Appendix A

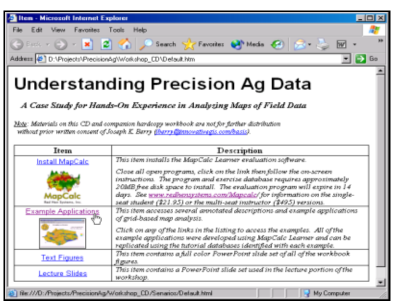
Quick Set of Exercises

<…being updated for use with Geo-Business data; March, 2003>

A.1 Installing MapCalc

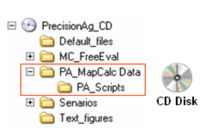
The companion MapCalc Learner CD contains the software and data set used in the following quick set of exercises.

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

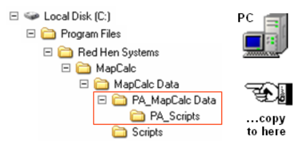


*If this main menu doesn't appear select "**Start**"→ "**Run**"→ "**Startup.bat**" from the Windows Task Bar.*

 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).

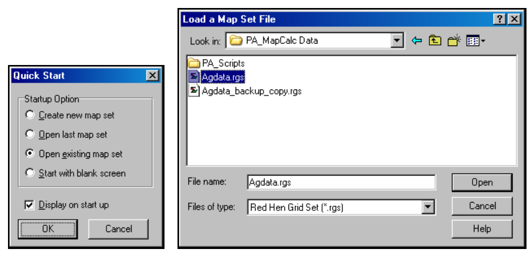


Install the data and support materials by copying the **\PA_MapCalc Data** folder on the CD to the—

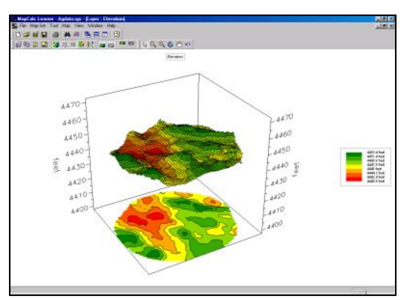


...\MapCalc Data folder where the MapCalc program was installed.

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



Select **Open existing map set** and browse to the …**\PA_MapCalc Data** folder with the special workbook data and support materials. Specify **PA_AgData.rgs** to access the data base used in this case study.



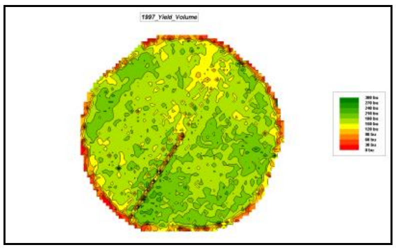
3D surface plot of field terrain (elevation)

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 → Exit** or by clicking on the "X" in the upper-right corner of the MapCalc program window.

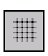
A.2 Mapped Data Visualization and Summary

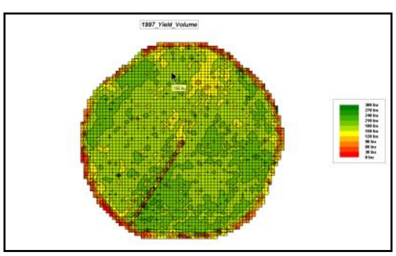
 Access the **1997_Yield_Volume** map by clicking on the *View* button and selecting the map from the list.



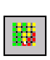
Basic Yield Map Display

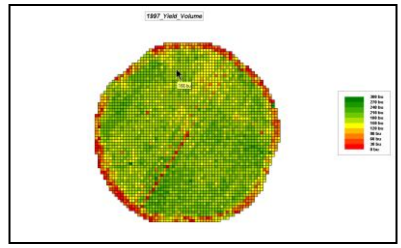
The yield pattern is shown as a contour map with 30 bushel intervals. Move the cursor around the map and note the variation yield estimates within the contour polygons.

 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, 54] and note the yield estimate for that location (166bu). It is classified as light-green and falls within the range 150-180bu. The "thematic" accuracy of this contour view is +/- 30 bushels (contour interval range).



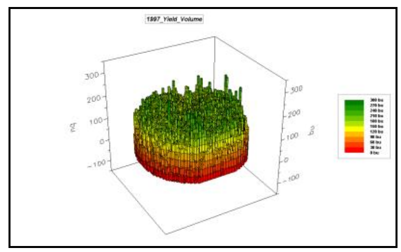
Analysis Grid Superimposed

 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.



