DOVER'S HANDS-ON MAPPING EXAMPLE, CHAPTER 4

Spatial Forecasting Using STAMP: The Manual Method

Getting Started

Knowing how to use a basic computer spreadsheet program will make STAMP calculations faster and easier. Manual calculations (which require a calculator with a square root function) are explained in each step.

Understanding X and Y Coordinates

Computer mapping programs work by assigning x- and y-coordinates to an incident, then placing a point on a map at those coordinates. This is usually at the **longitude** and **latitude** the crime occurred, but doesn't have to be. If the method for determining x and y is consistent, it will work. An x-coordinate is a measurement to the east or west of a fixed vertical line (like the **Greenwich Mean Time** (GMT) line) and a y-coordinate is a measurement to the north or south of a fixed horizontal line (like the equator). Mapping software assigns coordinates when geocoding, but coordinates can also be created with a paper map of a jurisdiction, a pencil, and a ruler. A drawing compass will also be needed for STAMP. Once Dover felt confident he had a crime series and the skills/equipment needed, he followed the steps below to forecast future crime locations.

Step 1. Plotting incidents on map

Using a paper map, Dover drew a point on the map for each incident in the crime series.
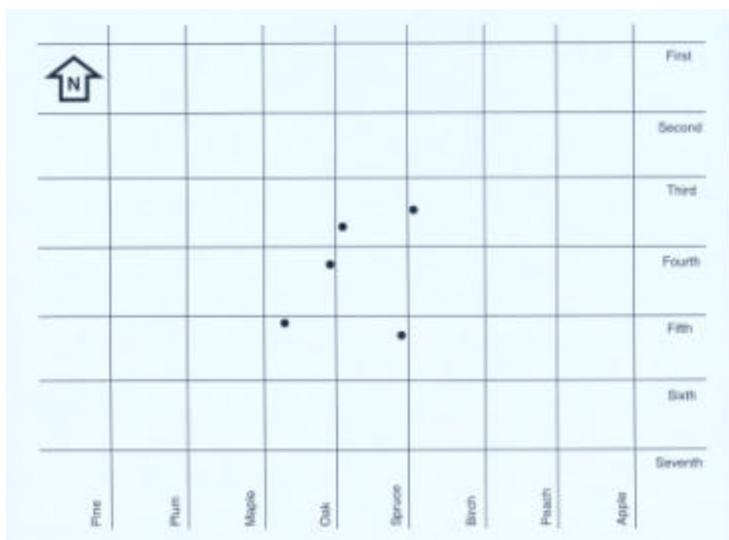

Step 2. Determining x- and y-coordinates

Using a paper map, he needed a ruler to measure the distance each point was from two places:

·   To determine x-coordinates, he measured the horizontal distance between the right side of the map and each point (as shown below). Using the right side of the page replicates the fact that the United States is west of the GMT line, which is zero longitude. Dover used millimeters rather than inches because they are divided into tens and can be represented as a decimal for calculations.
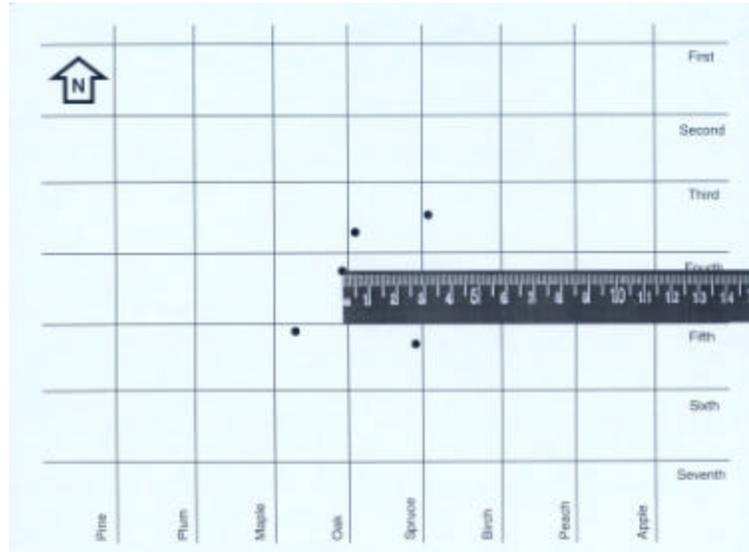
·   To determine the y-coordinates, he measured the vertical distance between the bottom of the map and each point (as shown below).
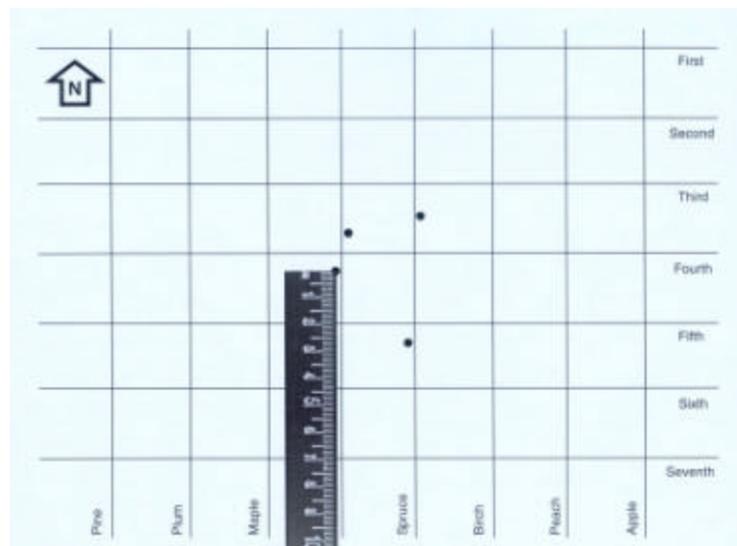
·   He recorded the x- and y-coordinates for each incident in columns, either in a spreadsheet or on paper, so further calculations could be done (as shown below).

