EXERCISE 8: MODELING TECHNIQUES AND TOOLS

In Step 1 through Step 4, you will learn some techniques for building binary suitability models using Map Algebra to reclassify and combine multiple rasters. in Step 5 through Step 10, you will learn how to use the Reclassify and Weighted Overlay tools, which are the key tools used in building weighted suitability models.

STEP 1: RECLASSIFY WITH MAP ALGEBRA

Sonic suitability problems are easy; you just want to find the cells that meet a limited set of simple criteria—in effect, applying a query to your data. For example, to find potential ski resort sites, your criteria may be something like 'good snow and good slope and good accessibility'.

You can implement this type of model by reclassifying the model layers into 'good' (1) and 'bad' (0) values and then combining the classified layers to find the cells that have all 'good' values. Because you are only dealing with two values (good and bad), this technique is often called 'binary' suitability modeling.

In this step, you will use Map Algebra to reclassify the model input layers into binary good and bad values using the logical operators, like this:

```
(Snowdepth GE 24) ... or ... (Slope LT 30)
```

The logical operators, like GE (Greater Than or Equal) or LT (Less Than), return either a logical true (a value of one) or a logical false (a value of zero) depending on the result of the test. You can use them to reclassify your model layers provided you have simple criteria; otherwise, you should use the Reclassify tool.

Start by opening ArcMap, loading some layers, and setting the analysis environment.

- □ Start *ArcMap* with *A new empty map*.
- □ Add the following layers to the map from your ... \Exercise11 folder:
  - *Slope.lyr*: Slope in degrees
  - *Snow.lyr:* Snow depth in inches
  - *Travel.lyr*: Drive time from the city in minutes
- □ Examine the layers' maps and legends (note that Water has been set to NoData) and then turn them off and collapse their legends.
- □ Open the *ArcToolbox* and set the following geoprocessing environment settings:
  - Current Workspace: browse to - -. \Exercise11
  - Scratch Workspace: browse to ... \Exercise11
  - Output Extent: select Same as Layer *"Slope"*
  - Cell Size: select Same as Layer *"Slope"*

- Mask: select *Slope*

For simple problems, you may reclassify the input layers into good and bad with Map Algebra (or equivalent toolbox tools) before you combine them, or you may reclassify and combine them in one longer Map Algebra expression. You will do both.

You will use the following criteria for your first suitability model:

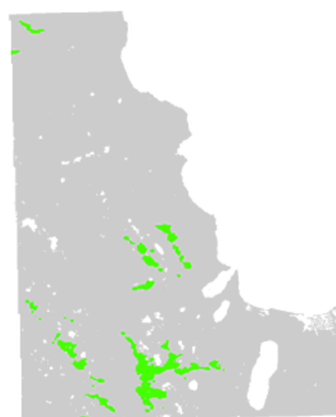
Snow depth must be 24 inches deep or more
Travel time must be 30 minutes or less to Lake Tahoe city

Now use Map Algebra to reclassify the SnowDepth and TravelTime layers.

- ☐ Run the *Single Output Map Algebra* tool:
- ☐ MapAlgebra expression: type **snowdepth GE 24**
- ☐ Output raster: type **goodsnow24**

- ☐ Run the *Single Output Map Algebra tool*:
- ☐ MapAlgebra expression: type **Traveltime LE 30**
- ☐ Output raster: type **goodtravel30**
- ☐ Compare the good (1) and bad (0) areas for snow and travel time (dark is good):

GoodTravel 30



GoodSnow 24

Now that the layers have been reclassified into good and bad, you can combine them.

STEP 2: USE AND IN A BINARY MODEL

With the Boolean AND operator, if both input cells contain true values (any nonzero value), it returns a one; otherwise, it returns a zero. In the context of a suitability model, this means that if both inputs are good, the output is good, and if any input is bad, the output is bad.

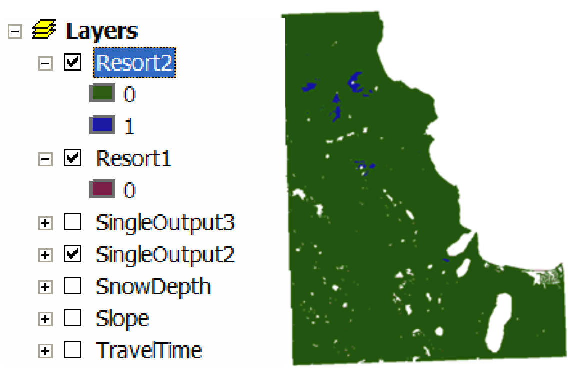
Now combine your reclassified snow and travel time layers with a Boolean AND.

