# GEOGRAPHY 4132/5132

SPATIAL MODELING FOR SOCIAL AND ECONOMIC APPLICATIONS

SPRING 2021

ASYNCHRONOUS - ONLINE

**Instructor**: Dr. Elizabeth C. Delmelle
**Email**: edelmell@uncc.edu
**Office Hours**: 9:00-10:00am (or by appointment) – use link on Canvas *(note – if for some reason it doesn't work, please just email me!!)*

**Teaching Assistant**: Hannah Palko
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**Office Hours**: 10:00-11:00am. Email to arrange

**Course Description**:
Scientific models, broadly defined as abstractions or simplified representations of reality, strive to make a particular part of feature of the world easier to understand, define, quantify, visualize, or simulate. Models often form the foundation of the scientific method and are used in conjunction with mathematical methods to explore a given theory or test a stated hypothesis in a real-world setting. This course will focus on models featuring a geographic component, or spatial models, used in social science applications. Students will be exposed to the fundamentals of 'model thinking' and the 'modeling process'. A number of specific geographic models will be covered and practical experience will be gained through a series of exercises.

My desired learning outcomes for you this semester include:

- To develop a 'model thinking' habit of mind
- Understand and appreciate that equations are NOT terrifying
- Be able to think through problems and implement GIS solutions

**Course Requirements:**
**Exercises**: A series of exercises will be assigned throughout the semester to illustrate each of the models and methods covered in the class. Assignments will be worth
Assignments are typically due one week after they are initially assigned – the due date will always be clearly indicated on the assignment. The late-fee policy is as follows:

- Up to 1 day late (24h): -25%

- 1 – 2 days late: -50%

- **More than 2 days late: No Longer Accepted**

**Readings:** To illustrate the application of the models discussed in this class, a series of journal articles are assigned. Students are to provide a summary (~1 page) that should be turned in to Canvas at the end of the week (Friday at midnight) it is assigned. **Late Reading Assignments are Not Accepted.**
Unless otherwise noted, the following items should be addressed in the summary:

1. The research question(s) being asked;
2. The stated hypothesis (if any);
3. Methodology used to answer the question(s);
4. Source of Data;
5. Results (answers to the question being asked);
6. Any particular limitation\weakness you observe in the study and/or any great strength (something you thought was very clever etc.).

Each reading summary will be worth 5 points.
Graduate students will have a greater number of readings than the undergraduates and more reflection on the articles is expected.

**Weekly Quizzes** - Following the weekly lectures, there will be a short quiz each week to make sure the material sunk in! These will sometimes be multiple choice questions or other times they will be small exercises for you to complete. They are not intended to be torturous experiences.

**Exams** – There will be a midterm and final exam given in online each worth 40 points.

**Final Project (Graduate Students Only):** Graduate students will complete a research project. The project will be structured in the same manner as the journal articles reviewed and should feature a research question or hypothesis, a literature review, collected data, a methodology for answering the question, and results and conclusions. Papers should be 10-15 pages in length. More details will be provided later in the semester. Final Projects will count for 50 Points.

| Assignments | Points |
|---|---|
| Labs | 150 Points Total (10*15) |
| Weekly Quiz | 33 Points total (11*3) |
| Readings | 30 Points Total (6*5) |
| Exams | 80 Points Total (2) |
| Final Project (Grad Only) | 50 Points |

Grading Scale
**Undergraduates:** 89.5-100% **A**; 79.5-89.4% **B**; 69.5-79.4% **C**; 59.5-69.4% **D**; <59.4 **F**
**Graduates**: 89.5-100% **A**; 79.5-89.4% **B**; 69.5-79.4% **C**; < 69.4% **U**

**Course Materials:**
We will cover much of the material in: **The ESRI Guide to GIS Analysis. Volume 2: Spatial measurements & statistics by Andy Mitchell** (Referred to as "Mitchell" in the reading list below).  This book is not very expensive and it is highly recommended that you purchase a copy. All other readings will be available on Canvas. The second version of the book has just been released, but the first version is perfectly suitable.

**Ethics:** If you are contemplating an ethical failure please read the code of student academic integrity: http://www.legal.uncc.edu/policies/ps-105.html, so you can plan for the consequences. Students are encouraged to work on their own, but helping each other understanding the concepts is fine. In other words, you may work with other students on lab assignments but you may not copy projects or written

answers to questions from another student. Plagiarism in article summaries or in your final term paper is strictly forbidden. If a student is caught plagiarizing in an assignment, the result the first time will be a score of 0 on that particular assignment; a second infraction will be handled by the University Academic Integrity Board (please see the aforementioned website for details).

**Email Policy:** I will do my best to answer your emails in a timely manner, however, please allow up to 24 hours for a response.

**Students with disabilities:** Students in this course seeking accommodations to disabilities must first consult with the Office of Disability Services and follow the instructions of that office for obtaining accommodations.

