APPLICATIONS: SPATIAL DATA EDITING

This applications section covers five tasks. Task 1 lets you use basic editing tools on a shapefile. Task 2 asks you to use a map topology and a cluster tolerance to fix digitizing errors between two shapefiles. You will use topology rules in Tasks 3 and 4: fixing dangles in Task 3 and fixing outline boundaries in Task 4. Task 5 is an edgematching operation using the Spatial Adjustment toolbar.

Task 1: Edit a Shapefile

What you need: *editmap2.shp* and *editmap3.shp.*

Task 1 covers three basic editing operations for shapefiles: merging polygons, splitting a polygon, and reshaping the polygon boundary. While working with *editmap2.shp* you will use *editmap3.shp* as a reference, which shows how *editmap2.shp* will look after editing.

1. Start ArcCatalog and connect to the Chapter 7 database. Launch ArcMap. Change the name of the data frame to Task 1. Add *editmap3.shp* and *editmap2.shp* to Task 1. To edit *editmap2* by using *editmap3* as a guide, you must show them with different outline symbols. Select Properties from the context menu of *editmap2.* On the Symbology tab, change the symbol to Hollow with the Outline Color in black. On the Labels tab, check the box to label features in this layer and select LANDED_ID to be the label field. Click the symbol of *editmap3* in the table of contents. Choose the Hollow symbol and the Outline Color of red. On the Selection tab in the table of contents, uncheck *editmap3.* Switch to the Display tab.
2. Make sure that the Editor toolbar is checked. Click the Editor dropdown arrow and choose Start Editing. Make sure that the target layer is *editmap2.* The first operation is to merge polygons 74 and 75. Click the Edit tool. Click inside polygon 75, and then click inside polygon 74 while pressing the Shift key. The two polygons are highlighted in cyan. Click the Editor dropdown arrow and choose Merge. In the next dialog, choose the top feature and click OK to dismiss the dialog. Polygons 74 and 75 are merged into one with the label of 75.

Q1. List other editing operations besides Merge on the Editor menu.

3. The second operation is to cut polygon 71. Click the Task dropdown arrow and choose Cut Polygon Features. Zoom to the area around polygon 71. Use the Edit tool to select polygon 71. Click the Sketch tool. To cut a polygon, the cut line should cross over the polygon boundary. Left-click the mouse where you want the cut line to start, click each vertex that makes up the cut line, and double-click the end vertex. Polygon 71 is cut into two, each labeled 71.

Q2. What other modify tasks besides Cut Polygon Features are on the Task menu?

4. The third operation is to reshape polygon 73 by extending its southern border in the form of a rectangle. Because polygon 73 shares a border (i.e., edge) with polygon 59, you need to use a map topology to modify the border. Click the Editor's dropdown arrow, point to More Editing Tools, and check Topology. Click the Map Topology tool on the Topology toolbar. In the next dialog, check the *editmap2* box. Change the Task on the Editor toolbar to the topology task of Modify Edge. Click the Topology Edit tool on the Topology toolbar, and then double-click on the southern edge of polygon 73. Now the outline of polygon 73 turns magenta with vertices in dark green and the end point in red.
5. The strategy in reshaping the polygon is to add three new vertices and to drag the vertices to form the new shape. Move the

mouse pointer to about the midpoint of the southern border, right-click the point, and select Insert Vertex. A new vertex appears. Position the mouse pointer over the new vertex (vertex 1). When the pointer changes to a four-headed arrow, drag it to where the new border is going to be (use *editmap3* as a guide), and release the mouse button. (The original border of polygon 73 remains in place as a reference. It will disappear when you click anywhere outside polygon 73.)

6. Next, add another vertex (vertex 2) along the line that connects vertex 1 and the original SE corner of polygon 73. Position the mouse pointer over vertex 2. When the pointer changes, drag it to the SE corner of the new boundary. Do the same to form the SW corner of the new boundary. After you have modified the edge, right-click the edge and select Finish Sketch.
7. Select Stop Editing from the Editor dropdown list, and save the edits.

