ArcView Tactical Crime Analysis Exercise

Overview of course:

This course will walk you through the analysis of a Residential burglary series at apartment complexes throughout Fort Collins Colorado.

What is Tactical Crime Analysis?

Definitions and descriptions:

Tactical analysis provides information to assist operations personnel (patrol and investigative officers) in the identification of *specific* and *immediate* crime problems and the arrest of criminal offenders. Analysis data is used to promote a quick response to field situations.[1]

Tactical Crime Analysis relates to the detection of specific crime trends, patterns, and particularly series, as well as the analytical deconstruction of such activity. Tactical analysis is characterized by rapidity and "shallowness" – that is, the tactical analyst typically does not research far into the past or conduct overly elaborate analysis; far more important is a quick and reliable report which will alert officers and agents to the emergence and character of a new trend, pattern, or series. The most difficult tactical enterprise is "Forecasting," the act of determining the likeliest time and place for a future criminal event with the intention of disrupting, dispersing, or intercepting the crime.[2]

Additional Tactical Definitions[3]:

Tactical crime analysis: An analytical process that provides information used to assist operations personnel (patrol and investigative officers) in identifying specific and immediate crime trends, patterns, series, sprees, and hotspots, providing investigative leads, and clearing cases. Analysis includes associating criminal activity by method of the crime, time, date, location, suspect, vehicle, and other types of information.

- Trend

  Criminal activity that is generally related by location, time, date, modus operandi, or other characteristics and is not committed by the same suspect(s).

- Pattern

  Criminal activity that is related by any number of characteristics (e.g. location, modus operandi, time, day, etc), but doesn't have sufficient suspect information to confirm or deny the same suspect(s) involvement in all of the incidents.

- Series
  Similar criminal activity most likely committed by the same suspect(s).

- Spree
  Criminal activity that occurs as one continuous incident involving the same suspect(s) usually over a limited amount of time.

- Hotspot
  A specific location where an unusual amount of criminal activity occurs.

- Hotdot
  A particular person responsible for an unusually high amount of criminal or suspicious activity at one or more locations.

- Hot Product
  A specific type of property that is targeted by criminals.

[1] Steven Gottlieb, Crime Analysis: from first report to final arrest.
[2] Dan Helms, Crime Analyst, "Analyst Arsenal" (private circulation 1998).
[3] Tempe Police Department Crime Analysis Unit web page www.tempe.gov/cau.

LESSON 1: Tactical Data and Map Layers discussion and demonstration

What are some types of tactical data?

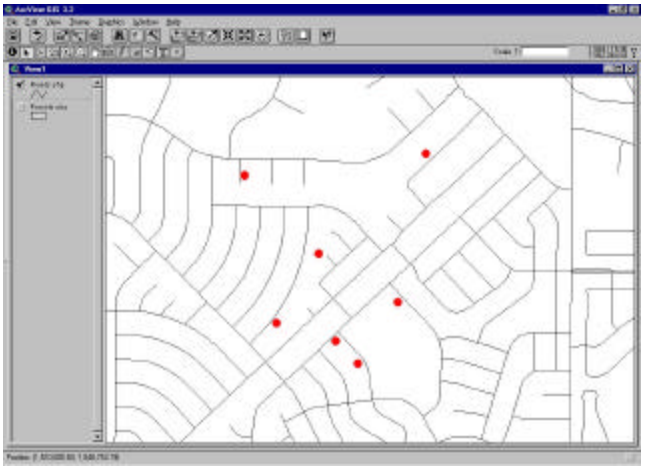
Zoning (Residential, Commercial, Industrial)
Business license file information (Bars, restaurants, convenience stores, etc.)
Electrical and water usage

Example: cultivating marijuana

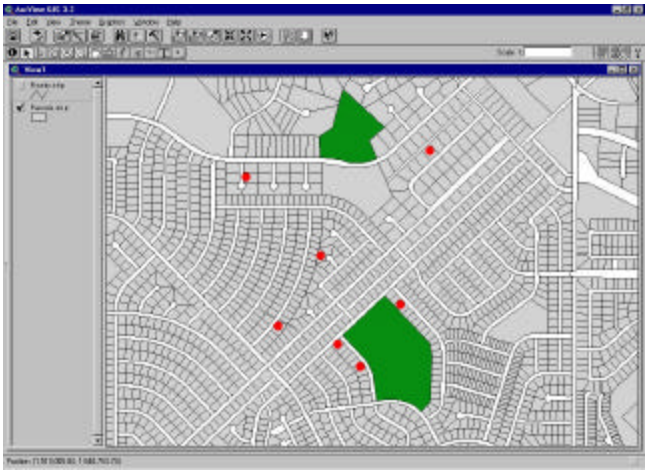
All of these are data useful to determine possible future targets "Target Analysis" or "Hunting Ground." Many of these types of data are not necessarily spatial in nature but are critical to conduct thorough Tactical Analysis.

What are some different map layers to consider when doing tactical analysis?

Street lights, bars, pay phones, bus stops, strip malls, number of employees / staffing, occupancy, stories / building levels, business license file (bar/liquor establishments, sex oriented businesses, taxing and zoning, etc.), subway or light rail system, parcel layer and underlying data, etc.



Example: *Why would we want to know how many employees are present?* Analyzing how many employees are present at any one time would allow you to select potential targets based on an analysis of the past crimes where a robbery suspect hit (targeted) convenience stores with only one clerk on duty.



Example: *Why use parcel information for tactical analysis?* Using parcel information provides more information for a visual analysis of the area under study. You can determine alley access, corner houses, houses not facing or adjacent to other houses, open spaces, parks, houses from corner, etc all from the construction of a parcel file.

Now let's examine the map and data layers we have available for our tactical exercise.

Do together:

The first step is to open our Fort Collins project in ArcView to view which data and geographic layers we have available to us.

Step 1) Launch ArcView, and when prompted at the 'quick start' menu, click **Cancel**. Now select from the ArcView menu **File | Open Project**.

Step 2) Navigate to the **C** drive. Select the **Fort Collins** subdirectory, select the **Fort_Collins.apr** file located therein. Click **OK**.

We now have the layers or "themes" that have been saved under our Fort Collins project. Only one theme should be visible at present – City_Streets. The next steps will show how to turn on and off the available themes to display the data.

- To turn a theme on, click the **open box** at the upper left corner of the theme you wish to display. A check mark will appear and the data layer will be displayed in the View.

Certain themes may be displayed but still not visible in the View. This may be due to a theme covering another theme, the data not being visible at the altitude you are viewing the View, or the data is not present at the area you have focused on your map. By reordering themes and changing the zoom level, you can better display the data.

Now let's view the data and map layers available to us in the Fort Collins project by turning on and off the following themes:

View Data layers available

Known Offenders
Recovered Property

View Map layers available

Point files

Apartments
Pawnshops
Bus Stops
Churches
Cemeteries
Shopping Malls
Schools

Line Files

Light Rail
Bike paths
Bus routes
Rivers

Highways
City Streets
County Streets
Railroads

Polygon Files

Reporting Districts
Parks
Residential Zone
Commercial Zone
Industrial Zone
Lakes
Airports
City Boundaries
Zip Codes
County Boundaries

LESSON 2: Geocoding, Point Symbol mapping, Proportional Symbol mapping

Now we will 'spatially' display our apartment burglary information by geocoding the tabular data.

