

**Hubert H. Humphrey School of Public Affairs**  
**PA5271: GIS IN PLANNING AND POLICY ANALYSIS**

Section 1, Fall 2017  
Time: 18:00-20:45 Wednesday  
Classroom: HHH Center 85

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## INTRODUCTION

Geographic Information Systems (GIS) is an increasingly growing field, providing spatial data management and analysis services to a broad range of business and public organizations. US News identified the GIS occupation as one of the “21 hot jobs for the 21st century”, claiming that the number of GIS positions in local governments alone will increase 6% per year.

The use of GIS is inevitable in urban planning and public policy as both fields involve exploring location-related trends and issues. For instance, planners routinely conduct geo-spatial analyses to study residential clustering, to explore the spatial mismatch between jobs and workers, and to identify suitable land for urban transition, infill development, or environmental conservation. To public policy professionals, GIS facilitates spatial visualization of poverty, crime, pollution, and health patterns, allowing those who on the front line of public services to distribute tax money more fairly and to protect life and property more effectively. In simple words, GIS skills are a valuable asset in today’s competitive job market.

This course covers GIS basics (e.g., map projections, coordinate systems, spatial data manipulation & visualization, and geodatabase management) as well as advanced GIS applications (e.g., network analysis, raster & TIN models, socio-demographic analysis, 3-D analysis, hot-spot analysis, spatial interpolation, and other spatial statistics). It gives special attention to making GIS useful to urban planners and policy analysts. It is not intended to make students into GIS coding, spatial modeling or spatial statistics experts – those interested in a GIS-based career path should continue to take programming and database courses in Computer Science and advanced GIS offerings in the Department of Geography.

## STUDENT LEARNING OUTCOMES

Although the course is literally about mastering GIS, the overarching goal is to improve students’ *problem solving* and *spatial thinking* skills. Upon completion of this course, the student will be able to

1. solve an diverse array of planning and public policy problems using GIS theory and methods;
2. sharpen spatial thinking skills by placing problems and objects within the space dimension, by recognizing the importance of space surrounding those problems and objects, and by reflecting on the relationships that occur within the whole system; and
3. develop analytical skills for addressing real-world problems within the GIS framework.

## APPROACH

To achieve student learning outcomes above, the course features hands-on learning in classroom, laboratory, and homework exercises. The class time will be divided into lecture and laboratory sessions that cover both theory and practice of topics of interest. Lab and homework exercises comprise of real-world tasks faced by planning and public policy practitioners.

Students will be using a Geographic Information System software package known as ArcGIS 10.5, published by Environmental Systems Research Institute (ESRI). There are many competitors, but ArcGIS (and ESRI's older software ArcView) is the most commonly used. In addition, students will be using various ArcGIS extensions (e.g., Spatial Analyst, 3D Analyst, Geostatistical Analyst, Network Analyst) and a few smaller 3rd party extensions (e.g., XTools Pro).

Note that you will never learn to use GIS unless you put time in learning how to use the software! Just like sports, GIS is learned through practice and repetition. In this course, you are expected to spend 4-6 hours every week to 'practice' GIS skills. I will also try to reduce lecture length so that you have more in-class time to work with the GIS software.

## TEXTS

There is no required textbook for this spring 2017 class. All course readings will be information available from online. Lab manuals are all designed and created by instructors.

## LOGISTICS

Access to the computer lab (Room 85) requires only your U of M student ID card. There are also computers with the software loaded in Rooms 80 and 40 (which also require your student ID card for access). You can access all HHH computers by using the same user name and password for e-mail.

In the computer lab we will be working from the courses drive T:\. There are two sub-directories that contain data and workspaces for the course. The general course materials (e.g., syllabus, readings, handouts, assignments, and datasets) will be found in subdirectory "PA5271\_YQData." Workspace will be found in subdirectory "PA5271\_YQStudents." In this latter subdirectory, you will find a group of sub-folders and one of these will have your name. This will be your private workspace. Only you (and the two instructors) can access the folder with your name on it. You will notice that from time to time instructors have copied some of the data you will be using to save you time.

For those who want to work on your home or laptop computers, ESRI makes available a full copy of the software for no charge but with a one-year time limit. Please check with your instructors should you need such a copy.

***Food and drink are not permitted at the workstations!*** There are shelves at the back of the room where food and drink can be stored while you are working.

## EVALUATION

Students are evaluated based upon performance on a series of small assignments and a larger final project.

