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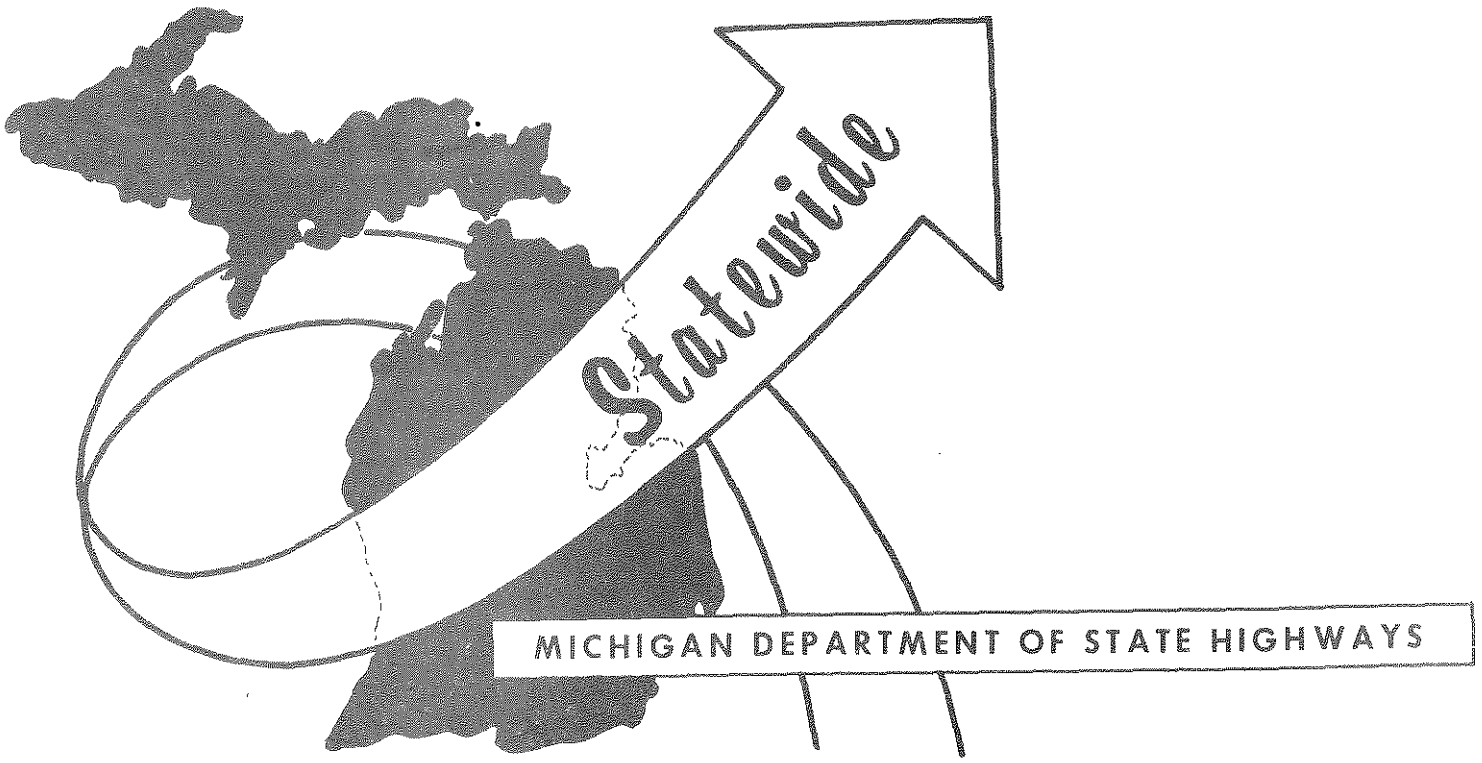
Statewide Transportation Analysis & Research

MAPPING SOCIO-ECONOMIC DATA WITH SYMAP

Vol. IX-A

PROCEDURE MANUAL



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MAPPING SOCIO-ECONOMIC DATA WITH SYMAP

SEPT. 1973

TRANSPORTATION PLANNING DIVISION
STATEWIDE STUDIES UNIT

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With the Participation of:
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

MAPPING SOCIO-ECONOMIC DATA
with SYMAP
by
Alan R. Friend

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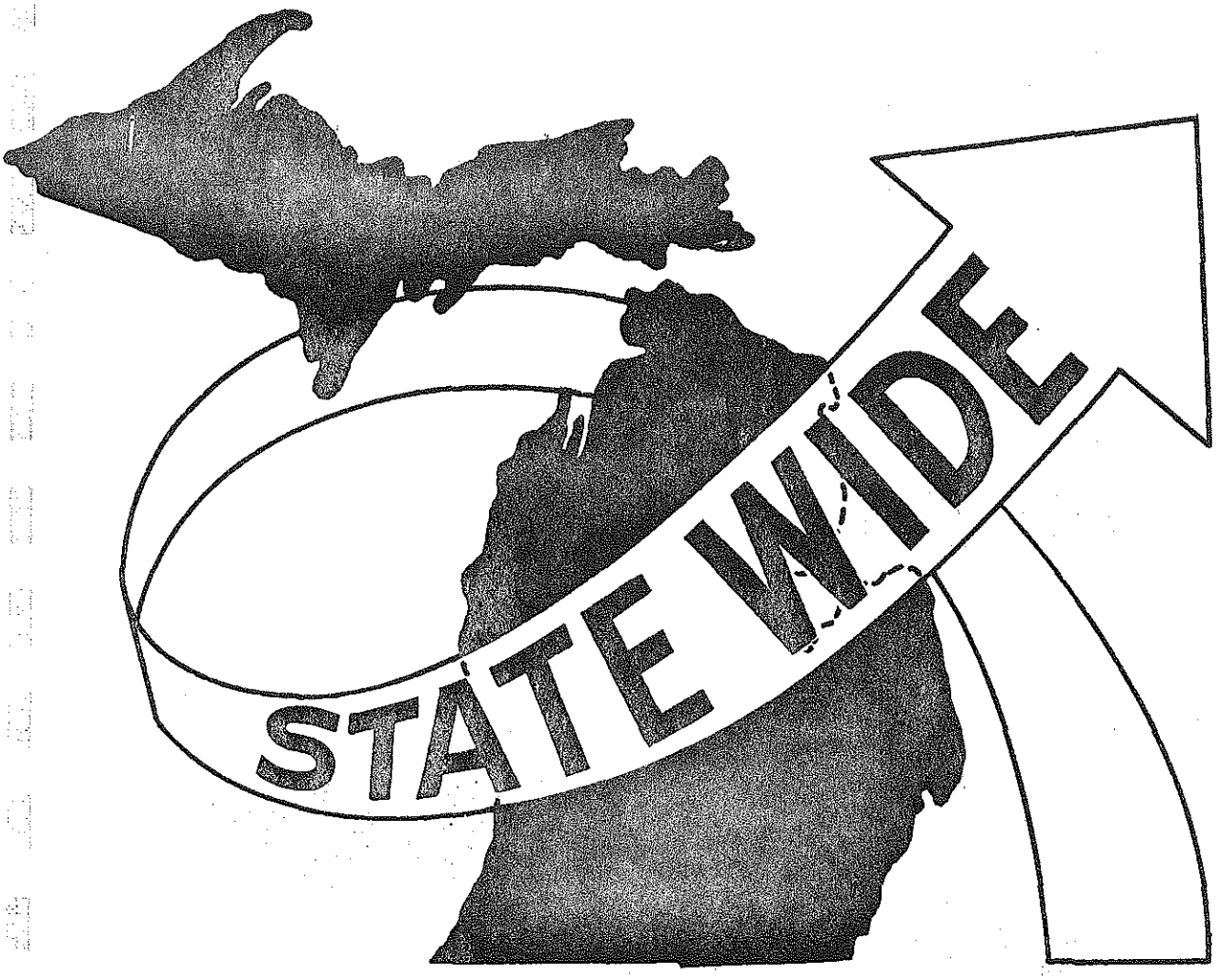
INTRODUCTION



INTRODUCTION

The current Statewide Transportation Modeling System contains 547 zones, 508 of which are in Michigan (see Figure 1). Any zone level data such as population, employment, or number of hospitals may now be mapped using the SYMAP program available at Michigan State University. Using the appropriate information SYMAP will produce a two-dimensional printer map of Michigan shaded according to the values of the data being displayed.

