Title: Basic Cartography

Critical Resources: an internet connected computer, ArcGIS Pro, Lab 3 datasets

Purpose: The purpose of this lab will be for you to gain knowledge and experience in cartographic design by constructing a basic thematic map using ArcGIS Pro for a disaster management scenario. Specifically, you will build a basic thematic map to investigate the relationship between earthquakes, population levels and roads categories in California, USA.

Learning Objectives – After completing the lab, you will know:

•   How to apply cartographic design concepts for thematic information;

•   How to establish figure/ground relationships in a map you create.

Deliverables:

A screen shot of your final map and a write-up of your response to the discussion questions.. Upload your write-up to the lab 3 drop box on myCourses.

Tasks and Steps:

Task 1 – Download data sets

Step 1: Down the lab_3_datasets.zip from myCourses

Step 2: Unzip the datasets

Unzip the datasets to a location where you can find them easily, like the C:\temp folder. Before proceeding with the next tasks, open ArcGIS Pro.

Task 2 – Add, explore and map California Counties datasets to the map display

Step 1: Add california_counties.shp to your map.

ArcGIS Pro Quick Steps Reference: Map Tab > Add Data > Data > Browse for california_counties.shp

These are counties from the state of California USA.

Step 2: Explore indicators for California Counties.

When working with GIS data, it is important to investigate the specific values contained within a dataset. Before creating a population map, open the attribute table for california_counties.shp

ArcGIS Pro Quick Steps Reference: Right Click california_counties in table of contents > Attribute Table (short cut key: Ctrl + T).

The attribute table is showing various US census attributes (or indicators) included with this dataset. Reference for what each indicator means can be found in the file california_counties_indicators.xlsx located inside the data_credits folder from the datasets folder download. For this exercise, we are interested in the indicator field TOTAL_POP that can be found on the far right of the attribute table. This is the total population per each county and is considered a form of ratio data as there are numerical differences between values with a non-arbitrary zero starting point.

Step 3: Stylize California Counties by raw population counts.

Create a choropleth map of California Counties by raw population counts.

ArcGIS Pro Quick Steps Reference: Highlight california_counties in table of contents if not already done so then > Appearance Tab > Symbology > Graduated Colors > Field: TOTAL_POP; Color scheme: White to Black

If you completed Task 2, step 3 correctly, you should have a choropleth map of California Counties by raw population counts that looks similar to Figure 1 below:
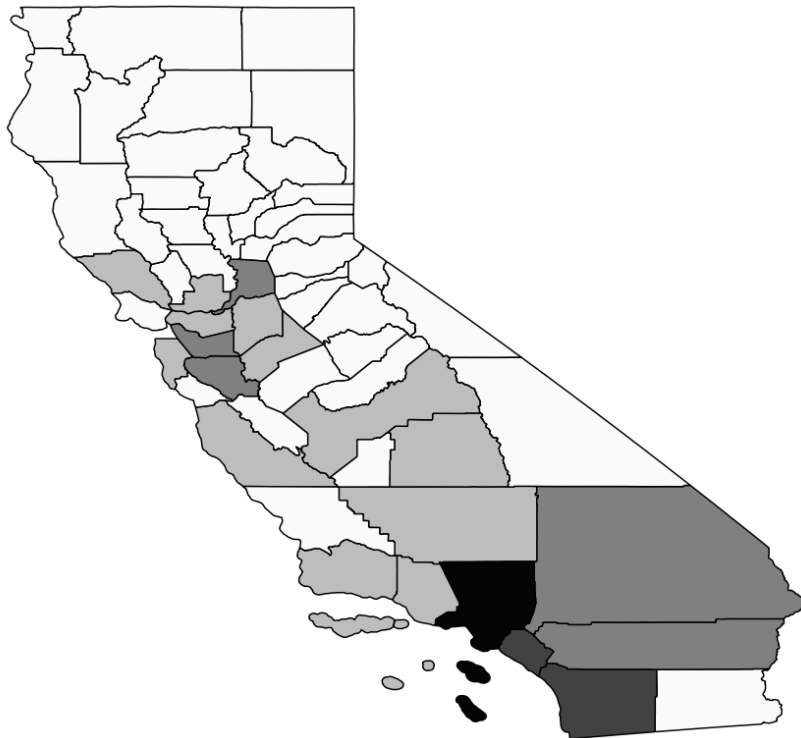

Figure 1: California Counties by raw population counts.

