

Spatial Sciences Institute
University of Southern California

SSCI 135g Maps in the Digital World

Fall 2017 — MWF 11:00 A.M.–12:20 P.M.

Location: WPH 207

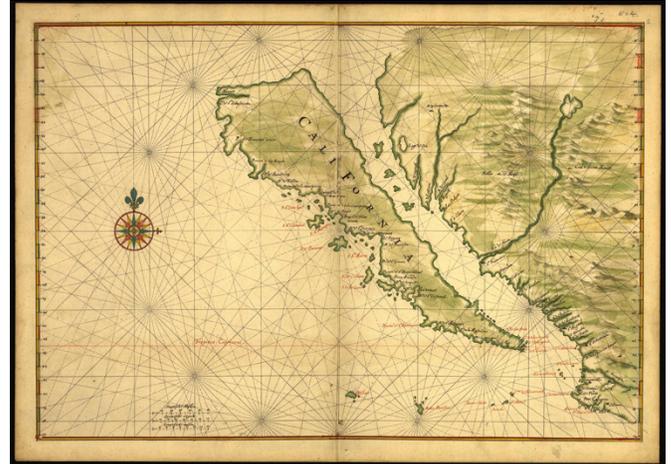
Instructor: Travis Longcore, Ph.D.

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Office Hours: Thursday, 2–4 P.M.

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Map of California shown as an island, circa 1650, by Joan Vinckeboons

1 Catalogue Description

SSCI 135g Maps in the Digital World

The role of formal reasoning, abstract representation, and empirical analysis in building maps for sharing knowledge across the physical, life and social sciences, and the humanities.

2 Introduction

This course explores all the ways in which maps are being used to compile, build, and share knowledge of the world around us. The first maps appeared long ago and today maps are used extensively across the physical, life, and social sciences as well as the humanities. Numbers and quantitative data feature prominently in the preparation of most maps. The overarching intent of this course is to examine some of the ways in which formal reasoning, abstract representation, and empirical analysis are used to construct the maps that you see and use in a given field of study and in everyday life. The topics covered in this course will range from geodetic principles (the way location is measured on the Earth's surface) to the various ways in which information is captured and represented on maps, the role of scale and map projections, and the ways in which various hierarchies and classifications can be combined and used with empirical analysis to add meaning to maps.

This course is a Quantitative Reasoning General Education course. Maps are used to engage you in the analysis and manipulation of data and information related to quantifiable objects, symbolic elements, and logic to help navigate the complexity and sophistication of the modern world. The lectures and accompanying homework assignments will focus on the role of maps in modern life and how numbers are used to construct maps of the world around us. The assignments and final project will increase your capacity to evaluate chains of formal reasoning (the use of formal logic and mathematics), abstract representation (the use of symbolic and diagrammatic representations), and empirical analysis (the use of statistical inference) in building and interpreting various kinds of maps.

3 Learning Objectives

The central objective of this course is to use maps to increase the capacity of students to use numbers in all their various guises to describe and interpret the complexity and sophistication of the modern world. Students will learn how to use a set of formal tools, including logical and statistical inference, probability and mathematical analysis, to pose and evaluate hypotheses, claims, questions, or problems with a variety of maps. Students will also explore the logical structures embedded in various kinds of maps and learn how to distinguish between their assumptions and implications. Maps are now a pervasive part of our everyday lives and by the end of the course, students will be able to identify both useful and specific applications of the various kinds of maps they study.

4 Textbooks

4.1 Required Texts:

Arlinghaus S L and Kerski J J (2014) *Spatial Mathematics: Theory and Practice through Mapping*. Boca Raton, FL, CRC Press

4.2 Recommended Texts:

de Smith M, Longley P A, and Goodchild M F (2006) *Geospatial Analysis: A Comprehensive Guide*. Available at <http://www.spatialanalysisonline.com/>

MacEachern A M (1995) *How Maps Work*. New York, Guilford Press

Monmonier M and de Blij H (2010) *How to Lie with Maps* (Second Edition). Chicago, IL, University of Chicago Press

Unwin D J (2010) *Numbers Aren't Nasty: A Workbook of Spatial Concepts*. Available at <http://teachspatial.org/numbers-arent-nasty-a-workbook-of-spatial-concepts/>

5 Course Outline

The course will be organized around the following seven modules and the accompanying lecture and classroom exercise (homework) topics. The dates below refer to those in Fall Semester, 2017.