There presently exists a wide variety of socio-economic data already available at the statewide zone level (see Figure 2). The creation and use of this data was documented in a previous Statewide publication entitled Statewide Socio-Economic Data File, March, 1973. The Statewide Facility File offers additional information about statewide facilities such as hospitals, parks, and universities (see Figure 3). The creation and contents of this file was documented in a previous publication entitled Statewide Public and Private Facility File, March, 1973. All of the above mentioned information may be displayed with SYMAP as well as any new information coded to the Statewide Model zone system.

The following report is not intended to serve as a user's manual for SYMAP, but is intended to show some of the usual options and setups used in mapping the Statewide Model socio-economic zone data. More detailed information on SYMAP may be obtained from MSU publications.

FIGURE 1

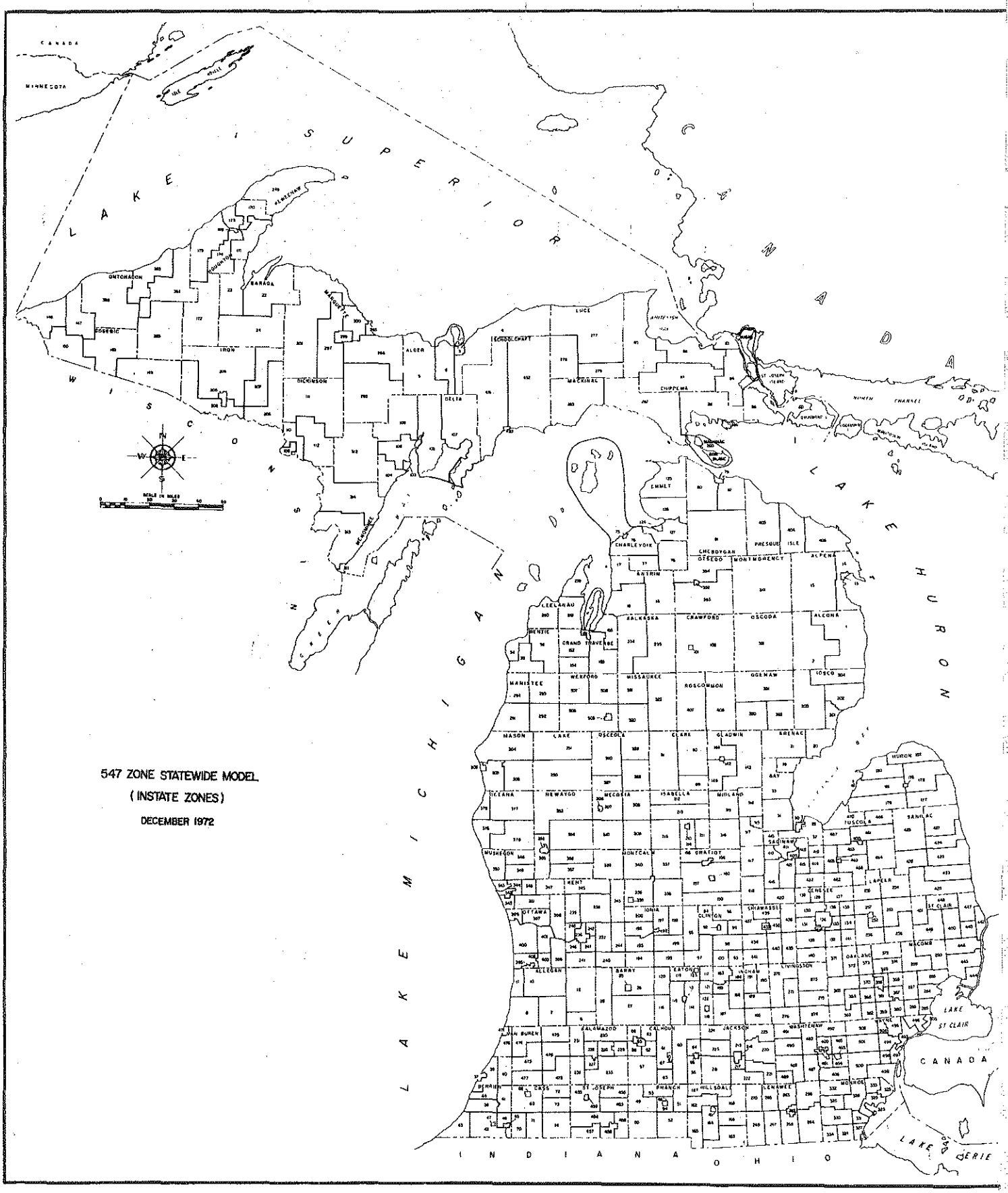

547 ZONE STATEWIDE MODEL
(INSTATE ZONES)
DECEMBER 1972
CANADA
MINNESOTA
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ST CLAIR
LAKE ERIE
INDIANA
OHIO
ONTONAGON
BARAGA
MARQUETTE
ALGER
SCHOOLCRAFT
LUCE
MACKINAC
CHIPPEWA
DICKINSON
DELTA
IRON
EMMET
CHARLEVOIX
CHEBOYGAN
PRESQUE ISLE
OTSEGO
MONTMORENCY
ALPENA
ANTRIM
LEELANAU
GRAND TRAVERSE
KALKASKA
CRAWFORD
OSCODA
ALCONA
BENZIE
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
ARENAC
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
SANILAC
TUSCOLA
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
MENT
GENESEE
LAPEER
OTTAWA
IONIA
CLINTON
SHIAWASSEE
ST CLAIR
ALLEGAN
BARRY
EATON
INGHAM
LIVINGSTON
MACOMB
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
CANADA

