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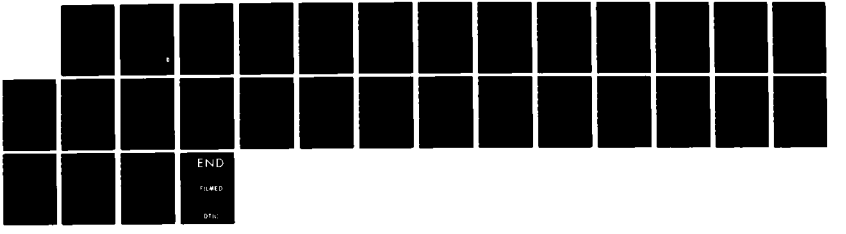

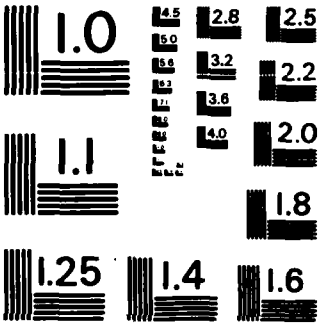

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AD-A162 011

A1: A Computer Program for Economic Analysis

by
Augustine A. Stagliano
Operations Research Analyst
Watervliet Arsenal, Watervliet, New York

Presented at the
19th Annual Department of Defense
Cost Analysis Symposium
Xerox Training Center
Leesburg, Virginia
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ABSTRACT

Economic Analysis enjoys widespread use in the Department of Defense as an aid to insure that available funding is invested wisely. The post data collection stage of a cost study requires that analytical techniques, collectively termed "economic analysis", be performed. The resulting "number crunching" (pre-decision making stage), when performed manually, may require hours to complete. A1 is an interactive BASIC program modeled after format A-1 found in Army regulation 11-28. Written for the IBM PC, it may readily be converted for use with microcomputer systems throughout the Department of Defense. A1 is easy to use, requiring no computer experience. The results are highly reliable, with human error reduced to a minimum. A1 enjoys a high degree of applicability and allows for multiple runs (sensitivity analysis) with a minimum of effort.

INTRODUCTION

Economic Analysis is among the most useful of tools employed by the cost analysis community. The typical cost analyst spends much time in the collection and processing of data into a meaningful form. As such, it is important for one to have access to a computer program which allows for rapid processing of cost data. This program should consider not only recurring costs and investment costs, but also those associated with employing and replacing existing assets, the terminal value of the new investment, and the cost avoidance experienced when the proposed system precludes requirements to refurbish or modify elements of the present system. Program A1 satisfies these requirements, performing all necessary mathematical operations within user defined parameters.

The intent of this paper is to introduce an economic analysis program tailored for use with the office microcomputer. It is assumed that the reader is familiar with the mathematics used in performing economic analysis, and as such, the development of those rudimentary mathematical techniques is not considered.

TERMINOLOGY

In order that the prospective user become familiar with the economic analysis terminology required to use A1, the following definitions are given. Included with each definition is a description of how those costs associated with the defined element are treated in the program.

Operating (Recurring) Costs. The operating costs for both the present and proposed alternatives must be annualized and will include any identifiable recurring costs associated with each alternative. Consumable material, labor, overhead, and support costs are all examples of recurring costs. A1 discounts the annual savings for both alternatives and sums each over the project life.

Investments Costs. The investment costs for the proposed system include all non-recurring (one-time) costs grouped by project year. Equipment acquisition and refurbishment, research and development, and construction costs are examples of non-recurring costs. A1 discounts the annual investment costs and sums them over the project life.

Existing Assets Employed. The value of existing assets required by the proposed system. When applicable, the salvage value of the existing asset, discounted to the end of the last year of the economic life, should be subtracted from the asset's current value. This insures that the existing asset's residual value at the end of the project is captured. A1 discounts the value of existing assets employed, then adds that value to the discounted investment cost.

Value of Existing Assets Replaced. The value associated with assets no longer required under the proposed system; i.e., the salvage value of the replaced assets. A1 discounts the value of replaced assets and subtracts that value from the discounted investment cost.

Terminal Value. An estimate of the value of land, buildings, and equipment (new investment) at the end of their useful life. A1 discounts the terminal value to the end of the final project year and subtracts that value from the discounted investment cost.

