Course	**GISC6301: Geo-Spatial Data Analysis Fundamentals**
Professor	Michael Tiefelsdorf, Ph.D.
Term	Fall Semester 2019
Lectures & Labs	Monday 5:30 pm – 6:45 pm in GR3.602 Wednesday 5:30 pm – 6:45 pm in GR3.602

Contact Information

Office Phone	(972) 883-4954 (email correspondence is highly preferred)
Office Location	GR3.204
Email Address	tiefelsdorf@utdallas.edu Please start the **subject line** of each email with **DAF** to alert the instructor that it is a GISC6301 related email and not junk mail.
Office Hours	Thursdays 3:00-5:00 pm in my office at GR3.204 and by appointment or for short drop-ins when my office door is open.
Other Information	Please check the ELEARNING's course site for lecture notes, quizzes, announcements, the discussion forum etc. on a regular basis.

Teaching Assistant	Yalin Yang
Office Location	GR3.414
Email Address	Yalin.Yang@UTDallas.edu Please start the **subject line** of each email with **DAF**
Office Hours	Mondays and Wednesdays 3:00-4:00 pm and by appointment

General Course Information

Pre-requisites, Co-requisites, & 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. Spatial observations combine locational with attribute information and are therefore multidimensional.

Furthermore, inherent in spatial observations is some degree uncertainty. However, spatial relationships among spatial objects usually constrain the degree uncertainties.

- This course will train its participants to read *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  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.

Learning 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 Texts & 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.

Supplemental Texts, Readings & Materials

Both supplemental texts are available online as *eBooks* at UTD's library.

KAB: Kabacoff, R.L. *in Action. Data Analysis and Graphics with* . Manning Publications, 2nd edition, 2015. Check www.amazon.com: ~$35 new

LAN: Lander, J.P. *for Everyone. Advanced Analytics and Graphics.* Addison Wesley, 2014. Check www.amazon.com: ~$24 new.

Additional reading material will be made available as required on the course's **eLEARNING** site throughout this semester.

Software

The ***free open source*** -environment for the operating systems Windows, Linux and Mac OS X.
More information on the installation of Microsoft's Open (https://mran.microsoft.com/rro/) and the development shell Studio (https://www.rstudio.com/home/) will be provided during the first and second course week.

Assignments & Academic Calendar

[Lecture Dates, Topics, Reading Assignments, Lab and Quiz Dates]

Date	*Topic*	*Reading*	*Lab & Quiz*
Aug. 19	INTRODUCTION / INSTALLATION OF	Handout	
Aug. 21	MATHEMATICAL TYPESETTING OF EQUATIONS GETTING STARTED WITH Studio	Handout LAN02 & LAN03	
Aug. 26	GETTING STARTED WITH (I)	Handout	*Sample Quiz*
Aug. 28	GETTING STARTED WITH (II)	LAN04, 05, and 06	*Lab01 out*
Sep. 02	***LABOR DAY***		
Sep. 04	GETTING STARTED WITH (III)	LAN08, 09 and 10	*Lab02 out*
Sep. 09	STATISTICS AND SPATIAL DATA	BBR01	*Quiz01*
Sep. 11	DISPLAYING AND INTERPRETING DATA (I)	BBR02 KAB03	*Quiz02*
Sep. 16	DISPLAYING AND INTERPRETING DATA (II)	KAB06	
Sep. 18	DISPLAYING AND INTERPRETING DATA (III)		*Lab03 out*
Sep. 23	DESCRIBING DATA WITH STATISTICS (I)	BBR03	*Quiz03*
Sep. 25	DESCRIBING DATA WITH STATISTICS (II)		*Lab04 out*
Sep. 30	STATISTICAL RELATIONSHIPS CORRELATION (I)	BBR04	*Quiz04 (4.1-4.3)*

Oct. 02	STATISTICAL RELATIONSHIPS CORRELATION(II)		*Lab05 out*
Oct. 07	STATISTICAL RELATIONSHIPS BIVARIATE REGRESSION (I)	LAN15 LAN16	*Quiz05 (4.4-Appendices)*
Oct. 09	STATISTICAL RELATIONSHIPS BIVARIATE REGRESSION (II)		*Lab06 out*
Oct. 14	STATISTICAL RELATIONSHIPS MULTIPLE REGRESSION (III)	BBR13	*Quiz06*
Oct. 16	REGRESSION PROJECT		*Lab07 out*
Oct. 21	RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS (I)	BBR05	*Quiz07*
Oct. 23	RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS (II)	LAN14	*Lab08 out*
Oct. 28	SAMPLING (I)	BBR06	*Quiz08*
Oct. 30	SAMPLING (II)		*Lab09 out*
Nov. 04	POINT AND INTERVAL ESTIMATION (I)	BBR07	*Quiz09*
Nov. 06	POINT AND INTERVAL ESTIMATION (II)		*Lab10 out*
Nov. 11	ONE-SAMPLE HYPOTHESIS TESTING (I)	BBR08	*Quiz10*
Nov. 13	***GIS DAY*** & ONE-SAMPLE HYPOTHESIS TESTING (II)		*Lab11 out*
Nov. 18	TWO-SAMPLE HYPOTHESIS TESTING	BBR09	*Quiz11*
Nov. 20	NON-PARAMETRIC METHODS: χ^2 Goodness-of-Fit, Kolmogorov-Smirnov Test, χ^2Contingency Tables & Kernel Density Estimator	BBR10	*Quiz12 (10.4-10.6)* *Lab12 out*
Nov. 25	***FALL BREAK***		
Nov. 27	***FALL BREAK***		
Dec. 02	INFERENTIAL ASPECTS OF LINEAR REGRESSION	BBR 12	Quiz 13
Dec. 04	SPATIAL AUTOCORRELATION IN REGRESSION RESIDUALS	BBR 14.2-14.3	
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

Course Policies

<table>
<tr><td>Grading (credit) Criteria</td><td>Policies:
Labs, quizzes and the final exam need to be solved <u>individually</u> unless otherwise stated. <u>Plagiarism cannot be tolerated!</u>
Participation is highly encourages but will not be graded.
<u>Note:</u> Engagement with the course material will lead to participation and indirectly to an increased comprehension of the course material!
<table>
<tr><th>Requirements</th><th>Points</th></tr>
<tr><td>11 Quizzes out of 13 quizzes @ 2 pts: <u>closed book</u>, based on assigned reading of chapters or selected sections of chapters in BBR at the beginning of class
Note: the weakest two quizzes will not count towards the final grade</td><td>22 pts</td></tr>
<tr><td>12 Labs @ 4 pts: labs should be handed in as hardcopies rather than electronically by email.
Note: the labs will prepare you for the final exam.</td><td>48 pts</td></tr>
<tr><td>Final Exam: based on BBR01 to BBR10, BBR12, BBR13.1 and BBR14.2. All concepts practiced in the labs are relevant.
Open book and open notes. Bring a pocket calculator</td><td>30 pts</td></tr>
</table></td></tr>
<tr><td>Late Work</td><td>Work that is late by one day will lead to a deduction of 10% of its points.
Work that is late by two days will lead to a deduction of 20 % of its points.
Later work will not be accepted unless special circumstances can be claimed.
Preferably contact the instructor before the deadline if you think that you may need to hand your assignment in late.</td></tr>
<tr><td>UTD Syllabus Policies</td><td>All UTD syllabus policies apply to this course. It is advisable to study these policies at least once per academic year.
See http://go.utdallas.edu/syllabus-policies for details.</td></tr>
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Tentative Grading Scale

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

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