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| **Course** | **GISC 7360: GIS Pattern Analysis** |
| **Term** | Spring Semester 2020 |
| **Meetings** | Wednesday, 7:00-9:45 pm in GR3.206 |

## Instructor

***Michael Tiefelsdorf***, GR 3.204, tiefelsdorf@utdallas.edu.
For course related emails please start the subject line with GISC7360.

Office hours: Monday 2:00-3:45 pm, when my office door is open or by appointment.

## Teaching Assistant

***Yalin Yang,*** GR3.414, Yalin.Yang@UTDallas.edu

Office hours: TBA and by appointment

## General Course Information

**Pre-requisites, Co-requisites, & other restrictions**

- Intermediate statistical knowledge (such as GISC6301).
- Basic R command line skills.
- A review to regression analysis and an introduction to matrix algebra may be offered on demand.

**Course Description**

This graduate course focuses on the geo-statistical methodology to [a] analyze, [b] model and [c] simulate spatial processes. Methods covered in the course deal with directional, point, lattice, surface and network data in a multivariate framework by accounting for underlying risk surfaces and spatial co-variables.
A vector based geographic information system perspective is loosely coupled with specialized spatial statistical and geo-statistical software tools in order to convey the different spatial pattern analysis methods and their software implementation.
This course focuses more on concepts associated with the analysis of geo-referenced data than on introducing the individual methods in a recipe style.

**Learning Outcomes**

*Upon completing this class, a course participant will:*

- *Have a working understanding of measuring spatial data, spatial autocorrelation, spatial processes and spatial statistics;*
- *Understand density or distance-based point pattern analysis methods with underlying risk surfaces and how to test for clustering and repulsion;*
- *Understand, model and test for spatial autocorrelation and spatial heterogeneity in regression models;*
- *Model surfaces with several Kriging interpolation methods and understand the differences between the different Kriging models;*
- *Be able to apply spatial statistical analysis from a confirmatory and exploratory perspective.*

**Required Texts & Materials**

Bivand, Roger S.; Pebesma, Edzer J.; and Gomez-Rubio, Virgilio, (2013). *Applied Spatial Data Analysis with R.* 2nd edition. Berlin: Springer Verlag.
*Available as downloadable eBook at UTD's library*

**Suggested Texts, Readings, & Materials**

Bailey, Trevor C. and Anthony C. Gatrell (1995). *Interactive Spatial Data Analysis.* New York: John Wiley & Sons.
*Material from several chapters will be discussed in this course. This book was formerly the main reference for this course.*

Baddeley, Adrian, Ege Rubak and Rolf Turner (2016). *Spatial Point Patterns. Methodology and Applications with R.* CRC Press.
*Several chapters will be discussed in this course.*

Pewsey, Arthur, Markus Neuhäuser and Graeme Ruxton (2013). *Circular Statistics in R.* Oxford Press
*Several chapters will be discussed in this course.*

Lovelace R., Nowosad J. & Muenchow J. (2019). *Geocomputation with R.* CRC Press
*This book extensively introduces R's new geographic simple feature data format in the library* ***sf****.*

Davis, John C. (1986). *Statistics and Data Analysis in Geology.* 3rd editions. John Wiley.
*Excellent classical resource with a broad spectrum of basis methods.*
*Available, for instance, through http://www.amazon.com for ~ $95*

De Smith, Michael J., Michael F. Goodchild, and Paul A. Longley (2007). *Geospatial Analysis. A Comprehensive Guide to Principles, Techniques and Software Tools.* East Sussex: The Winchelsea Press. ISBN: 1-905886-60-8
*This is an indispensable desk reference that covers many spatial analysis methods. See also http://www.spatialanalysisonline.com*

***Several online resources for Geostatistics and Pattern Analysis will be made accessible on the course*** *eLEARNING* ***site****.*

## Tentative Schedule

*[Topics, Reading Assignments, Due Dates, Exam Dates]*

| *Date* | *Topic and Reading* |
|---|---|
| ***Jan. 15*** | Geometric Concepts I (Handout) |
| ***Jan. 22*** | Geometric concepts II & Directional Data (Handout) **[Lab 1 assigned]** |
| ***Jan. 29*** | Univariate & Bivariate Kernel Densities (Handout) |
| ***Feb. 05*** | Bivariate and Network Kernel Densities (Handout) **[Lab 2 assigned]** |
| ***Feb. 12*** | Point Pattern Analysis I (Handout) |
| ***Feb. 19*** | Point Pattern Analysis II (Handout) **[Lab 3 assigned]** |

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| ***Feb. 26*** | Review: Matrices and Regression Analysis (Handout) |
| ***Mar. 04*** | Trend Surface Analysis for Spatial Interpolation (Handout) |
| ***Mar. 11*** | Spatial Interpolation with Kriging I (Handout) |
| ***Mar. 18*** | ***Spring Break*** |
| ***Mar. 25*** | Spatial Interpolation with Kriging II (Handout) **[Lab 4 assigned]** |
| ***Apr. 01*** | Area-Based Spatial Analysis I (Handout) |
| ***Apr. 08*** | Area-Based Spatial Analysis II (Handout) |
| ***Apr. 15*** | Spatial Regression Models I (Handout) **[Lab 5 assigned]** |
| ***Apr. 22*** | Spatial Regression Models II (Handout) |
| ***Apr. 29*** | Review |
| ***TBA*** | **Final Exam** |

**Tentative Grading**

| *Requirements* | *Percent* |
|---|---|
| ***Final Exam. Open book and open notes.*** | 35% |
| ***5 Labs @ ± 13 %.*** | 65 % |

## *Course & Instructor's Policies*

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

Participants will usually have 14 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.

**Extra assignments:** No extra credit assignments will be given.

**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 the final exam and train useful conceptional and technical skills.

**Class attendance:** Class attendance is expected. Students, who consistently miss classes, are on their own and will be reported to the program director.

## *Decorum during class:*

- Turn cell phones off during class and no text messaging.
- No course unrelated computer uses during the lecture.
- Respect the lab's no food and drink policies.
- Respectful interaction among all participants.

Additional information relating to UTD's policies on "Religious Holy Days", "Grade Appeals", "Disability Services", "Student Conduct" etc. can be found at: http://go.utdallas.edu/syllabus-policies

***These descriptions and timelines are subject to change at the discretion of the instructor.***