



# Spatiotemporal Analysis

STP 598

## Instructor Info



Shiwei Lan



Office Hrs: TTh 10:00-11:00 AM



<https://asu.zoom.us/j/8055899886>



<https://math.asu.edu/~slan>



[slan@asu.edu](mailto:slan@asu.edu)

## Course Info



Prereq: STP 421, STP 427



TTh 12:00 – 1:15 PM



Tempe WXLRA109; [Zoom](#)



<https://slan-teaching.github.io/STP598sta/>

## Grader Info



TBA



Office Hrs: TBA



TBA



TBA

## Description

This course focuses on modern techniques in analyzing spatiotemporal data. It consists of two major parts: spatial statistics and time series. The topics will include spatial process, areal data models, hierarchical spatial modeling, time series regression, ARMA/ARIMA models, Gaussian process, and state-space models.

## Objective

By the end of the course, students should get a good overview of spatiotemporal analysis. They will learn classical models including CAR, spatial process models, separable spatial models, ARIMA, Gaussian process, HMM, etc..

## Textbooks

### Required

HMASD - Hierarchical Modeling and Analysis for Spatial Data (2nd Edition) by Sudipto Banerjee, Bradley P. Carlin, Alan E. Gelfand

TSA - Time Series Analysis and its applications, with examples in R (4th Edition) by Robert H. Shumway and David S. Stoffer

### Recommended

SSTD - Statistics for Spatio-Temporal Data by Noel Cressie and Christopher K. Wikle

## Grading Scheme

Homework	50 %
Midterm	25 %
Final Project	25 %
Total	100 %

A+	[97%, 100%]	A	[93%, 97%)	A-	[90%, 93%)
B+	[87%, 90%)	B	[83%, 87%)	B-	[80%, 83%)
C+	[77%, 80%)	C	[70%, 77%)		
D	[60%, 70%)			E	[0%, 60%)

## Homework

There will be 5 written homework assignments each worth 10 points to cover the corresponding material. The total will be 50 points. Homework will be announced and submitted on [canvas](#). Each homework report should be submitted in either Word or PDF format, no other formats accepted. Late home will NOT be accepted. Do NOT send your homework by email!

## Exam

There will be 1 take-home midterm exam, each worth 25 points. If you are unable to take an exam, you must contact the instructor in advance. All excuses must be verifiable. The make-up exams will be given only under exceptional circumstances.

## Final Project

The final project will consist of a novel analysis of a spatial/temporal data set of the student's choosing. The student should submit a 1-2 page plan for their project including a description of the data set by **November 07**. The student will submit a written report to [canvas](#) by the scheduled final time (**December 10** at midnight). This is an individual project. Discussion is allowed but this is NOT a group work!

# FAQs

## ? Where can I find help?

! You can go to my virtual office hours and the grader's office hours. In addition, you can go to [slack STP 598sta channel](#) to post your questions and help others.

## ? How do I keep track of the class?

! Constantly check canvas and the course website. I will make announcements, post homework solutions, etc..

## ? Do we have incentives?

! I will give bonus points through the semester for e.g. extra-credit homework problems, most helpful slack users, etc..

## ? When shall I drop if I choose to?

! Last Day to Register or Drop/Add Without College Approval is 08/25/2021. Tuition & Fees Refund Deadline is 09/01/2021 for session C. Course Withdrawal Deadline (without 'W' on your transcript) is 11/03/2021 for session C. Refer to <https://students.asu.edu/academic-calendar> for more deadlines.

## Disability Accommodations

Qualified students with disabilities are encouraged to make their requests at the beginning of the semester to get disability accommodations. Disability information is confidential. *Note: Prior to receiving disability accommodations, verification of eligibility from the Disability Resource Center (DRC) is required.* Therefore, you should contact DRC immediately. Their office is located on the first floor of the Matthews Center Building. DRC staff can also be reached at: 480-965-1234 (V), 480-965-9000 (TTY). For additional information, visit: [www.asu.edu/studentaffairs/ed/drc](http://www.asu.edu/studentaffairs/ed/drc). Their hours are 8:00 AM to 5:00 PM, Monday through Friday.

## Make-up Policy

In case of valid absence (such as serious illness, going to court, etc.) during scheduled exam, you must notify the instructor BEFORE the exam, if the circumstances allow. To be eligible for make-up exam, valid excuse has to be supported by valid documentation (such as doctor's note, letter from court, etc.). Also, please follow Academic Affairs Manual, ACD 304-04, for appropriate University policies about requesting an accommodation for religious practices, in case you have to miss an assignment due to religious practice.

## Cell phones and Electronic Devices

Picture taking, talking or texting on your cell phone or any electronic device during class is prohibited. If you bring a cell phone and/or any other electronic equipment to the class, make sure they are turned off before class begins. Any sounds produced by such devices are disruptive to the class and, as such, will not be tolerated and may be reported to the Office of the Dean of Students.

## Academic Honesty

ASU expects and requires all its students to act with honesty and integrity, and respect the rights of others in carrying out all academic assignments. For more information on academic integrity, including the policy and appeal procedures, please visit <http://provost.asu.edu/academicintegrity>.

## Inclusion

The School of Mathematical and Statistical Sciences encourages faculty to address and refer to students by their preferred name and gender pronoun. If your preferred name is different than what appears on the class roster, or you would like to be addressed using a specific pronoun, please let me know.

