## Course Information

- **Course Name:** Geospatial Data Analytics
- **Registration info:**
  - **In person mode:** Geospatial Data Analytics - 29536 - CE 59700 - WN1
  - **Asynchronous mode:** Geospatial Data Analytics - 29537 - CE 59700 - EPH
- **Meeting day(s) and time(s):** MWF, 8:30 – 9:20am, Spring 2022 (January 10 – April 30)
- **Classroom:** WANG 2555
- **Instructional Modality:** Face-to-Face and online (asynchronous)
- **Course credit hours:** 3 credits
- **Prerequisites**: Graduate standing; prior GIS course; prior programming experience; college statistics and linear algebra; or consent from the instructor

## Instructor(s) Contact Information

- **Name of the instructor(s):** Jie Shan
- **Office Location:** HAMP 4110
- **Office Phone Number:** 494-2168
- **Purdue Email Address:** jshan@purdue.edu
- **Office Hour:** MW 3:00 – 4:30pm
- **Webex:** https://purdue.webex.com/meet/jshan

## Course Description

The course will introduce fundamental theories, analytical methods and programing skills, that are needed to work with geospatial data. Students will learn the theories, methods and techniques to access, visualize, analyze and model various geospatial data through programming practice and using open source geospatial packages. Besides, the course will provide each student an opportunity to apply the course content to a topic area of their own interests. The goal is to enable the learners to develop their own geospatial analytical applications.

## Learning Resources, Technology & Texts

1) No required texts
2) Lecture notes
3) Personal computer/laptop with Windows
4) Brightspace learning management system

**Reference materials:**

1) Spatial Data Science with R, https://www.rspatial.org/
   - Introduction to R
   - 'terra' package as an update to 'raster'
   - Many other materials
2) Spatial Data in R, Robert J. Hijmans, https://rspatial.org/spatial/Spatialdata.pdf , 75 pp.
3) Using Spatial Data with R, Claudia A Engel, https://cengel.github.io/R-spatial/
   - Last updated: February 11, 2019
4) Geocomputation with R, R. Lovelace, J. Nowosad, J. Muenchow, 2021-07-31, https://geocompr.robinlovelace.net/

5) Introduction to Spatial Data Programming with R，Michael Dorman，2021-08-04，http://132.72.155.230:3838/r/index.html
6) Spatial Data Science with applications in R，Edzer Pebesma, Roger Bivand， 2021-07-20，https://keen-swartz-3146c4.netlify.app/
7) R for Data Science, H. Wickham and G. Grolemud, and many authors https://r4ds.had.co.nz/ , 2017
8) Advanced R, by Hadley Wickham, http://adv-r.had.co.nz/ (it seems the link to 2nd Edition does not work).
9) R Packages, Hadley Wickham, http://r-pkgs.had.co.nz/
10) 17 Best R Programming Books (2021 Update), https://www.guru99.com/best-r-programming-books.html
11) Many more to find with Google, including YouTube

## Learning Outcomes

By successfully completing the course, students should be able to

1) **LO 1: interpret and evaluate the theories and methods of geospatial data analytics.**
   a) LO 1.1 mathematically formulate representative methods in geospatial data analytics.
   b) LO 1.2 interpret the notations and conditions of an analytical formulation.
   c) LO 1.3 be knowledgeable on the properties and limitations of popular geospatial methods.
2) **LO2: skillfully design and implement typical geospatial methods through programming.**
   a) LO 2.1 make a decent computer program to effectively implement specified geospatial analytic methods.
   b) LO 2.2 discuss the uncertainty of the related implementation and calculation.
   c) LO 2.3 extend and combine basic analytic methods to solve a complex real world problem through programming.
3) **LO3: effectively visualize and interpret the outcome of geospatial data analytics.**
   a) LO 3.1 effectively access and visualize various geospatial data.
   b) LO 3.2 make spatial analysis over multiple geospatial data layers.
   c) LO 3.3 logically evaluate their mapping and analysis outcome based on the used methods and nature of the problem.

## Assignments

1) Lab tutorials – self practice and review for class materials, no submission is needed. There are about 15 lab tutorials.
2) Projects/Homework
   ● Subject based;  ~9 projects
   ● Semi open-ended; possible bonus credits
3) Final term project
   ● Self selected topic/subject under consent of the instructor
   ● Start as early as possible
4) No midterm exam
5) Final exam (can be oral)
   ● As a group of a few students
   ● Possible some written questions and/or coding practice during the interview

## Grading Scale

1) Projects: report, presentation, discussion (the term project weighs about twice an ordinary project)                                           85%
2) Others: class performance, activity, attendance           5%
3) Final exam:                                               10%
4) Late submission: up to 20% deduction per day; < 1day counts 1 day
5) Academic dishonesty:      absolutely prohibited.
   - 1st incidence:       lowest in class;
   - 2nd incidence:       Fail ("F") for the course

According to the points outlined above, the following grades will be distributed:

A:     90% - 100%
B:     70% - 90%
C:     50% - 70%
F:     <50%

## Attendance Policy

1) Attendance is required
2) Excuse should be asked before the fact
3) COVID 19 related absences will be considered based on University policy

## Academic Guidance in the Event a Student is Quarantined/Isolated

If you must miss class at any point in time during the semester, please reach out to me via email so that we can communicate about how you can maintain your academic progress. If you find yourself too sick to progress in the course, notify your adviser and notify me via email or Brightspace. We will make arrangements based on your particular situation. Please note that, according to Details for Students on Normal Operations for Fall 2021 announced on the Protect Purdue website, "individuals who test positive for COVID-19 are not guaranteed remote access to all course activities, materials, and assignments."

## Course Schedule/Content

1. **Module 1 – Geospatial Data Visualization**
   - R basics and its geospatial capabilities
   - Temporal and spatial exploration of geospatial data
   - Data classification methods for thematic mapping
   - Geospatial data visualization
   - Coordinate reference systems and transform
2. **Module 2 – Geospatial Data Analysis**
   - Spatial point pattern analysis
   - Spatial data clustering
   - Spatial autocorrelation
   - Spatial operations and polygon analytics
3. **Module 3 – Geospatial Data Modeling**
   - Geographically weighted regression
   - Elements of estimation theory
   - Spatial interpolation
   - Surface modeling

## Classroom Guidance Regarding Protect Purdue

Any student who has substantial reason to believe that another person is threatening the safety of others by not complying with Protect Purdue protocols is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights and the Violent Behavior Policy under University Resources in Brightspace.

## Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

## Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies.

Based on template of July 30, 2021

## Accessibility

Purdue University is committed to making learning experiences accessible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

## Mental Health/Wellness Statement

1) If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time.
2) If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.
3) If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.
4) If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

## Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the Critical Needs Fund.

## Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

## Disclaimer

This document is subject to change during the semester when deemed necessary.

Based on template of July 30, 2021