

# GIS II: ArcMap Intermediate

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## Contents

Introduction .....	2
Objectives .....	2
Prerequisites .....	2
Related Training Available .....	2
Definitions .....	2
Explore ArcMap and ArcToolbox.....	3
More Information (Sources of Workshop Data) .....	12
Getting Additional Help .....	12

## Introduction

Work through hands-on exercises using ArcMap and ArcToolbox, and continue learning how to get around in ArcGIS. Use handy tools to explore projection of data, copy layers or features, and convert between various formats. Learn how to sort and calculate values in the table. Manipulate data within and between layers, through building queries and bringing in and displaying non-spatial data.

## Objectives

- Convert arc interchange files (.e00) to coverages
- Export data (copying layers)
- Display data by particular attributes
- Label features
- Save work as map document
- Save data settings as layer files
- Add external (tabular data) to existing spatial layers
- Select features in the data frame
- Select features using queries in a table
- Add new fields to a table
- Calculate field values
- Generate statistics for table data
- Add a new view
- Copy a layer from one view to another

## Prerequisites

[GIS I: ArcMap Introduction](#)

## Related Training Available

All workshops offered through Information Services are free to KU students, staff, faculty, and [approved affiliates](#). To learn more about or register for workshops, receive automatic announcements of upcoming workshops, and track workshops you registered for and attended, visit the KU Libraries Instruction Web site at [www.lib.ku.edu/instruction](http://www.lib.ku.edu/instruction). You can also check our online schedule at [www.ku.edu/acs/schedule](http://www.ku.edu/acs/schedule) for a list of class offerings and availability. For further workshop related questions, please email [training@ku.edu](mailto:training@ku.edu).

## Definitions

Term	Definition
<b>arc interchange file</b>	a file format with .e00 extension often used to compress ArcInfo coverages for transfer via the web or other means; ArcGIS converts .e00 files (fixed-length ASCII format) to coverages.
<b>coverage</b>	digital spatial data file forming the basic unit of vector data storage in ArcInfo; a coverage stores geographic features as primary features (arcs, nodes, polygons, etc.) and secondary features (tics, map extent, etc.) ( <a href="http://www.esri.com">www.esri.com</a> ).

<b>geodatabase</b>	relational database that contains geographic information such as feature classes and tables; feature classes can be organized into feature datasets or exist independently; feature classes store geographic features represented as points, lines, or polygons, and their attributes; many objects in a geodatabase can be related to each other (www.esri.com).
<b>layer file</b>	a file format (*.lyr) that retains data layer properties such as symbology, labels, and so on, in the same way a map document saves settings and parameters for all layers in the data view.
<b>map scale</b>	dimensions of a map compared to the dimensions of the Earth, usually expressed as a ratio between a distance on the map and a distance on the Earth; for instance, a scale of 1:24,000 means 1 unit of distance on the map equals 24,000 units on the ground.
<b>projection</b>	map projections describe ways to represent areas on the Earth's surface (three-dimensional) on a flat surface such as a map; imagine trying to wrap a piece of paper around a globe; all projections distort shape, area, distance or direction to some extent.
<b>shapefile</b>	spatial data files that store geographic features and their attributes; geographic features can be represented by points, lines, or polygons (areas) (www.esri.com).

### Copy Workshop Data

- To copy workshop data from network drive to hard drive, click on Start (button) → Programs → ArcGIS → Data
- Click once on the folder called **gis2\_3**
- Under **File and Folder Tasks**, choose '**Copy this folder**'
- Make sure **c:\wutemp** is selected as file destination
- Click on '**Copy**'

### Explore ArcMap and ArcToolbox

Examine unemployment and population levels in South America.

#### Convert arc interchange file to coverage showing railroads

The \*.e00 format (also \*.e01, \*.e02, etc.) is the most common distribution method for GIS files originating in ArcInfo- coverages. The Import71 utility in ArcView 3.x also converts .e00 files.