Task 3 – Add, explore and map California Roads datasets to the map display

Step 1: Add and examine California roads

For this step, add the California Roads shapefile (california_roads.shp) to your map. Quick reference steps for adding shapefiles to a map can be found under Task 2, step 1 of this exercise.

Open the attribute table of california_roads. Quick reference steps for opening attribute tables can be found under Task 2, step 2 of this exercise. Make note of the attribute FEATURE – this tells you the class of road – i.e., Principal Highway, Limited Access Highway etc. These are considered ordinal data as they do have a ranking as per the various road categories, but there is no numerical difference between the categories. In the next step, we will create a qualitative representation of the California roads. Specifically, we will show only major highways in California that would be used in the event of an evacuation.

Step 2: Stylize California roads by road category

Create a qualitative representation of California major highways by the FEATURE category. The roads will be stylized so they appear in the ground of the map.

ArcGIS Pro Quick Steps Reference:

Initial setup: Highlight california_roads in table of contents if not already done so then > Appearance Tab > Symbology > Unique Values > Field: FEATURE; Color scheme: Discrete Color Scheme

Symbol Modification: Under the list of symbols displayed after the initial setup (there should be 10 symbol classes), click on Ferry Crossing so it is highlighted, then click the delete button on your keyboard. The Ferry Crossing symbol class should be removed, leaving 9 symbol classes remaining. Repeat these general steps to remove the: Limited Access Highway   Business Route, Limited Access Highway   Toll Road, Other Highway, Other Through Highway   Business Route, Other Through Highway   Toll Road, Principal Highway   Business Route, and <all other values> classes.

When finished, you should only have Limited Access Highway, Other Through Highway, and Principal Highway symbol classes remaining.

Refining the symbols: Now that you have paired down the number of symbol classes, there are some steps you can take to make them look better and to place them more into the ground or visual background of the map.

Limited Access Highway – click once on symbol shape, the symbology tab will change to say 'Format Line Symbol – Limited Access Highway". Select the Gallery sub-view on this screen. Scroll down until you find the symbol 'Double Line' and click on that symbol. Limited Access Highway shapes should now appear as double lines.

The following are guidelines symbolizing for the other road shapes. These steps assume you have already clicked on the symbol shape for each symbol type like was first done for the previous Principal Highway instructions.

Other Through Highway - Scroll down until you find the symbol '1.0 Point' and click on that symbol. Other Through Highway shapes should now appear as a solid black line that is 1 point of thickness on the map. Now you will change the color of 1.0 Point symbol so it is more subdued in the background. To change the color, select the Properties sub-view on the screen. Under Appearance, select   Color > Grey 20%. Then click the Apply button.

Principal Highway - Scroll down until you find the symbol '0.5 Point' and click on that symbol. Principal Highway shapes should now appear as a solid black line that is 0.5 point of thickness on the map. Now you will change the color of 0.5 Point symbol so it is more subdued in the background. To change the color, select the Properties sub-view on the screen. Under Appearance, select   Color > Grey 20%. Then click the Apply button.

If you completed Task 3, step 2 correctly, your map should have California roads added to the map and as ground features in the display when compared to the population by county raw counts from the previous steps. Your map should looks similar to the Figure 2 below:
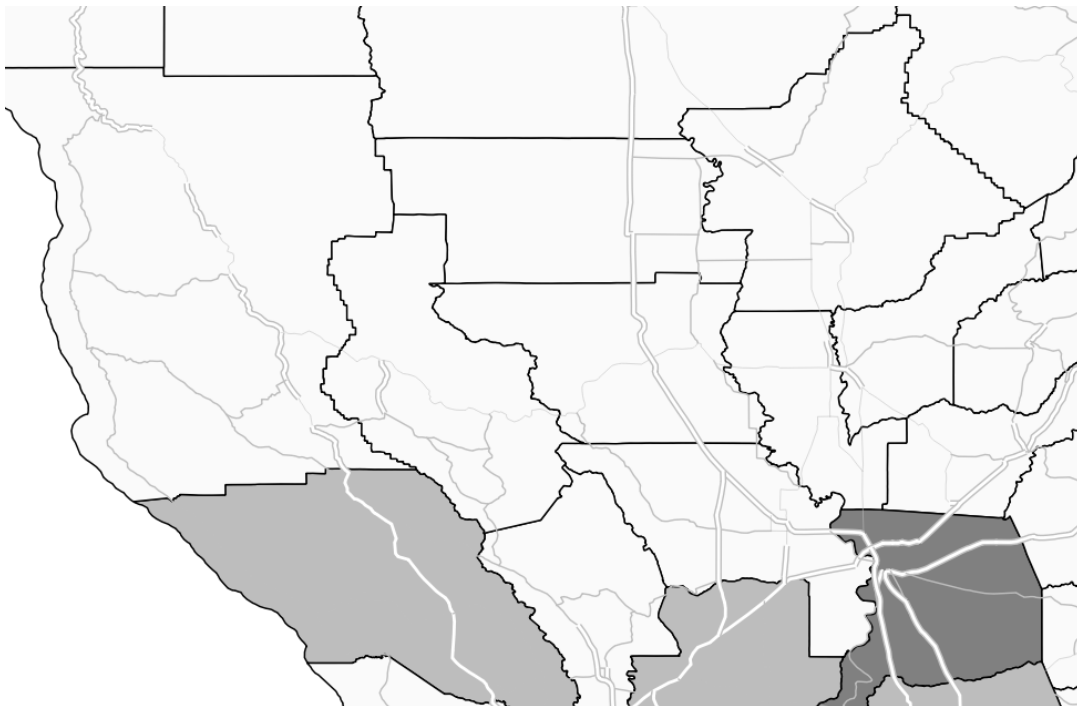

