Lab 8: Geoprocessing with Model Builder

Geoprocessing is the processing of geographic information. It is one of the fundamental functions of a geographic information system. For this lab you will use Model Builder to geoprocess spatial data. Model Builder is a visual modeling tool that allows you to build workflows and scripts.

Exercise 1: Introduction to Model Builder
The goal of this exercise is to give you a basic introduction to Model Builder.

Step 1: Start ArcMap
Start ArcMap and open the Robertson.mxd map document. You see the map of Robertson County in Texas located North of College Station. Open the File menu, Click on Map document properties, Uncheck Store relative pathnames to data sources.

Step 2: Create your own Toolbox
Right click within ArcToolbox, select Add Toolbox to open the Add Toolbox window. Navigate where you want to save and then click the New Toolbox button at the top right side of the dialog. Name the toolbox and click open. The newly created toolbox should appear in ArcToolbox.

Step 3: Create a model and toolset in your Toolbox
Right click on your New Toolbox, point to New and click on Model. A model will be created in the new toolbox and an open window will appear to edit the model. In the next step you will build your model in this window. Exit out of this window for now.

Right click on your Toolbox, point to New and click on Toolset. This Toolset allows you to gather your favorite tools and to make them easier to access. Right click on your Toolset and point to Add and click Tool. The Add Tool window will open. Select the Tool Copy Features contained in the Data Management Tools Toolbox in the Features Toolset. Click OK.

Step 4: Import project data in Model Builder. Each element within the model is given its own symbol.

Project data elements represent the geographic input data that exists before the model runs. Project data elements are represented by dark blue ovals.

There are three ways to import project data in your model:
- Use the import data tool in the ModelBuilder Toolbar.
- Drag the data from the ArcMap table of content to the ModelBuilder window.
- Right click in the ModelBuilder display window, click on Create Variable... and select the type of variable you are interested in.
Drag the County shapefile in the ModelBuilder display window. To display the display window, right click on the model and select Edit.

**Step 5: Import tools in Model Builder and setup a connection**
Tool elements represent the operations to be performed on input data parameter values. Tool elements are represented as yellow rectangles.

In your ArcToolbox window click on the script Calculate Areas in the Utilities Toolset, in the Spatial Statistics Tools Toolbox. Drag it in the ModelBuilder Display window. Your tool symbol appears white; it means that all its parameters haven’t been determined yet. Click the Connection tool in the ModelBuilder Toolbar. Then click the County shapefile element (Input variable) and click the Calculate Areas element. A pop up box will appear and click Input Feature Class. You have connected those two elements using a connector. A connector shows the direction of processing.

**Step 6: Setting values for a tool’s parameters and output**
Double click on the tool and a window with all the necessary and optional parameters will open. For the Calculate Area tool you just need to specify the path to the Output Feature Class. Name this Output CountyArea Click OK. Your final model should now look similar to this:

Add the model output to display. This option imports the model’s outputs directly to display (when you run the model from the ModelBuilder window). Right Click on CountyArea and check Add to Display.

**Step 7: Run the model**
They are two ways to run a model:
- You can run it from the ModelBuilder window by clicking the Model Menu and clicking Run Entire Model
- You can run it from the ArcToolbox window by right clicking on the model and selecting Open. *If you choose this method the intermediate results will be erased immediately.*

When creating your model, you will preferably run the model within the ModelBuilder window to be able to check the result of each process. Run your model from the
ModelBuilder window by clicking the **Model** Menu and clicking **Run Entire Model**. A new layer named CountyArea will appear in the ArcMap table of contents. If you check its attribute table, you will see that a field name F_AREA has been added and it contain the area in m² (you should get something similar to 2246559723). If you look at the model, you will see that the **Calculate Area** Tool and the CountyArea output are now displayed with drop shadows. That means that the process has been run.

![Diagram of Calculate Areas and CountyArea.shp](image)

Now save your model and close the ModelBuilder window.

**Exercise 2: Create and run a multi-process model**

In this exercise, you will create model parameters and variables for a tool, use tools from an ArcGIS extension, and run your model from the ArcToolbox window. The goal of this exercise is to determine where the slope is less than a specified percent.

**Step 1: Create a model in your Toolbox and rename**

Right click on your Toolbox, point to **New** and click on **Model**. A ModelBuilder window will open. Click the **Model** Menu and click **Model Properties**. Select the **General tab**. Rename this model SlopeSelection Click **OK**.

**Step 2: Import DEM as a variable in Model Builder and also import your first process**

Drag the DEM data from the ArcMap table of content to the ModelBuilder Display window. In your ArcToolbox window, click the **Spatial Analyst Tools** Toolbox, click the **Surface** Toolset and drag the **Slope** Tool in the model window. Click the **Add connection** tool in the ModelBuilder Toolbar. Then click the DEM element (Input variable) and click the **Slope** Tool. Then click **Input Raster**. Double click on the **Slope** Tool and a window with all the parameters will open. Specify the path to the Output Raster and name the Output Raster **Slope** Choose **PERCENT_RISE** as Output measurement.