Q3. Can you suggest another option for completing the third operation?

Task 2: Use Cluster Tolerance to Fix Digitizing Errors between Two Shapefiles

What you need: *land_dig.shp,* a reference shapefile; and *trial_dig.shp,* a shapefile digitized off *land_dig.shp.*

There are discrepancies between *land_dig.shp* and *trial_dig.shp* due to digitizing errors. This task uses a cluster tolerance to force the boundaries of *trial_dig.shp* to be coincident with those of *land_dig.shp.* Both *land_dig.shp* and *trial_dig.shp* are measured in meters and in UTM (Universal Transverse Mercator) coordinates.

1. Insert a new data frame and rename it Task 2. Add *land_dig.shp* and *trial_dig.shp* to Task 2. Display the shapefiles with the outline symbol of different colors. Label *land_dig* with the field LAND_DIG_I. On the Selection tab in the table of contents, uncheck *land_dig.* Zoom in and use the Measure tool to check the discrepancies between the two shapefiles. Most discrepancies are smaller than 1 meter.
2. The first step is to create a map topology between the two shapefiles. Click the View menu and make sure that both the Editor and Topology toolbars are checked. Select Start Editing from the Editor's dropdown menu. Make sure that the task is Modify Edge and the target is *trial_dig.* Click the Map Topology tool on the Topology toolbar. In the next dialog, select both *land_dig* and *trial_dig* to participate in the map topology and enter 1 (meter) for the Cluster Tolerance. Click OK to dismiss the dialog.
3. *trial_dig* has five polygons of which three are isolated polygons and two are spatially adjacent. Start editing with the isolated polygon in the lower right. Zoom to the area around the polygon. Click the Topology Edit tool on the Topology toolbar. Then use the mouse pointer to double-click the boundary of the polygon. The boundary turns into an edit sketch with green squares representing vertices and a red square representing a node. Place the mouse pointer over a vertex until it changes to a four-headed arrow. Right-click on the arrow, and select Move from the context menu. Hit Enter to dismiss the next dialog. (You are using the specified cluster tolerance to snap the vertices and edges.) Click any point outside the polygon to unselect its boundary. The polygon now should coincide perfectly with its corresponding polygon in *land_dig.* Move to the other polygons in *trial_dig* and follow the same procedure to fix digitizing errors.
4. All discrepancies except one (polygon 76) are fixed between *trial_dig* and *land_dig.* The remaining discrepancy is larger than the specified cluster tolerance (1 meter). Rather than using a larger cluster tolerance, which may result in distorted features, you will use the basic editing operations to fix the

discrepancy. Use the Edit tool to double-click the boundary with the discrepancy. When the boundary turns into an edit sketch, you can drag a vertex to meet the target line.

5. After you have finished editing all five polygons, select Stop Editing from the Editor's dropdown menu and save the edits.

Q4. If you had entered 4 meters for the cluster tolerance in Step 2, what would have happened to *trial_dig.shp?*

Task 3: Use Topology Rule to Fix Dangles

What you need: *idroads.shp,* a shapefile of Idaho roads; *mtroads_idtm.shp,* a shapefile of Montana roads projected onto the same coordinate system as *idroads.shp*; and *Merge_result.shp,* a shapefile with merged roads from Idaho and Montana.

The two road shapefiles downloaded from the Internet are not perfectly connected across the state border. Therefore *Merge_result.shp* contains gaps. Unless the gaps are removed, *Merge_ result.shp* cannot be used for network applications such as finding the shortest path. This task asks you to use a topology rule to symbolize where the gaps are and then use the editing tools to fix the gaps.