- ☐ Run the *Single Output Map Algebra tool*:
- ☐ Map Algebra expression: type **`goodsnow24 AND goodtravel30`**
- ☐ Output raster: type **resort1**

All the output values are zero; none of the cells passed both the snow depth and travel time tests. This illustrates one of the problems with binary models: they only return true and false, and there are no 'next-best' sites from which to choose.

Now try the model again with looser criteria. To save time, you will reclassify the layers and combine them in one Map Algebra expression.

- ☐ Run the *Single Output Map Algebra tool*:
- ☐ MapAlgebra expression: type
    - **`(SnowDepth GE 18) AND (TravelTime LE 60)`**
- ☐ Output raster: type **resort2**



This time the model found cells that passed both tests. Clearly, the more layers you have, the lower the chances are of finding cells that have all the best characteristics, which is another reason that the weighted suitability method is preferred over the Binary method. As a variation on the logical AND technique, you could multiply the layers together, like `GoodSnow24 * GoodTravel30`, and get exactly same results.

STEP 3: USE AND IN A BINARY MODEL

In another variation on binary suitability, you can combine the reclassified layers by adding them together. This variation 'counts' the number of good characteristics for each cell and returns values from zero (no good layers) to a value equal to the number input layers (all good layers). Now you will try this by including slope in your model (assume that slopes of 30 degrees or more are best) and adding the layers together.

- ☐ Run the *Single Output Map Algebra tool*
- ☐ Map Algebra expression: type

- ○ **(Snowdepth CE 18) + (TravelTime LE 60) + (Slope GE 30)**
- □ Output raster: type **Resort3**

The model returned values from zero to three, indicating the number of tests that each cell passed. If you opened the Resort3 attribute table, you would see that only 137 cells passed all three tests. At least with this variation, you know how many tests were passed by each cell. The problem is you do not know which tests were passed. Cells with a score of 2 are not good ski resort sites if they failed the snow depth test.

STEP 4: USE COMBINE IN A BINARY MODEL

The Combine function (or tool) combines up to twenty layers, finds the combinations of input layer values, assigns an identifier to each unique combination, and creates fields on the output raster attribute table to show the combinations. This is useful in other applications too, like finding associations between soils and vegetation types. Although in Map Algebra, you may use an expression for each Combine argument to reclassify the input layers, in practice it is best to classify them first. The classified layers you need are provided in the exercise folder. Now add the layers, combine them, and examine the output attribute table.

- □ Add the following layers to the map from your ... \Exercise11 folder:
- □ *GoodSlope30.lyr*: Slopes GE 30 degrees are good (1)
- □ *GoodSnow18.lyr*; Snow depths GE 18 inches are good (1)
- □ *GoodTravel60.lyr*: Travel times LE 60 minutes are good (1)
- □ Review each new layer. Then turn off all layers and collapse their legends.
- □ Run the *Single Output Map Algebra tool*:
- □ Map Algebra expression: type

Combine (GoodSlope30, GoodSnow18, GoodTravel60)

- □ Output raster; type **resort4**
- □ Open the resort4 attribute table and examine the fields.
- □ Click and drag over the fields to select them, then right-click and choose the *Sort Ascending option.*

Now you can tell which tests were passed and failed; all the existing combinations are shown in the output attribute table.

Even with the variations you have seen, binary suitability modeling still has two flaws. First, you can not assign relative suitability to the values within a layer; that is, all slopes are either good or bad. Second, you can not assign relative importance to the layers; that is, snow depth is probably more important than travel time for a ski resort.

The weighted suitability modeling method corrects these problems, but first you must learn about other techniques of classifying and combining raster data.

- □ Close the *Attributes of resort4* table.

