

Leveraging the *What* of Geographic Data

GIS I: Organizing Principles



Overview

- Starting Simple: Map Tools
- Working with Tables
- Introduction to Table Joins
- Introduction to Table Queries



Review: Geographic Data?

Components

- Spatial (where?)
 - *Geometry or shape of an object*
 - *Where it is located*
- Attributes (what?)
 - *Tabular data*
 - *Describes an object*



OBJECTID	NAME	AREA	PERIMETER	SHAPE
1	WATER	123456789	123456789	POLYGON
2	ROAD	123456789	123456789	POLYGON
3	LAND	123456789	123456789	POLYGON

Starting Simple: Map Tools

- Identify
- Find
- Select



Unleashing Table Operations

- Table Joins: Connecting your data
 - 
- Table Queries: Asking questions of your data
 - 

Table Components

Fields (columns)

Records (rows)

STFID	STATE	COUNTY	TRACT_1	BLKGRP	POP2000
37063000101	37	063	000101	1	1246
37063000101	37	063	000101	2	1905
37063000102	37	063	000102	1	4462
37063000200	37	063	000200	1	835
37063000200	37	063	000200	2	1323
37063000200	37	063	000200	3	958
37063000301	37	063	000301	1	1088
37063000301	37	063	000301	2	741
37063000301	37	063	000301	3	603
37063000302	37	063	000302	1	732

CEHI Table Components

- Columns
 - Must have unique names
 - Can contain different data type (text, numeric, date)
 - Column names limited to 10 characters

STPID	STPID_1	HSEHLD_1_M	HSEHLD_1_F	KGP_PUBA	STATE	COUNTY
370630001011	370630001011	63	135	0	37	063
370630001012	370630001012	51	103	5.402	37	063
370630001021	370630001021	268	482	1.707	37	063
370630002001	370630002001	73	118	1.86	37	063
370630002002	370630002002	68	67	7.947	37	063
370630002003	370630002003	66	96	2.613	37	063
370630003011	370630003011	100	114	7.376	37	063
370630003012	370630003012	42	67	6.438	37	063
370630003013	370630003013	80	70	1.511	37	063
370630003021	370630003021	37	78	0	37	063

CEHI Connecting Tables?

home_id	st_num	st_dir	st_name	st_type	unit_num	city	zip
1	1351 1000		Milwauk Avenue			Durham	27702
5	1352 1027		Rosedale Avenue			Durham	27702
10	1353 1114		Cornell Street			Durham	27702
15	1354 1202		Cornell Street			Durham	27702
20	1355 1205		Kent Street			Durham	27702
25	1356 1027		Kent Street			Durham	27702

CEHI Table Join

- Dynamic Connection between tables in your project
- Based on a common ID in each table
 - Must be the same data type
 - Do not have to have the same name

CEET Key Table Join Considerations

- Does your table have a primary key?
- What type of join are you doing?
- Are the data types the same?



CEET Attribute Selections

- Find features that meet a criteria
- Create a new layer based on a query
- Calculate statistics on a sample of features



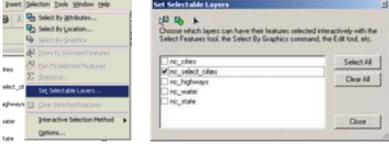
CEET Selection Tools

- Accessible through the 'selection' menu
- Tools allow different types of selections
- Zoom to, pan to, and statistics



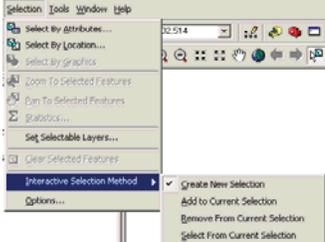
Selection Layers

- Determine what layers can be selected
- Good if you have many layers in one project
- Also useful if you only want to focus on one or two layers



