

**NAME: Repeating Shapes****Aka:** repeat\_shapes.avx**Last modified:** October 31, 2005**TOPICS:** hexagon, square, triangle, repeat, sample, tessellation, array, matrix, lattice, point, systematic, grid, extent**AUTHOR:** Jeff Jenness

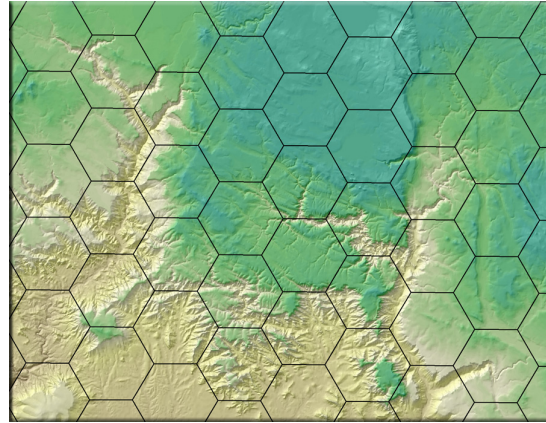
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**DESCRIPTION:** This extension generates an array of repeating shapes over a user-specified area. These shapes can be hexagons, squares, triangles, circles or points, and they can be generated with any directional orientation.

Shapes can be generated over all selected records of a feature theme, over the entire rectangular extent of a theme, over the rectangular extent of all themes in the view, or over the rectangular extent of the display.

This extension can be used in conjunction with the "Random Point Generator" extension ([http://www.jennessent.com/arcview/random\\_points.htm](http://www.jennessent.com/arcview/random_points.htm)) to generate random points within a systematically divided sampling area. This extension can be used to generate systematic polygons over the landscape, and the "Random Point Generator" extension can then be used to generate random sample points within those polygons.

**Output:** This extension produces either a point or a polygon shapefile and adds it as a theme to the view.

**REQUIRES:** This extension requires that the file "avdlog.dll" be present in the ArcView/BIN32 directory (or \$AVBIN/avdlog.dll) and that the Dialog Designer extension be located in your ArcView/ext32 directory, which they usually are if you're running AV 3.1 or better. The Dialog Designer doesn't have to be loaded; it just has to be available. If you are running AV 3.0a, you can download the appropriate files for free from ESRI at:

<http://support.esri.com/index.cfm?fa=downloads.patchesServicePacks.viewPatch&PID=25&MetalD=483>

**REVISIONS:** None yet

**Recommended Citation Format:** For those who wish to cite this extension, the author recommends something similar to:


Jenness, J. 2005. Repeating shapes (repeat\_shapes.avx) extension for ArcView 3.x. Jenness Enterprises. Available at: [http://www.jennessent.com/arcview/repeat\\_shapes.htm](http://www.jennessent.com/arcview/repeat_shapes.htm).

Please let me know if you cite this extension in a publication ([jeffj@jennessent.com](mailto:jeffj@jennessent.com)). I will update the citation list to include any publications that I am told about.


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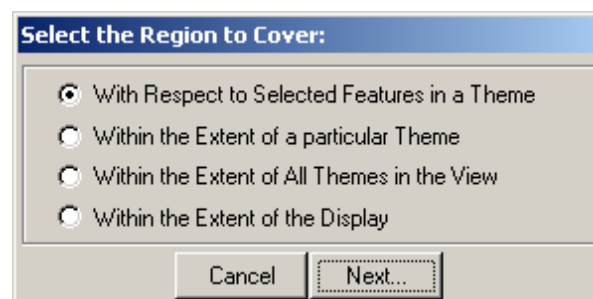
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## General Instructions:

- 1) Begin by placing the “**repeat\_shapes.avx**” file into the ArcView extensions directory (../Av\_gis30/Arcview/ext32/).
- 2) After starting ArcView, load the extension by clicking on **File → Extensions...**, scrolling down through the list of available extensions, and then clicking on the checkbox next to the extension called “**Repeating Shapes.**”
- 3) This extension adds 1 button to your View button bar:  Click this button to generate your shapefile of repeating shapes.
- 4) This extension adds 1 menu item to your View Help Menu [“Check ‘Repeating Shapes’ Scripts”]. Use this menu item if the extension crashes for any reason. Hopefully this function will generate a report with enough information to allow the author to find and fix the problem.

