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The University of South Carolina's Version of CMAP: A User's Guide

Richard Kimmel

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THE UNIVERSITY OF SOUTH CAROLINA'S VERSION OF CMAP:
A USERS GUIDE

by

Richard Kimmel
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UNIVERSITY OF SOUTH CAROLINA
July, 1973

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THIS BOOK DONATED BY R.L. Stephenson
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PREFACE

This paper presents a review of the CMAP program on system at the University of South Carolina Computer Center. This program was originally developed by Morton W. Scripter of the Department of Geography at the University of Idaho. The version on system at the University has been greatly simplified by Drs. Paul Lovingood, Jr. and David Cowen of the Department of Geography, University of South Carolina.

The program allows for the preparation of distribution maps of the type shown in Fig. 1. The program is simple to use and requires a minimum of experience on the part of the user.

We at the Institute of Archeology and Anthropology are indebted to Dr. Paul Lovingood, Dr. David Cowen and Mr. Shaym Verma for their consideration and assistance in helping us gain familiarity with the program.

I would also like to express my personal gratitude to Dr. Robert L. Stephenson, Director of the Institute of Archeology and Anthropology, Dr. Leland Ferguson, Archeologist, for their continuing support and kindness.
INTRODUCTION

The CMAP Program is written in the FORTRAN IV language and is designed for use with the IBM 360/65 System. No special printing features are required. The program allows the user to define any geographical or abstracted area and to express variable values for any segment of the area. This may be a county of a state, a unit in an excavation grid or whatever. The values of the variable must be grouped into classes with each class representing a range of values. Figure 1 shows an example of this.

There are four main components of the CMAP Program (Fig. 2). These are: the Job Control and Execute cards (JCL/EXEC) which tell the computer what program is to be run and for whom; the SCAN Deck which delimits the area to be mapped; the DATA Deck which supplies the values for the variables; and the Class Description cards (CLASS/END) which give the computer certain information about the data and its presentation on the map. Each of these components will be discussed separately in the sections that follow. In addition, two appendices are provided: one explaining the use of the IBM KP-29 Keypunch, and the other explaining the use of the South Carolina SCAN Deck.
THE FOUR COMPONENTS OF THE CMAP DECK

FIG. 2
JOB CONTROL AND EXECUTE CARDS (JCY/EXEC)

This first set of cards prepares the computer to accept your SCAN and DATA Decks. In Figure 3, the numbers above the solid line are IBM Punch Card columns. In some cases, these columns must be used for specific information. These cases will be noted. The lower case "n", when encountered in these instructions, is to be replaced with certain numerical information as called for in these instructions.

FIGURE 3: The JCL/EXEC Cards

```
//SEAMAP JOBnn (nnnnnnnn,nn), 'user name',TIME=(,nn),CLASS=A
/*ROUTE PRINT LOCAL
//PANDORA EXEC CMAP
//CMAP.FT06F001 DD SYSOUT=(A,,7141)
//CMAP.SYSIN DD *
```

The first card must have some things added where the n's occur. The nn after JOB may be any number, and is to be used by the user to keep track of map runs. In other words, the number is for your reference and is ignored by the computer. The n's in parentheses are, first, the eight digit account number which is issued by the Computer Center, and second, the number of thousands of lines of output. The best policy here is to specify 2 for your early sample or trial runs, and then when you begin to exceed 7 or 8 maps per run, up the entry to 5. The user's name entry should be filled in with your last name as this will identify the program when it returns to the computer center. The last nn entry (after
TIME=) is the time required to run your job (in seconds). This is computed at one second per map plus one second to load the program. The CLASS entry must always be A. These last two items may be left off of the first card and the computer will automatically select "default" options which are programmed into the system. For an unspecified TIME, the default will be one minute. If you choose to use the default, the card will have no entries past the " " following your name. You must keypunch this first card on a pink card. All other cards in the program will be white.

The rest of the cards in the JCL/EXEC component should be punched exactly as they appear in Figure 3. The second and fourth cards will provide for overprinting and the use of unlined paper. These cards may be left out if you prefer to use single symbols and the green-banded paper.
THE SCAN DECK

The SCAN Deck must be provided so that the computer "knows" the outline of your map and the units within the boundaries. The deck is prepared by drawing the area on specially designed IBM paper (IBM GX20-1816-0, 150/10/6 Print Chart). Figure 4 shows how to lay out your area. It is a good idea to center the map in the paper, using column 131 as your right hand limit. Keep the diagram near the top of the page. Give all of your segments numbers, beginning with one, and number from the top left working to the bottom right. Then give the background the next highest number (Fig. 4).