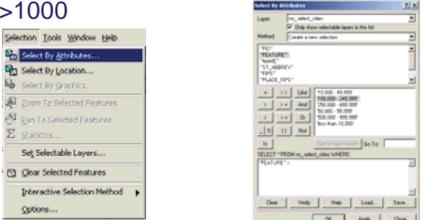
Interactive Selection Options

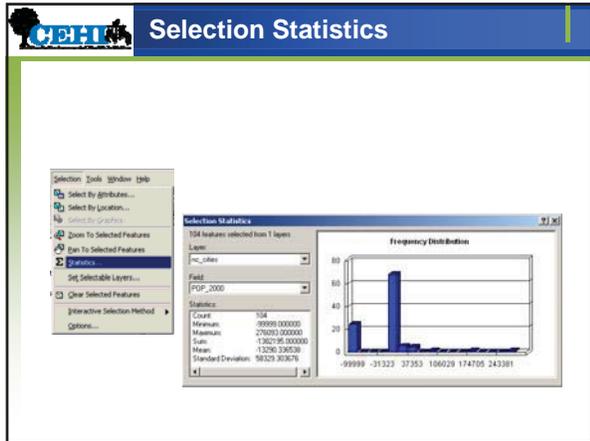
- Create new
- Add to current
- Remove from current
- Select from current



Attribute Selection

- Simple data query
- Uses query statements
- Ex: Show me all the features with a population >1000





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Exercise 5: Leveraging the *What* of Geographic Data

*** Files needed for exercise: Utah County Shapefile (UT_counties.shp); CENSUS 2000 county data table (ut_pop_co_2000.dbf); McDonald's restaurant table (mcdonalds.dbf); and UT McDonald's Shapefile (UT_mcdonalds.shp)

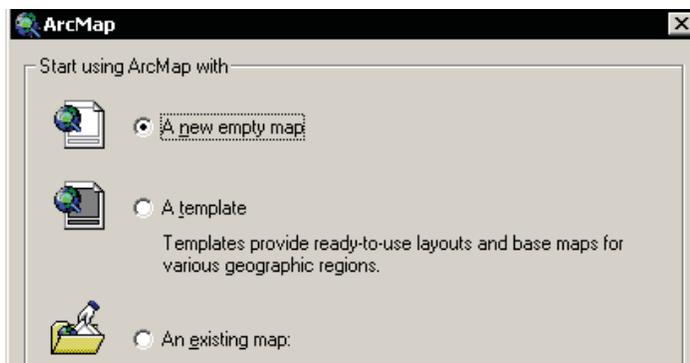
Exercise 5.1 Table Join

Goals: In this exercise you will join a UT county shapefile table to a .dbf table containing county population data from the 2000 US Census and export the combined table to a new .shp file for display.

Skills: After completing this exercise, you will understand basic table joins in ArcMap.

Setting up your project for this exercise:

1. Open ArcMap. Choose to start a new empty map



2. Click the Add Data button 
3. If you have not already connected to your folder, click on the Connect to Folder button 
4. Browse to your folder and connect to it. We now have a permanent connection to that folder.
5. Double click on the Exercise_05_data folder to open it
6. Add the UT_counties.shp and the ut_pop_co_2000.dbf files to your project
7. After added they will appear in your table of contents (TOC):
 - UT_counties
 - []
 - ut_pop_co_2000
8. Take a look, at the three tabs at the bottom of your TOC. How does what you see in your TOC change as you select the display vs. source tab (we will talk about the selection tab later)?



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Exercise 5: Leveraging the *What* of Geographic Data

Take a look at your tables to confirm you join field:

1. You will append data to the county shapefile (*UT_counties.shp*) attribute table – **this is the target table.**
2. Now you will take a look at your county shapefile attribute table fields, to view the attribute table right click on the shapefile in the Table of contents and select Open Attribute table. The table will open.
3. You will see the table associated with your county shapefile with attribute names (attribute fields) as columns and rows as records. At the bottom of the table the number of records is shown.
4. The first join will be based on the **NAME** attribute field; this field represents the county name.