1. The first step for this task is to prepare a personal geodatabase and a feature dataset, and to import *Merge_result.shp* as a feature class into the feature dataset. Right-click the Chapter 7 database in ArcCatalog, point to New, and select Personal Geodatabase. Rename the geodatabase *MergeRoads.mdb.* Right-click *MergeRoads.mdb,* point to New, and select Feature Dataset. Enter *Merge* for the Name of the feature dataset, and click Next. In the next dialog, click Projected Coordinate Systems and then import the coordinate system from *idroads.shp* for the feature dataset. Choose None for the vertical coordinate system. Change the XY tolerance to 1 meter, and click Finish. Right-click *Merge,* point to Import, and select Feature Class (single). In the next dialog, select *Merge_result.shp* for the input features and enter *Merge_result* for the output feature class name. Click OK to import the shapefile.
2. This step is to build a new topology. Right-click *Merge,* point to New, and select Topology. Click Next in the first two panels. Check the box next to *Merge_result* in the third. Click Next in the fourth panel. Click the Add Rule button in the fifth panel. Select "Must Not Have Dangles" from the Rule dropdown list in the Add Rule dialog and click OK. Click Next and then Finish to complete the setup of the topology rule. After the new topology has been created, click Yes to validate it.

Q5. Each rule has a description in the Add Rule dialog. What is the rule description for "Must Not Have Dangles" in ArcGIS Desktop Help?

Q6. What is the rule description for "Must Not Have Pseudonodes"?

3. The validation results are saved in a topology layer called *Merge_Topology* in the *Merge* feature dataset. Select Properties from the context menu of *Merge_Topology.* The Topology Properties dialog has four tabs. The General, Feature Classes, and Rules tabs define the topology rule. Click the Errors tab and then Generate Summary. The summary report shows 96 errors, meaning that *Merge_result* has 96 dangling nodes. The Preview tab in ArcCatalog shows these dangling nodes in red. Most of them are the end points along the border of the two-state area, which are acceptable dangling nodes. Those nodes along the border between the two states are the ones that need inspection and, if necessary, fixing.
4. Insert a new data frame in ArcMap, and rename the data frame Task 3. Add the *Merge* feature dataset to Task 3. Also add *idroads.shp* and *mtroads_idtm.shp* to Task 3. The two shapefiles can be used as references in inspecting and fixing errors. Use different colors to display *Merge_result, idroads,* and *mtroads_idtm* so that you can easily

distinguish between them. On the Selection tab, uncheck *idroads* and *mtroads_idtm.*

5. Now you are ready to inspect and fix errors in *Merge_result.* Make sure that both the Editor toolbar and the Topology toolbar are available. Select Start Editing from the Editor menu. Select *MergeRoads.mdb* as the database to edit data from. There are five places where the roads connect across the Montana-Idaho border. These places are shown with point errors. Zoom to the area around the first crossing near the top of the map until you see a pair of dangles, separated by a distance of about 5.5 meters. (Use the Measure tool on the standard toolbar to measure the distance.) Click the Fix Topology Error tool on the Topology toolbar, and then click a red square. The red square turns black after being selected. Click Error Inspector on the Topology toolbar. A report appears and shows the error type (Must Not Have Dangles). Use the Fix Topology Error tool and right-click on the black square. The context menu has the tools Snap, Extend, and Trim to fix errors. Select Snap, and a Snap Tolerance box appears. Enter 6 (meters) in the box. The two squares are snapped together into one square. Right-click the square again and select Snap. The square should now disappear. Remember that you have access to the Undo and Redo tools on the Edit menu as well as the standard toolbar.
6. The second point error, when zoomed in, shows a gap of 125 meters. There are at least two ways to fix the error. The first option is to use the Snap command of the Fix Topology Error tool by applying a snap tolerance of at least 125. Here you will use the second option, which uses the regular editing tools. First set up the editing environment. Select Snapping from the Editor's menu, and check the boxes for Vertex and End for *Merge_result.* Next select Options from the Editor's menu. On the General tab, enter 10 for the snapping tolerance. Make sure that the Task is Create New Feature and the Target is *Merge_result.* Click the Sketch tool. Right-click the square on the left, point to Snap to Feature, and select Endpoint. Right-click the square on the right, point to Snap to Feature, and select Endpoint. Press F2 to finish sketching, or right-click the square and select Finish Sketch. Now the gap is bridged with a new line segment. Click Validate Topology in Current Extent on the Topology toolbar. The square symbols disappear, meaning that the point error no longer exists.
7. You can use the preceding two options to fix the rest of the point errors.
8. After all point errors representing misconnections of roads across the state border have been fixed, select Stop Editing from the Editor's menu and save the edits.