FIGURE 2

STATEWIDE SOCIO-ECONOMIC DATA FILE *

GENERAL CHARACTERISTICS OF POPULATION

SCHOOL ENROLLMENT BY TYPE OF SCHOOL
YEARS OF SCHOOL COMPLETED
CITIZENSHIP BY AGE

INCOME CHARACTERISTICS OF POPULATION

FAMILY INCOME
INCOME BY OCCUPATION AND SEX
RATIO OF FAMILY INCOME TO POVERTY LEVEL

LABOR FORCE CHARACTERISTICS OF POPULATION

EMPLOYMENT BY AGE
EMPLOYMENT BY OCCUPATION AND SEX
EMPLOYMENT BY INDUSTRY AND SEX

SOCIAL CHARACTERISTICS OF POPULATION

AGE BY SEX
TYPE OF FAMILY
MARITAL STATUS

AREA CHARACTERISTICS

LAKE FRONTAGE
ASSESSED VALUATION
WATER AREA

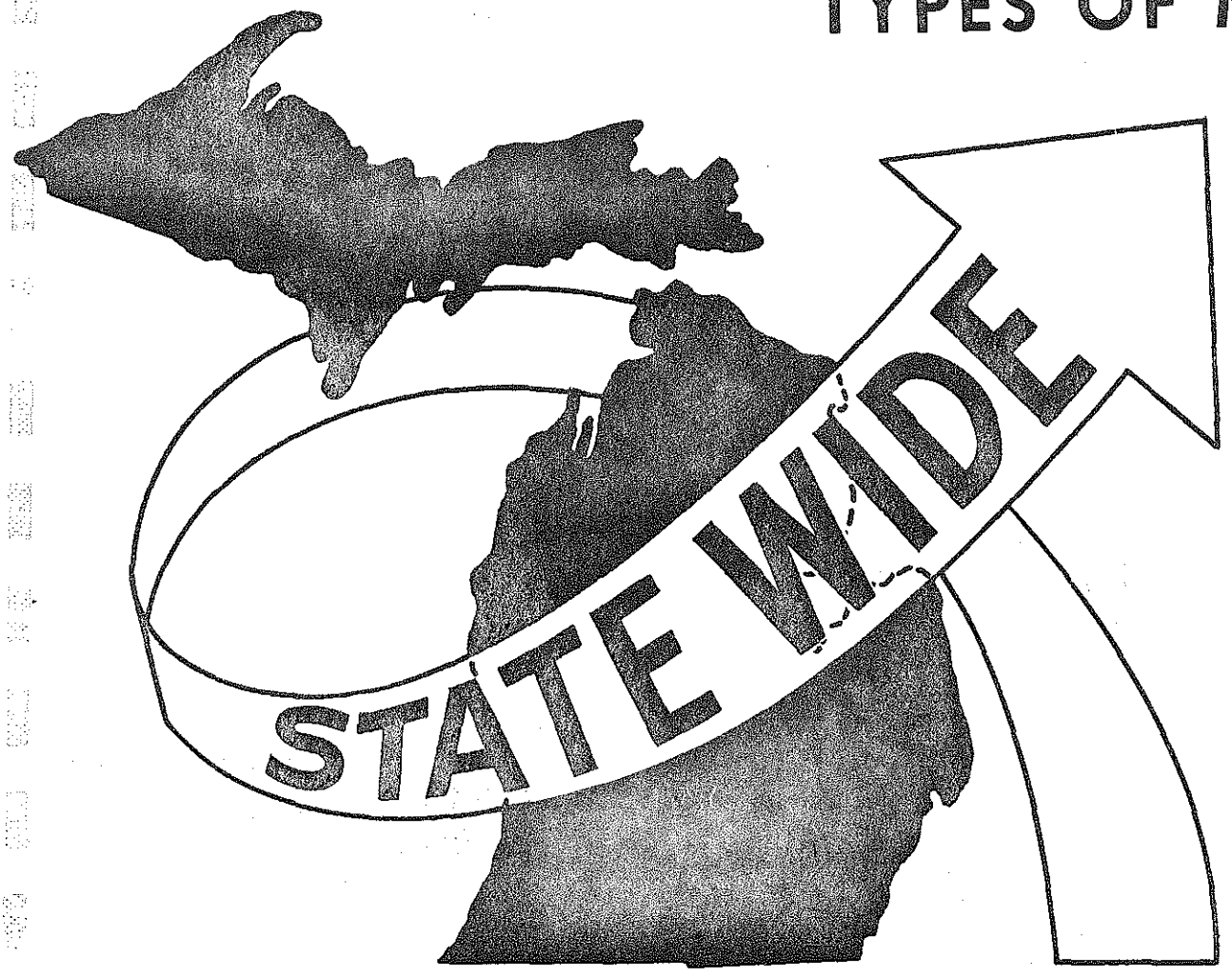
*THOSE ITEMS LISTED HERE ARE SAMPLES TAKEN FROM THE COMPLETE FILE WHICH CONTAINS OVER 700 ITEMS.

FIGURE 3

STATEWIDE FACILITY FILE

HISTORIC SITES
HOSPITALS
AIRPORTS
WHOLESALE TRADE CENTERS
MAJOR PARKS
NON-PUBLIC COLLEGES
PUBLIC COMMUNITY COLLEGES
CITIES OVER 30,000 POPULATION
UNEMPLOYMENT OFFICES
MENTAL HEALTH CENTERS
CERTIFIED INDUSTRIAL PARKS
MICHIGAN'S UNIVERSITIES
SKI AREAS
SNOWMOBILE TRAILS
CBD w/5,000 POPULATION
TRUCK TERMINALS
STATE POLICE POSTS
DAILY NEWSPAPERS
WEEKLY NEWSPAPERS
SEWAGE TREATMENT FACILITIES
TOURIST ATTRACTIONS
BUS TERMINALS
MANUFACTURERS
CAMPSITES

TYPES OF MAPS



TYPES OF MAPS

Three types of maps are available with SYMAP.

1. Contour (see Figure 4)

   All data points (508 instate zone centroids) having the same value are associated internally with a closed curved line (contour line). A continuous gradation is assumed between any two contour lines. This map should be used with continuous information such as population.

2. Conformant (see Figure 5)

   Each data point is associated with a user-specified boundary surrounding the point. Each of these areas corresponds to a statewide zone. The area enclosed by each zone is shaded according to the value of the data for that zone. A blank border is produced showing the zone boundary.

3. Proximal (see Figure 6)

   The shading of each point on the output map is determined by the value of the nearest data point. Zone boundaries are not involved in this map or in the contour map.

Small blank squares can be seen on each map. These squares correspond to the position of the data points.

General instructions for setting up each type of map as well as control cards are discussed in the next section.

