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Tutorial: Crime Mapping Techniques

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Introduction

The purpose of this instruction manual is to provide the user with step by step instructions of how to create three different mapping techniques for visually representing crime data. Each technique has a different purpose in regards to communicating for understanding of the crime data. In combination, the differing techniques provide a more complete picture of crime within the city; providing an examination of crime data including geographical changes as well as temporal changes.

Methodology

In the following sections, we examine the three methodologies chosen for the presentation of crime data. The three selected methodologies are Dot Maps, Kernel Density Maps, and grid maps presented in Google Earth.

In general, Dot Maps allow for the identification of how vast each crime incident phenomenon may be and a glimpse of where they are located and have changed over time. The Density Maps will represent the criminal incidents in a more generalized format allowing the user/audience to identify relative risk of criminal occurrences in a specific area; thus, allowing for the inclusions of multiple incidents occurring in the same location. Density Maps will also allow the user and audience the opportunity to see how the relative risk of a crime incident occurring has shifted from 1995.

The final mapping technique, grid maps presented in Google Earth, will be integrating the most current five years of crime data on to a grid system, overlaid onto a map of the City of Portland. This will allow the user/audience to identify areas, which resemble a four block area, as having higher or lower relative risks of criminal incidents. This final methodology will also allow the user/audience to zoom into areas of interest, while still displaying the relative risk of occurrence.

Dot Map Methodology

As implied by the name, "dot maps" are created by placing a dot at each crime incident location in the city. This kind of map allows the viewer to quickly identify geographic areas that have experienced a higher number of crime incidents. An important limitation of this type of map is that locations with multiple incidents at the same address still only show up as a single dot. Another caveat with these maps is that they do not control for underlying population differences. Downtown, for example, consistently shows a high

number of crimes as compared to other areas in the city. Although this initially suggests that downtown is a "riskier" place overall, on a per person basis, the actual risk could be less than other locations because there are more people living in, travelling through, and spending time downtown. Unfortunately, the population and transit data needed to more accurately quantify risk across different geographic areas are not readily available. As such, caution is urged when interpreting these maps. (Henning, Stewart & Peterson, 2012)

Kernel Density Map Detail / Methodology

Kernel Density (KD) Maps colors each region within a city based on the number of crimes in that specific area and nearby locations. KD maps make it easier to pinpoint areas with higher concentrations of criminal events.

KD map elements to consider for creation include the cut points (threshold) of the data set, which are used as the plotted data points of the dot map, and bandwidth of the range of cells for relative incident inclusion, and cell size, which will determine how blocky or refined the KD map appears. Items that may be considered in making decisions about cut points and bandwidth include average density of the city, which further leads to color selection for indicating crime density on the finished map. This procedure allows for the ensuing maps to reflect increases and decreases that occurred in crime over time and it also allows the viewer to identify changes in the location of "hotspots", areas identified as highest, relative risks based upon cut points.

It is important to remember that this sort of mapping does not control for population differences across regions of the city. An area may show up as a "hotspot" largely because there are a high number of people living in or travelling to that area, and hence, there are more targets available for offenders. A given person's actual risk for victimization in such an area may actually be quite low despite the high number of offenses happening there.

Another limitation of KD maps is that crime in border regions may be artificially deflated. This is a product of the fact that density maps are colored based on the count of crimes in a specific area and adjacent locations. In many cases, the adjacent city data may not be available because this data is maintained by other agencies. (Henning, Stewart & Peterson, 2012)

Google Earth Maps

Grid maps presented in Google Earth will enable the user/audience to see multiple years of criminal incident data in a grid system, overlaid on a map of the City of Portland. This type of map colors each grid within the city based upon the number of crimes that have occurred within that cell over a number of defined years. The grid system fishnet is definable by the

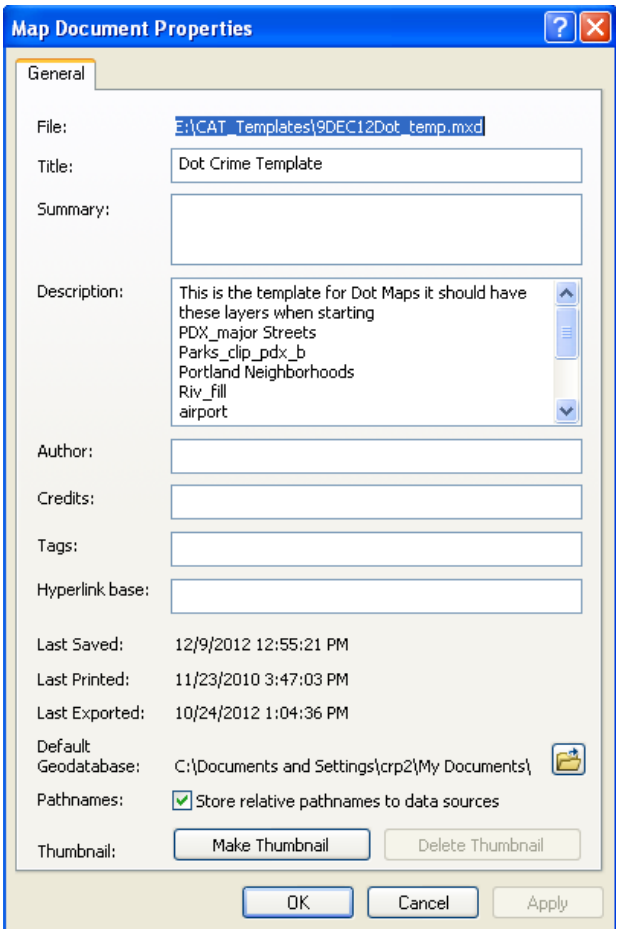
user and generally represents a categorization of city blocks and a number of crime incidents. In establishing the cut points of coloring the map, the initial cut point is based off of the mean for the defined time period. Additional cut points are established by the mean plus 1 standard deviation and the mean plus 2 standard deviations. Areas that have no incidents are also indicated though color selection.

It is important to remember that grid mapping does not control for differences in population across the city. Areas identified as high risk for victimization may actually be rather low when considering the number of people that live in or frequent the areas. This type of map allows the user/audience to not only see the relative risk within that area but also zoom in to see the physical surroundings of the areas identified with high relative risk. Unlike in the previous KD map, the relative risk identified with these grids is not limited by missing data from other agencies.

Step – by – Step Instructions

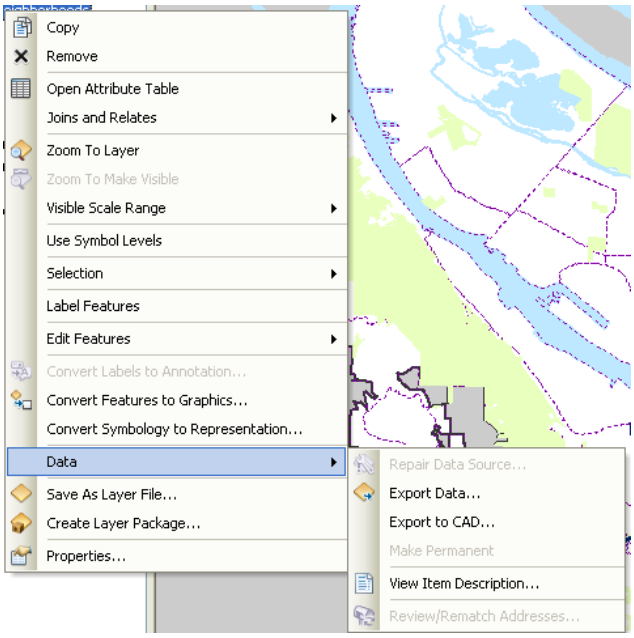
Dot Map

1. **Open** MXD file
    a. 9Dec12Dot_temp
2. Go to **File**
    a. Map document properties
        i. Verify that **Pathnames: Store relative path names to data sources** is selected
        ii. Select OK

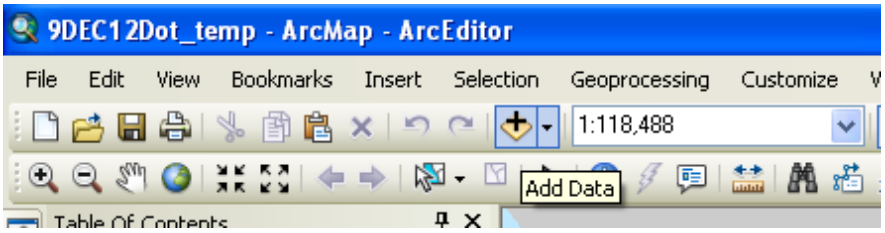


iii. *If* **Pathnames: Store relative path names to data sources** is not selected:

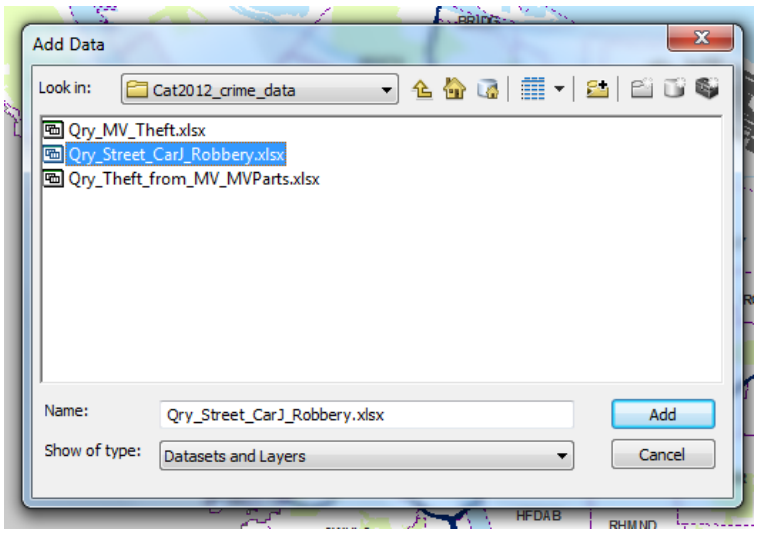
1. **Right click** on layer
2. **Data**
   a. **Repair data source**: Select the folder that contains the layer that is attached to this file (generally has the same name as the layer as long as you haven't changed the layer name). This will allow you to repair all of the layers that are in the same file structure at once. If you stored data in multiple, different file structures, you will need to file each data source that you want to make active individually.



3. Adding Crime Data
   a. **Select "add"** Data button on top Ribbon

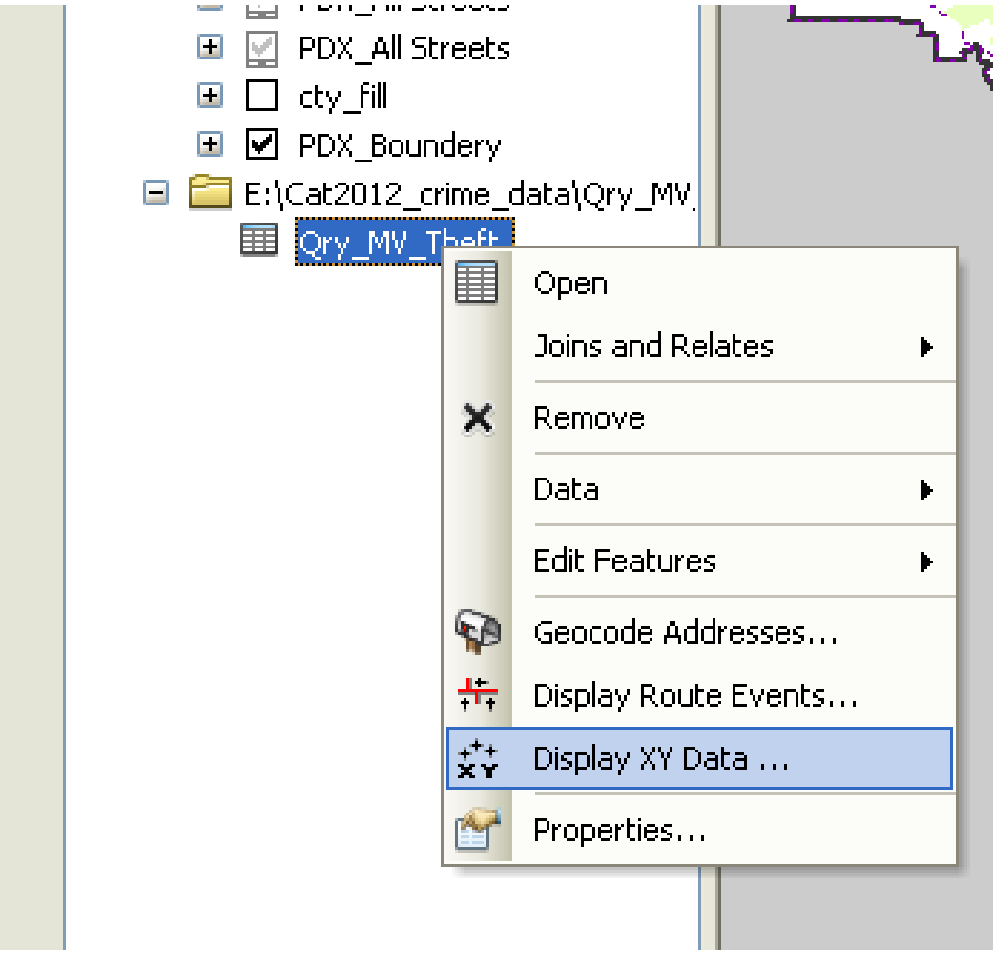


b. Navigate to the folder that contains your Excel file (your crime data file) and **select** the Excel file



c. **Click** on the Excel file
   i. **Click add data** –select appropriate data source

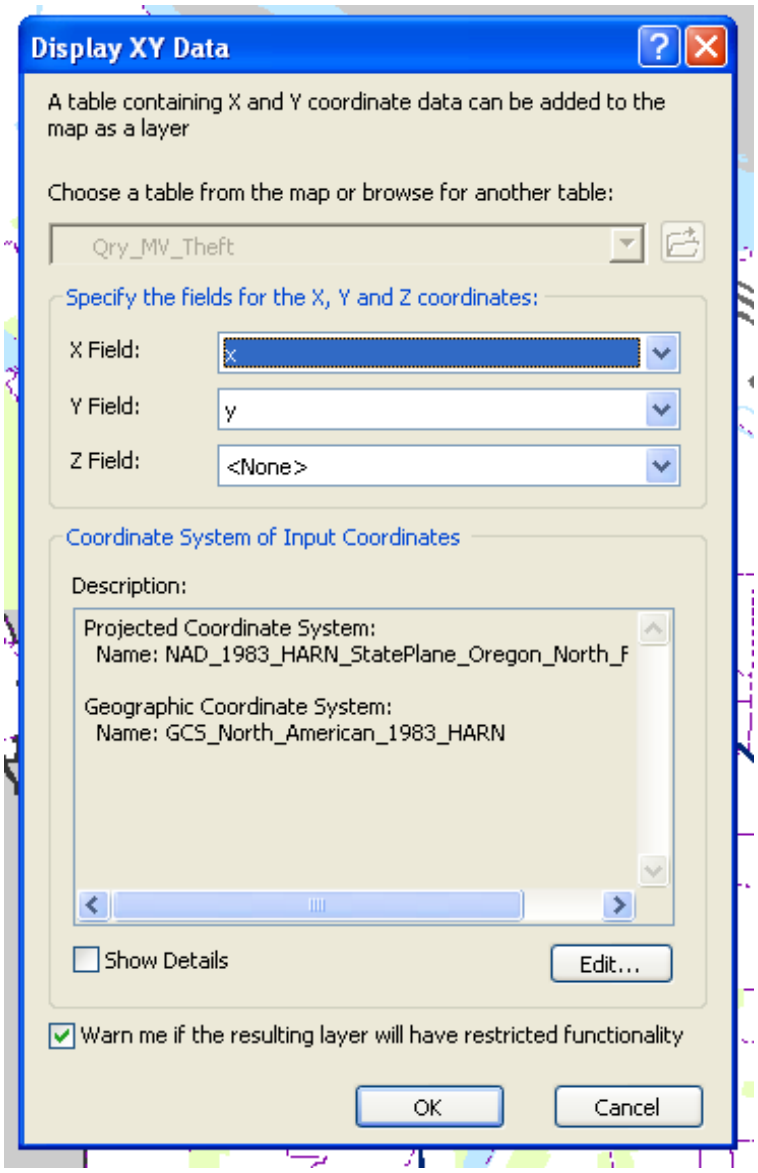
4. **Right click** on **Data** that was just added. This is the Excel spreadsheet data file
   a. Click Display XY data



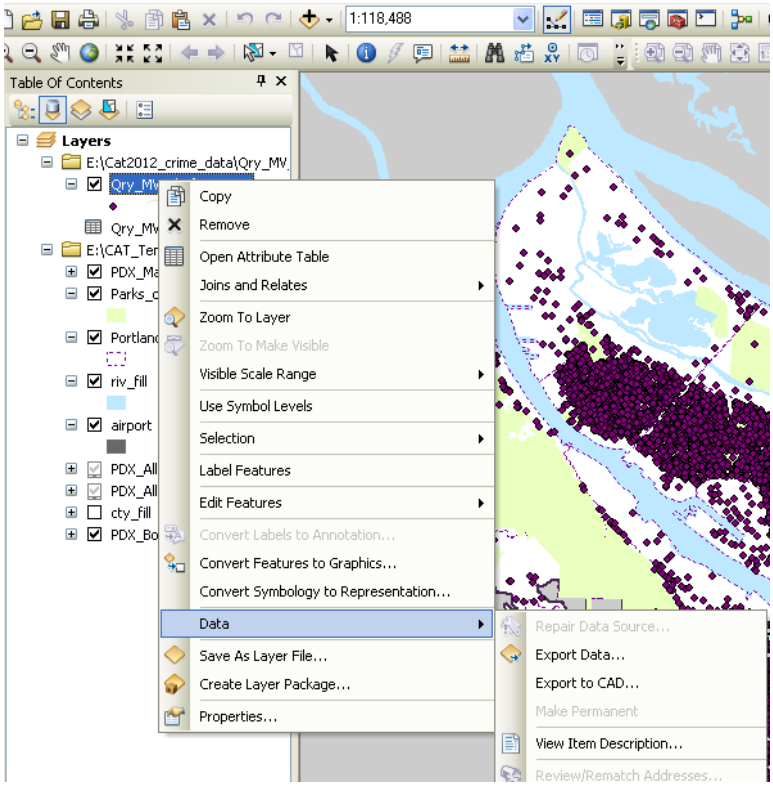
b. A new pop up screen is presented.

c. Select OK

d. This will result in a new pop screen labeled **table does not have object_ID** filed **select OK**

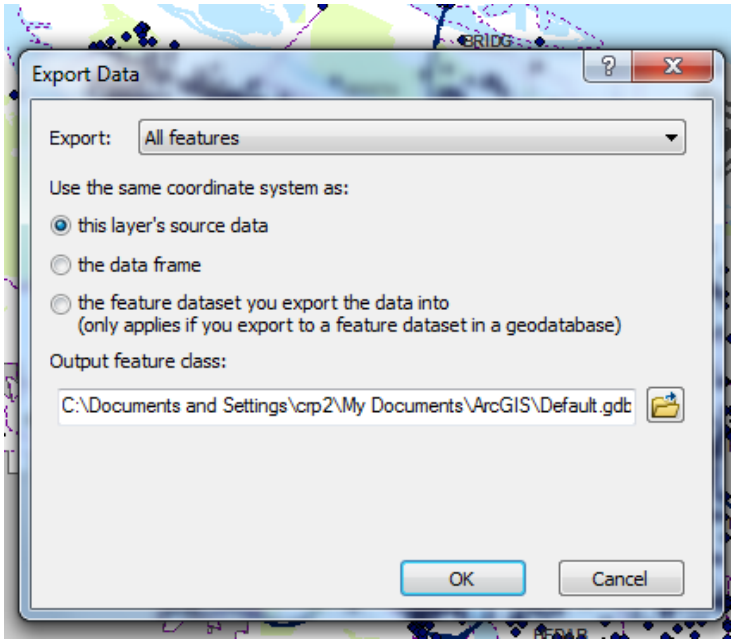


5. **Right click** Qry_"crime"_events
6. At this time, your crime dots should be visible on the map.