Task 4: Use Topology Rule to Ensure That Two Polygon Layers Cover Each Other

What you need: *landuse.shp* and *soils.shp,* two polygon shapefiles based on UTM coordinates.

Digitized from different source maps, the outlines of the two shapefiles are not completely coincident. This task shows you how to use a topology rule to symbolize the discrepancies between the two shapefiles and use the editing tools to fix the discrepancies.

1. Similar to Task 3, the first step is to prepare a personal geodatabase and a feature dataset and to import *landuse.shp* and *soils.shp* as feature classes into the feature dataset. Right-click the Chapter 7 folder in ArcCatalog, point to New, and select Personal Geodatabase. Rename the geodatabase *Land.mdb.* Right-click *Land.mdb,* point to New, and select Feature Dataset. Enter *LandSoil* for the Name of the feature dataset, and click Next. In the next dialog, click Projected Coordinate Systems and then import the coordinate system from

landuse.shp for the feature dataset. Choose None for the vertical coordinate system. Set the XY tolerance to be 0.001 meter, and click Finish. Right-click *LandSoil,* point to Import, and select Feature Class (multiple). In the next dialog, add *landuse.shp* and *soils.shp* as the input features.

2. Next build a new topology. Right-click *LandSoil,* point to New, and select Topology. Click Next in the first two panels. In the third panel, check both *landuse* and *soils* to participate in the topology. The fourth panel allows you to set ranks for the participating feature classes. Features in the feature class with a higher rank are less likely to move. Click Next because the editing operations for this task are not affected by the ranks. Click the Add Rule button in the fifth panel. Select *landuse* from the top dropdown list, select "Must Be Covered By Feature Class Of" from the Rule dropdown list, and select *soils* from the bottom dropdown list. Click OK to dismiss the Add Rule dialog. Click Next and then Finish to complete the setup of the topology rule. After the new topology has been created, click Yes to validate it.

Q7. What is the rule description for "Must Be Covered By Feature Class Of"?

3. *LandSoil_Topology* contains the validation results. The Preview tab shows areas not covered by each other.

4. Insert a new data frame in ArcMap, and rename the data frame Task 4. Add the *LandSoil* feature dataset to Task 4. Use outline symbols of different colors to display *landuse* and *soils.* Zoom to the area errors. Most deviations between the two feature classes are within 1 meter.

5. Select Start Editing from the Editor's menu. Click the Fix Topology Error tool on the Topology toolbar, and drag a box to select every area error. All area errors turn black. Right-click a black area and select Subtract. The Subtract command removes areas that are not common to both feature classes. In other words, Subtract makes sure that, after editing, every part of the area extent covered by *LandSoil* will have attribute data from both feature classes.

6. There are at least three other options to fix the errors. First, you can use the Create Feature command instead of Subtract. The Create Feature command creates new features for each area formed between the two sets of boundaries. The obvious problem with this option is that attributes must be gathered for the new features. Second, you can select one or more area errors at a time and choose either Subtract or Create Feature to fix the selected area errors. The problem with attributes for the new features still remains. Third, you can use the editing tools such as Modify Feature to fix area errors. The third option is most time consuming and requires knowledge as to how to reshape the boundaries. To see how each of these options works, you can click the Undo button between trials.

