Course Syllabus GISC 6301

Course Information

Course: GISC 6301 (Fall 2020)

Title: GIS Data Analysis Fundamentals

Meeting Times: Monday and Wednesday 5:30 – 6:45 pm via MS Teams

Professor Contact Information

Instructor: Michael Tiefelsdorf, Ph.D.

Email: tiefelsdorf@utd.edu

Office Hours: Tuesday 4:00 – 5:30 pm via MS Teams and on appointment.

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

Teaching Assistant: Yalin Yang

Email Address: Yalin.Yang@UTDallas.edu

Office Hours: Wednesdays 3:00-4:00 pm

Communications are preferred by email. Start the subject line with the phrase **DATA**. If Yalin is available in MS Team you can also try to contact me there.

Course Modality and Expectations

Instructional Mode	Remote/Virtual Learning
Course Platform	Lecture will be held in MS Teams. 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 particpants must have access to a computer (Windows or Apple) capable of running R and RStudio. The use of a webcam and microphone during our online sessions is highly encouraged but not required.
Asynchronous Learning Guidelines	Recordings of lectures will be available asychronously in MS Teams several hours after the lecture. Two time windows will be available for exams and quizzes. One during the scheduled lecture time and the other in consultation with the course participants 8-12 hours later.

COVID-19 Guidelines and Resources

The information contained in the following link lists the University's COVID-19 resources for students and instructors of record.

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

Classroom Conduct Requirements Related to COVID-19

UT Dallas requires that all students must wear a face covering that covers the nose and mouth in all university buildings and classrooms. To help protect the health and safety of students, instructors, and the University community, students who choose not to wear a face covering may not attend class in person but may attend a course remotely. Anyone attending class in person without a face covering will be asked to put one on or leave. Instructors may end the class if anyone present refuses to appropriately wear a face covering for the duration of class. Students should also be sure they are at least six feet away from their fellow students and faculty, and seated in a seat that is designated to ensure that distance. Students who either refuse to wear face coverings appropriately or to adhere to other social distancing protocols may face disciplinary action for Student Code of Conduct violations. Students who are unable to comply with the university policies including wearing a face covering should consult the Comets United webpage for further instructions.

Students who have tested positive for COVID-19 or may have been exposed should not attend class in person and should instead follow required disclosure notifications as posted on the university's website (see "What should I do if I become sick?" webpage)

Class Attendance

The University's attendance policy requirement is that individual faculty set their course attendance requirements. Regular and punctual class attendance is expected regardless of modality. Students who fail to attend class regularly are inviting scholastic difficulty. In some courses, instructors may have special attendance requirements; these should be made known to students during the first week of classes. These attendance requirements will not be used as part of grading (see Class Participation below for grading information).

In-person participation records may be used to assist the University or local public health authorities in performing COVID-19 occurrence monitoring. Please note – in-person attendance requires consistently adhering to University requirements, including wearing a face covering and other public safety requirements related to COVID-19, as presented in this syllabus. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Class Participation

Regular class participation is expected regardless of course modality. Students who fail to participate in class regularly are inviting scholastic difficulty. A portion of the grade for this course is directly tied to your participation in this class. It also includes engaging in group or other activities during class that solicit your feedback on homework assignments, readings, or materials covered in the lectures (and/or labs). Class participation is documented by faculty. Successful participation is defined as consistently adhering to University requirements, as presented in this syllabus. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Class Recordings

Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

NOTE: if the instructor records any part of the course, then the instructor will need to use the following syllabus statement:

The instructor may record meetings of this course. Any recordings will be available to all students registered for this class as they are intended to supplement the classroom experience. Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. If the instructor or a UTD school/department/office plans any other uses for the recordings, consent of the students identifiable in the recordings is required prior to such use unless an exception is allowed by law. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Class Materials

The instructor may provide class materials that will be made available to all students registered for this class as they are intended to supplement the classroom experience. These materials may be downloaded during the course, however, these materials are for registered students' use only. Classroom

materials may not be reproduced or shared with those not in class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

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, **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 geo-referenced objects.