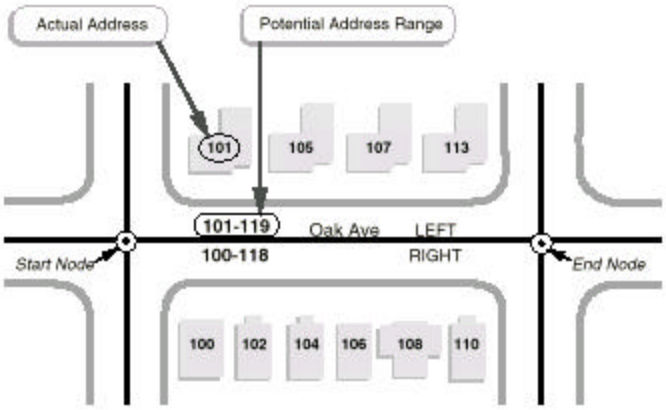
Purpose

Address matching is a process that compares two addresses to determine whether they are the same. To match addresses, ArcView looks at the components of addresses in both the tabular data file and the feature data source. Then ArcView looks for certain standards and makes a decision about whether addresses match.

Address Geocoding in ArcView is a process that creates a theme based on address data in tabular form and a reference feature theme. Address Geocoding in ArcView includes the following functions:

- Make a theme matchable
- Add address events to a view
- Locate an address in a theme
- Use place name aliases
- Use street intersections

Geocoding data



Record Type 1 contains separate data fields for both the start and end of each address range.

Record Type 1				Address Range			
				Left side		Right Side	
				Start	End	Start	End
RT	TLID	FENAME	FETYPE	FRADDL	TOADDL	FRADDR	TOADDR
1	0007654320	Oak	Ave	**101**	**119**	**100**	**118**

To perform geocoding in ArcView, you must have two data files:

- A feature data source. This is a theme that has address attributes associated with geographic features. The address attributes are stored in the theme's attribute table. Address geocoding requires certain attributes to make the theme matchable.
- A table of any format that ArcView supports, e.g., a customer list. This table should contain an address field (and a zone field if you want to geocode addresses in different zone or Zip Code) for each record that ArcView can use to match against the matchable feature data source.

Address matching

ArcView will compare addresses in the event table with the address attributes in the matchable theme. ArcView applies standards and rules to make decisions about whether addresses match. When a match is found, geographic coordinates are derived from the matched feature and assigned to the address. If a match cannot be found, you can edit the address if it has errors or relax the matching parameters in the Geocoding Preferences so that there is a higher likelihood of finding a match.

Alias Tables

ArcView allows you to use place name aliases for address geocoding and locating an address on a view. Aliases are useful for commonly known places such as City Hall and General Hospital that may not have commonly known addresses.

Using street intersections when you geocode addresses in a table

In the Address field of the address event table, you can have addresses represented by street intersections delimited by an "&" by default. An example is 'Post Ave & E Dayton St'. ArcView searches for the intersections in the matchable theme and assigns the coordinates of the intersection to the geocoded theme. In this case, an offset distance does not apply. Also for intersection addresses only, zone information is not needed even if the matchable theme uses an address style that requires a zone field.

The geocoding process. Follow these steps to perform address geocoding in ArcView:

To make a theme matchable

1. Add a theme to a view. The theme should contain the necessary matchable address attributes for geocoding. Geocoding against SDE database themes is not supported.

   Note: If the data source already contains a geocoding match source object database and a geocoding index, the theme will become matchable right away. See Geocoding Index. You can skip the following steps of making the theme matchable.
2. Make the theme active. Open the Theme Properties dialog box and display the geocoding theme property panel to choose a suitable address style for the theme. The address style you choose determines the fields and the way of indexing a field, as well as the data used for geocoding addresses and locating an address in a view.
3. ArcView finds the default field from the attribute table for each component of the address style. See Geocoding Theme Properties for description of each available style and its components. You can change the field by selecting a new field from the drop-down list. A check mark in front of the address component indicates that the component is required. A checked component needs to be filled with a data field from the attribute table. A

component without a check mark is an optional component. If no suitable data field is found from the attribute table, <None> can be set to the non-required component. Note that if no data fields are selected for the required components, the theme cannot be made matchable.

4. ArcView provides you with an option to use place name aliases. Select a table in your project that contains the aliases and their associated addresses. See Working with place name aliases to learn how to create and use an alias table. Attaching alias information to the theme allows you to locate an address using a place name alias. Select <None> if you do not want to use place name aliases.
5. Press OK to make the theme matchable. ArcView will display a message box for you to confirm building the geocoding index using the selected address style. Press Yes to start indexing the data of the required components. If <None> is selected for a required component of an address style, pressing OK will not make the theme matchable.

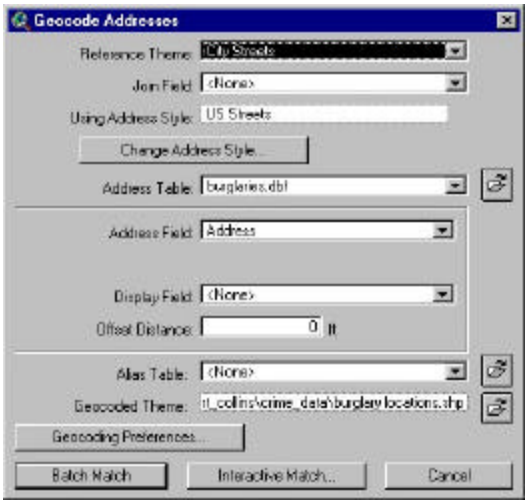
Geocoding: "Putting dots on a map "– take tabular data and display it spatially. *The following geocoding exercise is not to demonstrate how to geocode but some of the possible problems you may encounter when you do*.

Do Together

Step 1) In the Project window, select **Tables** and click **Add.** Navigate to **C:\ Fort_Collins\Crime_Data**, select the "**Burglaries.dbf**" database file and click **OK**.

Step 2) Make the "**City Streets**" theme active by clicking on it in the table of contents.

Step 3) Select **View | Geocode Addresses** from the menu bar.

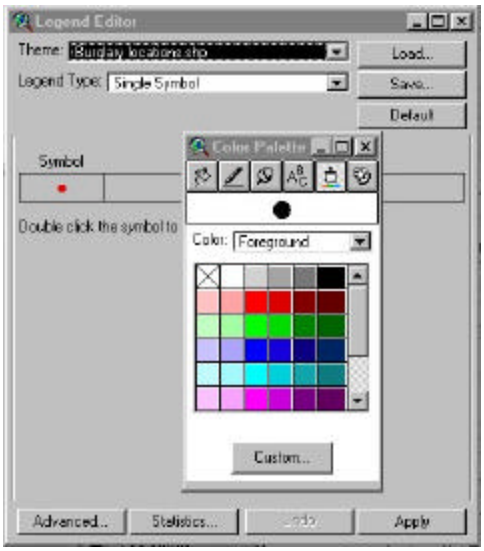


Step 4) Choose a new file name and location by clicking on the open file icon at the bottom of the dialog box, next to "Geocoded Theme". Let's name our new theme "**Burglary Locations.shp**" and place it in **C:\fort_Collins\Crime_Data**.

