THE V.R. SOFTWARE PROGRAM: COMPUTING YEARLY PRODUCTION COSTS OF COMMON COMBAT COMBAT ARMAMENTS CENTER, DOVER, NJ. T. ANDERSON DEC 86. AROCD-SF-86-2884. UNCLASSIFIED
THE YR SOFTWARE PROGRAM:
COMPUTING YEARLY PRODUCTION COSTS OF
COMMON COMPONENTS IN MULTI-ITEM AMMUNITION SYSTEMS

HAROLD T. ANDERSON

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U. S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
CLOSE COMBAT ARMAMENT CENTER
DOVER, NEW JERSEY

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**The YR Software Program: Computing Yearly Production Costs of Common Components in Multi-Item Ammunition Systems**

**Abstract**

The YR Computer Program was developed to reduce response time for providing production cost estimates for multi-item ammunition systems where the items use parts in common. The report has been written to make the program available to those required to make similar estimates.

The language used is the Hewlett-Packard Basic developed for the HP9845T desk calculator.
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INTRODUCTION

The YR Computer Program was developed to improve response time for preparing unit cost estimates for multiyear buys of the 120-mm ammunition used in the M1E1 tank.

Prior to the development of this program, the yearly unit cost of each component common to two or more rounds and subject to a learning curve was calculated separately. In addition, a separate learning curve was used for each vendor. The unit costs, thus obtained, were combined with other cost data to obtain the yearly total and unit cost for each round. Written in the Hewlett-Packard Basic language, the YR program combines the input cost data and prints out yearly cost estimates in one-fifth of the time previously required. The program also escalates the estimates to "then year" and "constant year" dollars.

The program avoids introduction of errors by eliminating the necessity for manual transfer of data from one set of calculations to another. It also provides a printout of input data for review and correction before continuing with the calculations.

Instructions for using the program are given below; a flow chart is contained in appendix A.

INSTRUCTIONS*

Organize data for entry into the program by the use of data sheets similar to the one shown in appendix B. Then:

1. Enter the YR PROGRAM in the computer memory.

2. Press the RUN key to start the program. YR PROGRAM will appear on the CRT.

3. A printout on the CRT will request inputs and list instructions. Requested information is to be typed in and entered by pressing CONT key.

Note: Data items and character lengths should be limited as follows:
- round designation-5, number of rounds-9, components/round-10,
- vendors/component-3, component name-15, number of years-25.

4. Entered information will appear on the CRT.

* This software program has been written in the Basic language used in the Hewlett Packard 9845T desk calculator. Modification may be required for use on machines using a different dialect.
5. After a group of inputs has been entered, a printout on the CRT will ask if the inputs are correct:

- If the inputs are correct, then the answer (yes) is indicated by keying in CONT. The program will then continue.
- If the inputs are not correct, then the answer (no) is indicated by keying in 0. The program will then go back and rerequest the last group of inputs. When an item of data that was previously entered correctly is rerequested, keying in CONT will reenter it without change. Data is corrected by typing in the correct data when requested and pressing CONT, per step 3, above. The incorrect data will remain on the CRT, but the corrected inputs will also appear on the CRT as they are reentered.

6. When all the data item inputs for a specific round have been entered, these inputs will be printed on paper. (A typical printout is shown in appendix B.) A printout on the CRT will ask if these inputs are correct. The procedure listed in step 5, above, will apply for approval or correction of the printed data.

7. When the data for all rounds have been entered and/or corrected, the required calculated costs will be printed on paper.

SOFTWARE

The software for the program is contained in appendix C.

REFINEMENT

The YR Program is currently being revised to interact with a mass storage so that learning curve first unit costs, fixed costs, and escalation factors can be retrieved for use without manual re-entry, if ammunition quantity changes require recalculation of yearly costs. It is also being translated into GW-Basic for use in WYSE personal computers.

A possible refinement is modification of the program to determine the quantity of a designated round that can be obtained for a set dollar value. The quantities of other rounds using common components must be known for this refinement.