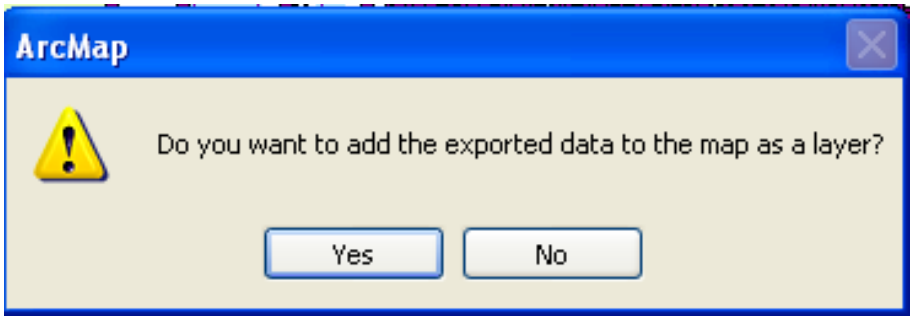


a. **Select Data.** This next step allows for your data file to be saved as a shape file.

   i. **Select Export data**

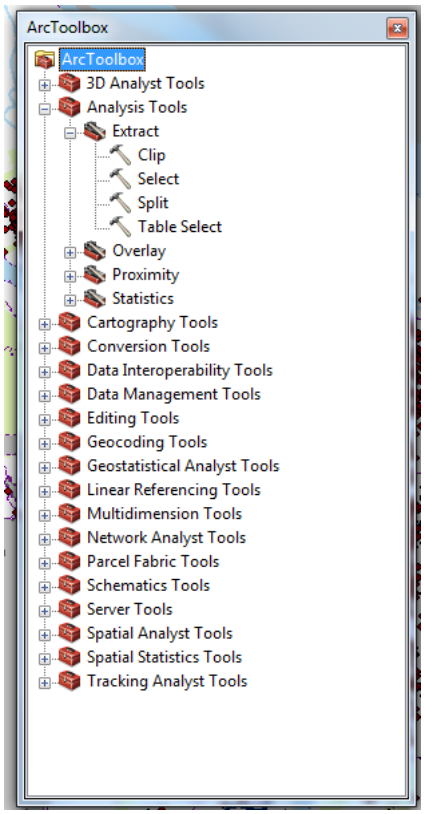


7. **Select file icon**
8. **Select save location and name file**
9. **Save** as type: "shapefile"
10. **Select OK**
11. "Do you want to add the exported data to the map as a layer?" **Select Yes**

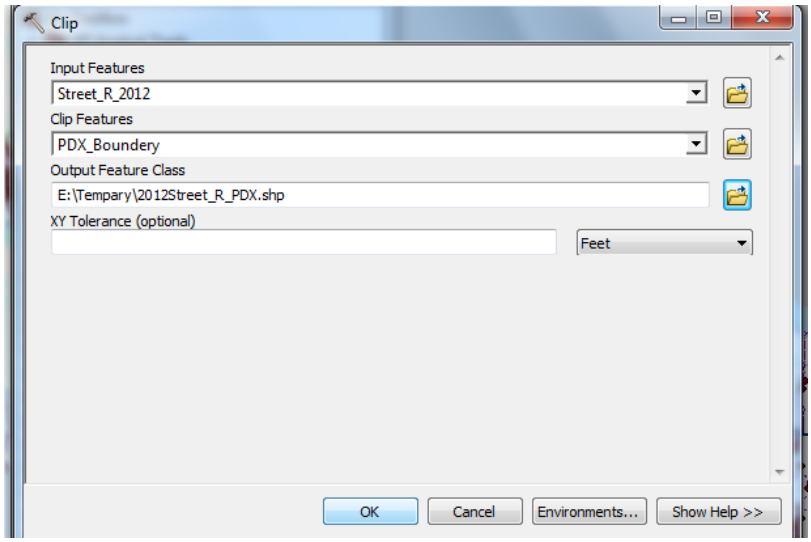


12. *Optional:* At this time you can delete the previous file from map.

13. **Clip Data** to Portland boundary file
    a. **Open ArcToolbox**

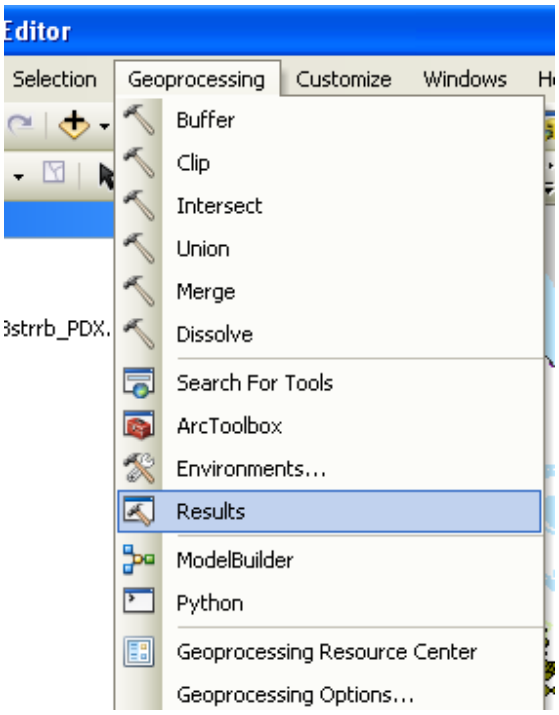


i. **Select Analysis tools**
   1. **Select Extract**
      a. **Select Clip**
         i. Input feature : will be crime dot layer
         ii. Clip Feature: PDX_boundary
         iii. Output feature class : "school year crime city"
         iv. **Select OK**

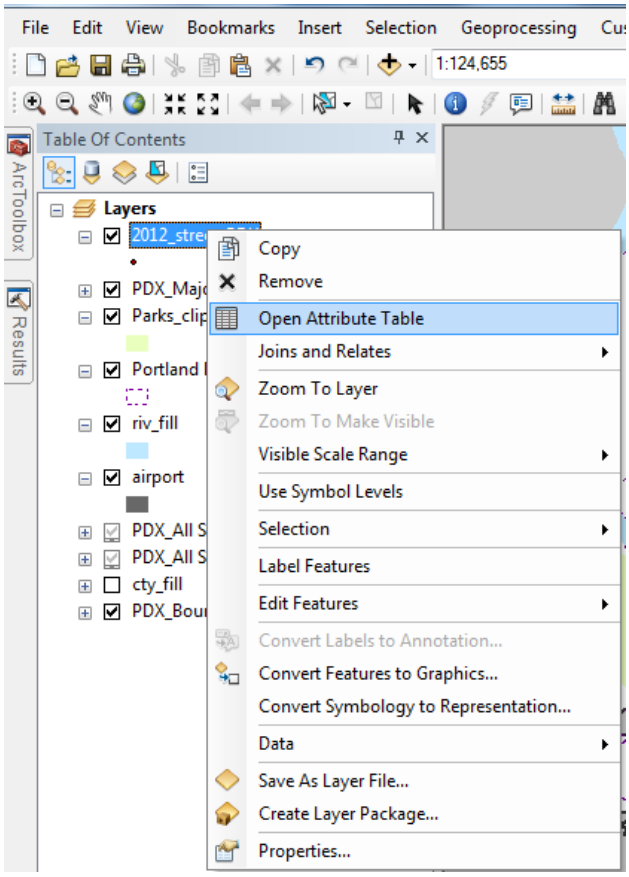


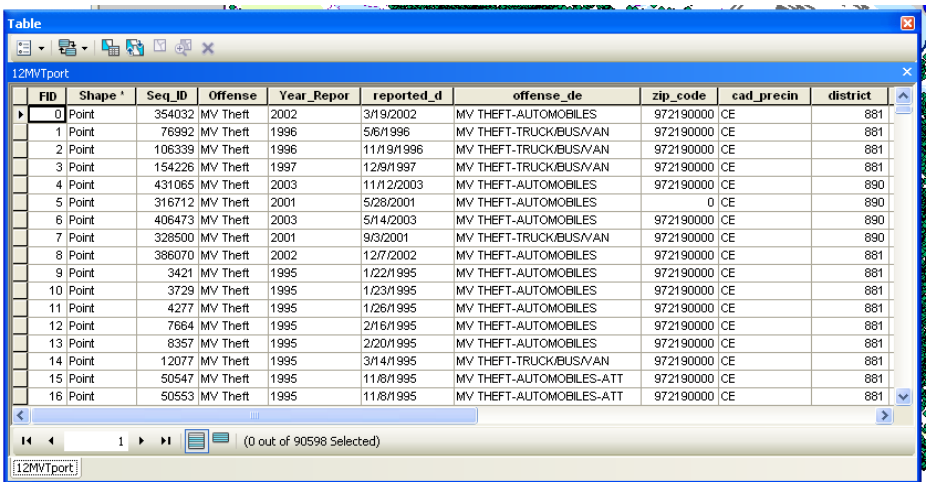
14. ***Note:*** if error with process view follow these steps:

15. Results Menu
    a. **Open geoprocessing tab**
        i. Results : this will allow you to see if there is an error in the process you are using
        ii. Clip will also scroll across the bottom of page showing it is in progress



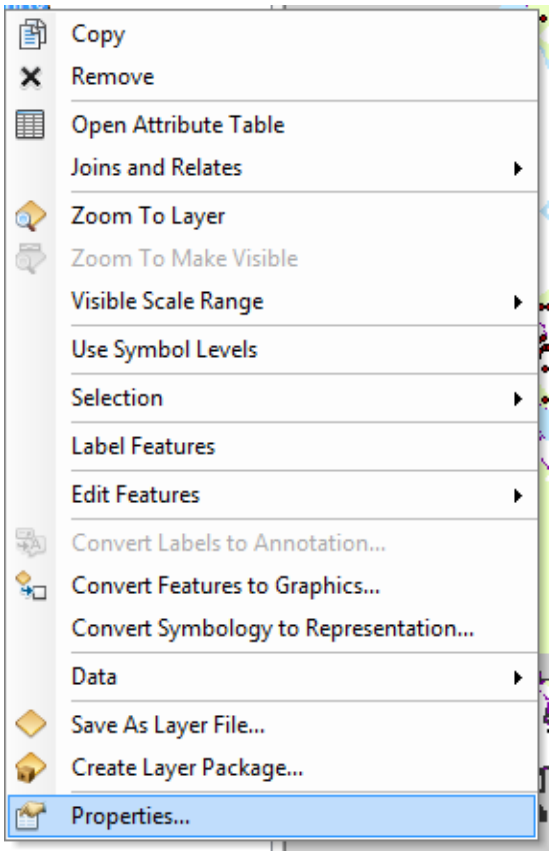
16. ***Note:*** to identify cases excluded from analysis
    a. Once you have finished clip **open attribute table**



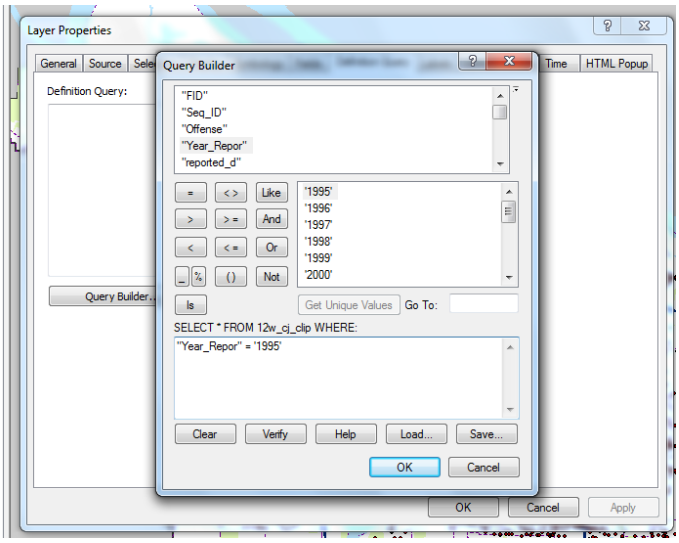


FID	Shape *	Seq_ID	Offense	Year_Repor	reported_d	offense_de	zip_code	cad_precin	district
0	Point	354032	MV Theft	2002	3/19/2002	MV THEFT-AUTOMOBILES	972190000	CE	881
1	Point	76992	MV Theft	1996	5/6/1996	MV THEFT-TRUCK/BUS/VAN	972190000	CE	881
2	Point	106339	MV Theft	1996	11/19/1996	MV THEFT-TRUCK/BUS/VAN	972190000	CE	881
3	Point	154226	MV Theft	1997	12/9/1997	MV THEFT-TRUCK/BUS/VAN	972190000	CE	881
4	Point	431065	MV Theft	2003	11/12/2003	MV THEFT-AUTOMOBILES	972190000	CE	890
5	Point	316712	MV Theft	2001	5/28/2001	MV THEFT-AUTOMOBILES	0	CE	890
6	Point	406473	MV Theft	2003	5/14/2003	MV THEFT-AUTOMOBILES	972190000	CE	890
7	Point	328500	MV Theft	2001	9/3/2001	MV THEFT-TRUCK/BUS/VAN	972190000	CE	890
8	Point	386070	MV Theft	2002	12/7/2002	MV THEFT-AUTOMOBILES	972190000	CE	881
9	Point	3421	MV Theft	1995	1/22/1995	MV THEFT-AUTOMOBILES	972190000	CE	881
10	Point	3729	MV Theft	1995	1/23/1995	MV THEFT-AUTOMOBILES	972190000	CE	881
11	Point	4277	MV Theft	1995	1/26/1995	MV THEFT-AUTOMOBILES	972190000	CE	881
12	Point	7664	MV Theft	1995	2/16/1995	MV THEFT-AUTOMOBILES	972190000	CE	881
13	Point	8357	MV Theft	1995	2/20/1995	MV THEFT-AUTOMOBILES	972190000	CE	881
14	Point	12077	MV Theft	1995	3/14/1995	MV THEFT-TRUCK/BUS/VAN	972190000	CE	881
15	Point	50547	MV Theft	1995	11/8/1995	MV THEFT-AUTOMOBILES-ATT	972190000	CE	881
16	Point	50553	MV Theft	1995	11/8/1995	MV THEFT-AUTOMOBILES-ATT	972190000	CE	881

17. **Select by attribute**
    a. **Right click** crime data layer
    b. **Select properties**



    c. On layer properties menu **Select definition query tab**



d. This will cause query builder menu to open up

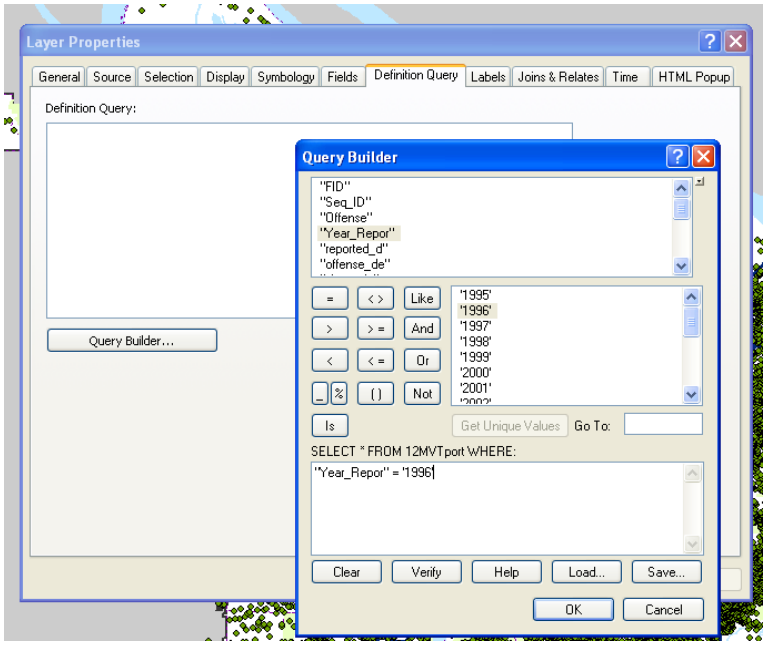
e. Select Year_Repor

f. **Select =**

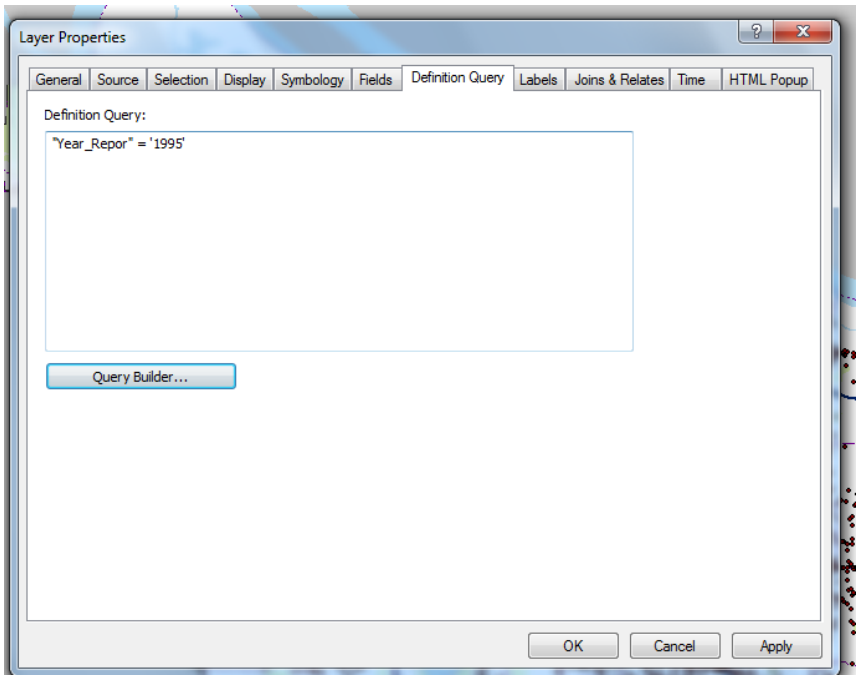
g. **Select Get Unique Value**

   i. **Select** the crime year you are interested in

h. Select OK



i. This will bring you back to layer properties window



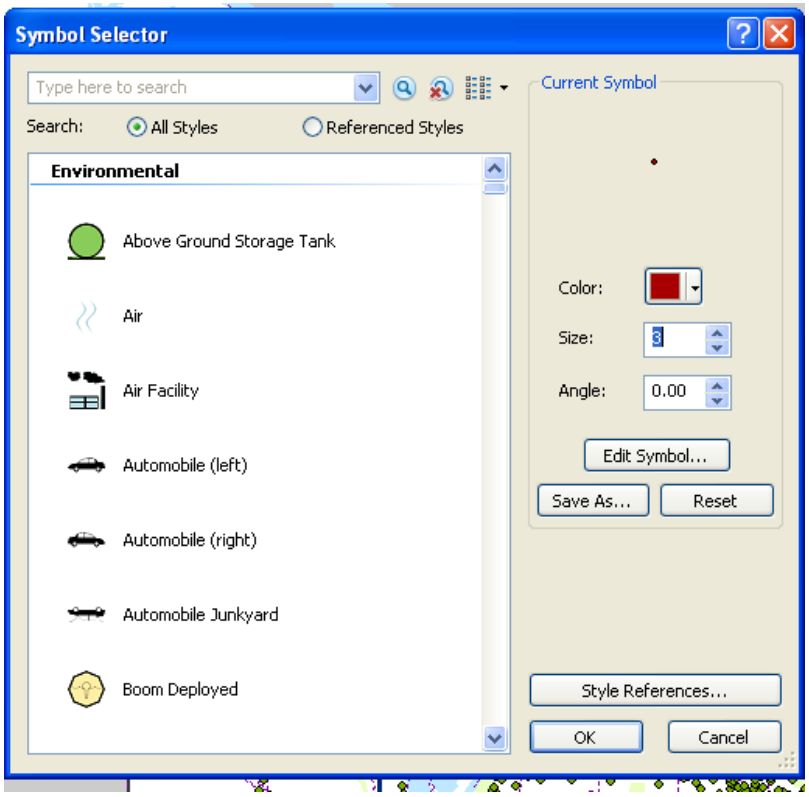
j. **Select OK**

k. Change the layer name to reflect what year is being represented: School year crime port crimeyear ie.12mvtport95