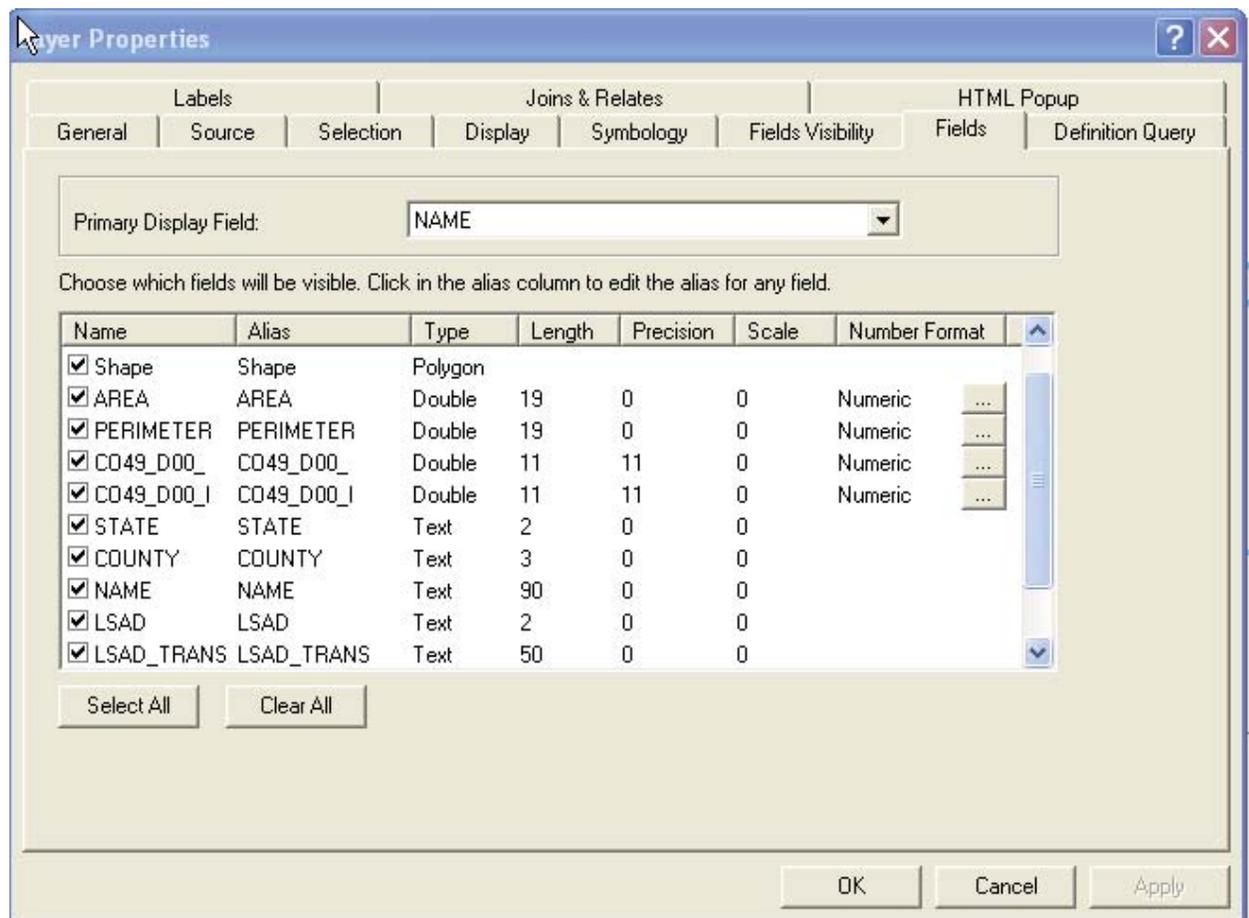
Is this field unique?