All the assignments should be done independently. For the final project, I strongly encourage you to select a planning or policy analysis problem that is the closest to your area of interest. Attendance as well as active participation and contribution to class discussion is required and counts in the final grade. Missing three classes will result in an at least 10-point deduction from your final grade. The relative weights for grading purposes are as follows:

- Final Project (26%)
- Eight Assignments (64% - each 8%)
- Class Participation (10%)

## STUDENT ACADEMIC INTEGRITY AND SCHOLASTIC DISHONESTY

Academic integrity is essential to a positive teaching and learning environment. All students enrolled in University courses are expected to complete coursework responsibilities with fairness and honesty. Failure to do so by seeking unfair advantage over others or misrepresenting someone else's work as your own, can result in disciplinary action. The University Student Conduct Code defines scholastic dishonesty as follows:

Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis.

Within this course, a student responsible for scholastic dishonesty can be assigned a penalty up to and including an "F" for the course. If you have any questions regarding the expectations for a specific assignment or exam, ask me directly.

## CLASS SCHEDULE, READINGS, AND ASSIGNMENTS

1. GIS Basics
2. Advanced GIS Applications

### PART 1. GIS BASICS

9/6 Course overview; GIS Mapping; ArcGIS

- Readings:

1. *Esri Insider*: "Smart Policies Lead to Smart Nations", Available at <https://blogs.esri.com/esri/esri-insider/2015/07/14/smart-policies-lead-to-smart-nations/>
2. *Esri ArcNews*: "Website Helps Discover, Explore, and Improve US City Parks", Available at <http://www.esri.com/esri-news/arcnews/winter1213/articles/website-helps-discover-explore-and-improve-us-city-parks>
3. *ArcGIS Online Help*: "Essential ArcMap vocabulary", Available at <http://desktop.arcgis.com/en/arcmap/latest/map/main/essential-arcmap-vocabulary.htm>

4. *ArcGIS Online Help*: “Essential ArcCatalog vocabulary”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/using-arcatalog/essential-arcatalog-vocabulary.htm>
- Lab: Using ArcCatalog and working with ArcMap
- 9/13 Basic Cartography: Coordinate Systems, Projections, and Metadata
- Readings:
    1. Kent, R. B., & Klosterman, R. E. (2000). GIS and mapping: pitfalls for planners. *Journal of the American Planning Association*, 66(2), 189-198. Available at <http://www.tandfonline.com/doi/abs/10.1080/01944360008976098>
    2. *ArcGIS Online Help*, “What are map projections?”, Available at <http://desktop.arcgis.com/en/arcmap/latest/map/projections/what-are-map-projections.htm>
    3. *ArcGIS Online Help*, “What are geographic coordinate systems?”, Available at <http://desktop.arcgis.com/en/arcmap/latest/map/projections/about-geographic-coordinate-systems.htm>
    4. *ArcGIS Online Help*, “Projection types”, Available at <http://desktop.arcgis.com/en/arcmap/latest/map/projections/projection-types.htm>
    5. *ArcGIS Online Help*: “Essential metadata vocabulary”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/metadata/essential-metadata-vocabulary.htm>
  - Lab: Managing coordinate systems and working with map projections
  - Assignment #1: Finding blockgroup IDs for single family units in northern Oregon
- 9/20 Spatial Data Structure: Maps, Tables, and Queries
- Readings:
    1. Esri ArcUser: “Data—The Secret Sauce for Economic Development”, Available at <http://www.esri.com/esri-news/arcuser/summer-2014/data-the-secret-sauce-for-economic-development>
    2. *ArcGIS Online Help*: “What is a shapefile?”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/shapefiles/what-is-a-shapefile.htm>
    3. *ArcGIS Online Help*: “Essential table and attribute information vocabulary”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/tables/essential-table-and-attribute-information-vocabulary.htm>
    4. *ArcGIS Online Help*: “Table Analysis and Management”, Available at <http://desktop.arcgis.com/en/arcmap/latest/analyze/commonly-used-tools/table-analysis-and-management.htm>
  - Lab: Working with tables and queries
  - Assignment #2: Measuring urban-suburban health disparities in US large metropolitan areas
- 9/27 Geodatabase
- Readings:
    1. *ArcGIS Online Help*: “What is a geodatabase?”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/geodatabases/what-is-a-geodatabase.htm>
    2. *ArcGIS Online Help*: “Essential readings about the geodatabase”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/geodatabases/essential-readings-about-the-geodatabase.htm>

- Lab: Creating and editing a geodatabase
- Assignment #3: Using a geodatabase to define logical relationships