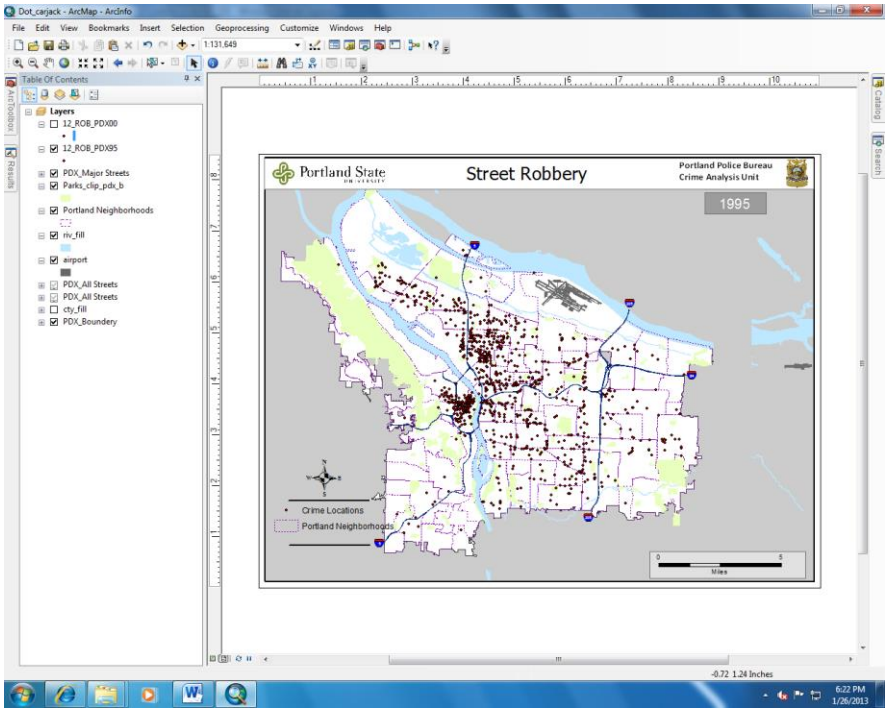
18. The next step is to add the clipped data again. Repeat steps 17a – 17 k for each year represented

    NOTE: each year will be noted with the appropriate year date

19. At this point you should have all crime dot layers added to your base map.
20. To modify Dot Characteristics, double **click a dot in the table of contents** which will bring up the symbol selector menu.
    a. **Size** = 3
    b. **Color** = Tuscan red
    c. Once you have made all of your changes, **select OK**



21. At this point you can make all of your dot maps. If doing one year, select year in the Table of Contents. If representing multiple years, turn on the specific years by checking the years you want to represent in the maps table of contents.
22. **Switch to Layout view**



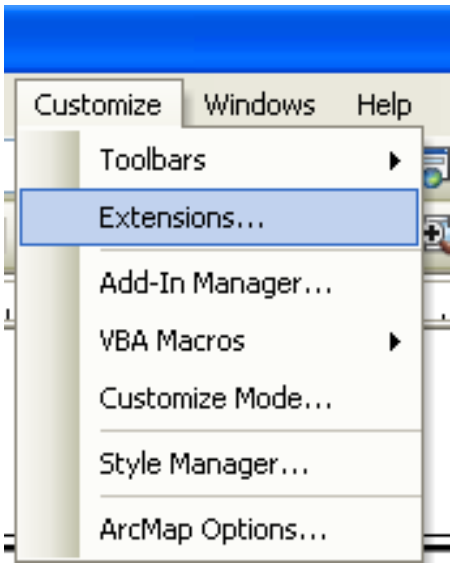
a. Note: You can interactively make changes in the view. Select (arrow) in the ribbon to individually modify" "Title", "Year", "Key" on the map.
b. **Change title** to reflect current crime
c. **Change year** to reflect year data displayed
d. **Insert crime count for year,** found in attribute table
e. **Insert percent change** [(current year – 1995 count)/1995 count] * 100
f. **Scale** should be 1:120,000; change the scale via the ribbon
g. You might have to center the map if it has moved use (hand icon) to move map to center or chosen position

23. The next step is Exporting map
    a. **Select File**
    b. **Select Export map**
    c. **Name the map**
        i. **Select file type**: Recommend using .PNG
        ii. **Adjust properties** to:
            1. **Resolution** 300DPI (will automatically adjust W and H)
            2. **Width** 3,300
            3. **Height** 2,550
        iii. **Save** changes

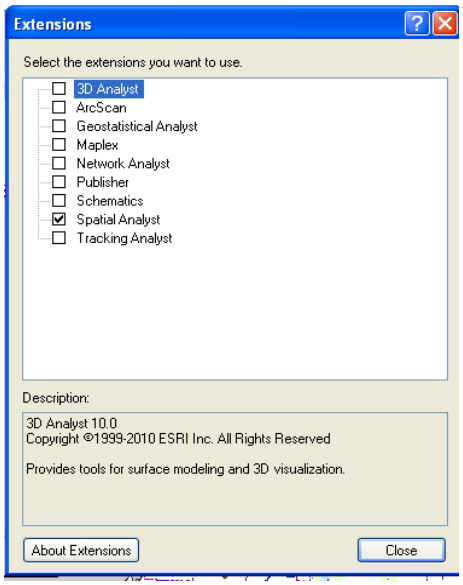
24. **Review** your output

Density Map

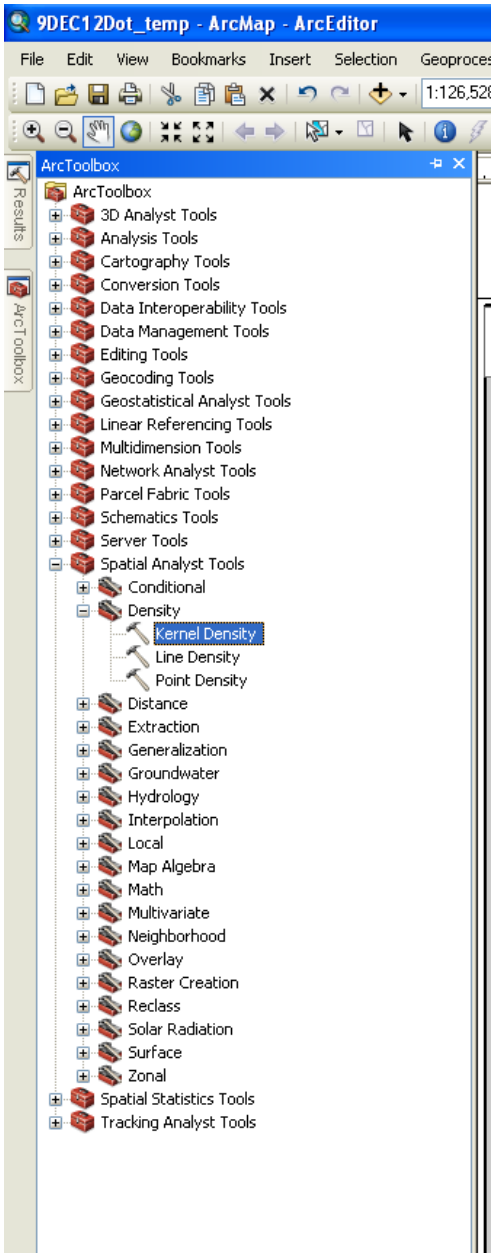
1. Creating Density Layers
    a. Make sure **spatial analyst** is **on**



    b. Select Customize
    c. Select Extension
    d. Check spatial analyst
    e. Select close

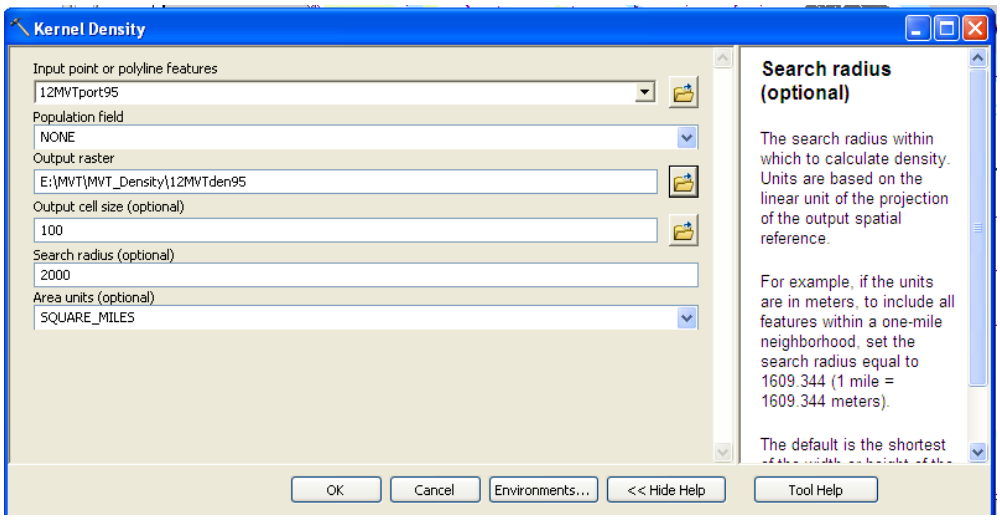


2. **Open ArcToolbox**

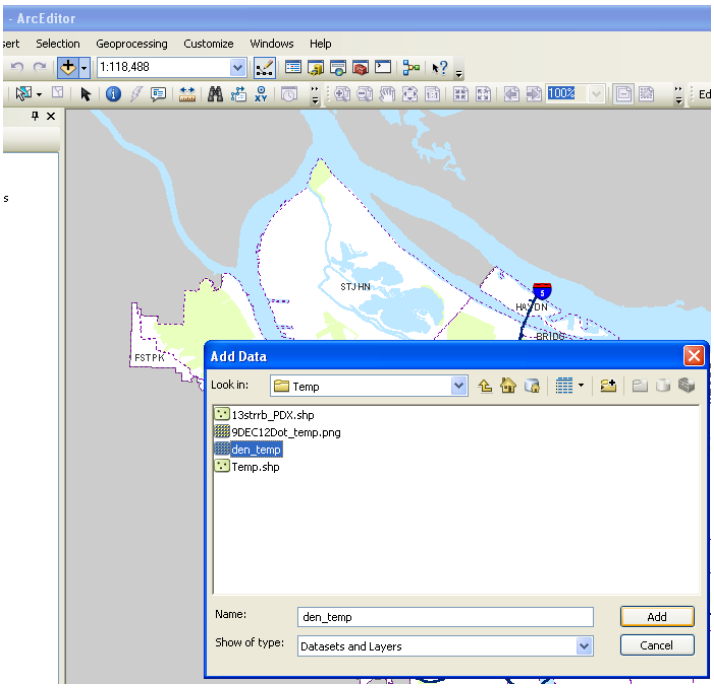


a. **Open Spatial analyst**
b. **Open Density**
c. **Open Kernel Density**
    i. **Input Feature** = crime_dot_year
    ii. **Output raster** = save as school year crime Den datayear
    iii. **Output cell size** = 100
    iv. **Search Radius** = 2,000

v. **Area Unit** = Square_miles
vi. **Select OK**



3. You will create a density layer for every year of your data following the above kernel density steps the only characteristic that will change is the input point or polyline feature to corresponding dot crime data layer and output raster which is saved output.
4. **Open** MXD base map file
    a. 9DEC12Dens_temp
5. **Add data**



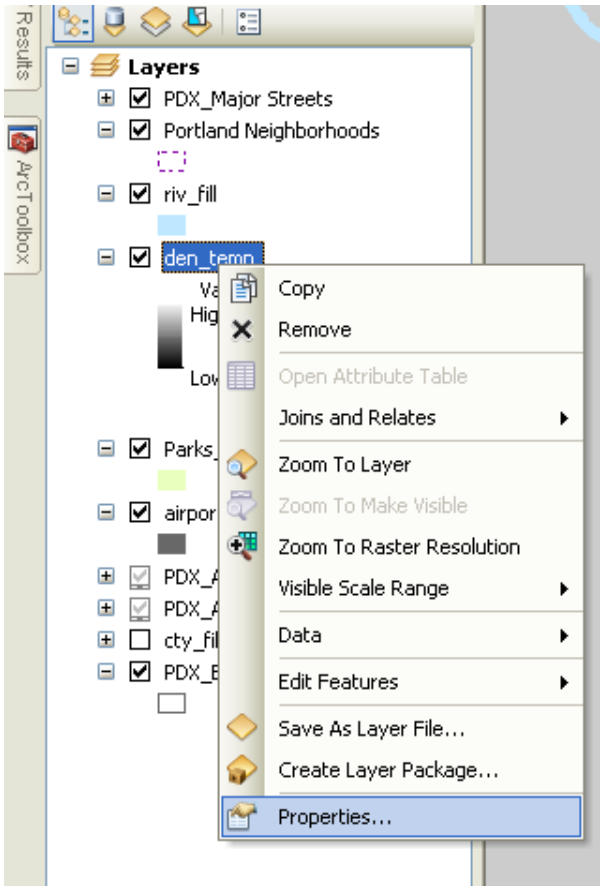
a. **Navigate** to saved location of kernel density layer just created in step 2

b. Select density layer

c. Select add

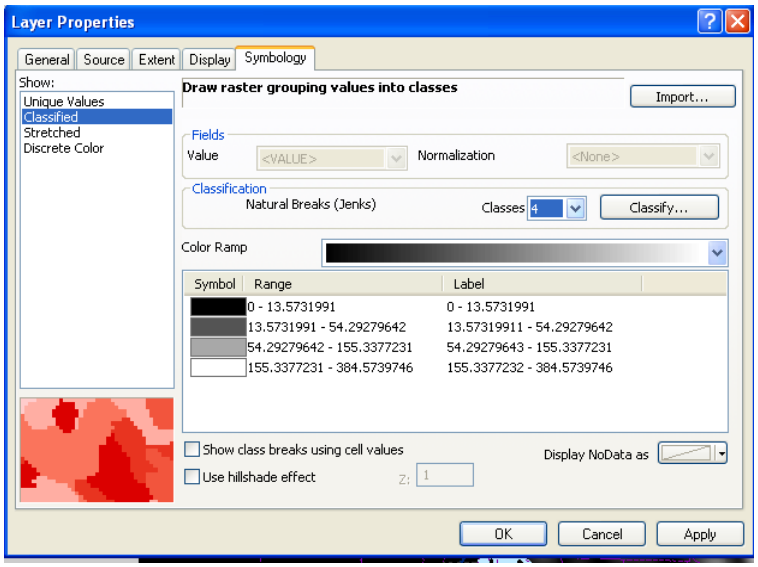
6. **Right Click on new Layer**

a. Select Properties

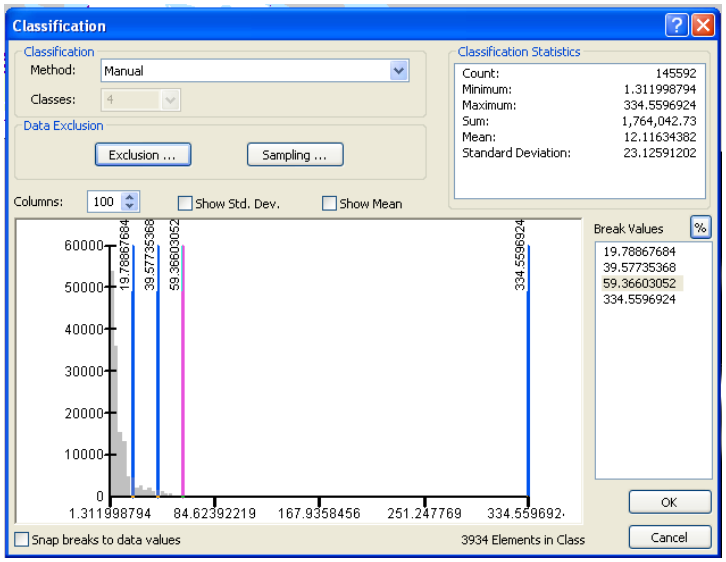


i. This results in a new layer properties window

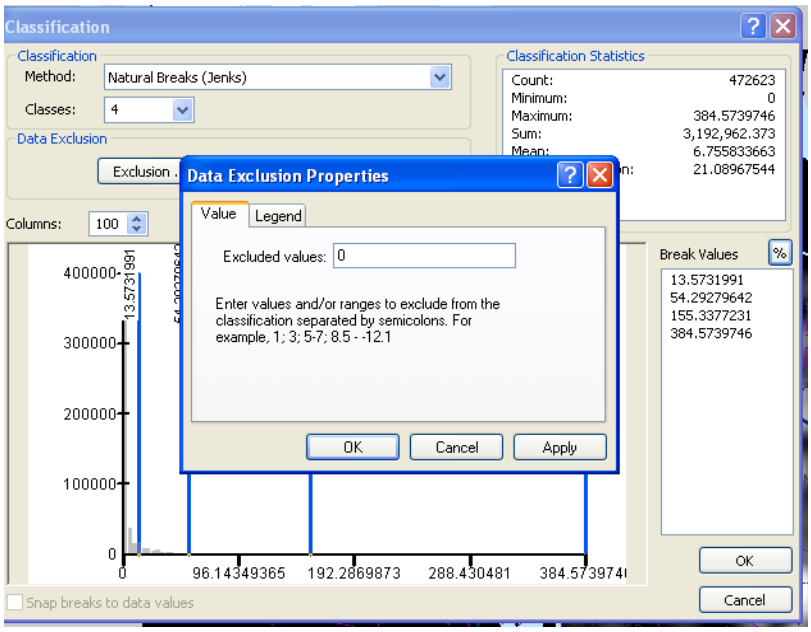
ii. **Select Symbology**



1. Select classified
2. Change classes to 4
    a. Select classify

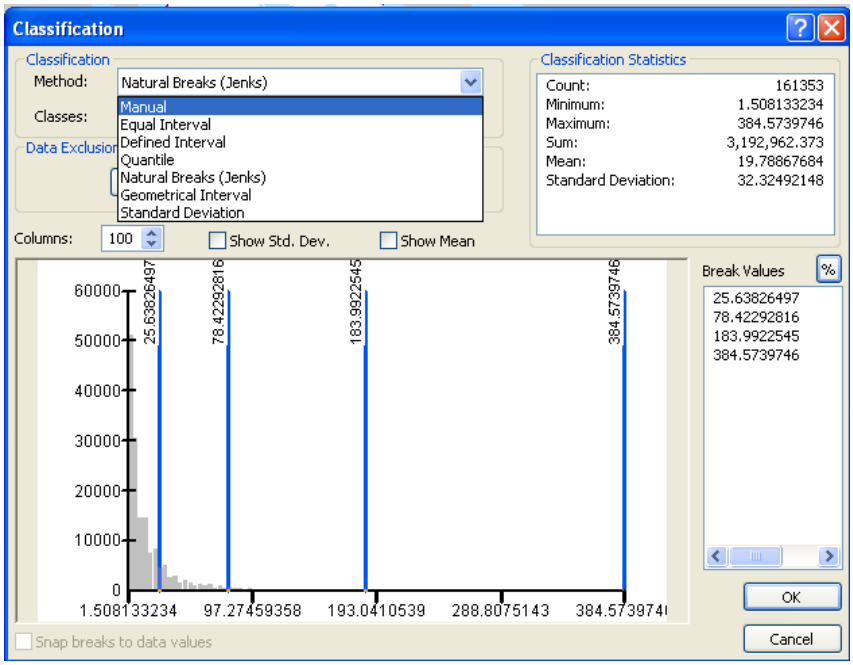


i. Click exclusion



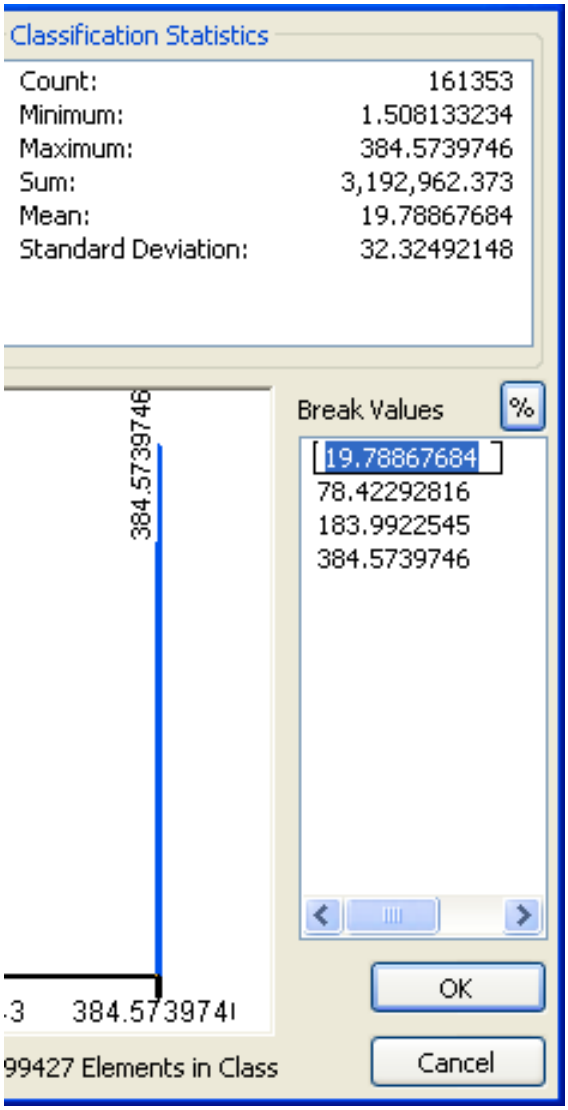
1. **Enter** "0"
2. **Select OK**

b. Change classification method to manual



c. Set the **break values**

i. Use the mean of 1995 for the first break, which can be derived from the classification statistics box



