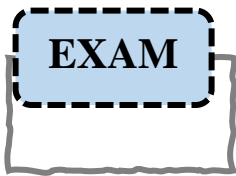
**Attendance:** I encourage full attendance since the in-class experience is a crucial component of learning in this course. Full attendance is rewarded.

**Extra Credit:** The Department of Geography does not allow extra credit assignments (work not specified on a course syllabus).



## What are we doing in this class?

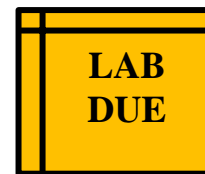
**Please read the following schedule carefully.** Note that all weeks marked with an **EXAM** indicator have a discussion questions set due on Tuesday. Also, all weeks marked **LAB** have statistical lab time on the *Thursday* of that week (split concept/lab focus that week). Also, all weeks that have either a Mid-Term Exam, a Lab Session, or a Lab Due are highlighted with one of three graphic indicators meant to alert you to that special activity.



= Exam This Week



= Lab Session This Week

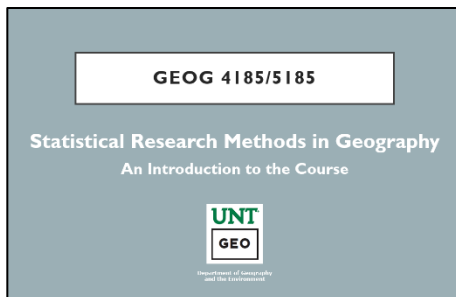


= Lab Due This Week

**Readings:** the readings for each week come from the required *Laerd* online resource, plus more readings as noted and accessible through the course website (details on access to these readings will be provided the first day of class).

## PART 1 – INTRODUCTION: STATISTICAL CONCEPTS AND MATHEMATICAL FOUNDATIONS

### Week 1 (Jan 12, 14)



### **Course Introduction: Motivation & Fundamentals**

Laerd “Creating a New File”, “Data Setup”, “Types of Variable”  
See week 1 resources on the “Syllabus and Handouts” page

- Introduction to course goals
- Importance and need for note-taking
- Discussion of basic terms for course, including statistics, data, research, element, sample, population, variable
- Two Basic Types of Statistical Methods: Inferential vs. Descriptive Statistics
- Geographical Data
- Scales of Measurement
- Focus on why the subject of statistical research is so important for society today

# LAB #1 TIME

## Week 2 (Jan 21, 23)



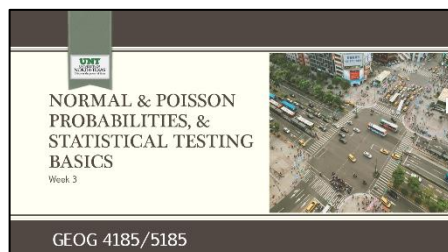
## *Introduction to Probability, Distributions, and Z-Scores*

Laerd “Creating a New File”, “Opening a File”, “Data Setup”, “Calculating a Z-Score”. See week 2 resources on the “Syllabus and Handouts” page

- What is “probability”?
- Theoretical Probability versus Empirical Probability
- Use of probability in the context of descriptive statistics
- Basic approaches to probability: non-parametric and parametric
- Probability Distributions
- Z-Scores

## **Lab 1 (Introduction to Probability Using SPSS) This Week (Thursday Lab Session)**

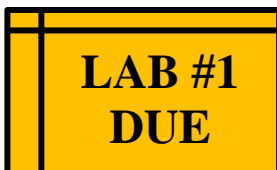
## Week 3 (Jan 28, 30)



## *Normal and Poisson Probabilities, and Statistical Testing Basics*

Laerd “Testing for Normality”, “Independent-Samples t Test”. See all week 3 resources on the “Syllabus and Handouts” page