TENTATIVE SCHEDULE. PLEASE FOLLOW ON CANVAS FOR ANY CHANGES OR UPDATES.

| Week | Date | Lectures & Labs | DUE |
|------|------|-----------------|-----|
| 1 | 1/20-22 | Course Outline & Introduction, Overview of Models & Modeling | Quiz 1 |
| 2 | 1/25-1/29 | Data & Geographic Distributions<br>Exercise 1: Geographic Distributions | Quiz 2<br>Reading Summary 1 |
| 3 | 2/1-2/5 | Sources of Socioeconomic Data\Intro to Census<br>Exercise 2: Geodatabase for socioeconomic data | Quiz 3<br>Exercise 1 (by Monday) |
| 4 | 2/8-2/12 | "Spring" Break | |
| 5 | 2/15-2/19 | Testing statistical significance\Hypothesis Testing | Quiz 4<br>Exercise 2 (by Monday) |
| 6 | 2/22-2/26 | Hypothesis Testing Continued<br>Exercise 3: Hypothesis Testing | Quiz 5<br>Reading Summary 2 |
| 7 | 3/1-3/5 | Global Spatial Autocorrelation (Join-Count)<br>Exercise 4: The Join Count Statistic | Quiz 6<br>Exercise 3 (by Monday) |
| 8 | 3/8-3/12 | Global Spatial Autocorrelation (Moran's I)<br>Exercise 5: Moran's I | Quiz 7<br>Reading Summary 3<br>Exercise 4 (by Monday) |
| 9 | 3/15-3/19 | Local Spatial Autocorrelation<br>Exercise 6: Local Moran's I & Hot Spot | Quiz 8 |
| 10 | 3/22-3/26 | Midterm Exam – Due by Friday | Exercise 6 (by Monday) |
| 11 | 3/22-3/26 | Geodemographic Modeling<br>Exercise 7: Geodemographic Modeling | Quiz 9<br>Reading Summary 4<br>Exercise 7 (by Friday) |
| 12 | 4/5-4/9 | Markov Modeling<br>Exercise 8: Markov Model Neighborhood Change | Quiz 10<br>Reading Summary 5 |
| 13 | 4/12-4/16 | Spatial Interaction Modeling<br>Exercise 9: Migration Modeling Migration | Quiz 11<br>Exercise 8 (by Monday) |
| 14 | 4/19-4/23 | Spatial Accessibility Modeling<br>Exercise 10: Spatial Accessibility | Quiz 12<br>Exercise 9 (by Monday) |

| 15 | 4/26-4/30 | Continue with Exercise 10\Review for final | Reading 6<br>Exercise 10 (by Friday) |
|----|-----------|-------------------------------------------|--------------------------------------|
| 16 | 5/3-5/5 | Final Exam | Exam due Wednesday |
| 17 | 5/12 | Graduate Final Projects Due | |

**(NS)** – Please read, but no summary required. Paper for reference in relation to lecture material.

**(G)** – Graduate Students only

## READING 1: GEOGRAPHIC DISTRIBUTIONS
**(NS)** Mitchel Chapters 1&2

Benassi, F., Lipizzi, F., Strozza, S. (2019) Detecting foreigners' spatial residential patterns in Urban Contexts: Two tales from Italy. *Applied Spatial Analysis and Policy* 12, 301-319.

**(G)** Niedomysl, T., Hall, O., Bustos, M., Ernston, U. (2017) Using satellite data on nighttime lights intensity to estimate contemporary human migration distance. *Annals of AAG*

## READING 2: TESTING STATISTICAL SIGNIFICANCE (HYPOTHESIS TESTING)
**(NS)** Rogerson, P. Inferential statistics: Confidence Intervals, Hypothesis Testing, and Sampling. In: Statistical Methods for Geography. SAGE

**(NS)** https://www.youtube.com/watch?v=0zZYBALbZgg

**(NS)** https://www.youtube.com/watch?v=eyknGvncKLw

Ogneva-Himmelberger and Huang (2015) Spatial distribution of unconventional gas wells and human populations in the Marcellus Shale in the United States: Vulnerability analysis. *Applied Geograph* 60, 165-174.

## READING 3: SPATIAL AUTOCORRELATION
**(NS)** Mitchell Ch. 3 pg. 121-142 (Global Autocorrelation)

**(NS)** Mitchell Ch. 4 pg. 187-206 (Local Clusters)

Garcia-Palmomares, J.C., Gutierrez, J., Minguez, C. (2015) Identification of tourist hot spots based on social networks: A comparative analysis of European metropolises using photo-sharing services and GIS. *Applied Geography* 63, 408-417.

## READING 4: GEODEMOGRAPHIC MODELING
Major, E., Delmelle, E.C., Delmelle, E.M. (2018) SNAPScapes: Using Geodemographic segmentation to classify the food access landscape. *Urban Science*

**(G)** Spielman, S. and Singleton, A. (2015) Studying neighborhoods using uncertain data from the American Community Survey: A contextual approach. *Annals of the Association of American Geographers* 1003-1025.

### READING 5: MARKOV MODEL

Nilsson, I. and Delmelle, E.C. (2018) Transit investments and neighborhood change: On the likelihood of change. *Journal of Transport Geography* 66, 167-179.

**(G)** Rey, S. and Gutierrez, M. (2015) Comparative spatial inequality dynamics: The case of Mexico and the United States. *Applied Geography* 61, 70-80.

### READING 6: SPATIAL ACCESSIBILITY

**(NS)** GIS-Based Measures of spatial accessibility and application in examining health care access. In: Quantitative Methods and Applications in GIS.

Dony, C., Delmelle, E.M., Delmelle, E.C. (2015) Re-conceptualizing accessibility to parks in multi-modal cities: A Variable-width Floating Catchment Area (VFCA) method. *Landscape and Urban Planning* 143.

**(G)** Vallee et al. (2020) Is accessibility in the eye of the beholder? Social inequalities in spatial accessibility to health-related resources in Montreal, Canada. *Social Science and Medicine* 245.