Each row of the paper will have a corresponding card in the SCAN Deck. The entries on the cards are made in three digit units. The first entry will be the row number always beginning with row one. This will be designated as 001. The next three numbers indicate the number of segments to be crossed as the computer scans the row. In the case of our sample there is one segment - Segment 10 - the background. This entry is added to the previous one and we thus have 001001 entered on the first card. The next entry on this line begins definition of the area. The 010 is the third number on the card and tells which segment number is being defined and the number immediately following tells where that segment will end. Thus the first card in our sample reads: 001001010030 and it means: "the first row has one segment and it is segment 10 and it proceeds to column 30". Later on in the deck we come to Row 4 which reads: 004005010010001015002020003025004030. This says that Row 4 has 5 segments. The first is segment Number 10 and it proceeds
First outline the area to be mapped as above. Center the map left and right but keep it close to the top of the page to avoid making a lot of empty cards.

Each row will have a card in the SCAN DECK, beginning with row one and ending with the last row needed to make the map. The punch card will have several entries; first will be the row number, next the number of segments that the row "encounters", and the segment number, followed by its terminal column number. Therefore, the above section would read:

1
001001010030
002001010030
00300501001001015002020003025004030
00400501001001015002020003025004030
00500501001001015002020003025004030
006002010025005030
007002010025005030
008002010025005030
009005010006015007020008025009030
010005010006015007020008025009030
011005010006015007020008025009030

This is a complete SCAN-DECK. It has 10 data areas (1 for background), and 11 scan lines. The map width is 30.
to Column 10. Then Segment 1 begins and it proceeds to Column 15, then Segment 2 begins and continues to Column 20, then 3 goes to 25, and 4 goes to 30 and that's it for Row 4.

Each row must have a card; so prepare them carefully and proof read them to avoid errors.

If you exceed thirteen segments in one row you will have to use two cards for that row. To do this you should account for 12 segments on the first card and then continue on the second with the 13th entry beginning in Column 7.

There is one other accessory card to go with the SCAN Deck and it is set up as follows:

```
nn TRUE FALSE 5
```

The nn is to be replaced with the number of rows used to make the map. In the case of our sample the nn is 11. The next two entries are called Logical variable and may be TRUE, FALSE, or left blank for the default. The first Logical entry tells the computer whether or not to print debug messages should an error be encountered. Since these messages are of help in correcting errors the first entry should be FALSE or unspecified (the default is to print warning messages). This entry must begin in Column 6 and is said to be left justified to Column 6. The second Logical variable specifies whether or not overprint is to be used. If it is to be used this must be TRUE, if FALSE no overprinting will occur. This entry must be left justified to Column 11 (it must begin in Column 11). The last entry tells the computer the Deck Unit number of the SCAN Deck. This is 5 in all cases unless the South Carolina state map by counties is to be used. The South Carolina SCAN Deck is stored in
memory and is called by specifying 8 in Column 20. The use of the South Carolina Deck is outlined in Appendix B.

With this card placed immediately before the SCAN Deck (or, if you prefer, immediately after the JCL/EXEC cards) the SCAN Deck is finished.
THE DATA DECK

The DATA Deck is the portion of the program that gives the computer the values for your variables. Since this deck can be used in other statistical programs (see Advantages of Computer Data Handling later in this paper) it should be set up in a fashion that will be suitable for future use. The method described here is appropriate.

The DATA Deck must be set up with one card for each segment of the area you have defined. In our sample this would be nine data cards, one for each of the segments. There may be many variables represented on one card. For instance, one may wish to record the number of automobile accidents per capita in Columns 13 and 14 and 15, the number of accidents per licensed driver in Columns 16, 17, and 18. What you record and in what columns is unimportant as long as you are consistent from card to card. Here is a sample card from a DATA Deck.

FIGURE 6

38CR01 Mound A 09 4532 12 56

The first 17 columns of this card have been reserved for user information and identification, and it tells the user what segment the card is for (09) and gives any other pertinent information. The computer will ignore these columns for every card in the DATA Deck (how this is done will be explained later on). The data actually begins in Column 19. The user may wish to reserve Column 19 and 20 for a count of a particular kind of ceramic, Columns 21 and 22 may be used to count the number of a certain kind of projectile point and so on. Now, it is necessary for the computer to "know" which columns to ignore and in
which columns it will find data. Therefore, a FORMAT statement is used. This statement consists of numbers and symbols which the computer can read. The FORMAT statement explained here is a shortened version of the normal FORTRAN FORMAT statement.