FID	Shape *	AREA	PERIMETER	CO49_D00_	CO49_D00_I	STATE	COUNTY	NAME	LSAD	LSAD_TRAHS	GEO_ID2
0	Polygon	0.304026	2.949886	2	1	49	033	Rich	06	County	49033
1	Polygon	1.880076	6.137284	3	2	49	003	Box Elder	06	County	49003
2	Polygon	0.328766	2.916776	4	3	49	005	Cache	06	County	49005
3	Polygon	0.183493	2.877793	5	4	49	057	Weber	06	County	49057
4	Polygon	0.169503	2.702826	6	5	49	029	Morgan	06	County	49029
5	Polygon	0.52069	4.943465	7	6	49	043	Summit	06	County	49043
6	Polygon	0.175633	2.170843	8	7	49	011	Davis	06	County	49011
7	Polygon	2.003301	6.018415	9	8	49	045	Tooele	06	County	49045
8	Polygon	0.200116	2.895183	10	9	49	009	Daggett	06	County	49009
9	Polygon	0.222852	2.318426	11	10	49	035	Salt Lake	06	County	49035
10	Polygon	1.231224	5.354266	12	11	49	047	Uintah	06	County	49047
11	Polygon	0.89321	3.940761	13	12	49	013	Duchesne	06	County	49013
12	Polygon	0.331825	3.224409	14	13	49	051	Wasatch	06	County	49051
13	Polygon	0.585928	4.858433	15	14	49	049	Utah	06	County	49049
14	Polygon	0.926541	6.753776	16	15	49	023	Juab	06	County	49023
15	Polygon	0.403491	3.638766	17	16	49	007	Carbon	06	County	49007
16	Polygon	0.433921	3.223753	18	17	49	039	Sanpete	06	County	49039
17	Polygon	1.201488	5.953197	19	18	49	015	Emery	06	County	49015
18	Polygon	1.840696	6.160707	20	19	49	027	Millard	06	County	49027
19	Polygon	0.994581	4.917174	21	20	49	019	Grand	06	County	49019
20	Polygon	0.514801	3.569653	22	21	49	041	Sevier	06	County	49041
21	Polygon	0.691985	4.248777	23	22	49	001	Beaver	06	County	49001
22	Polygon	0.204366	2.367568	24	23	49	031	Piute	06	County	49031
23	Polygon	0.658139	4.894553	25	24	49	055	Wayne	06	County	49055
24	Polygon	2.097212	8.683291	26	25	49	037	San Juan	06	County	49037
25	Polygon	1.380898	6.798509	27	26	49	017	Garfield	06	County	49017
26	Polygon	0.875574	4.571133	28	27	49	021	Iron	06	County	49021
27	Polygon	0.639304	3.587616	29	28	49	053	Washington	06	County	49053
28	Polygon	1.081238	5.988827	30	29	49	025	Kane	06	County	49025

Once you have confirmed this field is in fact unique and does represent county name, you should also determine what type of data field it is; to find this information right click on the shapefile in your TOC and select the properties tab. This will open the layer properties, select the fields tab and scroll to the NAME field. What type of field is it?

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Exercise 5: Leveraging the *What* of Geographic Data



- Now that you have that sorted, take a look at the table you will append to the county shapefile (ut_pop_co_2000.dbf) - **this is the join table**. Open this table and examine it, the common field that you will use to join this table to your shapefile is: **Co_name**, (this name differs from the county shapefile but represents the same information) confirm that it is the same data type as the field in the county shapefile.

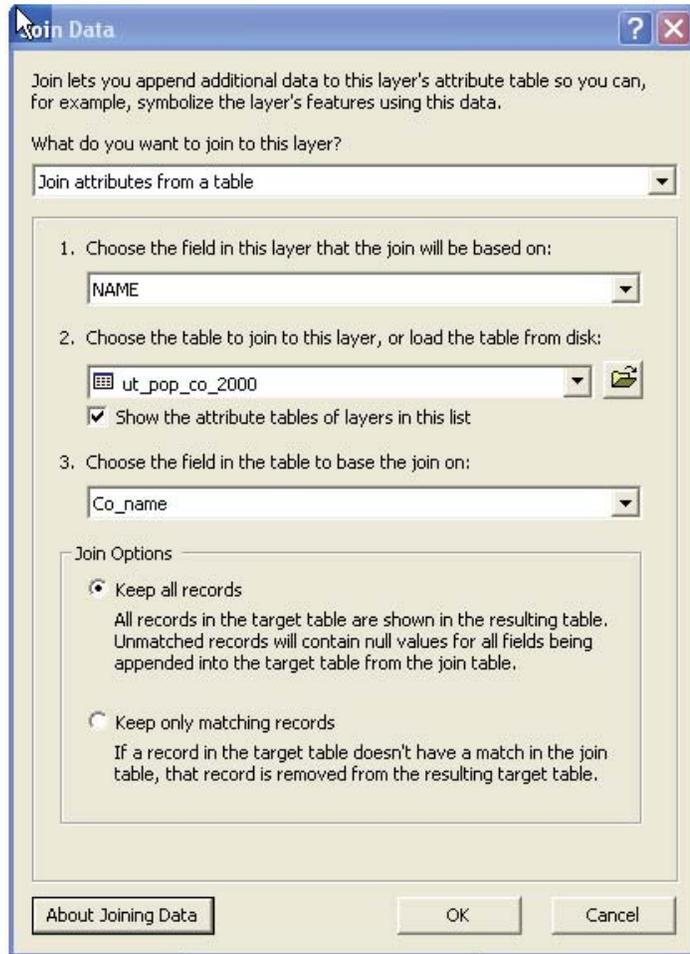
Join your tables:

- In examining your two tables you may have noticed that there are the same number of records in both your target and join tables, this means that your join is a *one to one join*.
- You have confirmed that the field you are basing your join on, is a *common field* to both the target table (*UT_counties.shp* "**NAME**"), and the join table (ut_pop_co_2000.dbf "**Co_name**"). The two fields have different names in each table, but are of the same data type, so you are ready to join.