FIGURE 4

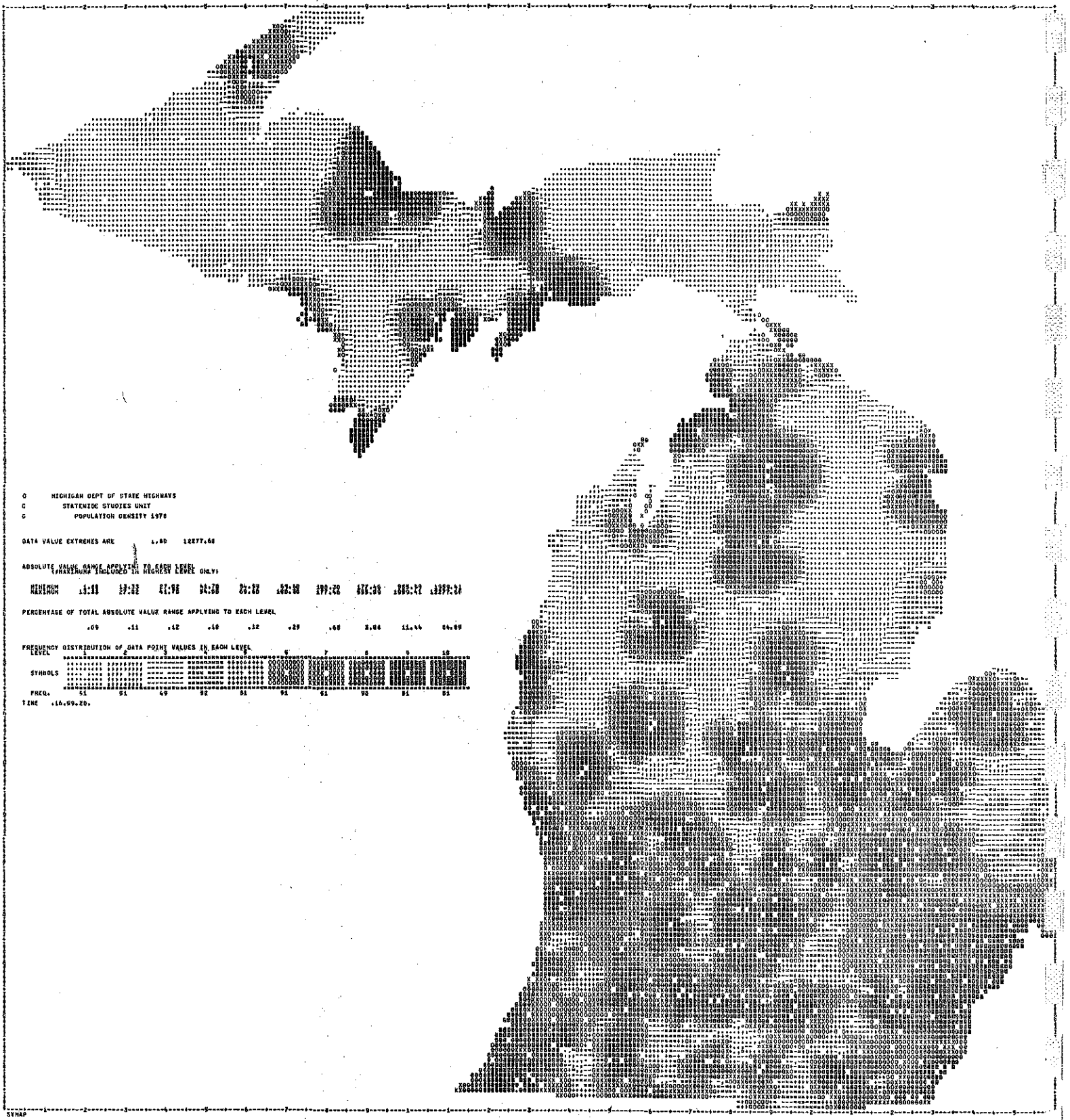

C MICHIGAN DEPT OF STATE HIGHWAYS
C STATEWIDE STUDIES UNIT
C POPULATION DENSITY 1970
DATA VALUE EXTREMES ARE 1.80 12877.68
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
(MAXIMUM INCLUDED IN HIGHEST LEVEL ONLY)
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
.09 .11 .12 .16 .32 .29 .65 2.84 11.44 84.88
FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL
LEVEL 1 2 3 4 5 6 7 8 9 10
SYMBOLS
FREQ. 51 91 49 92 81 92 81 90 81 81
TIME .16.59.20.
SYNAP