Step 5) Click **Batch Match**. The results should return that cumulatively 100% of our data geocoded. Click **Done**.

Step 6) Now while back at our View, let's change the default color value attributed to our

"**Burglary Locations**" theme to a red point. **Double-click** the "**Burglary Locations"** theme. The Legend Editor will appear.

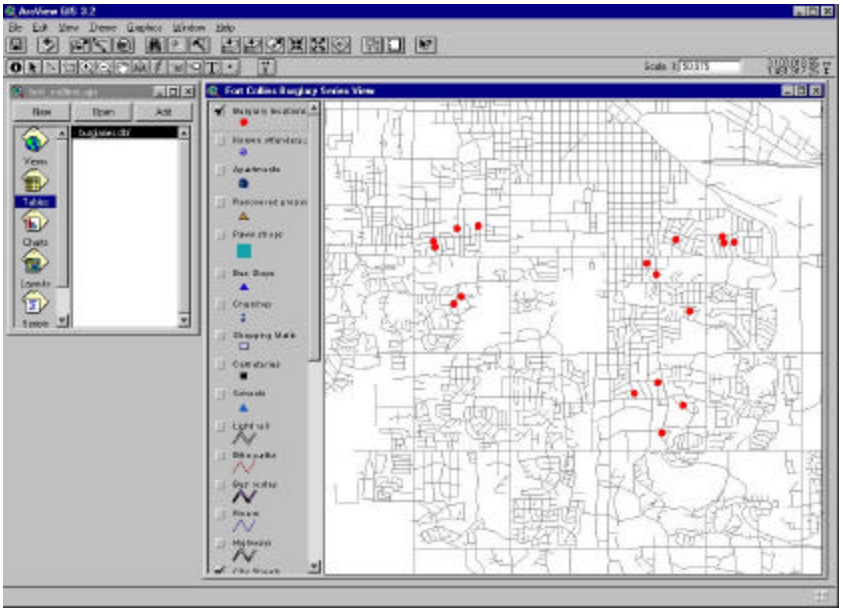


Step 7) **Double-click** the symbol and change it to a red circle, 10 point in size. Click **Apply**, and close the box.

Step 8) Select **Theme | Properties** from the menu bar. A dialog box will appear. In the "Theme Name" section, rename theme "**Burglaries**". Click OK.

We have points on a map – wonderful, now what?

Conduct further analysis if nothing apparent yielded. In the next lesson we will continue our analysis using Proportional Symbols mapping.



Proportional Symbol Maps

Proportional symbol mapping, also called graduated point symbol mapping, is used to show relative magnitudes of phenomena at specific locations. A symbol form, such as a circle, is chosen and the symbol size is varied in proportion to the quantity it represents. A series of graduate symbols illustrate ranges of data. Much research has been done on symbol size. Graduated or proportional symbol sizes are easily underestimated by map-readers forcing the cartographer to exaggerate their size to aid in map interpretation.

Problem Explanation

Proportional symbols are NOT based on the spatial relationships between point data but the frequencies of the underlying tabular data. Because of this, proportional symbol maps can be misleading or just plain wrong if the tabular data is not 'clean.' (Address data cleaning involves the process of removing unwanted characters from an address value, correcting spelling, prefix and suffix information, and assuring that each address is properly formatted.)

ArcView's geocoding preferences perpetuate the problem by finding and placing points on locations where the underlying address information is imperfect. Further geocoding done interactively will find even more problematic addresses and display a point, however, it will not change the tabular data. Because of these 'helpful' utilities in the GIS, when we conduct analysis using the tabular data, the results can be skewed. To avoid this pitfall, one must either clean the tabular data or use another 'reference' variable to conduct the analysis against. In the case of addresses and our apartment complex burglary series, the apartment's name variable is 'clean' and provides us with unique values for each apartment complex location. Using the apartment complex's name when conducting analysis of apartment complex data can also be helpful to avoid the problem where complexes that may have multiple addresses.

Data which can be problematic and thus, improperly counted and represented spatially

- Intersections
- Apartments, Suites, Additional addressing information (common place names)
- Interactively geocoded data
- Spelling and Geocoding sensitivities set at anything other than 100% accuracy.

Solution: How to avoid problems with geocoding and proportional symbol maps / spatial statistics.

One way to avoid the proportional symbol problems is to conduct frequency on counts of coordinates. The steps involved in using the X and Y values as a unique variable include: loading the ADDXYCOO script from the "Samples" directory of ArcView, running the script against your target data, creating a new unique variable, performing a concatenation function to join the X values and Y values and inserting the newly joined value in your new variable, and then conducting the count on this new variable.

Address name, business name, parcel ID number, or any unique value assigned to an address value can be used to perform accurate proportional symbol maps and spatial statistics.

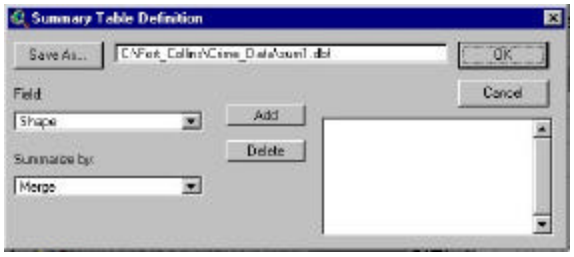
Do Together

Now let's perform a proportional symbol map using the Address Name variable in our "**Attributes of Burglaries"** file.

Step 1) Open the attribute table for your Burglaries theme. To do this click the "**Burglaries**" theme in your table of contents to make it active and then click the **Open Attributes Table** button located on the ArcView toolbar.

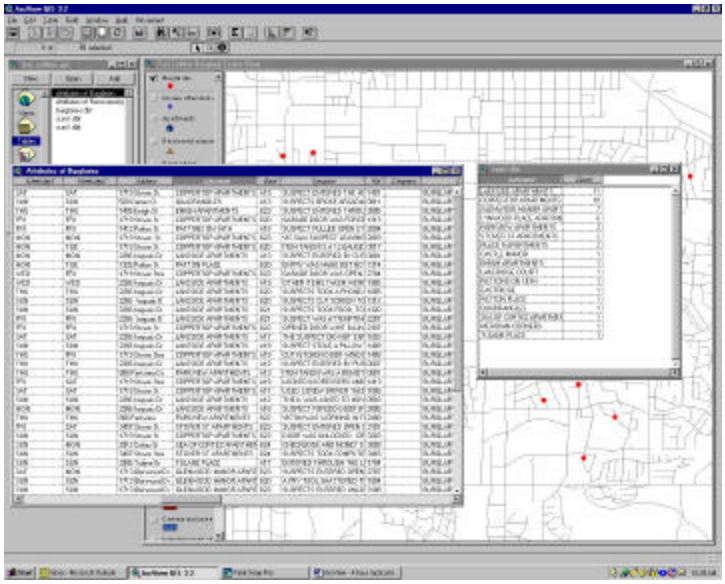
Step 2) From the Attributes of Burglaries tabular data view, select the Address Name variable (**Adrname**) by clicking on its column header.