The FORMAT statement in Figure 5 will be referred to here.

FIGURE 7

(17X,5F3.1,4F2.0,3I5)

The FORMAT statement in Figure 7 tells the computer to skip the first 17 spaces; these areas are for your information. Then the computer is told that it will encounter five, three-digit numbers and the decimal is to be placed one digit from the left of the number. This makes it unnecessary to include a decimal in your entry (hence saving space) and one will be assumed for you. Therefore an entry of 389 will be interpreted as 38.9. If you wish to specify your own decimals you can still do so since a decimal appearing in a number which you give the computer will supersede this instruction. Since we have told the computer that there will be five of these entries, we may see a string of figures like this: 234567176345242. The computer would register five entries. The first variable would be 23.4, the second 56.7, the third 17.6 and so on. The next entry, 4F2.0, tells the computer to reserve the next eight columns for four two-digit numbers and that you will supply the decimal. The final entry will tell the computer to save space for three integers (a number with no decimal) each to be five digits long. The code then is: X = skip the first (or next) nn spaces and is written nnX, F = a floating point number and is written nnFn.n where nn is the number
of such numbers to be encountered and \( n.n \) is the number of digits in each number and the number of spaces to be placed to the right of the decimal point, \( I = \) integer number (no decimal point) and it is written \( nInn \) where \( n \) is the number of such numbers to be encountered and \( nn \) is the number of digits that will make up each number.

If a column or group of columns does not have any data for a particular segment of the map, the columns may be left blank or filled with zeros. Any number that does not have the appropriate number of digits to fill the space reserved should be moved to the right unless this will put a decimal in the wrong position. For instance, if you have reserved space in this fashion \( F3.1 \) and you have an entry of 29 then you must enter the figure 290 and the computer will place the decimal.

If you have any trouble with the FORMAT statement you may consult an introductory text or consult with any staff or student at the computer center. Be sure that you make note of the variable names to be entered in the various columns.

This FORMAT card must immediately precede the DATA cards.

One other card must be placed immediately in front of the FORMAT card. This card has the following appearance:

FIGURE 8

```
n 10FALSE
```

The first entry on this card must be right, justified to Column 5 (i.e. it must end in or be placed in Column 5), and tells the computer how many segments appear on your map. This number should not include
the background. In Figure 4 there are nine areas. The next number, right, justified to Column 10, tells the computer how many variables are represented on each data card. In the case of our example in Figure 7, 12 variables are represented. The Logical variable tells the computer whether or not the print-out warning messages for this portion of the program. An entry of FALSE will have messages printed, an entry of TRUE will suppress such information.
THE CLASS/END CARDS

This group of cards gives the computer the additional information that it needs to complete your map. There are several cards to include and they must be placed directly after the DATA Deck in the order in which they are explained here.

FIGURE 9

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>83</td>
<td>FALSE</td>
<td></td>
</tr>
</tbody>
</table>

This card has six entries. The first tells the computer how many classes you have decided to break your data into (Fig. 1). You may group your data into any convenient and meaningful groupings, but you must not exceed ten groups and it is preferable to use as few as practical since the shadow-overprint distinctions become more difficult to interpret as the number of classes increase. This entry must be in Column 5 or it must be right, justified to (end in) Column 5. The next entry tells the computer which variable from the data card is to be mapped. Simply do as the computer must do to figure this out: skip the first nnX spaces and then start counting the variables as they are listed. The FORMAT statement in Figure 5 has 12 variables accounted for. This number must be right, justified to Column 15. The next entry on this card tells the computer the width of the map. In our sample in Figure 4 the width of the map is 30 columns. You must not exceed 131 columns. This number is to be right, justified to Column 20. The Logical variable tells the computer whether or not you want debugging information for the remainder of the mapping process. The
best choice here, of course, is for all messages to be printed. Hence, enter FALSE.

Columns 72-76 are to be used to enter the symbols to be used for the background of the map (that area not encased by your boundaries). In most cases it is undesirable to use any background since it generally confuses the interpretation of the shadow-overprint, therefore, it is usually wise to leave these areas blank. Columns 77-80 are to be used for the symbols which you wish to fill segments with no data reported. There are four spaces here should you wish to overprint the symbols. If you use only one symbol, a "." or an "n" for instance, it should occur in Column 77. This card then has the following appearance:

FIGURE 10

<p>| | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1</td>
<td>30</td>
<td>FALSE</td>
<td>nnnnnnnnn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Immediately after this card two title cards may be inserted. The information appearing on these cards will be printed above the map. If you do not require two title cards you must still supply blank cards to account for them in the program.