FIGURE 5

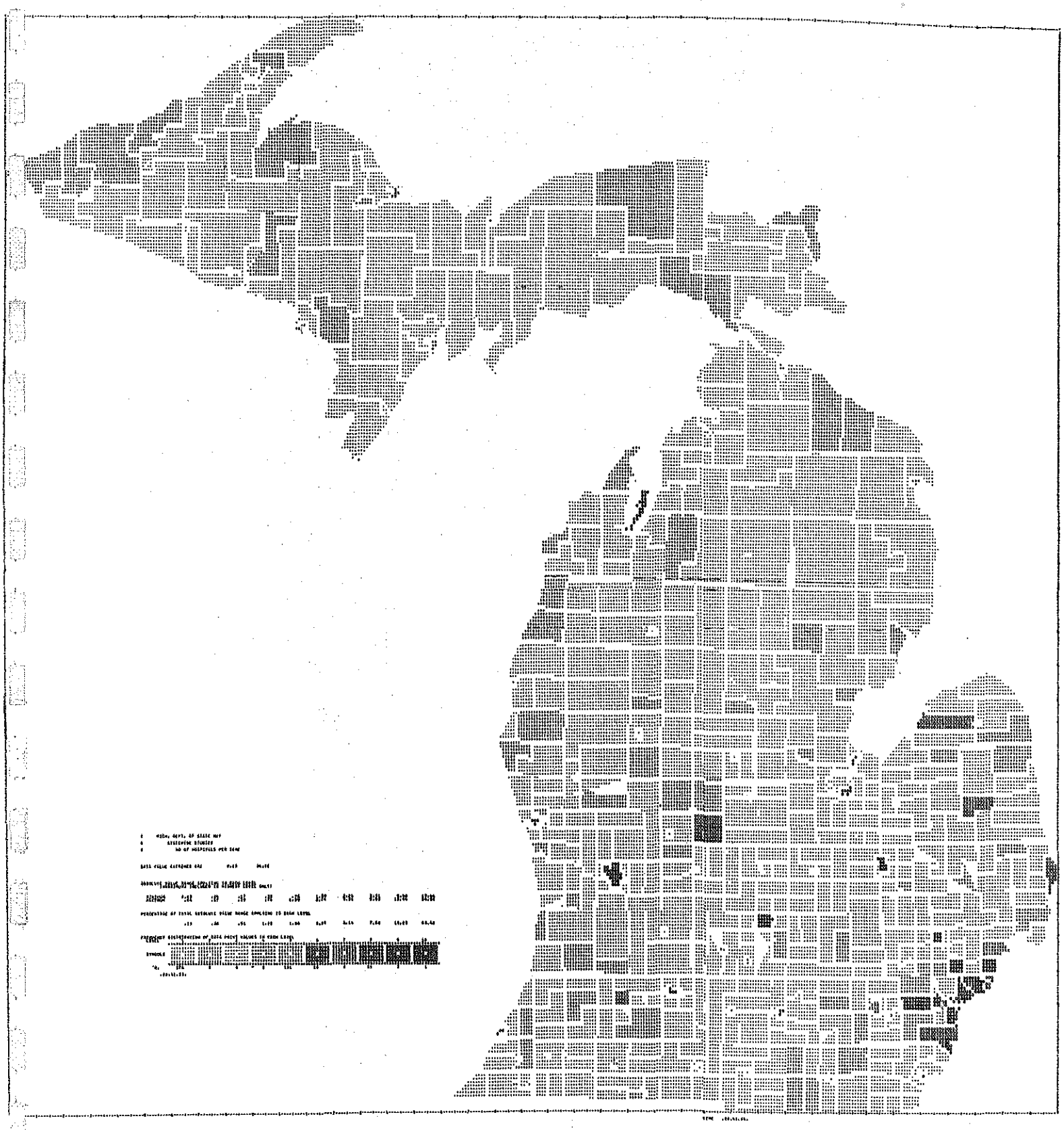
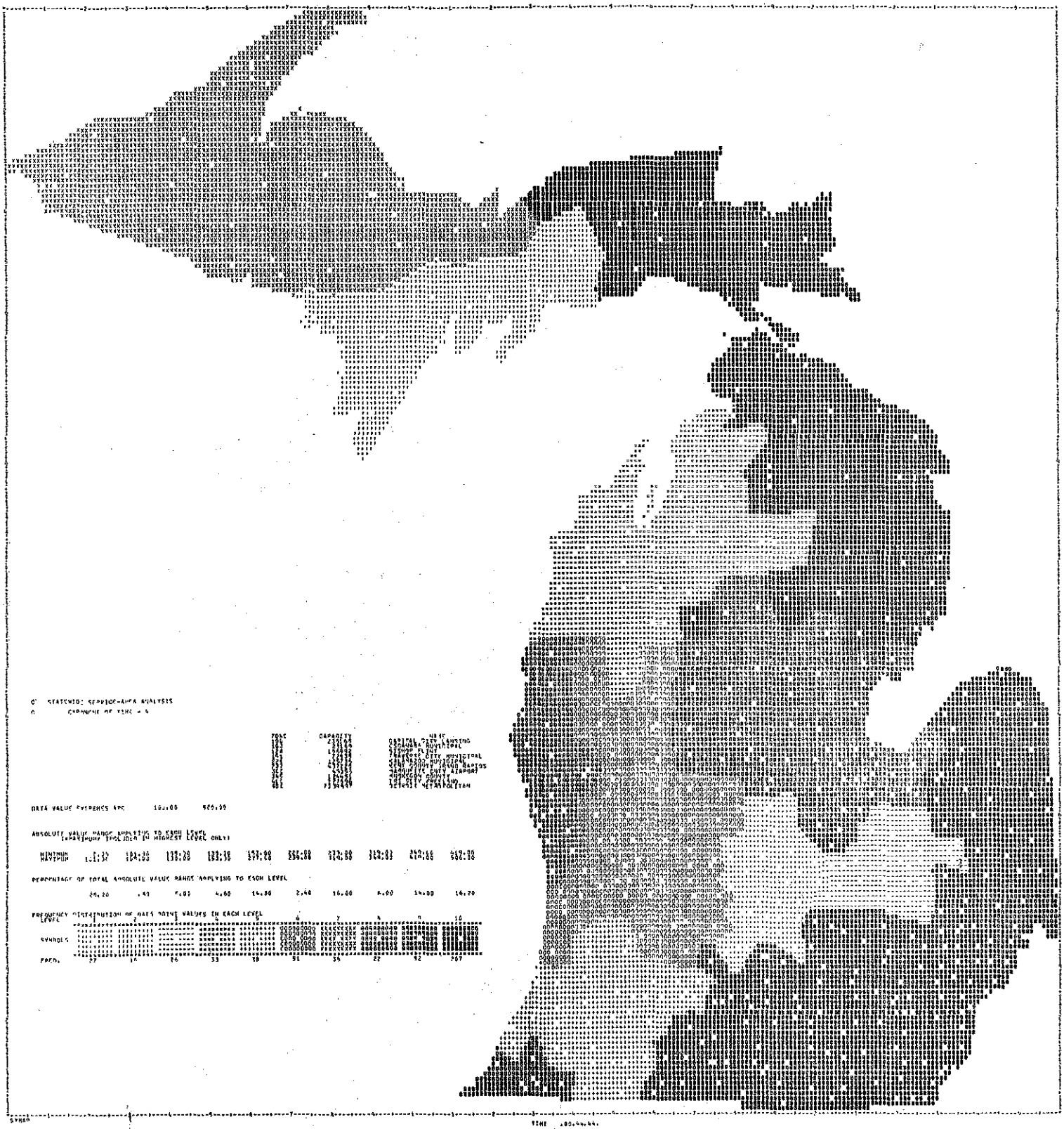
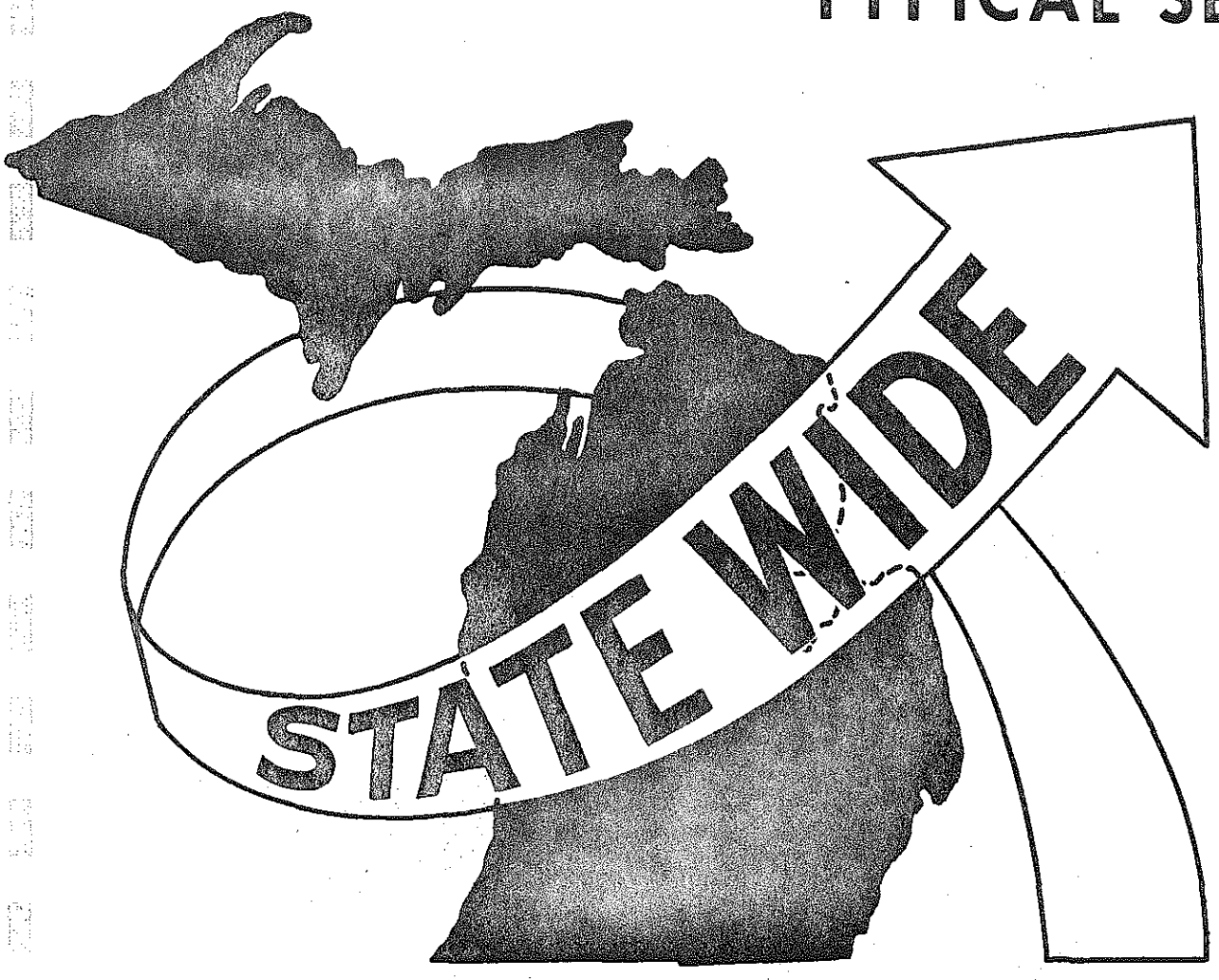


FIGURE 6


STATEMIDI SERVICE-AREA ANALYSIS
DATA VALUE EXTREMES ARE
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL
LEVEL
SYMBOLS
FREQ.
TIME

TYPICAL SETUPS



TYPICAL SETUPS

The necessary setup for running SYMAP at MSU on the CDC 6500 is shown in Figure 7. A description of usual packages and options for each type of map are discussed below.

For the details of coding each package see the MSU publication describing SYMAP. The cover of this publication is reproduced in Figure 8.