Step 3) Now click the **Summarize** button on the menu bar. The Summarize button is depicted by the sigma character. Once in the Summarize dialog box, there is no need to specify any additional calculation information as it will automatically calculate a count on the selected variable.



Step 4) Click the **Save As** button in the dialog box, navigate to **C:\Fort_Collins\Crime_Data** and **click OK** to save the file. **Click OK** again to return to the View. (Remember the name – sum1.dbf).

Step 5) To join the count table (sum1.dbf) to the crime data (Burglaries) you must open both the "**Attributes of Burglaries**" table and the "**sum1**."



Step 6) Starting with the **sum1.dbf** table, select the **Adrname** field by clicking its column header. Now click the **Adrname** column header in the "**Attributes of Burglaries**" table.

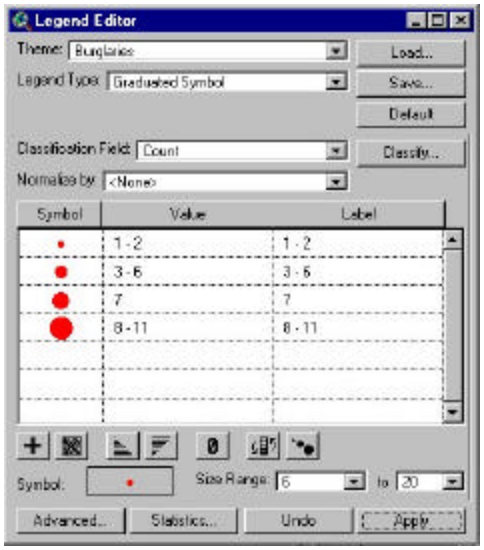
Step 7) Select **Table | Join,** or

click the **Join** button on the toolbar. We now have our Burglaries data containing our new summary data.

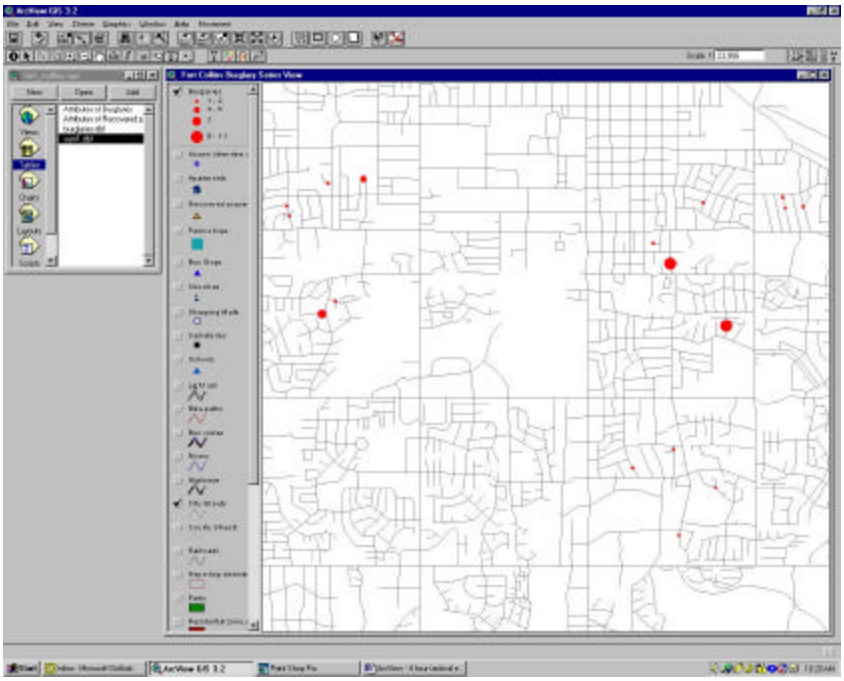
Step 8) To create a proportional symbol map, **double-click** the "**Burglaries**" theme. The legend editor will appear.

Step 9) From the legend editor, Change the **Legend Type** to "**Graduated Symbol**" and change the **Classification Field** to "**Count**". Change the **Size Range** to "**4-20**". Click on **Classify** and change the **Number of Classes** to "**4**."

Step 10) **Double-click** the symbol tool, and change the color to red. Now close out the legend editor dialog.



You have successfully created a proportional symbol map representing the count or frequency of burglaries at an address. Do the results of the proportional symbol map yield any interesting results? Have we learned more about our trend based on these results? If not, let's continue our analysis by creating a proportional symbol map based on another variable and begin to analyze the spatial relationships between our burglary locations and other data.



LESSON 3: More Proportional Symbols and spatial relationships

In lesson 2 we saw how to create proportional symbol maps, that is, increase the point symbol size relative to the number of occurrences at that location. Now we will use proportional symbols to show another variable or ordinal value.
We will now grow the point symbols *relative to the value of property take* at a location. Another application could be to shade the points based on their chronological order in the series.

We cannot simply create a proportional symbol map for each location's total monetary property losses because each location may contain multiple burglaries. If there are multiple burglaries at a given location and we were to create a proportional symbol based on the location, then the results would be multiple proportional symbols on top of one location. To avoid this, you must first calculate the TOTAL monetary property loss at each location, and then create a proportional symbol map based on those result totals. To retain our address name count proportional symbol results, we will use a copy of its theme to perform the property loss proportional symbol.

Do Together

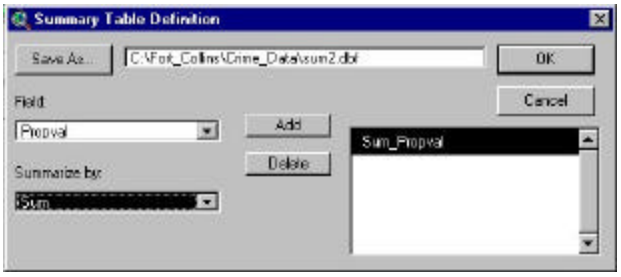
Step 1) The first step we'll need to perform is to make a copy of the Burglaries theme so that our property loss proportional symbol results will not override the location proportional symbol results. To do this, make the **"Burglaries"** theme active and then select **Edit |Copy theme** from the ArcView menu.

Step 2) Now select from the ArcView menu **Edit | Paste.** A copy of the Burglaries theme will appear in your table of contents.

Step 3) Make the new "**Burglaries"** theme active (it will automatically appear on the top of all other themes.) Select **Theme | Properties** and rename this theme to "**Property Totals".**

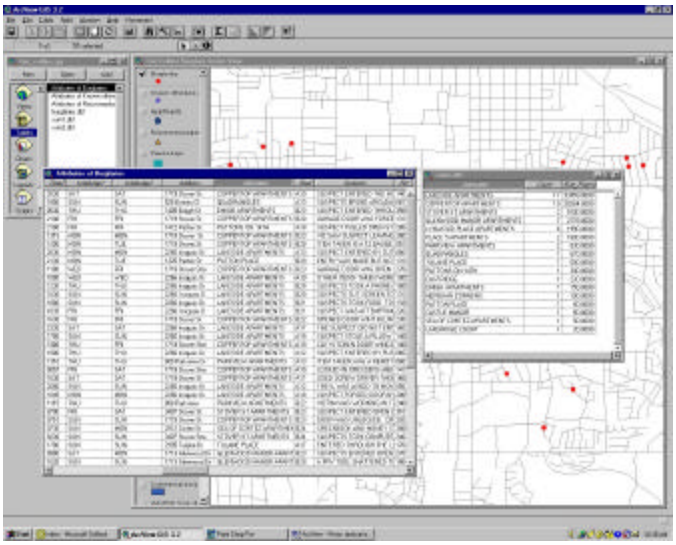
Step 4) Now we will perform the same steps as done in lesson 2 to create the proportional symbol map. Open the attributes table of "**Property Totals**" and select the **Adrname** field. Now select **Field | Summarize**. The summary dialog will appear.

