

WEBINAR HANDOUT

“IDENTIFYING HOT SPOTS”

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Getting to this point

To arrive at the point that we can identify and analyzing hot spots, we needed to:

1. Understand how to query data from our records management, CAD, and crash reporting systems to find datasets useful for predicting future activity (Access webinars).
2. Create a basemap in ArcGIS Pro on top of which to map hot spots (GIS class #1).
3. Get points representing crashes and crime on the map, whether by displaying coordinates already assigned, assigning coordinates from a coordinate library, or geocoding in ArcGIS Pro (GIS class #2).

Types of hot spots

In both GIS and spatial statistics programs, hot spots are identified and displayed through one of four primary means:

- **Aggregation.** Points can be aggregated (generally just counted, but sometimes also weighted) by specific address, street segment, grid cell, beat, census block, or some other unit of geography. CrimeStat’s mode and fuzzy mode routines are methods of aggregation, as are choropleth maps and graduated symbol maps.
 - **Buffering.** We use buffering when we want to represent hot spots in relation to a radius around existing geographic features, such as intersections or schools.
- **Adaptive scan.** Scanning methods do not attempt to summarize or aggregate points in reference to another object. Rather, they leave the points where they are and create polygons of varying sizes to encompass points with dense concentrations. CrimeStat’s Nearest Neighbor Hierarchical Spatial Clustering, STAC, and K-means Clustering routines are examples of scans.
- **Density mapping,** which as we discussed in Chapter 4 deals more with *risk* that with literal locations of criminal events.

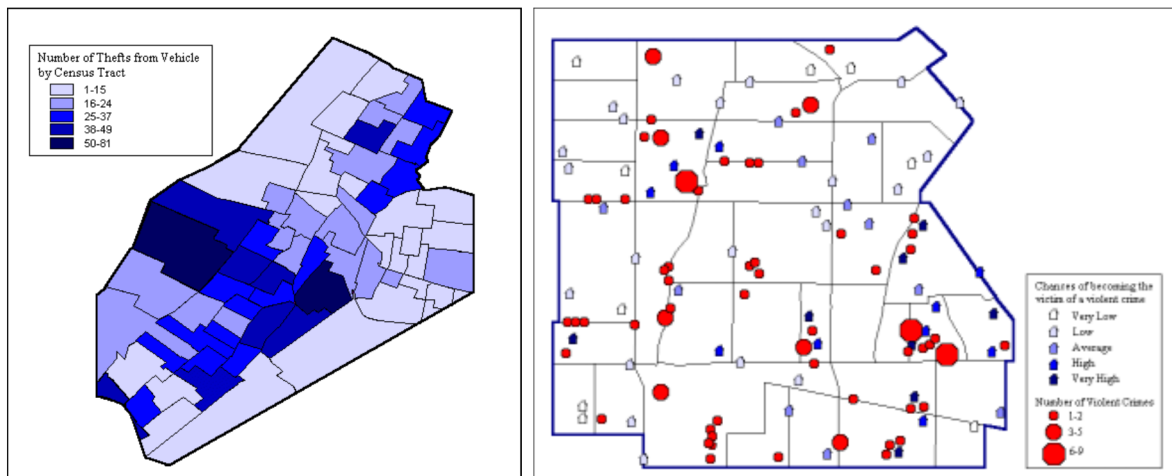


Figure 1: Choropleth maps (left) and graduated symbol maps (right) aggregate points into hot spots.