| X	Y
17.2	8.9
12.8	8.5
15.4	11.2
14.9	12.6
12.3	13.2

Step 3. Calculating mean center point

Dover calculated a mean (average) for x-coordinates, then for y-coordinates (as shown below). In a spreadsheet program, the AVERAGE function will do this. For manual calculations, he added the numbers in each column and divided that total by the number of incidents. These coordinates determined the location of a mean center point.
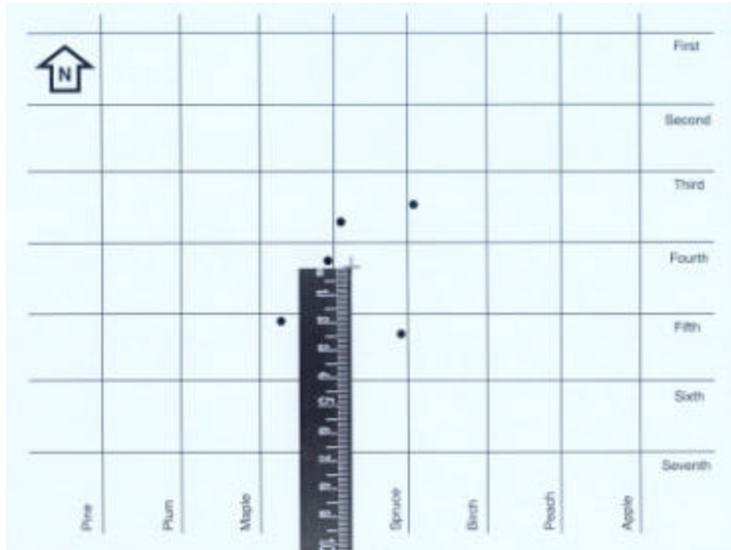
	X	Y
	17.2	8.9
	12.8	8.5
	15.4	11.2
	14.9	12.6
	12.3	13.2
Total	72.6	54.4
Divided by 5 = Mean	14.5	10.9

