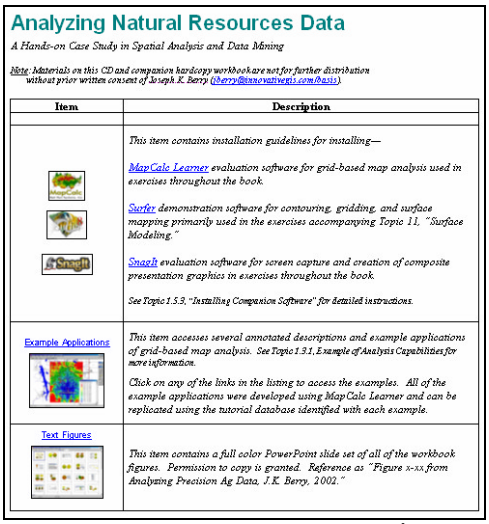
Appendix A

Quick Set of Exercises

A.1 Installing MapCalc

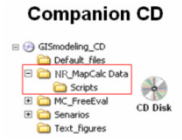
The companion MapCalc Learner CD contains the software and data set used in the following quick set of exercises.

To begin installation, insert the CD into your computer and the main menu will automatically appear.



*If this main menu doesn't appear select "**Start**" à "**Run**" à "**Startup.bat**" from the Windows Task Bar.*

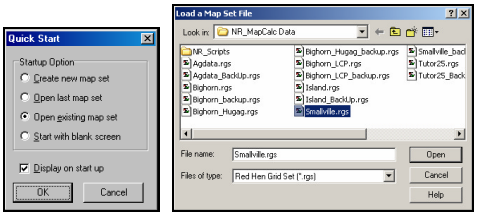
Select the **Install MapCalc** link to begin installing the MapCalc Learner evaluation program. Click on the **Open** button then follow the on-screen instructions using the default specifications (recommended).



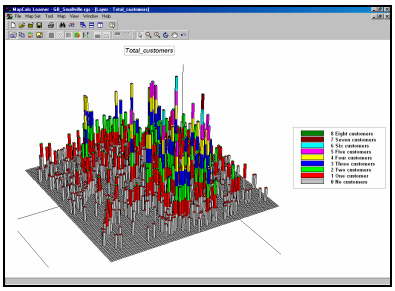
Install the data and support materials by copying the **\NR_MapCalc Data** folder on the CD to the—

...\MapCalc Data folder where the MapCalc program was installed.

Once the program and data are successfully installed, test the system by clicking on **Start** à **Programs** à **MapCalc Learner** à **MapCalc Learner**.



Select **Open existing map set** and browse to the …**\NR_MapCalc Data** folder you installed. Specify **Smallville.rgs** to access the data base used in this set of exercises.

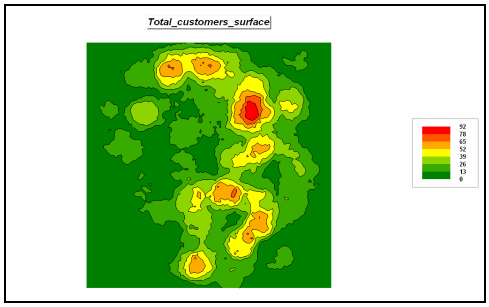


3D surface plot of Total Customers

The following exercise on *Mapped Data Visualization and Summary* will begin at this point. You can exit the program at any time by selecting **File** à **Exit** or by clicking on the "X" in the upper-right corner of the MapCalc program window.

A.2 Mapped Data Visualization and Summary

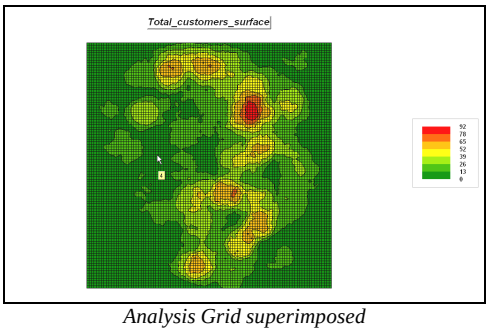
Access the **Total_customers_surface** by clicking on the *View* button and selecting the map from the list.



2D Contour display of the Total_customers_surface

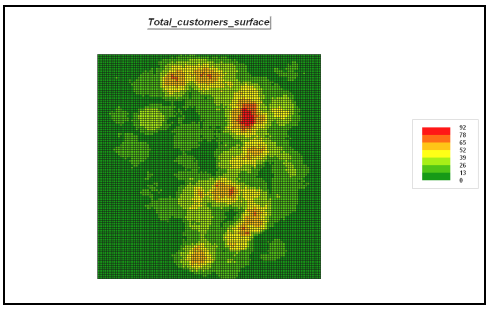
The spatial pattern is shown as a contour map with increasing intervals of 13 customers per .25 square mile. Move the cursor around the map and note the variation in customer density within the contour polygons.

Press the **Layer Mesh** button to overlay the analysis grid containing the actual data. Referring to the coordinates at the extreme lower-left, move the cursor to position [29, 55] and note the customer density estimate for that location (4 customers). It is classified as dark-green and falls within the range 0-13 customers. The "thematic" accuracy of this contour view is +/- 13 customers (contour interval range).