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3. Right click on the UT_counties.shp (this shapefile contains your target) in the table of contents; select the joins and relates tab, choose join-this will open the join dialogue.



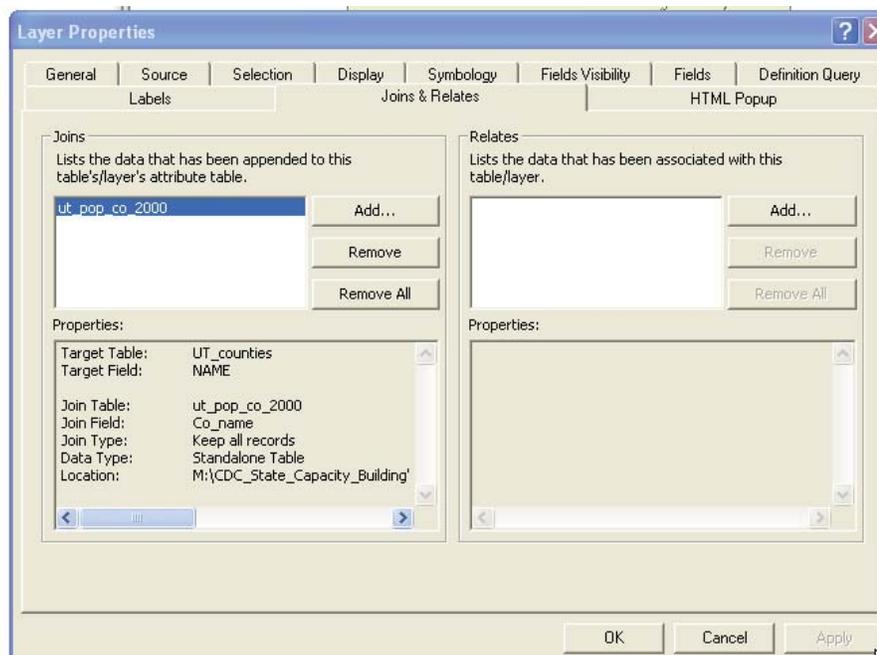
4. You are immediately confronted with a question: ***What do you want to join to this layer?*** In the drop down box, select "Join attributes from a table".
 - a. Next you will choose the join field present in your target table: NAME
 - b. Select the ut_pop_co2000 table as the table to join to your target
 - c. Finally choose the field in the join table to base the join on.
 - d. Before you click okay, take a look at some of the help: About Joining Data, and the contextual question mark 
 - e. Click OK.

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Take a look at the result of your join

1. Right click on your target (UT_counties.shp) in the TOC and open the attribute table
 - a. Does the table look different?
 - b. Do you see any records with NULL values in your table? If so this could be an indication that something went afoul with your join
2. Close your table. Open the layer properties by right clicking on the UT_counties.shp in your TOC, then choose the **Joins & Relates** tab.



This is the place to take a look at all of the information related to your join(s), after you take a look at the join information click on the **Fields** tab; all fields from both tables should be present in the join table.