☐ Turn off all layers and collapse their legends

STEP 5: RECLASSIFY DISCRETE DATA

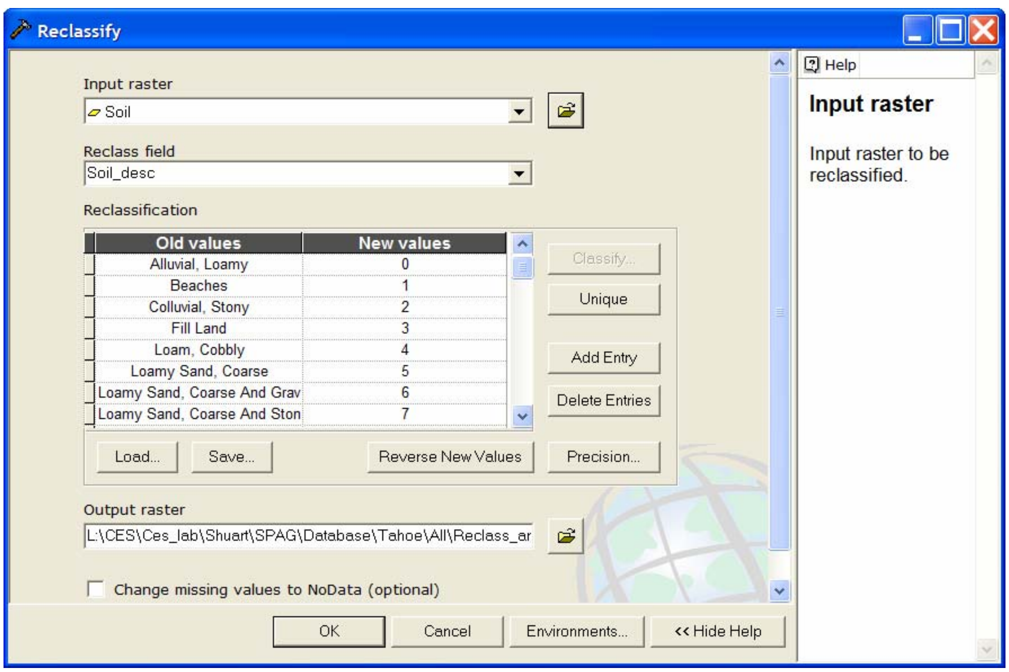
Classification is considered a 'core' capability of GIS. While Spatial Analyst has many tools and Map Algebra techniques for classifying data, the Reclassify tool is normally the best choice for this task. In this step, you will explore the features of the Reclassify tools main dialog. Start by adding some more layers to your map.

☐ Add the following layers to the map from your .. \Exercise11 folder:
- *Soil.lyr*: Soil types--discrete data
- *Sun.lyr*: Sun exposure—surface data

☐ Examine the new layers. Then turn them off and collapse their legends.
☐ In Arc Toolbox, open *Reclass* > *Reclassify*.

Reclassifying discrete data is conceptually easy. For the input Old values classes, you type an output New value. The Reclassify tool works the same with both integer and floating-point input rasters—but it always outputs an integer raster.

☐ For *Input* raster, select *Soil*.



The choice of Input raster controls the tool defaults. If you browse to a raster, then the Reclass field defaults to the Value attribute and the tool preclassifies the data into nine classes. If you select a layer, the layer symbology is used to set the Reclass field and the default classes (the Stretched renderer creates 255 classes).

Note that the Reclass field defaulted to the Soil.desc text field that was used to assign the Soil layer symbology.

If you classify with a text field like Soil.desc, you are just changing the numeric cell values that correspond to the text. The tool joins the text field to the output attribute table, but other fields on the input raster attribute table are not output.

- □ For Reclass field, select *Value*.
- □ In the Reclassification table, scroll to the bottom of the list.

The tool preclassified the 19 numeric soil code values into nine classes using ranges in the Old values column, like “402 - 902”.

- □ Click *Unique* to create a class for each soil code.

You may set your own Old values classes using ranges and lists. Ranges are two values with a hyphen between them (like 101 - 106), while lists are values delimited with semicolons. You need spaces on both sides of a hyphen and after a semicolon.

- □ In the Reclassification table first row, for Old values, overtype the value with **101 — 106**
- □ In the second row, for Old values, type **201; 202; 203; 204**
- □ In the third row; for Old Values, type **301; 302; 303 — 306**

You may select and delete rows from the Reclassification table. You select a row by clicking the small button to its left. You select adjacent rows by dragging over the small buttons or by selecting the first and Shift-clicking the last. You add or remove a row from the selection by Ctrl-clicking it.

- □ Click the button next to the row for *Old value 104* to select it.
- □ Scroll to the bottom of the table and *shift-click* the button for the last row.
- □ Click *Delete Entries* to delete the selected rows.

Notice that the lists were expanded to separate rows with the same New value. Also note that the last row (NoData = NoData) was automatically readded to the table.

You may add new rows to the bottom of the table, if you want.

- □ Click *Add Entry* and then scroll to the bottom of the table.
- □ In the blank new row, for Old values, type **401 - 902**
- □ In the new row, for New values, type **4**
- □ Note that the new row for 401 - 902 is below the NoData row.

The tool internally sorts the table by the New values column, so you may add the new value rows in any order, and any operation that refreshes the table causes it to display in the correct sort order. You can see this by flipping the new values that have been assigned to the classes from their default ascending order to descending order.