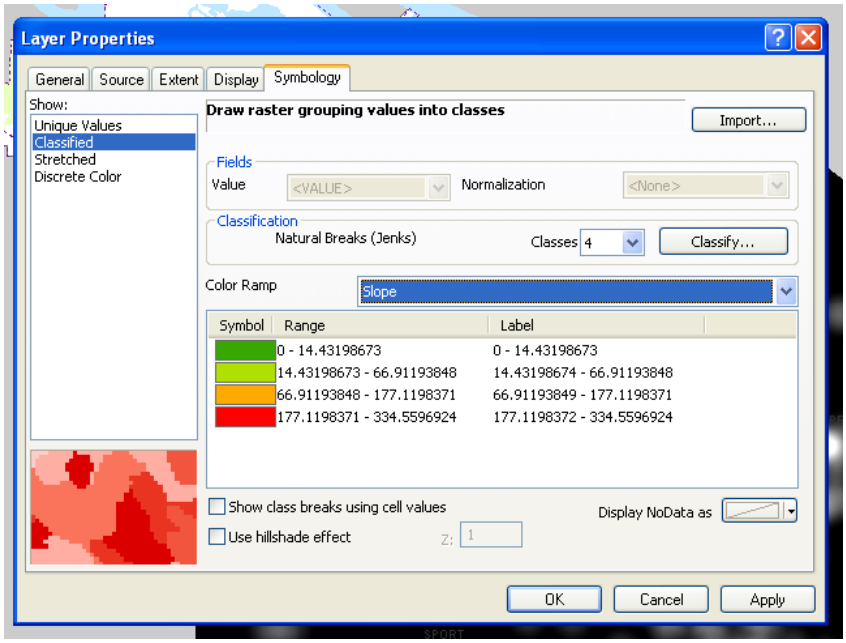
ii. The second and third values will be two and three times the mean

iii. ***Note:*** This will get you the cutoffs for the color break downs with 1995 as the reference year.

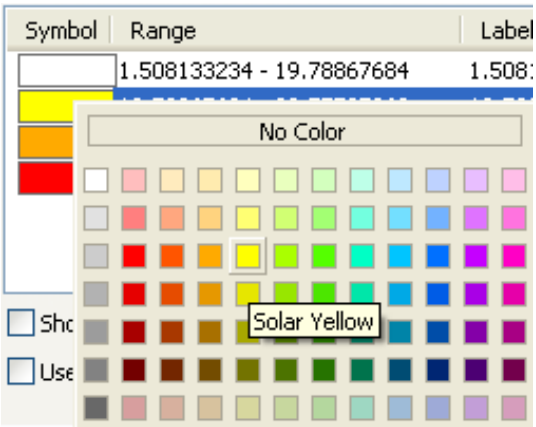
d. Select OK

3. **Click** on **color ramp**

a. **Select slope**

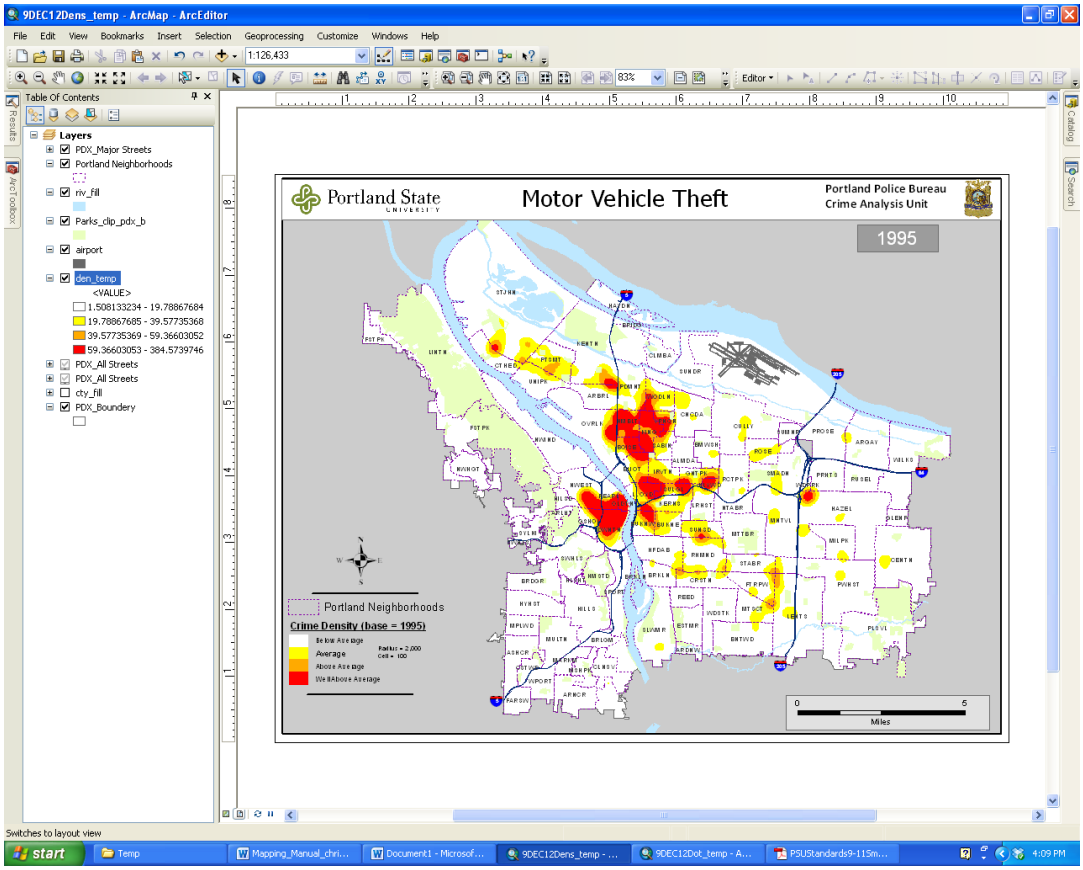


7. **Change first color** from green to **no color** by double clicking on color swatch and then selecting no color
8. **Change the second color** to **solar yellow**



9. **Select OK**
10. Move selected density layer in the table of contents below road, neighborhood, and airport layers.
11. You will add all the density layers to your density map template for any additional years using the same steps 1 – 10, except the break values will continue to use your base years data.

12. **Switch to layout view** to make final maps
    a. **On the top place the name of the crime centered**
    b. **Change the year** in the grey box to appropriate year



    i. ***Note:*** You can interactively make changes in the view. Select (arrow) in the ribbon to individually modify" "Title", "Year", "Key" on the map.
    c. **Change title** to reflect current crime
    d. **Change year** to reflect year data displayed
    e. **Insert crime count for year,** found in attribute table
    f. **Insert percent change** [(current year – 1995 count)/1995 count] * 100
    g. **Scale** should be 1:120,000; change the scale via the ribbon
    h. You might have to center the map if it has moved use (hand icon) to move map to center or chosen position

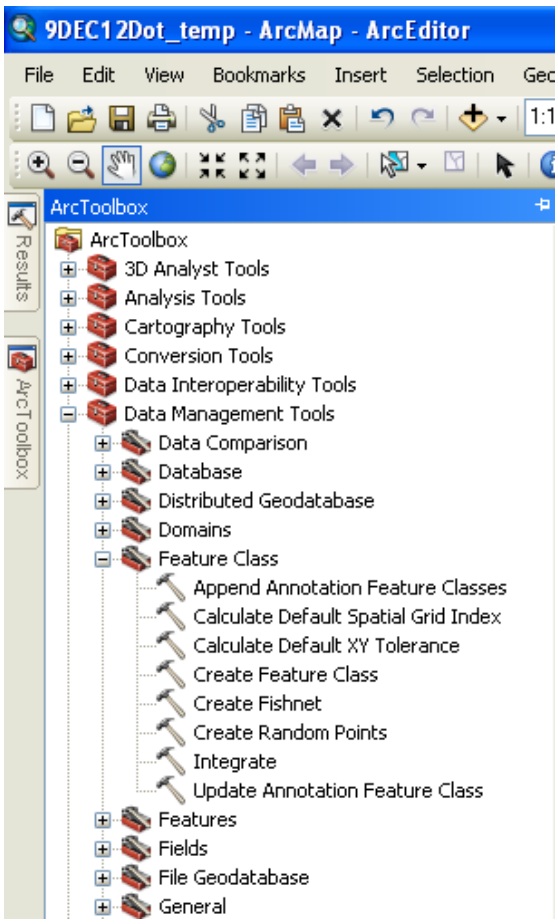
13. The next step is Exporting map
    a. **Select File**

b. **Select Export map**
c. **Save** the map "school year crime den year of data"
    i. **Select file type**: Recommend using .PNG

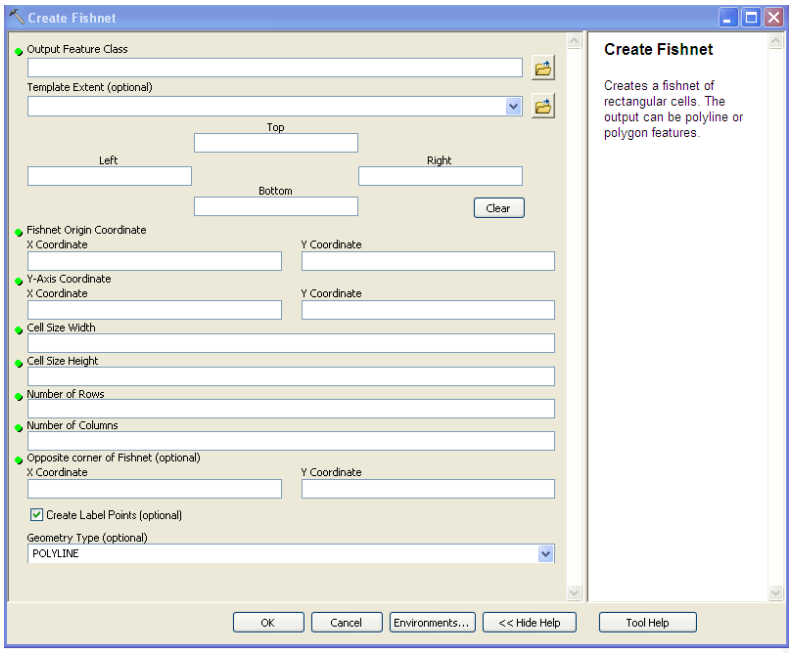
    ii. **Adjust properties** to:
        1. **Resolution** 300DPI (will automatically adjust W and H)
        2. **Width** 3,300
        3. **Height** 2,550
    iii. **Save** changes

Google Earth Map

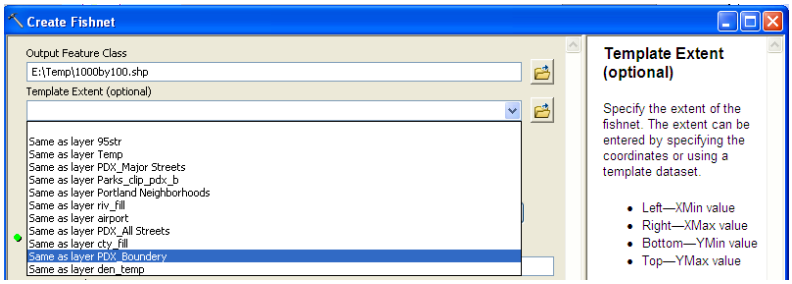
1. **Open** previously created dot MXD file
2. **Open ArcToolbox**
    a. **Select data management tools**
        i. **Select Feature class**
        ii. **Create fishnet**



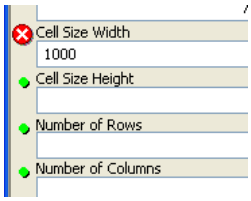
3. **Open Create fishnet window**



a. **Output Feature class** = save location and name of 1,000 by 1,000fish
b. **Template Extent** = same as layer PDX_Boundary



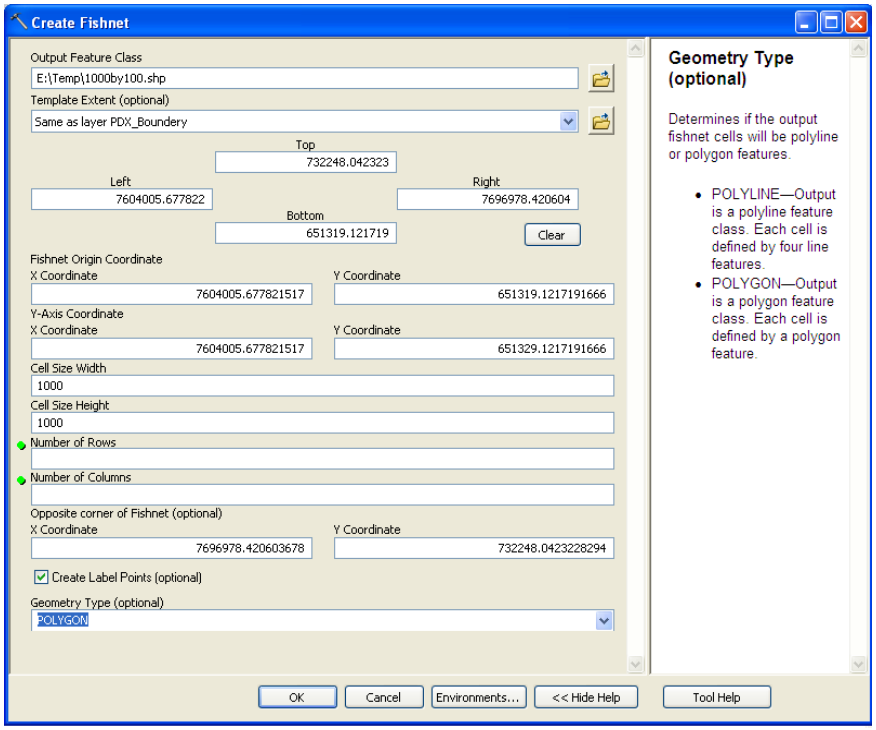
c. **Cell size width and height** should be 1,000



i. ***Note:*** a warning label will appear until you have placed a 1000 in both categories

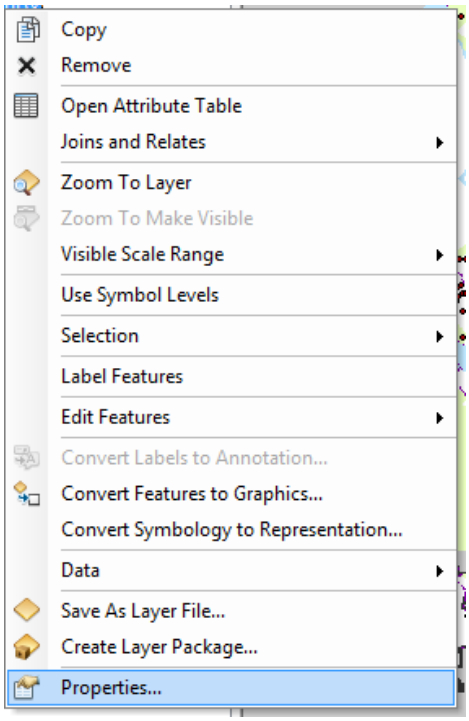
d. **Number rows** = 0
e. **Number columns** = 0

f. **Geometry type** = polygon

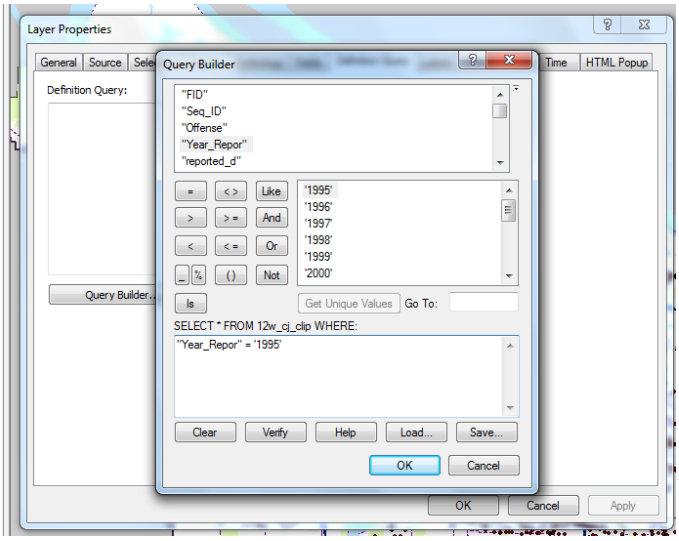


g. **Select OK**

4. **Select Crime dot layer** that was previously created
   a. **Right click crime data layer**
   b. **Select properties**