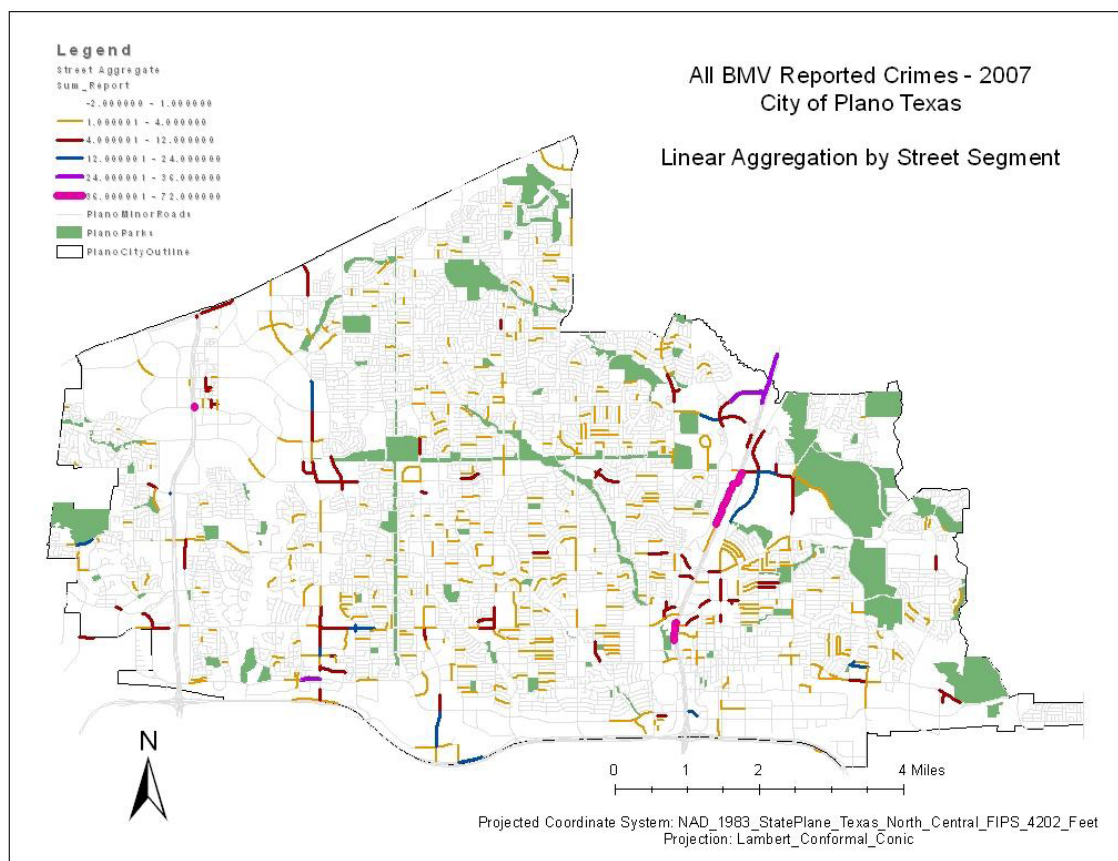


Figure 2: This map of thefts from vehicles in Plano, Texas aggregates by line segment.

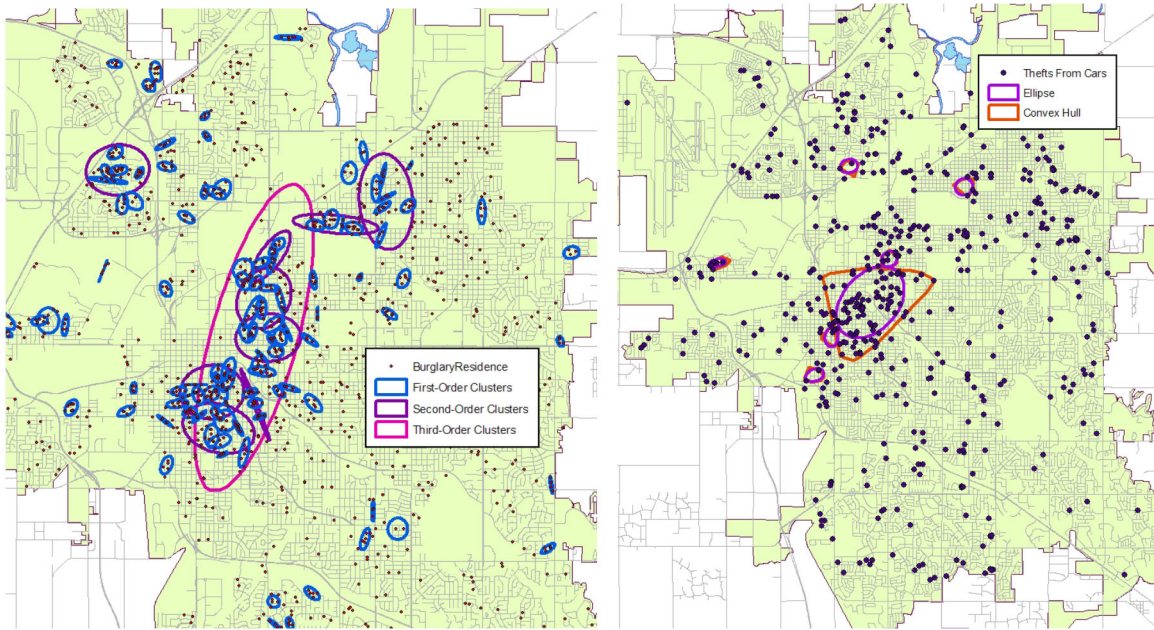
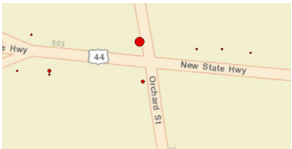



