

## Using the Annotate Facility With Maps: A Tutorial

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### What Is the Annotate Facility?

The Annotate Facility is a feature of the SAS<sup>®</sup> System that allows the addition of points, lines, and symbols to charts and maps generated with the PROCs of SAS/GRAPH. This paper deals specifically with features of the Annotate Facility that are useful for enhancing maps.

The Annotate Facility is similar to various plotter control languages. It uses commands, in the form of key words called *functions*, to indicate what action is desired. These functions are defined in the *SAS/GRAPH Users Guide* in the chapters dealing with the Annotate Facility. The functions we will use most for mapping applications are:

- \* MOVE - locate the next operation based at the given X-Y coordinate.
- \* DRAW - draws a line from the current position to a given X-Y location.
- \* SYMBOL - places a symbol at the given location.
- \* LABEL - places a string of text in a position relative to the given location.
- \* POINT - places a point at a specific location.
- \* PIE - draws a pie chart at a given location. We will use a special case of this function to draw circles of varying sizes on a map.

Each function requires additional data, such as: X and Y coordinates, text (for LABEL), and line width (for DRAW).

To use the Annotate Facility, you must construct a SAS data set. Each observation of the data set is one Annotate command. The variable FUNCTION contains the command, and other variables, defined in the SAS documentation, contain the additional information required for the function.

### The SYMBOL Function: Sample Map MWMAP01

Figure 1 is an example of the use of the SYMBOL function. Little squares are placed at the locations of 5-digit zip codes of persons who receive the SAS Institute publication *SAS Communications*.

The base map for this example was extracted from the unprojected unreduced SAS/GRAPH data set MAPS.STATES. The twelve states of the MWSUG region were selected, and were further subset by keeping only those records having DENSITY less than or equal to 3. The higher resolution provided by DENSITY levels 4 and 5 is unnecessary for this type of display.

The data used for this example, and the other examples dealing with *SAS Communications* mailing list, were provided by SAS Institute in the form of a file containing 5-digit zip codes and the number of *SAS Communications* subscribers in each zip code.

The zip codes were matched to a file containing latitude and longitude for each 5-digit zip code. The latitude and longitude were used as X and Y in the Annotate data set. This data set was combined with the map data set, projected using PROC GPROJECT, extracted with another DATA step, and used to annotate the map produced by PROC GMAP.

### **The POINT and PIE Functions: Sample Map MWMAP02**

Figure 2 is an example of the use of the POINT and PIE functions. Circles having areas proportional to the number of *SAS Communications* subscribers in a 3-digit zip code are shown, with the center of the circles marked with a point.

The base map for this example is the same as for the preceding example.

The data from Figure 1 were summarized to 3-digit zip codes. Circle were drawn by specifying the PIE function with a radius computed to give an area proportional to the count of subscribers at this 3-digit zip code. A concentric circle "bull's-eye" effect appears in several places on the map. This is a result of the way zip codes are designated; sometimes more than one 3-digit zip code applies to a given area. In these cases, several different 3-digit zip code counts will produce different sized circles centered at the same point.

### **The LABEL Function: Sample Map MWMAP03**

Figure 3 further refines the data display. The 3-digit zip code data have been summarized to the state-city level. Labels have been added for points having counts over 200. The labels include the state and city of the point, and the count of subscribers. As before, each circle is sized so that its area is proportional to the count at its center point.

The base map remains the same.

A reasonable level of aggregation was provided by summarizing the data to the state-city level. Selecting the level of detail and relative proportions of the data elements of a map is a subjective judgement. Often, several iterations of map drawing are necessary to provide the best display.

Note that labels for Chicago, Detroit, and Saint Paul were moved to the right side of their points to avoid overprinting other city names. This type of fine tuning must be done on a case by case basis, and can add significantly to the amount of work required to produce a legible and useful map.

### **Synthesizing Map Areas: Sample Map MWMAP04**

Figure 4 brings in a new element to the display. Lines of latitude and longitude have been drawn, producing a grid covering the area from 35 to 50 degrees north and 80 to 105 degrees west, in five degree increments. This grid was generated using a DATA step to produce synthesized "states" that are appended to the map data set.