The packages need for a conformant (zone boundary) map are shown in Figure 9. An actual run deck is reproduced in Figure 10. In order to avoid loss of small zones a large map is needed. The 39 inch wide map is recommended. The map will then be printed in three strips and must be taped together for the completed map. This type of map should be used wisely since the cost is approximately 2 times the cost of contour or proximal maps. Based on computer costs at MSU the contour maps for the 508 instate zone system is around $10.00

The packages for contour and proximal maps are illustrated in Figure 11.

The B-data points package for mapping the 2300 zone system will soon be available. Due to SYMAP's limit of 1000 data points, the 2300 system will require at least three runs of SYMAP to produce a complete state map.

The next sections deals with some specific suggestion regarding several options and how to put zone boundary coordinates on tape for use at MSU.

FIGURE 7

SYMAP

SETUP

1.	PNC Card	
*2.	6500 Scope Card	YOUR ID, T100, CM65000, RG2,JCO
3.	PASSWORD Card	PW = Your Password
4.	SYMAP Library Request	APLIB(LTT389,*SYMAP)
5.	Tape Request Card (Use if Zone Boundary Coordinates On Tape)	REQUEST, TAPE 11, RØ, VRN=109, Z,S.
6.		SYMAP.
7.	Multipunch 7, 8, 9	
8.	SYMAP Packages	(See Figure 9 and 11)
9.	6-Nines Card	999999
10.	Multipunch 6, 7, 8, 9	

*The number after the "T" is the processor time in seconds. Use 150 for each proximal or contour map. Use 200 for each conformat map.

FIGURE 8

MICHIGAN STATE UNIVERSITY

Computer Institute for Social Science Research

Technical Report No. 100

This technical report is a revision of the Laboratory for Computer Graphics' Reference Manual, Version V, Draft #2, Graducate School of Design Harvard University.

SYMAP

C. Young

Revised: Donald D. Dugger
Robert I. Wittick

Disclaimer

Although this program has been tested by its contributor, no warranty, expressed or implied, is made by the contributor or Michigan State University Computer Laboratory as to the accuracy and functioning of the program and the related program material. Any questions concerning the technical details of programming for this routine should be addressed to the Computer Institute for Social Science Research.

June 1969
Revised: January 1972

FIGURE 9

SYMAP

CONFORMAT MAP

PACKAGES

(Zone boundaries shown)

1. A-Conformolines pkg. (Zone boundary coordinates)
   Coordinates are on tape. See control cards setup for card which requests use of this tape.
2. E-Values pkg. (Data to be mapped)
3. F-Map pkg. (Options describing maps desired)
   A. Option 1 - Size (usually 39")
   B. Option 3 - Number of levels (usually 10)
   C. Option 6 - Range of data for each level
   D. Option 7 - Symbols for each level
   E. Option 9 - Suppress Histogram
   F. Option 17 - Suppress print of output data list
   G. Option 25 - Suppress print of level number

FIGURE 10

```
=
999999
99999
9999
     MEAN INCOMES
   10
   27
   17
    9
    8
        V
        A
       -XX
.,-=+0X000
    7
    6
    3              10
    1                      39.
C              INCOME DATA
C          STATEWIDE STUDIES
C      MICH. DEPT. OF STATE HWY
F-MAP
99999
E-VALUES                X
99999
A-CONFORMOLINES         X                                    X
.
SYMAP.
REQUEST,TAPE11,RO,VRN=109,Z,S.
APLIB(LTT389,*SYMAP)
PW=YOUR PASSWORD
YOUR ID,T100,CM65000,P2,JCO.
```

use RG in place of P

PNC	507664	7 3 0 7 4	12	FRIEND, ALAN R.	100PCT PAY
CARD TYPE	PROBLEM NUMBER	EXPIRATION DATE	PROB TYPE	PROBLEM NUMBER HOLDER NAME OR ID NAME	USER CODE

MICHIGAN STATE UNIVERSITY
COMPUTER LABORATORY
PROBLEM NUMBER CARD

THIS CARD IS A COMPUTER SERVICES AUTHORIZATION CARD AND THE APPLICANT MUST ASSUME FULL RESPONSIBILITY FOR ITS USE. THE COMPUTER LABORATORY RESERVES THE RIGHT TO INVALIDATE A PROBLEM NUMBER WITHOUT PRIOR NOTICE.

DO NOT PUNCH ADDITIONAL INFORMATION INTO THIS CARD.
IN CASE OF LOSS, PHONE 355-3800 OR NOTIFY C.L. OFFICE, ROOM 220, CC.