Figure 2: California roads added to the ground in contrast with California Counties by raw population counts. This map is zoomed in in Northern California so road features can be seen more clearly.

Task 4 – Add, explore and map California Earthquakes datasets to the map display

Step 1: Add and examine California Earthquakes

For this step, add the California Earthquakes shapefile (california_earthquakes.shp) to your map. Quick reference steps for adding shapefiles to a map can be found under Task 2, step 1 of this exercise. With the addition of earthquakes, you have now added all of the exercise datasets, their drawing order should be: earthquakes at the top of table of contents/layer list, followed by roads, followed by county population counts.

Open the attribute table of california_earthquakes. Quick reference steps for opening attribute tables can be found under Task 2, step 2 of this exercise. Make note of the attribute MAG – this tells you the magnitude of the earthquake. These are considered ratio data as they have an absolute zero starting point and there is a numerical difference between values.

In this step, you will create a quantitative representation of California earthquakes using graduated symbols of Earthquakes by magnitudes. The earthquakes will be stylized so they appear as figures in the map so they receive more visual prominence.

Step 2: Add earthquakes and Create graduated symbols of Earthquakes by magnitudes

ArcGIS Pro Quick Steps Reference:

Setup and Modification: Highlight california_earthquakes in table of contents if not already done so then > Appearance Tab > Symbology > Graduated Symbols > Field: MAG; Method: Natural Breaks (Jenks); Classes: 5, Minimum Size: 2pt; Maximum Size: 10pt; Click the Symbol and select Dot White. This will make the inside of the symbols white yet retain their black outline as this is a compound symbol.

If you completed step 2 correctly, your map should have California earthquakes added to the map and as figure features in the display making them more visually prominent. Your map should looks similar to the Figure 3 below:
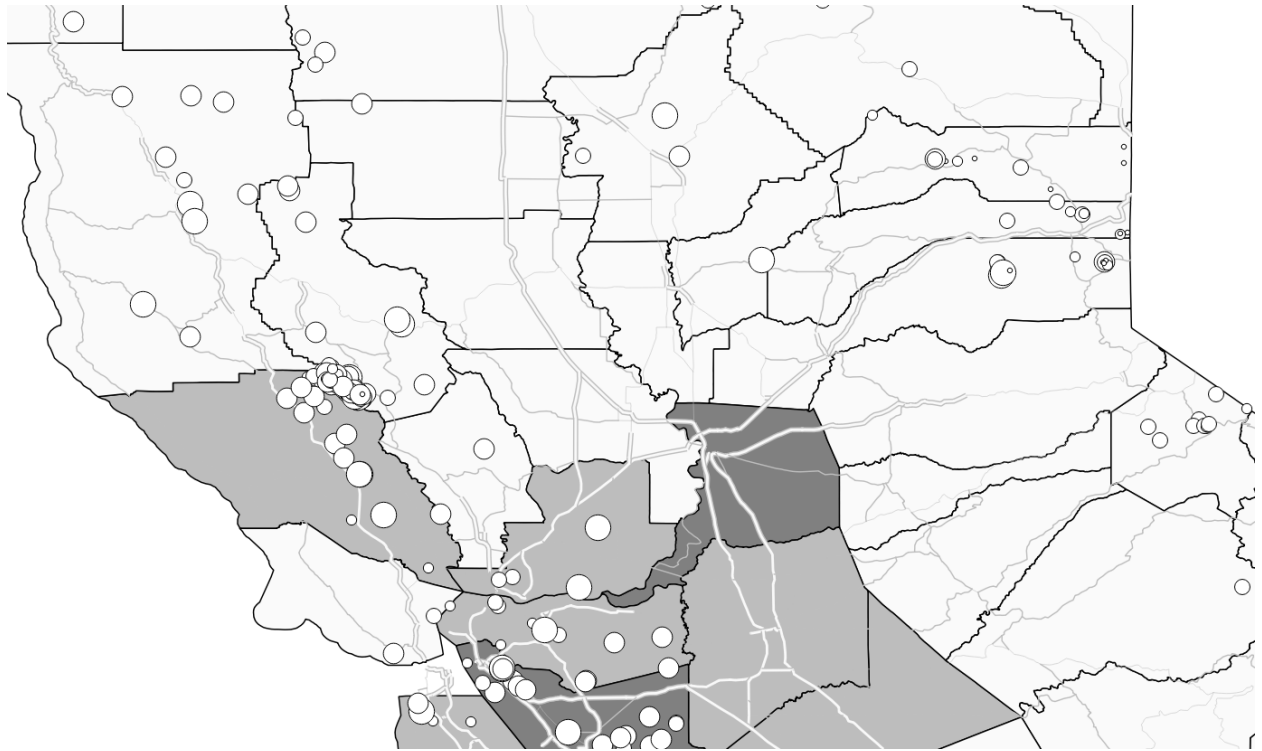
Figure 3: California earthquakes added as figures. This map is zoomed in in Northern California so road features can be seen more clearly.