## Sexual Violence and Harassment

Both Title IX federal law and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at <https://sexualviolenceprevention.asu.edu/faqs>. As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, <https://eoss.asu.edu/counseling>, is available if you wish to discuss any concerns confidentially and privately. ASU online students may access 360 Life Services, <https://goto.asuonline.asu.edu/success/online-resources.html>.

## Syllabus Disclaimer

This syllabus is tentative and should not be considered definitive. The instructor reserves the right to modify it (including the dates of the tests) to meet the needs of the class. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary. It is the student responsibility to attend class regularly and make note of any change.

# FAQs

## ? Where can I find help?

! You can go to my virtual office hours and the grader's office hours. In addition, you can go to [slack STP 598sta channel](#) to post your questions and help others.

## ? How do I keep track of the class?

! Constantly check canvas and the course website. I will make announcements, post homework solutions, etc..

## ? Do we have incentives?

! I will give bonus points through the semester for e.g. extra-credit homework problems, most helpful slack users, etc..

## ? When shall I drop if I choose to?

! Last Day to Register or Drop/Add Without College Approval is 08/25/2021. Tuition & Fees Refund Deadline is 09/01/2021 for session C. Course Withdrawal Deadline (without 'W' on your transcript) is 11/03/2021 for session C. Refer to <https://students.asu.edu/academic-calendar> for more deadlines.

## University Guideline About COVID-19

In case you cannot attend class in person as a result of illness or possible exposure to infectious disease, you may participate in this class remotely via ASU Sync. To participate remotely, use the zoom with [this link](#). Note that all students should bring a mobile device to class regularly to allow participation with colleagues via ASU Sync as necessary.

In case you cannot attend class in person as a result of illness or possible exposure to infectious disease, you may access the digital recordings of the class sessions you are unable to attend. The links to the recordings will be provided in Canvas.

Note that class sessions may be recorded and recordings provided to enrolled students, instructors or instructional support personnel. If you have concerns about being recorded, please contact the course instructor. Recordings of all class sessions will be posted in Canvas for all students to access for reviewing course materials.

In case you cannot attend class in person as a result of illness or possible exposure to infectious disease, you may request make-up work from the instructor by reviewing online zoom recordings.

Attendance and participation in class activities is an essential part of the learning process, and students are expected to attend class regularly. Some absences are, however, unavoidable. Excused absences for classes will be given without penalty to the grade in the case of (1) a university-sanctioned event [ACD 304-02]; (2) religious holidays [ACD 304-04; a list can be found here <https://eoss.asu.edu/cora/holidays>]; (3) work performed in the line-of-duty according [SSM 201-18]; and (4) illness, quarantine or self-isolation related to illness as documented by a health professional.

Anticipated absences for university-sanctioned events, religious holidays, or line-of-duty activity should be communicated to the instructor by email at least 14 days before the expected absence.

Absences for illness, quarantine or self-isolation related to illness should be documented by a health professional and communicated to the instructor as soon as possible by email.

Excused absences do not relieve students from responsibility for any part of the course work required during the period of absence. Faculty will provide accommodations that may include participation in classes remotely, access to recordings of class activities, and make-up work.

If there is a disagreement as to whether an absence should be accommodated, the instructor and student should contact the academic unit chair immediately for resolution.

## Class Rules in response to COVID-19

- **Immersion modality:** This class will follow the Immersion model of delivery. Classes will be held in person in our scheduled room and at the scheduled time, with a simultaneous remote delivery via Zoom. Your instructor will specify how the in-person arrangements will occur. If you are unable to attend in person, please notify your instructor (from your ASU email account) in a timely manner to make them aware.
- **Zoom Etiquette:** During the Zoom sessions, please log in on time and assure that you have a reasonably secure connection. Please use your full name or first name-last initial. No outside attendees will be allowed, and during the sessions, please keep your microphone's audio muted except when needing to talk to the instructor. The instructor reserves the right to remove anyone from the Zoom sessions for disruptive behavior.
- **Masks: \*\*IMPORTANT!\*\*** For sessions held in person, masks and other personal protection equipment (PPE) **\*\*MUST BE WORN\*\*** in accordance with ASU's policies. Failure to do so will result in your being asked to comply, then asked to leave if unable or unwilling to comply. Deliberate refusal to comply will be treated as a Student Code of Conduct violation and referred to the Dean's office for review.

## Class Schedule (tentative)

Week	Date	Topic	Assignments
1	08/19 - 08/20	Introduction	
2	08/23 - 08/27	Overview of spatial/temporal data problems	Homework 1 out
3	08/30 - 09/03	Basics of point-referenced data models	
4	09/07 - 09/10	Basics of areal data models	Homework 1 due
5	09/13 - 09/17	Basics of Bayesian inference	Homework 2 out
6	09/20 - 09/24	Hierarchical modeling for univariate spatial data	
7	09/27 - 10/01	Multivariate spatial modeling	Homework 2 due
8	10/04 - 10/08	Multivariate spatial modeling	Homework 3 out
9	10/11 - 10/15	Fall break / Review	midterm-exam: due 10/17/2020
10	10/18 - 10/22	Introduction to time series	Homework 3 due
11	10/25 - 10/29	ARIMA and related models	Homework 4 out
12	11/01 - 11/05	ARIMA and related models	project proposal: due 11/07/2019
13	11/08- 11/12	State space models	Homework 4 due
14	11/15 - 11/19	State space models	Homework 5 out
15	11/22 - 11/24	Multivariate models	
16	11/29 - 12/03	Gaussian process	Homework 5 due
Final	12/06 - 12/11	Final Exam	final-project: due 12/10/2019