GRAPHICS IN BUSINESS

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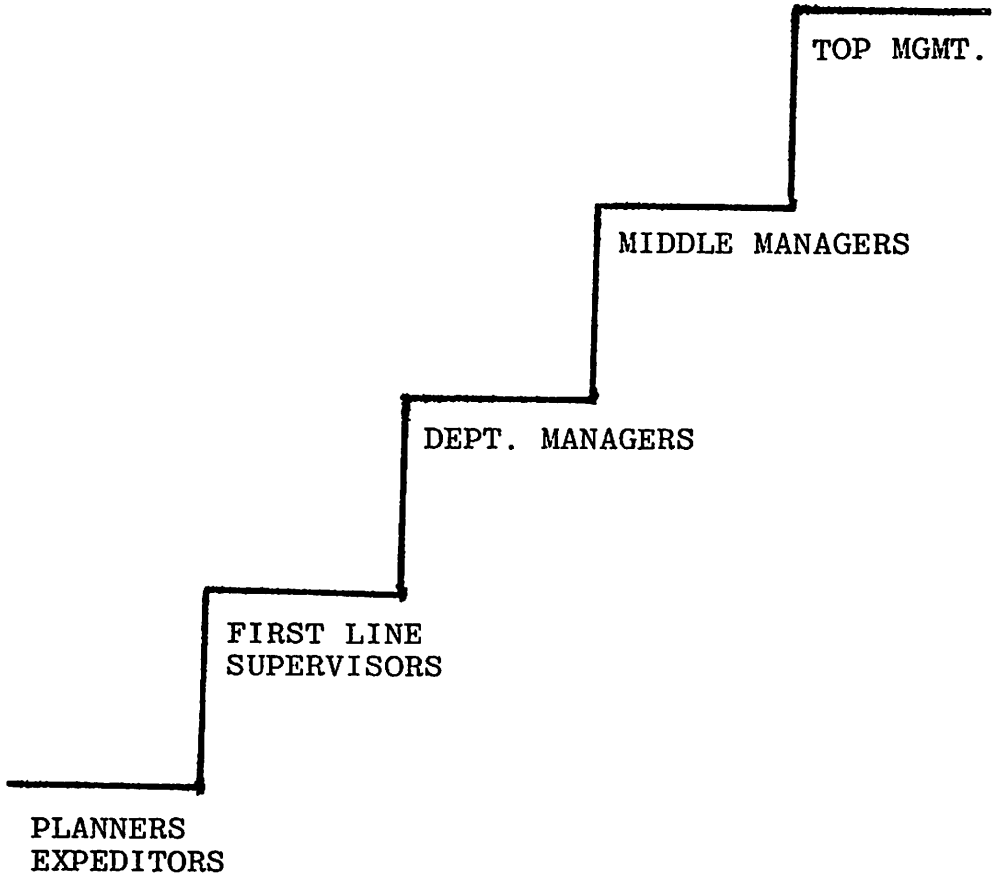
Although there is no graphics software language currently supported on the HP3000, many products are offered to give the 3000 user excellent business graphics capability. One of these products, the HP2648A, especially lends itself to business graphics because of the terminal oriented nature of the HP3000.

My purpose here is to explore some ways of applying graphics to business applications. In the past, graphics have been primarily used in scientific and engineering applications because graphics technology was developed for those kinds of jobs. The business data processing area is on the brink of a new era in data reporting through the use of graphics.

Looking at the users of information output from business systems, a hierarchy of job positions can be seen as shown in the following chart:



MANAGEMENT REPORTING

STAIRSTEPS

This hierarchy will be referred to throughout this presentation as possibilities for graphics applications are explored.

Of prime consideration for a planner/expeditor type person is "How is the output of my department doing with respect to schedule?". In the past, reports have been available to show at any given instant, what the schedule number of output units are versus actual output. Typically, there have been time lags between reported data and actual output data. These time lags make scheduling very difficult. In addition, data of this type ignores the time continuum needed to know where one stands with respect to remaining schedule and time.

With a simple graph, one can easily tell at a glance not only where one stands today but also over a time continuum. The fact that the output is coming from a terminal oriented system allows the user the ability of reporting this information on a "pseudo-real-time" basis, thus eliminating the confusing time lags between reported and actual.

Figure 1 would be a good example of a planner's tool from a batch type system. The planner should expect to get this type of information the day after the output actually takes place. The list would point out that 181 units were output as of the end of M-Day 13, but it

would not indicate how the production line is doing so far during the current day.

It may also be a good example of a planner's tool from an online system. In this case, the information would be much more timely and therefore much more useable. The information should be expected to be available at any hour of any M-Day, and should be expected to reflect output already finished during the current day.

Graph 1 shows this same planner's tool graphically. Note that not only does the graph indicate production to date, but also gives an excellent trend line to let the planner know what needs to be done between now and the end of the production period. It answers questions like, "Do I need to recommend overtime to management", or "Do I have a problem with material flow?".

Notice also, that during the current day an indication is given as to whether the ahead/behind trend is being impacted by the current day's production. This indication is given by the slope of the graph line during the current day.

While this type of detail information is important to the planner, the first level supervision may well be more interested in more long-term type information. Again the same progression of data reporting can be seen at this level. Figure 2 is an example of year to date type information. The same kind of "timely information" parameters

apply to this reporting level.

In addition, some modelling is in order at this level to indicate to management what the year end production will be if projected at current production levels. There are a number of good forecasting methods which may be used to extend the production line out through the end of the year or beyond. This kind of information is essential for good manpower planning and for good material control.

Another topic of great importance to first line supervision and also to department managers is that of productivity. One measure of productivity is "dollars per manhour". The method I've chosen to work with here is number of dollars transferred from a production department versus the amound of labor applied. Going back to our earlier example, I've applied an arbitrary price to the units in the graph. In addition, I've established an arbitrary standard time for producing one of the units. This new data is represented in chart form in figure 3. Although this is a very simplified example of productivity measurement, the following conclusion can easily be reached: Data of this type can be understood much more simply and easily when it is presented graphically. Again, the graph which results from this data shows a trend over a time continuum. This trend cannot be readily gleaned from the same data presented in the traditional columnar form.

Efficiency is another topic of importance to management at this level. Efficiency is derived by comparing actual time spent on a unit to a predetermined standard time. Efficiency is usually shown as a percentage, which is easily understood as a number and does not need to be depicted graphically. But managing efficiency cannot be accomplished by a snapshot of any one particular time period. Here again, a group of percentages spread over time is needed to spot trends. With a computer, the current day's efficiency can be reported with respect to past days, and probably more important, a moving average can be derived and displayed quickly. This kind of information is very useful for spotting trends in efficiency to enable management to be responsive to developing problems. Figure 4 shows data of this type.

Middle and top level management are interested in more long-term information. Managers at this level are interested in topics like "What are my projected sales over the next 24 months?" or "How is my business doing compared to others in this industry?". Using forecasting algorithms, the computer can easily be made to project future trends based upon past performance and expected future trends in the market place. Adding graphics to these projections produces a pictoral view of future trends, making the data very easy to understand. The

whole idea of making projections (modelling) is to enable management to set a direction for future business. Questions about manpower, material, and financial requirements can be answered in this manner. It is incumbent upon data processing systems to report this information in any easy to understand and readily useable form. Graphics capabilities make this requirement easy to fulfill.

Figure 5 is an example of forecasted sales in the form one might expect to see from conventional systems. The corresponding graph makes the data much more digestable and easier to comprehend at a glance.