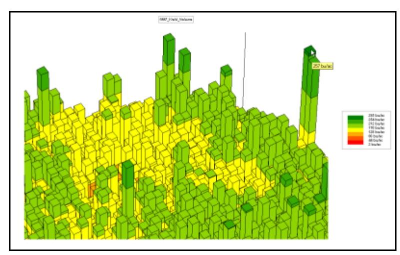
Grid Map Display

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

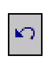


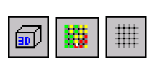
3D Grid Map Display

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

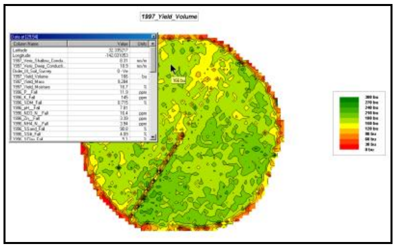


Enlarged and Rotated View

 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 yield 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 yield within the field—large spikes indicating grid cells with high yields.

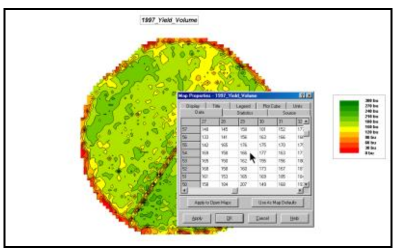
 Press the **Toggle 3D View** button to return the display to 2D; the **Use Cells** button to return to a standard contour map; and the **Layer mesh** button to remove the analysis grid.

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.



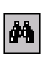
Data Drill-Down Table

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



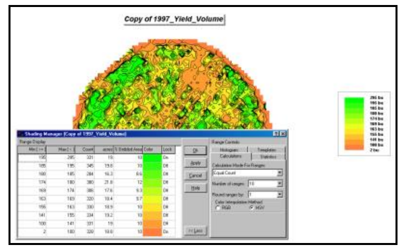
Map Properties Showing the Data Table

Click on the **Statistics** tab to get a statistical summary of the map values— mean= 158.8 and StDev= 41.3. 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 **1997_Yield_Volume** then press the *Clone view* button to generate a copy of the yield 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.

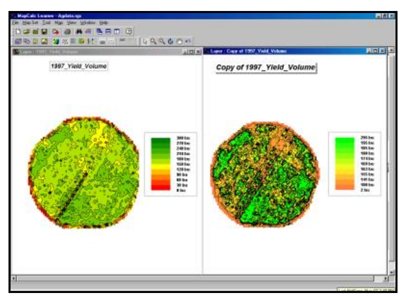
- ✓ Select **Equal Count** from the *Calculation Mode for ranges* scroll list.
- ✓ Select **10** from the *Number of ranges* scroll list.
- ✓ Click on the **red** color strip for the lowest interval, select **orange** from the pallet and press **Apply** to register the change.
- ✓ Click on the green color strip for the highest interval, select **bright green** for the color
- ✓ Under the "Lock" column, click off the yellow inflection point to form a continuous color ramp (gradient) from orange to bright green.
- ✓ Press **OK** to apply all of the changes and re-display the map using the new interval/color themes.



Redefining 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 1997_Yield_Volume data.

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



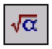
Visually Comparing Maps

The *Equal Ranges* method of calculating contour interval divides the range of yield values into equal data steps… 30 bushels per step. The *Equal Count* method, on the other hand, divides the data range into groups having about the same proportion of location… about 320 grid cells (19 acres).

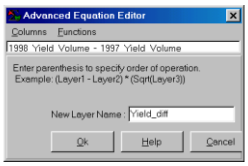
*See **Topic 2**, Mapped Data Visualization and Summary, for discussion and more hands-on experience with this type of analysis.*

A.3 Comparing Mapped Data

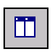
Access *MapCalc Learner* using the **AgData.rgs** database.



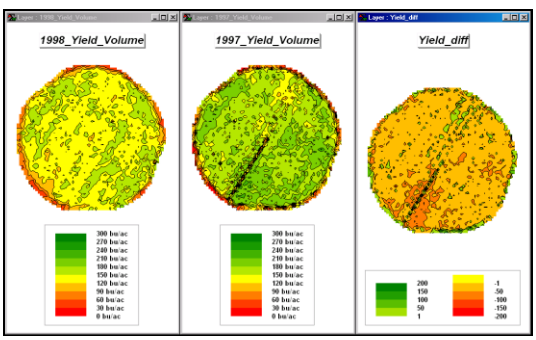
Press the **Map Analysis** button to access the analytical operations then select **Overlay→ Calculate** and complete the dialog box as shown below using the *Columns* item to select maps and *Functions* item to select mathematical operations.