#### 10/4 Geoprocessing: Multi-layer Spatial Analyses

- Readings:
  1. *ArcGIS Online Help*: “[Essential geoprocessing vocabulary](http://desktop.arcgis.com/en/arcmap/latest/analyze/main/essential-geoprocessing-vocabulary.htm)”, Available at <http://desktop.arcgis.com/en/arcmap/latest/analyze/main/essential-geoprocessing-vocabulary.htm>
  2. *ArcGIS Online Help*: “[What is ModelBuilder?](http://desktop.arcgis.com/en/arcmap/latest/analyze/modelbuilder/what-is-modelbuilder.htm)”, Available at <http://desktop.arcgis.com/en/arcmap/latest/analyze/modelbuilder/what-is-modelbuilder.htm>
  3. *ArcGIS Online Help*: “[Essential ModelBuilder vocabulary](http://desktop.arcgis.com/en/arcmap/latest/analyze/modelbuilder/essential-modelbuilder-vocabulary.htm)”, Available at <http://desktop.arcgis.com/en/arcmap/latest/analyze/modelbuilder/essential-modelbuilder-vocabulary.htm>
- Lab: Clipping, intersecting, dissolving, and working with buffers
- Assignment #4: Examining land development patterns around the Hiawatha LRT stations

#### 10/11 Geocoding and Editing in ArcMAP

- Readings:
  1. Krieger, N., Waterman, P., Lemieux, K., Zierler, S., & Hogan, J. W. (2001). On the wrong side of the tracts? Evaluating the accuracy of geocoding in public health research. *American journal of public health*, 91(7), 1114. Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1446703/>
  2. *ArcGIS Online Help*: “[Introducing Geocoding](http://desktop.arcgis.com/en/arcmap/latest/manage-data/geocoding/what-is-geocoding.htm)”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/geocoding/what-is-geocoding.htm>
  3. *ArcGIS Online Help*: “[Essential geocoding vocabulary](http://desktop.arcgis.com/en/arcmap/latest/manage-data/geocoding/essential-geocoding-vocabulary.htm)”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/geocoding/essential-geocoding-vocabulary.htm>
  4. *ArcGIS Online Help*: “[What is editing?](http://desktop.arcgis.com/en/arcmap/latest/manage-data/editing/what-is-editing.htm)”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/editing/what-is-editing.htm>
  5. *ArcGIS Online Help*: “[Essential editing vocabulary?](http://desktop.arcgis.com/en/arcmap/latest/manage-data/editing/essential-editing-vocabulary.htm)”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/editing/essential-editing-vocabulary.htm>
- Lab: Working with map elements and geocoding street addresses
- Assignment #5: Creating and editing building footprints in subdivisions

#### 10/18 Web-Based GIS Maps

- Readings:
  1. Drummond, W. J., & French, S. P. (2008). The future of GIS in planning: Converging technologies and diverging interests. *Journal of the American Planning Association*, 74(2), 161-174. Available at <http://www.tandfonline.com/doi/abs/10.1080/01944360801982146>
  2. *ArcGIS Online Help*: “[Web maps](https://doc.arcgis.com/en/arcgis-online/reference/what-is-web-map.htm)”, Available at <https://doc.arcgis.com/en/arcgis-online/reference/what-is-web-map.htm>
  3. *ArcGIS Blog*: “[Nine things you didn't know you could do with Story Maps](https://blogs.esri.com/esri/arcgis/2016/02/16/story-maps-9-things/)”, Available at <https://blogs.esri.com/esri/arcgis/2016/02/16/story-maps-9-things/>
- Lab: Creating a web-based map using CARTO

- Assignment #6: Creating a web-based story map using ArcGIS Online

## PART 2. ADVANCED GIS APPLICATIONS

### 10/25 Transportation Network Analysis

- Readings:
  1. Guthrie, A. and Fan, Y. (2017). Accessibility Scenario Analysis of Hypothetical Future Transit Network: Social Equity Implications of GTFS-Based, Sketch Planning Tool, Available at the Moodle course site
  2. *ArcGIS Online Help*: “An overview of the extensions of ArcGIS”, Available at <http://desktop.arcgis.com/en/arcmap/10.3/main/get-started/about-arcgis-for-desktop-extensions.htm>
  3. *ArcGIS Online Help*: “What is the ArcGIS Network Analyst extension?”, Available at <http://desktop.arcgis.com/en/arcmap/latest/extensions/network-analyst/what-is-network-analyst.htm>
  4. *ArcGIS Online Help*: “Essential ArcGIS Network Analyst extension vocabulary”, Available at <http://desktop.arcgis.com/en/arcmap/latest/extensions/network-analyst/essential-network-analyst-vocabulary.htm>
- Lab: Network tracing, routing, and allocation
- Assignment #7: Mapping job accessibility by transit in the Twin Cities region