- ☐ Click *Reverse New Values* to apply descending New values to the classes.
- ☐ Scroll to the bottom of the table and note that the Old values are now sorted.

You may use NoData as the New value for any class. Among other uses, this provides a quick way of making a mask. Also, you may cause any input values that are not represented in the table to be output as NoData.

- ☐ For the Old values 401 - 902 row, overtype the New value of 1 with NoData.
- ☐ Check the Change missing values to *NoData* (optional) check box.

You may save your classes to a remap file in Info and then load it when you run Reclassify again later. This is useful if you must reclassify many rasters using the same classes.

- ☐ Click *Load* and then navigate to and load .. \Exereise11 soil.rmp.
- ☐ Review the new Old values classes and their New values.

You have reviewed most of the controls on the Reclassify tools main dialog. In the next step, you will experiment with the subdialog that the Classify button opens. Now classify your soils and then move on to the next step.

- ☐ For Output raster, type **NewSoil**
- ☐ Click OK.

STEP 6: RECLASSIFY CONTINUOUS DATA

You have just seen how you may use the Reclassify tool to classify discrete data like soils. Reclassify also provides a statistical classification tool that may be a better choice for building classes for continuous data like your sun exposure layer. In this step, you will explore the capabilities of the Classification subdialog.

- ☐ Open the Reclassify tool
- ☐ For Input raster, select *SunExposure*
- ☐ For Reclass field, select *Value*.
- ☐ Click *Classify* to open the Classfication dialog.

The histogram shows the frequency distribution of the values. The height of each gray bar is proportional to the number of cells that have that value. For example, the highest bar tells you that there are about 24,000 cells with a sun exposure value of about 179. The

vertical blue lines show the location of the current class boundaries. In the rest of this step, you will see how you can interact with the histogram and control the classes.
Working with the histogram

By checking the Show Mean and Show Std. Dev. check boxes, you can cause vertical lines to appear in the histogram at these statistically important places.

- □ *Check Show Mean* and note the dashed vertical line that appears.
- □ *Check Show Std. Dev*. and note the dotted vertical lines that appear every first, second, and so on standard deviation above and below the mean.

The vertical blue breaklines in the histogram are the locations of the class boundaries. Notice that their labels correspond to the numbers in the Break Values list. You may change the break values in three ways: you may choose a new classification method, you may edit the values in the list, or you may change the breaklines in the histogram.

- □ In the Break Values list, click *88* to select it.
- □ Notice that the breakline in the histogram turns *red*.
- □ Type **70** to change the *Break Value* and press *Enter*.

Notice that the breakline label changes and that it moves to the new value location.

- □ In the histogram, *click the 70* breakline to select it.

Notice that the breakline turns red and that the mouse pointer changes to a left-right arrow when it is over the breakline.

- □ Drag the breakline a little to *the right*.

Notice that the value in the Break Values list updates as you move the breakline. The breaklines and break values are linked; changing one automatically changes the other.

- □ Drag the breakline so its value is close to 80 (the value is not important).
- □ Right-click on the breakline and click *Delete Break* from the context menu.
- □ Right-click near where you deleted the breakline and click *Insert Break*.

The histogram context menu has several other options that you will now explore.
The histogram frequency bars are actually classes, not data values. The tallest bar is not for 24,000 cells that all have a value of 179; rather, it is a class of cells whose values are near 179. The histogram defaults to 100 bars, but you may increase that up to 1,000 with the Columns control. Zooming in on the histogram gives more detail.

- □ Right-click on the 179 breakline and select Zoom In.
- □ Zoom in again on the 179 breakline.

You can now see that there are only about 5,000 cells with a value near 179. You can also zoom by dragging a box (left-click) over an area of the histogram, and there are options for recentering the histogram and for returning to the full view.

- □ *Right-click on* the far right of the histogram and select *Center*.
- □ *Right-click on* the histogram and select *Reset Zoom*.

Working with the classification methods

When you first opened the Reclassify tool, it automatically applied the Natural Breaks method to create the initial classification. You may change the initial classes with the histogram and/or break values as you have just seen, or by using a different method.

- □ For Method, select *Equal interval*.
- □ For Classes, *select 9*.

Notice that the breaklines are evenly spaced. The Equal interval method divides the data into equally sized classes. You set up to 256 classes with the Classes control. This method is best used with ratio and interval data like distance or temperature; it may create classes that have no values when it is used with nominal data like soil codes.