The next card lists the numerical value limits for your variables (the class limits in Figure 1). The first entry will be the lower limit and it must occur in Columns 1-10. Any variable lower than this number will receive the nnnn entry in Columns 77-80 as discussed for Figure 10. Columns 11-20, 21-30, and so on in groups of ten are to be used to list the upper limit for each class. If you have more than seven classes you will need two cards to complete the class definition, and it is appropriate here to begin the second card in Column 1 and continue as above.
The following figure is an example of how a class limit card may look.

**FIGURE 11**

| 1.0 | 5.0 | 10.0 | 20.0 | 30.0 | 40.0 | 50.0 |

The next group of cards, one for each class that you defined in the above card, gives the symbols to be printed for each group defined. If you specified the overprint option then each card will have up to four entries. The example in Figure 12 would be suggested for the grouping in Figure 11.

**FIGURE 12**

*  
++  
+++  
+=  
+=:  
+=:M

This arrangement, when overprinted, will give a progressively darker shading for the six areas claimed in Figure 11. There will be as many of these cards as there are classes.

Immediately following these cards there will be two sub-title cards which will be printed below the map. As with the super-titles you may print any information on these cards, in any columns, or they may be left blank.
All of the cards discussed thus far in this section must be repeated for each map desired.

The last four cards in the program are shown in Figure 13 below.

FIGURE 13

FALSEFALSE
-5
/*
//

The first card with two logical variables tells the computer whether or not there is to be a new DATA Deck read in. If FALSE then there is no new deck to be used and all maps on this run will use only the one deck. This entry is left, justified to Column 1. The second variable tells whether or not there is to be a new SCAN Deck read in. If FALSE there is no new deck. If TRUE then it is also assumed that there is to be a new DATA Deck (it is very rare indeed that you will have identical data for different geographical areas).

The remaining three cards are to be entered exactly as they appear here. They will stop the program and indicate to the computer that there is no more information to store for your program, and it can now process the data.
HAVING PROBLEMS?

As you read these directions you were undoubtedly confused, and you will probably remain confused until you have attempted to make a map run or two. Unfortunately, there is no easy way to explain or understand even a simple program such as CMAP.

If you have trouble in the initial running, as explained in this Guide, there are several sources of assistance open to you. If you are on the University of South Carolina Campus, you may call or visit the Department of Geography or the Institute of Archeology and Anthropology. Another available source of assistance is through the Computer Center at the University of South Carolina or at your nearby facility.

If you are interested in obtaining this program for use on your system, you may contact Mr. George Walters at the University of South Computer Services Center or contact the Department of Geography at the University.

As was noted in the early portion of this Guide, the best way to familiarize yourself with the computer is through an introductory text, or through Computer Science classes at any University or Technical School.
SOME ADVANTAGES OF COMPUTER DATA HANDLING

There are hundreds of programs available which are applicable to research problems in the Physical, Biological and Social Sciences. To an archeological research facility such as the Institute of Archeology, the promise is three-fold. First, we have access to a program which is easy to use and which allows us to save hundreds of man-hours in the making of distribution maps; secondly, after initiating the initial program, our data is in a form that is amenable to use with the Statistical Programs for the Social Sciences and the Statistical Analysis System Programs. These programs provide for a variety of statistical procedures including correlation, regression, cross-tabulation and the construction of graphs and tables. Finally, our data is in a form that is amenable to computer cataloging. This procedure has not yet been worked out for the Institute of Archeology and Anthropology, however, with its completion later this year, the cataloging system for artifact inventories will be shortened by months. There will be the added advantage of being able to recall our cataloged data in any cross-index form we desire.

The possibilities are unlimited.
APPENDIX A: USING THE KP-29 KEYPUNCH

In order to avoid errors and misunderstandings in setting up your program it is advisable to punch your own deck, or to at least be familiar with the IBM KP-29 Keypunch. This will allow you to correct any errors should you have someone else punch the deck for you.

A sample of the IBM FORTRAN Coding Form (GX28-7327-6 U/M 050) is shown in Figure 14. This form allows you to lay out your cards to be punched ahead of time, thus avoiding confusion at the machine.