Stars were placed using the SYMBOL function to indicate locations of SAS User Groups.

## Building a Map From Scratch: Sample Map MWMAP05

Figure 5 is a map based on digitized data for the city outline, roads, and suburb points. A sheet of graph paper was laid over a map, the coordinates were determined by inspection, converted to a standard X-Y coordinate system, and plotted. The Chicago city outline is the base map; all the roads, shoreline, text, and symbols were produced using an Annotate data set. Creating such maps is tedious, but may be justified if there is a need for geographic data reporting.

A recent development in mapping technology makes this type of map production much easier. The U.S. Census Bureau has created a vast data base of all the roads, rivers, rail lines, and political boundaries in the country: the TIGER files. This data, which is grouped into counties, can be read using SAS and plotted using the Annotate Facility.

### Summary

This exercise has shown some techniques for using the Annotate Facility of SAS and SAS/GRAPH to help display geographic data. Although not a real geographic information system, SAS offers a collection of tools that can, with practice, produce valuable maps and geographic graphics.

I urge the Institute to help us, its users, by providing the cross-reference data that will allow us to use these tools more effectively. Data resources that are essential to geographic analyses include:

- \* map data sets for 5-digit and 3-digit zip code area outlines.
- \* latitude-longitude cross-reference files for 5-digit and 3-digit zip code and state-city centers.

### Acknowledgements

I appreciate the encouragement of Dr. Karl Kriesel of the Department of Geography and Environmental Studies at Northeastern Illinois University. His insight into the scope and philosophy of geography has enriched my experiences with both traditional and computer-assisted cartographic methods.

### References

The following publications will be of value to users of the SAS/GRAPH Annotate Facility:

SAS Institute, Inc. 1988. *SAS/GRAPH User's Guide, Release 6.03 Edition*. Cary, NC, USA.

SAS Institute, Inc. 1988. *SAS/GRAPH Hardware Interfaces for Personal Computers, Version 6 Edition*. Cary, NC, USA.

Rand McNally 3-digit zip code map.

United States Postal Service ZIP code reference.

"Drawing Lines and Symbols on SAS/GRAPH Maps", *SAS Communications* Volume 8, Number 3 (Winter 1982).

- Gary F. Plazyk. 1984. "Using the SAS and SAS/GRAPH Products For Transportation Analysis" 269-276. *Proceedings of the Ninth Annual SAS Users Group International Conference*. Cary, NC: SAS Institute, Inc.
- Gary F. Plazyk. 1990. "Using SAS/GRAPH to Display the Geographic Distribution of WISAS Membership" 83-101 *MWSUG '90 MidWest SAS Users Group First Regional Conference Proceedings*. MWSUG.
- Gary F. Plazyk. 1991. "Getting Started With TIGER: A Tutorial" *MWSUG '91 MidWest SAS Users Group Second Regional Conference Proceedings*. MWSUG.
- Robert P. Wederich, Jr. 1990. "Selecting Optimal Branch Locations Based on Geographic Distribution of Service Call Volume". *Proceedings of the 15th Annual SAS Users Group International Conference*. Cary, NC: SAS Institute, Inc.
- J. Jacob Wind and Jeff VanGorder. 1990. "Using SAS/GRAPH<sup>(r)</sup> Maps as a Nucleus for an Interactive Geographic Information System". *Proceedings of the 15th Annual SAS Users Group International Conference*. Cary, NC: SAS Institute, Inc.

The following publications deal with the issues of geographic data presentation techniques:

- F. J. Monkhouse and H. R. Wilkinson 1971. *Maps and Diagrams: Their Compilation and Construction, Third Edition*. London: Methuen & Co. Ltd.
- Phillip C. Muehrcke. 1978. *Map Use: Reading, Analysis, and Interpretation*. Madison, WI: JP Publications.
- Arthur H. Robinson and Randall D. Sale. 1969. *Elements of Cartography, Third Edition*. New York, NY: John Wiley & Sons, Inc.
- Edward R. Tufte. 1983. *The Visual Display of Quantitative Information*. Cheshire, CT: Graphics Press.