- □ For Method, select *Defined Interval.*
- □ For Interval Size, type *28* and click in the histogram so the change takes effect.

Notice that the breaklines are evenly spaced. The Defined interval method is like the Equal Interval method, except that you define the class sizes, not the number of them. The number of classes it creates is determined by the interval size and the data range. The maximum interval size is a little less than half of the maximum data value.

- □ For Method, select *Quantile*.
- □ For Classes, select *9*.

Notice that the breaklines are not evenly spaced and that the classes become narrower as the frequency increases. The Quantile method builds the classes such that each has about the same number of cells, which equates to roughly equally sized areas on the map. This method works best with normally distributed data.

- □ For Method, select *Natural Breaks (Jenks).*
- □ For Classes, select *9*.

Notice that the breaklines are not equally spaced. The Natural Breaks method finds naturally occurring groups in the data. The class breaks are determined statistically by finding adjacent value pairs where there are relatively large differences in values between the pairs. This is the default method and is perhaps the best general-purpose classifier because it tends to highlight differences in the data.

- □ For Method, select *Standard Deviation*.
- □ For Interval Size, select *1 Std Dev*.

Notice that the classes defined by the equally space breaklines are centered on the mean and standard deviation lines. The Standard Deviation method builds classes such that middle class is centered on the mean and the other classes are centered 1, 1/2, 1/3 or 1/4 of a standard deviation above and below the mean. Use this method to show how much the data varies from the average.

- □ For Method, select *Manual*.

The Manual method is automatically set if you edit the class breaks with the histogram or the break values list. Use this method if you want to emphasize patterns in your data by placing breaks at important values. You may use any of the other methods to create a preliminary classification and then manually adjust the class breaks.

You have seen the main features of the Classification dialog. Now select the Jenks method with nine classes and return to the main Reclassify dialog.

- □ For Method, select *Natural Breaks (Jenks).*
- □ For Classes, select *9*.
- □ Click *OK* to close the *Classification* dialog.

One last task remains. In the context of a ski resort model, less sun exposure is better. You must reverse the default New value assignments and then you can run the tool.

- □ In the Reclassify dialog, click *Reverse New Values*.
- □ For Output raster, type **Newsun**
- □ Click *OK* to run the *reclassify* tool.

STEP 7: RECLASSIFY WITH SYMBOLOGY

By default, the Reclassify tool creates its Old values classes from a layers symbology. A useful technique is to set layer symbology to visualize the new classes and then use the classes in the Reclassify tool. In this step, you will classify TravelTime with its layer symbology to create a raster of travel suitability for the ski resort model.

- □ Turn off all layers and collapse their legends.
- □ Turn on Travel lime, expand its legend, and review the classes.
- □ *Double-click TravelTime* to open its *Layer Properties* and click the *Symbology* tab.

The layer uses the Classified renderer with 10 classes. The dialog shows the class value ranges and labels.

- ☐ Click *C1assify* to open the *Classification dialog*.

The dialog should look familiar; it is exactly the same as the Classification dialog that is used by the Reclassify tool. For the TravelTime layer, the class breaks were set manually at 10, 30, 45, and so on minutes. Do not make any changes to the classes.

- ☐ Click Cancel to close the *Classification* dialog.
- ☐ Click Cancel to close the *Layer Properties* dialog.

Now run the Reclassify tool and use the symbology classes to reclassify the data.

- ☐ Open the *Reclassify* tool.
- ☐ For Input raster, select *TravelTime*.

Notice that the ten Old values class ranges are the same as the symbology classes. The default New values were assigned in ascending order from I to 10. For the ski resort model, short drive times are best, so reverse the New values assignments. Also, the modeling team wants the resort to be at least a ten minute drive from the city.