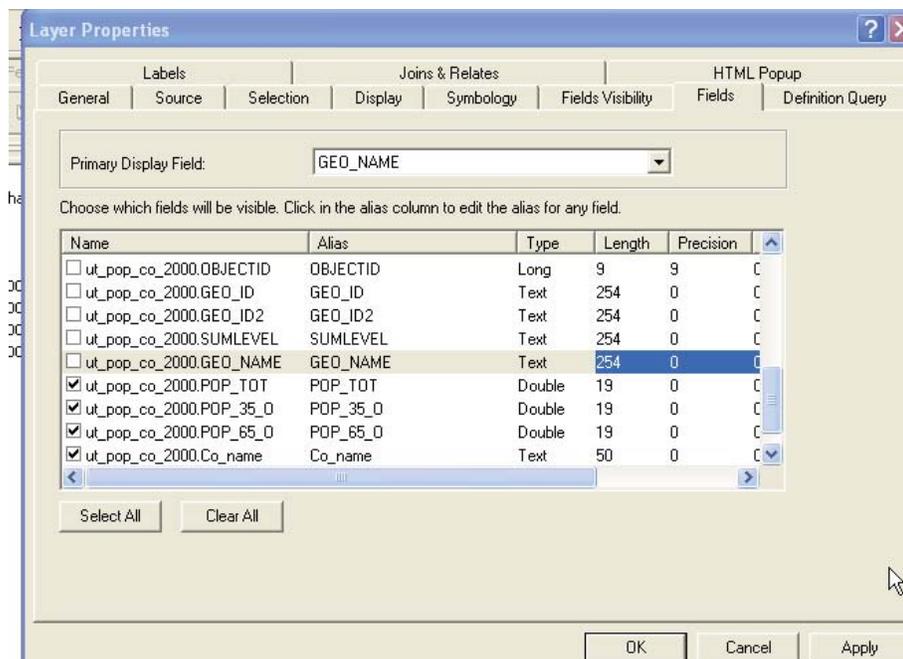
3. A successful attribute join is very useful, you can select, display and or calculate fields based on the appended data in the target table
4. It is important to remember that in a join the data are dynamically linked: what does this mean?
 - a. Nothing is written on disk- the join exists in your project only
 - b. Edits to the underlying tables will appear in appended fields
 - c. Fields in your target table can be edited, but the data in the appended fields cannot be directly edited

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5. You will now export your joined data (target + join) to a new feature as a shapefile, The table associated with this feature will include all of the data from the two original tables, and will be written- so you will need to name and save it.

6. Open the layer properties by right clicking on the UT_counties.shp in your TOC and choose the fields tab, before you export your joined data you can select the fields that you want to be present in your new feature class. Click clear all at the bottom and choose the following five fields by checking the boxes:
 - a. UT_counties.GEO_ID2
 - b. ut_pop_co_2000.POP_TOT
 - c. ut_pop_co_2000.POP_35_0
 - d. ut_pop_co_2000.POP_65_0
 - e. ut_pop_co_2000_CO_name



Click *Apply*, and take a look at your table. The five fields you selected should be the only fields you see in the table.

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Attributes of UT_counties

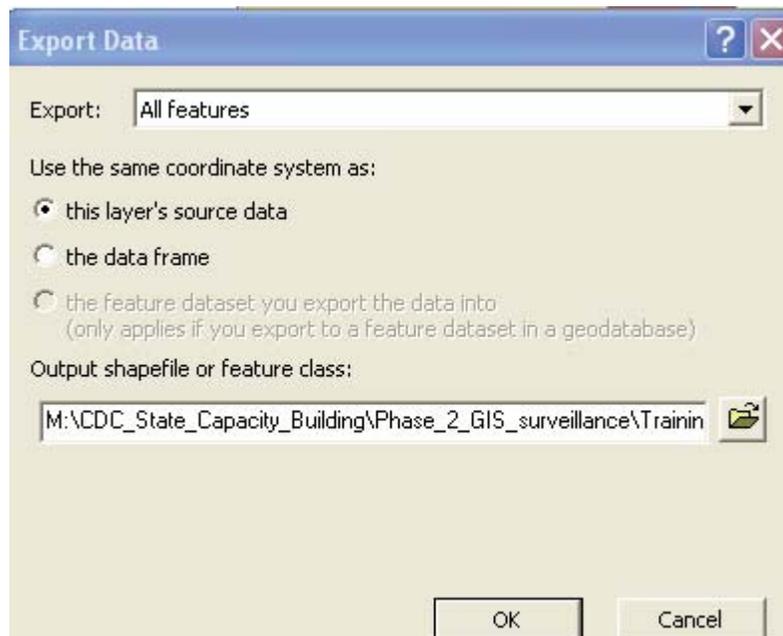
GEO_ID2	POP_TOT	POP_35_0	POP_65_0	Co_name ^
49033	1961	967	277	Rich
49003	42745	17936	4443	Box Elder
49005	91391	29046	6539	Cache
49057	196533	83527	20280	Weber
49029	7129	3117	620	Morgan
49043	29736	14080	1446	Summit
49011	238994	92491	17540	Davis
49045	40735	15419	2975	Tooele
49009	921	508	124	Daggett
49035	898387	364524	72680	Salt Lake
49047	25224	11012	2507	Uintah
49013	14371	6149	1349	Duchesne
49051	15215	6412	1284	Wasatch
49049	368536	109524	23503	Utah
49023	8238	3204	809	Juab
49007	20422	9913	2706	Carbon
49039	22763	9101	2463	Sanpete
49015	10860	4900	1094	Emery
49027	12405	5626	1529	Millard
49019	8485	4464	1061	Grand
49041	18842	8574	2426	Sevier
49001	6005	2741	835	Beaver
49031	1435	776	245	Piute
49055	2509	1233	362	Wayne
49037	14413	5564	1214	San Juan
49017	4735	2318	667	Garfield
49021	33779	12059	2891	Iron
49053	90354	41475	15343	Washington
49025	6046	3316	1010	Kane