## Choose the Region of Interest:

Click the  button and choose your region of interest:

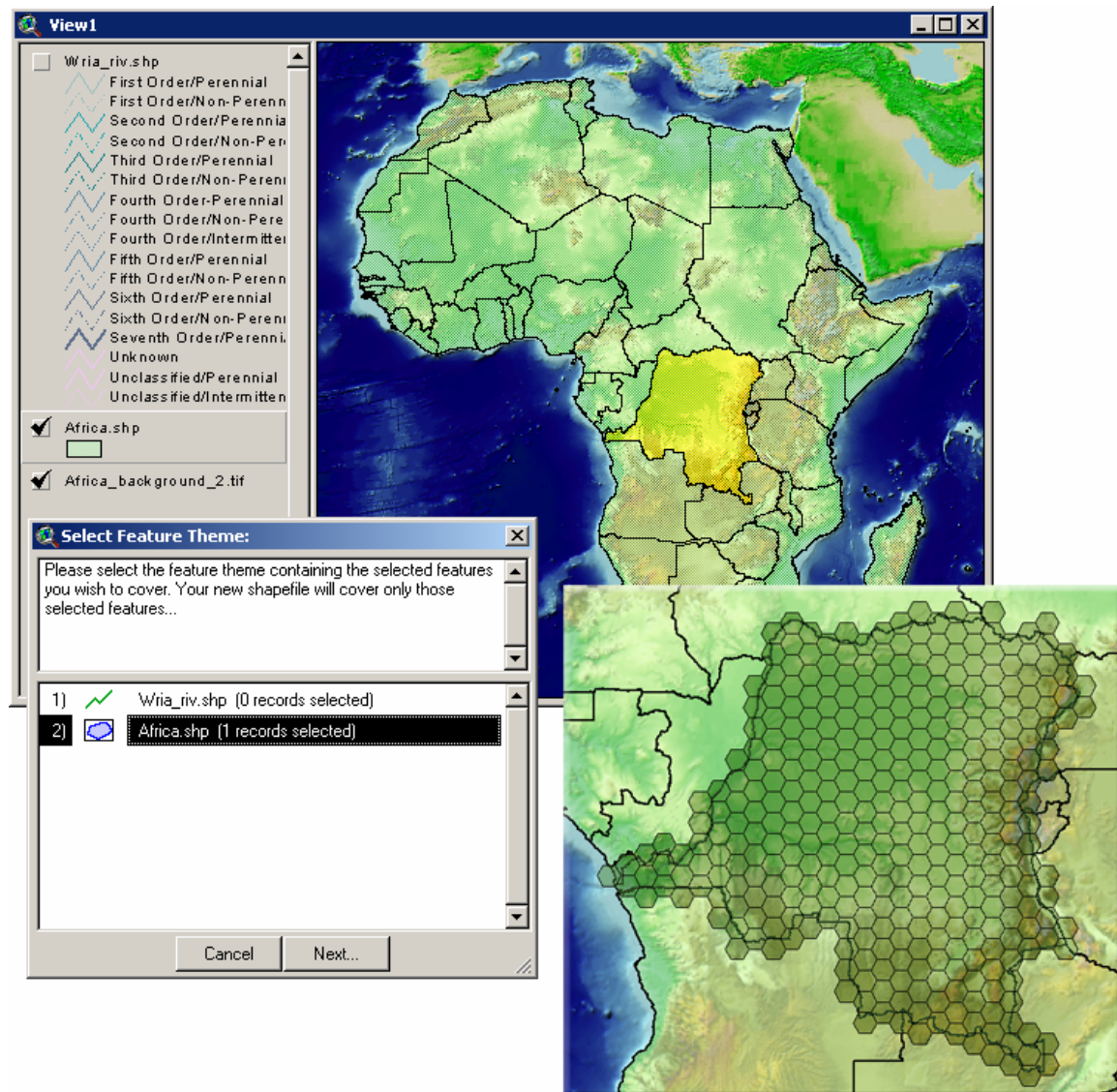


The first option, “With Respect to Selected Features in a Theme”, will generate shapes that will completely cover all the selected features in some point, line or polygon theme. The other three