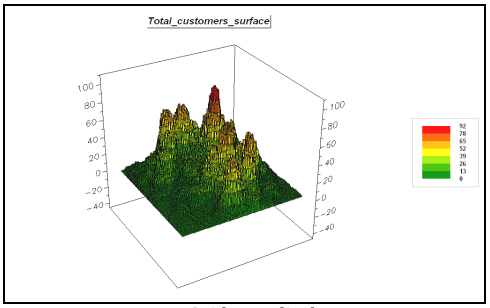
Analysis Grid superimposed

Press the **Use Cells** button to convert the display from a contour line map to a grid cell surface map. In this display each grid cell containing a yield estimate is displayed with a color within its interval range. Note that the contour map contained irregular polygons whereas the grid map contained regular mesh of cells defining the spatial pattern of yield. In *MapCalc* the grid map surface is stored and the contour lines are generated "on-the-fly" as a map is displayed.



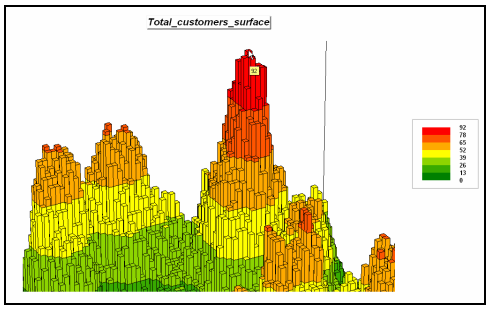
2D Grid map display

Press the **Toggle 3D View** button to convert the display to a 3D Grid map



3D Grid map display

Use the **Zoom In/Out, Rotate** and **Move** tools to resize, shift and spin the display.

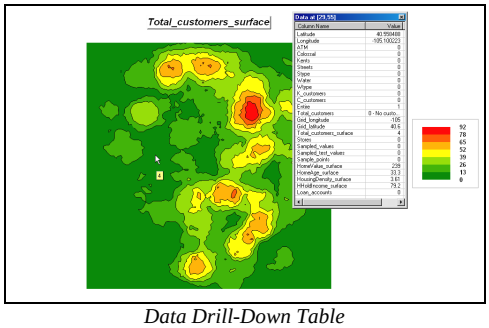


Enlarged and Rotated view

Press the **Reset View to defaults** button to return to the normal display settings. Note that the height of the extruded cell indicates the actual customer density estimate at each location, while the color of the top portion indicates the contour range that contains the estimate. The "peaks and valleys" of the surface define the spatial distribution of customer density within the project area—large spikes indicating grid cells with high customer densities.

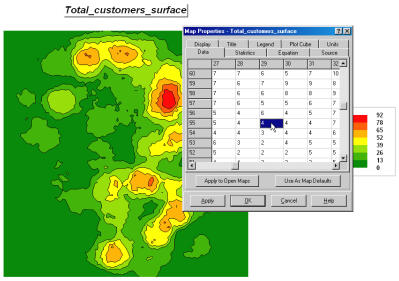
Press the **Toggle 3D View** button to return the display to 2D; the **Use Cells** button to return to a standard contour map. Toggle off the **Layer mesh** button to remove the analysis grid.

Double-click anywhere on the map to pop-up the "Data drill-down" window. As you move the cursor over the map, the window reports the data values on all of the maps in the data set for each grid cell location. Click on the "XC" in the upper right corner to close the data drill-down window.



Data Drill-Down Table

Right-click anywhere on the map and select **Properties** to get a summary of the customer density data. Click on the **Data** tab to get a listing of the values stored in the map's table.



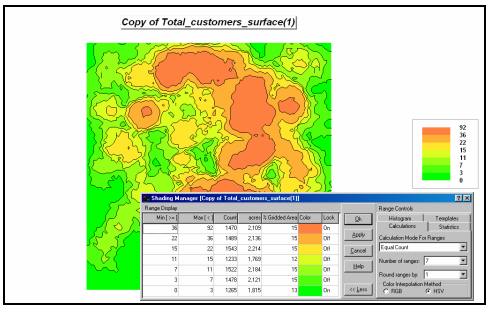
Map Properties showing the Data Table

Click on the **Statistics** tab to get a statistical summary of the map values— mean= 17.7and StDev= 16.0. Click on the other tabs to see what information they contain… e.g., "Title" and "Legend" specifies the appearance of the text in the map display. Press the **Cancel** button to dismiss the map properties window.

Press the **View, rename and delete layers** button, select **Total_customers_surface** then press the *Clone view* button to generate a copy of the customer density map.

Right-click on the copied map and select **Shading Manager** to pop-up the display settings. Complete the following steps to generate a different map display.

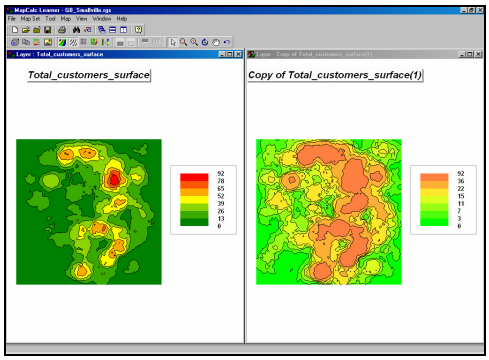
- ü Select **Equal Count** from the *Calculation Mode for ranges* scroll list.
- ü Select **7** from the *Number of ranges* scroll list.
- ü Click on the **dark green** color strip for the lowest interval, select **light green** from the pallet and press **Apply** to register the change.
- ü Click on the green color strip for the highest interval, select **orange** for the color
- ü Under the "Lock" column, click off the yellow inflection point to form a continuous color ramp (gradient) from bright green to orange.
- ü Press **OK** to apply all of the changes and re-display the map using the new interval/color themes.