Step 5) From the summary dialog, select **Propval** from the **Field** drop down combo and **Sum** from the **Summarize By** combo. Now click the **Add** button to move the desired calculation to the box to the right.



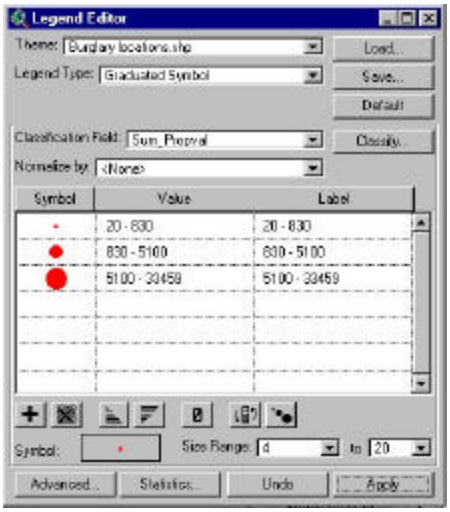
Step 6) Before we proceed, however, we will want to save the summary results to our Fort Collins crime data directory. **Click** the **Save As** button and navigate to C:\Fort_Collins\Crime_Data. Click **OK** to save the **sum2.dbf** file to this location. Now click **OK** to complete the summary.

Step 7) Now we must join the summary results to our Burglary data. Open both the attribute tables for "**Property Totals**" and "**sum2.dbf.**"



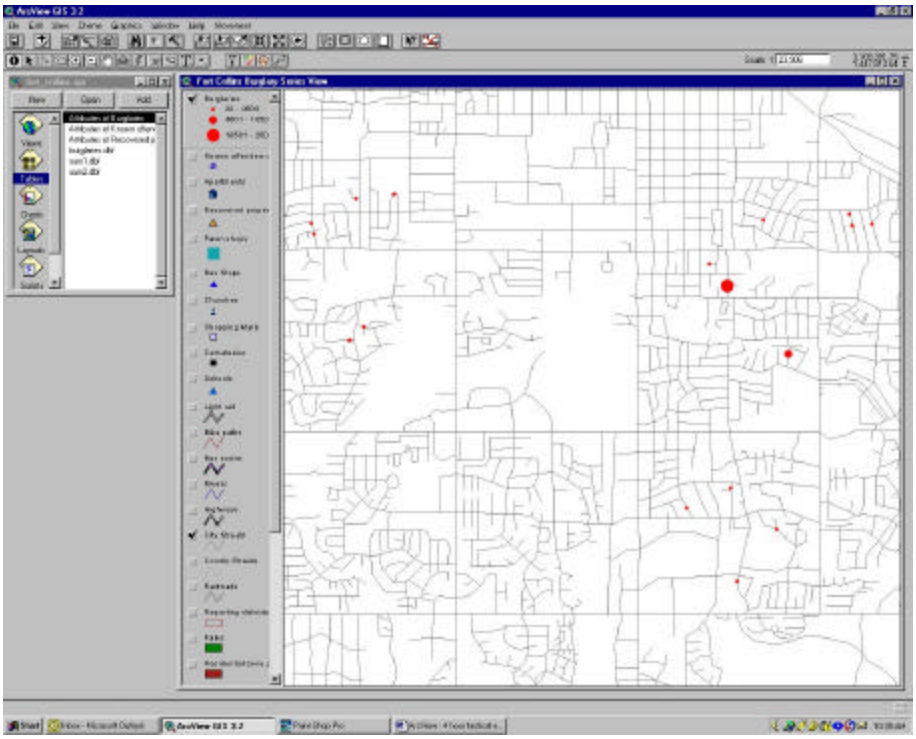
Step 8) From the Sum2.dbf attribute table, click the column header of the **Adrname** variable. Now click the column header of **Adrname** in the "**Attributes of Property Totals**" table.

Step 9) Select **Table | Join** from the ArcView menu. The sum2.dbf file will disappear and the Property Totals table will now contain our summary results.



Step 10) To create proportional symbol map based on property value totals for each location, double-click the "**Property Totals**" theme to open the legend editor. Select **Graduated Symbol** from the **Legend Type** combo. Select "**Sum_Propvals** from the **Classification Field** combo. Select the **Classify** combo and change the **Number of Classes** to **3**. Change the Size Range from 4-12 to **4-20**. Double-click the symbol in the legend editor, and change the color to red. Click **Apply** and close the editor by clicking the X in the upper right corner of the dialog.

You have just created a proportional symbol map which depicts the total monetary loss accrued by each apartment complex. The results have been represented visually by increasing the point size relative the amount of property taken.



Do the results of our property value loss map provide us any insight about the trend? Did we learn anything from these results that could be used to predict where the suspect may strike next? What was the top location for property loss?

There are other uses for proportional symbol maps other than to show relative magnitude of data at a location. We could also use the proportional symbol map to depict movement, sequencing, or strikes in chronological order.

One example of how you may use the proportional symbol map to depict movement is to grow the points relative to their chronological order in a trend or series. The results would depict small points for older or initial strikes in a case and grow larger as the strikes occurred more closely to the most recent case. This is a means of performing temporal analysis using the static results provided through a GIS.

Let's now take what we have done so far and compare it against the other spatial data we have available.

Spatial analysis of relationships between crime series and?…

Let's begin by turning on and off our various layers to identify possible spatial relationships. Do you see any possible spatial relationships that we should explore further?

In Lesson 4 we will begin to use the GIS power to assist us in identifying potential underlying spatial relationships. We will also utilize a free extension originally developed by

Ecologist to study animal movement patterns and apply it in the study of our offender and his patterns.

Animal Movements:

One of the best sets of tools available to the modern crime analyst was developed for the science of Ecology; specifically, the United States Geological Survey's homegrown **ArcView** extension, **Animal Movement**s. Developed to study migration and movement patterns, but containing many tools for general movement study, this professional extension was practically unknown outside the science of Ecology. The potential of this extension to radically advance the field of tactical crime analysis was realized in 1997. Dan Helms, Crime Analyst for the Las Vegas Metropolitan Police Department, was unsatisfied with existing methods for studying and predicting spatial behaviors, so he turned to game tracking experts in Southern Africa for help in analyzing the movements of a serial sexual predator on the hypothesis that the seemingly disparate disciplines might share some important truths.