7. Select Stop Editing from the Editor dropdown menu. Save the edits.

Task 5: Perform Edgematching

What you need: *hoytmtn* and *mrblemtn,* two soil feature classes in *edgematch.mdb* (a personal geodatabase) that need to be edgematched.

Both *hoytmtn* and *mrblemtn* are based on the UTM coordinate system and are measured in meters. The task assumes that *mrblemtn* is more accurate than *hoytmtn.* Therefore, vertices (and lines) in *hoytmtn* are moved in the editing process to match those in *mrblemtn.* In ArcMap, *hoytmtn* is called the source layer and *mrblemtn* the target layer.

1. Insert a new data frame and rename it Task 5. Add *hoytmtn* and *mrblemtn* from the *edgematch.mdb* to Task 5. To differentiate the source layer from the target layer, change *hoytmtn* to an outline symbol in red

and *mrblemtn* to an outline symbol in black. Click the View menu, point to Toolbars, and make sure that both the Editor toolbar and the Spatial Adjustment toolbar are checked.

2. First set the snapping environment and options. Select Start Editing from the Editor's dropdown menu. Select Snapping from the same menu, check the Vertex box for *hoytmtn,* and close the dialog. Then select Options from the Editor's menu to open the Editing Options dialog. On the General tab, enter 10 (map units) for the snapping tolerance.
3. Next set the parameters using the Spatial Adjustment menu. Select Set Adjust Data from the Spatial Adjustment dropdown menu. Select the option for adjusting all features in *hoytmtn* but not *mrblemtn.* Click the Spatial Adjustment dropdown arrow, point to Adjustment Methods, and check Edge Snap. Select Options from the Spatial Adjustment dropdown menu to open the Adjustment Properties dialog. On the General tab, click on the Options button in the Adjustment method frame and make sure that the method is Smooth. On the Edge Match tab, first select *hoytmtn* for the source layer and *mrblemtn* for the target layer. Next check Use Attributes. The two feature classes have the same attribute fields, which can be used to assist the edgematching operation.

Q8. The Options button in the Adjustment method frame shows the methods Smooth and Line. What is the difference between the two methods? (Tip: Right-click on Smooth and read the description.)

4. You are ready for edgematching. Zoom to the top area between *hoytmtn* and *mrblemtn* so that you can see the first pair of unmatched soil lines. Click the Edge Match tool on the Spatial Adjustment toolbar, and drag a box around the gap. A link should now connect the two end points: the link is shown as an arrow and the end points as squares.
5. The Edge Match tool can work with more than one link at a time. Click the Full Extent button in ArcMap. Make sure that the Edge Match tool is activated. Drag a box so that the box covers the remaining unmatched soil lines and the bottom border. Click the View Link Table tool on the Spatial Adjustment toolbar. The Link Table should have 10 records (nine new links plus the one from Step 4). Each record shows the shift of a vertex in *hoytmtn* to its new location through adjustment.
6. If all links are set, select Adjust from the Spatial Adjustment dropdown menu. At this point, the edgematching operation is complete. Select Stop Editing from the Editor menu and save the edits.

Challenge Task

What you need: *idroads.shp, wyroads.shp,* and *idwyroads.shp.*

The Chapter 7 database contains *idroads.shp,* a major road shapefile for Idaho; *wyroads.shp,* a major road shapefile for Wyoming; and *idwyroads.shp,* a merged road shapefile of Idaho and Wyoming. All three shapefiles are projected onto the Idaho Transverse Mercator (IDTM) coordinate system and measured in meters. This challenge task asks you to examine and fix gaps that are smaller than 200 meters on roads across the Idaho and Wyoming border. There are at least two options for completing the challenge task.

Option 1: Treat the challenge task as an edgematching task. Import *idroads.shp* and *wyroads.shp* as line feature classes into a personal geodatabase, and perform the edgematching operation.

Option 2: Use a topology rule in the geodatabase data model to fix dangles in *idwyroads.shp.*