The program as written reserves storage for up to a maximum of eight rounds, each with up to ten components made by three possible vendors. The program can be modified so the reserved storage for these input data items can be expanded and contracted within the storage capability of the computer.
APPENDIX A

FLOW CHART
START

SET INITIAL CONDITIONS

SUB-PROGRAM FOR DATA INPUT
SEE SN 2

SUB-PROGRAM TO PRINT HARD COPY OF INPUT DATA SEE SN 6

SUB-PROGRAM TO CALCULATE COSTS
SEE SN 10

SUB-PROGRAM TO PRINT HARD COPY OF COSTS
SEE SN 13

LAST YEAR CONSIDERED?

NO LOOP

YES

STOP

FLOWCHART
APPENDIX-A1
APPENDIX B

DATA SHEET, INPUT DATA
AND TYPICAL PRINTOUT
<table>
<thead>
<tr>
<th>COMPONENT DESIGNATION:</th>
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<tr>
<td>PROC. FACTOR Z</td>
<td>PROC. FACTOR Z</td>
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<tr>
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<td>COMMON W/DESIG.</td>
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<tr>
<td>I LEARNING</td>
<td>I LEARNING</td>
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<tr>
<td>VENDOR No.</td>
<td>VENDOR No.</td>
</tr>
<tr>
<td>ITEM OF BUY</td>
<td>ITEM OF BUY</td>
</tr>
<tr>
<td>PRIOR QTY.</td>
<td>PRIOR QTY.</td>
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<td>ITEM OF BUY</td>
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<tr>
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ROUND XM829  BUY YEAR 1985

BUY QTY= 41000  PRIOR BUY QTY= 9800
REF QTY= 1290  P&A QTY= 4654
P&A COST= $242985  Q&A COST= $13660

LAP COMPONENT 1 OF 9
PROCUREMENT FACT. 3 %
COMPONENT NOT SHARED
VENDOR 1 OF 3
% OF BUY BY VENDOR 100 %
VENDOR 2 OF 3
% OF BUY BY VENDOR 0 %
VENDOR 3 OF 3
% OF BUY BY VENDOR 0 %
MPTS

COMPONENT 2 OF 9
PROCUREMENT FACT. 4 %
COMPONENT NOT SHARED
VENDOR 1 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 2 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 3 OF 3
% OF BUY BY VENDOR 0 %

COMPONENT 3 OF 9
PROCUREMENT FACT. 4 %
COMPONENT NOT SHARED
VENDOR 1 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 2 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 3 OF 3
% OF BUY BY VENDOR 0 %

COMP. UC=$ 86.26
1st UC=$ 251.7 LEARNING= 90 %
PRIOR QTY BY VENDOR 12246.7
PRIOR QTY BY VENDOR 0
PRIOR QTY BY VENDOR 0

COMPONENT 4 OF 9

SHARED DESIG. 1
VENDOR 1 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 2 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 3 OF 3
% OF BUY BY VENDOR 0 %

CRTG CASE
PROCUREMENT FACT. 5 %
VENDOR 1 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 2 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 3 OF 3
% OF BUY BY VENDOR 0 %

COMP. UC=$ 0
LEARNING= 90 %
PRIOR QTY BY VENDOR 23262.75
PRIOR QTY BY VENDOR 23262.75
PRIOR QTY BY VENDOR 0

COMPONENT 5 OF 9
PROP CHARGE
PROCUREMENT FACT. 4 %
COMPONENT 6 OF 9
C BASE & SEAL
PROCUREMENT FACT. 2 %
SHARED DESIG. 2
VENDOR 1 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 2 OF 3
% OF BUY BY VENDOR 50 %
VENDOR 3 OF 3
% OF BUY BY VENDOR 0 %

COMP. UC=$ 170.14
COMP. UC=$ 0
LEARNING= 90 %
PRIOR QTY BY VENDOR 28159.65
PRIOR QTY BY VENDOR 28159.65
PRIOR QTY BY VENDOR 0

