Lab 2 - The Geodatabase

Exercise 1: Test drive a geodatabase

This exercise will help you gain an understanding of the power of geodatabases. Don’t get frustrated if you do not understand all of the terminology. They will be covered in the sections that follow. The primary components of a geodatabase are feature classes. A feature class is a collection of features that share the same geometry type (point, line, or polygon). Feature classes can be grouped together into feature datasets. Tables of nonspatial data, which can be associated with feature classes, can also be stored in a geodatabase. Feature Datasets—are composed of feature classes that have been grouped together so they can participate in topological relationships with each other. All the feature classes in a feature dataset must share the same spatial reference; that is, they must have the same coordinate system and their features must fall within a common geographic area. Feature classes that participate in a geometric network must be placed in a feature dataset. As you go through the exercise, notice the feature classes grouped into feature datasets.

Step 1: Start ArcMap and open a map

Start ArcMap and open the CityWaterS.mxd map document from the folder (...\Data\intro). You see a map of a subdivision. This subdivision contains lots with homes on them, two wells, and water lines that are joined together to form a water network. The data for all of these layers are contained in a single geodatabase (CityWaterS.mdb). Click the Source button in the Table of Contents. At the top of the Table of Contents, you can now see that the source of the data shown in the map is a personal geodatabase named CityWaterS.mdb.

Step 2: Add a new well feature to the subdivision

A big advantage of storing data in a geodatabase is that you can enforce validation of data edits. If your Editor toolbar is not displayed, click the Customize tab in the standard menu at the top of the screen to display it. From the Editor tool, choose...
Start Editing. Click “Continue” in the window that opens warning about license issues. In the Create Features window to the right (click button in toolbar to display window if not already displayed), you will only see and be able to edit the Wells layer. This is because of the previous license issues related to using ArcView.

Next, right click on Wells and make sure that Point is selected as your Construction Tool. Click OK. Click in the lot in the southwest corner of the subdivision to add a well. Now click on the Editor tool so you don’t add another well if you click in the dataframe.

**Step 3: Add attribute data for the new well**

Now that you’ve created a new well feature, you need to add its depth attribute. On the Editor toolbar, click the Attributes button. In the Attributes pane click on Wells and the attribute table information will appear below. The value for Depth is currently shown as <null>. Replace the null value with 50 (feet) for the well depth. Click on other wells and notice that the attribute for depth changes for each well point. Close the Attributes dialog.

**Step 4: Validate the attribute data**

In the area where this subdivision is located, state regulations specify that residential wells must be between 40 and 120 feet deep. An attribute domain was created in the geodatabase to make sure that only lawful depth values are associated with residential well features.

Attribute domains are created and edited in ArcCatalog. They are a property of the geodatabase and available to any feature class or table in the geodatabase. Domains are applied to one or more attribute fields. Multiple feature classes and tables can share the same domain. The only caveat is that the field to which you apply the domain must be the same field type as the domain. For instance, text domains can be applied only to text fields. In ArcMap, domains are helpful for preventing errors when users add or edit attribute values and for validating previously entered attribute values.

There are two types of attribute domains: range and coded value. Range domains can be created for numeric fields only and specify acceptable minimum and maximum values. For example, you could create a range domain for water transmission mains that sets their valid pressure range between 40 and 100 psi. Values can be either integers or numbers with decimal places. Validation for range domains is interactive; you use ArcMap's Validate Section command to detect errors in attribute values. Coded Value attribute domains are explicit listings of acceptable values. They can apply to any type of attribute—for example, text, numeric, or date. This domain includes both the coded value and a more user-friendly description of what that code actually means. Validation is automatic for coded value domains. When you work with attributes that have coded value domains, you see a dropdown list of valid values in ArcMap.
In this step, you'll check to see that the well you just added, plus the two other wells, comply with state regulations. Hold down your Shift key, then highlight all the wells by clicking on each one. Make sure you do not select other features in the process.

From the Editor menu, choose Validate Features. The well in the northwestern lot is selected and a message tells you its Depth value is not within the acceptable range. Because this well's depth is actually 60 feet, you know there has been a data entry error. Edit the depth attribute for this well to fix the error and run the validation again.

