

Introduction to ArcGIS

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<http://julius.csscr.washington.edu/pdf/arcgis.pdf>

MAKING MAPS WITH ARCGIS

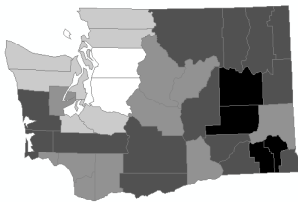
ArcGIS is a software package that allows you to store, manipulate, analyze, and display spatial data. The program is broken down into three primary interfaces: ArcCatalog, ArcToolbox, and ArcMap. ArcCatalog allows you to manage spatial data, ArcToolbox allows you to manipulate and analyze spatial data, and ArcMap allows you to display spatial data. This handout provides instruction on how to use ArcMap.

ArcMap deals with two forms of data: spatial data and attribute data. Spatial data refers, most commonly, to the shapes that we see on maps: points (cities, fire-hydrants), lines (rivers, streets), and polygons (regions, states, lakes). This type of spatial data (known as vector data) is stored in shape files in ArcMap. Attribute data is the information that we associate with the spatial data (population, density, pollution, traffic volume, etc.) Most often you'll want to use both types of data to make a map with ArcMap.

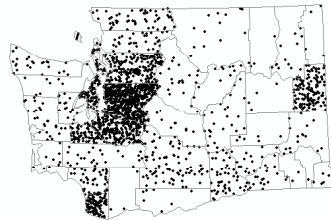
ArcMap organizes data in the form of a relational database; data is stored in tables that relate to each other through unique keys. Therefore, if you wish to make a map showing population density by county in Washington State, you'll want to have all the data (spatial data describing the shape, and the attribute data describing the area and the population) in one table (explained below).

Before you begin with ArcMap

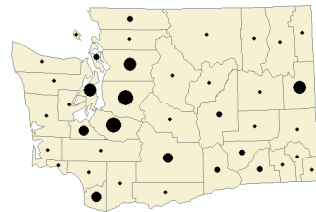
Think carefully about what you want to map and how you want to display the information before you begin using ArcMap. You'll need to consider the spatial scale at which the data is collected (e.g. census tract, county, state, city, road segment) and the extent of the area that you wish to display. You will also need to carefully consider the type of symbolization that you will use to convey your information. Common map types are:



Graduated Color
(a.k.a. choropleth)



Dot Density



Graduated Symbol

It is a good idea to sketch your map before you try to create it with the software so that you will have a sense of how to display your information.

What you'll need in order to begin

Shape file

In order to make a map, you'll need both spatial data and attribute data. Chances are that you already have the attribute data, you know what you want to map, but that you do not have the spatial data. You can find spatial data in a number of places. CSSCR has a number of shape files located in the following directory: P:\Windows\ESRI\ESRIDATA. This data is from ESRI, the company that makes this particular software. Another good place to find spatial data is from the University of Washington's GIS/Map library.

The following web site provides information about the University's holdings and how to download spatial data: <http://www.lib.washington.edu/maps/gis3.html>. If you cannot find what you are looking for at the web site, contact one of the Map librarians.

Attribute data

ou'll need to organize your attribute data into a table format and save it as a .dbf (database file). ArcMap cannot read Excel files. To convert your .xls table into a .dbf file, open the .xls table in Excel and save it as a.dbf. Statistical packages like SAS and SPSS can also export data in the .dbf format in most cases.

In order for ArcMap to relate the shape file to the attribute table, you will need to have a unique identifier. A unique identifier is a field that has a different value for each record. For example, in the table below, NAME, is the unique identifier – each county has a different name. (FIPS is also a unique identifier.) The table below is the attribute table for the Washington County shape file.

Attributes of wacount								
	FID	Shape	NAME	STATE_NA	STA	CNTY	FIPS	AREA
▶	0	Polygon	Ferry	Washington	53	019	53019	2280.2319
	1	Polygon	Stevens	Washington	53	065	53065	2529.9794
	2	Polygon	Okanogan	Washington	53	047	53047	5306.18
	3	Polygon	Pend Oreille	Washington	53	051	53051	1445.0286
	4	Polygon	Whatcom	Washington	53	073	53073	2170.2019
	5	Polygon	Skagit	Washington	53	057	53057	1765.1474
	6	Polygon	San Juan	Washington	53	055	53055	55.9182
	7	Polygon	Chelan	Washington	53	007	53007	3017.2079
	8	Polygon	Clallam	Washington	53	009	53009	1779.6932

If you wanted to make a map of population density in Washington State, by county, you would need to have population data by county. The table below shows population by county, you can use this data for your map.