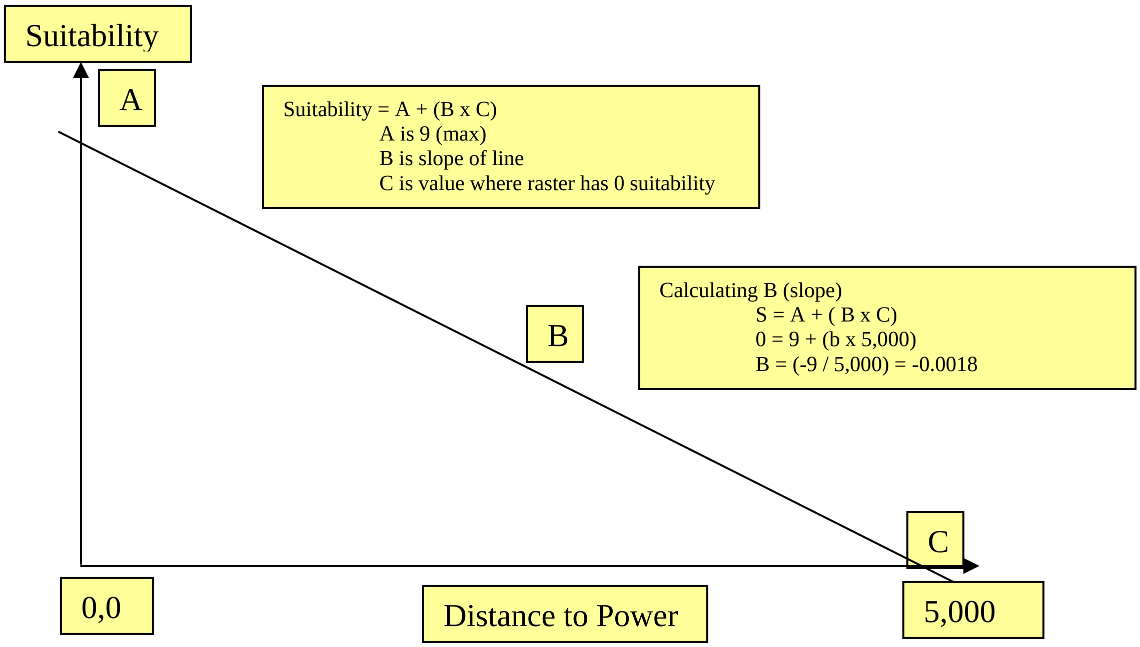
- ☐ Click *Reverse New Values*.
- ☐ In the first row of the table, for New values, overtype the existing10 with 1
- ☐ For Output raster, type **NewTravel**
- ☐ Click *OK* to run the *Reclassification tool*.

STEP 8: RECLASSIFY WITH AN EQUATION

There are times when you need to create a classification that varies continuously with the data. If there is a mathematical relationship between the input and output values, it may be more appropriate to reclassify the raster with an equation in Map Algebra.

For this step, assume that you want to reclassify distance to power lines into suitability values for a model. The suitability is best (a value of nine) at a distance of zero meters, and decreases linearly to the worst suitability (a value of zero) at 5,000 meters.

The following graphic shows the general equation for a line “S a -- (b xc)”as applied to this example. S is the output suitability value, a is the y-intercept (where Suitability is nine when Distance is zero), b is the slope of the line, and c is the x intercept (where Suitability is zero when Distance is 5,000).



Using the equation is easy. You only need to know the values of S (which you set to 0), a (which you set to 9), and c (which you set to 5,000). You plug the values into the equation and solve for the slope, b. Then you can reclassify your data with a Map Algebra expression like this:

`Suitability = 9 + –0.0018 * DistanceRaster`

This is an inverse linear function. If suitability increased with distance, you would set S to 9, a to 1, and c to 5,000 to solve for the slope b—which would then be positive. Map Algebra has the math operators and functions you need to model almost any type of mathematical relationship, like exponential or logarithmic.

- ☐ Turn off all layers and collapse their legends.
- ☐ Add the following layer to the map from your ... \Exercise11 folder:
- ☐ *Power.lyr*: Distance to power lines—floating-point data
- ☐ Examine the new layer. Then turn it off and collapse its legend.

- ☐ Run the *Single Output Map Algebra* tool:
- ☐ Map Algebra Expression:type **9 + (-0.0018 * Power)**
- ☐ Output raster: type **Newpower1**
- ☐ Examine the NewPower1 legend and notice that the values range from -15.03 to 9.

The equation returned negative values, where the distances were greater than 5,000 meters. If your models suitability scale is 1 to 9, you need to replace all the values that are less than one with one. You can easily do this with the Con function.

- □ Run the Single Output Map Algebra tool:
- □ Map Algebra expression: type **Con (NewPower1 LT 1, 1, NewPower1)**
- □ Output raster: type **NewPower2**
- □ Examine the NewPower2 legend and notice that the values range from 1 to 9.

The NewPower2 raster has floating-point suitability values that range from 1 to 9. If you are modeling with Map Algebra, then you arc done.

If you use the raster as input to the Weighted Overlay tool, then you will need to convert it to integer first (the tool only accepts integer rasters as input). You can convert the raster to integer in Map Algebra by adding 0.5 to the values to round them, then use the Int (integer) function to truncate the floating-point values to integers.

- □ Run the *Single Output Map Algebra* tool:
- □ Map Algebra expression: type **Int (NewPower2 + 0.5)**
- □ Output raster: type **Newpower3**
- □ Turn off all layers and collapse their legends.