COMPONENT 7 OF 9
PRIMER
PROCUREMENT FACT. 3 %

COMP. UC=$ 6.61

COMPONENT 8 OF 9
TRACER

24
<table>
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<td>SHARED DESIG. 3</td>
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<tr>
<td>1st UC=$ 143.94</td>
<td>% OF BUY BY VENDOR 50 %</td>
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<tr>
<td>COMP. UC=$ 1.14</td>
<td>VENDOR 2 OF 3</td>
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<tr>
<td>COMP. UC=$ 0</td>
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<tr>
<td>LEARNING= 98 %</td>
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ROUND, XM829

BUY YEAR 1985

BUY QUANTITY, 41000
REFERENCE QUANTITY, 1296
P&A QUANTITY, 4654

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<td>$ 51.78</td>
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<td>$ 550.84</td>
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<td>$ 15.91</td>
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TOTAL HARDWARE COST, $ 54803477.83
P&A COST, $ 242985.00
QA COST, $ 13660.00
ESIP COST, $ 2192139.11
TOTAL BUY COST, $ 57252261.94

ROUND UNIT COST, $ 1396.40
ESCAGATED TO CONSTANT FY 1984.00 DOLLARS BY FACTOR OF 1.18
<table>
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TOTAL HARDWARE COST: $ 6472230.44

P&A COST: $ 287183.97
QA COST: $ 16144.75
ESIP COST: $ 2590889.22
TOTAL BUY COST: $ 6766448.39

ROUND UNIT COST, $ 1650.48

ESCALATED TO THEN YR DOLLARS BY FACTOR OF 1.24
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TOTAL HARDWARE COST $ 67786421.72

PLA COST $ 300548.15

QA COST $ 16896.05

ESIP COST $ 2711456.87

TOTAL BUY COST $ 70815322.79

ROUND UNIT COST, $ 1727.20
APPENDIX C

SOFTWARE
OPTION BASE 1

PRINTER IS 16

PRINT "YR PROGRAM"

STANDARD

DIM Rnd$(8),Bvqt(8),Prqt(8),Rfqqt(8),Paqt(8),Yr(25)

DIM Past(8),Qast(8),Ess(8),U(),Ba($),Vt(8,10,3),Vp(8,10)

DIM CmpS(8,10),Pf(8,1),Uccmp(8,1),Cmps(8,16),Iuc(Spl)

DIM Vpqt(8,1,3),vct(8,10,3),B(8,10),L(8,10),V(8,16)

INPUT "ENTER NUMBER OF YEARS CONSIDERED",Sy

INPUT "ESCALATION TO CONSTANT YR & RED? YES ? ENTER YEAR. NO ? ENTER 0. ",Yrc

IF Yrc=0 THEN 130

INPUT "ENTER ESCALATION FACTOR.",Esc(1)

FOR T=1 TO Sy

PRINT "YEAR",T,"OF",Sy

Yrs=Yrs+1

PRINT "ESCALATION TO THEN YR & RED? YES ? ENTER FACTOR. NO ? ENTER 0. ",E

IF T>1 THEN 240

INPUT "ENTER NUMBER OF ROUNDS CONSIDERED.",W

FOR X=1 TO W

INPUT "ENTER COMPONENT NAME.",CmpS(X,Y)

PRINT Cmp$(X,Y),"COMPONENT ";Y;"OF ";U(X)

INPUT "ENTER PROCUREMENT FACTOR",Pf(X,Y)

IF Pf(X,Y)=0 THEN 730

INPUT "ENTER COMPONENT UNIT COST,ENTER 0 IF UNKNOWN",Uccmp(X,Y)

INPUT "OTHER RND SHARE COMPONENT? NO=0, IF YES ENTER SHARED DESIG",Cmps(X,Y)