Attributes of 2000pop			
	OID	COUNTY	POPULATION
▶	0	Adams County	16428
	1	Asotin County	20551
	2	Benton County	142475
	3	Chelan County	66616
	4	Clallam County	64525
	5	Clark County	345238

ArcMap will not be able to join these two tables because the unique identifier is not exactly the same in both tables – in the table below the word County was deleted after every county name so that the tables would join successfully. See the modified table below.

Note: ArcMap can only perform a join based on two text fields or two number fields: beware of numbers stored as text in your attribute tables !


	A	B	C
1	COUNTY	POPULATION	
2	Adams	16428	
3	Asotin	20551	
4	Benton	142475	
5	Chelan	66616	
6	Clallam	64525	
7	Clark	345238	


Begin with ArcMap

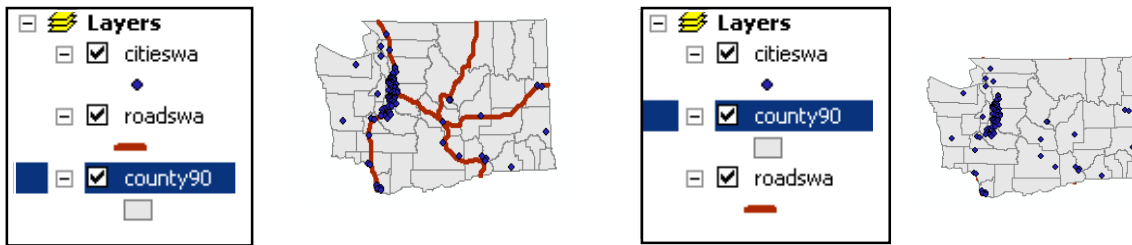
Once you have all of your data, you can begin to make your map. Launch ArcMap by clicking on the Start button, choosing ‘programs’, then choose ‘ArcGis’, and then select ArcMap.

ArcMap displays information by layering one spatial file on top of another. On the left side of the screen is the ‘table of contents’ – this is where you add and delete data. The right side of the screen displays the data.

Add Data

In order to add data, click on the ‘file’ drop down menu and select Add data, or simply click on the  button on the menu bar. The box that pops up will allow you to navigate to the directory where you have stored your data. If your directory is not immediately accessible, you may need to map the directory by

clicking on the  button. This will allow you to tell ArcMap where to find your data. To bring the data into your map layout, double-click on the file name. You can add as many files as you like to your map layout. Two caveats: 1) all of your spatial data must be in the same projection in order for it to display correctly in the same map layout. 2) ArcMap draws from the bottom up, this means that spatial data at the top of the list in your table of contents may be preventing you from seeing data listed at the bottom. For example, compare the two maps and their tables of contents:



You can change the draw order simply by rearranging the files listed in the table of contents by clicking and dragging them.

Change Projection

If you want to change the projection that your map is in, right click on the word Layers in the table of contents. Choose Properties at the bottom of the pop-up list. A stack of file folders will pop up, choose the folder labeled Coordinate System. From here you can choose among many different projections. When working with Washington State data, you might do well to choose: Predefined, Projected, State Plane, NAD 1983 (feet), as that is the projection that most local municipalities use.

Join attribute data to spatial data

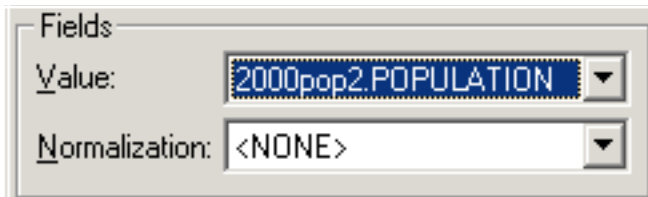
In order to join the attribute data to the spatial data, you'll need to bring all data sets into ArcMap. You can add a data table the same way you add spatial data, by clicking on the add data button.

Right click on the shape file to which you want to join the attribute data (in this case it would be the counties file). From the menu that pops-up, choose Joins and Relates. Then choose Join. Follow the instructions on the dialogue box that appears. Remember, when it says, 'choose the field in the table to base the join on', that field must be a unique identifier and must match the field in the shape file exactly (in this case it would be the county name field). Click okay, and you should be done. To make sure that the data joined correctly, open the attribute table for the shape file, the data you joined should be appended. Right click on the shape file and choose Open Attribute Table from the pop-up menu. Scroll through the table until you see the data that you joined. When ArcMap joins data from one table to another table the two tables are not changed. ArcMap saves the pointers that tell one table to join to another, but it will not create a new table per se.