1998_Yield_Volume – 1997_Yield_Volume For Yield_diff



Use the *Arrange windows vertically* button as previously described to create side-by-side displays of the three maps involved in the calculation.

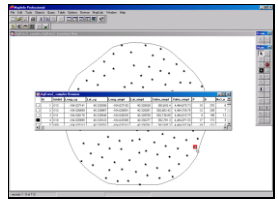


Note that the difference in yield between the two years ranged from -191 to +161bu/ac with most of the change being a decrease in yield.

To get a statistical summary of the yield difference, right-click on the *Yield_diff* map, select **Shading Manager** and click on the **Statistic**s tab.

*See **Topic 3**, Comparing Mapped Data, for discussion and more hands-on experience with this type of analysis.*

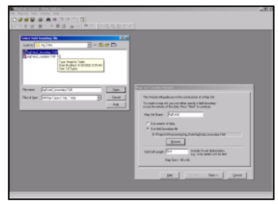
A.4 Spatial Interpolation



Point Samples (MapInfo)

Note: point data for interpolation must be in either ESRI (.shp) or MapInfo (.tab) format.

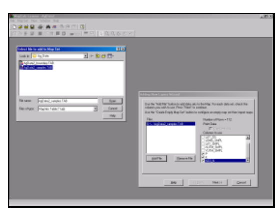
The first step in the *Interpolation Wizard* identifies the *Name* of the new data set, the *Extent* (boundary) and the *Gridding Resolution* (cell size).



Interpolation Wizard Step 1

- ✓ Enter the new map set name as **AgData2**
- ✓ Select **Use Field Boundary File**, browse to the *MapCalc Data* folder and specify **AgData2_boundary.tab**
- ✓ Specify the *Grid Cell Size* as **50** feet
- ✓ Press the **Next** button.

The second step identifies the point sampled data you want to map (**P** <phosphorous>, **K** <potassium>, **NO3_N** <nitrogen>). These specifications identify the "data fields" (columns) in the sample data table that will be used—the X,Y (Longitude, Latitude) positions each data point and the measured value reports the results of chemical analysis for each soil sample.

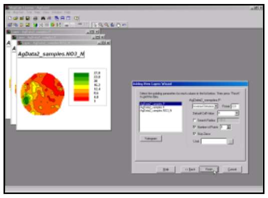


Interpolation Wizard Step 2

<u>Note</u>: The data must be in lat/Lon WGS84 projection for the MapCalc Learner version. MapCalc Academic and Professional versions contains projection conversion.

- ✓ Press the **Add File** button and browse to the **AgData2_samples.tab** table containing the sample data
- ✓ Check the **P**, **K** and **NO3_N** as the *Columns to use* at the bottom of the listing
- ✓ Press the **Next** button.

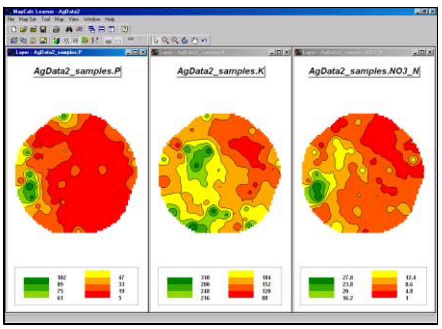
The final step specifies the interpolation technique and appropriate parameters to use.



Interpolation Wizard Step 3

✓ Press the **Finish** button to interpolate the three maps using the default Inverse Distance Square technique and parameters.

Use the Tile Vertically button to generate side-by-side displays of all three maps.

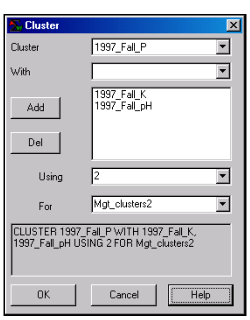


*See **Topic 4**, Spatial Interpolation, for discussion and more hands-on experience with this type of analysis.*

A.5 Characterizing Data Groups

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

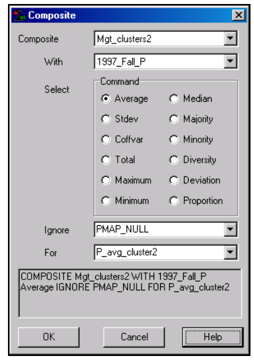
Press the **Map Analysis** button to access the analytical operations, select **Statistics→ Cluster** then complete the dialog box as shown below…



CLUSTER 1997_Fall_P WITH 1997_Fall_K, 1997_Fall_pH USING 2 FOR Mgt_clusters2

This creates a map of "clusters" that have "as different data patterns as possible" given the set of P, K, pH map layers.