Refurbishment or Modification Eliminated. Cost avoidance resulting when the requirement to refurbish or modify existing equipment is eliminated through the implementation of the proposed system. A1 discounts the refurbishment or modification eliminated savings, then adds those savings to the discounted total savings.

Savings-Investment Ratio. The ratio of the estimated present value savings to present value investment cost.

Return on Investment. The percent return on investment. The return on investment is calculated based upon the DOD mandated ten percent, mid-year present value formula. A1 employs a trial and error approach which drives the savings investment ratio to one. The discount factor used to accomplish this is the return on investment value.

USING THE PROGRAM

In order to illustrate the results obtained using A1, the following example is given.[1] The Rutherford B. Hayes Army Depot is seeking the least costly method of removing paint from a component of the M355 Armament System. Presently, solvent is brushed onto the component and then the paint is scraped off by hand. One proposal suggests that automatic dip tanks be used to remove the paint. This method significantly reduces both labor and building maintenance costs. The economic life is eight years, with benefits occurring in project year three. Cost data is given in Figure 1. The data from Figure 1 is entered into the computer as listed (See Appendix V), with the exception of the value of existing assets employed. Here, the building's discounted salvage value ($158,900 x .368 = $58,475) is subtracted from the current value of existing assets required ($240,900), resulting in a net value of $182,425. Figure 2 is the printout produced by A1.

[1] Example is from the DARCOM Pamphlet for Economic Analysis, June 1984. Please refer to this for details.

Rutherford B. Hayes Army Depot
Removal of Paint from M355 Armament System

Alternative 1: Brush and Scrape

* Operating Costs (Labor, Material Building Maint., Forklift Oper., Etc.)	PY's 1-3	$ 908,480	
	PY 4	1,051,560	
	PY's 5-10	1,058,560	
* Current Assets Required (Bldg. 1-40)	PY 2	$ 130,843	
* Salvage Value		None	

Alternative 2: Automatic Dip Tanks

* Operating Costs (Labor, Material, Building Maint., Forklift Oper., Etc.)	PY 1 & 2	$ 908,480	
	PY 3-10	$ 759,660	
* Current Assets Required (Bldg. 1-12, Two Bays & Overhead Conveyor)	PY 0	$ 222,400	(Bldg.)
		18,500	(Conveyor)
	Total PY-0	$ 240,900	
* Current Assets Replaced (Bldg. 1-40)	PY 2	$ 130,843	
* New Investment	PY 1	$ 126,400	(Dip Tanks)
		45,500	(Drying Comp.)
		58,000	(Facility Mod.)
	Total PY-1	$ 229,000	
	PY 2	$ 87,000	(Facility Mod.)
		10,000	(Training)
		$ 97,000	
	PY 8	$ 28,000	(Tank Reline)
* Salvage Value	End of PY 10	$ 14,000	(Process Equip)
		$ 158,900	(Bldg. 1-12)

Figure 1 - Summary of Costs

Referring to Figure 2, note that the proposed alternative (automatic dip tanks) is the preferred one, with a savings-investment ratio equal to 3.306 and a return on investment which is highly desirable at 37.125 percent.

PROGRAM A1BATCH AND EDLIN

Program A1BATCH is a variant of A1 which employs data files created using the system's line editor (EDLIN in IBM's DOS 2.0). Upon the execution of A1BATCH, the user is prompted only for a data filename. In order to access IBM's line editor, one must enter EDLIN (filename) after the system prompt. If a file already exists under the specified filename, an end of file message is listed on the monitor. If the file is new, then a new file message is listed. When creating a new file, enter the letter i after the EDLIN prompt. Now, begin entering the data line by line. When data entry is complete, press the two key combination of CTRL-BREAK to exit from the data input mode. The newly created file may be saved by entering the letter e after the EDLIN prompt. Once the file is saved, control is shifted to the command mode. Refer to the IBM DOS Reference Manual for additional information on the use of the line editor.

A1BATCH uses sequential access files, and the only file structure requirement is that the data be entered sequentially and separated by commas. A suggested format for the data file is given in Figure 3.