What Helms discovered was a wealth of tactics, techniques and science created over decades and centuries to observe, analyze and even predict animal movements. These techniques could make use of scattered observations to deduce such factors as "Home Range," "Hunting Grounds," migratory patterns, and much more. Helms' contacts stated that many of their techniques have been incorporated into an ArcView script, Animal Movements. Helms downloaded the free extension from the United States Geological Survey web page http://www.absc.usgs.gov/glba/gistools.

The Animal Movement Analysis ArcView Extension developed by the Alaskan Biological Science Center (USGS) is a free add-on to ESRI's ArcView desktop GIS software application that provides ArcView users with numerous functions to analyze and predict spatial information.

The extension was developed by Hooge and Eichenlaub in 1997. Dr. Hooge is a Research Population Ecologist and Mr. Eichenlaub is the GIS Coordinator for the Glacier Bay National Park. The Animal Movement extension is a collection of more than 40 functions to aid in the analysis of animal movement data. The extension fills a definite void in the availability of affordable, powerful tools to incorporate into one's GIS.

Let's take a look at just a few of the functions provided by this extension and review their law enforcement applicability with real-world examples.

LESSON 4: Sequencing and Temporal Analysis

Polyline from Pointfile

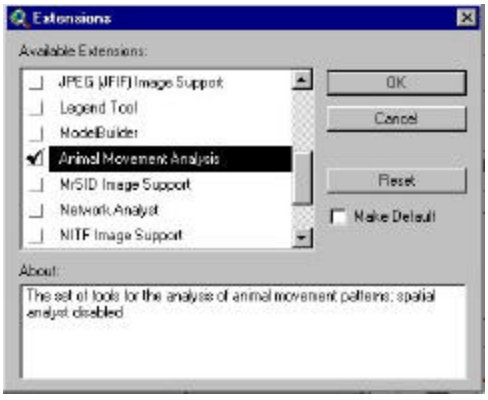
The first function we will we examine and apply to our burglary series is the Polyline from Pointfile routine. This function will "connect the dots" from a point file which has been ordered chronologically and will provide distance measurements from point-to-point. While this capability might at first seem trivial, in fact it represents one of the most crucial advances in viewing the distribution of serial crimes, and exemplifies how simply changing our perspective can revolutionize our ability to analyze crime.

By analyzing relationships between intervals in time and distances in space, we will be able to calculate statistics on the development of patterns between cases and provide enhanced predictions. Taking the basics of this information a step further, we could apply a Lag Variogram to the cases under study. This technique allows the analyst to identify and analyze repeating cyclic patterns within a crime series - in other words, the "tempo" of a series. For instance, if a suspect were to strike in distance intervals of 1 mile, then 3 miles, then 1 mile, then 3 miles etc., we could analyze the cyclic pattern of this series to reveal that the next strike may occur 1 mile from the last strike. If one were to simply take the mean distance between strikes, the results would be less accurate by yielding an average strike distance of 2 miles and a prediction that the suspect may strike 2 miles from the last strike location. A Lag Variogram applied to the distance measurement results returned from the Polyline from Point file function enables the analyst to more accurately predict next or future occurrences based on past behaviors.

Instead of trying to identify patterns based on the locations of points, we can study the changes between points, symbolized by the lines, to create a more accurate and refined forecast.

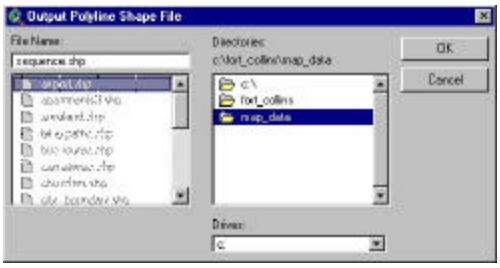
Do Together

Step 1) To load the Animal Movements extension: Open **Windows Explorer**, navigate to the **Fort Collins** directory and double click on **MOVEMENT.EXE**. This is a self-extracting zip file. When prompted choose the destination location as: **C:\ArcView\Av_gis30\ArcView\Ext32** or wherever ArcView is installed. Click **OK** to unzip the files to this directory and then **close** the WinZip utility to return to ArcView.

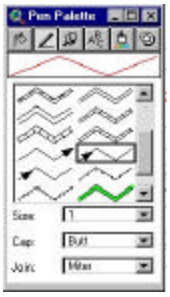


Step 2) Select **File | Extensions** and click on box next to "**Animal Movement Analysis." C**lick **OK** to load the Animal Movement Analysis extension.

Step 3) From Fort Collins View, make the "**Burglaries**" theme active. select **Movements | Create Polyline from Point File.** Navigate to **C:\Fort_Collins\Crime_Data** and name the theme "**sequence.shp**". Click **OK** to save the new line theme. The **sequence.shp** line theme should now be added to your table of contents.



Step 4) Double-click "**sequence.shp"** to open its legend editor. Double-click the line under "Symbol" to open the Pen Palette. Select the second arrow line option, change the size to 1 and change the line color to red. Click **Apply** and then close the legend editor by clicking the **X** at the upper right corner of the dialog.



Step 5) Let's now label our newly created arrow line theme by placing a number depicting the sequence or order of each case in the series. First, make the "**sequence.shp"** active. Select **Theme | Auto-label.** From Label Field, select "**Link ID**." Click **OK**.

We now have created a line theme that depicts the movement or course of our series. Does the results of this routine provide us with any information about our trend that was not apparent before? Can we begin to predict future events based on these results?

LESSON 5: Direction & Distribution

Jennrich-Turner Ellipse

The Jennrich-Turner Ellipse allows you to calculate a bivariate normal probability ellipse, the major and minor axis, and the arithmetic mean from a sample or population of event points. It is primarily geared toward developing simple home range-habitat models. Simplistic in function and flawed in its dependency on a bivariate normal distribution, the tool allows the analyst to construct possible hunting grounds based on probability ellipses. The results of the function are ellipses providing an area accounting for 95, 90, and 50 percent distribution respectively, as well as a graphic representation of the polarity of the cases and the center (centroid) of the cluster under study. The polarity graphic will allow an analyst to discern the statistical direction of the cluster. Many crime analysts will recognize similarities with analytical methods already used in the profession, most notably Spatial and Temporal Analysis of Crime, **(S.T.A.C.)** Unlike the original S.T.A.C. program, however, the sensitivity of the Jennrich-Turner Ellipse in the Animal Movements extension is infinitely adjustable, and ellipses are polarized along a complete 180 degree sweep, not constrained to a rectangular grid. The graphic quality is also more dynamic, allowing for the conversion of the ellipse to a polygon theme. Given this new theme, you can then perform spatial queries for further analysis using the Jennrich-Turner results.

We will use the Jennrich-Turner Ellipse to determine the area where 50% of our burglaries occurred.