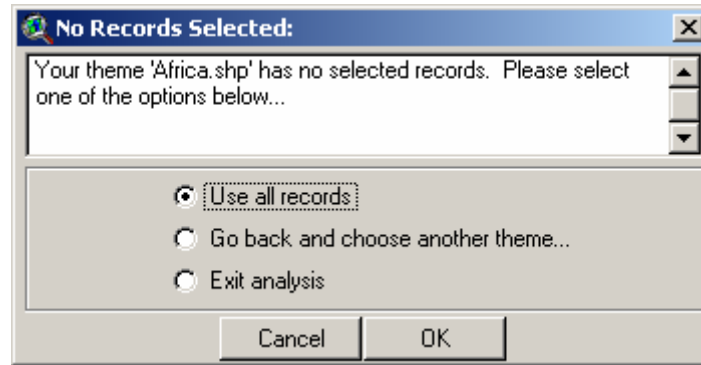
options will generate shapes that completely cover some rectangular area encompassing either a single theme, all the themes in the view, or the visible extent in the view.

***With Respect to Selected Features in a Theme:***

This option will generate shapes that completely cover all the selected features in a feature theme. You will be asked which feature theme to use:

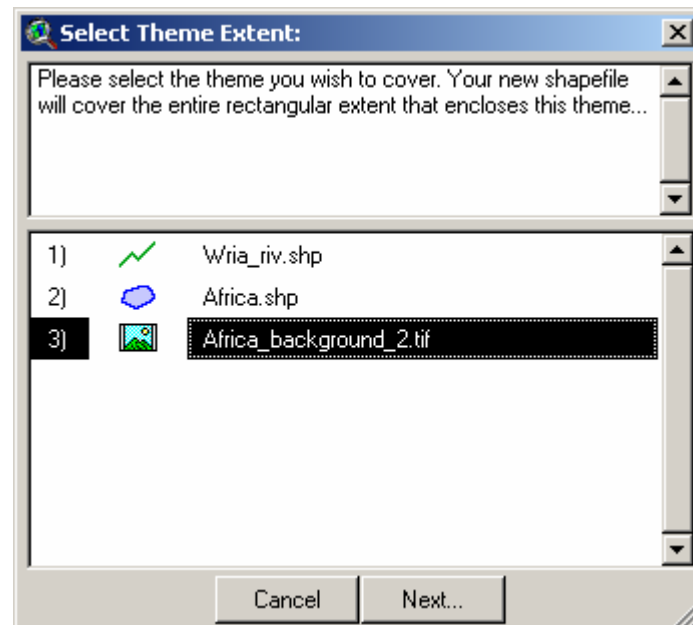


If you choose a theme with no records selected, then you will have the option to either generate shapes over all features or go back and choose another theme:




### ***Within the Extent of a Particular Theme:***

This option will generate shapes that completely cover the entire rectangular area that encompasses your theme. You will be asked with theme to use, and you are not restricted to feature themes for this function:



### ***Within the Extent of All Themes in the View:***

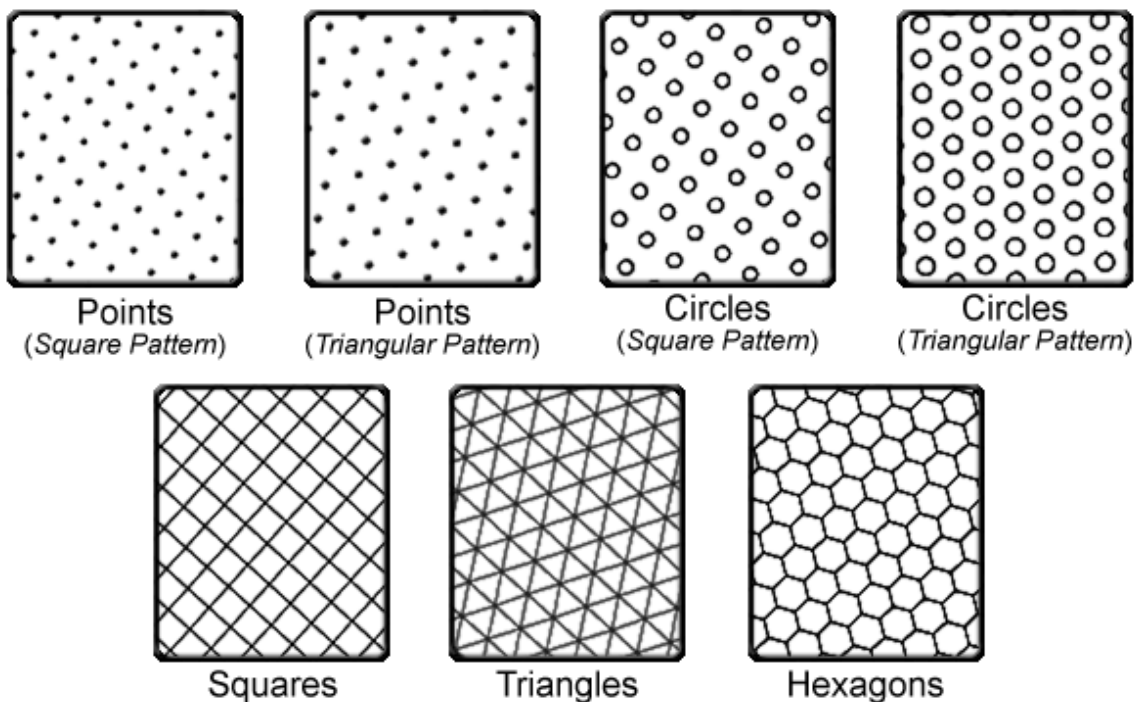
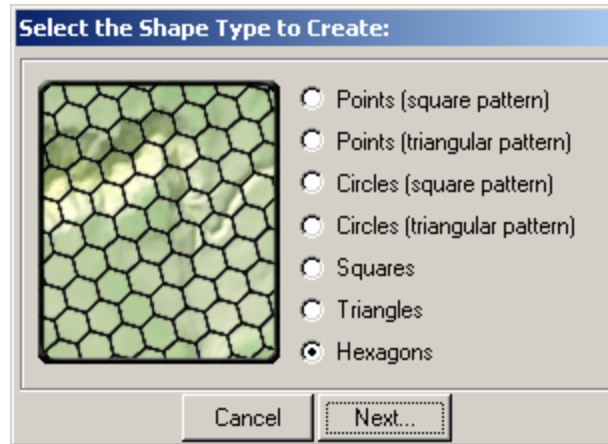
This option will cover all the themes in your view; essentially equal to the rectangular region that you see when you click the “Zoom to Full Extent” button .

### ***Within the Extent of the Display:***

This option will use cover the entire visible region within your view.

## **Choose the Shape Type to Create**

You have seven options for shape type and arrangement. Points and circles may be generated in either a square or triangular pattern. Squares, triangles and hexagons will completely cover the region of interest. All options can be oriented in any direction.



### Set Shape Parameters:

All options have several parameters relating to size, spacing and orientation of shapes. The directions and size values are based on your view projection and data. If your view has no projection set, then you must know the map units of your data and enter your size parameters based on those units. If your view is projected, then this extension will create all points and polygons in the view projection. The extension will then unproject those features before adding them to the shapefile, and therefore the shapes will appear correctly when the theme is added to your view.

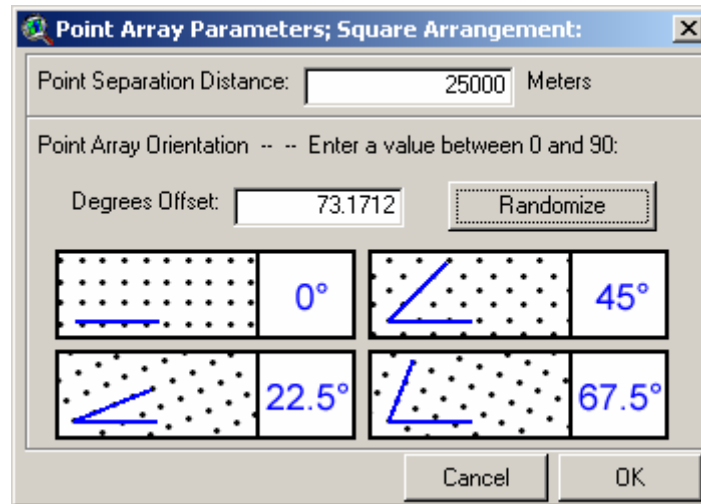
Polygon shapefiles will include an *Area* field, and point shapefiles will include *X-* and *Y-coordinate* fields. If your view is projected, then these area and coordinate values will reflect the area or coordinates in that projection.