When using a separate diskette to store data files, place the program diskette in drive B and the data diskette in drive A. Load the program using the BASIC command, LOAD "B:A1BATCH". If only one drive is available, load the program first, then replace the program diskette with the data diskette.

SENSITIVITY ANALYSIS

A1 is ideally suited for sensitivity analysis. Select the parameter(s) which appear to be major costs drivers. After changing the selected parameters, re-execute the program.

In order to examine the effects of changing a system parameter, refer to the original data in Figure 1. Suppose that the annual building maintenance cost is $100,000 higher than first estimated. This results in an increase in the annual operating cost from $759,660 to $859,600. The program is re-executed using the revised operating costs with the results shown in Figure 4.

SUMMARY

A1 is an interactive program which prompts the user for input data. This program is ideally suited for the analyst with limited computer experience. Since A1BATCH reads data directly from an existing file, experience using such files is necessary. Either program will prove a valuable tool for anyone actively engaged in economic analysis.

********** Economic Analysis - Format A-1 **********

Project Title: Modification of the M355 Armament System
Date of Analysis: 4 June FYXX
Present Alternative: Brush & Scrape
Proposed Alternative: Automatic Dip Tanks
Project Life : 10 Years
Economic Life : 8 Years

Project Year	Operations Present	Operations Proposed	Differential Cost	Discount Factor	Present Value Diff. Cost
1	908480	908480	0	.954	0
2	908480	908480	0	.867	0
3	908480	759660	148820	.788	117270
4	1051560	759660	291900	.717	209292
5	1058560	759660	298900	.652	194883
6	1058560	759660	298900	.592	176949
7	1058560	759660	298900	.538	160808
8	1058560	759660	298900	.489	146162
9	1058560	759660	298900	.445	133011
10	1058560	759660	298900	.405	121055
Total					1259430

Total Present Value of New Investment: 317116

Value of Existing Assets Employed: 182425

Value of Existing Assets Replaced: 113441

Discounted Terminal Value of Investment: 5152

Total New Present Value of Investment: 380948

Present Value of Cost Savings (Operations): 1259430

P.V. Cost of Refurb. or Mod. Eliminated: 0

Total Present Value of Savings: 1259430

Savings/Investment Ratio: 3.306

Return on Investment: 37.125

********** Investment - Assets Data **********

Project Year	Investment Amount	Discount Factor	Present Value
1	229900	.954	219325
2	97000	.867	84099
8	28000	.489	13692

Project Year	Exist Asset Value	Discount Factor	Present Value
0	182425	1	182425

Project Year	Repl Asset Value	Discount Factor	Present Value
2	130843	.867	113441

Project Year	Terminal Value	Discount Factor	Present Value
10	14000	.368	5152

Figure 2 - Printout of Results

1. Project Name, Date of Analysis

2. Present Alternative

3. Proposed Alternative

4. Project Life, First Year of Economic Life

5. Present Operating Costs (C1, C2,.....,CN)

6. Proposed Operating Costs (C1, C2,.....,CN)

7. Number of Years of Investment

8. Project Year of Investment, Amount of Investment (PY1, INV1, PY2, INV2,...PYN, INVN)

9. Number of Existing Assets Employed

10. Project Year Employed, Net Value of Assets Employed (PY1, AE1, PY2, AE2,...PYN, AEN). Skip if zero entered in 9.

11. Number of Existing Assets Replaced

12. Year Asset Replaced, Net Value of Asset Replaced (PY1, AR1, PY2, AR2,.....PYN, ARN). Skip if zero entered in 11.

13. Undiscounted Terminal Value

14. Number of Items Requiring Refurbishment/Modification

15. Project Year Refurbished/Modification Eliminated, Net Value of Refurbishment/Modification Elimination (PY1, RM1,...PYN, RMN). Skip if zero entered in 14.