Step 4. Plotting mean center point

He measured the x-coordinate distance from the right side of the map (as shown below).
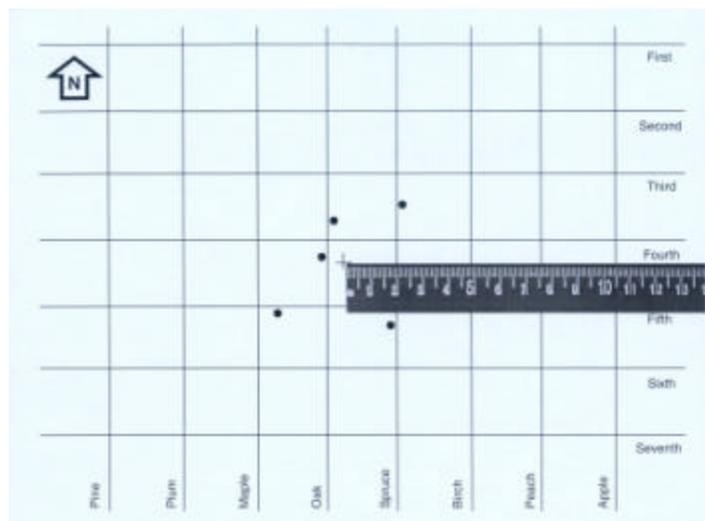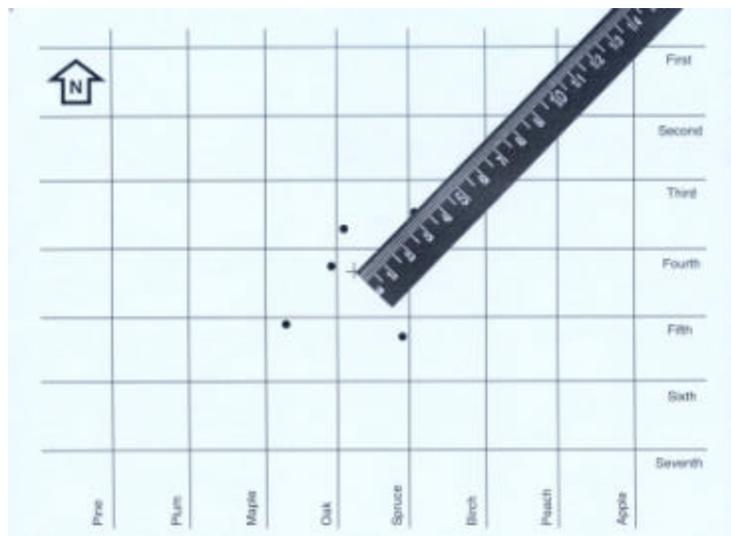
He measured the y-coordinate distance from the bottom of the map (as shown below).
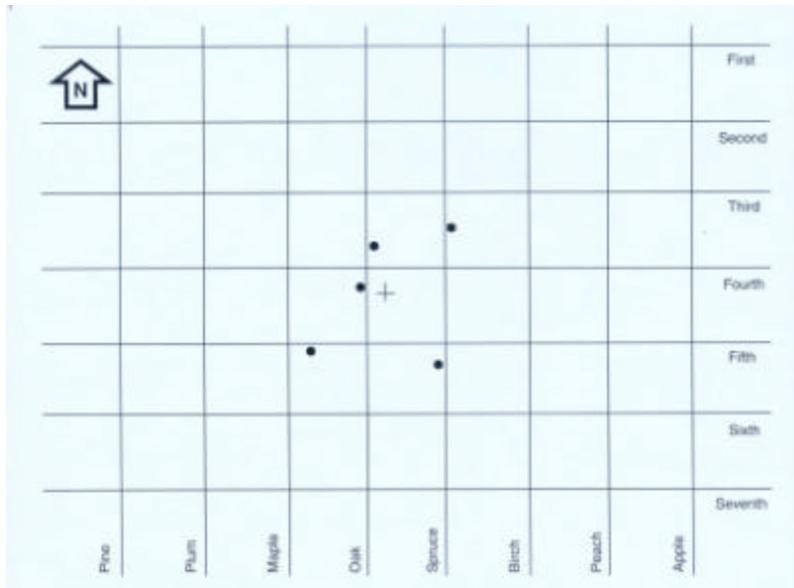

Step 5. Determining distances from mean center point

Dover measured and recorded the distance between the mean center point and each incident. He measured the distances with a ruler (as shown below).

At this stage, his map looked similar to the figure below.

Step 6. Calculating mean distance

Dover listed distances in a column either in a spreadsheet program or on paper. He calculated a mean distance using the AVERAGE function in the spreadsheet or by adding the distances and dividing by the number of incidents (as shown below).

Step 7. Calculating standard deviation of distances

Using the same distances, Dover calculated the *standard deviation*. He used the STDEV function in a spreadsheet program. Manually, he started with the same column of distances as Step 6 and used the following instructions: (Refer to the figure below, as needed.)
- Wrote the mean distance to the right of each measured distance, forming a second column.
- Subtracted the mean distance from each measured distance, and wrote these results in a third column to the right of the second.
- Squared each value (multiplied it times itself) in the third column and marked these values in a fourth column to the right of the third.