I would be happy to provide copies of the programs used to generate Figures 1 through 5. All the examples in this paper were generated on a Compaq SLT/386 running MS-DOS 3.3 and SAS 6.04. Hard copy was printed on an Apple Laserwriter II PostScript printer.

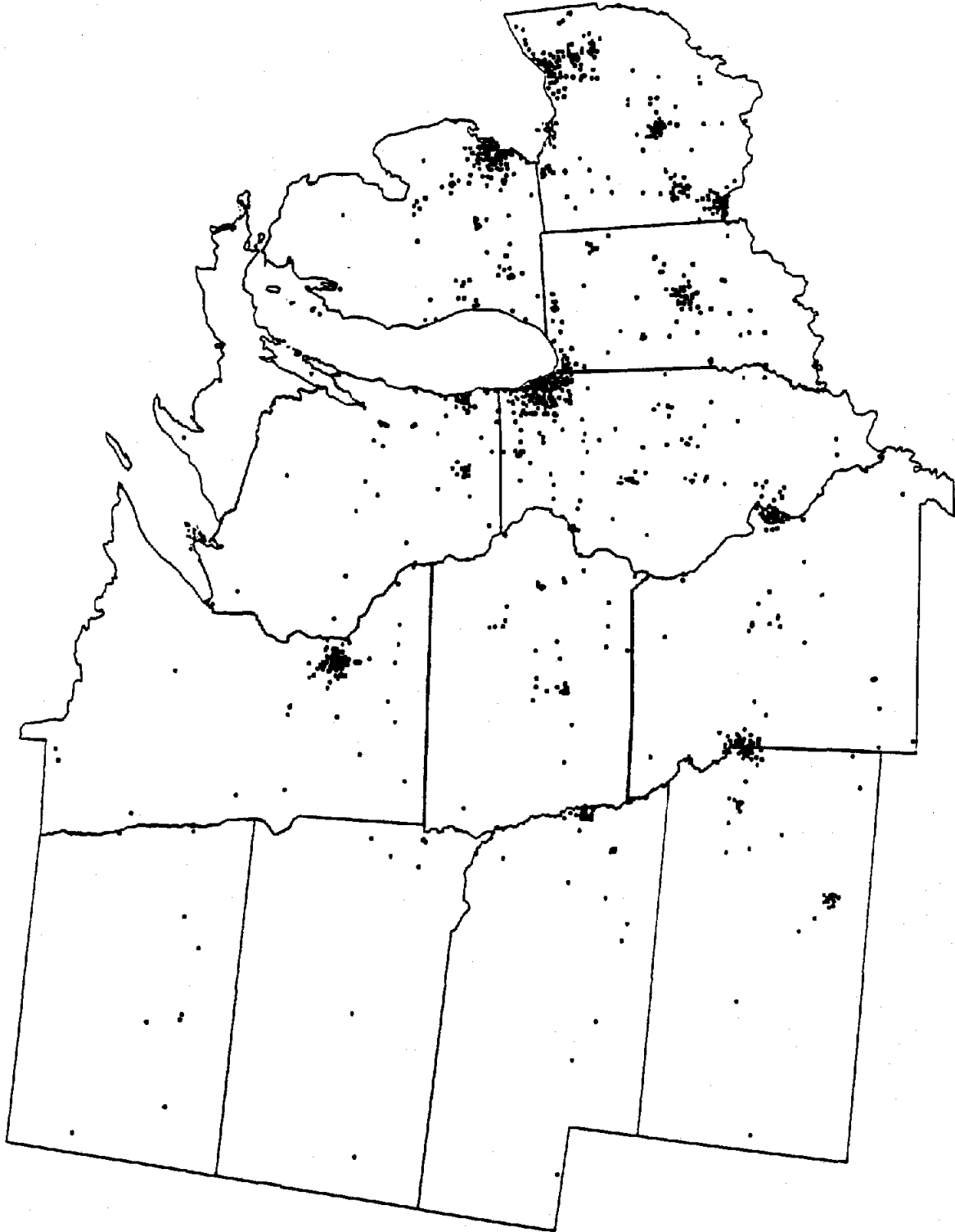
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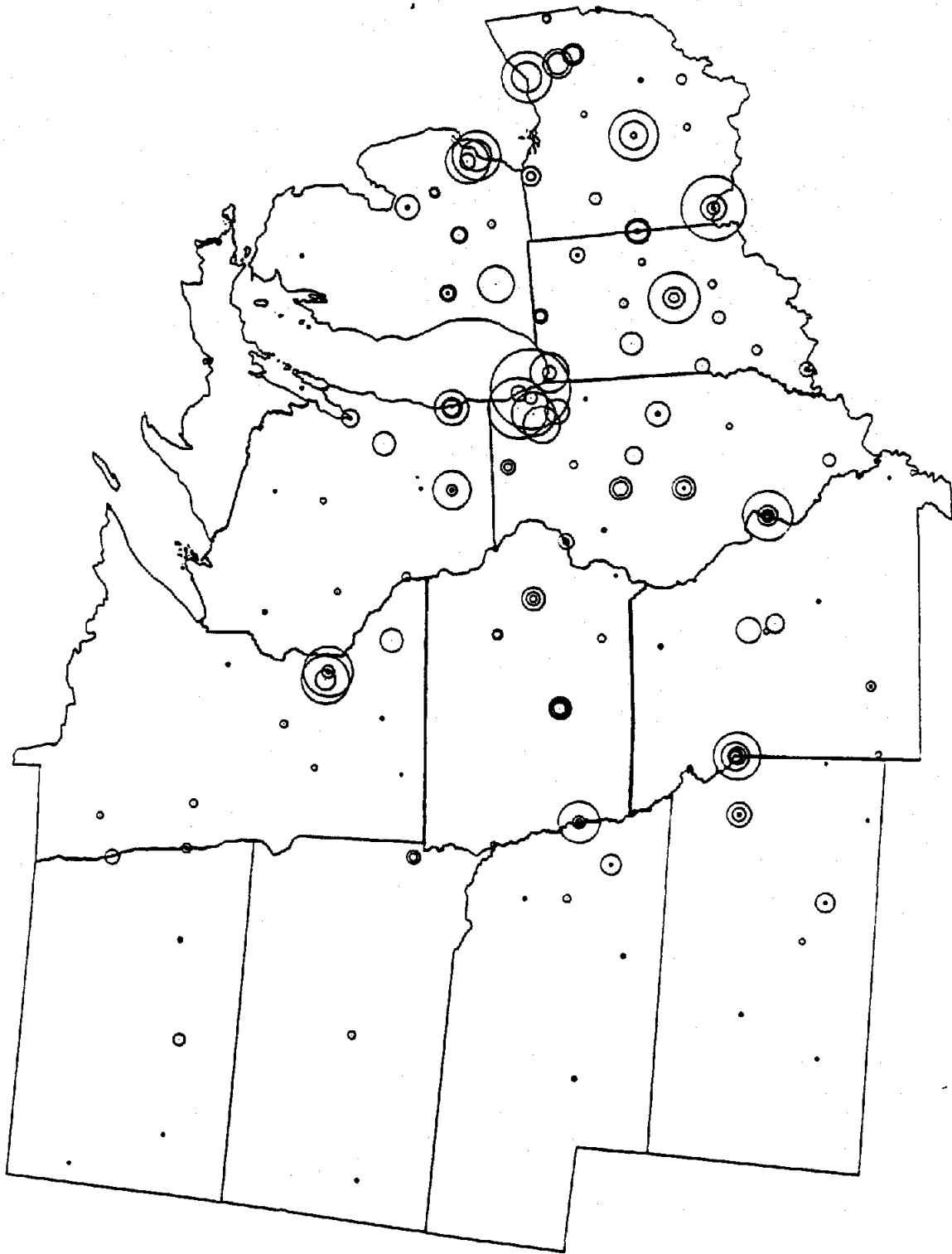
**MWSUG Region Analysis**  
SAS Communications Meeting List ZIPs Centers