Figure 6 is an example of trend analysis. This type of data answers the question about how my business is doing with respect to the rest of the industry. Industry data is available from Dunn and Bradstreet or the Securities and Exchange Commission. A manager can place his company in perspective over time to see how the company is performing and whether the performance is improving or degrading over time.

To this point we've looked at reporting to all five levels of management through the use of linear graphs. A short mention should be given to the ease of generating these graphs on an HP2648. The fact is that the HP2648 has an autoplot function imbedded in firmware within

the terminal. The autoplot function is complete with a menu to describe the X and Y axes. Once the axes are described, the terminal will draw the graph, with tic marks and an optional grid. Data for the graph can be obtained either from the display or from the HP3000. With this versatility, linear graphs become very easy to generate.

The next area of importance to business graphics is generating other types of general purpose report forms. One example of this type of report is a pie chart. Unlike linear graphs, there is no firmware driven menu to generate a pie chart. However, with a little imagination, a simple program can be written to accomplish this feat. Appendix 1 to this report is a source listing of a Fortran program which generates a pie chart. Going through the program, one can see that the terminal graphics are controlled through the use of "escape sequences". The sequences are easily edited into a source program or data file through the use of the editor. This program is included here to demonstrate the relative ease of generating business graphics, and is intended to stimulate the imagination.

Over the past few years, the data processing industry has seen a migration of trends. From batch systems to interactive systems; from main frame processing

to distributed processing. The industry has also seen a shift in the way people think about computers. The computer is losing its' shroud of mystery and is becoming a tool to aid businessmen accomplish goals and plan for the future. Data reporting through graphics is a natural extension to these trends and opens a whole new methodology for data reporting.

FIGURE 1

NOV. '78 ABC PRODUCTION TOTAL SCHEDULE: 330

M-DAY	SCHEDULED	CUM.	ACTUAL	CUM. OUT
1	15	15	14	14
2	15	30	18	32
3	15	45	13	45
4	15	60	12	57
5	15	75	15	72
6	15	90	8	80
7	15	105	10	90
8	15	120	8	98
9	15	135	10	108
10	15	150	5	113
11	15	165	14	127
12	15	180	16	143
13	15	195	8	151
14	15	210		
15	15	225		
16	15	240		
17	15	255		
18	15	270		
19	15	285		
20	15	300		
21	15	315		
22	15	330		

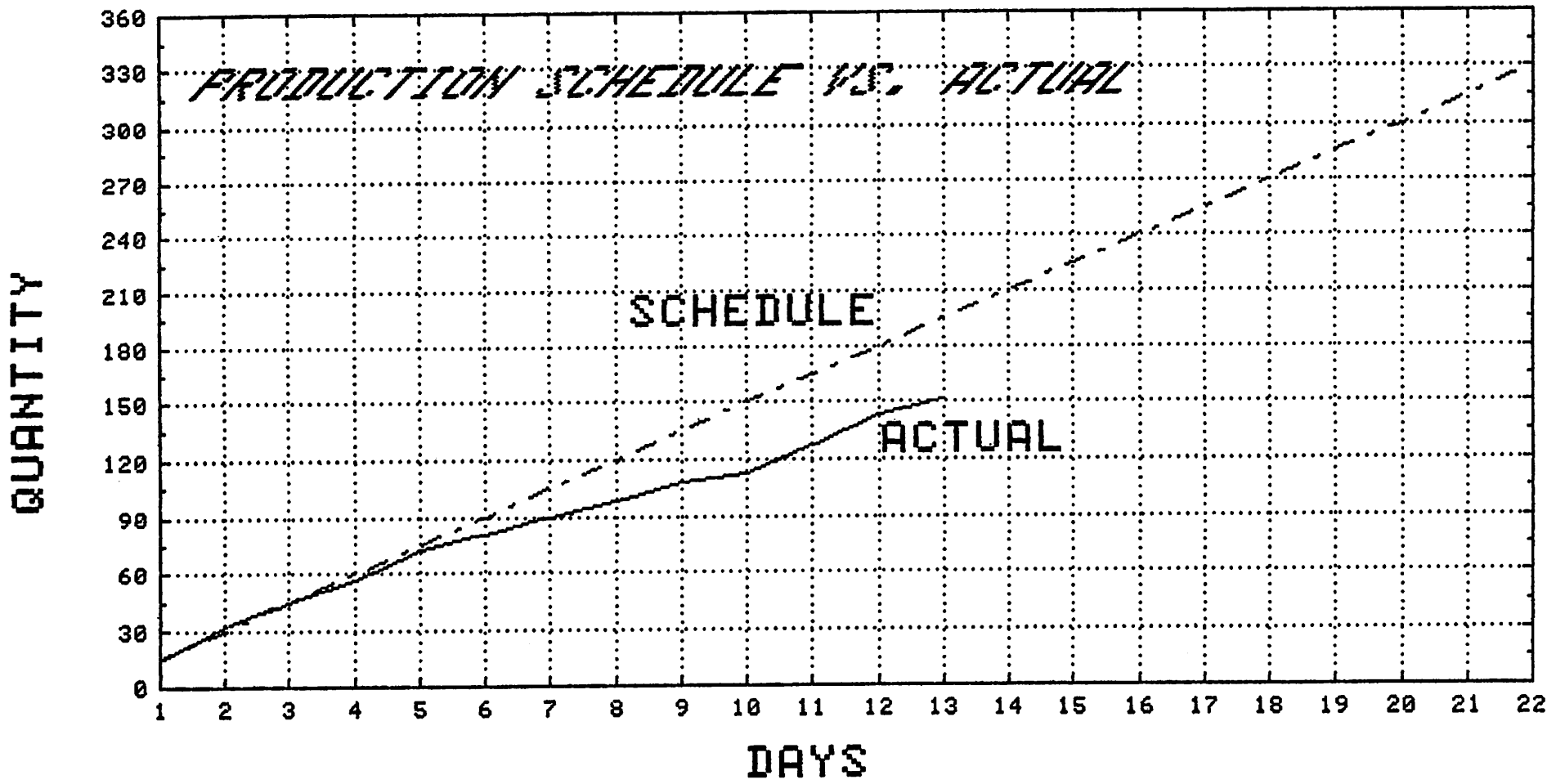

PRODUCTION SCHEDULE VS. ACTUAL
SCHEDULE
ACTUAL
QUANTITY
DAYS
0
30
60
90
120
150
180
210
240
270
300
330
360
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

FIGURE 2

1978 ABC PRODUCTION TOTAL SCHEDULE: 3960

MONTH	SCHEDULED	CUM.	ACTUAL	CUM. OUT
1	330	330	325	325
2	330	660	340	665
3	330	990	298	963
4	330	1320	308	1271
5	330	1650	240	1511
6	330	1980	290	1801
7	330	2310	270	2071
8	330	2640	310	2381
9	330	2970	288	2669
10	330	3300		
11	330	3630		
12	330	3960		