**Step 5: Display the Utility Network Analyst toolbar**

From the Customize menu, choose Toolbars, then click Utility Network Analyst. The network functions that you will use in the next task are located in this toolbar. You will now solve a network problem using a geometric network that has been created in the geodatabase. The first five layers shown in the Table of Contents participate in the network (lots, wells, and homes do not participate).

**Step 6: Specify a junction flag**

In the remaining steps, you will perform some basic network analysis. Don't worry if you don't understand the terminology or process you follow here—Remember, you're just on a test drive. First, you'll perform an upstream trace from the end of a water main back to the water tank, the origin of flow for this network. Before you can perform a trace, you need to add a junction flag at the water main location.

On the Utility Network Analyst toolbar, click the Add Junction Flag button. Your mouse pointer changes to a flag. Click the Cap junction at the end of the 6-inch water main line, as shown below, to add a junction flag.

**Step 7: Perform a trace operation**

On the Utility Network Analyst toolbar, in the Trace Task dropdown list, choose Trace Upstream. Click the Solve button. The flow path from the water tank to the junction flag displays in red. From the Analysis menu choose Clear Results. From that same menu click Clear Flags.
Step 8: Test network connectivity

Suppose that several water customers have called in to complain that their water pressure has suddenly dropped. You suspect a broken pipe, and you want to identify the pipe that is common to all the call locations.

Using the method described in the previous step, set three junction flags at the water meter locations shown in the figure to the right. In the Trace Task dropdown list, choose Find Common Ancestors. Click the Solve button. The break is probably on the first highlighted pipe that is upstream from all the complaint locations.

When you're finished examining the results, from the Analysis menu, choose Clear Results. Again from the Analysis menu, click Clear Flags.

This exercise introduced you to three geodatabase features: attribute domains, geometric networks, and relationship classes. You'll learn more about each of these later in this lab.

Exercise 2: Explore the structure of a geodatabase

Now that you have seen the power of the geodatabase, you should explore the structure of the geodatabase. In this exercise, you'll see what domains, networks, and relationship classes look like in ArcCatalog.

Step 1: Open ArcCatalog and create a connection to the lab data

Open ArcCatalog within ArcMap as a window by clicking the ArcCatalog icon. You'll first create a connection to the folder where your data are. Creating this connection will make exploring the data easier and faster. Click the Connect to Folder button and navigate to your ...\Data folder. Click OK. You see the folder connection in the Catalog Tree.

Step 2: Examine the geodatabase in the catalog tree

In the Catalog Tree, expand the folder connection you just created by clicking the plus (+) next to it. Within the intro folder, you will see the personal geodatabase named CityWaterS.mdb that you worked with in the previous exercise.

Expand the CityWaterS.mdb geodatabase. This geodatabase contains one feature dataset named PublicWater, three stand-alone feature classes (Homes, Lots, and Wells), one table of nonspatial data named WLnMaintenance, and a relationship class named HomesLots. A relationship class establishes how certain features are related to others.
This relationship class establishes how the Homes features are related to the Lots features. The HomesLots relationship class merely established a relationship between the Homes feature class and the Lots feature class—this relationship class is set up so that if a lot is removed, the home “associated” with the lot will be removed as well.

**Step 3: Examine the feature dataset**

The PublicWater feature dataset contains the network features you worked with in the previous exercise. Expand PublicWater to see its contents. The first five items listed in PublicWater are user-defined feature classes. The last two items, WaterNet and WaterNet_Junctions, were created by the software when the geometric network was created. All the components in the PublicWater feature dataset work together to form an integrated network that allowed you to trace the flow of water through the water lines and locate a broken pipe.

**Step 4: Preview the wells feature class**

In the previous exercise, you created a new well feature and added attribute data for it. These data were stored in the Wells feature class. In this step, you'll find out more about this feature class. In the Catalog Tree, right click the Wells feature class, and select Item Description from the dropdown menu. Click on the preview tab at the top of the Item Description box to preview the geography of Wells. You see three wells features. Each feature is stored as a row in the feature class table. In the dropdown list at the top of the Preview area, choose Table. The OBJECTID and SHAPE fields were automatically generated by the software. The Depth field is a user-defined attribute field. Click on the Description tab. Here are the metadata stored with this feature. You can see that this file was created by ESRI for training, demonstration, and education purposes.