The KP-29 Keypunch is quite similar to a typewriter in general appearance and the alphabetic characters are located on the same keys. However, there are a large number of special features which must be noted (see Figure 15).

Most important is the location of the numerals. These are located on the right side of the keyboard, and are typed onto the card by depressing the NUMERIC key on the left side of the keyboard. This key also causes the printing of the other special symbols on the other keys.

The keypunch is turned on by a switch located under the console table by the users right knee. When this switch is ON the keypunch is ready to use. The hopper on the right side of the machine must be loaded with cards, and the first of these should be Red since this will be the first card in the program. Be sure to empty the left hopper of any cards since this is where completed cards are stored.

There are six toggle switches on the console. Some of these should be ON and some OFF. Using Figure 15, we will proceed from left to right. The first switch is marked AUTO SKIP DUP and it should be ON. This will allow you to duplicate cards in the SCAN Deck (this will be explained
FIG. 15
THE IBM KP-29 CONSOLE
THE SHADED KEYS ARE FOR SPECIAL FUNCTIONS SUCH AS FEEDING AND RELEASING CARDS
shortly). The next switch marked ONE-TWO PROG SEL should be on ONE. The AUTO FEED switch should be ON. The PRINT switch should be ON, and the LZ PRINT switch should be down (not ON). The CLEAR switch is spring loaded and is used to clear cards from the print station and all other stations. This allows you to remove any erroneous cards immediately.

To move the first card into position, simply press the FEED key, and then press the REG key. The card may now be punched. Be sure you have moved the card to the proper column as noted on the drum index. When you have punched the card, press the REL key and the card will move to the next station and a new card will be loaded automatically (if the AUTO FEED switch is off it will be necessary to push the FEED key). Now push the REG switch and you're ready for the second card. If you should fail to push the REG switch, the keypunch will lock up. To correct this simply depress the ERROR RESET key on the left side of the machine.

When printing the SCAN deck you will often have to duplicate cards since several rows of the map will cross the same segment and will, therefore, contain the same information except for row number. To duplicate in this manner simply punch the first card of these to be duplicated, press the REL key, REGister the new card and then punch the appropriate row number in the first three columns. Now all you must do is punch the DUP key on the keyboard and the remainder of the card in station two will be duplicated onto the new card.

When you have punched all of your cards, simply lift the CLEAR switch and all of your cards will be placed into the hopper in the proper order for processing.
At the University of South Carolina, the keypunch facility is located in the basement of the Physical Sciences building. When you have punched the program the completed cards should be taken to the Job Window which is next door to the Keypunch Room.
APPENDIX B: USING THE SOUTH CAROLINA SCAN DECK

The CMAP Program provides for the use of the South Carolina State map by counties. This is the map shown in Figure 1. It is not necessary to supply a SCAN Deck for this map since it is stored on system at the University of South Carolina Computer Center and is specified as Deck Unit 8.

If you wish to use the South Carolina Deck there are certain items to note in the deck set-up. First, there are no changes necessary in the JCL/EXEC cards. Secondly, the accessory card described in the SCAN Deck section of this paper must have the number 8 appearing in the Deck Unit Column (column 20), and the number of SCAN lines entered on this card should be 50 (columns 4 and 5). Thirdly, the card immediately preceeding the FORMAT card of the data deck should have 46 (the number of counties in South Carolina and, hence, the number of segments of the map) entered in columns 4 and 5. Fourthly, the card immediately following the DATA Deck, the first card of the CLASS/END section, should have 90 entered as the map width in columns 19 and 20.

The DATA Deck is different also in that it does not use numbers to designate the row number as is normally done. Instead, the computer is programed to accept the variables for each county from cards designated with the counties initials as shown in Figure 16.

FIGURE 16

1. ABB  9. CAL  17. DIL  25. HAM  33. MCC  41. SAL
2. AIK 10. Cha  18. DOR  26. HOR  34. MAR  42. SPA
3. ALL 11. CHE  19. EDG  27. JAS  35. MAB  43. SUM
4. AND 12. CHS  20. FAI  28. KER  36. NEW  44. UNI
5. BAM 13. CHF  21. FLO  29. LAN  37. OCO  45. WIL
6. BAR 14. CLA  22. GEO  30. LAU  38. ORA  46. YOR
7. BEA 15. COL  23. GRV  31. LEE  39. PIC
8. BER 16. DAR  24. GRN  32. LEX  40. RIC
These designations are to be punched into the first three columns of each data card and must be given to the computer in the proper order.