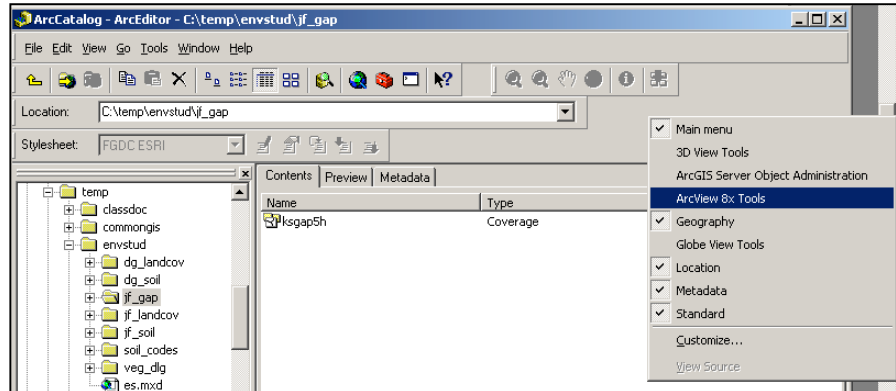
- Start **ArcMap**: Start menu → All Programs → ArcGIS → **ArcMap**

- Maximize ArcMap (click on  middle button, top right corner)

- Click on ArcCatalog icon 

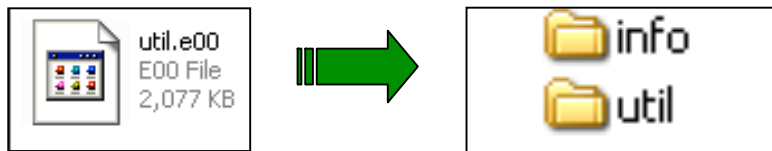
- Right-click in the gray area of the menu and choose 'ArcView 8.x Tools'

- Click on the new 'Conversion Tools' menu and choose 'Import from Interchange File'



- For the input file: navigate to: **c:\wutemp\gis2\_3** and choose **util.e00** (compressed ArcInfo coverage representing utility lines in South America)

- Save the output file in **c:\wutemp** as **util**
- Click OK



- Click 'X' button in corner to close ArcCatalog
- Find your toolbar in ArcMap


- Click on the 'Add Data' button  to bring data layers into ArcMap

- Navigate to: **c:\wutemp\gis2\_3**

- To add the following layers ALL at once, hold down the control (Ctrl) key and click on (highlight) each layer:

- **CITIES.shp** (major cities)
- **INWATERA.shp** (rivers/streams/lakes)
- **POLBND.A.shp** (country boundaries)
- **ROADTRLL.shp** (roads and trails)

- Click on 'Add'

- Click on the 'Add Data' button  again

- Navigate to **c:\wutemp** and select the **util coverage**
- Click on 'Add'

- Order the layers so that water features draw on top of country boundaries
- Turn on all layers; hold down control (Ctrl) key and click in the checkbox of one layer to turn on all at once

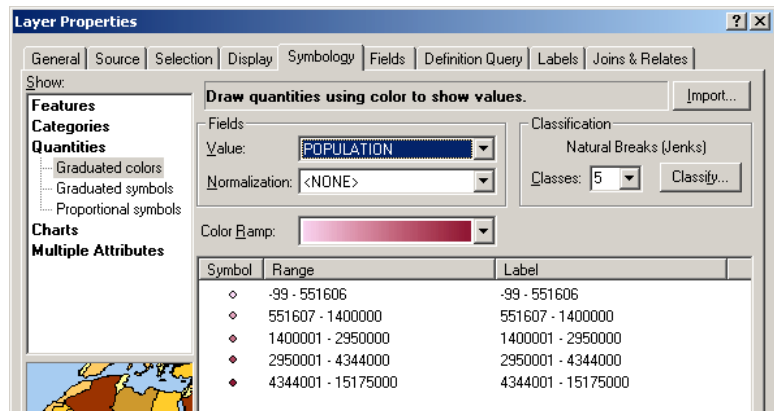
Display cities by population

ArcGIS applies a **default display scheme** to data layers (i.e. colors, classes, patterns used to represent data). These settings are **dynamic**, allowing data to be displayed by a certain field (column) from attribute table or with a certain color, line thickness/pattern, or symbol.

- Turn on ONLY the cities and country boundaries layers
- Click on the 'Identify' tool , then click on a city

*What information is included for each city?*

- Double-click on the **cities** layer in the table of contents to bring up 'Layer Properties'
- Click on **Symbology** tab
- Click on 'Quantities' and choose 'Graduated Colors'
- Set 'Value' field to **POPULATION**
- Optionally, change the number of classes and/or color scheme
- Click OK



Save cities layer settings

- Right-click on layer and choose 'Save as Layer File'
- Save in **c:\wutemp** as **cities.lyr**
- Remove (right-click on layer) cities data and add back in the cities shapefile and the new layer file
- Turn both on alternately
- Remove the unformatted shapefile
- Look at the source of the layer file (Properties → Source tab)