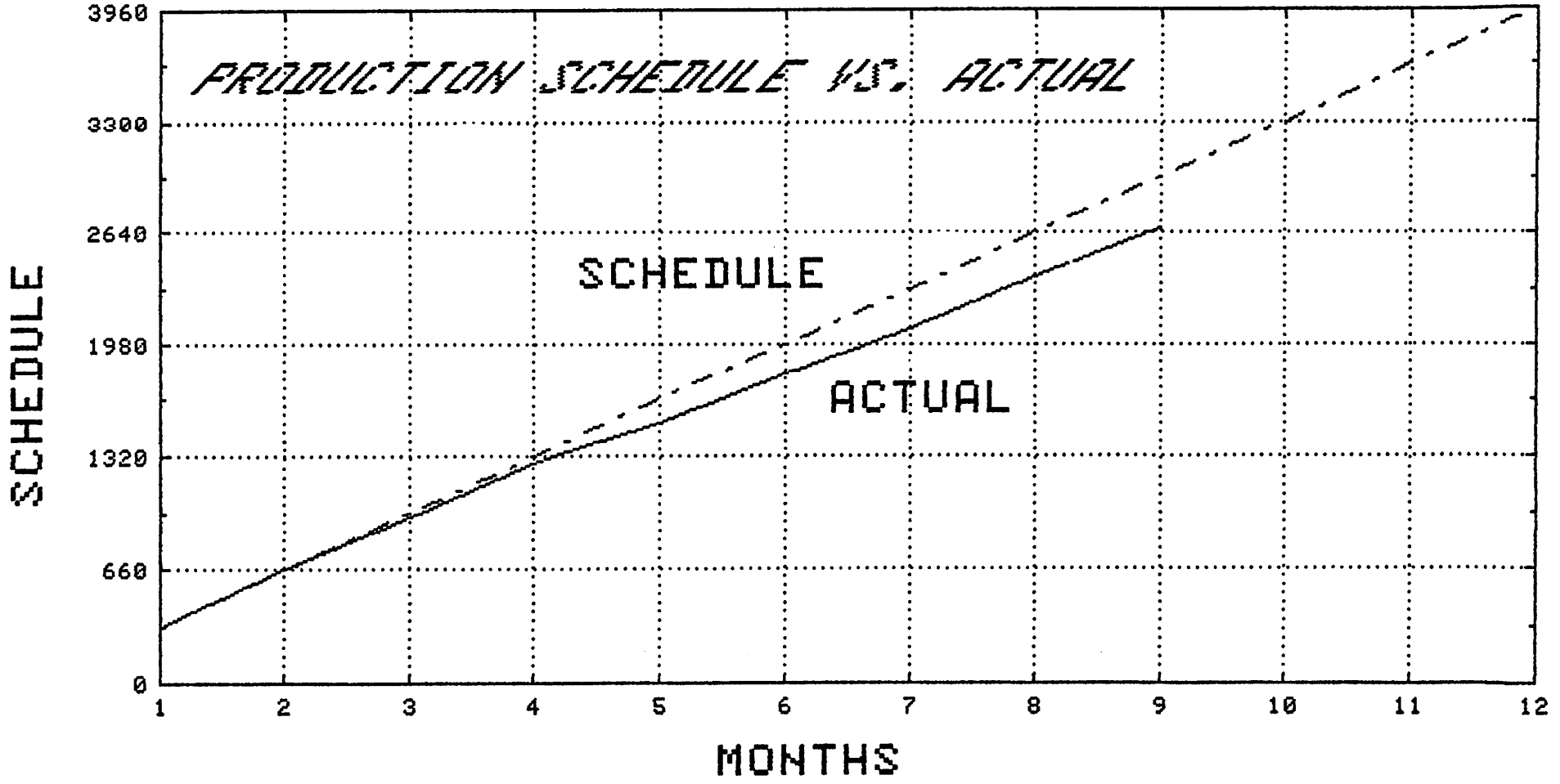

PRODUCTION SCHEDULE VS. ACTUAL
SCHEDULE
ACTUAL
SCHEDULE
MONTHS
3960
3300
2640
1980
1320
660
0
1
2
3
4
5
6
7
8
9
10
11
12

FIGURE 3

STANDARD COST PER UNIT: $200.00

STANDARD TIME PER UNIT: 7.5 HOURS

MONTH	SCHEDULED OUTPUT	ACTUAL OUTPUT	STD. TIME APPLIED	ACTUAL TIME APPLIED	STD. $ OUT	ACTUAL $ OUT	STD. $/ HOUR	ACTUAL $/ HOUR
1	330	325	2475	2480	66000	65000	26.67	26.2
2	330	340	2475	2510	66000	68000	26.67	27.1
3	330	298	2475	2540	66000	59600	26.67	23.5
4	330	308	2475	2540	66000	61600	26.67	24.3
5	330	240	2475	2470	66000	48000	26.67	19.4
6	330	290	2475	2462	66000	58000	26.67	23.6
7	330	270	2475	2470	66000	54000	26.67	21.9
8	330	310	2475	2520	66000	62000	26.67	24.6
9	330	288	2475	2536	66000	57600	26.67	22.7
10	330		2475		66000		26.67	
11	330		2475		66000		26.67	
12	330		2475		66000		26.67	