IF Cmps(X,Y)=0 THEN 700

F=F

G=0

31
S=Cmps(X,Y)
X=X-1
IF X=0 THEN 670
IF Byqt(X)>0 THEN 630
GOTO 2520
X=F
Y=G
IF Prqt(X)=0 THEN 2600
INPUT "ENTER 1ST. UNIT COST",Iuc(X,Y)
INPUT "ENTER % LEARNING.",Ba(X,Y)
B(X,Y)=(-2+LGT(2))/LGT(2)
PRINT "PROCUREMENT FACT.":Prf(X,Y);"%","COMP. UC=":Uccmp(X,Y)
IF Uccmp(X,Y)>0 THEN 790
PRINT "COMPONENT COMMON";Cmps(X,Y);"1st UC=";Iuc(X,Y);"LEARN.";Ba(X,Y);"%"
GOTO 790
GOTO 790
PRINT "COMPONENT USED IN COMMON WITH PRIOR ROUND".
Vp(X,Y)=1
INPUT "ARE THE INPUTS CORRECT ? 1=YES,0=NO",Ans
IF Ans=0 THEN 520
IF Vp(X,Y)=1 THEN 1000
IF Uccmp(X,Y)>0 THEN 1000
FOR Z=1 TO 3
IF Z<>1 THEN 870
INPUT "VENDOR No1 TO MFG. WHAT % OF BUY ?",Vt(X,Y,Z)
GOTO 910
IF Z<>2 THEN 900
INPUT "VENDOR 2 TO MFG. WHAT % OF BUY ?",Vt(X,Y,Z)
GOTO 910
INPUT "VENDOR 3 TO MFG. WHAT % OF BUY ?",Vt(X,Y,Z)
Vt(X,Y,Z)=Vt(X,Y,Z)*.01
IF T>1 THEN 940
INPUT "PRIOR PRODUCTION BY VENDOR ?",Vpqt(X,Y,Z)
NEXT Z
FOR Z=1 TO 3
INPUT "ARE THE INPUTS CORRECT ? 1=YES,0=NO",Ans
IF Ans=0 THEN 830
PRINT
GOTO 790
NEXT Y
GOSUB 2160
NEXT X
FOR X=1 TO W
IF Byqt(X)=0 THEN 1200
FOR Y=1 TO U(X)
B=B(X,Y)
Lc=L(X,Y)
IF Uccmp(X,Y)>0 THEN 1170
IF Cmps(X,Y)>0 THEN 1220
GOTO 1370
1120 N=Vpqt(X,Y,Z)+.5
M=Lc+N
K=(Lc*(B+1)/(M*(B+1)-M*(B+1)))-(1-B)
Uccmp(X,Y)=Iuc(X,Y)*K-B
GOTO 1430
1170 Cps(X,Y)=Uccmp(X,Y)*L(X,Y)
1180 IF Cmps(X,Y)>0 THEN 1480
NEXT Y
GOTO 1658
NEXT X
GOTO 1658
F=X
G=Y
S=Cmps(X,Y)
X=X+1
1260 IF X>W THEN 1350
1270 IF Byqt(X)=0 THEN 1250
1280 Y=1
1290 IF S=Cmps(X,Y) THEN 1330
1300 Y=Y+1
1310 IF Y=W THEN 1250
1320 GOTO 1250
1330 Lc=L(X,Y)+Lc
1340 GOTO 1250
1350 X=F
1360 Y=G
1370 Lc=Lc
1380 UC=0
1390 FOR Z=1 TO 3
1400 IF Vct(X,Y,Z)=0 THEN 1450
1410 Lc=Lc+Vct(X,Y,Z)
1420 GOTO 1120
1430 UC=Uccmp(X,Y)*Vct(X,Y,Z)+UC
1440 Vpq%(X,Y,Z)=Lc*Vpq%(X,Y,Z)
1450 NEXT Z
1460 Uccmp(X,Y)=UC
1470 GOTO 1170
1480 F=X
1490 G=Y
1500 S=Cmps(X,Y)
1510 M=Uccmp(X,Y)
1520 X+X+1
1530 IF X=W THEN 1620
1540 IF Byqt(X)=0 THEN 1520
1550 Y=1
1560 IF S=Cmps(X,Y) THEN 1600
1570 Y=Y+1
1580 IF Y=W THEN 1520
1590 GOTO 1560
1600 Uccmp(X,Y)=M
1610 GOTO 1520
1620 X=F