Map MWMAP01

Figure 1. Use of the Annotate Facility SYMBOL Function

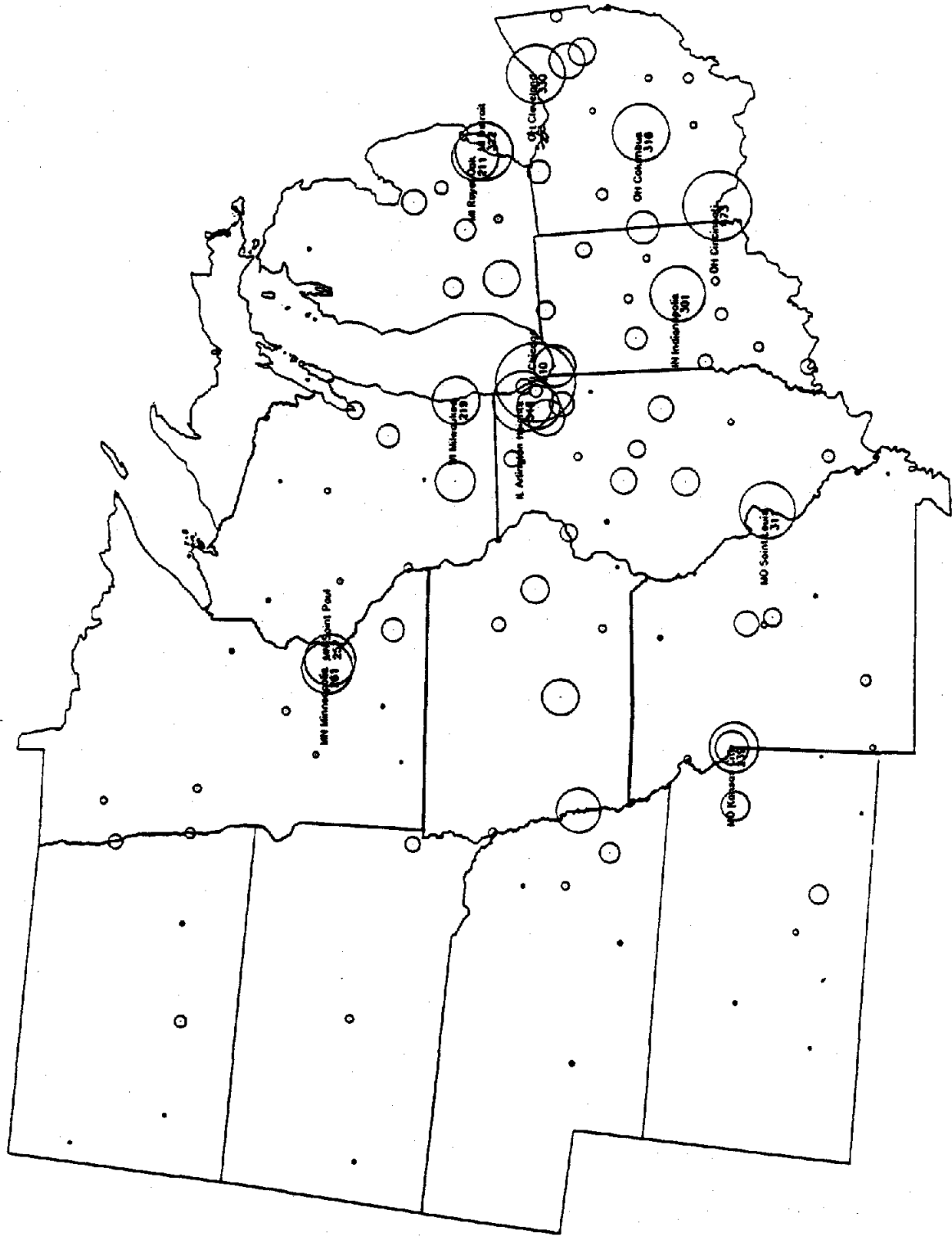
**MWSUG Region Analysis**  
SAS Communications Mailing List ZIP Centers