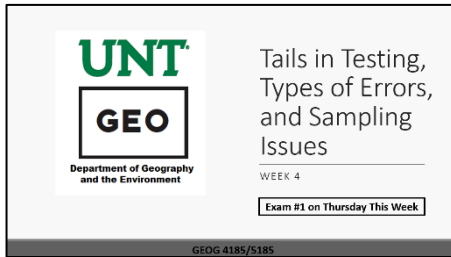
- ✓ **Lab 1 Due on Thursday This Week**
- Normal Probability Distribution
  - Background, Examples
  - Fitting the Normal Curve to Data
  - Using the Normal Table
  - Foundations of Testing for a Normal Distribution
- Poisson Distribution
  - Background, Examples
  - Relevance
  - Meaning
- Introduction to Statistical Testing
  - Hypotheses
  - Assumptions
  - Critical values, test statistics, and the p-value



# PART 2 – SIGNIFICANCE TESTING AND SAMPLING

## EXAM

Week 4 (Feb 4, 6)



### *Tails in Testing, Statistical Testing Errors, and Sampling Issues*

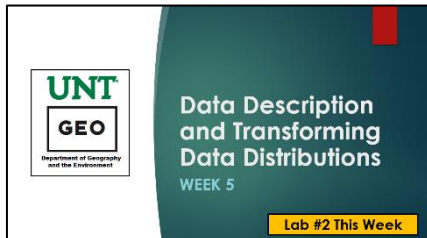
Chapman et. al (2014) Chapter 9

See all week 4 resources on the “Syllabus and Handouts” page

- One versus Two-Tailed Tests
- Errors in Statistical Testing
  - Type 1 versus Type 2 errors
- Samples and Sampling
  - Sampling Methods

## LAB #2 TIME

Week 5 (Feb 11, 13)



### *Data Description and Transforming Distributions*

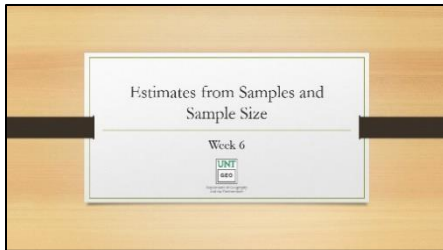
Laerd “Testing for Normality”, “Transforming Data”

See all week 5 resources on the “Syllabus and Handouts” page

- Description
  - Central Tendency
  - Dispersion
  - Skewness and Kurtosis
- Transforming Data
  - What Transformations Are
  - Why you do them
  - Major Types

**Lab 2 (Sampling and Significance Testing) This Week (Thursday Lab Session)**

## Week 6 (Feb 18, 20)



## *Estimates from Samples and Sample Size Determination*

Chapman et. al (2014) Chapter 7

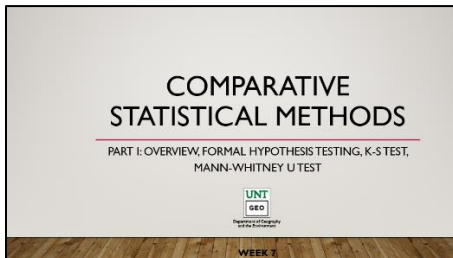
See all week 6 resources on the "Syllabus and Handouts" page

### ✓ **Lab 2 Due on Thursday This Week**

- Estimates from Samples
  - Estimating the Mean
  - Estimating the Standard Deviation
  - Estimates from Small Samples
  - Estimating Proportions
- Sample Size

## PART 3 – FOUNDATIONAL STATISTICAL METHODS & APPLICATIONS

## Week 7 (Feb 25, 27)



## *Comparative Statistical Methods, Part I*

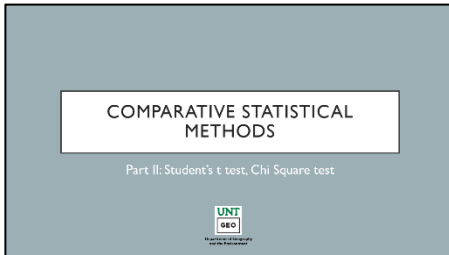
Laerd "Mann-Whitney U Test". See all week 7 resources on the "Syllabus and Handouts" page

- Overview of available options
- Six Steps of a Formal Hypothesis Test
  - Summary
  - Example
- K-S Test
- Mann-Whitney U Test