Redefining the color pallet for a map display

Use the **Arrange windows vertically** button to display all of the open map windows. Use the **Close** button in the upper right corner of the window to close all of the windows except the two views of the *Total_customers_surface* data.

Press **Arrange windows vertically** button again to place the map windows side-by-side. Both displays use the same data but the characterization of customer patterns look radically different.



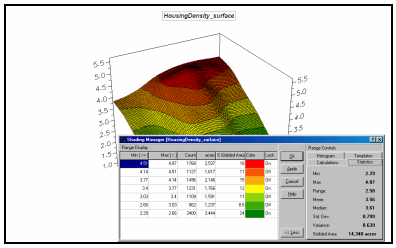
Visually comparing maps

The *Equal Ranges* method of calculating contour interval divides the range of yield values into equal data steps… 13 customers per step. The *Equal Count* method, on the other hand, divides the data range into groups having about the same proportion of the project area… about 1425 grid cells (14% of the total area).

*See **Topic 3**, Grid-based Mapping, for discussion and more hands-on experience with map display and data types.*

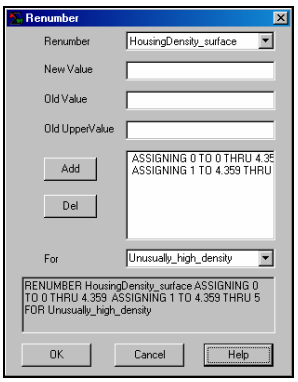
A.3 Identifying Data Zones

Display the **HousingDensity_surface** map, press the **Shading Manager** button and select the **Statistics** tab.



Note that the Mean value of housing density is 3.56 units/ac with a standard deviation of 0.799. The cutoff for unusually high density levels is 4.359 (3.56 + 0.799).

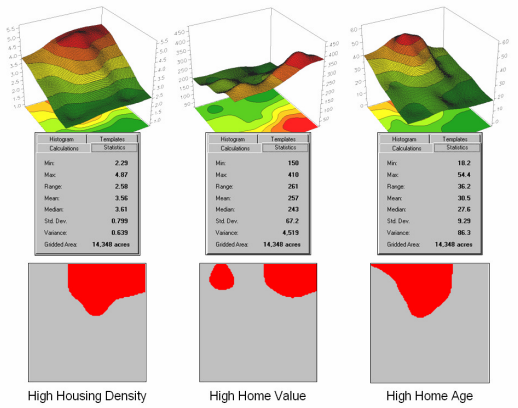
Select **Map Analysis** à **Reclassify** à **Renumber** to generate a binary map of unusually high housing density by completing the following.



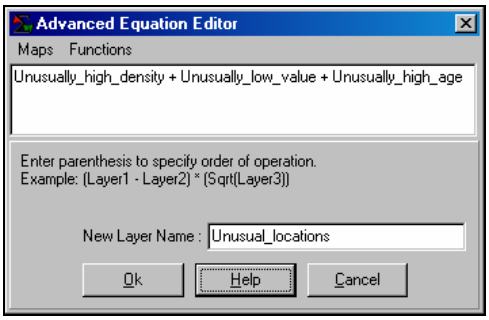
RENUMBER HousingDensity_surface ASSIGNING 0 TO 0 THRU 4.359 ASSIGNING 1 TO 4.359 THRU 5 FOR Unusually_high_density

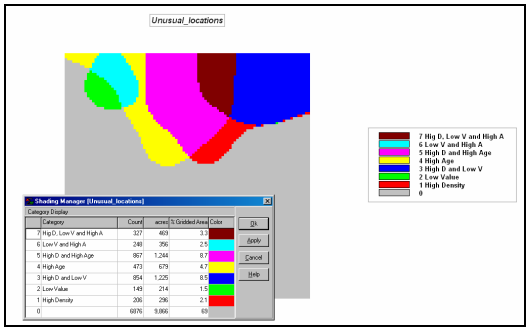
Repeat similar processing (cutoff= mean - StDev) to isolate the areas of *Low home value* as **2** from the **HomeValue_surface** map.

Repeat (cutoff= mean + StDev) *High home age* levels as **4** from the **HomeAge_surface** map *High home age* levels as **4** from the **HomeAge_surface** map.



Select **Map Analysis** à **Overlay** à **Calculate** and add the three binary maps together.