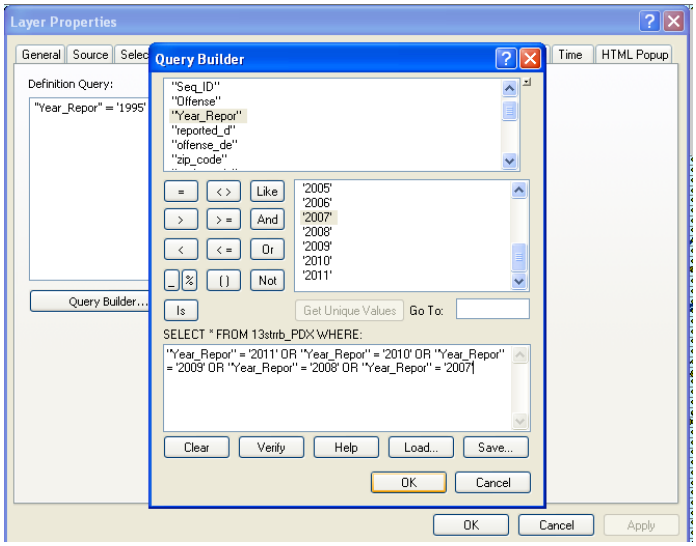


c. On layer properties menu **Select definition query tab**



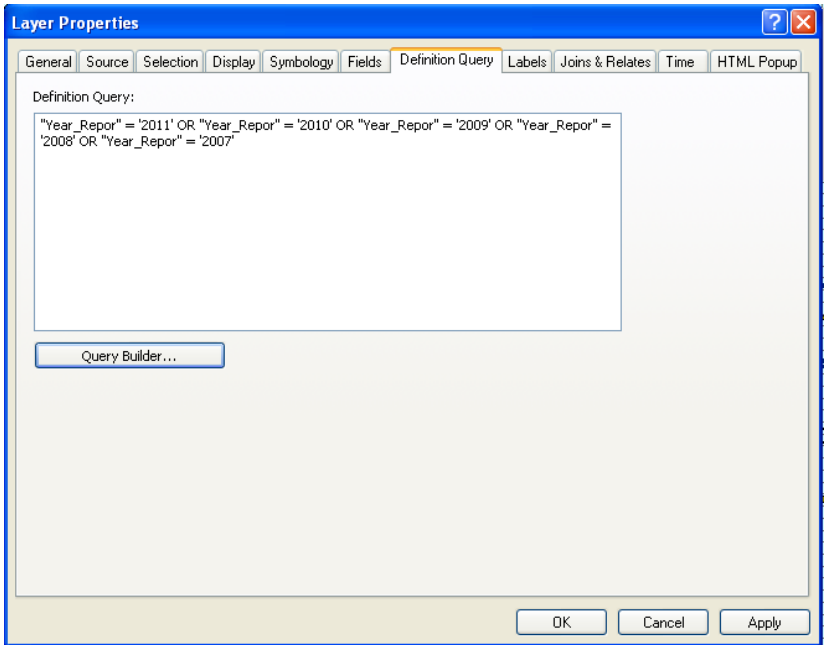
d. This will cause query builder menu to open up
e. **Select Year_Repor**
f. **Select =**
g. **Select Get Unique Value**
    i. **Select** the crime year you are interested in
h. **Select "Or"**

i. Repeat step e through h until you have the last five years of data selected



j. Select OK

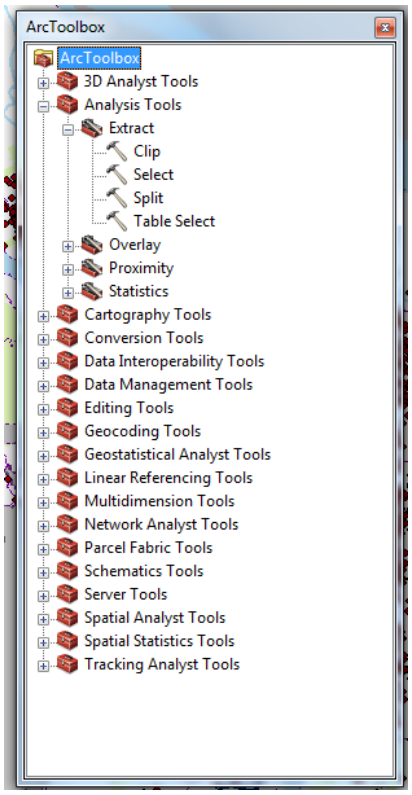
k. This will bring you back to layer properties window



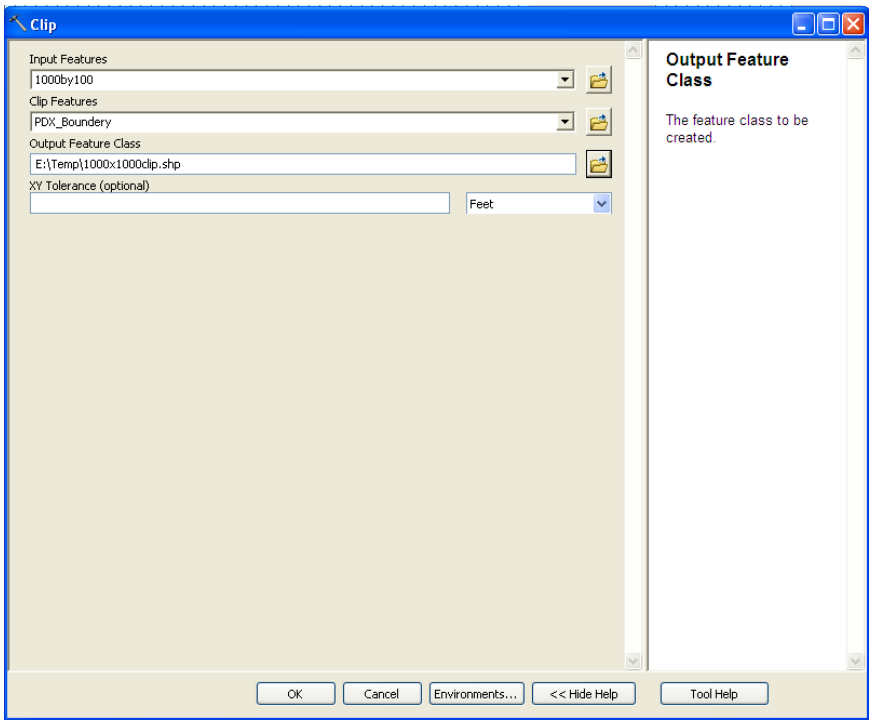
l. Select OK

m. **Change the layer name** to reflect the yearsbeing represented: School year crime port crimeyear ie.12mvtport07_11

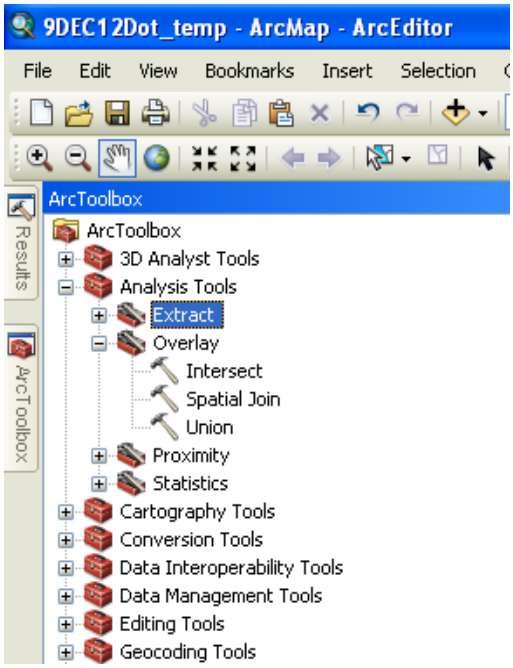
5. **Open ArcToolbox**
   a. **Clip Fishnet** to Portland boundary file
   b. **Open ArcToolbox**



i. **Select Analysis tools**
   1. **Select Extract**
      a. **Select Clip**
         i. **Input feature** : "1000by1000fish"
         ii. **Clip Feature**: is PDX_boundary
         iii. **Output feature class** : "1000by1000clip"
         iv. **Select OK**

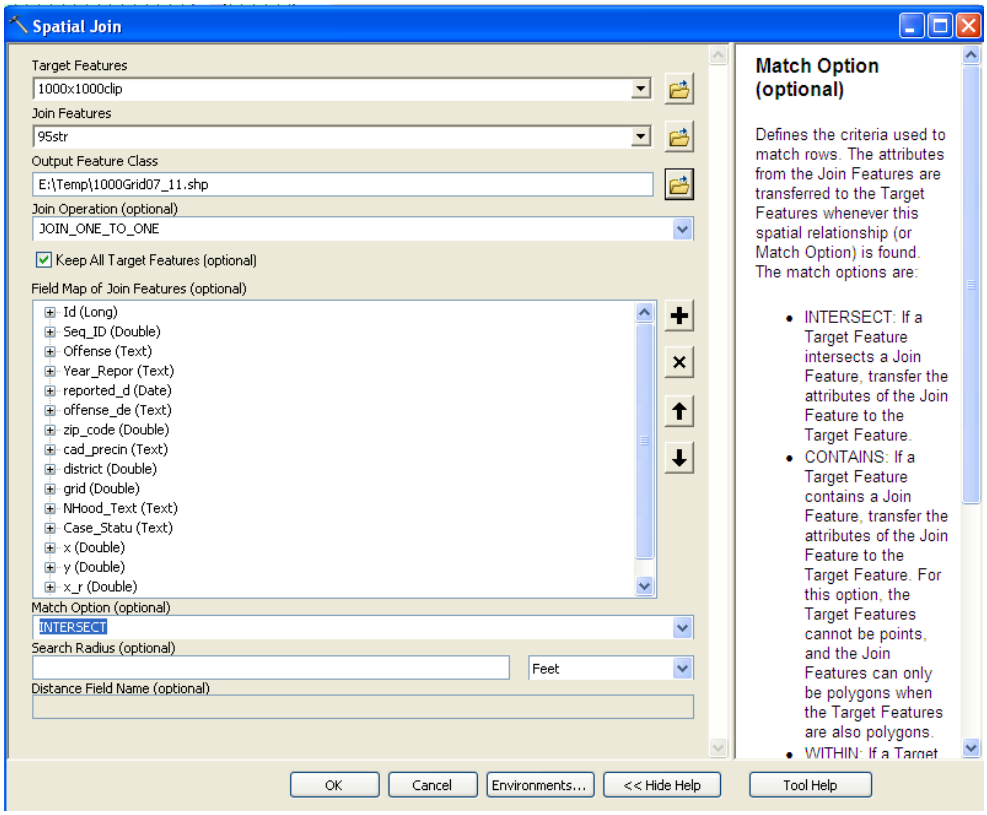


6. Open **ArcToolbox**



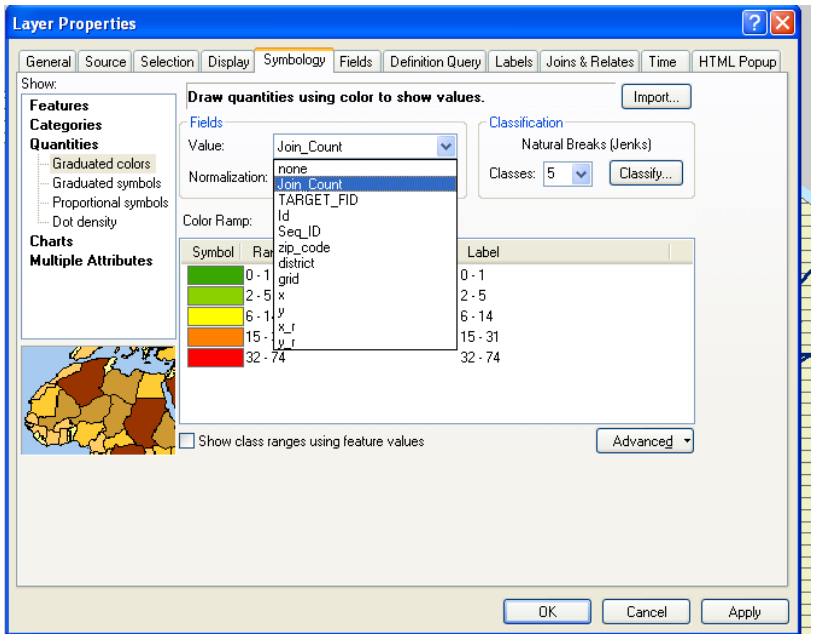
a. **Select analysis tools**
   i. **Select overlay**
      1. **Spatial join**

a. **Target feature** = 1,000 by1,000 clip
b. **Join Feature**= 5 year crime data layer created
c. **Output Feature class** = select save location name it 1000GridYears representing.
d. **Join operation** one to one
e. **Match option** intersect



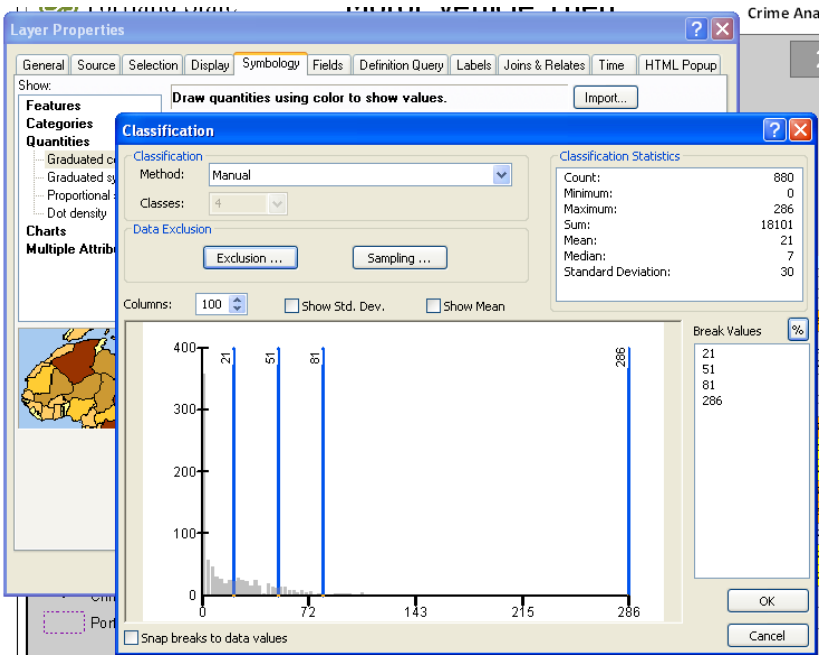
f. **Select OK**

7. **Right click** on 100Grid07_11
    a. **Select properties**
    b. **Select Symbology tab**



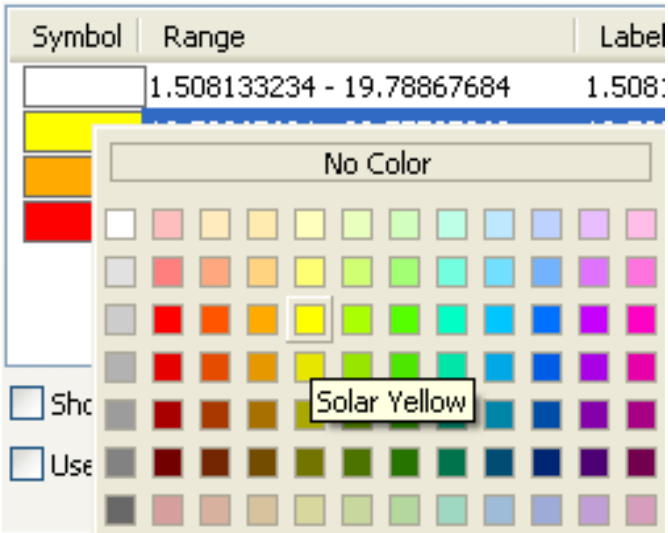
c. **Select Quantities**
   i. **Select value** = Join_count
   ii. **Classes** = 4

d. **Select classify**
   i. **Method** = manual
   ii. **Break values** originate from classification statistics box
      1. **First value** = the mean
      2. **Second value** = the mean plus 1 standard deviation
      3. **Third value** = the mean plus 2 standard deviations



e. **Select OK**

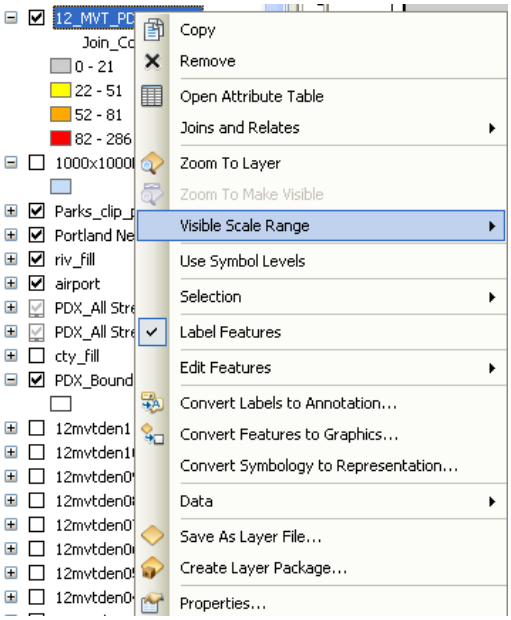
8. **Select color ramp = slope**
   a. **Change first color** from green to **20% grey** by double clicking on color swatch and then selecting 20% grey.
   b. **Change the second color** to **solar yellow**



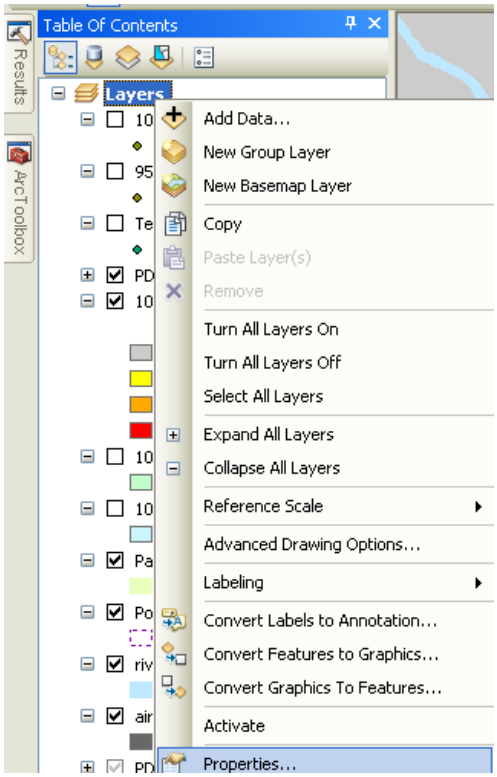
i. **Select OK**

9. **Right click 100Grid07_11**

a. **Select label feature**

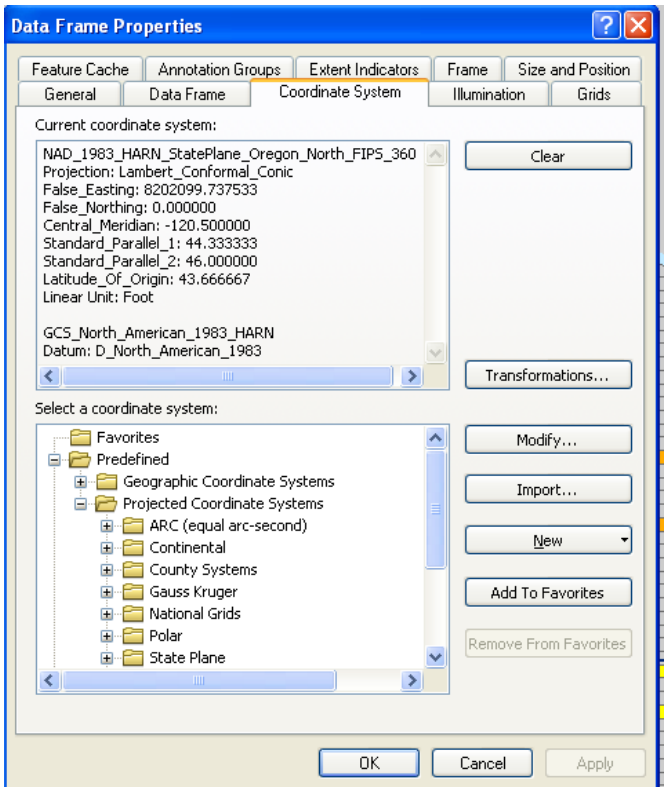


10. **Right click layer frame**



a. **Select properties**

b. **Select coordinate system**



i. **Select predefined**

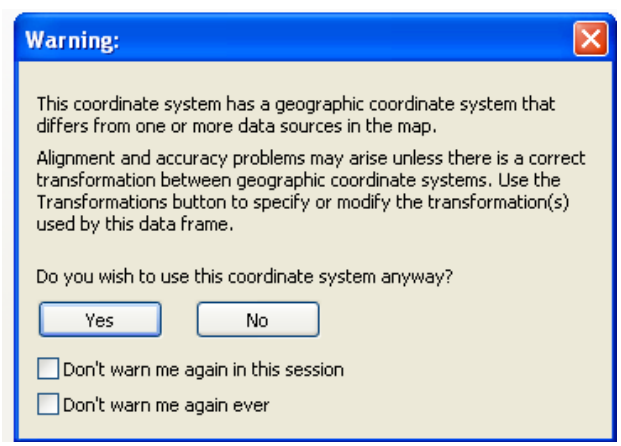
1. **Select projected coordinate systems**

a. **Select world**

i. **Select** WGS 1984 Web Mercator(Auxiliary sphere)

c. **Select OK**

i. ***Note***: when you Select OK you will see a warning window ignore it and **Select OK**