Display roads by type

- Turn on the **roads** layer (**ROADTRLL**)
- Right-click on the **roads** layer and choose 'Properties'
- Click on the **General** tab and type a name for the layer to appear in the table of contents
- On the **Symbology** tab, click on 'Categories' and choose 'Unique Values'
- Set 'Value' field to **DCW\_DESC**
- Click on **Add All Values**

- Uncheck the <all other values> box
- Double-click on the lines for **Path/Trails** and **Prim/Sec Roads** and set color to 'No Color' for each (so that only highways are visible)
- Choose a dark color for highways
- Click OK

#### Display utilities by type

- Turn on the **utilities** layer
- Right-click on the **utilities** layer and choose 'Properties'
- On the **Symbology** tab, click on 'Categories' and choose 'Unique Values'
- Set 'Value' field to **DCW\_DESC**
- Click on **Add All Values**
- Click OK

#### Change water bodies display

- Right-click on the rivers/lakes layer (**INWATERA**) and choose 'Properties'
- Click on the **General** tab and type a name for the layer to appear in the table of contents
- On the **Symbology** tab, click on the box of color near 'Symbol'
- Set 'Fill Color' and 'Outline Color' to **any color** or choose a custom style (make outline color dark)
- Click OK
- On the **Display** tab, change the transparency to 50 or 60% so water polygons are partially see-through
- Click OK
- Turn on the waters layer

#### Change country boundaries display

- Turn off all layers except for country boundaries (**POLBND A**)
- Double-click on the boundaries layer title to bring up 'Layer Properties'
- Click on the **General** tab and type a name for the layer (countries)
- On the **Symbology** tab, click on the box of color near 'Symbol'
- Change 'Fill Color' to **No Color** and 'Outline Color' to **any color**
- Click OK
- Click on the **Labels** tab
- Set the field to label by (Label Field) to **NA2\_DESCRI**; this field/column of attribute table contains **country names**
- Click OK
- Open the attribute table to see the 'label' field, then close
- Turn on ONLY the boundaries layer
- Right-click on the layer title and choose 'Label Features'

*Is this correct? What did we do?*

- Bring up **boundary layer** properties again

- Click on the **Labels** tab
- Click on the 'Label Placement Options' button, and choose 'Remove Duplicate Labels'
- Click OK and OK again

Make a copy of South American country boundaries

We want 2 copies of political (country) boundaries, one to manipulate and an original copy to show country boundaries.

*How many records (countries) are included in the original layer?*

- Right-click on the **boundary layer** and choose 'Properties'
- Click on the 'Definition Query' tab and then on the 'Query Builder' button to build an equation that **displays only** South American countries (in both view and table)
- **Double-click** on field name (**NA3\_DESCRI**) and **Single-click** on operator (=)
- Click 'Get Unique Values' button to display all possible field values
- **Double-click** on field value (**South America**) to complete the equation: "**NA3\_DESCRI**" = '**South America**'
- Click OK and OK again
- Right-click on country layer title and choose **Data → Export Data**
- Export **all features** using the **same coordinate system as the layer's source data** and save in c:\wutemp as **countries2.shp**
- Choose **Yes** to add the new layer

*How many records are included in the new (clipped) layer?*


*Which field (column) includes continent names?*

Bring in external data

- Right-click on the SECOND country boundaries layer (copy) and choose '**Joins and Relates → Join**'
- Choose '**Join attributes from a table**' to add external (non-spatial) data to the table of the countries layer

The common (linking) fields are **country name**; the **attribute table of the countries layer** and the **geodatabase table** have fields for country name. These are **NA2\_DESCRI** for the country layer and **COUNTRY** for the unemployment table.

Attributes of countries2		
c2.NAM	c2.NA2	c2.NA2_DESCRI
CHILE	CI	Chile
UNK	CO	Colombia
RIO BRANCO	BR	Brazil
VENEZUELA	VE	Venezuela
CHILE	CI	Chile
ARGENTINA	AR	Argentina
CHILE	CI	Chile




Attributes of unemp			
Country	unemp1997	unemp1998	unemp1
Argentina	13.7	12.4	
Brazil	5.53	7.13	
Chile	<Null>	6.1	
Colombia	12	15.6	
Mexico	3.7	3.2	
Peru	<Null>	7.6	
Venezuela	<Null>	10.6	

- On Step 1. choose **NA2\_DESCRI** as the join field
- On Step 2. navigate to: **c:\wutemp\gis2\_3\isi\_data\_geodatabase**
- Select the table called: **unemp** (unemployment)
- Click on Add
- On Step 3. choose **Country** as the join field
- Click OK
- Right-click on the **country layer** and choose 'Open Attribute Table' to see additional data

Unemployment figures represent the **percentage of the labor force not working**.