STEP 9: MODEL WITH WEIGHTED OVERLAY

In the Weighted Suitability modeling method, you reclassil5' the individual rasters into units of suitability and then you multiply them by a weight to assign relative importance to each, and add them together for the final result. The Weighted Overlay tool does all these tasks in one execution.

In this step, you will explore the capabilities of the Weighted Overlay tool in the context of implementing the ski resort Accessibility submodel.

- □ In Arc Toolbox, open the Overlay> Weighted Overlay tool.

1. Set the Evaluation scale

You may choose any Evaluation (suitability) scale you want, so long as its From, To, and By values are integers. All the input rasters must use the same scale, and the tool enforces this rule. The input rasters are classified into the scale as they are added, and the Weighted overlay table will not allow you to set Scale Values that exceed the range of the specified Evaluation scale.

If the input rasters have already been classified, you should use a matching Evaluation scale. Changing the scale after adding the rasters causes extra work (you must change the classes), so you normally set the scale first. The default is the Ito 9 scale.

□ For Evaluation scale, review the options in the pulldown.
□ For From, type **0**
□ For To, type **20**
□ For By, type **5**
□ For Evaluation scale, review the options and note that the 0 to 20 by 5 scale was added.
□ For Evaluation scale, **select 1 to 9 by 1.**

2. Add the input rasters and manage them in the Weighted overlay table

You add rasters to the Weighted overlay table by clicking the Add Raster Row button. The Add Weighted Overlay Layer dialog opens, from which you may either browse to rasters or select raster layers. You also select the attribute field that will be used.

□ Click the *Add raster row* button

The Add Weighted Overlay Layer dialog opens. This is a specialized tool that only displays integer rasters in the layer list or in the browser. If you type the path to a floating-point raster, the Add dialog will show an error and will not accept the raster.

□ In the *Add Weighted Overlay Layer* dialog, for Input raster, select *Soil*.

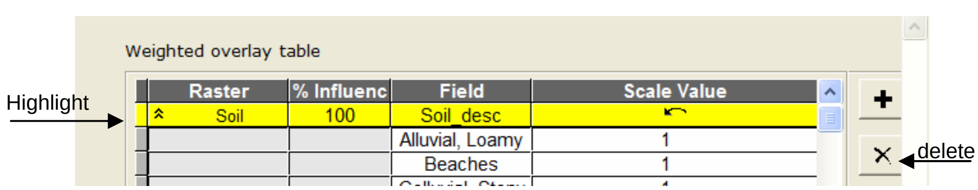
□ For input field, select *Soil_desc*.
□ Click OK to close the *Add Weighted Overlay Layer* dialog.

As you see, text fields may be used in the Weighted overlay table. Using a text field may make it easier to assign the Scale Values, if you need to reclassify the raster.

You may collapse and expand the field value rows for a raster.

□ Click the *Hide rows* control to the left of the *Soil* rasters name.
□ Click the *Show rows* control to the left of the *Soil* rasters name.

You may change the position of a raster in the table by selecting its row and then clicking the Move up or Move down buttons (the arrows) to the right of the table.



You may delete rasters that you might have added by mistake. You select the raster by clicking its table row and then you delete it by clicking the Remove row(s) button.

□ Click the small button to the left of the Soil row to select the raster layer.
□ Click the *Remove* row(s) button.

3. Optionally classify the input values

The Weighted overlay table allows you to classify the input values shown in the Field column and to assign output Scale Values to the classes. If the input raster is already classified, then you generally do not need to do this. You may define classes using lists and ranges, like you do in the Reclassify tool.

- ☐ Add the Soil layer to the Weighted Overlay table. Select Value for the input field.
- ☐ For the first Field row, over-type the Value of 101 with 101 – 106

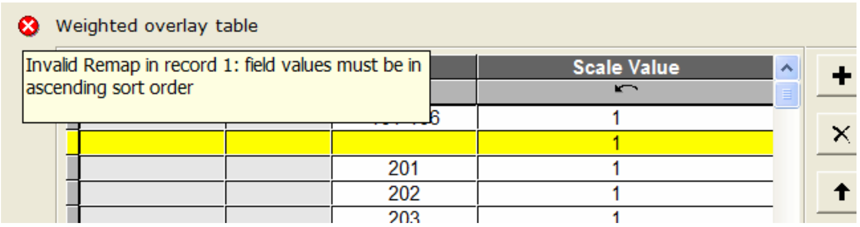
It may be necessary to remove or add rows to the table when you define new classes. You must first select rows to perform these actions.