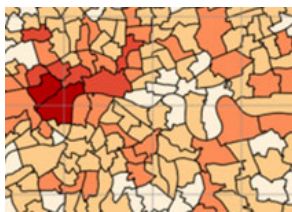

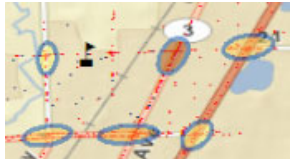

Figure 3: Adaptive scanning methods expand and contract the size of the hot spots to fit the specific points that make them up.

A second consideration with all of these methods is what, specifically, we count. The most common approach is to count each incident once, so that a choropleth map, for instance, shows a total count of all incidents that occurred within each geographic area. But there are other ways to do it using *weights*. Perhaps, for instance, we want to count certain crimes more than others. Perhaps we want to count fatal crashes more than injury crashes, and injury crashes more than regular crashes. If we've assigned a weight to each record within the original data, we can sum by that weight for any of these methods rather than representing the data as a raw count.

Summary of how to make each type of hot spot map

Watch the webinar for the specific steps, but here's a brief summary of each method and how to do it.

Hot spot method	Uses and Pitfalls	How to do it
Aggregation by point 	To identify specific locations that have a lot of activity. This method depends on inherent imprecision in geocoding (two incidents rarely share the same exact coordinates).	Three options: 1. Export data from incident databases with count at each location already queried 2. Use CrimeStat "mode" routine 3. Use "collect events" in ArcGIS Whichever method above, display as a graduated or proportional symbol map.

Hot spot method	Uses and Pitfalls	How to do it
Aggregation by line 	An odd method, but occasionally useful for depicting incidents that happen on the street, such as crashes or thefts from vehicles.	Spatial join to count points along each street segment, then graduated symbol map to depict results.
Aggregation by polygon 	Useful for depicting volume (and other values) in relation to existing geographic areas.	Spatial join to polygon layer, then graduated color map.
Buffering 	Useful to show hot spots in relation to a central point that has some meaning, such as drug incidents within 1000 feet of a school.	Use buffer tool in ArcGIS Pro to create buffers, then spatial join to count points within the buffers. Dissolve (combine overlapping) buffers if desired.
Adaptive scanning 	Identify hot spots irrespective of underlying geography. Apply tests of statistical significance to hot spots.	CrimeStat nearest neighbor hierarchical spatial clustering or STAC routines.
Density mapping 	Spread the effects of each incident in a radius around where it actually occurred to create a "risk surface" for crime or other events.	Spatial Analyst "Density" tools or CrimeStat Kernel Density Estimation routines.

About CrimeStat

CrimeStat, developed over the last 13 years by Ned Levine & Associates with funding from the **National Institute of Justice**, sought to aggregate all of the various spatial statistics used by criminologists and crime analysts. Before CrimeStat, those seeking to apply spatial statistics had to either acquire an entire catalog of applications that only did one thing, or they had to spend hours calculating the statistics by hand.

CrimeStat reads geo-referenced files in multiple formats, performed the desired spatial calculations, and rendered output files in formats read by most modern GIS applications. To use it effectively, the analyst or researcher must use it in conjunction with a GIS to create the source data and analyze the results.