To determine the average Phosphorous within each cluster, from the map Analysis window select **Overlay→ Composite** and enter…



COMPOSITE Mgt_clusters2 WITH 1997_Fall_P Average FOR P_avg_cluster2

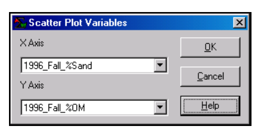
This calculates the average phosphorous levels within each cluster—24.2 and 21.3ppm.

*See **Topic 5**, Characterizing Data Groups, for discussion and more hands-on experience with this type of analysis.*

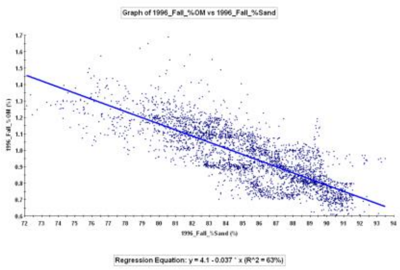
A.6 Developing Predictive Models

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

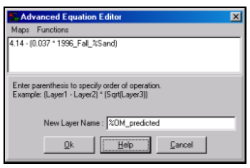
From the main menu, select **Map Set→ New Graph→ Scatter Plot** and specify **1996_Fall_%Sand** for the X-axis and **1996_Fall_%OM** for the Y-axis.



A scatter plot showing the relationship between the two map variables will be displayed. Each dot on the plot represents a map location and depicts the values for %Sand and %OM at that grid cell. The downward slope of the graph reports that there is a strong negative relationship (R^2= 68%) between the amounts of sand and organic matter.



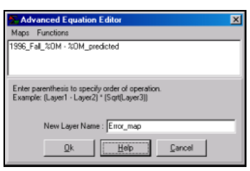
Press the **Map Analysis** button to access the analytical operations, select **Overlay→ Calculate** then complete the dialog box as shown below to evaluate the regression equation…



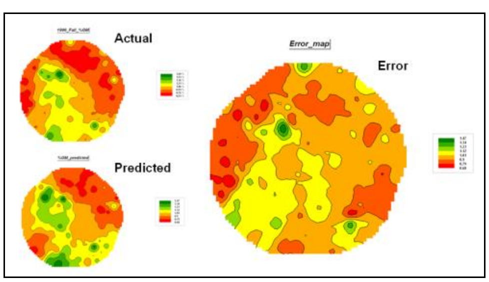
*Calculate 4.14 - (0.037 * 1996_Fall_%Sand) For %OM_predicted*

This evaluates the regression equation relating the two maps and generates a predicted organic matter value based on the percent of sand for each map location.

To determine how good the prediction map is subtract it from the actual %OM map by…



Calculate 1996_Fall_%OM - %OM_predicted For Error_map

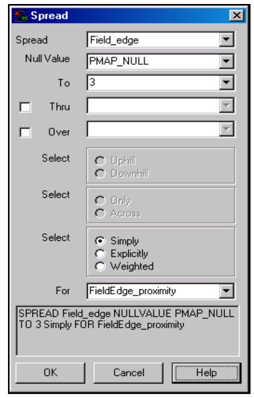


*See **Topic 6**, developing Predictive Models, for discussion and more hands-on experience with this type of analysis.*

A.7 Spatial Analysis

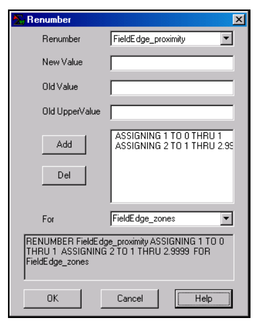
Access *MapCalc Learner* using the **AgData.rgs** database.

Press the **Map Analysis** button to access the analytical operations, select Distance→ Spread and complete the dialog box below to create a map of near-by proximity to the edge of the field.



SPREAD Field_edge NULLVALUE PMAP_NULL TO 3 Simply FOR FieldEdge_proximity

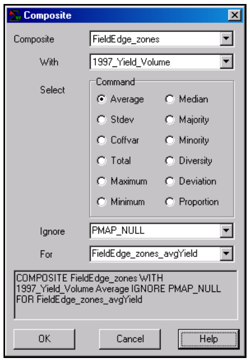
Select **Reclassify→ Renumber** and complete the following dialog box to identify three proximity zones in the field—edge, transition, and field interior.