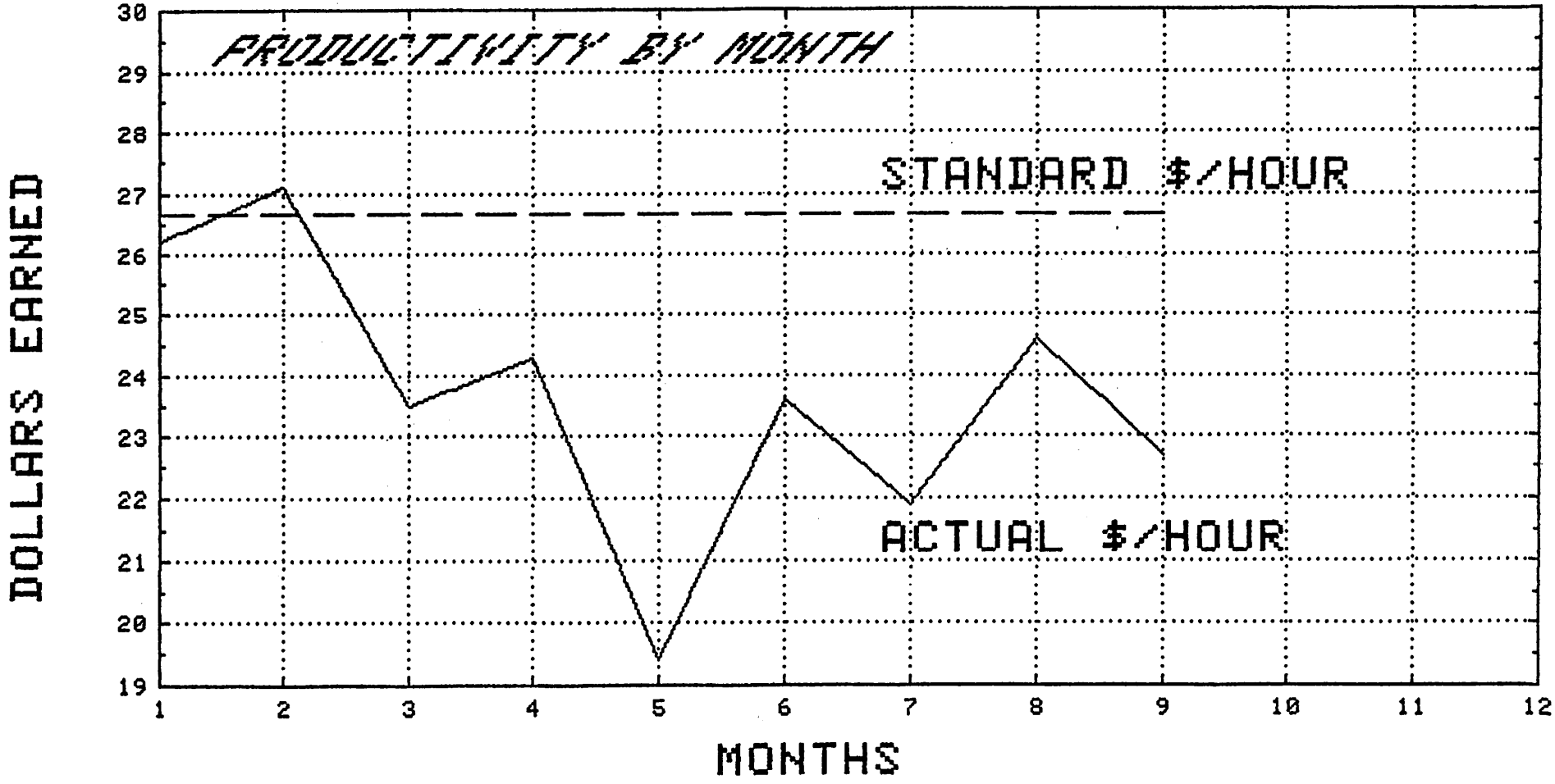

PRODUCTIVITY BY MONTH
STANDARD $/HOUR
ACTUAL $/HOUR
DOLLARS EARNED
MONTHS
30
29
28
27
26
25
24
23
22
21
20
19
1
2
3
4
5
6
7
8
9
10
11
12

FIGURE 4

NOV. '78 ABC EFFICIENCY

M-DAY	HOURS EXPENDED	HOURS EARNED	% EFFICIENCY	MOVING AVERAGE
1	104	105	100.9	100.9
2	112	135	120.5	111.1
3	108	98	90.7	101.2
4	102	90	88.2	100.4
5	112	112	100.0	100.3
6	88	60	68.2	95.8
7	80	75	93.8	95.6
8	88	60	68.2	92.6
9	88	75	85.2	91.8
10	48	38	79.2	91.2
11	104	105	100.9	92.2
12	108	120	111.1	94.0
13	72	60	83.3	93.3
14				
15				
16				
17				
18				
19				
20				
21				
22				

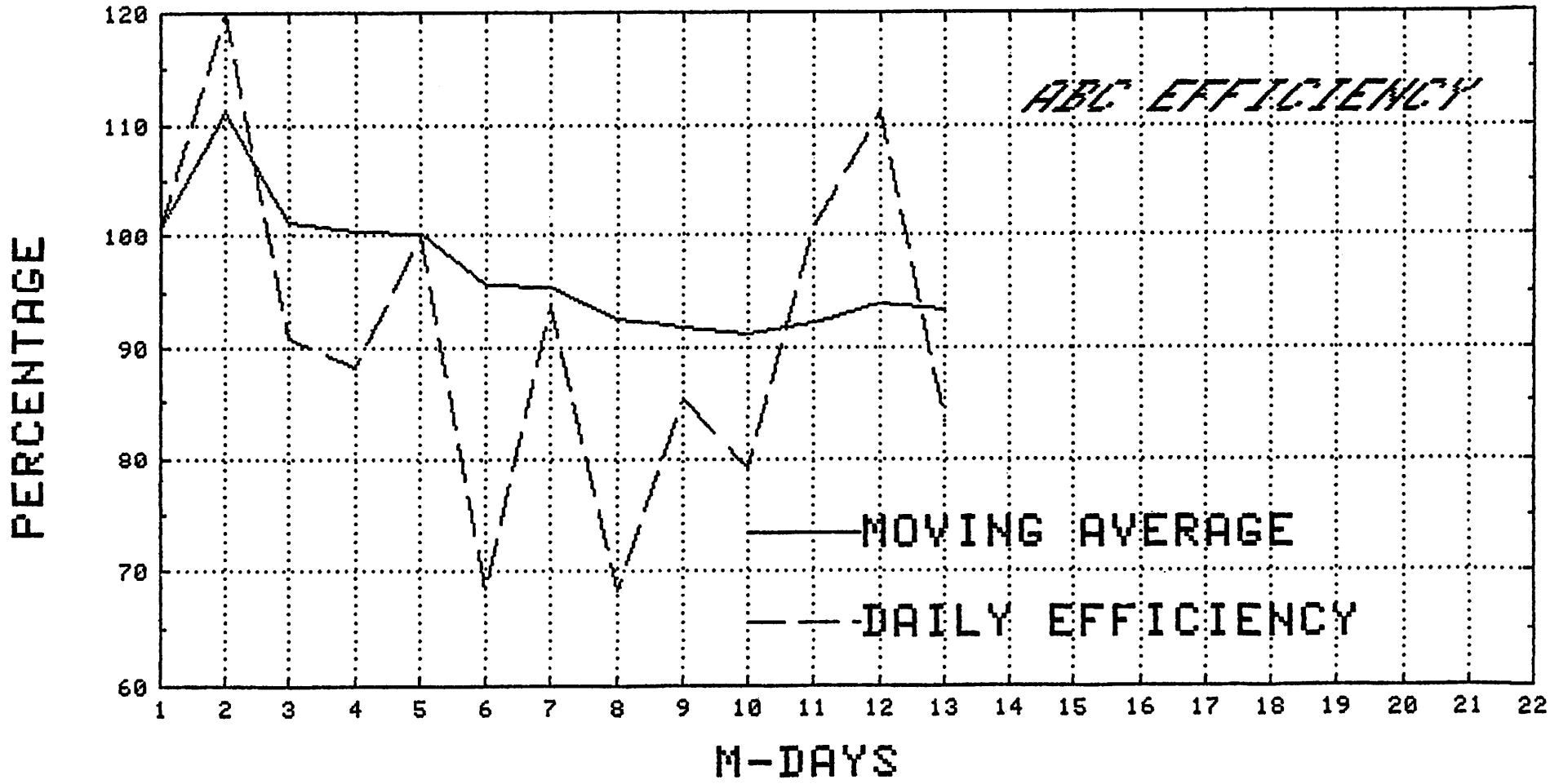

ABC EFFICIENCY
PERCENTAGE
M-DAYS
MOVING AVERAGE
DAILY EFFICIENCY
120
110
100
90
80
70
60
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

FIGURE 5

FORECASTED SALES AS A FUNCTION OF INVENTORY

YEAR	SALES	INVENTORY
1973	50,000	22,000
1974	100,000	24,000
1975	150,000	26,000
1976	200,000	28,000
1977	250,000	30,000
1978	300,000	32,000
1979	350,000	34,000
1980	400,000	36,000
1981	450,000	38,000
1982	500,000	40,000