Task 6 – Implement some other cartographic concept

Select and implement **(2) two** of the following options in your map:

Option 1: Find and incorporate additional relevant datasets into the map. Ideas include fault lines, census tracts, evacuation shelters, fire and police department locations and anything else that might be relevant to earthquake activity. Stylize these layers accordingly in terms of figure/ground relationships and visual hierarchy.

Option 2: Create a second map display based on a different indicator and normalize the map with that indicator using total population map. For example, as per the attribute field metadata provided with this lesson, indictor DP0010016 are total population age 70 to 74, Creating a map that shows this population group as a percentage of the overall population in a given county (i.e., normalized) could provide insight about vulnerable populations such as the elderly.

Option 3: Have the map focused on a specific California county, as opposed to the state level like was done in the previous steps. A map of a specific county could show all of the available road types for a more detailed analysis of evacuation options in case of earthquake activity. Use an inset map to show the area of interest within the state of California

Option 4: Aggregate earthquakes point locations to show density of earthquakes by square mile/kilometer for improved state-level view of earthquake activity.

See:
ArcGIS Pro Point Density: https://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/point-density.htm

Task 7 - Creating a basic layout

For references on how to use the various layout tools of ArcGIS Pro, see:

ArcGIS Pro Layouts:

https://pro.arcgis.com/en/pro-app/get-started/add-maps-to-a-layout.htm

Figure 4 is a layout provided to give you a sense of what you should try and create yourself along with comments about the layout that are things you should think about when making your map:
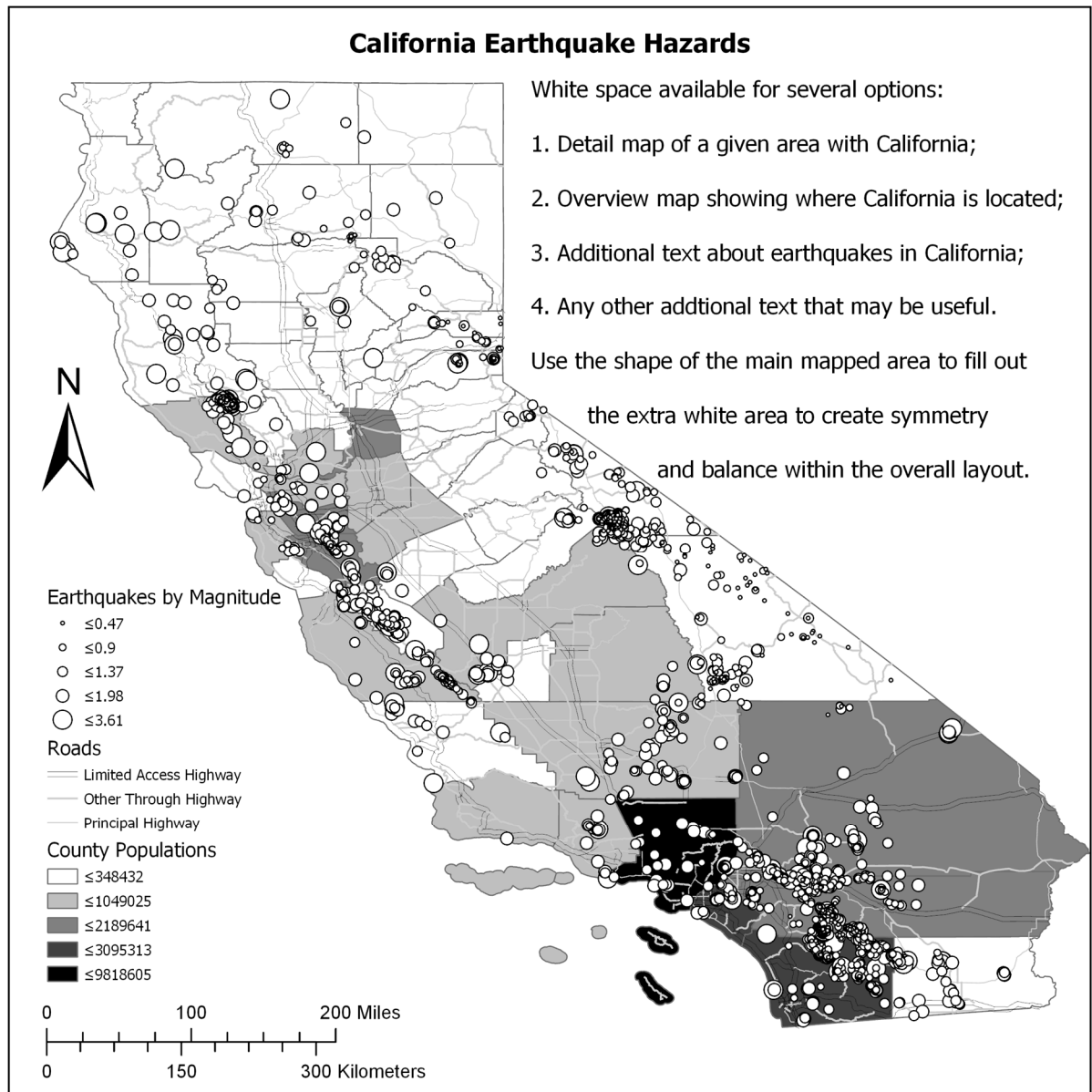
California Earthquake Hazards

White space available for several options:

1. Detail map of a given area with California;