*Did column headings change? Are we missing data for any years/ countries?*

#### Display countries by unemployment levels

- Drag the second countries layer to the bottom of the table of contents so it displays UNDERNEATH all other layers
- Double-click on the **countries2 layer** to bring up 'Layer Properties'
- Click on **Symbology** tab
- Click on 'Quantities' and choose 'Graduated Colors'
- Set 'Value' field to **unemp.unemp2002**
- Change number of classes to **3**
- Optionally, change the color scheme
- Click OK
- Use the Identify button  to click on a country (specify the correct layer) to get the exact unemployment level for 2002 and for other years, for any country

#### Save Data/View Settings as One File

- Choose **File → Save As** and save map document in c:\wutemp as **gis2.mxd**
- As you work, choose **File → Save** to save your changes

#### Calculate simple statistics

You can obtain descriptive statistics for table values.

- Right-click on countries layer (with unemployment data) and choose 'Open Attribute Table'

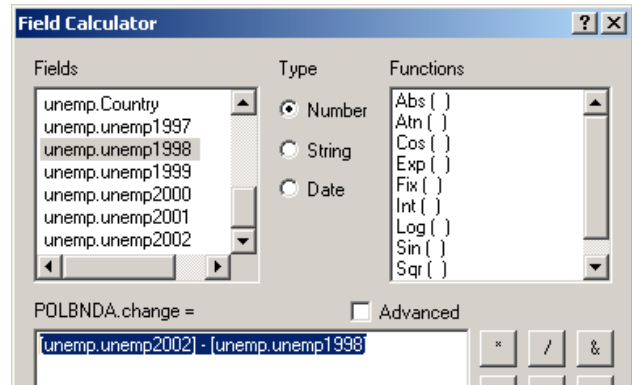
- Right-click on the column containing unemployment data for 2000 (**unemp.unemp2000**) and choose 'Statistics'
- Change the target field in the Statistics window to 1999 to get stats for that year

*What was the average percent of the labor force that was unemployed in the year 2000?*

*What was the highest unemployment rate in 1999? (change 'Field in dropdown window)*

### Calculate change in unemployment

- With the attribute table still open, click on 'Options' and 'Add Field' to add a new blank field
- Assign a **name (i.e. change)** and **type (float)** to the field; float numbers can have decimals
- Click OK
- Right-click on the new field name (top of column) and choose 'Calculate Values...' (choose Yes to the warning message)
- Set the 'change' field **equal** to unemployment levels in 2002 minus levels in 1998: **[unemp.unemp2002] - [unemp.unemp1998]**
- Click OK



*In which countries did unemployment go down? (levels in 2002 lower than in 1998)*

### Display countries by change in unemployment

- Double-click on the **countries2 layer** to bring up 'Layer Properties'
- Click on **Symbology** tab
- Click on 'Quantities' and choose 'Graduated Colors'
- Set 'Value' field to **change**
- Change number of classes to **3**
- Click OK

### Select countries where unemployment (2002) was greater than 10%

- Right-click on the countries 2 layer in table of contents and choose 'Open Attribute Table'
- Click on 'Options' button, then **Select by Attributes**
- Use the 'Create a new selection' method and build the equation: **unemp.unemp2002 > 10**  
**Double-click** on field name, **Single-click** on operator, **Double-click** on field value

- **Type in '10'** as it is not an available value
- Click on 'Apply' and 'Close'

*How many countries had more than 10% unemployment in the year 2002?*

- Close the table

In these countries (**unemp > 10%**), determine where efforts at reducing unemployment can be concentrated, by locating the highest populated cities.

Highlight cities located in selected countries

- Choose **Select** → **Select by Location** from the view menu
- Select the **cities that are contained by the selected features in the countries2 layer:**

Complete the sentence 'I want to **select features from** the following layers: **CITIES** that **are contained by** the features in this layer: **countries2**

- Make sure the box is checked next to '**Use Selected Features**'
- Choose Apply and Close

*How many cities are selected?*

Select a subset of highly populated cities

- Right-click on the cities in table of contents and choose 'Open Attribute Table'
- Click on 'Options' button, then **Select by Attributes**
- Make sure to use the '**Select from current selection**' method (to select a subset)
- Build the equation: "**POPULATION**" > **3000000**
- Type in the value for 3 million
- Click on 'Apply' and 'Close'