### ***Generating Points in a Square Pattern:***

This option generates an array of points lined up in rows and columns, and oriented in any direction you choose. If you found the 4 closest points to some random location within the array, those 4 closest points would form a square.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with perfectly vertical and horizontal rows and columns. An offset value of either 0° or 90° will produce vertical and horizontal rows and columns, and you can enter any value within this range.

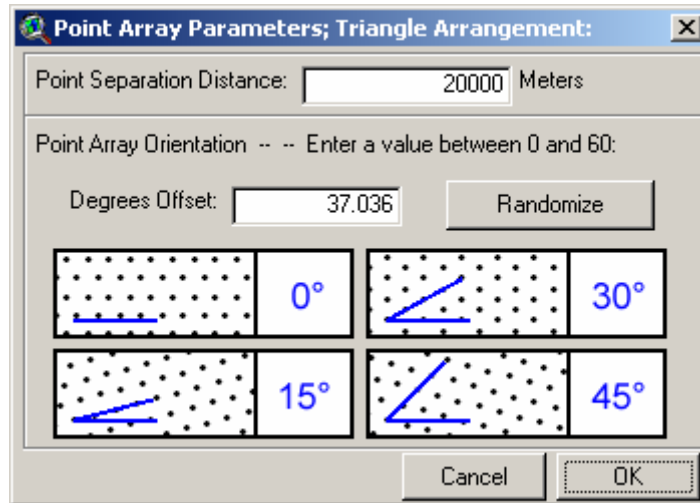


TIP: If you wish to use values of 0°, 22.5°, 45° or 67.5°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 90°, simply click the “Randomize” button.

### ***Generating Points in a Triangular Pattern:***

This option generates an array of points lined up in 3 general directions and oriented in any direction you choose. If you found the 3 closest points to some random location within the array, those 3 closest points would form an equilateral triangle.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array with one perfectly horizontal orientation. An offset value of either 0° or 60° will produce an array with one horizontal row of points, and you can enter any value within this range.



TIP: If you wish to enter values of 0°, 15°, 30° or 45°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 60°, simply click the “Randomize” button.

### ***Generating Circles in a Square Pattern:***

This option generates an array of circular polygons lined up in rows and columns, and oriented in any direction you choose. If you found the 4 circle centerpoints that are closest to some random location within the array, those 4 points would form a square. These circles may overlap and/or may fail to cover the entire region, depending on the size parameters you enter.

You must specify the size of the circles. Circle size may be defined in terms of area, radius, diameter or circumference. If you enter a value for any one of these, the other 3 will fill in automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array with perfectly vertical and horizontal rows and columns. An offset value of either 0° or 90° will produce an array with vertical and horizontal circles, and you can enter any value within this range.

**Circle Parameters; Square Arrangement:**

Circle Size and Spacing -- -- Fill in any of the following:

Area =  sq. Meters

Radius =  Meters

Diameter =  Meters

Circumference =  Meters

Spacing Between Circle Centers:  Meters

Array Orientation -- -- Enter a value between 0 and 90:

Degrees Offset:

	0°		45°
	22.5°		67.5°

TIP: If you wish to enter values of 0°, 22.5°, 45° or 67.5°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 90°, simply click the “Randomize” button.

### ***Generating Circles in a Triangular Pattern:***

This option generates an array of circular polygons lined up in 3 general directions, and oriented in any direction you choose. If you found the 3 circle centerpoints closest to some random location within the array, those 3 points would form an equilateral triangle. These circles may overlap and/or may fail to cover the entire region, depending on the size parameters you enter.