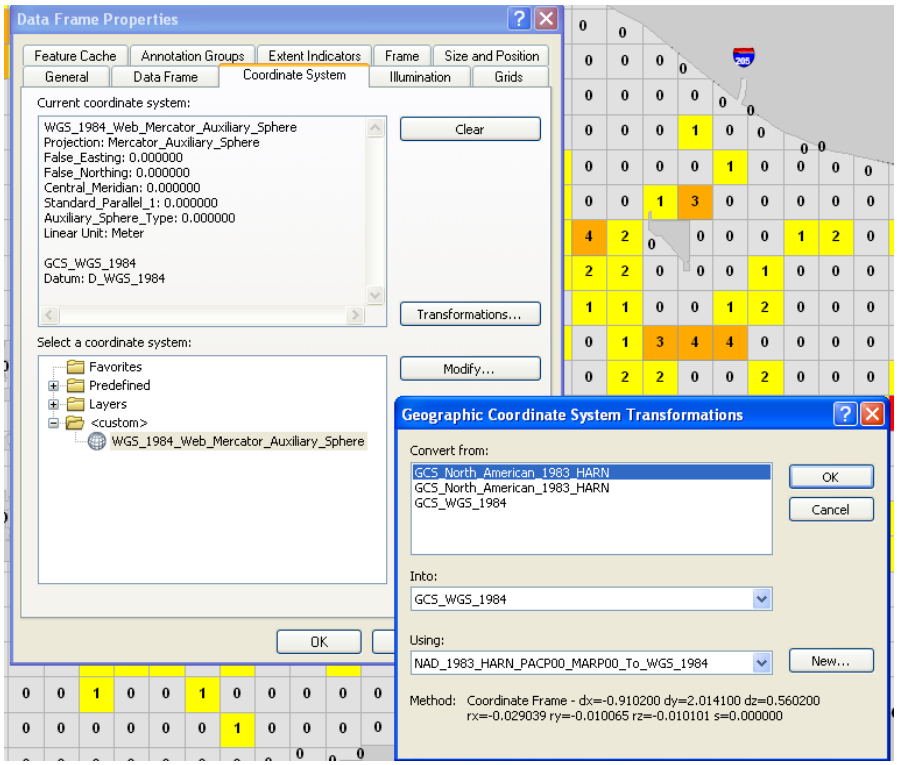


d. **Right click layer**

i. **Select properties**

1. **Select coordinate system**

a. **Select transformations**



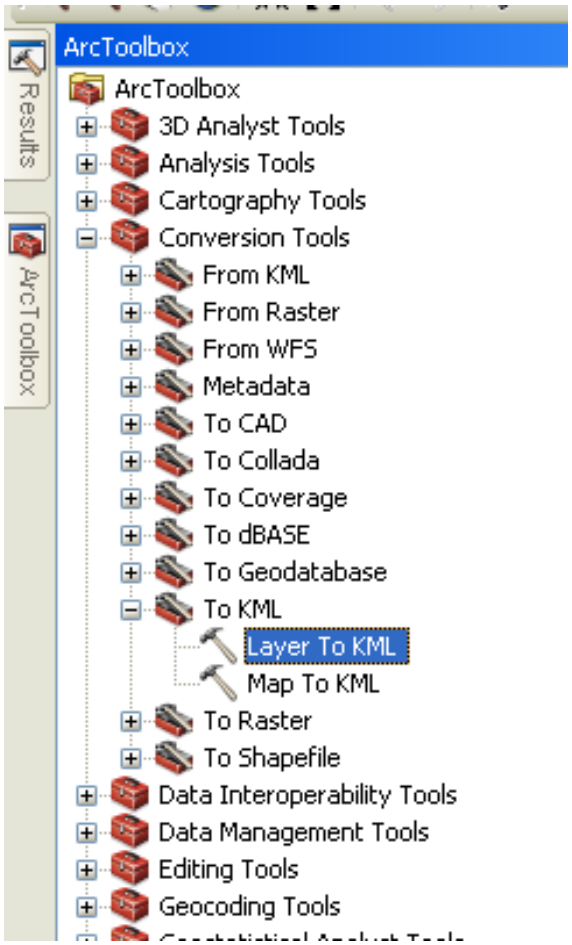
b. **Convert from** = GSS_North_American_1983_harn

c. **Into** = GSC_WGS_1984

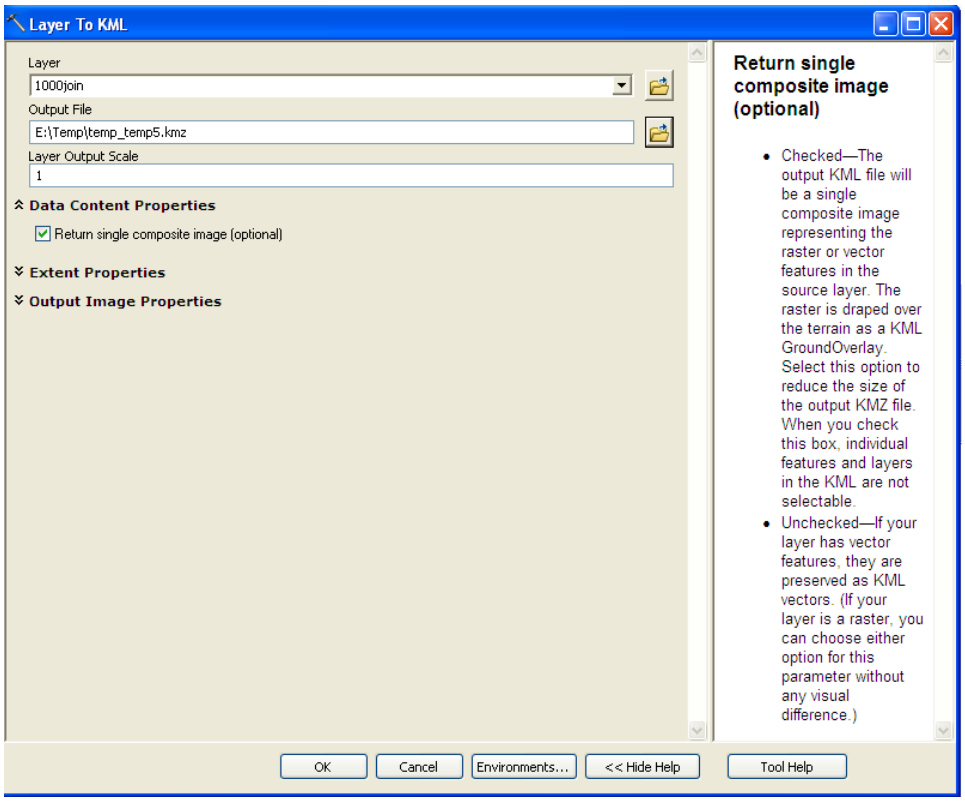
d. **Using** = Nad1983_hARN_PACP00_MARPOO_to_WGS_1984

e. **Select OK**

11. **Open ArcToolbox**

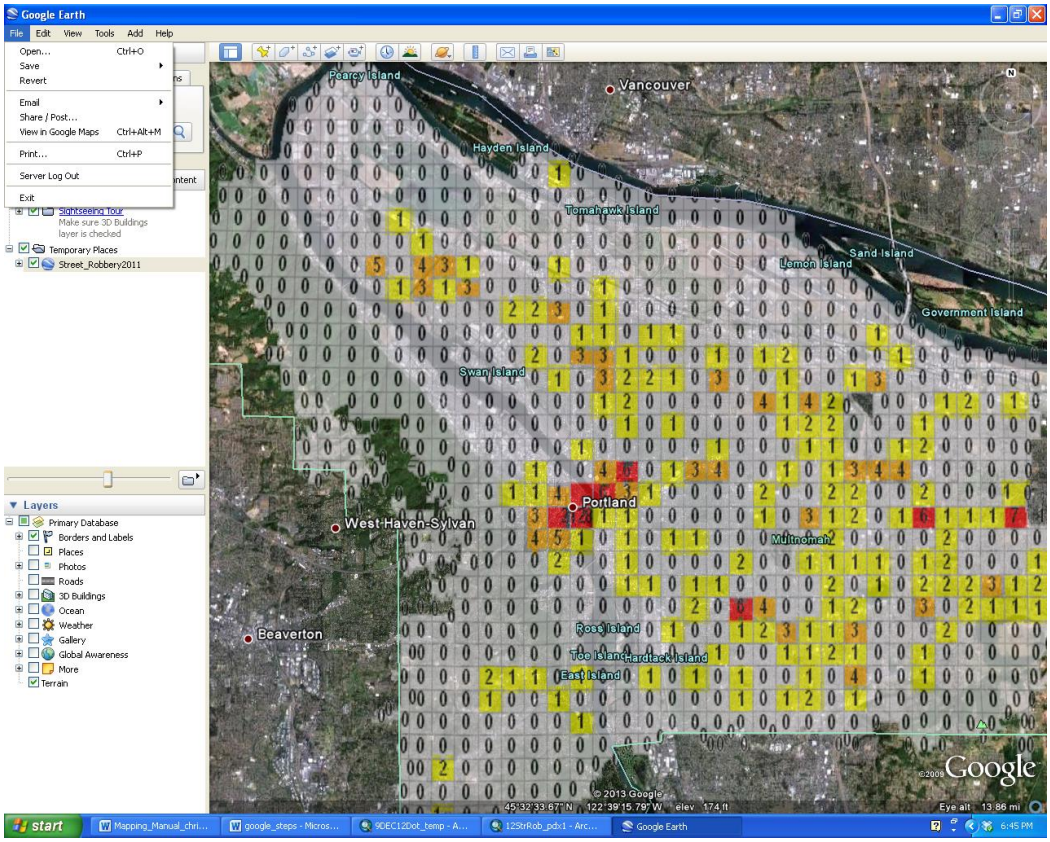


a. **Select conversion tools**
   i. **Select to KML**
      1. **Layer to KML**

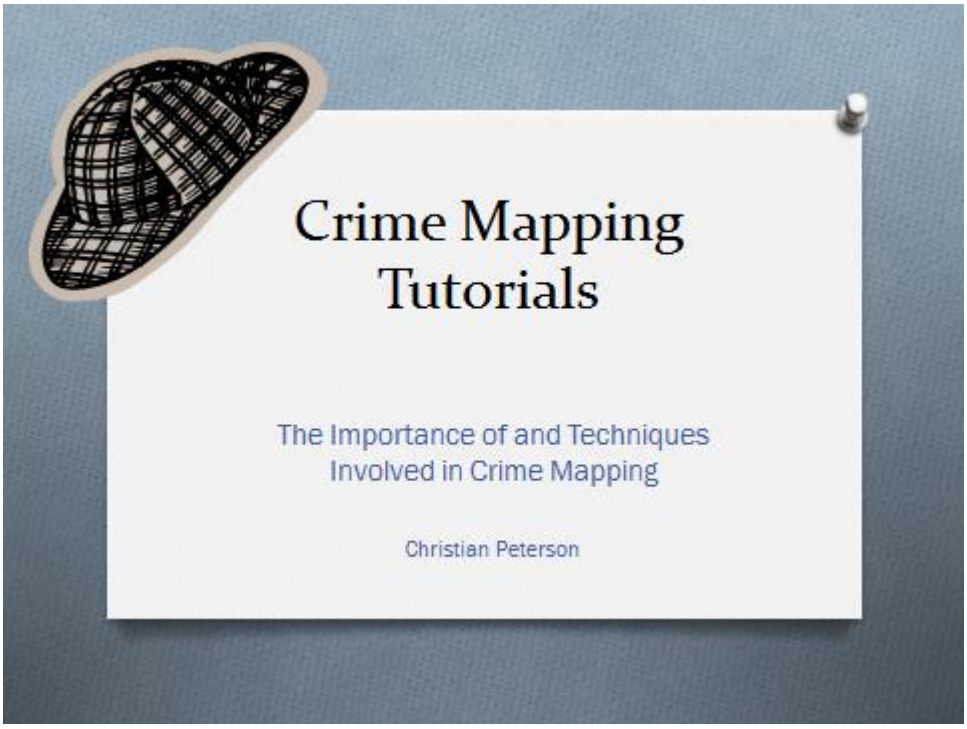


a. **Layer** = crime grid layer "1000Grid07_11"
b. **Output**= Name of save file and location "Streetrb07_11
c. **Layer output scale** =1
d. **Data content Properties**
    i. Check return single composite image

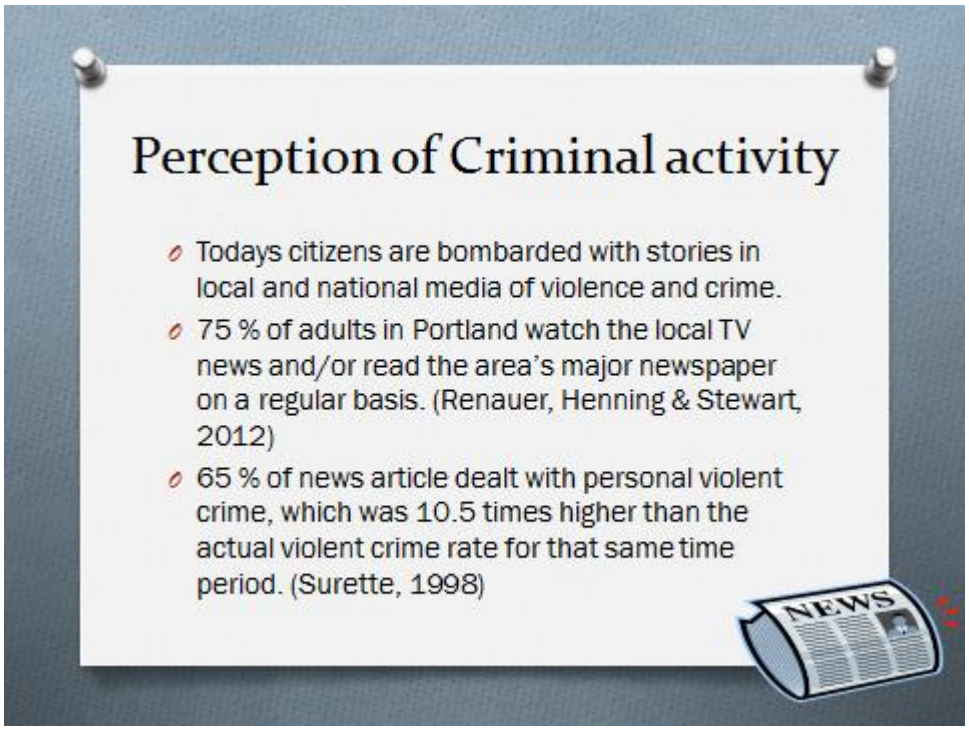
12. **Open Google Earth**
    a. **File**
        i. **Open**
            1. **Select** newly created KMZ file


Google Earth
File Edit View Tools Add Help
Open... Ctrl+O
Save
Revert
Email
Share / Post...
View in Google Maps Ctrl+Alt+M
Print... Ctrl+P
Server Log Out
Exit
Sightseeing Tour
Make sure 3D Buildings layer is checked
Temporary Places
Street_Robbery2011
Layers
Primary Database
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
More
Terrain
Pearcy Island
Vancouver
Hayden Island
Tomahawk Island
Sand Island
Lemon Island
Government Island
Swan Island
Portland
West Haven-Sylvan
Multnomah
Beaverton
Ross Island
Toe Island
Hardtack Island
East Island
© 2013 Google
45°32'33.67" N 122°39'15.79" W elev 174 ft
Eye alt 13.86 mi
start
Mapping_Manual_chri...
google_steps - Micros...
9DEC12Dot_temp - A...
12StrRob_pdx1 - Arc...
Google Earth
6:45 PM

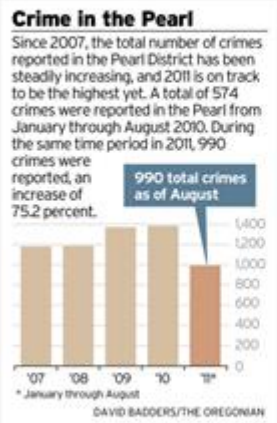
Appendix 1


Crime Mapping
Tutorials
The Importance of and Techniques
Involved in Crime Mapping
Christian Peterson

Agenda
Perception of criminal activity
How information shapes perception
Consistency of crime mapping and perception of crime
Tutorial objectives

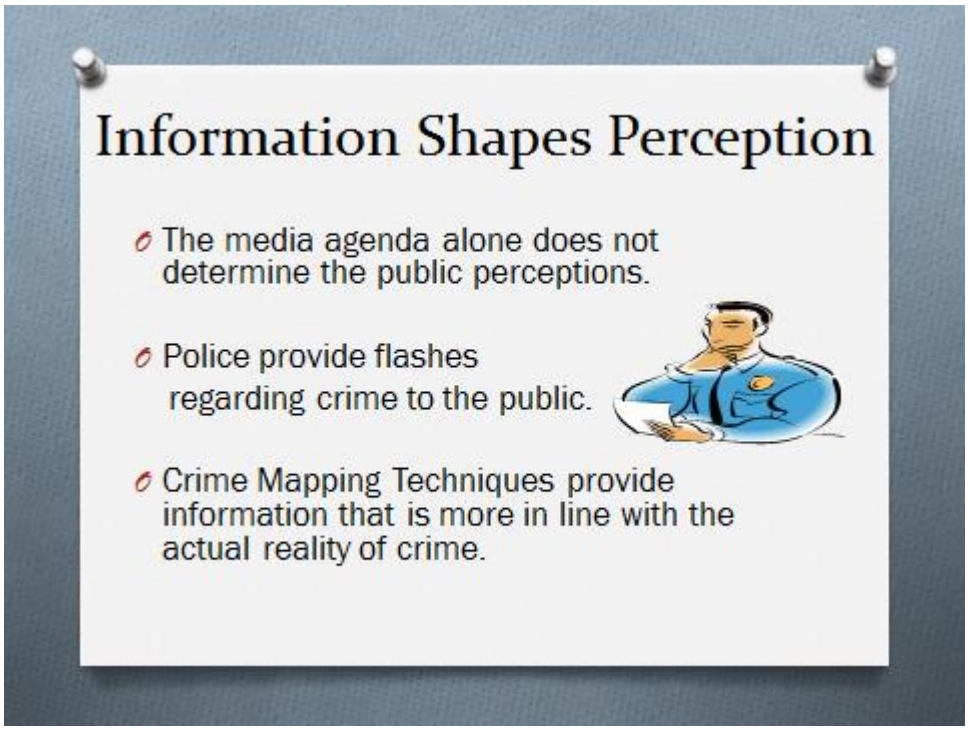

Perception of Criminal activity
Todays citizens are bombarded with stories in local and national media of violence and crime.
75 % of adults in Portland watch the local TV news and/or read the area's major newspaper on a regular basis. (Renauer, Henning & Stewart, 2012)
65 % of news article dealt with personal violent crime, which was 10.5 times higher than the actual violent crime rate for that same time period. (Surette, 1998)
NEWS