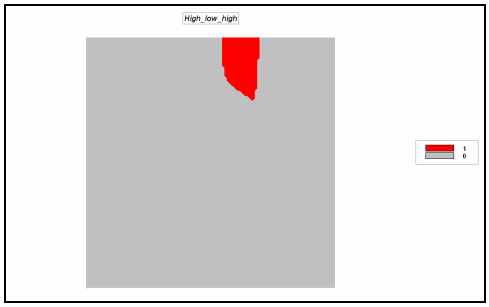




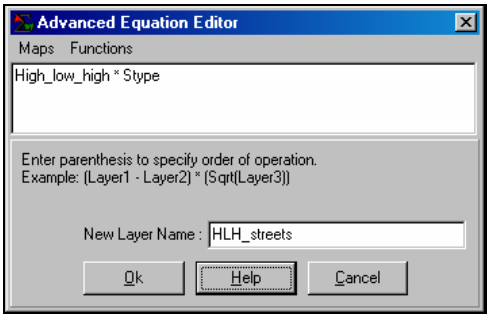
The summed values identify unique combinations of the three maps—

7= *High Density, Low Value and High Age*
6= *Low Value and High Age*
5= *High Density and High Age*
4= *High Age*
3= *High Density and Low Value*
2= *Low Value*
1= *High Density*
0= *not unusual*

Most of the project area (69% grey) does not contain areas with unusual conditions. Note that all three conditions coincide in a small area in the northern part of the project area (3.3% dark magenta). Isolate this area by selecting Reclassify à Renumber and entering the command "RENUMBER **Unusual_locations** ASSIGNING **0** TO **1** THRU **6** ASSIGNING **1** TO **7** FOR **High_low_high**."

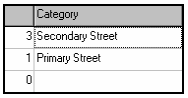


Identify the streets in this area by selecting **Overlay** à **Calculate** and entering the command "Calculate **High_low_high * Stype** FOR **HLH_streets**."

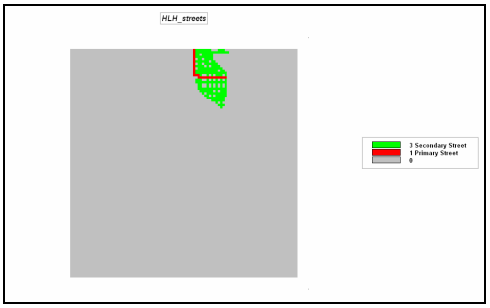


 Press the **Use Cells** button to switch to Grid *display type*.

 Press the **Data Type** button to switch the *data type* to Discrete.



Double-click on the map legend to pop-up the discrete map *Shading Manager* window. Enter the labels "Primary Street" for category 1 and "Secondary Street" for category 3. Press **OK** to display.



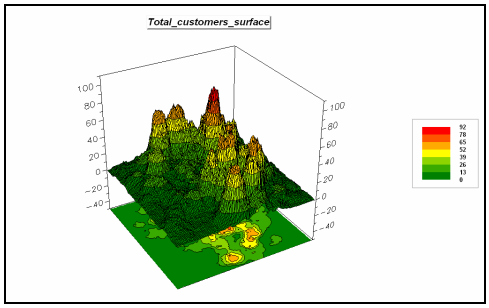
*See **Topic 7**, Spatial Data Mining, and **Topic 8**, Predictive Modeling for discussion and more hands-on experience with analyzing spatial relationships among maps.*

A.4 Identifying Unusual Areas

Access *MapCalc Learner* using the **GB_Smallville.rgs** database.

 Access the **Total_customers_surface** by clicking on the *View* button and selecting the map from the list.

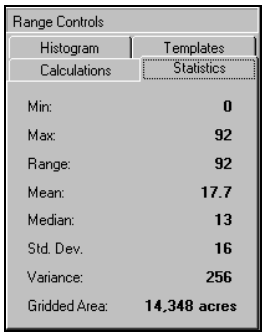
 Press the **Toggle 3D View** button to convert the display to 3D and then press the **Layer Mesh** button to superimpose the analysis grid to generate a "3D wireframe," or Lattice view.

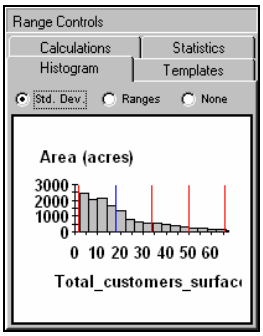


3D Lattice display with projected 2D contour map

Note that customer density varies from 0 (no customers within 6 cells—1500 feet) to a high of 92 customers in the northeastern quadrant.

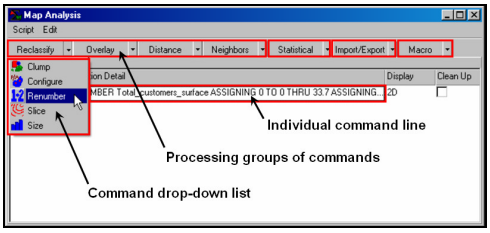
 Press the **Shading Manager** button (or right-click on the map and select *Shading Manager*) to pop-up its dialog box. Select the **Statistics** tab to get a summary of the mapped data forming the customer density surface. Select the **Histogram** tab click on the *Std. Dev.* option to get a histogram plot of the data with vertical lines indicating the mean (blue) and standard deviation (red).





Note that the *Mean* (average) density is 17.7 and the *Standard Deviation* is 16.0. Generally speaking, locations with customer densities greater than the mean plus one standard deviation are considered unusually high densities—pockets of high customer density.

The **Map Analysis** button provides access to all of the analytical operations in MapCalc—*Reclassify, Overlay, Distance, Neighbors and Statistical*. Note the organization of the map analysis menu as shown in the following figure.

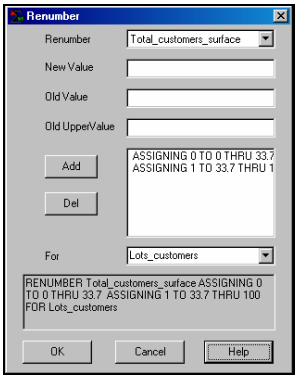


The map analysis window is used to process maps and develop analytical models.