HACKETT Y00878

Zone Boundary (Conformant) Map Run Deck

FIGURE 11

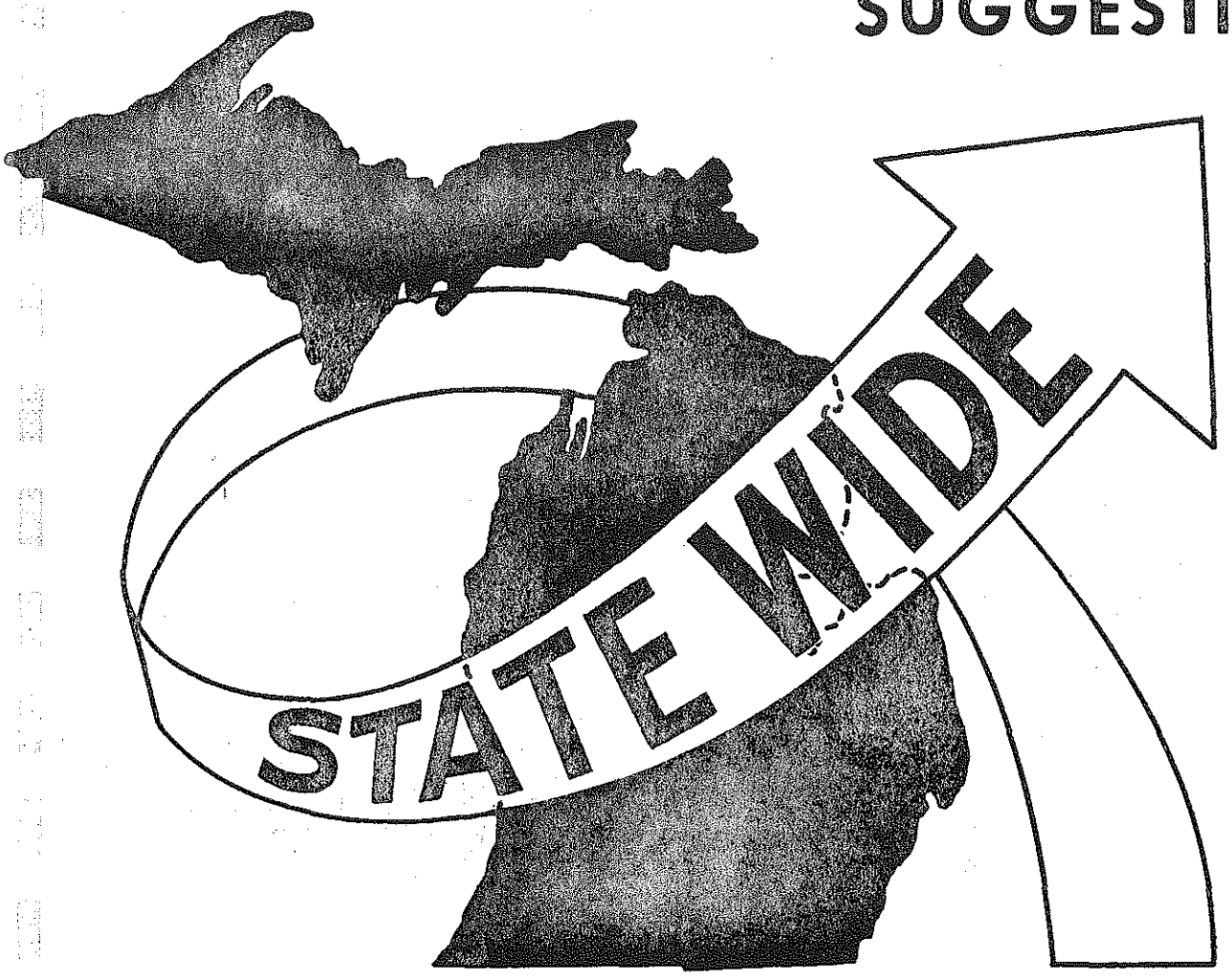
SYMAP SETUP

CONTOUR AND PROXIMAL MAP

1. Control Cards (see control-card setup)
2. A-Outline pkg. (coordinate outline of Michigan)
3. B-Data Pts. pkg. (location of centroids)
4. E-Values pkg. (data to be mapped)
5. F-Map pkg. (options describing map desired)
   - A. Option 1 - Size (usually 24")
   - B. Option 3 - Number of levels (usually 10)
   - C. Option 6 - Range of data for each level
   - D. Option 7 - Symbols for each level
   - E. Option 8 - Suppress white contour boundaries
   - F. Option 9 - Suppress histogram
   - G. Option 17 - Suppress print of output data list
   - H. Option 27 - For contour map

   Option 27,31,36,37 - For proximal map
6. Multi-punch 6,7,8,9 (End of run deck)

SUGGESTIONS



SUGGESTIONS

Use of F-Map Option 6 - Range of Values for Shading

The best looking map is usually produced by using Option 6 without specifying values for each level of shading. The program will place the same number of data points in each level. Using the Statewide Model zone system and 10 levels this means about 50 points in each level. Figure 12 was produced in this manner. Figure 13 was produced by deleting the Option 6 card. The program then divides the range of values into equal intervals. The former (Figure 12) produced very unequal intervals.

Note that the number of points (FREQ) in each interval of the range of values are shown below the shading key at lower left-center of each map.

Use of F-Map Option 7 - Symbols for Shading

The ten levels of shading seen in the previous maps are produced by the following cards for Option 7.