You must specify the size of the circles. Circle size may be defined in terms of area, radius, diameter or circumference. If you enter a value for any one of these, the other 3 will fill automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array with one perfectly horizontal orientation. An offset value of either 0° or 60° will produce an array with one horizontal row of circles, and you can enter any value within this range.



**Circle Parameters; Triangular Arrangement:**

Circle Size and Spacing -- -- Fill in any of the following:

Area =  sq. Meters

Radius =  Meters

Diameter =  Meters

Circumference =  Meters

Spacing Between Circle Centers:  Meters

Array Orientation -- -- Enter a value between 0 and 60:

Degrees Offset:

	0°		30°
	15°		45°

TIP: If you wish to enter values of 0°, 15°, 30° or 45°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 60°, simply click the "Randomize" button.

### **Generating Squares:**

This option generates an array of adjacent square polygons, arranged so that they line up in rows and columns and cover the entire region of interest, and are oriented in any direction you choose.

You must specify the size of the squares. Square size may be defined in terms of area or edge length. If you enter a value for either of these, the other value will fill automatically.

You must specify the general orientation of the array. The "Degrees Offset" value in the dialog below refers to the general orientation of the array in comparison with an array with perfectly vertical and horizontal rows and columns. An offset value of either 0° or 90° will produce an array with vertical and horizontal squares, and you can enter any value within this range.

**Square Parameters:**

Square Size (in view map units) -- -- Fill in any of the following:

Area =  sq. Meters

Edge =  Meters

Square Orientation -- -- Enter a value between 0 and 90:

Degrees Offset:

0° 45° 22.5° 67.5°

TIP: If you wish to enter values of 0°, 22.5°, 45° or 67.5°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 90°, simply click the “Randomize” button.

### ***Generating Triangles:***

This option generates an array of equilateral triangular polygons arranged so that they cover the entire region of interest, and are oriented in any direction you choose.

You must specify the size of the triangles. Triangle size may be defined in terms of area, edge length or height. If you enter a value for any one of these, the other 2 will fill automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array in which one edge of the triangles is perfectly horizontal. An offset value of either 0° or 60° will produce an array with one horizontal edge on the triangles, and you can enter any value within this range.

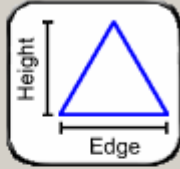
**Triangle Parameters:**

Triangle Size (in view map units) -- -- Fill in any of the following:

Area =  sq. Meters



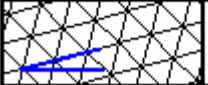
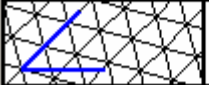
Height =  Meters

Edge =  Meters



Triangle Orientation -- -- Enter a value between 0 and 60:

Degrees Offset:

	0°		30°
	15°		45°

TIP: If you wish to enter values of 0°, 15°, 30° or 45°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 60°, simply click the “Randomize” button.

### ***Generating Hexagons:***

This option generates an array of hexagonal polygons arranged so that they cover the entire region of interest, and are oriented in any direction you choose.

You must specify the size of the hexagons. Hexagon size may be defined in terms of area, edge length, width or diameter. If you enter a value for any one of these, the other 3 will fill automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array in which one edge of the hexagons is perfectly horizontal. An offset value of either 0° or 60° will produce an array with one horizontal edge on the triangles, and you can enter any value within this range.

**Hexagon Parameters:**

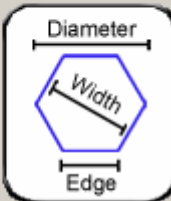
Hexagon Size (in view map units) -- -- Fill in any of the following:

Area = 541265877.365274 sq. Meters

Edge = 14433.756730 Meters

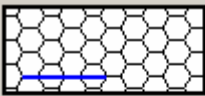
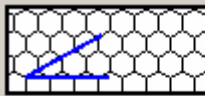
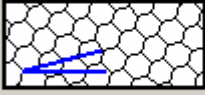
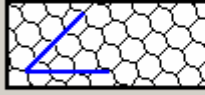
Diameter = 28867.513459 Meters

Width = 25000 Meters



Hexagon Orientation -- -- Enter a value between 0 and 60:

Degrees Offset: 14.3541 Randomize

	0°		30°
	15°		45°

Cancel OK

TIP: If you wish to enter values of 0°, 15°, 30° or 45°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 60°, simply click the “Randomize” button.