**Step 5: Examine feature class properties**

In ArcMap, you can see features and their attributes. In ArcCatalog you can get more information about feature classes. Right-click Wells and choose Properties. The Feature Class Properties dialog displays. Click the Fields tab. The three fields in the Wells feature class attribute table are listed along with the type of data each field contains.

Click the gray box to the left of Depth to see its field properties. Notice that there is a domain called WellDepth associated with this field. You'll find out more about this domain in the next step. Click the Subtypes tab. If the well features had been grouped into subtypes, the subtypes would be described in this panel. However, you can see that the Wells feature class has no subtypes. Click the Relationships tab. The Wells feature class does not participate in any relationships. Click OK or Cancel to close the Feature Class Properties dialog.

**Step 6: Geodatabase properties**

In ArcCatalog right click CityWaterS.mdb and choose Properties and then select the Domain tab. At the top of the dialog, three domains are listed. The first two domains,
AncillaryRoleDomain and EnabledDomain, are part of the geometric network. The third domain, WellDepth, is the domain you used in the previous exercise to validate well depths. Click the gray box to the left of WellDepth to display its properties. Here you can see the “rules” associated with this domain, including the minimum and maximum allowable depths for wells. Close the Database Properties dialog.

**Step 7: Create a stand-alone feature class (preview for next exercise)**

There are a couple of ways to create a feature class in a geodatabase. You'll try one method in this step. In ArcCatalog, right click on CityWaterS.mdb, click New, and then click Feature Class. The New Feature Class dialog displays. Name it Roads. Select Line Features as type. Click Next. Select Next to indicate unknown Geographic Class. Accept the default coordinate range or domain extent and click Next.

In the second row, click the gray box next to SHAPE to see its field properties. You will see the geometry type is line. In the third row, click in the empty cell below SHAPE. Type RoadName and press Tab to move to the Data Type column. The default is Text, which is the appropriate data type. Click Finish and OK for the unknown spatial reference warning. The new Roads feature class is created and displays in the Catalog Tree. Preview the table for the Roads feature class (as in Step 4 of this exercise).

Notice that ArcCatalog automatically added the SHAPE_Length field (column). The length values will be added automatically when the roads are digitized.

**Step 8: Add Features and Attribute data**

Now that the feature class structure has been created, the next step is to add its features and attribute data using ArcMap. Go to the Editor toolbar and select Start Editing. Click on the Create Features button. Make sure Roads is highlighted in the Create Features panel on the left side of the screen. Go to the data frame and make a road by clicking on any point in the data frame. To finish the road, double click. Now click on the Attributes button in the Editor toolbar. Replace RoadName <Null> with a road name of your choice and hit enter. Repeat these instructions to make a second road and name it. Go to Editor, Stop Editing, and Save your changes. Right click on Roads in your Table of Contents and select the attributes table. You will see your newly created roads.

**Exercise 3: Create a geodatabase and add data, new feature classes, and a feature dataset**

In this exercise, you will now learn how to create a basic geodatabase. You will import existing data into the geodatabase, as well as create new feature classes.

**Step 1: Create a new geodatabase**

Start ArcCatalog from within ArcMap. In the Catalog Tree, right-click the folder create within your Data folder and choose New, then click Personal Geodatabase.
A geodatabase is created. It has the generic name of New Personal Geodatabase. Rename the new geodatabase to Transportation.mdb. (If the geodatabase name is not currently editable, you can rename it by right-clicking and choosing Rename or by clicking the generic name in the Catalog Tree and typing the new name). Transportation is currently an empty geodatabase.

**Step 2: Import a coverage into the geodatabase**
Right click Transportation.mdb. Select Import and click on Feature Class (Single).
In the Feature Class to Feature Class dialog box, browse to select the zip_clip polygon file in the Input feature. Make sure your output location in Transportation.mdb. For the output feature class name, enter “Zip”. Leave the rest as default and click OK.
In the Catalog Tree, expand Transportation.mdb. The new Zip feature class has been added. Open the attribute table for Zip. Notice that ArcCatalog added two new fields: Shape_Length and Shape_Area. ArcCatalog adds these fields for all polygon feature classes. Next, you'll examine the properties associated with Zip. In the Catalog Tree, right-click Zip and choose Properties. Click the Fields tab. Under Field Name, click the gray box next to Shape. Notice that the Data Type for the Shape field is Geometry. In the Field Properties area below, you can see that the geometry type is polygon.
Click OK or Cancel to close the Feature Class Properties dialog.