**Step 3: Add another process**

In your ArcToolbox window, click the **Spatial Analyst Tools** Toolbox, click the **Reclass** Toolset and import the **Reclassify** Tool in the model window. Click the **Add connection** Tool in the ModelBuilder Toolbar. Then click the Slope element (Output variable) and click the **Reclassify** Tool. Then click **Input Raster**. Double click on the **Reclassify** tool and a window with all the parameters will open. Reclassify in order to give a value of 1 to slope inferior to 5% and 0 for the others. Old values can be given a range with spaces before and after the hyphen (e.g., 0 – 5). Name the Output raster **SlopeReclass**. Click **OK**.

**Step 4: Creating a variable for a parameter**

You can create a variable for any parameter. We are going to create a variable that represents the table that we want use to Reclassify the Slope raster. This element will represent by a light blue oval because it is a Value element. Value elements reference nongeographic data parameter values. Right click on the Reclassify element, select **Make Variable**, select **From Parameter**, and select Reclassification.

Double click on it. The table entered for the reclassification will open. Save this table as “less5”. Then modify this table to give a value of 1 to slope inferior to 3% and 0 for the others. Save this new table as “less3”.

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Click **Load** and you will see that you can choose which table to use for the reclassification. Select the table less5. Click **OK**.

**Step 5: General view of the model**
Click the **full extent** tool. It will show the whole model and center it on the window. Click the **Auto Layout** tool. It will reorganize the model.

Your model should look like this:

![Model Diagram](image)

There are two processes in this model. The first one calculates the slope using the DEM and creates a raster. The second one reclassifies the raster.

**Step 6: Set up model parameters**
You can set up some of the parameters as model parameters. The user will therefore have to define those parameters when running the model from the ArcToolbox window. Right Click on the Reclassification variable and check **Model Parameter**. Model parameters are symbolized with a P.

**Step 7: Intermediate data and overwriting output**
By default the Output data are usually flagged as intermediate. If you don’t want Output data to be qualified as Intermediate: Right click on the variable and uncheck **Intermediate**.

By default, you overwrite the outputs of Geoprocessing operations when using Model Builder. You have to change the name of the output to save previous work.

**Step 8: Run a multi-process model**
There are different ways to run a multi-process model; you can run just one process, or all the processes that are ready to run, or all the processes.

**Running a single process**
Right-click the process you want to run. Click **Run**. If the process is linked to a chain of processes, earlier processes in the chain will also run if they have not already been run. Run the **Slope** Tool by itself. After the process finishes running, right click on the Slope raster and select Add to Display. This should add the intermediate output to your Table of Contents. The Slope raster will appear in the Display and the Slope box will have drop shadow around the tool (indicating that it has been run).
Running only the ready-to-run processes
Click the Model menu and click Run. Alternatively, click the Run button on the ModelBuilder window toolbar. All processes that are in a ready-to-run state will run. The tools that have already been run, indicated by the drop shadows around the tool, will not run again. Run only the ready-to-run processes. Only the Reclassify Tool will run because the Slope Tool has already processed. Right click on the SlopeReclass raster and select Add to Display. The reclassification has been done to select the slope that is less than 5 percent.

Running all processes from ArcToolbox
Click the Model Menu and click Delete Intermediate Data. You will see BOTH output rasters disappear in the Table of Contents because you just deleted them. Click the Save tool in the ModelBuilder Toolbar, it will save the latest modifications. Close your ArcMap project and reopen it. All your Toolboxes have been saved and will be loaded automatically.

Right click on your SlopeReclass Model in the ArcToolbox and click Open (Or Double click on it). A window with the reclassification table will open (because it has been defined as a Model Parameter). Click load and choose the table less3. Click OK. The Slope and SlopeReclass rasters won’t appear in the Table of Contents. But if you use the import data tool in the ArcMap Toolbar, you will see that one output raster has been created. Import it. The reclassification selected slopes less than 3 percent.

Step 9: View the Status messages
Edit the SlopeReclass model. Click the Model menu and select report…. A Model Report window will open. Verify that the option View report in a window is checked and click OK. A report window will open. Click Expand/Collapse All. You can have a look all the messages. Click OK. You can also look at the report of a specific tool. Right click on the Slope box, select View Messages. You can have a look at the messages specific to the Slope Tool.

Exercise 3: The best way to learn Model Builder is to play with it.
The purpose of this exercise is for you to get comfortable using ModelBuilder without guidelines. Create a model for the following scenario…

A person would like to buy some land in Robertson County. He would prefer not living too far from an urban area (maximum 15 km away) and if possible next to the Railroads (maximum 2 km away) because he likes trains.

The model should look similar to the one below. Run this model.
Lab 8 Assignment

Implement a model in ModelBuilder with at least three processes (actions). You may replicate the toolbox I show as an example in Exercise 3, but that is not required. If you replicate my example, you should personalize at least one of the processes. For example, instead of clip use select (analysis) to pull out the data. Submit a short report (~1 page). Start with describing briefly your reasoning for the model. Describe the inputs, outputs and result of the model. Incorporate a figure of model flow chart and a figure of the result.