Record: 1 Show: All Selected Records (0 out of 29)

- Close your table and right click on UT_couties.shp in your TOC one last time. Choose the *Data - Export Data* option to open the export data option

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You are exporting all features, and want to use the same coordinate system as the layer's source data; name the file `UT_CO_POP_join` and save it in your data folder.



Add the exported data as a layer and take a look at the attribute table, Only the fields you selected should have come though in the resultant shapefile. Leave your project open, or save it; you will use it in the next exercise.

Exercise 5.2 Selections

Goals: In this exercise you will join a UT county shapefile table to a .dbf table containing county summary information on McDonald's restaurants and export the combined table to a new .shp file for display. Along the way you will become familiarized with some of the attribute selection settings an tools in ArcMap.

Skills: After completing this exercise, you will have some experience working with attribute settings and selections in ArcMap.

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Exercise 5: Leveraging the *What* of Geographic Data

Setting up your project for this exercise:

1. You will use the same project from exercise 5.1
2. Click the Add Data button 
3. If you have not already connected to your folder, click on the Connect to Folder button 
4. Browse to your folder and connect to it. We now have a permanent connection to that folder.
5. Double click on the Exercise_05_data folder to open it
6. Add the UT_mcdonalds.shp to your project- these are the point locations for McDonald's restaurants in UT
7. Add the mcdonalds.dbf table and join it to your UT Counties Shapefile, paying attention to the following:
 - a. What is your common field?
 - b. How many records are in your target table (UT Counties Shapefile) and your join table? How will this affect your join result?
8. Take a look at your table. You should have 9 records with Null values, there are no records of McDonald's restaurants for these counties in your join table (remember there were fewer than 29 records in this table). If your McDonald's table was your target table, how would the resultant table look?

Working with selections

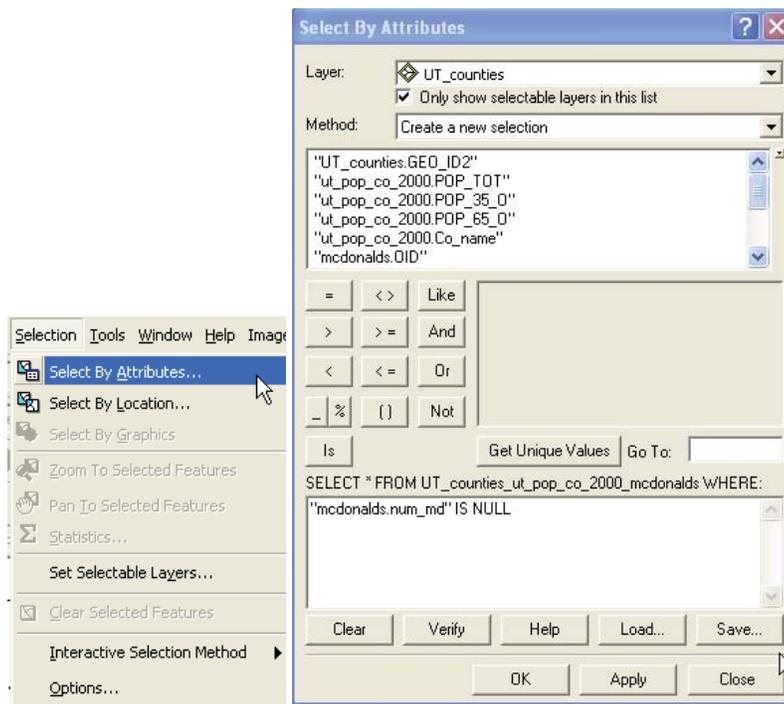
1. Left click on the Selection tab in Menu Bar



2. You can control the options for your selections in this menu and you can build your attribute selections. You are now going to make a selection based on your join.