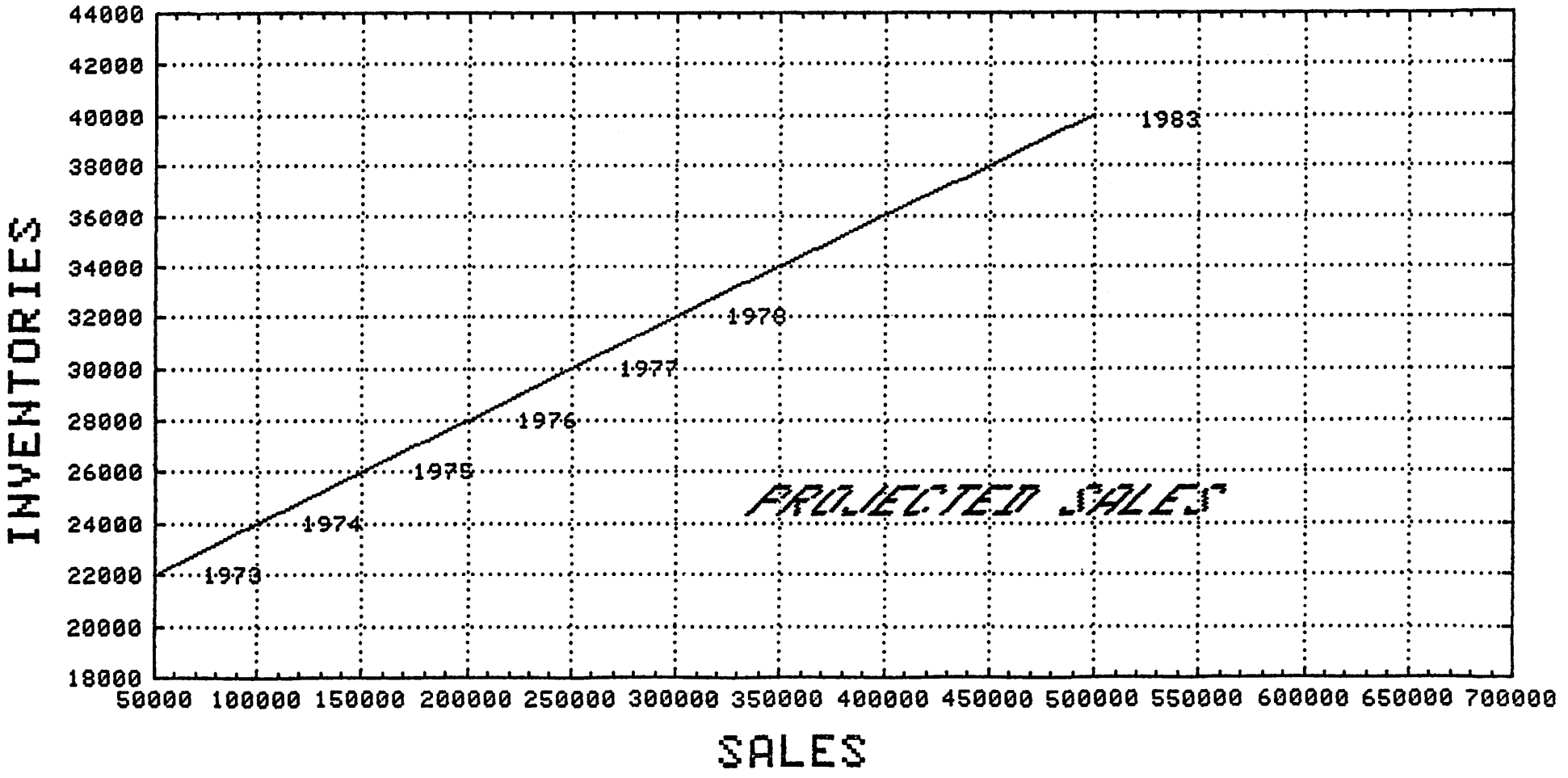
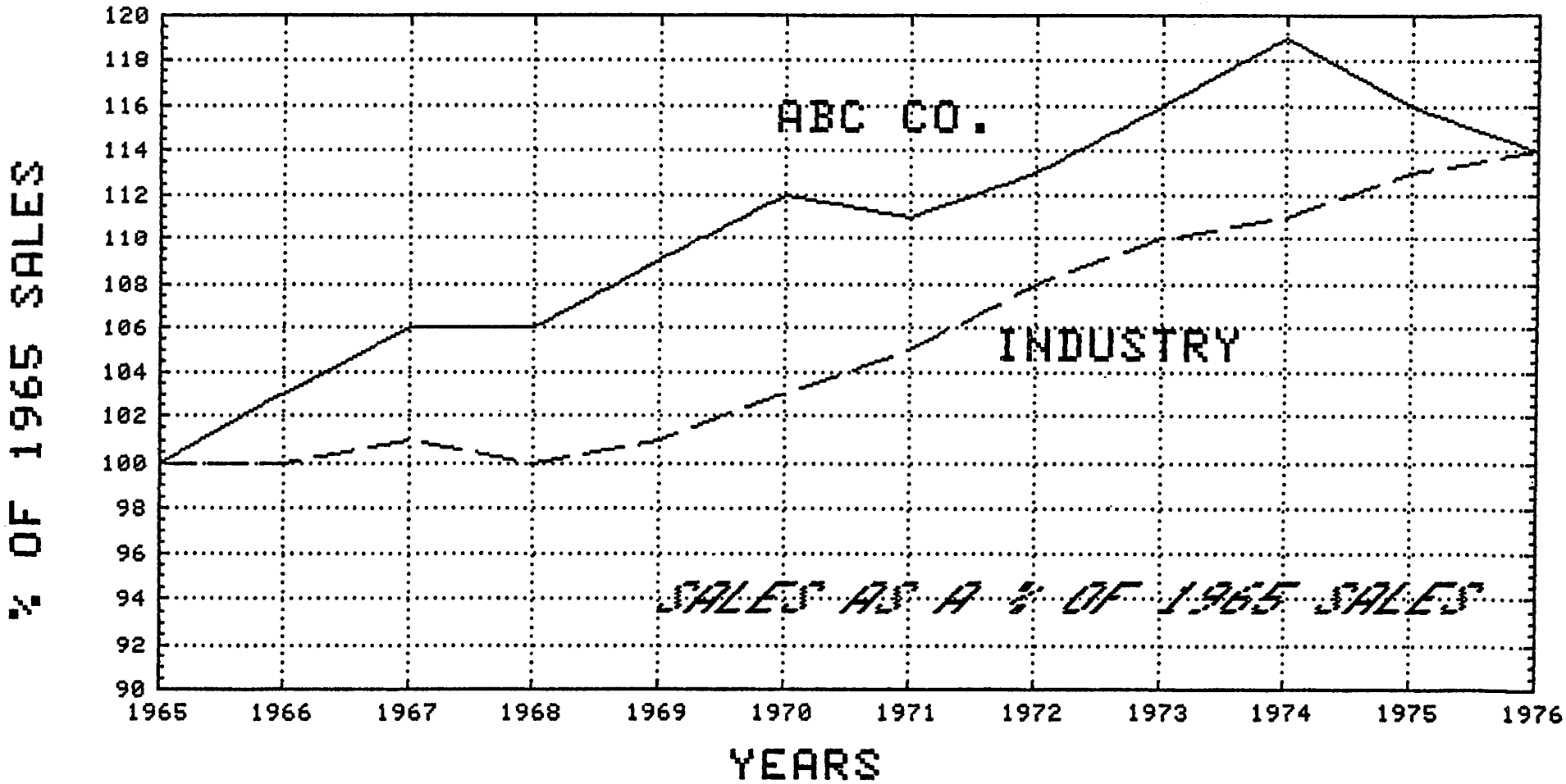
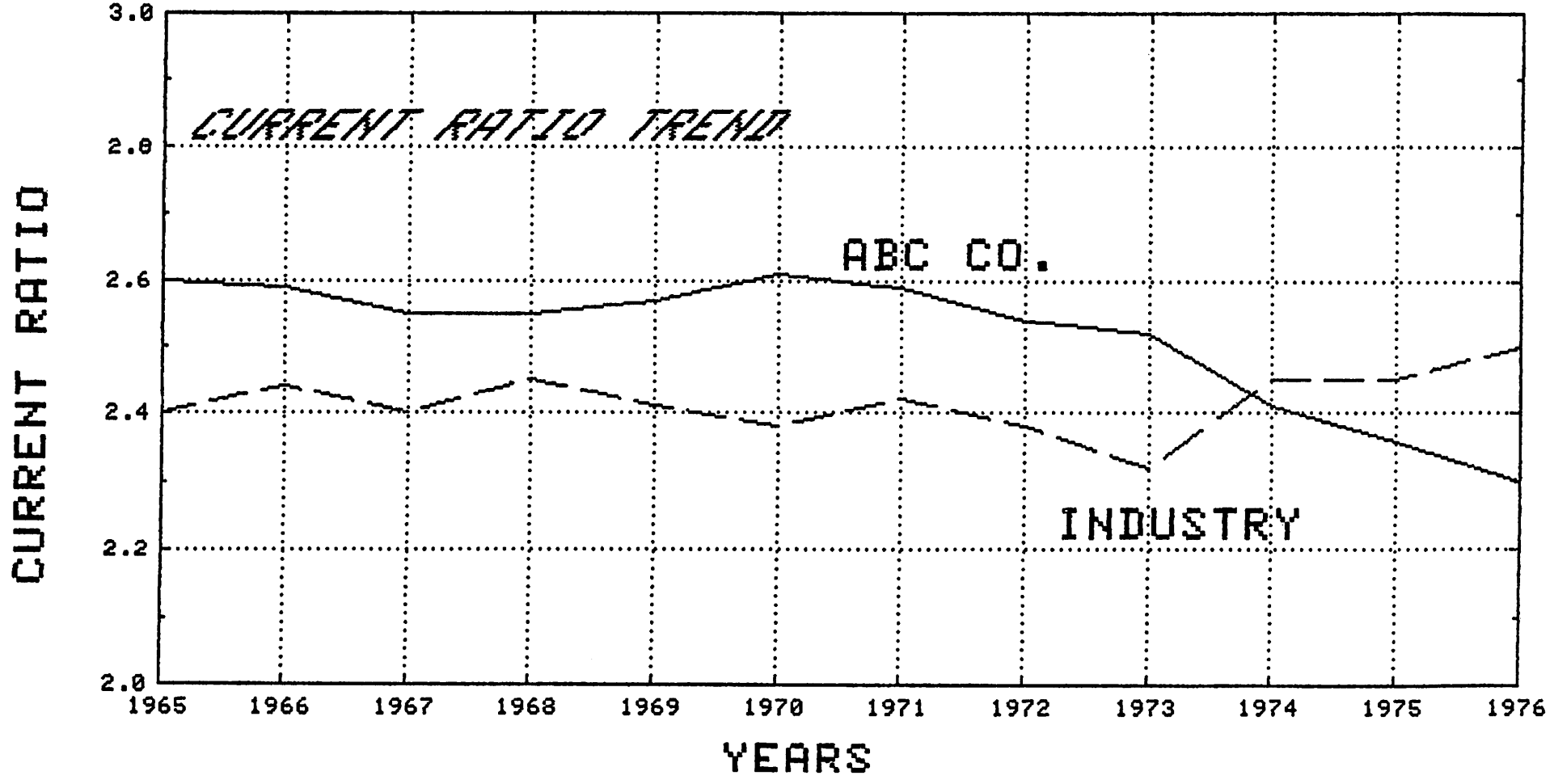