Map MWMAP02

**Figure 2. Use of the Annotate Facility POINT and PIE Functions**

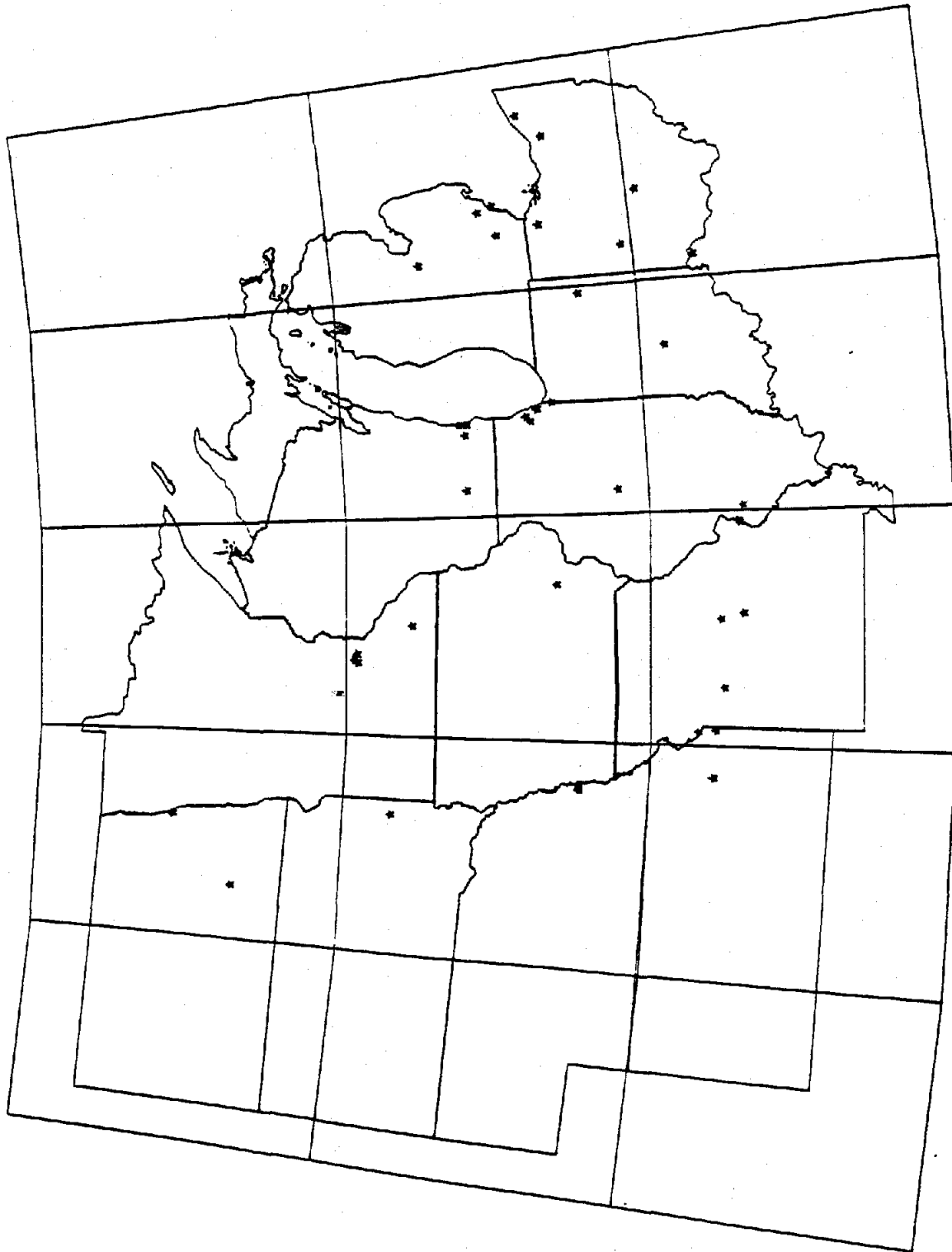
**MWSUG Region Analysis**  
SAS Communications Mailing List State - City Centers



