Course Syllabus GISC 6301

Course Information

Course: GISC 6301 (Fall 2022)

Title: GIS Data Analysis Fundamentals

Meeting Times: Monday and Wednesday 5:30 – 6:45 pm in GR 3.206 (in person)

Professor Contact Information

Instructor: Michael Tiefelsdorf, Ph.D.

Email: tiefelsdorf@utd.edu

Office Hours: Thursday 5:00 – 6:30 pm via MS Teams and in the office GR3.204.

Communications are preferred via email. Start the subject line with the term ***DATA***. If Dr. Tiefelsdorf is available in MS Team you can also try to contact me there.

Teaching Assistant: Yeamin Faria Chowdhury, GR3.414

Dongeun Kim

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Office Hours: In person or via MS Teams Tuesdays 2-4 pm in the GR3.414.

Communications are preferred by email. Start the subject line with the term ***DATA***.

Course Modality and Expectations

Instructional Mode	In-person
Course Platform	Lecture notes will be available in weekly channels in MS Teams. UTD's eLearning will be used for quizzes, lab assignments and exams.
Expectations	All participants must have access to a computer (Windows or Apple) capable of running R and RStudio.

Asynchronous Quizzes and Exam	Exam & Quizzes: • The final exams will be offered online via eLearning. • Short online quizzes on the assigned reading material will be available in a 6 hours window prior to the scheduled class.

General Guidelines

Please see http://go.utdallas.edu/syllabus-policies.

Course Pre-requisites, Co-requisites, and/or Other Restrictions

A prior undergraduate course in basic statistical analysis is highly recommended (e.g., SOCS 3405)
Ability to operate a personal computer, data handling skills, ability to use the University Library, **MS TEAMS**, **ELEARNING** and internet resources is required. No prior GISciences knowledge is necessary.

Course Description

This service course lays the conceptional and methodological foundation for several technical and analytical courses in the ***Geo-spatial Information Sciences*** program and general ***Data Analytics*** practices. In addition, it introduces to the special nature of spatial data that describe their underlying georeferenced objects.

Topics covered in this course are:

- This course will train its participants to understand *statistical equations* and their internal structures as well as to professionally type-set equations.
- This course provides on a *technical level* a basic introduction into spatial data handling, analysis operations and the design of numerical algorithms. Brief scripts using the open-source statistical programming language R are employed to illustrate these operations.
- This course introduces on a *methodological level* statistical concepts [a] to describe and measure the inherent uncertainties within aspatial and spatial data and their distributions, [b] to approach research questions and decisionmaking processes from a statistical perspective, [c] to find and model relationships among objects, and [d] to model simple spatial data generating processes.
- The *range of analytical methods* covers descriptive statistics, data visualization and exploratory methods, measures of spatial variability, study designs, probability and sampling theory, statistical inference and decision making up to regression analysis.

- Underlying *statistical concepts* are emphasized, which allow selecting proper analysis instruments to answer specific research questions. Examples with aspatial and spatial data illustrate the application of these instruments. A strong focus on concepts − rather than a plain execution of recipes − provides guidelines of finding appropriate analysis instruments for emerging research questions.

Geo-spatial Data Analysis Fundamentals is the first in a sequence of GISciences courses focusing on the statistical analysis of aspatial and spatially distributed data:

- GISC6323: ***Machine Learning for Socio-Economic and Geo-Referenced Data*** ○ GISC7310: ***Advanced Geo-spatial Data Analysis*** ○ GISC7360: ***Pattern Analysis***
- GISC7364: ***Demographic and Epidemiological Analysis and Modeling*** ○ GISC7361: ***Spatial Statistics***

GISc students are encouraged to take ***Advanced Geospatial Data Analysis*** as sequel to ***Geospatial Data Analysis Fundamentals***.
It covers in-depth variants of spatial regression analysis and will prepare GISc students for their Master's projects, several methodologically oriented GISc courses and challenges encountered in their professional careers. This is a required course for Ph.D. students and prepares them for their Qualifying Exam.

Student Learning Objectives/Outcomes

Upon completing this class, students will:

- Handle data, visualize data and perform exploration tasks within the  environment using short scripts;
- Understand the nature of aspatial and spatial data and their implications for statistical data analyses;
- Perform data collections, exploratory studies and statistical analyses to answer research questions;
- Select appropriate statistical tools specific to particular research questions and available data structures;
- Be able to follow statistical arguments in textbooks and research articles.
- Become prepared for more advanced courses in spatial data analysis.

Required Textbooks and Materials

BBR: Burt, James E., Gerald M. Barber, and David L. Rigby (2009). *Elementary Statistics for Geographers*. 3rd edition, 2nd and above printing. New York: The Guilford Press. ISBN 978-1-57230-484-0 Check www.amazon.com: ~$80 new.
Note: If you select to buy a used copy then ***avoid*** the ***1st*** printing of the 3rd edition, it contains some confusing typos, which require to download an errata document.

Suggested Course Materials

KAB: Robert I. Kabacoff, 2022. *R in Action. Data Analysis and Graphics in R and Tidyverse*. 3rd edition, Manning

The 2nd edition is available online at UTD's Eugene McDermott Library. **LAN:** Lander, J.P. *for Everyone. Advanced Analytics and Graphics.* Addison Wesley, 2014.