RENUMBER FieldEdge_proximity ASSIGNING 1 TO 0 THRU 1 ASSIGNING 2 TO 1 THRU 2.9999 FOR FieldEdge_zones

Select **Overlay→ Composite** and complete the dialog box below to identify the average yield within each of the three proximity zones.

Note the dramatic increase in average yield from the edge of the field to the interior.



COMPOSITE FieldEdge_zones WITH 1997_Yield_Volume Average IGNORE PMAP_NULL FOR FieldEdge_zones_avgYield

Re-access the Map Analysis window and…

- ✓ Right-click on the command line you just entered
- ✓ Select **Copy**
- ✓ Right-click on the command line again and select **Paste**

…to create a copy the command line.

Double-click on the copied command line and…

- ✓ Change the option from "Average" to **Coffvar**
- ✓ Edit the name to **FieldEdge_zones_cvYield**
- ✓ Press **OK**.

…to modify the command specifications and create a different summary map.

Note that the coefficient of variation (variability in the data subsets) sharply decreases from the edge of the field to the interior.

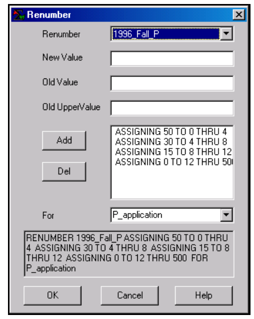
*See **Topic 7**, Analyzing Spatial Context, for discussion and more hands-on experience with this type of analysis.*

A.8 Deriving Prescription Maps

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

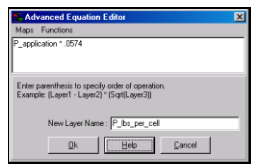
Press the **Map Analysis** button to access the analytical operations, select **Reclassify→ Renumber** then complete the dialog box as shown below to implement the following decision rule for phosphorous recommendations.

If [*0<P<4ppm*] Then [*apply 50 lbs P_2O_5/acre*]
If [*4<P<8ppm*] Then [*apply 30 lbs P_2O_5/acre*]
If [*8<P<12ppm*] Then [*apply 15 lbs P_2O_5/acre*]
If [*P>12ppm*] Then [*apply 0 lbs P_2O_5/acre*]



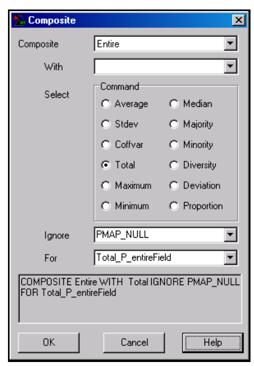
RENUMBER 1996_Fall_P ASSIGNING 50 TO 0 THRU 4 ASSIGNING 30 TO 4 THRU 8 ASSIGNING 15 TO 8 THRU 12 ASSIGNING 0 TO 12 THRU 500 FOR P_application

To convert the rate map recommendations (pounds per acre) to per cell amounts select **Overlay→ Calculate** and complete the dialog box below using a conversion factor of .0574 (50x50=2500sq-ft per cell / 43,560sq-ft per acre = .0574).



*Calculate P_application * .0574 For P_lbs_per_cell*

To calculate the total pounds of phosphorous for the entire field, select **Overlay→ Composite** and complete the dialog box below.

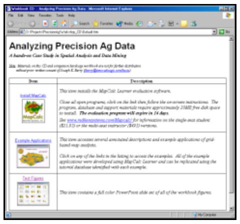


COMPOSITE Entire WITH Total IGNORE PMAP_NULL FOR Total_P_entireField

*See **Topic 8**, Generating Prescription Maps, for discussion and more hands-on experience with this type of analysis.*

A.9 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→ MapCalc Tutorials**.



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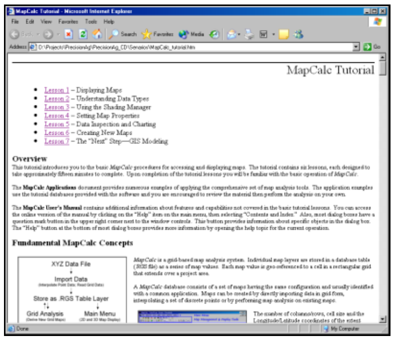

- ✓ Lesson 1 – Displaying Maps
- ✓ Lesson 2 – Understanding Data Types
- ✓ Lesson 3 – Using the Shading Manager
- ✓ Lesson 4 – Setting Map Properties
- ✓ Lesson 5 – Data Inspection and Charting
- ✓ Lesson 6 – Creating New Maps
- ✓ Lesson 7 – The "Next" Step—GIS Modeling

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