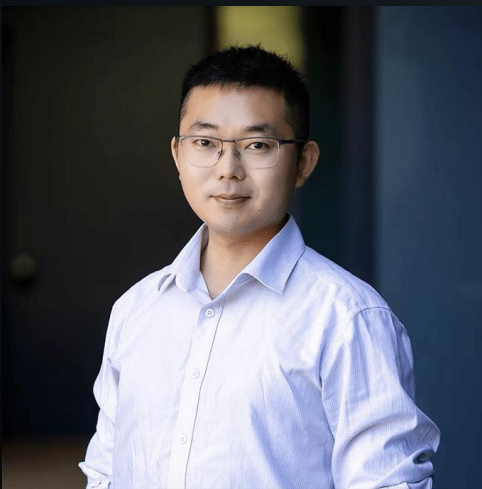


Geospatial Data Analysis, Prediction, and GeoAI: New Theories, Methods, and Software

Topic 5. Research design, spatial and remote sensing data collection, and pre-processing

Lecture website: <https://yongzesong.com/lecture-20260104>



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Associate Editor: *International Journal of Earth Observation and Geoinformation* (IF 8.6, Q1)

Associate Editor: *GIScience & Remote Sensing* (IF 6.9, Q1)

Topic Editor: *Geoscientific Model Development* (IF 4.9, Q1)

Lecture outline

Lecture website: <https://yongzesong.com/lecture-20260104>

Password: 20260104

Contents

Part 1. Lecture (1st class)

1. Research design
2. Remote sensing data collection using GEE
3. Data pre-processing

Part 2. Practice (2nd to 4th classes)

1. Feedback session for Assignment 4 (20 min)
2. Practice on Kriging (40 min)
3. Assignment 5 (40 min)
4. Submit your assignment (10 min)

Tips:

1. Working in a group of 3 or 4
2. Collecting feedback at each day
3. Individual assignments and working in a group
4. Complete assignments in the class
5. Assignment feedback sections after day 2
6. Install R and Rstudio
7. Sign Up for Google Earth Engine