1630 Y=G
1640 GOTO 1190
1650 FOR X=1 TO W
1660 IF Byqt(X)=0 THEN 1750
1670 Hwst(X)=0
1680 FOR Y=1 TO U(X)
1690 Hwst(X)=Hwst(X)+Cpsst(X,Y)
1700 NEXT Y
1710 IF Estt(X)>100 THEN 1730
1720 Estt(X)=Hwst(X)+81*Estt(X)
1730 Rdst(X)=Hwst(X)+Qast(X)+Rast(X)+Estt(X)
1740 Rast(X)=Rdst(X)/Byqt(X)
1750 NEXT X
1760 FIXED 2
1770 PRINTER IS 0
1780 FOR X=1 TO W
1790 STANDARD
1800 E#=CHR$(27)
1810 PRINT PAGE,E#&"$S ROUND","Rnd$(X);"BUY YEAR ";Yrs,LIN(2)
1820 IF Byqt(X)>0 THEN 1870
1830 PRINT
1840 PRINT "THERE IS NO BUY OF ";Rnds(X);" IN YEAR ";Yrs
1850 PRINT E#&"$S""REFERENCE QUANTITY","Rfqt(X),LIN(1)
1860 PRINT "REFERENCE QUANTITY","Rfqt(X),LIN(1)
1870 PRINT "REFERENCE QUANTITY","Rfqt(X),LIN(1)
1880 IMAGE 163X,6D.11X","5D.20B","10D.2D
191c PRINT "COMPONENT"," QTY ";" UNIT COST","COST"
1920 PRINT
1930 FOR Y=1 TO U(X)
1940 PRINT USING 1900;Cmp$(X,Y),L(X,Y),Uccmp(X,Y),Cpst(X,Y)
1950 PRINT
1960 NEXT Y
1970 IMAGE 28A34X"*",10D.2D
1980 PRINT TAB(57),"-------------
1990 PRINT USING 1970;"TOTAL HARDWARE COST","Rdst(X)
2000 PRINT
2010 PRINT USING 1970;"PLA COST","Paqt(X)
2020 PRINT
2030 PRINT USING 1970;"ESIP COST","Esst(X)
2040 PRINT
2050 FIXED 2
2060 PRINT "ROUND UNIT COST, ",&";Rst(X)
2070 IF Yrc<>8 THEN 2798
2080 IF Esc(2)<0 THEN 2813
2090 NEXT X
2100 NEXT T
2110 STOP
2120 PRINT "INPUT DATA",LIN(I)
2130 STANDARD
2140 PRINT "ROUND ";Rnd$(X),"BUY YEAR";Yrs,LIN(I)
2150 IF Byq(X)=0 THEN 2220
2160 GOTO 2240
2170 PRINT "THERE IS NO BUY OF ";Rnd$(X);" THIS YEAR."
2180 GOTO 2260
2190 PRINT "BUY QTY=";Byq(X),"PRIOR BUY QTY=";Prqt(X)
2200 PRINT "REF QTY=";Rfqt(X),"PLA QTY=";Paqt(X)
2210 IF Esst(X)<100 THEN 2290
2220 PRINT "PLA COST-";P&st(X),"ESIP COST-";Esst(X)
2230 FOR Z=1 TO U(X)
2240 PRINT CmpS(X,Y),"COMPONENT";Y,"OF";U(X)
2250 IF Uccmp(X,Y)>8 THEN 2378
2260 IF Vp(X,Y)<0 THEN 2396
2270 GOTO 2476
2280 FOR Z=1 TO 3
2290 PRINT "VENDOR";Z,"OF 3"
2300 GOTO 2460
2310 IF Y=U(X) THEN 2570
2320 PRINT "COMPONENT SHARED WITH PRIOR ROUND 
2330 GOTO 2438
2340 PRINT "COMPONENT NOT SHARED ","1st UC-";Iuc(X,Y),"LEARNING-";Ba(X,Y)