# EXAM

## Week 8 (Mar 3, 5)



### **Comparative Statistical Methods, Part II**

Laerd “One-Sample t Test”, “Independent-Samples t Test”, “Paired-Samples t Test”, “Chi-Square Test of Association”. See week 8 resources on the “Syllabus and Handouts” page

- Student's t test
- Chi Square test
  - One Sample
  - Two Sample
  - Three or More Sample

**Notebook Check Up: Hand in Notebooks at Thursday Exam for a Preliminary Evaluation (Not for Grades: Advisory Only)**

Mar 9-13

**Spring Break: No Classes (Enjoy Your Week!)**

## LAB #3 TIME

### Week 9 (Mar 17, 19)

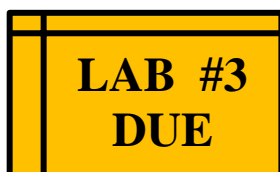


### **Comparative Statistical Methods, Part III**

Laerd “One-Way ANOVA”, “Two-Way ANOVA”, “Three-Way ANOVA”, “Kruskal-Wallis H Test”. See week 9 resources on the “Syllabus and Handouts” page

- ✓ **Lab 3 (Chi Square test) This Week (Thursday Lab Session)**
- ANOVA
- ANOVA and Correlation Analysis
- Kruskal-Wallis H Test
- Errors and Inferential Statistics
  - Type I versus Type II Errors

## Week 10 (Mar 24, 26)



## *Relationships: Correlation*

Laerd "Pearson's Correlation". See week 11 resources on the "Syllabus and Handouts" page

### ✓ **Lab 3 Due on Thursday This Week**

- The Meaning of Correlation
- Typology of Correlation Coefficients
  - Phi
  - Pearson
  - Spearman Rank
- Calculation of Each Correlation Measure
- Introduction to Correlation in a Multivariate Context
  - Partial Correlation Coefficients
  - Multiple Correlation Coefficient

## LAB #4 TIME

## Week 11 (Mar 31, Apr 2)



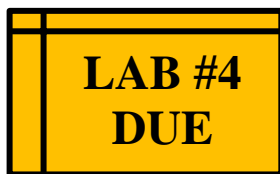
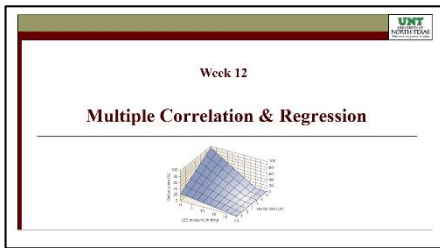
## *Trends: Simple Linear Regression*

Laerd "Linear Regression". See week 12 resources on the "Syllabus and Handouts" page

- Regression Concept
  - Form of Relationship
  - Strength of Relationship
- Simple Linear Regression
  - Calculation
  - Assumptions
  - Residuals and their analysis
  - Confidence Limits

**Lab 4 (Correlation and Regression) This Week  
(Thursday Lab Session)**

## Week 12 (Apr 7, 9)



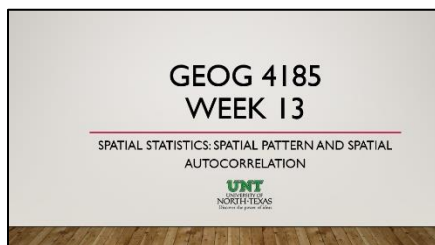
## Multiple Regression Modeling

Laerd "Standard Multiple Regression". See all week 12 resources on the "Syllabus and Handouts" page

- ✓ **Lab 4 (Correlation and Regression) Due on Thursday This Week**
- ✓ **Mid-Term Exam #2 on Thursday This Week**
- Multiple Regression
  - Basic Idea and Interpretation
  - Partial Regression Coefficients
  - Beta Coefficients
  - Multicollinearity
  - Use of Dummy Variables
    - Dummy Variables and Multicollinearity
  - Multiple Regression and Geographic Space
    - Introduction to Geographically Weighted Regression