INVENTORIES
SALES
44000
42000
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
50000
100000
150000
200000
250000
300000
350000
400000
450000
500000
550000
600000
650000
700000
1973
1974
1975
1976
1977
1978
1983
PROJECTED SALES

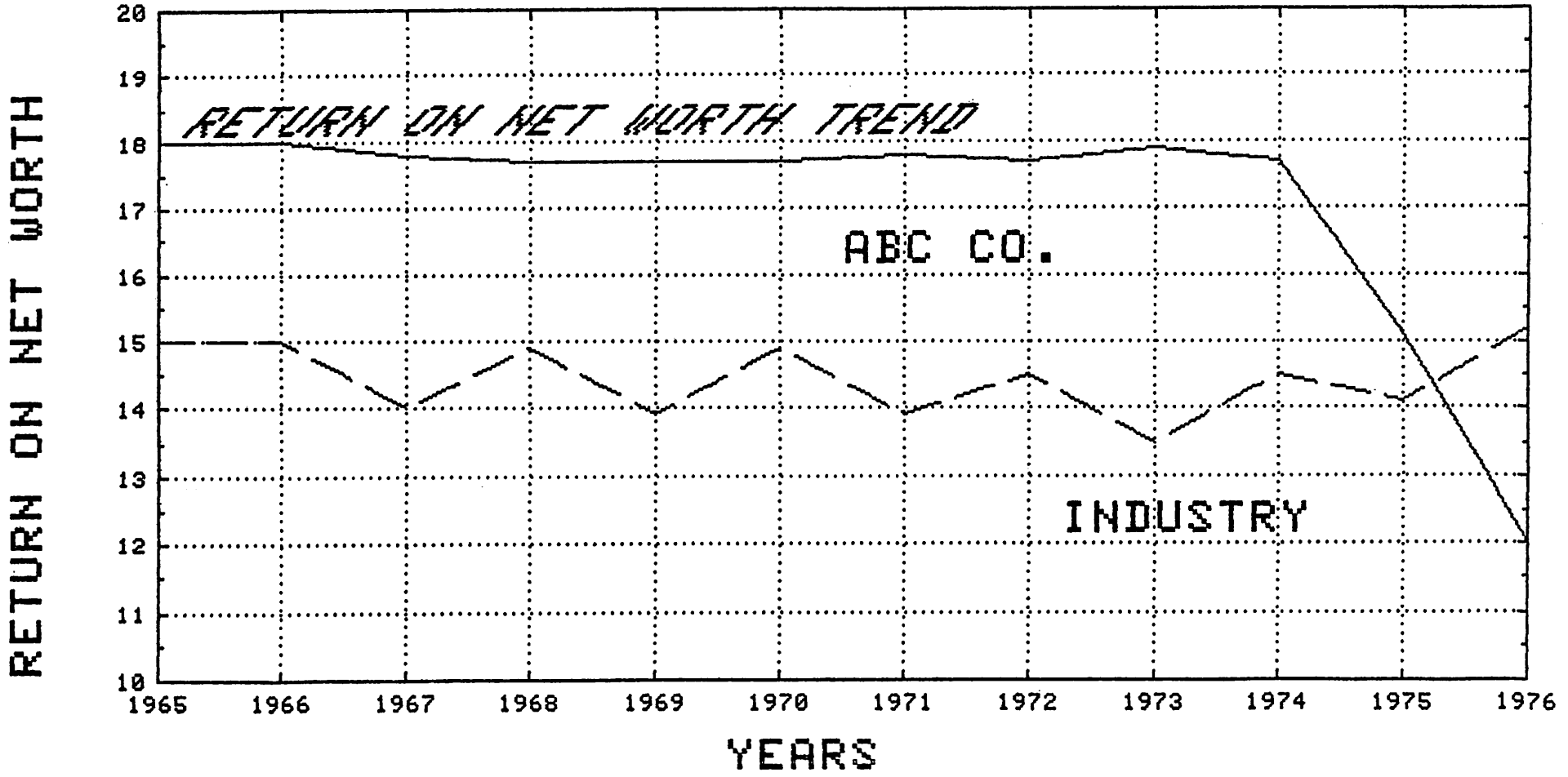
FIGURE 6

TREND ANALYSIS

	Sales as a % of 1965 Sales		Current Ratio		Return on Net Worth	
	ABC	INDUSTRY	ABC	INDUSTRY	ABC	INDUSTRY
1965	100	100	2.60	2.40	18.0	15.0
1966	103	100	2.59	2.44	18.0	15.0
1967	106	101	2.55	2.40	17.8	14.0
1968	106	100	2.55	2.45	17.7	14.9
1967	109	101	2.57	2.41	17.7	13.9
1970	112	103	2.61	2.38	17.7	14.9
1971	111	105	2.59	2.42	17.8	13.9
1972	113	108	2.54	2.38	17.7	14.5
1973	116	110	2.52	2.32	17.9	13.5
1974	119	111	2.41	2.45	17.9	14.5
1975	116	113	2.36	2.45	15.1	14.1
1976	114	114	2.30	2.50	12.0	15.2
1977						