A review of last four topics and assignments

General process of spatial prediction

Spatial modeling

Standard spatial models

- Kriging
- Regression
 - GWR
 - Spatial hierarchical Bayesian
 - GeoGAM

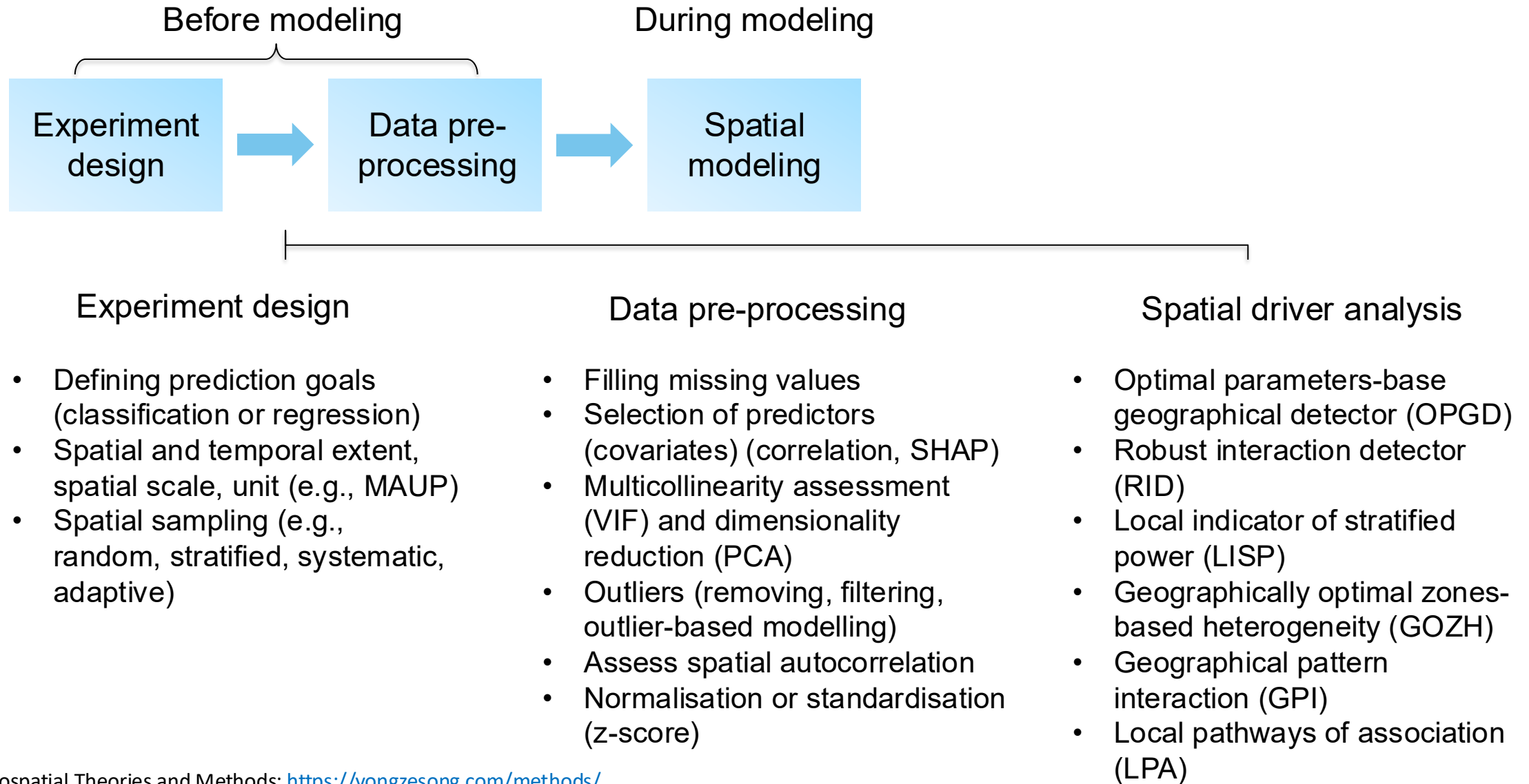
Spatial learning models

- Kriging + machine learning
- GWR + ML
- Spatial Bayesian + ML
- Spatial Convolutional Neural Networks (CNN) (local pattern)
- Spatial Graph Neural Networks (GNN) (e.g., road networks)
- Spatial transfer learning (e.g., domain adaptation for cross-location generalization)

Spatial feature engineering

- Second-dimension spatial association (SDA)
- Geographically optimal similarity (GOS)
- Geocomplexity explains spatial errors
- Generalised heterogeneity model (GHM)
- Heterogeneous spatial autocorrelation (HSA)

General process of spatial prediction



Google Earth Engine (GEE)

GEE platform <https://earthengine.google.com/>

GEE datasets <https://developers.google.com/earth-engine/datasets/>

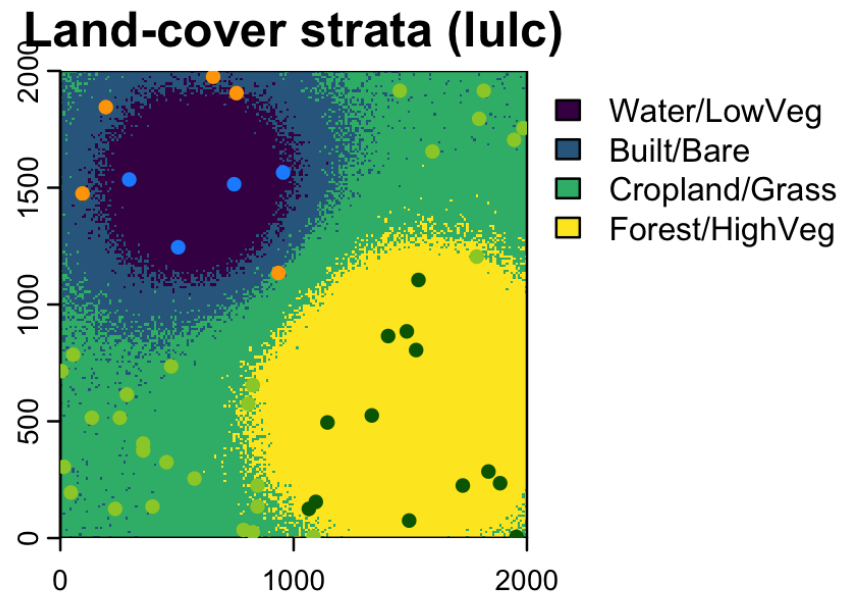
Timelapse examples <https://earthengine.google.com/timelapse/>

Case studies https://earthengine.google.com/case_studies/

Tutorials <https://developers.google.com/earth-engine/tutorials>

Spatial sampling with R

- <https://dickbrus.github.io/SpatialSamplingwithR/>
- A practical example:
 - Accuracy assessment for a land-cover (LULC) map using remote sensing data. We stratify the study area by mapped classes (e.g., water, built-up, cropland, forest), then randomly sample validation points within each class.
- stratified random sampling_ndvi.R



Assignment 5

You will have 40 min for working on Assignment

Write a 200 word essay on the analysis of applying stratified random sampling.

- stratified random sampling_temp.R

Question for the essay:

We need to design and implement a spatial stratified random sampling strategy using real remote-sensing data of temperature (e.g., in Australia, China, Europe, etc), where spatial strata are defined based on data-driven thresholds or quantiles. Please justify your stratification scheme, generate stratified random samples, and analyse the sampled data to demonstrate how stratification improves the representation of spatial heterogeneity compared with simple random sampling.

Send to Email before 10 am next day:

Yongze.song@outlook.com

Document name: A5_YourName.docx

Any questions?