- ☐ *Click* the small button to the left of the row for *Field value 102*.
- ☐ *Shift-click* the small button to the left of the row for *Field value 106*.
- ☐ *Click* the *Remove row(s)* button to remove the selected rows.
- ☐ *Select* the row for Field value *101 - 106*.

If a single value row is selected, then the Add button inserts a new row below it. If no value rows are selected, then the Add button adds a raster to the table.

- ☐ Click the *Add value* row button

The new row has no Field value, which causes an error. The tool shows errors in the table (the text in the row above the error turns red) and displays an error icon next to the Weighted overlay table control title. The error icon can describe the error.



- ☐ For the new, blank row, type a *Field value* of 107 and press *Enter*.

4. Set the output Scale Value (layer suitability)

After you have defined one or more classes in the Field rows, you then set their output Scale Value. The control only accepts legal values as defined by the Evaluation scale or the special values of Restricted and NoData. You may select values from a pulldown or you may type them.

- ☐ In the row for *Field* value 101-106, click in the *Scale Value*.

□ From the *Scale Value* pulldown, select *Restricted*.

The Restricted value is defined to be one less than the Evaluation scale minimum. That is, in the I to 9 by 1 scale, the Restricted value is zero. If any input layer cell is set to Restricted, the output cell will have that value.

□ Move your mouse over the *Error* icon to raise *ToolTip* text describing the error.

NoData and Restricted values serve different purposes. The NoData value is normally used to identify cells for which you do not know a value, while the Restricted value is used to purposefully exclude unsuitable cells in the model. You should use Restricted so you can tell the difference between unknown and unsuitable values in the output.

5. Set the % influence (layer weights)
The percent influence (% Influence) sets the relative importance of each of the raster layers. When you run the tool, each layers' classified Scale Values are multiplied by the layers' percent influence; then they are added together and are written to the output raster. The sum of all the percent influence values you set must equal 100.

□ Add the *newpower3* layer to the table. Select *Value* for the *Input field*.
□ *Click Hide* rows for both Rasters (this is optional)

You set the percent influence either by typing integer values that add up to 100 for all the rasters or by clicking the Set Equal Influence button (if you had two rasters, each would get 50% influence). The sum is displayed in the Sum of Influence text box.

□ Click *Set Equal Influence* to assign equal influence to all raster layers.
□ For the *Soil layer % Influence*, overtype the existing value with **75**
□ For the *newpower3 layer % Influence*, overtype the existing value with **25**

You may save your classifications and weights to a text file for later use. The one file stores all the layers with their classes and weights. Loading a saved classification replaces all the current rasters and their settings.

□ Click the *Load Table* button to the lower right of the Weighted overlay table.
□ In the browser, navigate to and load ... *\Exercise11\AccessWeights.txt.*
□ Notice that the Rasters have been replaced with *newtravel* and *newpower3.*

You classified both of these layers earlier in this exercise. Since the Weighted Overlay tool cannot input floating-point rasters and has limited classification capabilities, you may find it easier to classify the model layers before you run Weighted Overlay.

□ Click Show rows for each Raster and notice the *Field and Scale Values*.

If you add a raster whose values are within the range of the Evaluation scale you have set, then the input Field values are simply copied to the output Scale Values, and you only need to set the % Influence for each raster.

The ski resort Accessibility submodel combines the travel time and distance to power lines layers to derive an overall value for accessibility. The travel time layer has an importance of 70%, and the distance to power lines layer has an importance of 30%. These weights were set in the table you just loaded, so you are ready to run the tool.

6. Run the tool
Once you have set the classification and influence for each layer, you are ready to run the tool. A new integer raster is created as the output and the output values will be in the range that is defined by the Evaluation scale (like I to 9, with 0 for Restricted).

- □ For *Output raster*, type **Access1**
- □ Click *OK* to run the *Weighted Overlay* tool.

STEP 10: MODEL WITH MAP ALGEBRA
If your model layers are already classified into the same suitability scale, then you can easily weight and combine them with Map Algebra. Just multiply each layer by its weight and add the layers together, as you will in this step. The differences are that the weights are fractions that add up to one and that the result is a floating-point raster.

- □ Run the *Single Output Map Algebra* tool:

- □ MapAlgebra expression: type

```
(NewTravel * 0.70) + (NewPower3 * 0.30)
```

- □ Output raster: type **Access2**

At the end of Step 8, you learned how you could convert Access2 to an integer raster.

- □ Exit ArcMap without saving your changes.

EXERCISE END