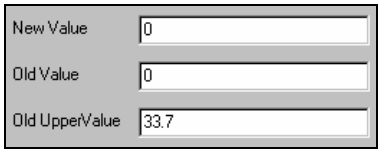
The following command determines the areas of high customer density in the Smallville project area—locations that are greater than the Mean + 1 Standard Deviation = 17.7 + 16.0 = 33.7 customers.

 Press the map Analysis button to pop-up the map analysis window.

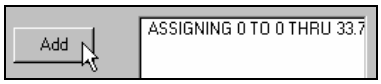
Select **Reclassify** à **Renumber** to pop-up the Renumber command input fields. Complete the dialog box as shown below and described in the step-by-step instructions.



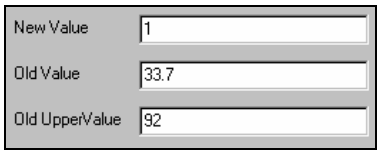
Select the **Total_customers_surface** map.



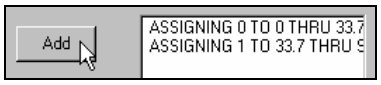
Enter the assignment values that assigns **0** (*New Value*) to **0** (*Old Value*) through **33.7** (*Old UpperValue*). This assignment phrase assigns the value 0 to the range of customer density values from 0 (minimum value) to 33.7—not unusually high.



Press the **Add** button to submit the assignment phrase.

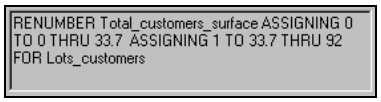


Enter the assignment values that assigns **1** (*New Value*) to **33.7** (*Old Value*) through **92.0** (*Old UpperValue*). This assignment phrase assigns the value 1 to the range of customer density values from 33.7 to 92 (maximum value)—unusually high as more than one standard deviation above the mean.



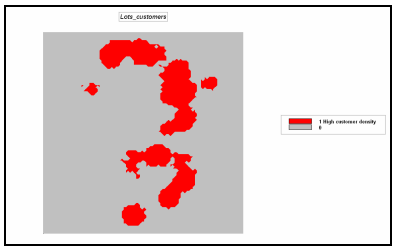
Press the **Add** button to submit the second assignment phrase.

Enter **Lots_customers** as the map name for the new map that will be created.



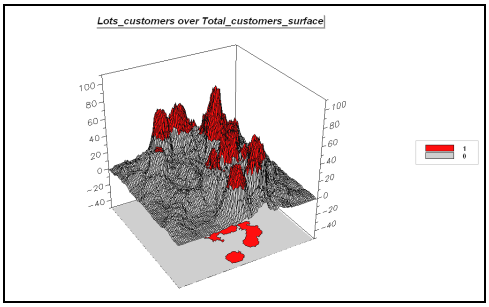
Note that a grammatically correct command sentence is constructed that "Renumbers" the original customer density map for a new map that isolates locations of high customer density.

Press **OK** to generate the map. Press the *close* button ("**X**") in the upper right corner of the *Map Analysis* window to close it (no need to save the working script).



The new map you just generated can be graphically overlaid on the original. Use the *View* button to access the **Total_customers_surface**. Use the *Toggle 3D* and *Layer Mesh* buttons to display the map as a 3D wireframe plot.

From the *Main Menu* select **Map** à **Overlay** à **Lots_customers** to drape it on the surface.

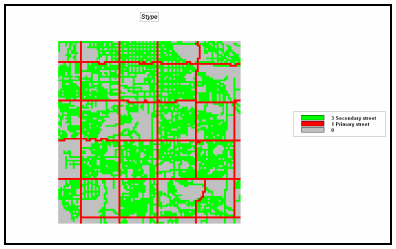


Note that locations of unusually high customer density align with the peaks of the customer density surface.

*See **Topic 6**, Surface Modeling, for discussion and more hands-on experience with procedures analyzing surface maps generated from point data.*

A.5 Creating Travel-Time Maps

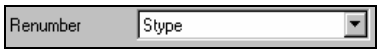
Use the *View* button to obtain a display of the street type map (***Stype***). Note that there are two types of streets in the project area—Primary and Secondary.



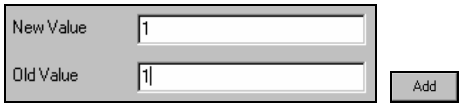
It is assumed that movement along secondary streets is three times slower than movement along primary streets.

 Click on the Map Analysis button, select **Reclassify** à **Renumber** and complete the dialog box to generate the command line…

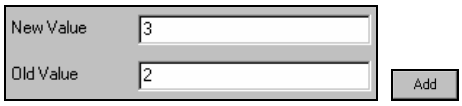
RENUMBER Stype ASSIGNING 1 TO 1
ASSIGNING 3 TO 2 FOR Travel_friction



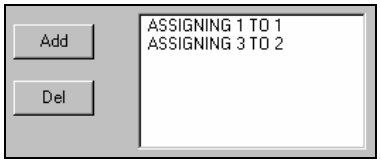
Select **Stype** from the drop-down list of maps.



Enter the "assignment" phrase for the primary streets that assigns the new value of 1 (easiest to cross; relative friction) to the old value of 1 (street type 1) and press the *Add* button to register the assignment.