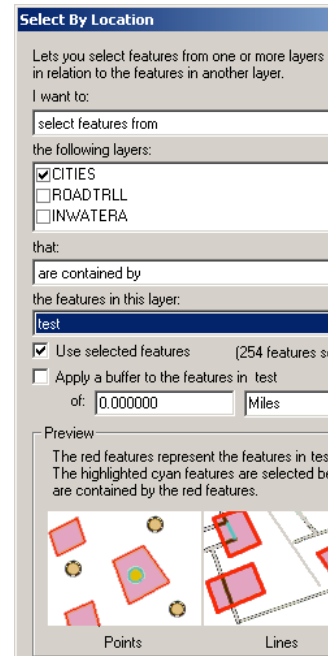
**3 cities should be selected;** these have **populations of at least three million** and are in countries with **unemployment higher than ten percent.**

- Close the attribute table

*What cities are highlighted (names)?*

Add a view/ copy a layer


- Right-click on the countries2 layer and choose → Copy
- On the menu, choose **Insert** → **Data Frame**

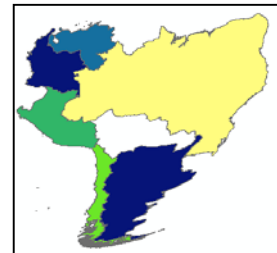


- Right-click on new data frame and choose 'Paste Layer'
- Right-click on new data frame and choose 'Activate'
- Right-click on pasted layer choose 'Zoom to Layer'
- Turn on layer
- Right-click on copied layer and choose → **Joins and Relates** → **Remove Join(s)** → **unemp**

#### Set Projection for New View


Set projection of data frame (temporary) to a projection **unsuitable** for South America.

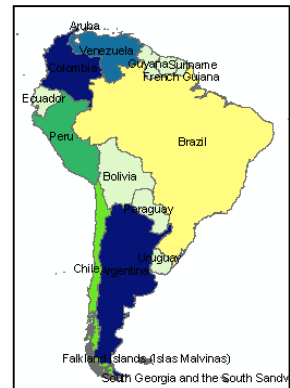
- In the new view, choose **View** → **Data Frame Properties**
- Click on the **Coordinate System** tab and in the 'Select a Coordinate System' box choose:  
Predefined → Projected Coordinate Systems → Continental  
→ North America → **North American Albers Equal Area Conic**
- Click OK
- Click **Yes** to any warning messages
- Click on 'Full Extent' button  as setting the projection may have shifted the view



*What happened to the shapes/sizes of South American countries?*

#### Set Projection for Original View

- Right-click on the original data frame (at top) and choose → **Activate**
- Set projection of data frame (temporary) to a projection **more suitable** for South America.
- Choose **View** → **Data Frame Properties**
  - Click on the **Coordinate System** tab and in the 'Select a Coordinate System' box choose:  
Predefined → Projected Coordinate Systems → Continental  
→ South America → **South American Albers Equal Area Conic**
  - Click OK
  - Click **Yes** to any warning messages
  - Click on 'Full Extent' button 



*Did the size or shape of the countries change?*

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**Note:** Please complete a workshop evaluation. An online evaluation is linked from the internet browser 'Favorites' menu. We value your feedback.

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### For More Information (Sources of Workshop Data)

- **GIS data:** Global GIS database: Digital Atlas of Central and South America (library CD), Call No. I 19.121:62-A
- **Unemployment data:** ISI Emerging Markets, library database available to KU campus. Includes 'news, company and financial data from more than 35 emerging markets in Asia, Latin America and Central and Eastern Europe.'

### Getting Additional Help

**Online Tutorials-** Learn GIS at your own pace through virtual tutorials. ESRI online tutorials are available free to KU-affiliates and can be used by individuals or classes. See a list of courses at: [www.kars.ku.edu/user/vc\\_courses.shtml](http://www.kars.ku.edu/user/vc_courses.shtml) and email or call ([data@ku.edu](mailto:data@ku.edu), [mickey@ku.edu](mailto:mickey@ku.edu) or 864-1238, 864-0454) to register for one or more.

**GIS and Data Lab** - 105 Anschutz Library

Hours (while KU is in session): Mon-Thurs **9AM-8PM**, Fri **9AM-5PM**, Sat/Sun **1PM-5PM**

Contact: [data@ku.edu](mailto:data@ku.edu) or 864-1238 (Rhonda Houser), 864-7777 (Mickey Waxman)

More information: [www.lib.ku.edu/gis](http://www.lib.ku.edu/gis)

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