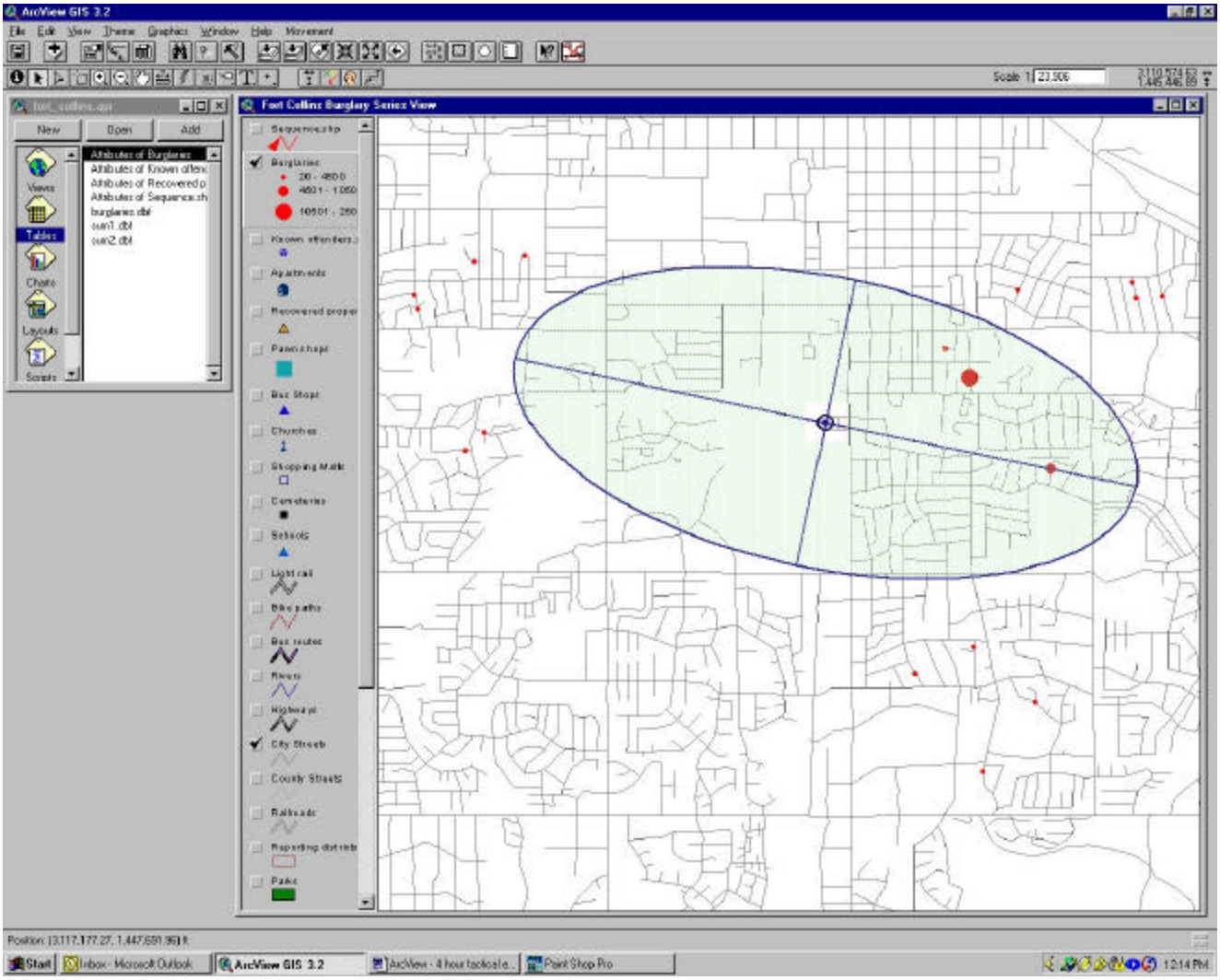
Do Together

Step 1) Make the "**Burglaries**" the active theme.

Step 2) Select **Movement | Jennrich-Turner Home Range** from the ArcView menu.

Step 3) Select **50 as a probability ellipse and then click OK.** Statistical results will be displayed in a dialog box.

Step 4) Click **OK** to close the statistics dialog and return to the ellipse results.



So what does this tell us about our burglary series? The Jennrich-Turner Ellipse can be used to analyze the polarity of the cases under study. The polarity is simply the statistical direction of our cases. This can be compared against existing transportation routes to determine if the polarity of the cases follow bus lines, major roads, highways, bike paths, etc. It may also be used to predict future events given a general direction that our cases follow.

The arithmetic center or "statistical center" of our cases is also provided. Much research has done which stipulates that offenders commit their crimes where they "live, work and play." A comparison of the center of our cases to known offenders, investigative leads, field contact, etc. should be completed in an attempt to uncover potential suspects. Finally, we also know now where 50% of our cases fell.

- Now, let's turn on "**Known Offenders**".

In Lesson 6, we will use the power of the GIS and its ability to query data based on its spatial relationship to analyze our burglary trend.

LESSON 6: Target Analysis & Spatial Relationships

We will begin our analysis by selecting those apartment complexes that have been the victim of our burglary suspect and analyze them for any commonality or similarity. This takes a step further in our analysis by not solely analyzing the suspect or crimes he has committed, but by analyzing and understanding his targets. By understanding the types of targets that our suspect favors, we can begin to focus on targets that fit the 'profile' and discount targets because they don't fit the profile. This is the basis for Victim/Target Analysis or "Establishing the Hunting Ground."

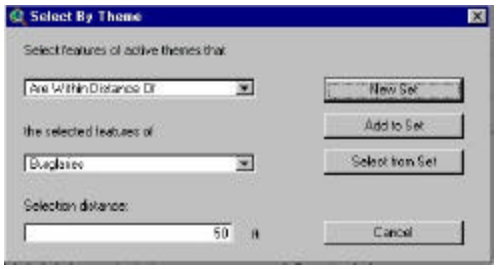
Target Analysis

Do Together

Step 1) We will first begin by querying against the "Apartments" point file which share a 'spatial relationship' with the "Burglaries" point file (i.e. those apartments that have been the victim of a burglary.) So, first we must make the "**Apartments"** theme **active**.

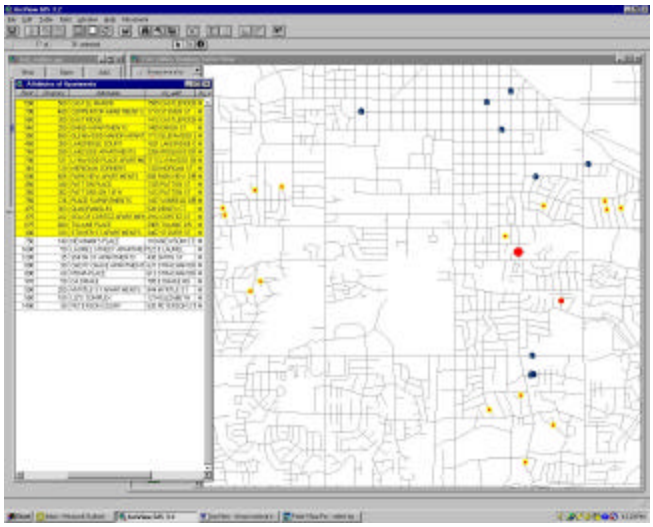
Step 2) Select from the ArcView menu **Theme | Select by theme.**

i. Change "the selected features of" combo box to reflect **"Burglaries".**
ii. Change "Selected features of active themes that" to "**are within distance of**"
iii. Change "Select distance" to **50 feet** .
iv. Click the **New Set** button.



Step 3) Open the attributes table of "**Apartments**."