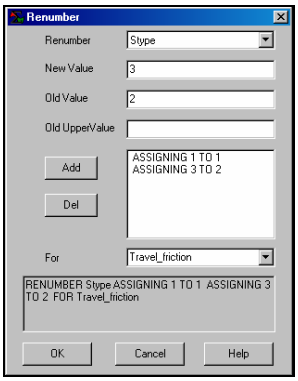


Enter the "assignment" phrase for the secondary streets that assigns the new value of 3 (three times more difficult to cross) to the old value of 2 (street type 2) and press the *Add* button to register the assignment.



The accumulative assignment list should have two entries.

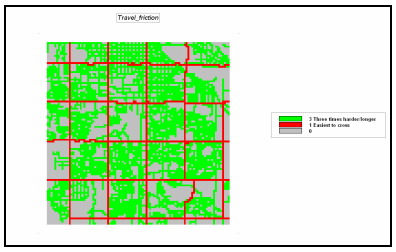
Enter the map name **Travel_friction** for the new map that will be created. The completed renumber command window should like the one below.



Command line created:

RENUMBER **Stype**
ASSIGNING **1** TO **1**
ASSIGNING **3** TO **2**
FOR **Travel_friction**

 Press the **OK** button to create the travel friction map. Press the **Use Cells** button to generate the display shown below.

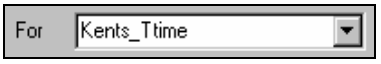


 Click on the *Map Analysis* button, and select **Distance** à **Spread**. Complete the dialog box as…

Specifying **Kents** as the "starter" map.

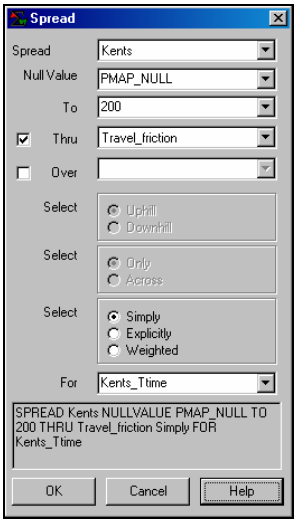
Specifying up to **200** cells away to insure travel-time is computed throughout the entire map area.

Specifying the **Travel_friction** map as the "Thru" map indicating relative ease of travel— 1= easiest, 3= three times longer and 0= can't go (absolute barrier to vehicular travel).

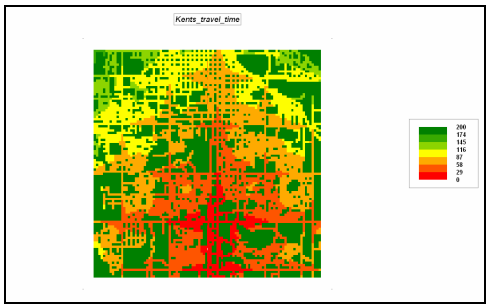


Specifying **Kents_Ttime** as the output map's name.

The completed dialog box should look like the one below. If so, then press **OK** to generate the travel-time map from Kent's.



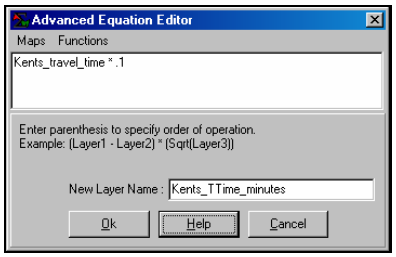
Press the **Use Cells** button to generate the display shown below.



Moving the cursor about the map shows the relative travel-time. Locations with the value 200 assigned are "200 or more units away" (dark green) that are actually infinitely far away for a car as they are not part of the street network. The farthest away location reachable by car is in the upper-left corner (NW) reporting 171 "base cells" away.

Field study shows that it takes on the average one-tenth of a minute (6 seconds) to traverse a primary street grid cell. The knowledge that the "base cell" value of 1 cell is equated to .1 minute can be used to recalibrate the map to "minutes" away from Kent's.

Click on the *Map Analysis* button, select **Overlay** à **Calculate** and complete the dialog box as shown below. Click on the "Maps" menu item to pop-up a list of current maps and select **Kents_travel_time**. Complete the equation to read "Calculate Kents_travel_time * .1" and name the output map **Kents_TTime_minutes**.



Now as you move the cursor over the map the values indicate the estimated travel-time in minutes from Kent's Emporium to all street locations in the project area (20 indicates off road).

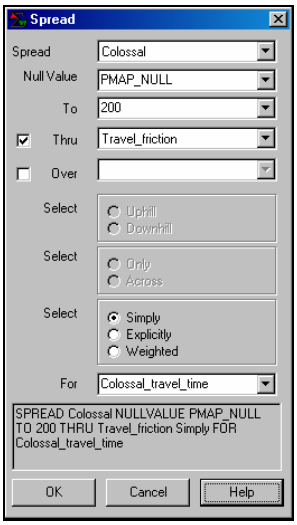
*See **Topic 4**, Spatial Analysis for discussion and more hands-on experience with procedures calculating distance and connectivity.*

A.6 Competition Analysis

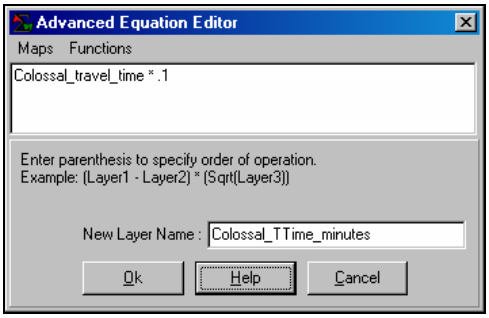
Create a travel-time surface for Colossal Mart using the same procedure you used in the previous exercise.