Figure 3 - Data File Format for A1BATCH

********** Economic Analysis - Format A-1 **********

Project Title: Modification of the M355 Armament System
Date of Analysis: 4 June FYXX
Present Alternative: Brush & Scrape
Proposed Alternative: Automatic Dip Tanks
Project Life : 10 Years
Economic Life : 8 Years

Project Year	Operations Present	Operations Proposed	Differential Cost	Discount Factor	Present Value Diff. Cost
1	908480	908480	0	.954	0
2	908480	908480	0	.867	0
3	908480	859660	48820	.788	38470
4	1051560	859660	191900	.717	137592
5	1058560	859660	198900	.652	129683
6	1058560	859660	198900	.592	117749
7	1058560	859660	198900	.538	107008
8	1058560	859660	198900	.489	97262
9	1058560	859660	198900	.445	88511
10	1058560	859660	198900	.405	80555
Total					796830

Total Present Value of New Investment: 317116

Value of Existing Assets Employed: 182425

Value of Existing Assets Replaced: 113441

Discounted Terminal Value of Investment: 5152

Total New Present Value of Investment: 380948

Present Value of Cost Savings (Operations): 796830

P.V. Cost of Refurb. or Mod. Eliminated: 0

Total Present Value of Savings: 796830

Savings/Investment Ratio: 2.092

Return on Investment: 24.750

********** Investment - Assets Data **********

Project Year	Investment Amount	Discount Factor	Present Value
1	229900	.954	219325
2	97000	.867	84099
8	28000	.489	13692

Project Year	Exist Asset Value	Discount Factor	Present Value
0	182425	1	182425

Project Year	Repl Asset Value	Discount Factor	Present Value
2	130843	.867	113441

Project Year	Terminal Value	Discount Factor	Present Value
11	14000	.368	5152

Figure 4 - Sensitivity Analysis

REFERENCES

AR 11-28, Economic Analysis and Program Evaluation for Resource Management, 2 December 1975

ARRCOM Pamphlet 37-2, Economic Analysis - Rate of Return on Investment, 15 January 1977

DARCOMP 11-X, DARCOM Pamphlet for Economic Analysis, June 1984

IBM, Disk Operating System, Personal Computer-Computer Language Series, January 1983