2. Overview map showing where California is located;

3. Additional text about earthquakes in California;

4. Any other addtional text that may be useful.

Use the shape of the main mapped area to fill out

the extra white area to create symmetry

and balance within the overall layout.

N

Earthquakes by Magnitude
- ≤0.47
- ≤0.9
- ≤1.37
- ≤1.98
- ≤3.61

Roads
— Limited Access Highway
— Other Through Highway
— Principal Highway

County Populations
- ≤348432
- ≤1049025
- ≤2189641
- ≤3095313
- ≤9818605

0   100   200 Miles

0   150   300 Kilometers

Figure 4: Suggested layout to present mapped data created in previous steps.

Layout Comments:

1. Legend:
        a. Legend classes have been re-named to intuitive headings. For example,
        'Earthquakes by Magnitude' instead of the default 'California_Earthquakes'.
        b. Legend class sub-headings have been removed. For example, don't need to show
        'mag' sub-heading under 'Earthquakes by Magnitude'.
        c. Trailing zeros removed from magnitude values. For example, 0.47 instead of
0.470000

2. Scale bars:
        a. Even numbers used (200 miles and 300 kilometers)
        b. English and metric units provided

3. Ideas of use of additional whitespace in top/right/middle section of the layout.

Discussion Questions

Now that you have completed this exercise, here are some discussion points:

1. What area of California are most susceptible to earthquake hazards in terms of earthquake frequency, magnitude and population density?

2. Limited access highways can move the largest number of people. What area of California would be most susceptible to earthquakes causing damage to Limited access highways?

3. What spatial patterns do you see emerging in your map? What might those patterns imply for disaster management issues?

Deliverable:

Submit to the lab 3 drop a single MS Word (no PDFs or individual image files) that contains:

1. The two options you selected in Task 6 so I know what to look for.

2. Your response to the three discussion questions.

3. Screen shot(s) of the maps you created following the assignment instructions.