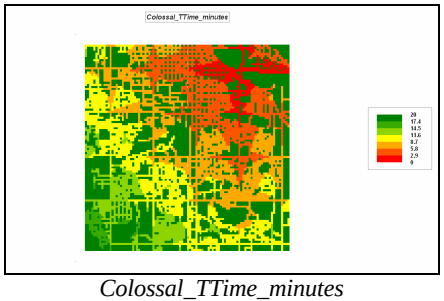
Access the *Map Analysis* window.

Select **Distance** à **Spread** command and complete the *Spread* dialog box as shown below to derive a travel-time map from Colossal Mart.

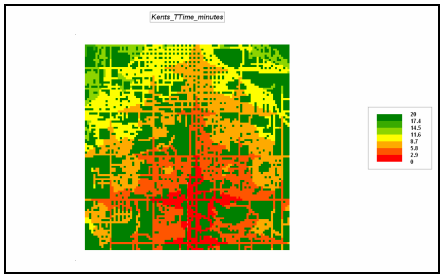


Select **Overlay** à **Calculate** command and complete the *calculate* dialog box as shown below to calibrate travel-time in minutes.



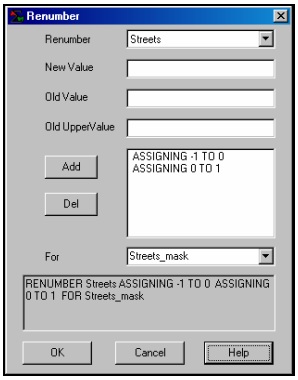


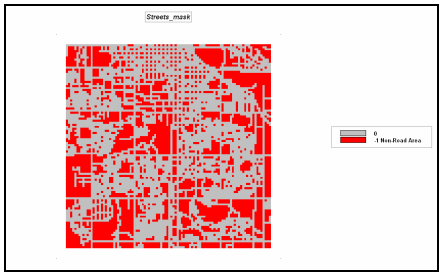
Colossal_TTime_minutes



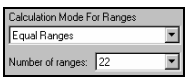
Kents_TTime_minutes

Create a "mask" of the non-road areas by selecting **Reclassify** à **Renumber** and entering the following command.





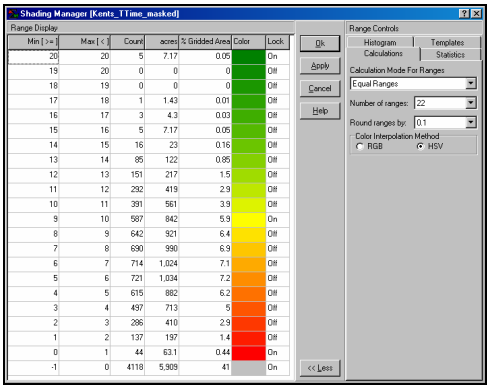
Use the **Overlay** à **Cover** command to mask the non-road areas on the **Kents_TTime_minutes** map as shown below.



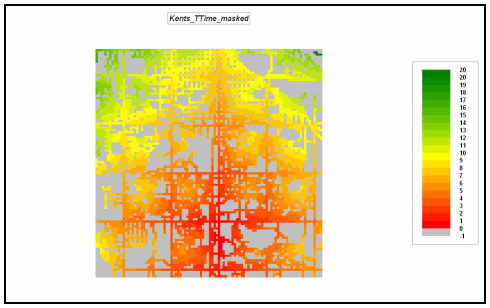
Double-click on the map legend and set the Number of ranges to 22 to set a one-minute interval.

Click on the red color box for the -1 to 0 interval and set its color to light grey. Click on the 0 to 1

interval's color box and set its color to red. Click off the color *Lock* beside the yellow box and the colors will ramp from red (close) to green (far away). Click on the 9 to 10 color box and set it to yellow to create a color inflection at that point (see below).

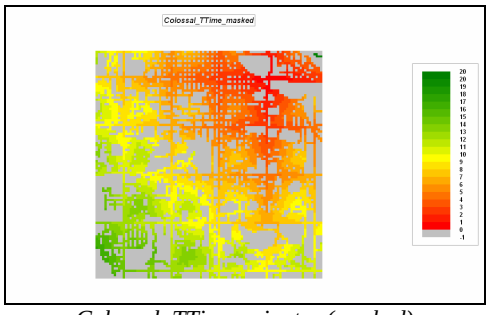


Click **OK** to generate a display with the new legend settings.



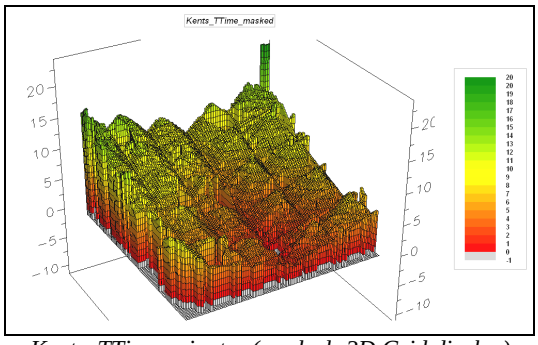
Kents_TTime_minutes (masked)

Repeat the masking procedure for the **Colossal_TTime_minutes** map and display with the same color pallet.