### Save Your Data:

After you set your shape parameters, specify a name and location for your new shapefile. This is a standard ArcView dialog box and should be familiar to most users:

**Please specify a name for your shapefile:**

File Name: hexagons47.shp

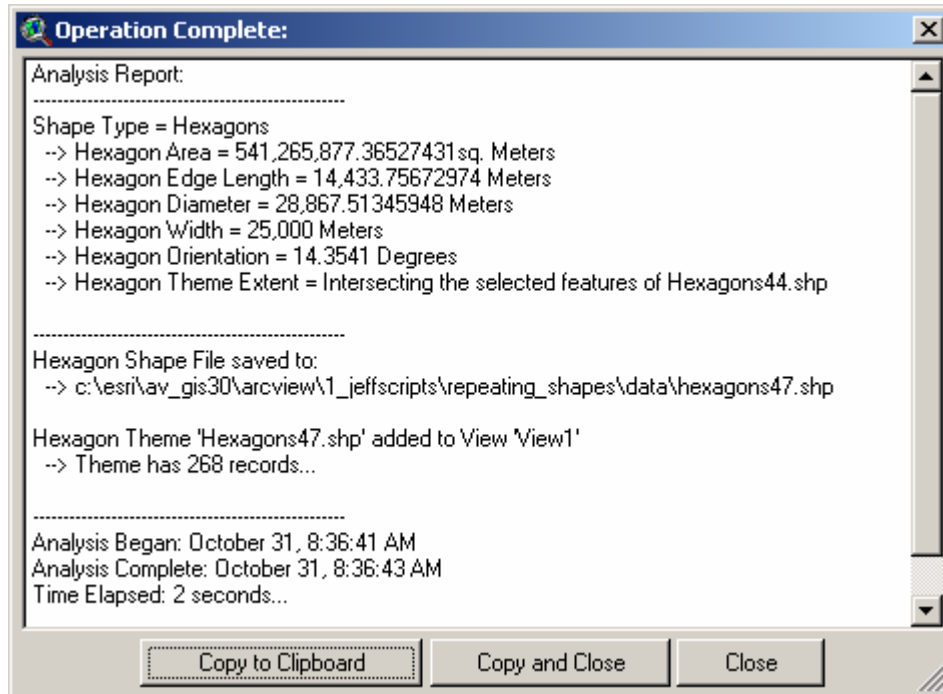
Directories: c:\esri\av\_gis30\arcview\1\_jeffscript

- c:\
- esri
- av\_gis30
- arcview
- 1\_jeffscripts
- repeating\_shapes
- data**

Drives: c:

OK Cancel

As soon as the process finishes, the extension will generate a short report describing what it has done:



## General Notes:

**Stopping the Process:** At any point during the computations you may cancel the process by clicking on the "Stop" button at the bottom right corner of the ArcView window. This will stop the process as soon as the blue progress bar changes. This may be useful to you if you, like the author, accidentally enter a size value in "degrees" while forgetting that the view is currently projected, and therefore causing the extension to attempt to generate a new shapefile with trillions of shapes.

**Troubleshooting:** Please let the author know if the extension crashes for any reason. If it does crash, and if ArcView is still running, click the menu item "Check 'Repeating Shapes' Scripts" in the View "Help" menu to generate a report of all scripts that appear to be malfunctioning. Please copy this report into an email or text file and email it to the author. This report will help the author to identify and fix the problem.

Enjoy! Please contact the author if you have problems or find bugs.

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Updates to this extension and an on-line version of this manual are available at

[http://www.jennessent.com/arcview/repeat\\_shapes.htm](http://www.jennessent.com/arcview/repeat_shapes.htm)

Please visit *Jenness Enterprises* [ArcView Extensions](http://www.jennessent.com/arcview/extensions) site for more ArcView Extensions and other software by the author. We also offer customized ArcView-based [GIS consultation](http://www.jennessent.com/arcview/gis_consultation) services to help you meet your specific data analysis and application development needs.