Choose symbolization

Now that your data is organized, you can begin to symbolize your variables to display them on the map. In the table of contents, right click on the shape file that contains information you wish to display. Choose Properties, then choose symbology. Choose the category of features that you wish to map – features, categories, quantities, charts, or multiple attributes (in this case choose quantity). When you select quantity, you'll need to choose among: graduated colors, graduated symbols, proportional symbols, and dot density. Be sure to think through this decision as some forms of data are better suited to some forms of symbolization. For example, if you are mapping ordinal or interval data, you'll do well to use graduated or proportional symbols. When mapping nominal data, you're better off choosing Categories.

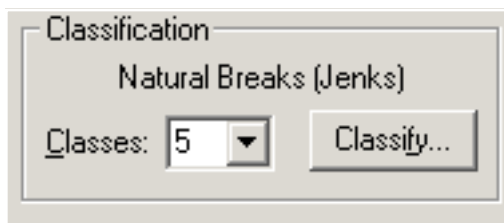
In this example we'll make a choropleth map of population density so choose graduated color under the quantities header. (A dot density map would also be a good choice.) In the window that pops-up, you'll want to first define the value field. When you click on the down button, you'll notice that every field in your data table is listed. Select the one with the population.



The Normalization function acts as a denominator – so in this case since density = population/area, you'll want to put area in the normalization slot. In most cases you'll leave the Normalization function empty.

The next step is to choose a color ramp. If you will be printing in black and white you should choose a ramp that goes from black to white.

The next step is to choose the classification method. The default method is Jenks iterative method (which minimizes within class differences and maximizes between class differences). You can choose more or fewer classes, and to change the classification method, click on the Classify method. By clicking on this button you will also be able to see a histogram that displays how your data is classified.



When you are satisfied with your classification method and symbolization, click Okay and close the properties dialogue box.

Make a layout

Before you print your map you'll want to design a map layout. Until this point you've been working in the data view, you'll need to go to layout view to create your layout. To do this, simply click on the layout view icon (the one that looks like a page) at the bottom of the view screen (these buttons allow you to toggle back and forth between the two views).



Once in the layout view you'll notice rulers around the page to help you design your map. You can change the page orientation by going to File, Page Setup from the pull down menu at the top of the screen.

To create a title, go to Insert, and choose Title. Follow the same step to add a legend, neatlines, north arrow, text, scale bar, pictures, and objects. Once these elements are in your map layout you can move them around and change their sizes.

Designing a Legend

When you insert a legend, a pop-up menu asks you to choose which elements from your data view that you want to include in the legend. The next step is to create a legend title, you may choose to leave this empty. Notice that you can change the type justification, size, and font at this point. You can also change it later if you like. The next step asks you to select legend frames, drop shadows, and other fancy elements. The next

two steps allow you to control the spacing between the elements in the legend. When you're satisfied with your choices, click Finish. If you want to change something later, simply double click on your legend and apply changes as you see fit.

The layout and the data views are dynamically linked – a change in one will produce the same change in the other. If you are not happy with some of the titles as they appear in the legend, you'll need to change them in the table of contents in the data view. It's easy to toggle between the two with the button at the bottom of the view. Further, you can add more elements to your map by simply going back to the data view and adding additional shape files.

Export a Map

You may wish to export your map into a different format in order to insert it into a Word document. In the layout view, go to Edit, Copy Map to Clipboard. Alternatively, File, Export Map, allows you to choose a more permanent format to save your map in, like JPEG.

Save your work

To save your map project, go to File, Save. Notice that ArcMap saves this project as a .mxd – an ArcMap document. Note: The .mxd file does not contain your spatial and attribute data, but only the pathways to the shapefiles and .dbf files. All of these files must remain at same file location for your project to re-open as you left it.

ArcGIS is a relatively powerful and user-friendly software package. Once you become familiar with the program you will find that you can make more sophisticated maps suited to your needs. You can explore the symbolization window to find ways that will allow you to creatively display your data with things like pie charts or bar graphs. You can also define the data that you want to display by delimiting exclusion criteria. With ArcToolbox, you can create new shape files based on parameters that you set through tools such as union, buffer, select, or you can even draw your own shapes with the digitizing tools.

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