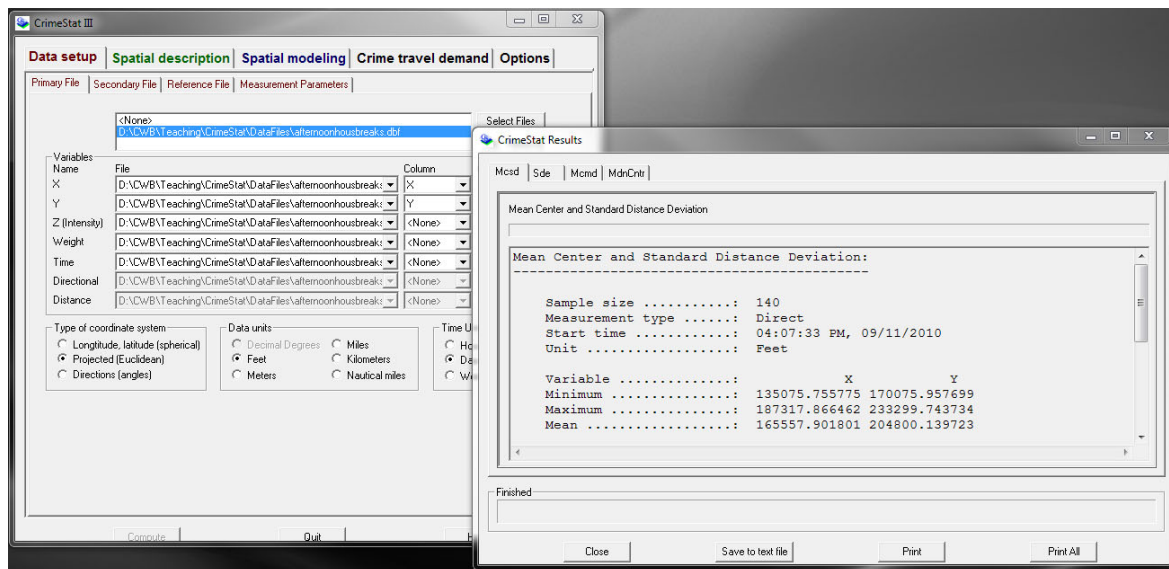


Figure 4: A screen shot from CrimeStat version 3.3

Target Areas and Enforcement Areas

The *target area* is the area in which the agency hopes its efforts will have a reduction effect. It may comprise a single hot spot or several hot spots depending on their proximity. It is best to designate the target area using common boundaries such as street blocks or police reporting areas so as to facilitate evaluation.

Enforcement areas are where the agency intends to deploy personnel to affect the target area. Depending on the nature of the geography and the incidents themselves, the enforcement areas might be larger or smaller than the target areas, and they may be located inside or outside. When crash and crime hot spots directly overlap, identification of enforcement areas is often easier than when they are nearby but not directly on top of each other.

Hot spots, target areas, and enforcement area examples

Hot spots	Target area	Enforcement area
A busy intersection with a high rate of crashes and street crimes	A 1000-foot radius of the intersection	Directly within the intersection
A shopping mall parking lot with many property crimes and an adjacent (but not overlapping) crash hot spot on the busy street out front	The police reporting area including both the shopping mall and the street	Entrances to the shopping mall along the busy street
A high-traffic downtown business area	A six-city block area encompassing the business area	A saturation patrol zone of 10 city blocks, encompassing both the business area and streets leading in and out
A residential subdivision with high property crimes and limited access located a quarter mile from a crash hot spot on a major state route	A customized polygon encompassing both the subdivision and the state route	The state route, focusing on secondary roads leading into the subdivision

Designation of target and enforcement areas is part of an analytical process that also includes several other factors. The depth of this analysis will depend on the available data, technology, and analytical experience in the agency. Highly-visible enforcement can be initiated immediately upon designation of target and enforcement areas, but consideration of these other factors will help the agency refine the nature, duration, and type of enforcement.

- *Time and day:* A consideration of time of day and days of the week for various crashes and crimes can direct enforcement to those times in which it is most likely to have a preventative effect.
- *Victim characteristics:* For crimes, identification of common victim or target characteristics can help officers give attention to those most likely in danger.
- *Offender characteristics:* Similarly, a consideration of common offender and offender vehicle characteristics can help officers identify those most likely to be engaged in criminal activity (with appropriate consideration for due process and civil liberties).
- *Crash types and causes:* Knowledge of crash types and causation factors can help target specific enforcement efforts rather than just general highly-visible enforcement.
- *Modus operandi factors for crime:* If there are common M.O.s at work within the target area, officers can be alert for that type of behavior.
- *Type of location:* Understanding the types of locations within the target area at which incidents occur (e.g., parking lots, convenience stores, crosswalks) can help direct enforcement efforts.

To identify and analyze your target areas:

1. Use the ArcGIS drawing tool to draw a polygon around the hot spots that you want to turn into a target zone.
2. Use “Drawing” and “Convert Graphics to Features” to save the target area drawings to a permanent shapefile.
3. Use spatial joins to identify which target areas (if any) your points are in.
4. Bring the resulting shapefile’s .dbf into Access or Excel to count and analyze the points in target areas and non-target areas.