**Step 3: Import a shapefile into the geodatabase**
Right-click Transportation.mdb, choose Import, then click Feature Class (Single). For Input feature, drag sd_railstop.shp into the box (from ArcCatalog). Enter Railstop for the name of the output feature class name. In the Field Map (Optional) area, select the fieldname ‘XNM1’ and remove it. Also, remove fieldnames, ‘XNM2’, ‘IYR’, and ‘IPARK’. Click OK to start the import process. In the Catalog Tree, expand the Transportation geodatabase to see the new Railstop feature class.

**Step 4: Use batch mode importing**
Right-click Transportation.mdb, choose Import, then click Feature Class (Multiple). Add sd_fwy.shp to the Input Feature box. You can see the selected shapefile listed in the box area below the input box. Now add sd_majrds.shp. Both the files are listed now in the list below the input box. Click OK. The import tool will process both shapefiles.
Expand Transportation.mdb and rename sd_fwy to Freeways and sd_majrds to Roads. Next, you will import an INFO table into the Transportation geodatabase. You will use the Table to Geodatabase tool to do this.

**Step 5: Import a table into the geodatabase**
Right-click Transportation.mdb, choose Import, then click Table (Single). Add place_aliases.dbf for the input table and name the output geodatabase table Names. Click OK. Navigate to Transportation.mdb and preview Names.
Step 6: Define a new feature class
Right-click Transportation.mdb, choose New, then click Feature Class. Name the new feature class Majroads_fwys. Select Line Features in the type drop down list. Click Next. Choose the coordinate system from the Layers folder that matches that coordinate system of the other files in the geodatabase. Accept the rest of the default configurations and click Finish.

Step 7: Load data from one shapefile
In the Catalog Tree, right-click Majroads_fwys and choose Load > Load Data. The first panel of the Simple Data Loader wizard displays. You see an overview of what the wizard does. Click Next. Click the Browse button to the Input data text box and navigate to sd_fwy.shp. Click it and click Open. In the Simple Data Loader, click Add to add this file to the box under "List of source data to load." Click Next. In this wizard panel, the target geodatabase (Transportation.mdb) and feature class (Majroads_fwys) are already selected. The option "I do not want to load all features into a subtype" should be selected. Click Next. You're going to load all the fields from the sd_fwy shapefile into the Majroads_fwys feature class, so click Next. The option to load all of the source data should be selected. Click Next. You see a summary of all the selections you have made in the Simple Data Loader wizard. Check to make sure they are all correct. The option "Load all of the source data" should be selected. Click Next. Click Finish. The data are loaded into the Majroads_fwys feature class. In the next step, you will load data from another shapefile into this feature class.

Step 8: Load data from another shapefile in the same feature class
In the Catalog Tree, right-click Majroads_fwys and choose Load > Load Data. Click Next. For Input data, browse to Data\create\sd_majrds.shp and add these data to the source data box. Click Next. Click Next in the next three wizard panels as well. Review the summary of your selections, then click Finish. Look at the Item Description and Preview both the table and geography for Majroads_fwy. Features from both shapefiles are now consolidated into the feature class.

Step 9: Create a new feature dataset
In the Catalog Tree, right-click Transportation.mdb, click New, then click Feature Dataset. Name the new feature dataset Railways. You need to define a spatial reference for the feature dataset. All feature classes added to the feature dataset will use the same spatial reference. You will import a spatial reference from the Layers folder. Select the coordinate system that is consistent with the other data in the geodatabase. Click Next. Accept none for Z coordinates. Click Next and Finish. The spatial reference for the
Railways feature dataset is now defined. Railways is added to Transportation.mdb. Currently, it has no data.

**Step 10: Add a new feature class and load data**
Right-click the Railways feature dataset, click New, then Feature Class. For Name, enter Railroad. Select Line Feature as type. Click Next. Accept the default configuration and click Next. Notice that the spatial reference has already been set. The feature class inherits the spatial reference set for the feature dataset.