APPENDICES

I - Definition of Program Variables

II - A1 Program Listing

III - A1BATCH Program Listing

IV - Creating a New File Using EDLIN

V - Sample Execution of A1 and A1BATCH

A$ - Project Title
D$ - Date of Analysis
PROP$ - Proposed Alternative
L1 - Number of Project Years
B - First Year of Economic Life
01(I) - Present Operating Cost (Year I)
02(I) - Proposed Operating Cost (year I)
L - Number of Years of Investment
T(I) - Project Year of Investment I
I(I) - Investment in Year I
NA - Number of Existing Assets Employed
YE(I) - Project Year Asset I Employed
EE(I) - Value of Asset I
NR - Number of Existing Assets Replaced
YR(I) - Project Year Asset I Replaced
CR(I) - Value of Asset I
AE - Terminal Value
NM - Number of Items Requiring Refurbishment or Modification
R(I) - Year Item I Requires Refurbishment or Modification
C(I) - Cost of Refurbishment or Modification in Year I
TO1 - Sum of Present Operating Costs
TO2 - Sum of Proposed Operating Costs
D(I) - Differential Cost for Year I
S - Sum of Differential Costs
DS(I) - Present Value Differential Cost for Year I
TDS - Sum of Present Value Differential Cost
RS(I) - Savings in Year I (ROI)
DI(I) - Present Value Investment Cost for Year I
TDI - Sum of Present Value Differential Cost
RD(I) - Investment in Year I (ROI)
TAE - Sum of Present Value of Existing Assets Employed
TAR - Sum of Present Value of Existing Assets Replaced
TV - Discounted Terminal Value
TMR - Sum of Present Value of Refurbishment or Modification Eliminated
SAV - Sum of Present Value Savings (Adjusted)
INV - Sum of Present Value Investment (Adjusted)
SIR - Savings - Investment Ratio
ROI - Return on Investment

```
10 REM FORMAT A-1 ECONOMIC ANALYSIS PROGRAM - "A1"
20 REM AUTHOR: A.A. STAGLIANO
30 REM COST ANALYSIS DIVISION  (AV 974-5423)
40 REM WATERVLIET ARSENAL - WATERVLIET, N.Y.
50 CLS:COLOR 10,0
60 LOCATE 12,18:PRINT"*********************************************************"
70 LOCATE 13,18:PRINT"****** Program A1 - Economic Analysis Package *******"
80 LOCATE 14,18:PRINT"*********************************************************"
90 DIM P(36),O1(36),O2(36),I(36),DI(36),D(36),PD(36),RD(36),DF(36),DS(36)
100 DIM DT(36),ME(36),EE(36),DV(36),M(36),T(36),TV(36),RS(36),ID(36),SD(36)
110 DIM YE(36),CR(36),YR(36),R(36),C(36)
120 INPUT "Project Title";A$
130 INPUT "Today's Date";D$
140 INPUT "Present Alternative: ";PRES$
150 INPUT "Proposed Alternative: ";PROP$
160 INPUT "Number of Project Years";L1
170 INPUT "Project Year Economic Life Begins";B
180 LET ECLIFE=L1+1-B
190 INPUT "Are Present And/Or Proposed Operating Costs Constant (y or n)";BS$
200 IF BS$="N" OR BS$="n" THEN GOTO 300
210 INPUT "Present Alt. Operating Cost";O1
220 INPUT "Proposed Alt. Operating Cost";O2
230 FOR I=1 TO L1
240 LET O1(I)=O1
250 NEXT I
260 FOR I=B TO L1
270 LET O2(I)=O2
280 NEXT I
290 GOTO 410
300 CLS
310 REM COSTS NOT CONSTANT
320 FOR I=1 TO L1
330 PRINT "Enter Present Cost For Project Year";I
340 INPUT O1(I)
350 NEXT I
360 CLS
370 FOR I=1 TO L1
380 PRINT "Enter Proposed Cost For Project Year";I
390 INPUT O2(I)
400 NEXT I
410 REM INVESTMENT DATA
420 INPUT "How Many Years of Investment";L
430 FOR I=1 TO L
440 INPUT "Enter Project Year of Investment & Investment Value";T(I),I(I)
450 NEXT I
```

```
460 INPUT "Are Existing Assets Employed on this Project(y or n)";E$
470 IF E$="N" OR E$="n" THEN 520
480 INPUT "Number of Items Under Consideration";NA
490 FOR I=1 TO NA
500 INPUT "Project Year Employed & Net Value of Existing Assets Employed";YE(I),EE(I)
510 NEXT I
520 INPUT "Will Existing Assets Be Replaced(y or n)";R$
530 IF R$="N" OR R$="n" THEN 580
540 INPUT "How Many Items Will Be Replaced";NR
550 FOR I=1 TO NR
560 INPUT "Project Year Asset Replaced & Net Value of Replaced Asset";YR(I),CR(I)
570 NEXT I
580 INPUT "Is Terminal Value Claimed(y or n)";T$
590 IF T$="N" OR T$="n" THEN 610
600 INPUT "Terminal Value";AE
610 INPUT "Have Refurbishment or Modification Costs Been Eliminated(y or n)";M$
620 IF M$="N" OR M$="n" THEN 670
630 INPUT "Number of Items Requiring Refurb/Mod";NM
640 FOR I=1 TO NM
650 INPUT "Project Year Refurb/Mod Scheduled & Net Value of Refurb/Mod";R(I),C(I)
660 NEXT I
670 CLS:LOCATE 12,18:PRINT "****************************************"
680 LOCATE 13,18:PRINT "* Processing Data - Please Stand By *"
690 LOCATE 14,18:PRINT "****************************************"
700 REM READ 10% MID-YEAR DISCOUNT FACTORS
710 FOR I=0 TO L1+1
720 READ P(I)
730 NEXT I
740 DATA 1,.954,.867,.788,.717,.652,.592,.538,.489,.445,.405,.368,.334,.304
750 DATA .276,.251,.228,.208,.189,.172,.156,.142,.129,.117,.107,.097,.088
760 DATA .081,.073,.066,.060,.055,.050,.045,.041,.037
770 REM CALCULATE PRESENT ALTERNATIVE OPERATING COST
780 GOSUB 1040
790 REM CALCULATE PROPOSED ALTERNATIVE OPERATING COST
800 GOSUB 1100
810 REM CALCULATE DIFFERENTIAL OPERATING COST
820 GOSUB 1270
830 REM CALCULATE INVESTMENT COST
840 GOSUB 1370
850 REM EXISTING ASSETS EMPLOYED CALCULATION
860 GOSUB 1450
870 REM EXISTING ASSETS RELACED CALCULATION
880 GOSUB 1530
890 REM TERMINAL VALUE CALCULATION
900 GOSUB 1610
```