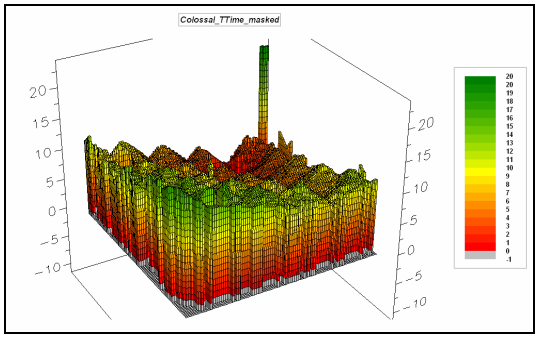


Colossal_TTime_minutes (masked)

  use the 3D Toggle, Zoom-out, Zoom-in, Rotate and Pan tools to investigate the configuration of the travel-time surfaces.



Kents_TTime_minutes (masked; 3D Grid display)

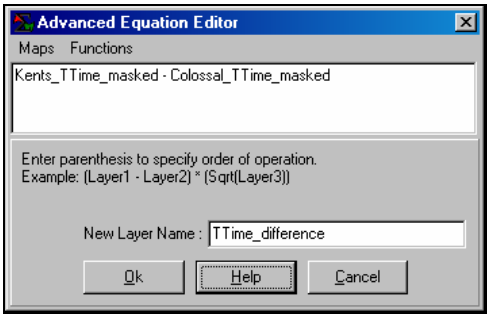


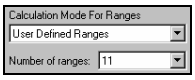
Colossal_TTime_minutes (masked; 3D Grid display)

Note that the surfaces have low values near the store that increase as locations become farther away. The result is a bowl-like configuration with the store at the lowest location (0 minutes away from itself).

Can you explain the peculiar-looking pillar in the northeast corner of the 3D display? Hint: has something to do with disconnected streets.

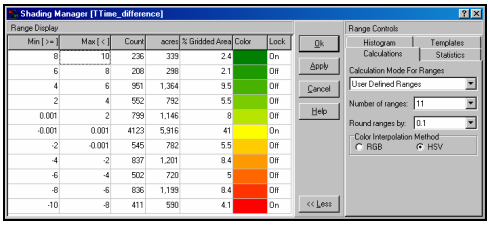
 Use **Overlay** à **Calculate** to compute the difference between the two travel-time surfaces as shown below.

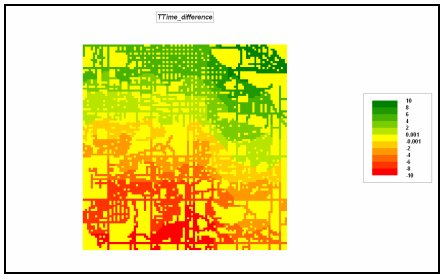




Double-click on the **TTime_difference** map's legend to pop-up the *Shading Manager*. Select **User Defined Ranges** as the *Calculation Mode* and **11** for the *Number of*

Ranges. Click on the last number in the *Min [>=]* extreme left column and enter **-10**. Press the up arrow and enter **-8**. Repeat the process to enter the other range breaks— **-6**, **-4**, **-2**, **-.001**, **.001**, **2**, **4**, **6**, **8** and **10** (top of the *Max [<=]* column). Assign **red** to the -10 to -8 range, **yellow** to -.001 to .001 and **green** to 8 to 10. Press **OK** to display the as a 2D Grid.

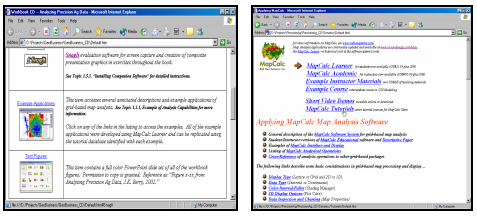




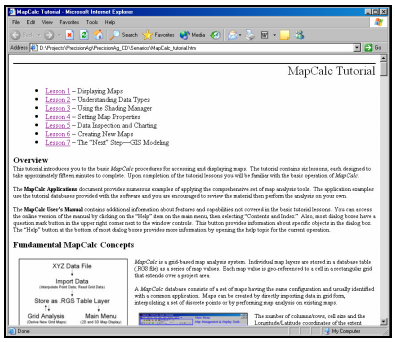
*See **Topic 5**, Analyzing Location for discussion and more hands-on experience with procedures analyzing effective proximity.*

A.7 Additional Tutorial Exercises

Additional tutorial exercises using MapCalc are available with the CD materials. To view the tutorials insert the CD into your drive and select **Example Applications** à **MapCalc Tutorials**.



*If this main menu doesn't appear select "**Start**" à "**Run**" à "**Startup.bat**" from the Windows Task Bar.*



- ü Lesson 1 – Displaying Maps
- ü Lesson 2 – Understanding Data Types
- ü Lesson 3 – Using the Shading Manager
- ü Lesson 4 – Setting Map Properties
- ü Lesson 5 – Data Inspection and Charting
- ü Lesson 6 – Creating New Maps
- ü Lesson 7 – The "Next" Step—GIS Modeling

There are seven tutorials designed to give you a working knowledge of basic concepts and procedures used in grid-based map analysis.