Step 4) Promote those selected records to the top of the matrix by clicking the **Promote** button located on the ArcView toolbar.



Now we can conduct our analysis of those apartment complexes that were the victims of a burglary in an attempt to identify commonalities or similarities. Begin by doing a visual comparison of these data. Does anything jump out at you? Do you see anything the targets have in common?

Identified that: all apartments that were hit are under 800 in rent and had a capacity for occupancy of over 100 units.

Given that our analysis of these data yielded that those apartment complexes that were the victims of a burglary from our suspect each had in common (< $800 rent and >100 unit occupancy) we can use that criterion to select ALL apartment complexes in our city (or hunting ground) that fit this profile to determine possible future targets! So let's do it.

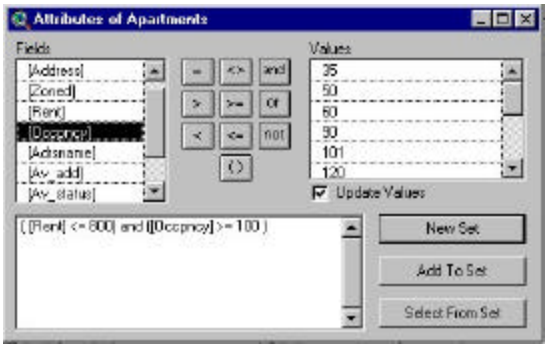
Establishing the Hunting Ground

Do Together

Step 1) With the "**Apartments**" attribute table open, deselect those complexes that have been highlighted by clicking the **Clear Selected Features** button on the tool bar.

Step 2) Select **Table | Query** from the ArcView menu.

i. In the Query view, type of construct this statement: ([Rent] <= 800) and ([Occupancy] >=101)
ii. **Click** the **New Set** button.
iii. **Click** the **X** in the upper right corner to close the Query dialog.



Step 3) Now make the Fort Collins View active by **clicking** on its **title bar**. The "**Apartments"** theme should still be the active theme. If not, make it so.

Step 4) Select **Theme | Convert to shapefile** – name the new shapefile "**Possible Targets**" and save in **C:\Fort_Collins\Map_Data.**

i. When asked to **"Project"** the data, choose **NO**.
ii. When asked to **"Add theme to current display"**, choose **YES**.

Step 5) From the View's table of contents, **Double-click** the "**Possible Targets**" theme to open the legend editor.

Step 6) Make "**Apartments**" active, and again deselect the highlighted apartments by clicking the **Clear Selected Features** button.

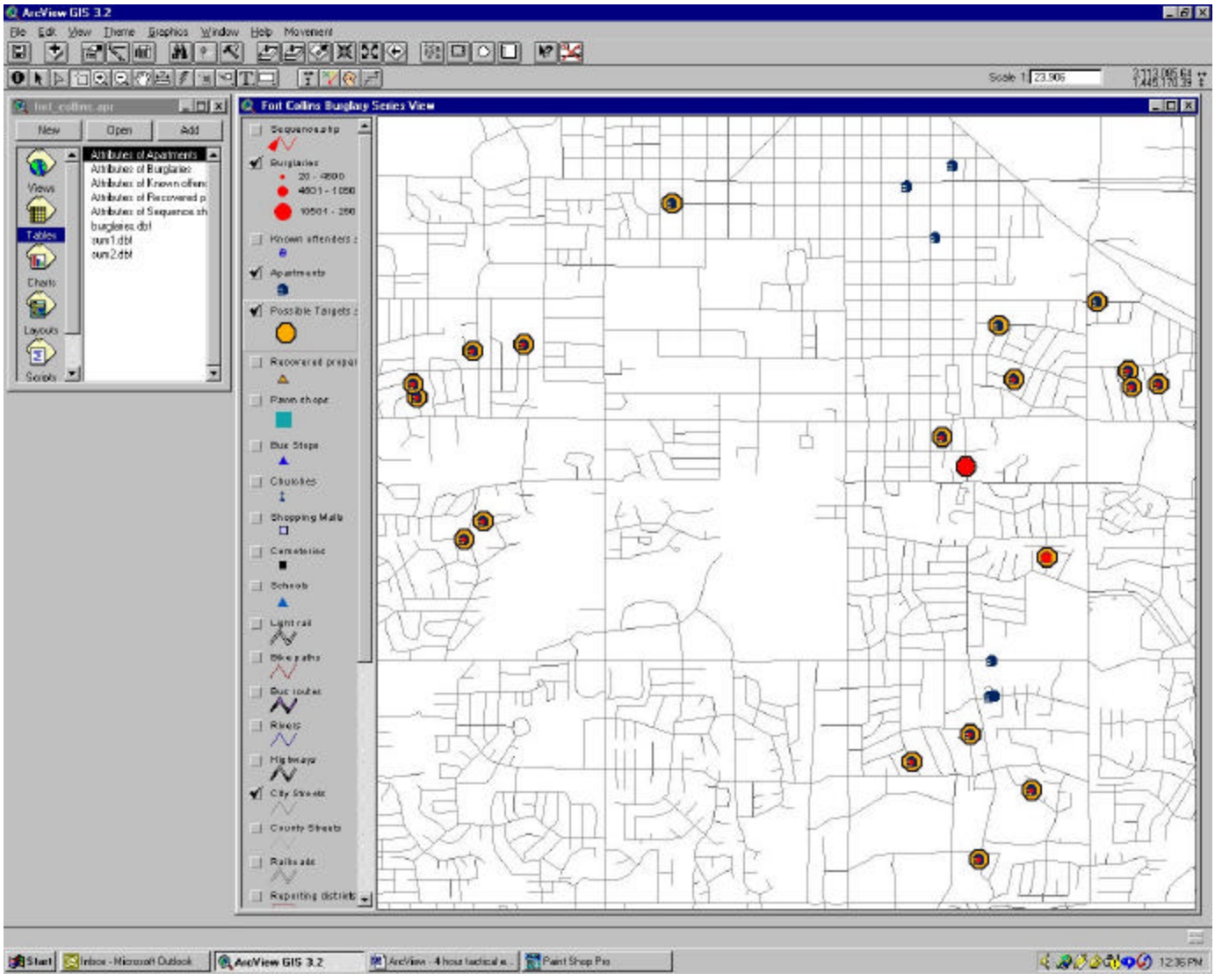
Step 7) Make **"Possible Targets"** active.

Step 8) Now **double-click** the **symbol** displayed to change its properties to:

i. Symbol: **outlined circle**
ii. Color: **orange**
iii. Size: **24**

Step 9) **Click** the **Apply** button and close the legend editor by **clicking** the **X** in the upper right corner of the dialog.

Step 10) Now we must reorder the new "Possible Targets" theme so that it is below our "Apartments" theme. This is because the "Possible Targets" theme uses a larger symbol than the "Apartments**"** theme and will not be visible. To do this, **click** and **hold the mouse button down** while you **drag** the "**Possible Targets**" theme until it is below "**Apartments**". **Release** the **mouse button** to set the new location.



Step 11) Now turn on the Polyline to point file theme "**Sequence.shp**" to assist us in identifying potential future targets based on our analysis of past targets and the movement patterns displayed by our suspect.

Where will he strike next?