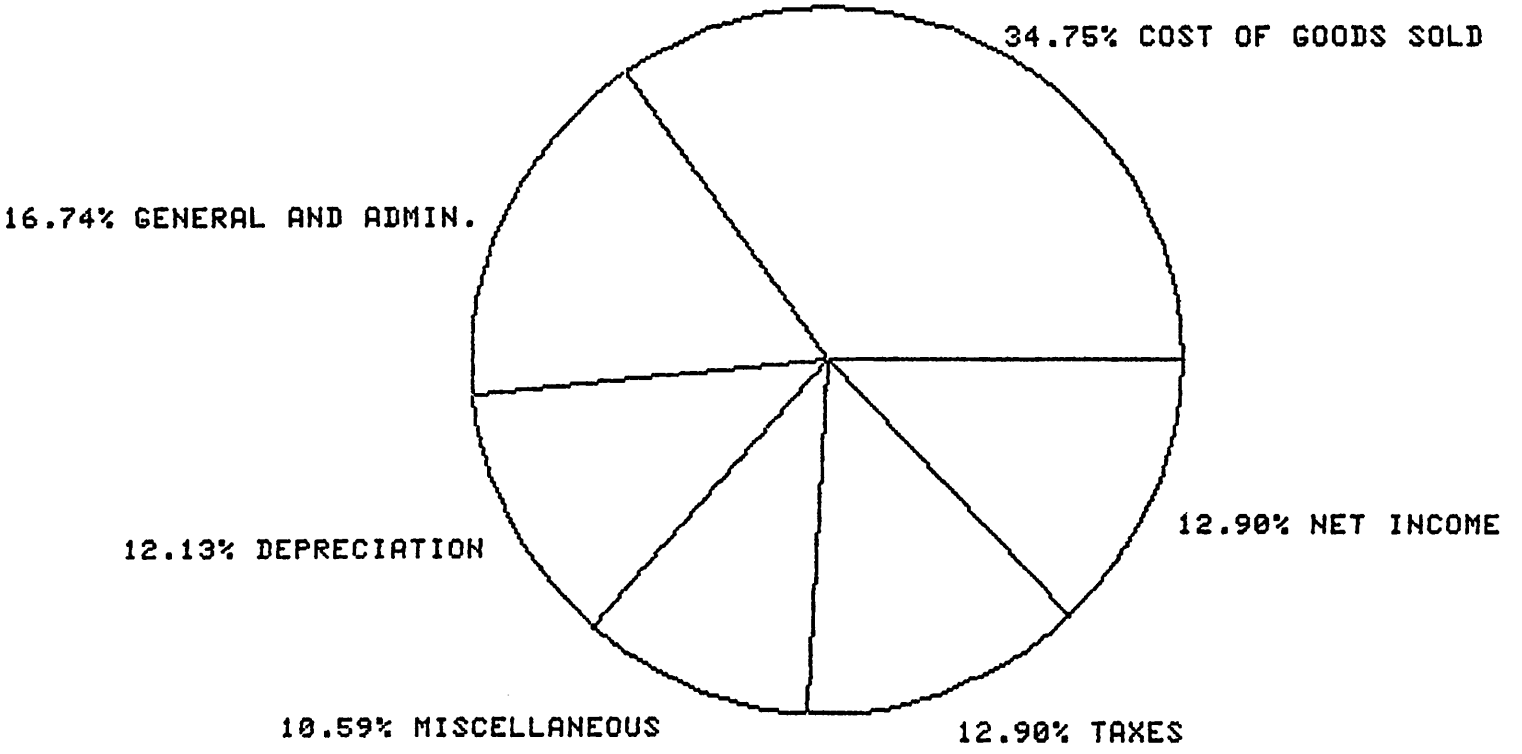

ABC CO.
INDUSTRY
SALES AS A % OF 1965 SALES
% OF 1965 SALES
YEARS
120
118
116
114
112
110
108
106
104
102
100
98
96
94
92
90
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976


CURRENT RATIO TREND
ABC CO.
INDUSTRY
CURRENT RATIO
YEARS
3.0
2.8
2.6
2.4
2.2
2.0
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976


RETURN ON NET WORTH TREND
ABC CO.
INDUSTRY
RETURN ON NET WORTH
YEARS
20
19
18
17
16
15
14
13
12
11
10
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976