Appendix II (cont.)

```
910 REM REFURBISHMENT/MODIFICATION CALCULATIONS
920 GOSUB 1670
930 REM TOTAL NEW PRESENT VALUE OF INVESTMENT
940 LET TNI=TDI+TAE-TAR-TTV
950 REM CALCULATE SAVINGS - INVESTMENT RATIO
960 GOSUB 1750
970 REM CALCULATE RATE OF RETURN ON INVESTMENT
980 GOSUB 1810
990 REM PRINT RESULTS OF ANALYSIS
1000 GOSUB 2060
1010 REM PRINT INVESTMENT COSTS
1020 GOSUB 2660
1030 CLS:PRINT "Program A1 Loaded & Ready for Execution - Press F2 Key":END
1040 REM PRESENT ALT. OPERATING COST SUBROUTINE
1050 LET T01=0
1060 FOR I=1 TO L1
1070 LET T01=T01+01(I)
1080 NEXT I
1090 RETURN
1100 REM PROPOSED ALT. OPERATING COST SUBROUTINE
1110 LET T02=0
1120 IF B>1 THEN GOTO 1180
1130 FOR I=1 TO L1
1140 LET T02=T02+02(I)
1150 LET TP=TP+P(I)
1160 NEXT I
1170 GOTO 1260
1180 FOR I=1 TO B-1
1190 LET 02(I)=01(I)
1200 LET T02=T02+02(I)
1210 NEXT I
1220 FOR I= B TO L1
1230 LET T02=T02+02(I)
1240 LET TP=TP+P(I)
1250 NEXT I
1260 RETURN
1270 REM DIFFERENTIAL & P.V. DIFFERENTIAL COST SUBROUTINE
1280 LET S=0:TDS=0
1290 FOR I=1 TO L1
1300 LET D(I)=01(I)-02(I)
1310 LET S=S+D(I)
1320 LET DS(I)=D(I)*P(I)
1330 LET TDS=TDS+INT(DS(I)+.5)
1340 LET RS(I)=D(I)
1350 NEXT I
```

```
1360 RETURN
1370 REM INVESTMENT COST SUBROUTINE
1380 LET TDI=0
1390 FOR I=1 TO L
1400 LET DI(I)=I(I)*P(T(I))
1410 LET TDI=TDI+DI(I)
1420 LET RD(T(I))=I(I)
1430 NEXT I
1440 RETURN
1450 REM EXISTING ASSETS EMPLOYED SUBROUTINE
1460 LET TAE=0
1470 FOR I=1 TO NA
1480 LET DE(I)=EE(I)*P(YE(I))
1490 LET TAE=TAE+DE(I)
1500 LET RD(YE(I))=RD(YE(I))+EE(I)
1510 NEXT I
1520 RETURN
1530 REM EXISTING ASSETS REPLACED SUBROUTINE
1540 LET TAR=0
1550 FOR I=1 TO NR
1560 LET RA(I)=CR(I)*P(YR(I))
1570 LET TAR=TAR+RA(I)
1580 LET RD(YR(I))=RD(YR(I))-CR(I)
1590 NEXT I
1600 RETURN
1610 REM TERMINAL VALUE SUBROUTINE
1620 LET TTV=0
1630 LET TV=AE*P(L1+1)
1640 LET TTV=TTV+TV
1650 LET RD(L1+1)=RD(L1+1)-AE
1660 RETURN
1670 REM REFUBISHMENT - MODIFICATION ELIMINATED SUBROUTINE
1680 LET TMR=0
1690 FOR I=1 TO NM
1700 LET ME(I)=C(I)*P(R(I))
1710 LET TMR=TMR+ME(I)
1720 LET RS(R(I))=RS(R(I))+C(I)
1730 NEXT I
1740 RETURN
1750 REM SAVINGS - INVESTMENT SUBROUTINE
1760 LET SAV=0:INV=0:SIR=0
1770 LET SAV=TDS+TMR
1780 LET INV=TNI
1790 LET SIR=SAV/INV
1800 RETURN
```