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Exercise 5: Leveraging the *What* of Geographic Data



In the dropdown select the UT County shapefile as your layer and select *create a new selection as your method* Build the following statement using the wizard:

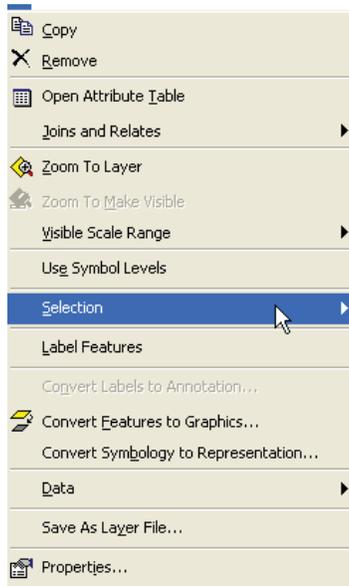
`"mcdonalds.num_md" IS NULL`

This query will select those counties that had no corresponding record in your join table. Click OK to close the dialogue.

3. Right click on your county shapefile in the TOC and choose the **selection** option

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4. Choose zoom to selection this will allow you to zoom to the selected features on your map, in this menu you can also:
 - a. Clear selected features
 - b. Copy selected
 - c. Switch selected features
 - d. Create a layer for selected features

5. You are going to switch your selected features to select only those counties that contain McDonald's restaurants, after you have done this open your attribute table, you are now going to take a look at some descriptive statistics for your selected records. Right click on the "num_emp field and select statistics.

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GEO_ID2	POP_TOT	POP_35_O	POP_65_O	Co_name'	OID	POP_TOT	POP_35_O	County'	num_md	num_emp	rate_1000
49033	1951	967	277	Rich	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49029	7129	3117	620	Morgan	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49009	921	506	124	Daggett	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49023	9238	3204	809	Juab	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49015	10860	4900	1094	Emery	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49031	1435	776	245	Plute	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49055	2509	1233	362	Wayne	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49037	14413	5564	1214	San Juan	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49017	4735	2318	667	Garfield	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
49001	6005	2741	835	Beaver	0	6005	2741	Beaver	1	20	3.33056
49025	8046	3316	1010	Kane	8	8046	3316	Kane	2	40	6.61594
49019	8485	4464	1061	Grand	6	8485	4464	Grand	1	23	2.71067
49027	12405	5626	1529	Millard	9	12405	5626	Millard	1	40	3.22451
49013	14371	6149	1349	Duchesne	5	14371	6149	Duchesne	1	30	2.08754
49051	15215	6412	1284	Wasatch	17	15215	6412	Wasatch	1	45	2.95761
49041	18842	8574	2426	Sevier	12	18842	8574	Sevier	1	30	1.59219
49007	20422	9913	2706	Carbon	3	20422	9913	Carbon	1	30	1.469
49039	22763	9101	2463	Sanpete	11	22763	9101	Sanpete	1	41	1.80117
49047	25224	11012	2507	Uintah	15	25224	11012	Uintah	1	53	2.10117
49043	29736	14080	1446	Summit	13	29736	14080	Summit	1	60	2.01776
49021	33779	12059	2891	Iron	7	33779	12059	Iron	2	51	1.50981
49045	40735	15419	2975	Tooele	14	40735	15419	Tooele	1	65	1.59568
49003	42745	17936	4443	Box Elder	1	42745	17936	Box Elder	2	95	2.22248
49053	90354	41475	15343	Washington	18	90354	41475	Washington	4	131	1.44985
49005	91391	29046	6539	Cache	2	91391	29046	Cache	5	145	1.58659
49057	196533	83527	20280	Weber	19	196533	83527	Weber	10	390	1.9844
49011	238994	92491	17540	Davis	4	238994	92491	Davis	14	454	1.89963
49049	368536	109524	23503	Utah	16	368536	109524	Utah	16	451	1.22376
49035	898387	364524	72680	Salt Lake	10	898387	364524	Salt Lake	40	1337	1.48822

- Here you can get summary statistics for any meaningful attributes within your selection