HP3000
GRAPHICS

DOLLAR DISTRIBUTION



MON, OCT 30, 1978, 3:54 PM

APPENDIX 1

```
L 1/50
$CONTROL USLINIT
      PROGRAM PIE
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCC
CCC
C       THIS PROGRAM GENERATES A PIE CHART FROM DEFAULT DATA
C       HARDCODED IN THE PROGRAM, OR FROM DATA INPUT FROM THE
C       OPERATOR'S TERMINAL.
C
C       WRITTEN:    OCTOBER, 1978
C                   DEVELOPED FOR SSR'S CONTRIBUTION TO THE
C                    HP3000 USER'S GROUP IN DENVER, COLORADO.
C
C                   PAUL COOPER
C                   SYSTEMS ENGINEER
C                   HEWLETT PACKARD COMPANY
C                   TULSA, OKLAHOMA
C                   (918) 665-3300
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      SYSTEM INTRINSIC DATELINE
      CHARACTER*8 HP,GR
      CHARACTER*2 IYES,IBLK1
      CHARACTER*20 LAB(11)
      DIMENSION IDUMY(10,11)
      CHARACTER*27 DATE
      DIMENSION NUMCHARS(11),POSLAB(11)
      DIMENSION VALUES(11),ANGLE(11),IBLK2(1),PERCT(11)
      CHARACTER*5 CLEAR,SIZE1,SIZE2
      CHARACTER*4 INIT,GRTXON,GRTXOF,ALPOF
      CHARACTER*5 COMP
      REAL THETA,RAD
      EQUIVALENCE (IDUMY,LAB)
      EQUIVALENCE (IBLK1,IBLK2)
CCC
C  BEGIN NOW TO INITIALIZE CHARACTER STRINGS AND VARIABLES.
C
      HP=" HP3000 "
      GR="GRAPHICS"
      ALPOF="␛*dF"
      IBLK1="  "
      LAB(1)="DOLLAR DISTRIBUTION "
      LAB(2)="COST OF GOODS SOLD  "
      LAB(3)="GENERAL AND ADMIN.  "
      LAB(4)="DEPRECIATION        "
      LAB(5)="MISCELLANEOUS       "
      LAB(6)="TAXES               "
      LAB(7)="NET INCOME          "
      LAB(8)="                    "
      LAB(9)="                    "
```

```
L51/100
   51            LAB(10)="                              "
   52            LAB(11)="                              "
   53            VALUES(1)=2210.
   54            VALUES(2)=768.
   55            VALUES(3)=370.
   56            VALUES(4)=268.
   57            VALUES(5)=234.
   58            VALUES(6)=285.
   59            VALUES(7)=285.
   60            VALUES(8)=0.
   61            VALUES(9)=0.
   62            VALUES(10)=0.
   63            VALUES(11)=0.
   64            CLEAR="E*daZ"
   65            INIT="E*mR"
   66            COMP="E*m3A"
   67            SIZE1="E*m1M"
   68            SIZE2="E*m2M"
   69            GRTXON="E*dS"
   70            GRTXOF="E*dT"
   71      CCC
   72      C
   73      C  THE NEXT TWO VARIABLES ARE THE X AND Y CENTER OF THE PIE
   74      C
   75            IXCTR=360
   76            IYCTR=180
   77            RAD=130.
   78            RRAD=140.
   79            INUM=6
   80      CCC
   81      C  INITIALIZE TERMINAL AND SET COMPLIMENT MODE.
   82      C
   83            WRITE(6,1)CLEAR,INIT,COMP
   84       1    FORMAT(1X,3(A5))
   85      CCC
   86      C  PROMPT OPERATOR FOR VALUE OVERRIDE
   87      C
   88            WRITE(6,21)
   89      21    FORMAT(1X,"VALUES FOR SALES, COSTS, ETC. WILL BE DEFAULTED")
   90            WRITE(6,22)
   91      22    FORMAT(1X,"DO YOU WANT TO OVERRIDE THESE DEFAULTS?")
   92            READ(5,23)IYES
   93      23    FORMAT(A2)
   94            IF(IYES.NE."YE")GO TO 25
   95      CCC
   96      C    IF WE'RE HERE WE NEED NEW LABELS FOR THE PIE CHART
   97      C    AS WELL AS NEW NUMBERS FOR THE SUBPARTS (PIECES).
   98      C
   99            DISPLAY "INPUT THE LABELS PROMPTED FOR:"
  100            DO 49 I=1,11
/D
```

```
L101/150
  101             LAB(I)="                              "
  102       49    VALUES(I)=0.
  103       50    FORMAT(A20)
  104       91    DISPLAY "INPUT NUMBER OF PIECES IN WHOLE"
  105             DISPLAY "(NOT MORE THAN 10)"
  106             READ(5,*)INUM
  107             IF(INUM.LE.10)GO TO 90
  108             DISPLAY "GIMME A BREAK!  THE NUMBER CAN'T BE MORE THAN 10"
  109             GO TO 91
  110       90    WRITE(6,53)
  111       53    FORMAT(" INPUT TITLE FOR PIE CHART:")
  112             READ(5,50)LAB(1)
  113             DO 60 I=2,INUM+1
  114             JJ=I-1
  115             WRITE(6,51)JJ
  116       51    FORMAT(/," INPUT CHARACTER STRING FOR LABEL",I3,":  ")
  117             READ(5,50)LAB(I)
  118             WRITE(6,52)JJ
  119       52    FORMAT(/," INPUT VALUE FOR LABEL",I3,":  ")
  120             READ(5,*)VALUES(I)
  121       60    CONTINUE
  122             DO 61 I=2,INUM+1
  123       61    VALUES(1)=VALUES(1)+VALUES(I)
  124       CCC
  125       C  FIND OUT THE # OF CHARACTERS IN EACH LABEL
  126       C
  127       25    DO 110 I=1,11
  128             ICNT=0
  129             DO 109 J=1,10
  130             IF(IDUMY(J,I).EQ.IBLK2(1))ICNT=1
  131             IF(ICNT.EQ.0)GO TO 109
  132             NUMCHARS(I)=J-1
  133             GO TO 110
  134       109   CONTINUE
  135             NUMCHARS(I)=10
  136       110   CONTINUE
  137       CCC
  138       C  COMPUTE THE ANGLES FOR THE PIE CUTS HERE.
  139       C  THE FORMULA IS THE RATIO X IS TO 360 AS PART IS TO TOTAL.
  140       C
  141             ANGLE(1)=0.
  142             DO 28 I=2,INUM+1
  143             ANGLE(I)=(360*VALUES(I))/VALUES(1)+ANGLE(I-1)
  144             POSLAB(I)=((ANGLE(I)-ANGLE(I-1))/2)+ANGLE(I-1)
  145             PERCT(I)=(VALUES(I)*100)/VALUES(1)
  146       28    CONTINUE
  147       CCC
  148       C  DRAW THE CIRCLE USING POLAR COORDINATES!
  149       C
  150             DISPLAY " Eh EJ"
/E
```

```
L151/200
  151            WRITE(6,2)
  152       2    FORMAT(1X,"*pa")
  153            DO 4 I=0,360,5
  154            THETA=I/57.295779
  155            IX=IXCTR+RAD*COS(THETA)
  156            IY=IYCTR+RAD*SIN(THETA)
  157            WRITE(6,3)IX,IY
  158       3    FORMAT(1H+,I4,1X,I4," ")
  159       4    CONTINUE
  160      CCC
  161      C
  162      C  COMPUTE AND DRAW THE PIE CUTS FOR THE VALUES
  163      C
  164            DO 35 I=1,INUM
  165            THETA=ANGLE(I)/57.295779
  166            IX=IXCTR+RAD*COS(THETA)
  167            IY=IYCTR+RAD*SIN(THETA)
  168      C
  169      C DRAW THE PIE CUT
  170      C
  171            WRITE(6,31)IXCTR,IYCTR,IX,IY
  172      31    FORMAT(1X,"*pa",I4,","I4," ",I4,",",I4,"Z")
  173      35    CONTINUE
  174      CCC
  175      C  DRAW LABELS
  176      C
  177            WRITE(6,204)GRTXON
  178            DO 200 I=2,INUM+1
  179            THETA=POSLAB(I)/57.295779
  180            IX=IXCTR+RRAD*COS(THETA)
  181            IY=IYCTR+RRAD*SIN(THETA)
  182      CCC
  183      C  POSITION THE PEN
  184      C
  185            WRITE(6,203)IX,IY
  186            IF(POSLAB(I).LE.90.OR.POSLAB(I).GE.270)WRITE(6,201)
  187            IF(POSLAB(I).GT.90.AND.POSLAB(I).LT.270)WRITE(6,202)
  188      201   FORMAT(1H+,"*m1Q")
  189      202   FORMAT(1H+,"*m7Q")
  190            KK=NUMCHARS(I)
  191      200   WRITE(6,205)PERCT(I),(IDUMY(J,I),J=1,KK)
  192      205   FORMAT(1X,"*1",F5.2,"%",1X,10A2)
  193      204   FORMAT(1H+,A4)
  194      203   FORMAT(1H+,"*pa",I3,",",I3,"Z")
  195            CALL DATELINE(DATE)
  196            IX=360
  197            IY=10
  198            WRITE(6,203)IX,IY
  199            WRITE(6,207)SIZE2
  200      207   FORMAT(1X,A5)
/D
```

```
   L201/LAST
   201              WRITE(6,208)
   202      208     FORMAT(1H+,"*m4Q")
   203              WRITE(6,206)DATE
   204              IY=339
   205              WRITE(6,203)IX,IY
   206              J=1
   207              KK=NUMCHARS(1)
   208              WRITE(6,209)(IDUMY(I,J),I=1,KK)
   209      209     FORMAT(1X,"*1",10A2)
   210      206     FORMAT(1H+,"*1",A27)
   211              IX=61
   212              WRITE(6,203)IX,IY
   213              WRITE(6,301)HP
   214              WRITE(6,301)GR
   215      301     FORMAT(1H+,"*1",A8,/)
   216              WRITE(6,204)GRTXOF
   217              DISPLAY " h*dF"
   218              STOP
   219              END
/EZ
```