Information Shapes Perception



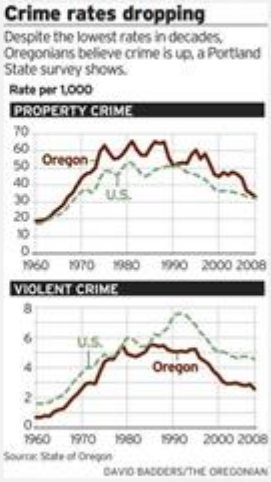
- Perception is shaped by individual beliefs and experience.
- 52% of people in Oregon believe crime has increased. (Renauer, Henning & Stewart, 2012)

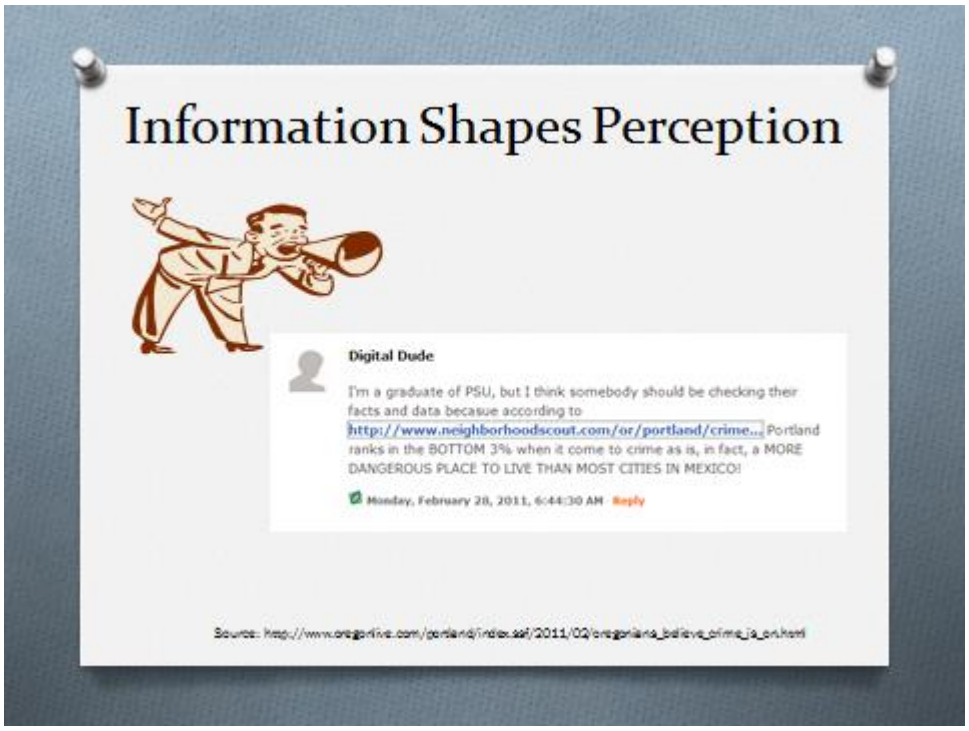
Source: http://www.oregonlive.com/portland/index.ssf/2011/02/oregonians_believe_crime_is_on.html

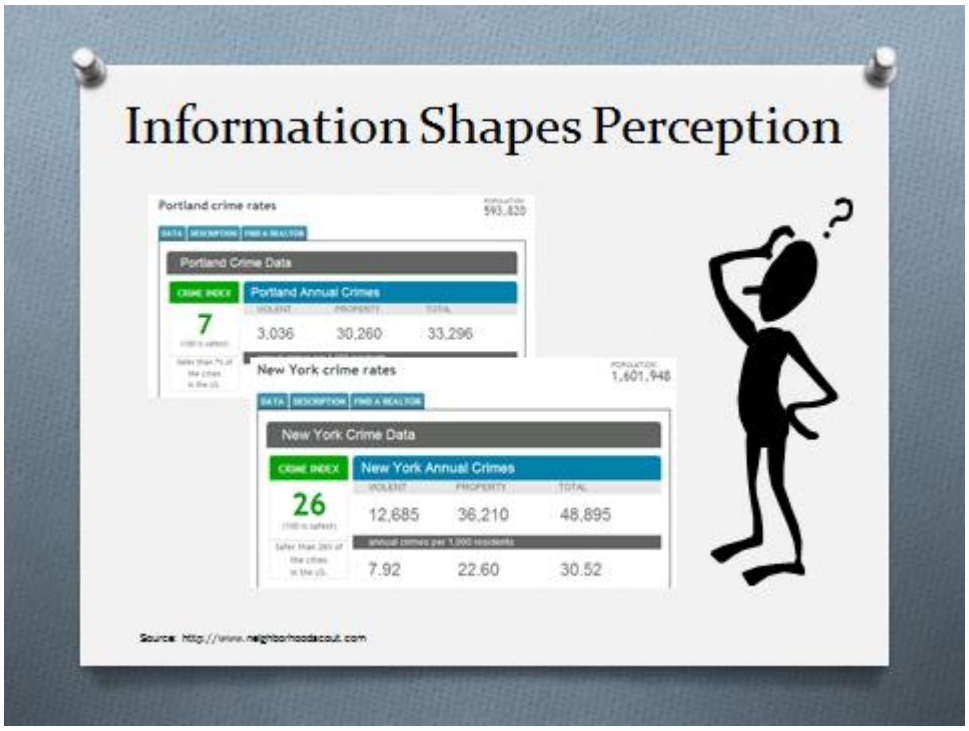

Information Shapes Perception
The media agenda alone does not determine the public perceptions.
Police provide flashes regarding crime to the public.
Crime Mapping Techniques provide information that is more in line with the actual reality of crime.

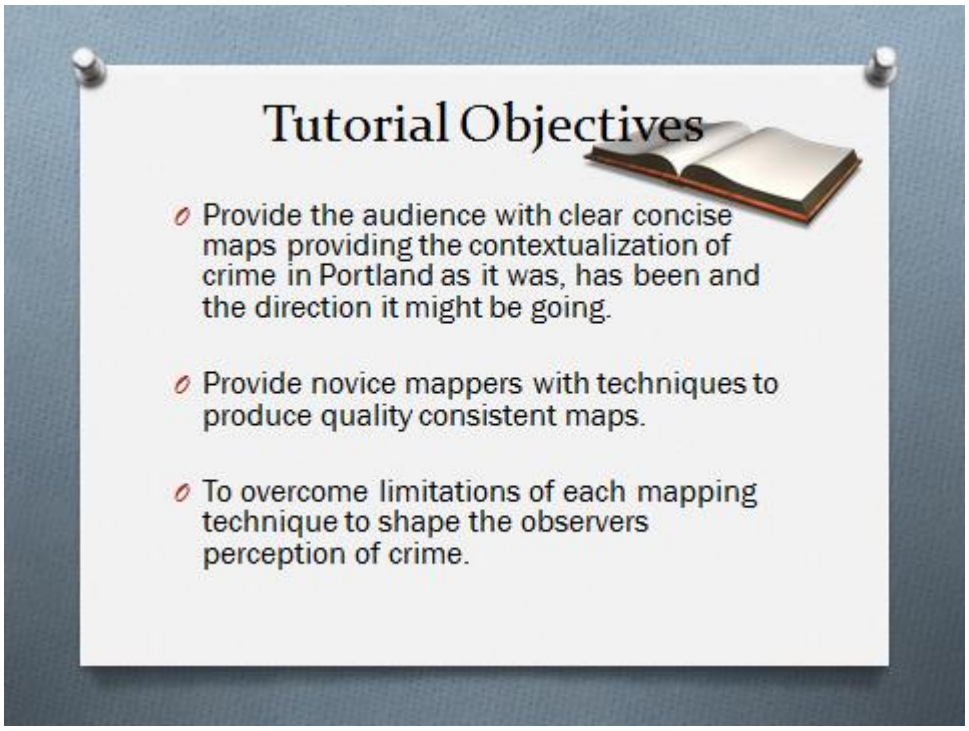
Information Shapes Perception

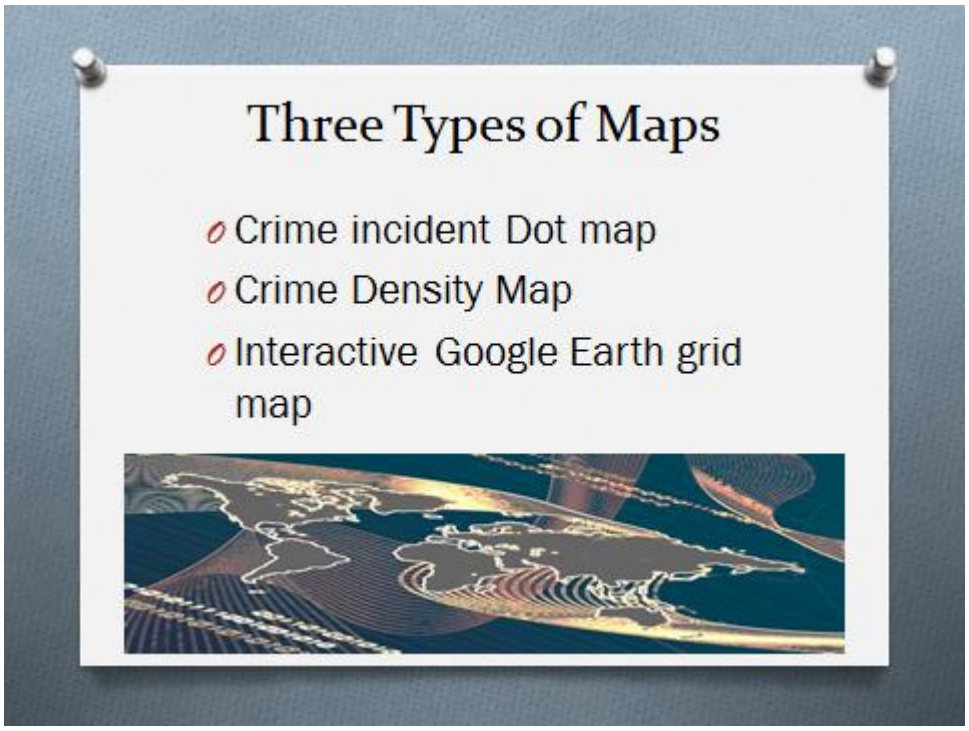
- Oregon: State of Fear which illustrated the misperceptions of Oregon residents in regard to crime. (The Oregonian, 2011)
- Presented information of how crime has changed and allowed for readers to express there concerns regarding fear of crime.

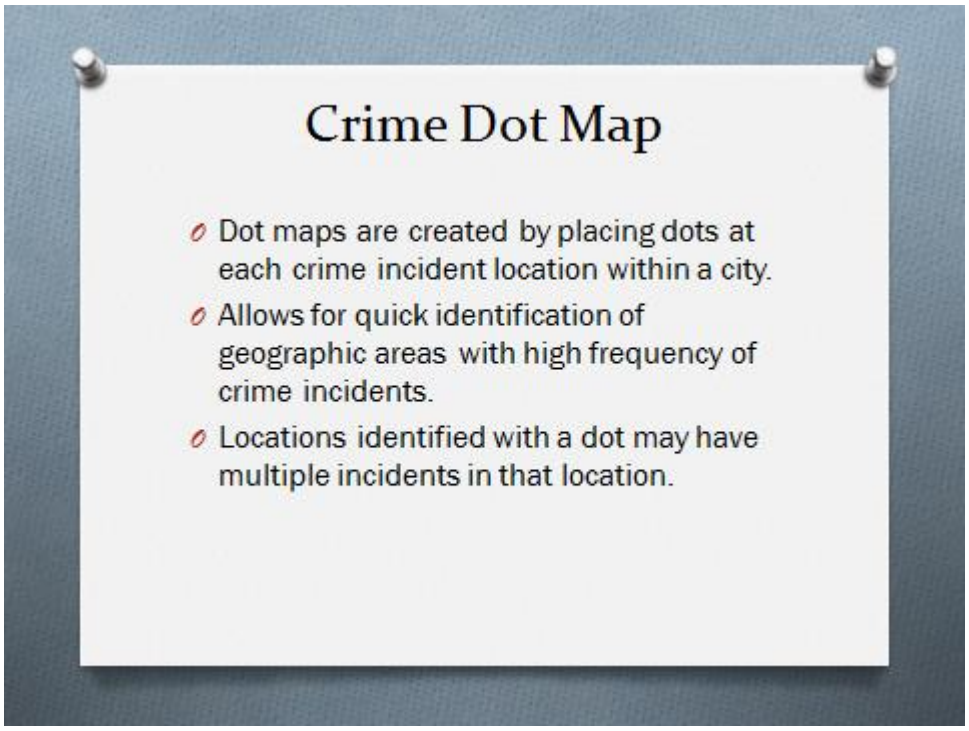


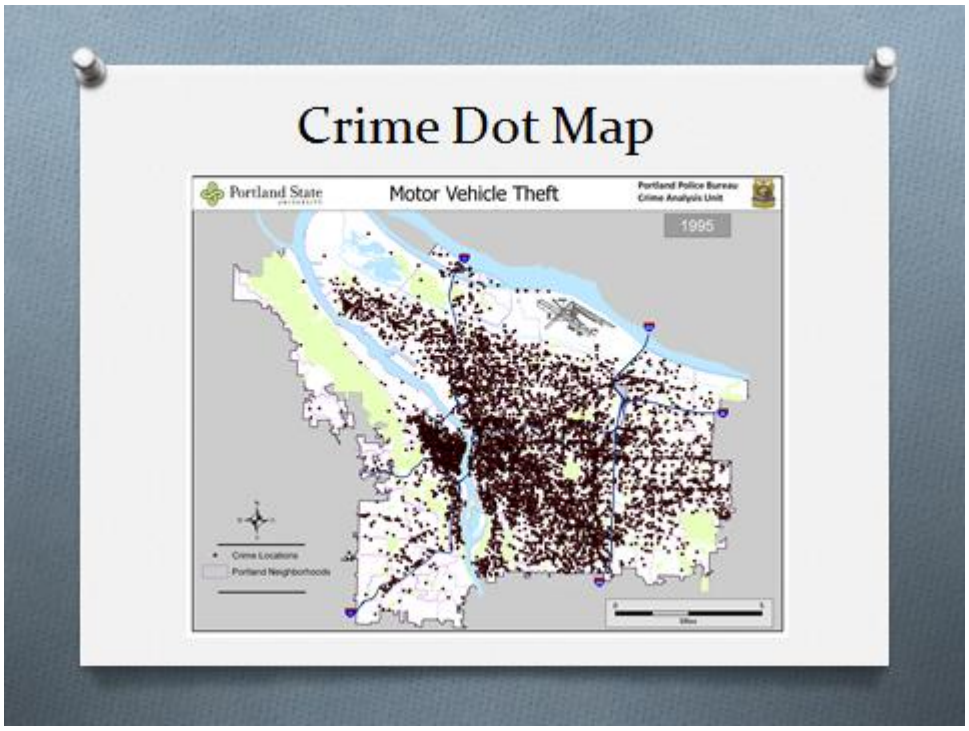

Information Shapes Perception
Digital Dude
I'm a graduate of PSU, but I think somebody should be checking their facts and data becasue according to http://www.neighborhoodscout.com/or/portland/crime... Portland ranks in the BOTTOM 3% when it come to crime as is, in fact, a MORE DANGEROUS PLACE TO LIVE THAN MOST CITIES IN MEXICO!
Monday, February 28, 2011, 6:44:30 AM Reply

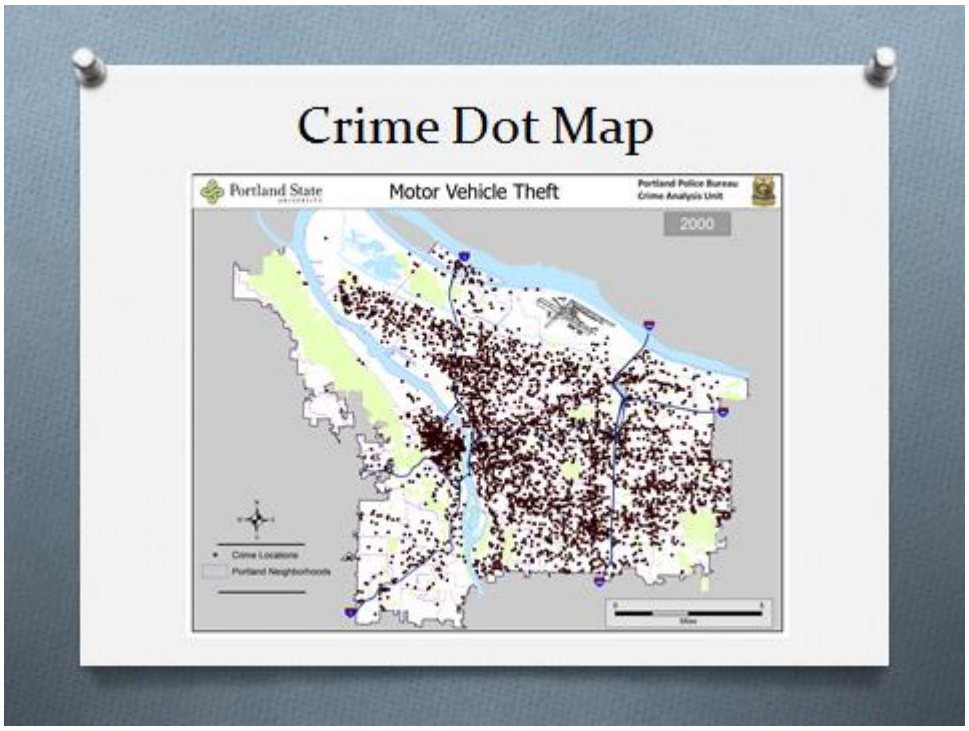

Information Shapes Perception
Portland crime rates
593,820
Portland Crime Data
CRIME INDEX
Portland Annual Crimes
7
3,036
30,260
33,296
New York crime rates
1,601,948
New York Crime Data
CRIME INDEX
New York Annual Crimes
26
12,685
36,210
48,895
7.92
22.60
30.52
Source: http://www.neighborhoodscout.com

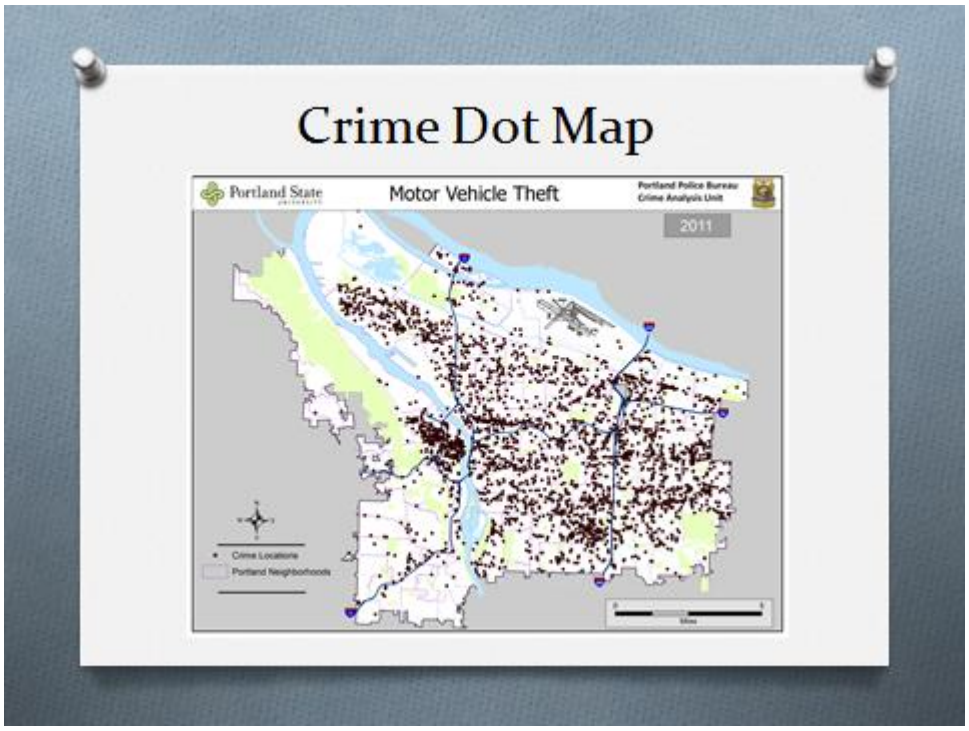

Tutorial Objectives
Provide the audience with clear concise maps providing the contextualization of crime in Portland as it was, has been and the direction it might be going.
Provide novice mappers with techniques to produce quality consistent maps.
To overcome limitations of each mapping technique to shape the observers perception of crime.