This book is available online at UTD's Eugene McDermott Library.

Software

The ***free open source*** -environment for the operating systems Windows, Linux and Mac computers.
More information on the installation (https://mirrors.nics.utk.edu/cran/) and the development shell Studio (https://www.rstudio.com/home/) will be provided during the first course week.

Assignments & Academic Calendar

Date	Topic	Labs & Quizzes Handed Out
Aug 22	INTRODUCTION	
Aug 24	USING RMARKDOWN TO ANSWER LAB ASSIGNMENTS (Handout, see also Introduction to R Markdown.)	
Aug 29	MATHEMATICAL TYPESETTING OF EQUATIONS WITH Studio (Handout)	*Sample Quiz*
Aug 31	GETTING STARTED WITH I (Handout, KAB02 & KAB03)	
Sep 05	Labor Day	
Sep 07	GETTING STARTED WITH II (Handout, KAB04 & KAB05)	*Lab01*
Sep 12	STATISTICS AND SPATIAL DATA (BBR01)	*Quiz01*
Sep 14	DISPLAYING AND INTERPRETING DATA I (BBR02 & KAB07)	*Quiz02 & Lab02*
Sep 19	DISPLAYING AND INTERPRETING DATA II (KAB11)	
Sep 21	DISPLAYING AND INTERPRETING DATA III	*Lab03*

Sep 26	Describing Data with Statistics I (BBR03 & KAB07)	*Quiz03*
Sep 28	Describing Data with Statistics II	*Lab04*
Oct 03	Statistical Relationships: Correlation I (BBR04)	*Quiz04 (Sections 4.1-4.3)*
Oct 05	Statistical Relationships: Correlation II (KAB07)	*Lab05*
Oct 10	Statistical Relationships: Bivariate Regression I (KAB08)	*Quiz05 (Sections 4.4Appendix)*
Oct 12	Statistical Relationships: Bivariate Regression II	*Lab06*
Oct 17	Statistical Relationships: Multiple Regression (BBR13 & KAB08)	*Quiz06 Lab07*
Oct 19	Random Variables and Probability Distributions I (BBR05)	*Quiz07*
Oct 24	Random Variables and Probability Distributions II	*Lab08*
Oct 26	Sampling I (BBR06)	*Quiz08*
Oct 31	Sampling II	*Lab09*
Nov 02	Point and Interval Estimation (BBR07)	*Quiz09*
Nov 07	Point and Interval Estimation	*Lab10*
Nov 09	One-Sample Hypothesis Testing I (BBR08)	*Quiz10*
Nov 14	One-Sample Hypothesis Testing II Two-Sample Hypothesis Testing for Matched Pairs (BBR09)	*Lab11*
Nov 16	Two-Sample Hypothesis Testing (BBR09)	*Quiz11*
Nov 21	Fall Break	
Nov 23	Fall Break	
Nov 28	Non-parametric Methods: χ^2 Goodnessof-Fit, χ^2 Contingency Tables & Kernel Density Estimator (BBR10)	*Quiz12 (Sections 10.4-10.6) & Lab12*
Nov 30	Inferential Aspects of Linear Regression I (BBR 12)	*Quiz13*

Dec 05	INFERENTIAL ASPECTS OF LINEAR REGRESSION II	
Dec 07	REVIEW	
TBA	FINAL EXAM	

Labs:

Lab	Topic
Lab01	Working with RStudio and the Equation Editor
Lab02	Data Management and Programming with R
Lab03	Data Visualization with R
Lab04	Describing Univariate and Bivariate Distributions
Lab05	Correlation Analysis
Lab06	Bivariate Linear Regression
Lab07	Regression Project
Lab08	Probability Calculus and Theoretical Distributions
Lab09	Sampling
Lab10	Point and Interval Estimation
Lab11	Test Theory, One-Sample Tests
Lab12	Two-Sample Tests and Non-parametric Statistics

Grading Policy

Tasks	Points (100 Total)
13 Quizzes. Closed Book. The weakest Quiz will not be counted.	12 x 2 pts (24 pts)
12 Labs. Course participants usually have one week to complete the lab	12 x 4 pts (48 pts)
Final Exam, cumulative over course material. Open book and notes. Excluded: No applied R work.	28 pts

Tentative Grading Scale

Rounded Points	Letter Grade
90-100	*A*
85-89	*A-*
80-84	*B+*
75-79	*B*
70-74	*B-*
65-69	*C+*
60-64	*C*

< 60	*F*

Make-up exam/Late assignment policy: A make-up exam will only be given in extenuating circumstances.

Participants will usually have 7 days to complete a lab. A late lab will lead to a deduction of its grade. A late lab can no longer be accepted once its solution has been posted and discussed.

Plagiarism: The university's rules of plagiarism will be strictly enforced. While you are encouraged to discuss the labs with other course participants to enhance your understanding of the course material, the labs must be answered individually by each course participant unless teamwork is explicitly requested by the instructor. The labs prepare you for final exam and train useful conceptional and technical skills.

Comet Creed

This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

"As a Comet, I pledge honesty, integrity, and service in all that I do."

Academic Support Resources

The information contained in the following link lists the University's academic support resources for all students.

Please see http://go.utdallas.edu/academic-support-resources.

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.