2350 FOR Z=1 TO 3
2360 PRINT "VENDOR";Z,"OF 3"
2370 PRINT "% OF BUY BY VENDOR";Vt(X,Y,Z)
2380 NEXT Z
2390 IF Y=U(X) THEN 2570
2400 IF S=Cmps(X,Y) THEN 2538
2410 IF Y=U(X) THEN 2548
2420 IF S*Cmps(X,Y) THEN 2570
2430 IF Y=U(X) THEN 2638
2440 IF S*Cmps(X,Y) THEN 2570
2450 IF Y=U(X) THEN 2638
2550 \ Y=\ Y+1
2560 \ GOTO \ 2530
2570 \ X=F
2580 \ Y=G
2590 \ GOTO \ 2570
2600 \ F=X
2610 \ G=Y
2620 \ S=\ caps(X, Y)
2630 \ X=X+1
2640 \ IF \ X>W \ THEN \ 2730
2650 \ Y=1
2660 \ IF \ \ caps(X, Y)>S \ THEN \ 2780
2670 \ Y=Y+1
2680 \ IF \ Y>U(X) \ THEN \ 2630
2690 \ GOTO \ 2660
2700 \ Rz=\ vpt(X, Y, 1)
2710 \ Bz=\ vpt(X, Y, 2)
2720 \ Cz=\ vpt(X, Y, 3)
2730 \ X=F
2740 \ Y=G
2750 \ vpt(X, Y, 1)=Rz
2760 \ vpt(X, Y, 2)=Bz
2770 \ vpt(X, Y, 3)=Cz
2780 \ GOTO \ 2700
2790 \ PRINT \ "ESCALATED TO CONSTANT FY", \ Yrc, \ "DOLLARS BY FACTOR OF \ E", \ Esc(1)
2800 \ PRINT
2810 \ Esc(1)
2811 \ GOSUB \ 2610
2812 \ IF \ Esc(2)+0 \ THEN \ 2130
2813 \ E=\ Esc(2)
2814 \ PRINT
2815 \ PRINT \ "ESCALATED TO THEN YR DOLLARS BY FACTOR OF \ E"
2816 \ PRINT
2817 \ GOSUB \ 2620
2818 \ PRINT
2819 \ GOTO \ 2130
2820 \ PRINT \ "COMPONENT", , "QTY", , "UNIT COST", , "COST"
2830 \ PRINT
2840 \ Hw=0
2850 \ FOR \ Y=1 \ TO \ U(X)
2860 \ Ucp=Ucap(X, Y)+E
2870 \ Cp=Cps(X, Y)+E
2880 \ PRINT \ USING \ 1980; \ Cap\$(X, Y), \ L(X, Y), \ Ucp, \ Cp
2890 \ PRINT
2898 \ Hw=Hw+Cp
2908 \ NEXT \ Y
2910 \ PRINT \ TAB(57), \ "TOTAL", \ "HARDWARE COST", \ Hw
2920 \ PRINT
2930 \ PRINT \ USING \ 1970; \ "TOTAL HARDWARE COST", \ Hw
2940 \ PRINT
2950 \ Pa=\ past(X)+E
2960 \ PRINT \ USING \ 1970; \ "P&A COST", \ Pa
2970 \ PRINT
2980 \ Qa=\ past(X)+E
2990 \ PRINT \ USING \ 1970; \ "QA COST", \ Qa
3000 \ Es=\ Estat(X)+E
3010 \ PRINT
3020 \ PRINT \ USING \ 1970; \ "ESTIP COST", \ Es
3030 \ Total=Hw+Pa+Qa+E
3040 \ PRINT \ TAB(57), \ "TOTAL", \ "BUY COST", \ Total
3050 \ PRINT \ USING \ 1970; \ "TOTAL BUY COST", \ Total
3060 \ Avg=\ Total/\ vpt(X)
3070 \ PRINT
3080 \ PRINT \ "ROUND UNIT COST, \ Avg"
3090 \ RETURN
3100 \ END

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