5.1 Module 1: Guiding Principles

- 8/21: Introduction to Class | Special Properties of Maps
- 8/23: Maps in the Physical and Life Sciences
- 8/25: Maps in the Social Sciences
- 8/28: Maps in the Humanities

5.2 Module 2: Geometry of the Sphere

- 8/30: Earth coordinate systems
 - 9/1: Precision of latitude and longitude values
 - 9/6: Introduction to Homework #1
- Read Arlinghaus & Kerski, Chapter 1*

5.3 Module 3: Location, Trigonometry, and Measurement of the Sphere

- 9/8: Location and measurement: From antiquity to today
 - 9/11: Other common coordinate systems
 - 9/13: Introduction to #2, #3; collect Homework #1 for grading
- Read Arlinghaus & Kerski, Chapter 2*

5.4 Module 4: Transformations: Analysis and Raster/Vector Formats

- 9/15: Transformations
 - 9/18: Partition: Point-line-area transformations
 - 9/20: Raster and vector mapping: Know your file formats
 - 9/22: Scope, purpose and choice of final projects
 - 9/25: Introduction to Homework #4; collect Homework #2, #3 for grading
- Read Arlinghaus & Kerski, Chapter 3*

5.5 Module 5: Replication of Results: Color and Number

- 9/27: Color straws, voxels & ramps
 - 9/29: Image transformations
 - 10/2: Introduction to Homework #5; collect Homework #4 for grading
- Read Arlinghaus & Kerski, Chapter 4*

5.6 Module 6: Scale

- 10/4: Scale and scale change
 - 10/6: The dot density map
 - 10/11: Distribute Homework #6; collect Homework #5 for grading
 - 10/13: Mid-term Examination
- Read Arlinghaus & Kerski, Chapter 5*

5.7 Module 7: Partitioning of Data: Classification and Analysis

- 10/16: The choice of data ranges
 - 10/18: Normalizing data
 - 10/20: Making something from nothing? Isolines, contours, & mapplets
 - 10/23: Introduction to Homework # 7; collect Homework #6 for grading
- Read Arlinghaus & Kerski, Chapter 6*

5.8 Module 8: Visualizing Hierarchies

- 10/25: Traditional hierarchies
 - 10/27: Hexagonal hierarchies
 - 10/30: Introduction to Homework #8; collect Homework #7 for grading
- Read Arlinghaus & Kerski, Chapter 7*

5.9 Module 9: Distribution of Data

- 11/1: Ann Arbor, Michigan Tornado Siren Infill Project
 - 11/3: Mean center and standard deviational ellipse
 - 11/6: Introduction to Homework # 9, #10; collect Homework #8 for grading
- Read Arlinghaus & Kerski, Chapter 8*

5.10 Module 10: Map Projections

- 11/8: Looking at maps and their underlying projections
- 11/10: Sampling projection distortion
- 11/13: Contemporary approach: Web Mercator Auxiliary Sphere projection
- 11/15: Making the perfect map: Fact or fiction?
- 11/17: Introduction to Homework #11, #12; collect Homework #9, #10 for grading

Read Arlinghaus & Kerski, Chapter 9

5.11 Module 11: Integrating Past, Present, and Future Approaches

11/20: From the classics to the modern: Past and present

11/27: A non-Euclidean future?

11/29: Class Review

12/1: Wrap up; Collect Homework #11, #12

12/6: Final Examination (11:00 A.M.–1:00 P.M)

Read Arlinghaus & Kerski, Chapter 10

6 Homework Topics

In addition to the lectures and in-class discussions, there are a series of homework assignments that are designed to introduce the tools of quantitative reasoning and provide practical experience in implementing these tools to explore various problems within the framework of the scientific method. These assignments are linked to the lectures and class discussions, but do not duplicate the classroom experience. Weekly homework assignments will be graded and returned, and the mid-term and final exams will have a homework component to them. In other words, the homework component is an important and integral part of the course as a whole.

The homework experiences will be organized around the topics listed below. The letter “P” listed at the end of selected homework topics indicates assignments that include components contributing to your final project:

Homework #1: Routes, Coordinates, Precision and Accuracy

Homework #2: Measuring the Circumference of the Earth

Homework #3: Measuring Positions on the Earth’s Surface

Homework #4: Transformations and Raster/Vector Analysis (P)

Homework #5: Role of Color and Image Interpretation

Homework #6: Role of Scale and Dot Density Maps

Homework #7: Classification and Normalization of Data (P)

Homework #8: Role of Traditional and Hexagonal Hierarchies (P)

Homework #9: Examining the Distribution of Tornado Data

Homework #10: Calculating Mean Centers and Standard Derivational Ellipses

Homework #11: Comparing Map Projections (P)

Homework #12: Network Analysis (P)

7 Grading Scheme

Homework Assignments (12 x 4 points per assignment)	48%
Midterm Examination (in class)	12%
Final Project (1 with multiple components)	10%
Final Examination	30%

8 Important Dates

8/14-18 Last day to register and settle without a late fee

10/13 Mid-term Examination

11/22–26 Thanksgiving Break

12/1	Fall semester classes end
12/2–5	Study days
12/6	Final Examination (11:00 A.M.–1:00 P.M.)

No make-up opportunities will be offered for missed exams, so mark the appropriate dates on your calendars! If you have a legitimate conflict, speak with the course instructor as soon as possible so we can make alternative arrangements. If you have read this far, please send the instructor an email with your favorite map as an attachment.

9 Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. SCampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions can be found at: <http://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.

10 Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. More information about academic accommodations based on a disability can be found at: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to an instructor as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.