- Added the squared differences (the numbers in the fourth column).
- Divided the total of squared differences by the number of incidents (this number is called the *variance*).
- Computed the square root of the variance to get the standard deviation.

| 1 Distances	2 Mean	3 Differences	4 Squared Diffs.	
3.3	2.4	0.9	0.81	
3	2.4	0.6	0.36	
1	2.4	-1.4	1.96	
1.7	2.4	-0.7	0.49	
3.2	2.4	0.8	0.64	
Sum Of Squared Differences >			4.26	
Sum Of Squared Differences Divided by 5 >			0.852	< Variance
Square Root of Variance >			0.92	< Standard Deviation

Step 8. Calculating confidence intervals

Using the mean distance and standard deviation, Dover calculated three levels of *confidence intervals*. He did this by adding one standard deviation unit to the mean distance, two standard deviation units (the standard deviation times two) to the mean distance, and three standard deviation units (the standard deviation times three) to the mean distance (as shown below).

| Mean Distance	Standard Deviations	Confidence Intervals
2.4	(1 Unit) .92	(Level 1) 3.3
2.4	(2 Units) 1.84	(Level 2) 4.2
2.4	(3 Units) 2.76	(Level 3) 5.2

Step 9. Plotting buffers using confidence intervals

Dover plotted three buffers (circles) around the mean center point using the confidence interval distances as the radii (as shown below). He used a drawing compass to accomplish this step manually. First, he set the compass to the first confidence interval distance and drew a circle using the mean center point as a pivot point. He drew two more circles in a similar manner using the second and third confidence interval distances to set the compass.
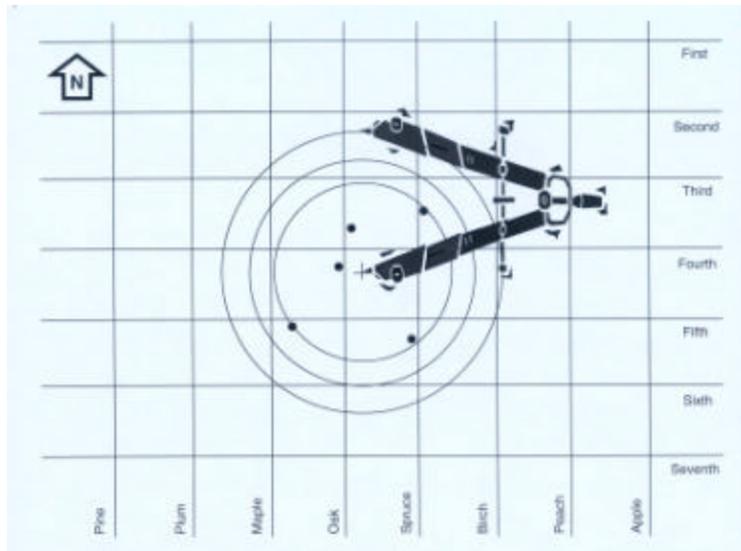
Step 10. Interpreting results

The resulting map showed the original incidents, mean center point, and three buffers (as shown below). The small circle covers a *likely area* (approximately 66% chance) where the next incident may occur, the small and medium circles cover a *very likely area* (approximately 95% chance) where the next incident may occur, and the three circles cover an *extremely likely area* (approximately 99% chance) where the next incident may occur.
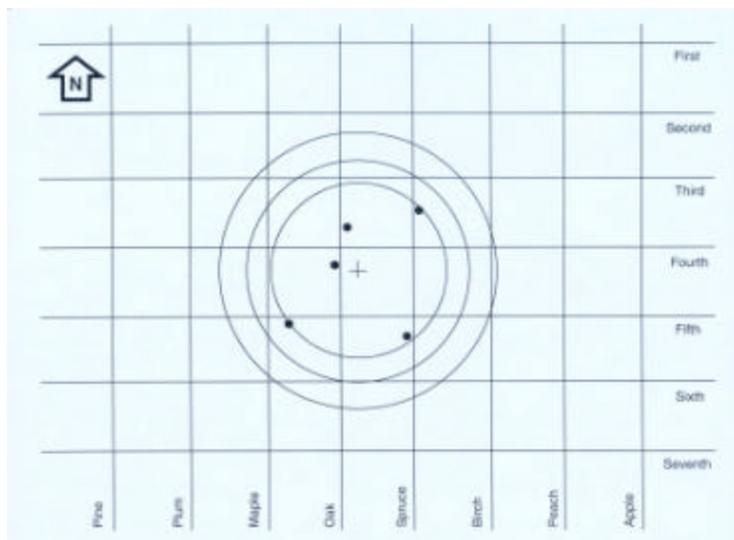
Step 11. Evaluating and updating the analysis

Dover kept track of continuing crimes in the area and noted if any additional incidents matched the series. If they fitted into the time and location predictions, he knew the method was working. He added any new incidents to the map of original crimes and began again at Step 1 to produce an updated analysis of the series.