## PART 4 – AN INTRODUCTION TO SPATIAL STATISTICS

### Week 13 (Apr 14, 16)



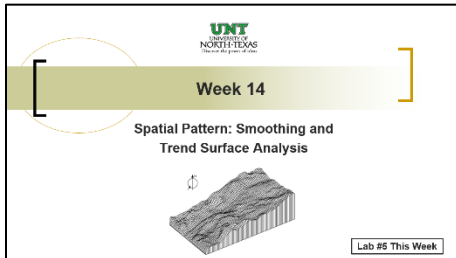
## Spatial Statistics

Boots and Getis "Point Pattern Analysis", Chapter 1 (e-book),  
Odland "Spatial Autocorrelation", Chapter 1 (e-book)  
See all week 13 resources on the "Syllabus and Handouts" page

- Point and Areal Pattern Analysis

## LAB #5 TIME

### Week 14 (Apr 21, 23)



### *Spatial Statistics*

Unwin "Trend Surface Analysis" (e-book)

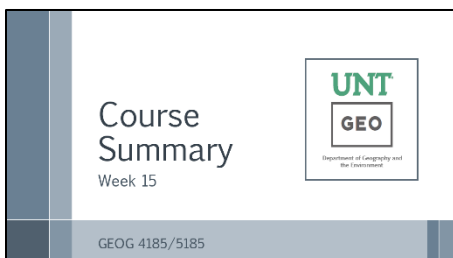
See all week 14 resources on the "Syllabus and Handouts" page

- Smoothing and Trend Surface Analysis

**Lab 5 (Spatial Area Pattern Analysis) This Week (Thursday Lab Session)**

## PART 5 – COURSE REVIEW AND CONCLUSION

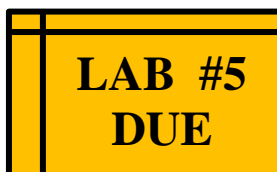
### 15 (Apr 28, 30)



### *Summary and Synthesis*

No reading this week

- ✓ **Lab 5 (Spatial Point and Areal Pattern Analysis) Due on Tuesday This Week**
- Summary and review of key course concepts and applications



**End of Course**

## Sources Referenced in the Course Reading List

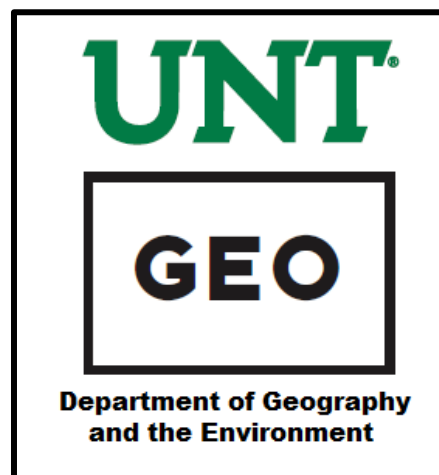
Each of the following books and other publications provide excellent background reading for this course. We will examine selected chapters from each book listed in this course, along with our required course textbooks. Some marked readings are available through links on the course website. Aside from the Church and Murray course textbook, none of the books listed below are available in the UNT bookstore, but copies of most are available through online retailers such as Amazon. The Rice and Hernandez course textbook is available through the Applied Geography Conference website (link provided on course website).

Boots, B. and A. Getis (1988) *Point Pattern Analysis*. Beverly Hills, CA: Sage Publications.

Laerd (no date) Laerd Statistics. <https://statistics.laerd.com/> Nottingham, UK: Lund Research.

Odland, J. (1987) *Spatial Autocorrelation*. Beverly Hills, CA: Sage Publications.

Unwin, D. (1978) *An Introduction to Trend Surface Analysis*. CATMOG 5. Norwich, UK: Geo Abstracts, University of East Anglia.





**My goal in this course is for your time here to be of great value to you.** This course provides concepts and skills you will find a helpful starting-point for a career in geography. However, even if you follow a career path outside of geography, my hope is that this course will provide you with insights into analytical methods that can help you in many ways.

Please do not hesitate to let me know if there is anything else we can do, beyond what you see in this course package, that could be useful in preparing you for your future.