### 11/1 3-D Analysis

- Readings:
  1. *ArcGIS Online Help*: “What is the ArcGIS 3D Analyst extension?”, Available at <http://desktop.arcgis.com/en/arcmap/latest/extensions/3d-analyst/what-is-the-3d-analyst-extension.htm>
  2. *ArcGIS Online Help*: “Essential 3D Analyst vocabulary”, Available at <http://desktop.arcgis.com/en/arcmap/latest/extensions/3d-analyst/essential-3d-analyst-vocabulary.htm>
- Lab: Comparing actual and zoned density in Montgomery County, Maryland (identifying suitable locations for infill development)

### 11/8 Raster Analysis

- Readings:
  1. *Esri ArcNews*: “3D Modeling Shows Off Elevated Rail System Landscape”, Available at <http://www.esri.com/esri-news/arcnews/spring13articles/3d-modeling-shows-off-elevated-rail-system-landscape>
  2. *ArcGIS Online Help*: “What is raster data?”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/what-is-raster-data.htm>
  3. *ArcGIS Online Help*: “Essential raster data vocabulary”, Available at <http://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/essential-raster-data-vocabulary.htm>
- Lab: Working with the ArcGIS Spatial Analyst
- Assignment #8: Finding a suitable site for a new school in Stowe, Vermont

### 11/15 Socio-Demographic Analysis Using Census Data

- Readings: Browse through the Census Bureau Geography education website: [http://www.census.gov/geo/education/census\\_geo\\_topics.html](http://www.census.gov/geo/education/census_geo_topics.html)
- Lab: Mapping racial distribution in the Twin Cities Metropolitan Area

**11/22 Hot-Spot Analysis and Kernel Density Map (Heat Map)**

- Readings:
  1. *ArcGIS Online Help*: “An overview of the Mapping Clusters toolset”, Available at <http://desktop.arcgis.com/en/arcmap/latest/tools/spatial-statistics-toolbox/an-overview-of-the-mapping-clusters-toolset.htm>
  2. *ArcGIS Online Help*: “Kernel Density”, Available at <http://desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/kernel-density.htm>
  3. Optional Reading: Eck, J., Chainey, S., Cameron, J., & Wilson, R. (2005). Mapping crime: Understanding hotspots. Available at <http://discovery.ucl.ac.uk/11291/1/11291.pdf>
- Lab: Identifying pedestrian crash concentration zones in Miami-Dade County, Florida

**11/29 Spatial Interpolation**

- Readings:
  1. *ArcGIS Online Help*: “An overview of the Interpolation toolset”, Available at <http://desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/an-overview-of-the-interpolation-tools.htm>
  2. *ArcGIS Online Help*: “Understanding interpolation analysis”, Available at <http://desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/understanding-interpolation-analysis.htm>
- Lab: Mapping the probability of ozone exceeding a critical threshold in California

**12/6 Student Presentations**
**12/13 Student Presentations**
**SUMMARY SCHEDULE OF SESSIONS**
**Week** *Part I: GIS Basics*

<b>1</b>	9/6	Course overview; GIS Mapping; ArcGIS	
<b>2</b>	9/13	Basic Cartography: Coordinate, Projections, & Metadata	
<b>3</b>	9/20	Spatial Data Structure: Maps, Tables, and Queries	HW#1 Due
<b>4</b>	9/27	Geodatabase	HW#2 Due
<b>5</b>	10/4	Geoprocessing: Multi-layer Spatial Analyses	HW#3 Due
<b>6</b>	10/11	Geocoding and Editing in ArcMAP	HW#4 Due
<b>7</b>	10/18	Web-Based GIS Maps	HW#5 Due

*Part II: Advanced GIS Applications*

Final Project Guideline Out

<b>8</b>	10/25	Transportation Network Analysis	HW#6 Due
<b>9</b>	11/1	3-D Analysis	HW#7 Due
<b>10</b>	11/8	Raster Analysis	

<b>11</b>	11/15	Socio-Demographic Analysis Using Census Data	HW#8 Due
<b>12</b>	11/22	Hot-Spot Analysis and Kernel Density Map (Heat Map)	
<b>13</b>	11/29	Spatial Interpolation	
<b>14</b>	12/6	Student Presentations	
<b>15</b>	12/13	Student Presentations	Final Paper Due 12/16