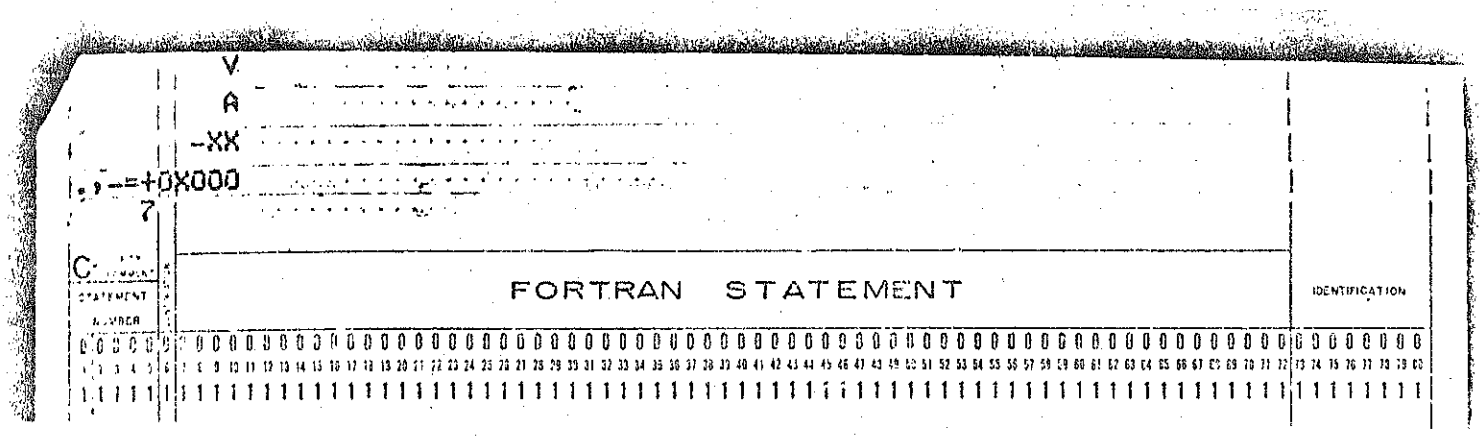


FIGURE 12

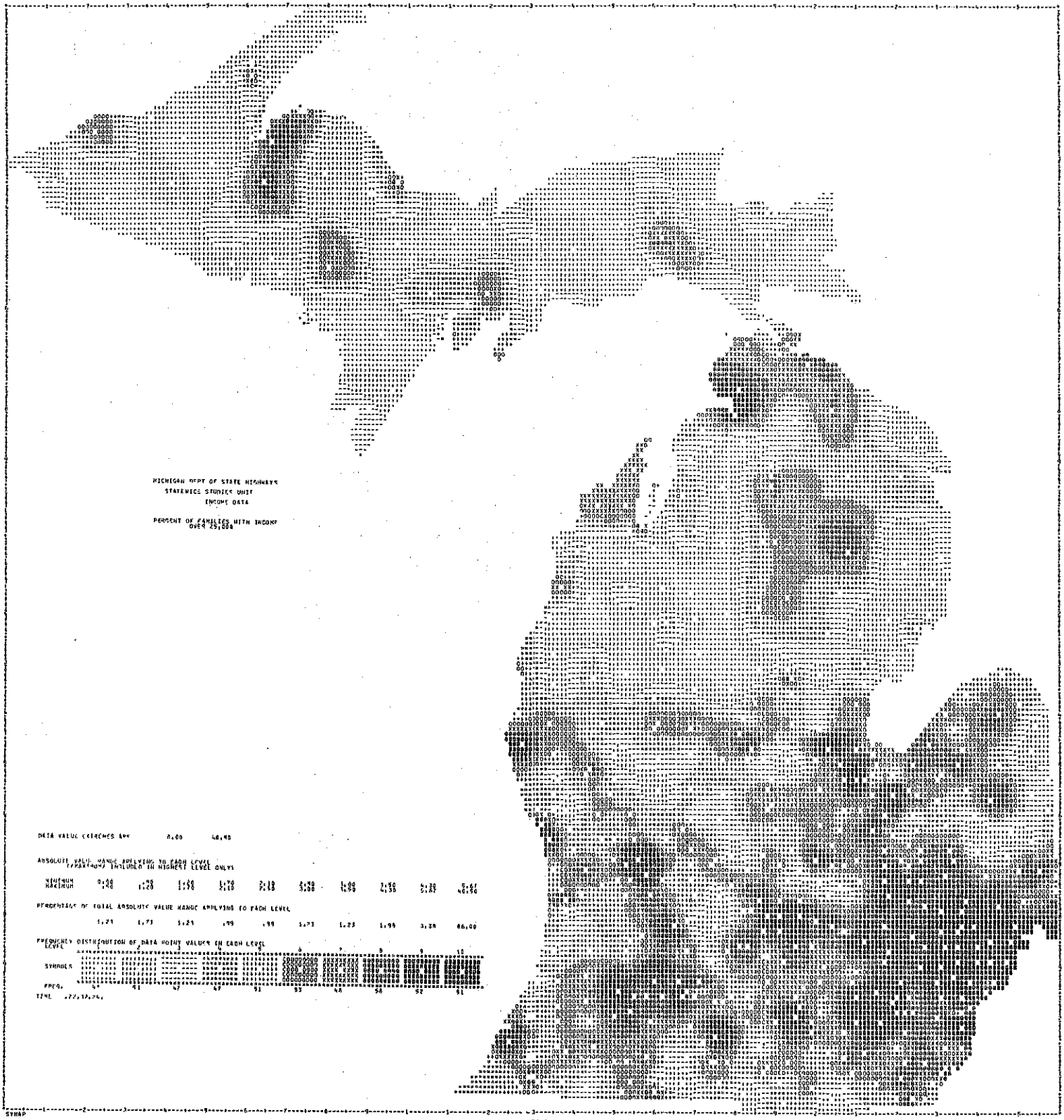
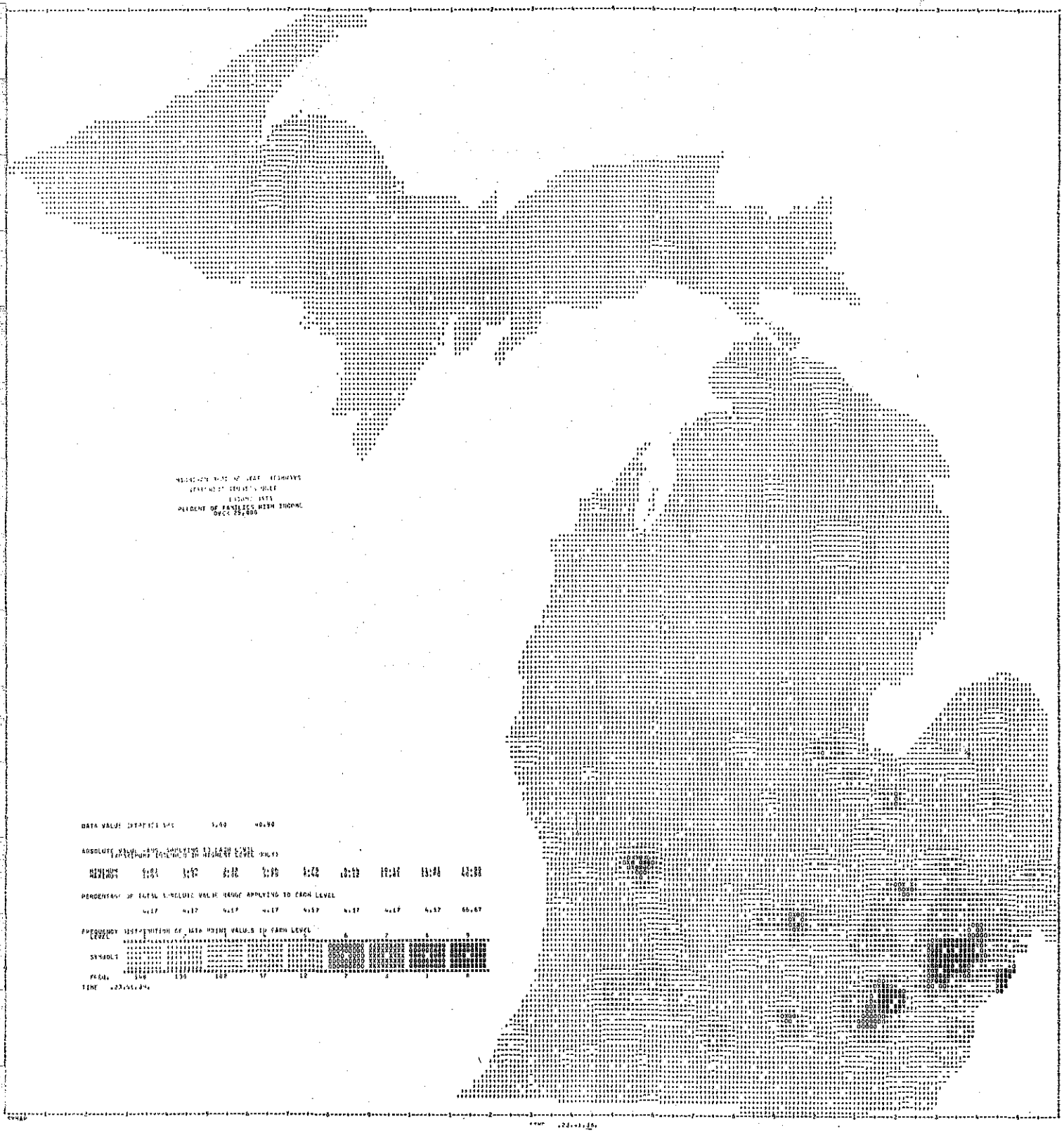

MICHIGAN DEPT OF STATE HIGHWAYS
STATEWIDE STUDIES UNIT
INCOME DATA
PERCENT OF FAMILIES WITH INCOME
OVER 25,000
DATA VALUE EXTREMES ARE 0.00 40.50
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
(MAXIMUM) INCLUDED IN HIGHEST LEVEL ONLY
MINIMUM 0.00 .50 1.00 1.70 2.10 2.50 3.00 3.50 4.30 5.67
MAXIMUM .50 1.20 1.70 2.10 2.50 3.00 3.50 4.30 5.67 40.50
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
1.23 1.23 1.23 .99 .99 1.23 1.23 1.99 3.38 86.00
FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL
LEVEL 1 2 3 4 5 6 7 8 9 10
SYMBOLS
FREQ. 4* 41 47 47 51 53 48 58 52 51
TIME .22.32.24.
SYMAP
TIME .22.32.23.

FIGURE 13



Use of F-Map Option 10 - Text Cards

The F-Map package always provides for three title cards to be printed at the base of the map.

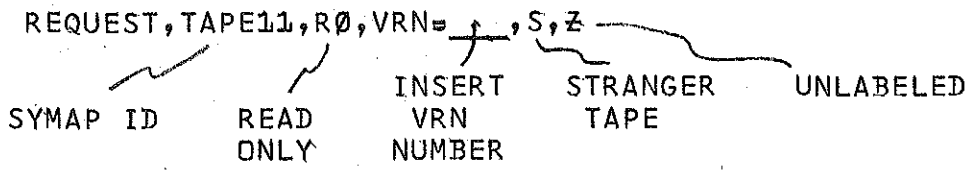
It will often be desirable to have more cards to further explain each map. These extra cards may be submitted with Option 10. See the MSU publication for details.

Creation of Tape with Zone Boundary Coordinates.

Zone boundary coordinates for use with the A-Conformolines package may be punched on cards in the same format as suggested in the MSU publication. These cards should be loaded to tape with the B-5500 using Q17208. The tape should conform to the following:

1. 556 BPI
2. 80 char/record
3. 1 record/block
4. Even parity (i.e. non-standard)
5. Unlabeled

This tape should be logged in at MSU data center where a "VRN" number is assigned to the reel. To use this tape in SYMAP, a request card is included in the control cards. The format follows:



Use of MSU County System

MSU has county data points, county boundaries, and an outline of Michigan available for use with SYMAP. Data points are geographic centers of the counties. County numbering conforms to the federal system (Saint Clair = 74). To obtain a card deck of the data points and outline use PNC card, JOB card, password card and the following APLIB card:

APLIB(LTT85,R*AMI=PUNCH,BMI=PUNCH)

To run a county level SYMAP with county boundaries use the following APLIB card to obtain use at the A-Conformolines package of county boundaries:

APLIB(LTT85,R*CMI=TAPE11).

Suggestions for mapping the 2300 zone system will be made available at a later date.