Topics covered in this course are:

- This course will train its participants to read and write *statistical equations* and understand their internal structure.
- 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 decision-making 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 as well as basic correlation and 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 GISc classes 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***
- 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 at their work places.

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 ***first*** printing of the 3rd edition, it contains some confusing typos.

Suggested Course Materials

KAB: Robert I. Kabacoff, 2015. *R in Action. Data Analysis and Graphics in R*. 2nd edition, Manning

This book 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*** R-environment for the operating systems Windows, Linux and Mac OS X.
More information on the installation R (https://mirrors.nics.utk.edu/cran/) and the development shell RStudio (https://www.rstudio.com/home/) will be provided during the first and second course week.

Assignments & Academic Calendar

Date	Topic	Labs & Quizzes Handed Out
Aug 17	INTRODUCTION	
Aug 19	MATHEMATICAL TYPESETTING OF EQUATIONS GETTING STARTED WITH RStudio (Handout, LAN02 & 03)	
Aug 24	GETTING STARTED WITH R I (Handout)	*Sample Quiz*
Aug 26	GETTING STARTED WITH R II (Handout, Lan04, 05 & 06)	*Lab01*
Aug 31	GETTING STARTED WITH R III (Handout, LAN08, 09 & 10)	
Sep 02	STATISTICS AND SPATIAL DATA (BBR01)	*Quiz01* & *Lab02*
Sep 07	LABOR DAY	
Sep 09	DISPLAYING AND INTERPRETING DATA I (BBR02 & KAB03)	*Quiz02*
Sep 14	DISPLAYING AND INTERPRETING DATA II (KAB06)	
Sep 16	DISPLAYING AND INTERPRETING DATA III	*Lab03*
Sep 21	DESCRIBING DATA WITH STATISTICS I (BBR03)	*Quiz03*
Sep 23	DESCRIBING DATA WITH STATISTICS II	*Lab04*
Sep 28	STATISTICAL RELATIONSHIPS: CORRELATION I (BBR04)	*Quiz04 (Sections 4.1-4.3)*
Sep 30	STATISTICAL RELATIONSHIPS: CORRELATION II	*Lab05*
Oct 05	STATISTICAL RELATIONSHIPS: BIVARIATE REGRESSION I	*Quiz05 (Sections 4.4-Appendix)* & *Lab06*
Oct 07	STATISTICAL RELATIONSHIPS: BIVARIATE REGRESSION II	

Oct 12	STATISTICAL RELATIONSHIPS: MULTIPLE REGRESSION (BBR13)	*Quiz06*
Oct 14	REGRESSION PROJECT	*Lab07*
Oct 19	RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS I (BBR05)	*Quiz07*
Oct 21	RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS II	*Lab08*
Oct 26	SAMPLING I (BBR06)	*Quiz08*
Oct 28	SAMPLING II	*Lab09*
Nov 02	POINT AND INTERVAL ESTIMATION (BBR07)	*Quiz09*
Nov 04	POINT AND INTERVAL ESTIMATION	*Lab10*
Nov 09	ONE-SAMPLE HYPOTHESIS TESTING I (BBR08)	*Quiz10*
Nov 11	ONE-SAMPLE HYPOTHESIS TESTING II TWO-SAMPLE HYPOTHESIS TESTING FOR MATCHED PAIRS	*Lab11*
Nov 16	TWO-SAMPLE HYPOTHESIS TESTING (BBR09)	*Quiz11*
Nov 18	NON-PARAMETRIC METHODS: χ^2 GOODNESS-OF-FIT, χ^2 CONTINGENCY TABLES & KERNEL DENSITY ESTIMATOR (BBR10)	*Quiz12 (Sections 10.4-10.6) & Lab12*
Nov 23	INFERENTIAL ASPECTS OF LINEAR REGRESSION (BBR 12)	*Quiz13*
Nov 25	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. No applied R work. Open book and notes.	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.

UT Dallas Syllabus Policies and Procedures

The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus.

Please go to http://go.utdallas.edu/syllabus-policies for these policies.

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