Three Types of Maps
Crime incident Dot map
Crime Density Map
Interactive Google Earth grid map


Crime Dot Map
Dot maps are created by placing dots at each crime incident location within a city.
Allows for quick identification of geographic areas with high frequency of crime incidents.
Locations identified with a dot may have multiple incidents in that location.


Crime Dot Map
Portland State
Motor Vehicle Theft
Portland Police Bureau
Crime Analysis Unit
1995
Crime Locations
Portland Neighborhoods


Crime Dot Map
Portland State
Motor Vehicle Theft
Portland Police Bureau
Crime Analysis Unit
2000
Crime Locations
Portland Neighborhoods


Crime Dot Map
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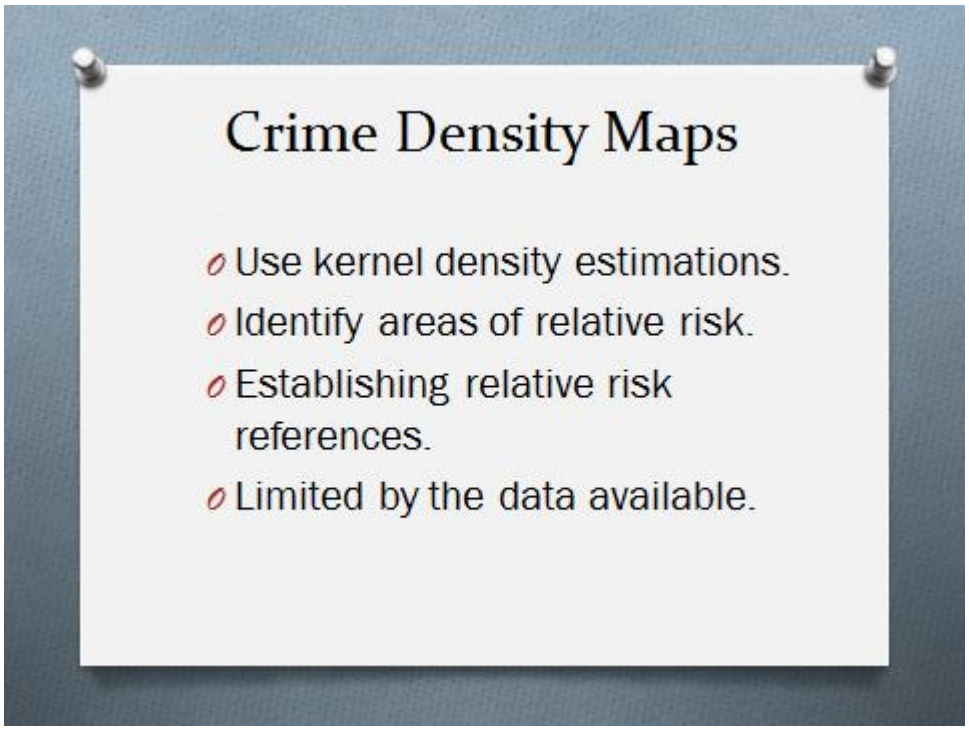
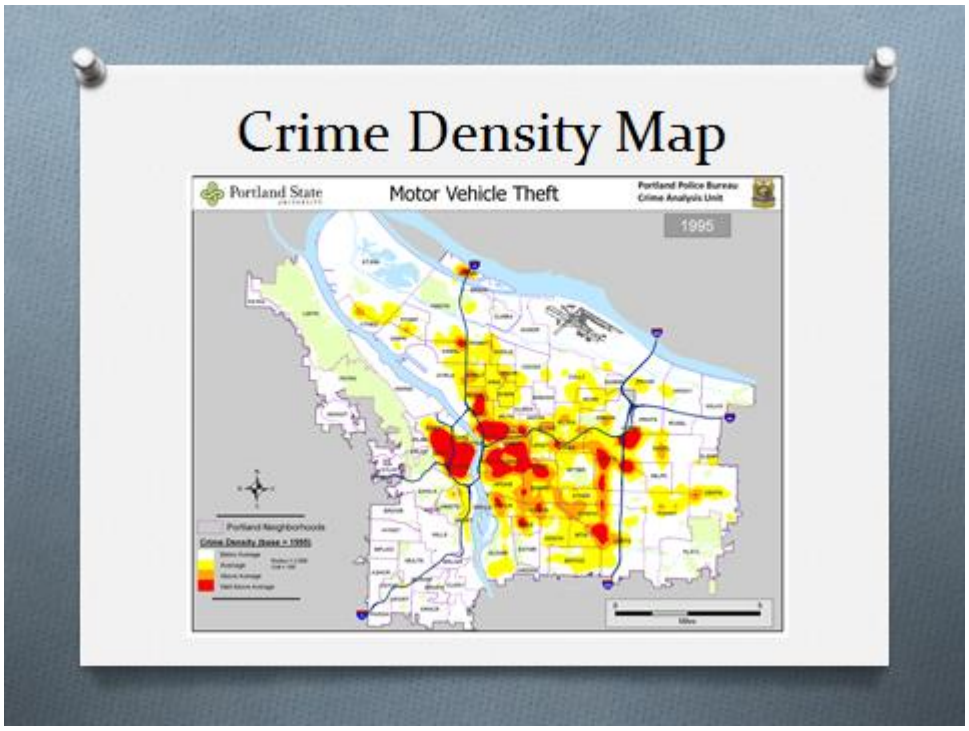
Motor Vehicle Theft
Portland Police Bureau
Crime Analysis Unit
2011
Crime Locations
Portland Neighborhoods


Crime Density Maps
Use kernel density estimations.
Identify areas of relative risk.
Establishing relative risk references.
Limited by the data available.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Motor Vehicle Theft
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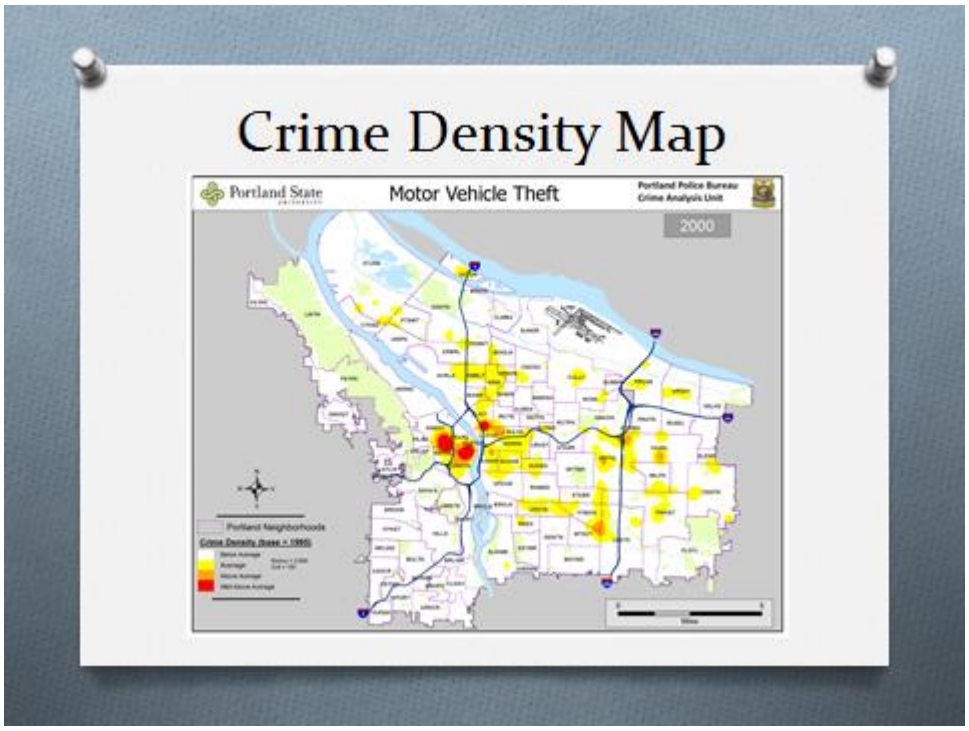
Portland Neighborhoods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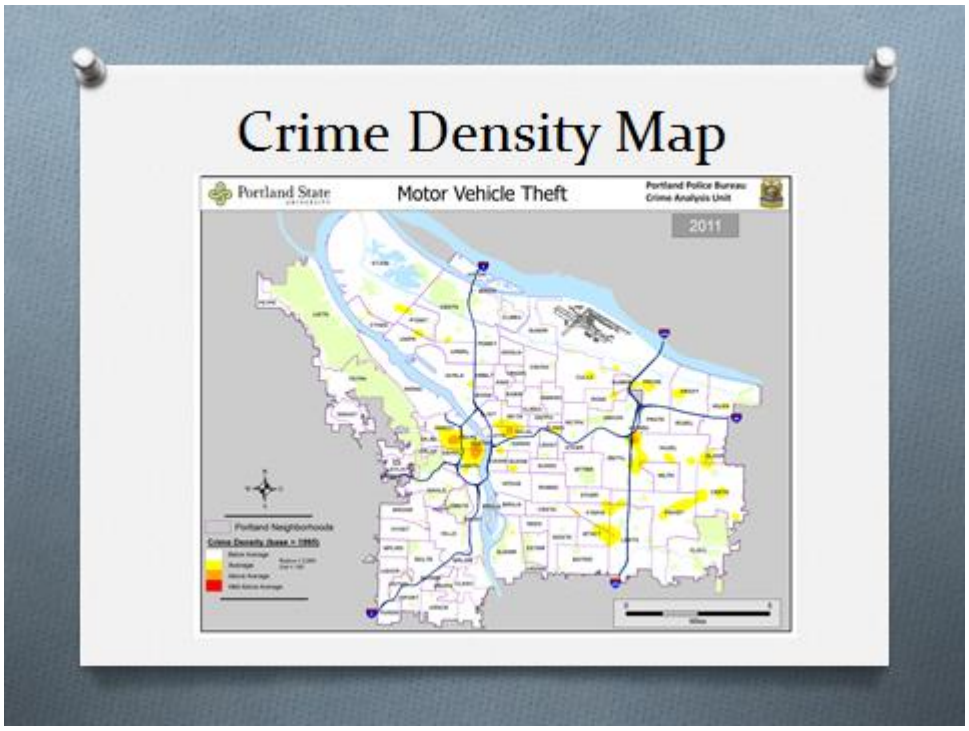
Crime Density Map
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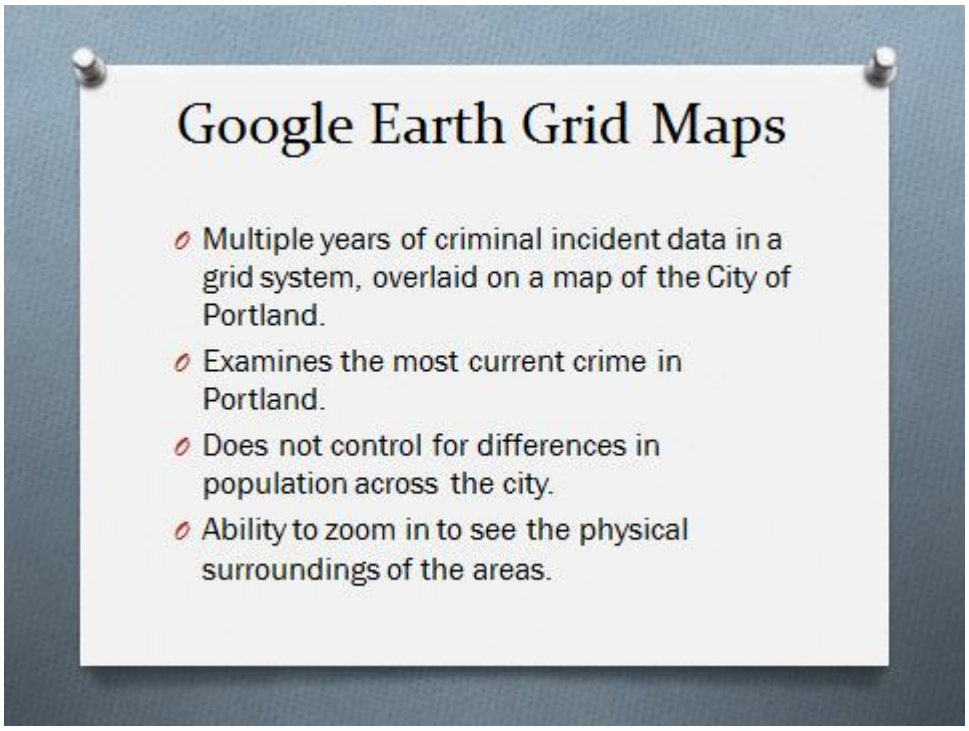
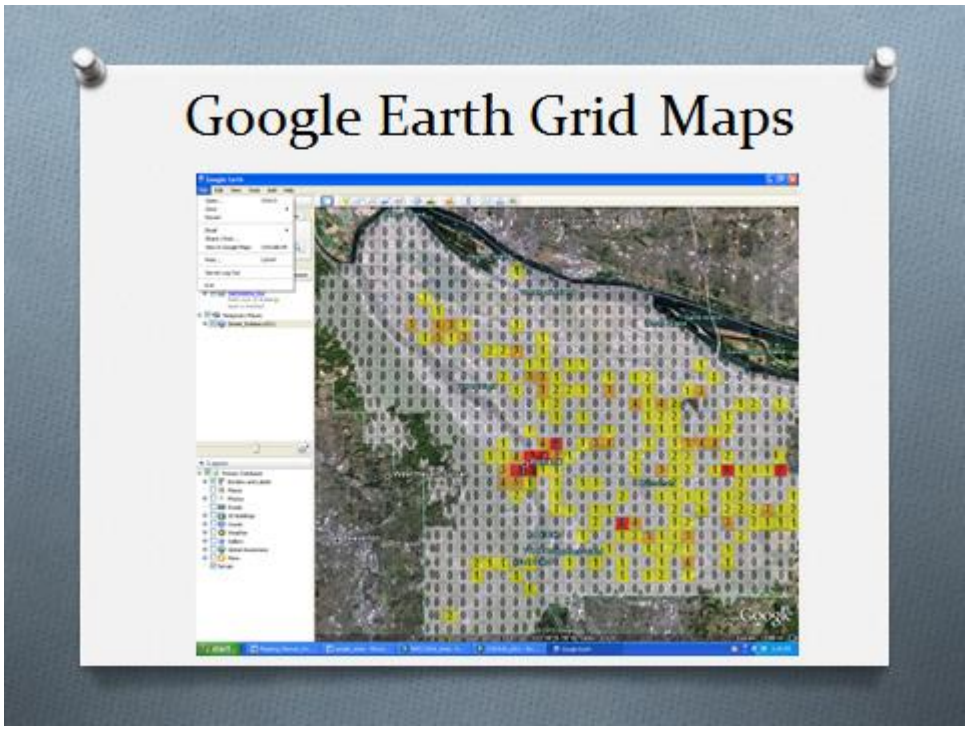
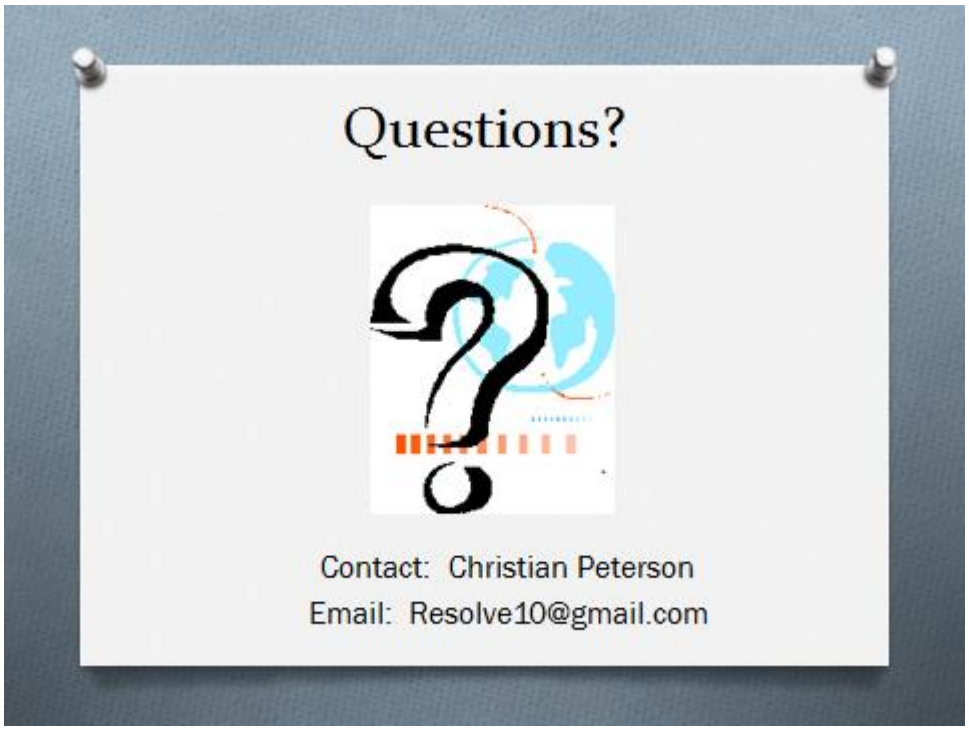

Google Earth Grid Maps
Multiple years of criminal incident data in a grid system, overlaid on a map of the City of Portland.
Examines the most current crime in Portland.
Does not control for differences in population across the city.
Ability to zoom in to see the physical surroundings of the areas.


Google Earth Grid Maps


Questions?
Contact: Christian Peterson
Email: Resolve10@gmail.com

References

- Renauer, B., Henning, K., & Stewart, G. (2012). *Crime in the news: How do people feel about crime reporting in Portland, Oregon?* . research brief, CJPRI.
- Surett, R., (1998). Media, crime, and criminal justice: Images and reality. 2nd edition, Belmont, CA: Wadsworth Press.
- http://www.oregonlive.com/portland/index.ssf/2011/02/oregonians_believe_crime_is_on.html

References

Henning, K., Stewart, G., & Peterson, C. (2012). *Summary of research methods*. Retrieved from http://stage.pdx.edu/crime-data/methodology