Map MWMAP03

Figure 3. Use of the Annotate Facility POINT, PIE, and LABEL Functions

**MWSUG Region Analysis**  
Midwest Region SAS User Groups



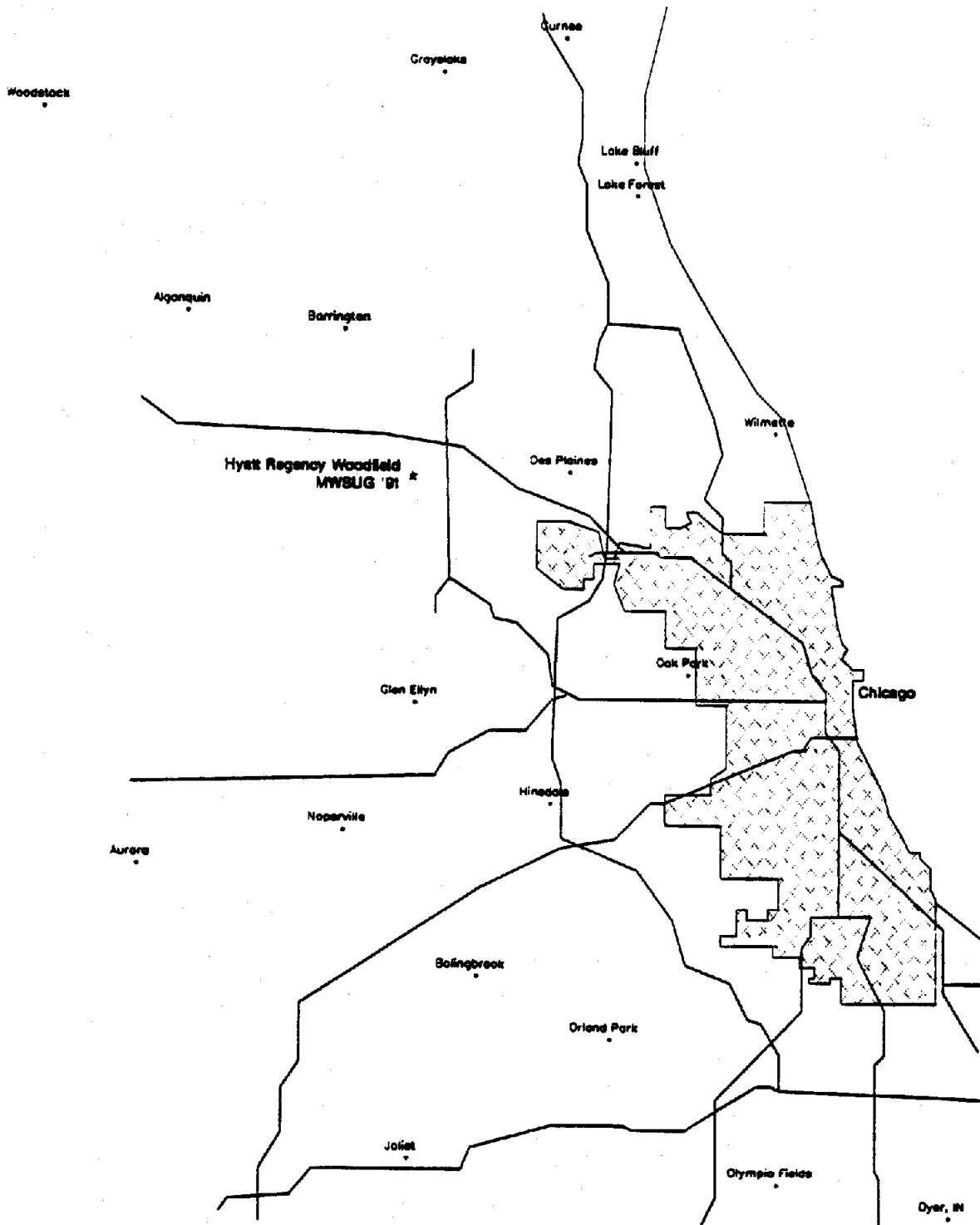
Map MWSUG91

Figure 4. Synthesizing Map Areas



# MWSUG Region Analysis

MWSUG '91 Site



Map MWMAPO8

Figure 5. Use of the Annotate Facility LABEL, MOVE and DRAW functions