Appendix II (cont.)

```
1810 REM ROI SUBROUTINE
1820 IF SIR=1 THEN GOTO 2040
1830 LET F=1
1840 GOSUB 1930
1850 IF NSIR>=1 THEN LET ROI=101:GOTO 2050
1860 LET DELTA=-.32
1870 LET F=F+DELTA
1880 GOSUB 1930
1890 IF NSIR>1 AND DELTA<0 THEN DELTA=(-DELTA/2)
1900 IF NSIR<1 AND DELTA>0 THEN DELTA=(-DELTA/2)
1910 IF ABS(DELTA)<.0005 THEN ROI=F*100:GOTO 2050
1920 GOTO 1870
1930 FOR Y=0 TO L1+1
1940 LET DF(Y)=((1/((1+F)^(Y-1)))+(1/((1+F)^Y)))/2
1950 LET ID(Y)=RD(Y)*DF(Y)
1960 LET TID=TID+ID(Y)
1970 LET SD(Y)=RS(Y)*DF(Y)
1980 LET TSD=TSD+SD(Y)
1990 NEXT Y
2000 LET NSIR=TSD/TID
2010 LET TID=0
2020 LET TSD=0
2030 RETURN
2040 LET ROI=10
2050 RETURN
2060 REM PRINT RESULTS
2070 LPRINT:LPRINT:LPRINT
2080 LPRINT "*************** Economic Analysis - Format A-1 ***************"
2090 LPRINT:LPRINT
2100 LPRINT "Project Title: ";A$
2110 LPRINT "Date of Analysis: ";D$
2120 LPRINT "Present Alternative: ";PRES$
2130 LPRINT "Proposed Alternative: ";PROP$
2140 LPRINT TAB(1)"Project Life :";TAB(19)L1;TAB(24)"Years"
2150 LPRINT TAB(1)"Economic Life :";TAB(19)ECLIFE;TAB(24)"Years"
2160 LPRINT
2170 LPRINT "Project";TAB(12)"Operations";TAB(28)"Differential";TAB(41)"Discount";TAB(51)"Present Value"
2180 LPRINT TAB(2)"Year";TAB(9)"Present";TAB(19)"Proposed";TAB(32)"Cost";TAB(43)"Factor";TAB(54)"Diff. Cost"
2190 LPRINT "-------";TAB(9)"-------";TAB(19)"--------";TAB(28)"------------";TAB(41)"--------";TAB(51)"-------------"
2200 LPRINT
2210 FOR I= 1 TO L1
2220 LET D(I)=INT(D(I)+.5)
2230 LET DS(I)=INT(DS(I)+.5)
2240 LPRINT TAB(2)I;TAB(7)O1(I);TAB(17)O2(I);TAB(29)D(I);TAB(41)P(I);TAB(53)DS(I)
2250 NEXT I
```

```
2260 LPRINT
2270 LET S=INT(S+.5)
2280 LET TDS=INT(TDS+.5)
2290 LPRINT "Total";TAB(53)TDS
2300 REM PRINT SAVINGS - INVESTMENT DATA
2310 LPRINT
2320 LET K$="**********"
2330 LET M$="***.***"
2340 LPRINT"Total Present Value of New Investment:";
2350 LPRINT USING K$;TDI
2360 LPRINT
2370 LPRINT"Value of Existing Assets Employed:";
2380 LPRINT USING K$;TAE
2390 LPRINT
2400 LPRINT "Value of Existing Assets Replaced:";
2410 LPRINT USING K$;TAR
2420 LPRINT
2430 LPRINT "Discounted Terminal Value of Investment:";
2440 LPRINT USING K$;TTV
2450 LPRINT
2460 LPRINT "Total New Present Value of Investment:";
2470 LPRINT USING K$;TNI
2480 LPRINT
2490 LPRINT "Present Value of Cost Savings (Operations):";
2500 LPRINT USING K$;TDS
2510 LPRINT
2520 LPRINT "P.V. Cost of Refurb. or Mod. Eliminated:";
2530 LPRINT USING K$;TMR
2540 LPRINT
2550 LPRINT "Total Present Value of Savings:";
2560 LPRINT USING K$;SAV
2570 LPRINT
2580 LPRINT "Savings/Investment Ratio:";
2590 LPRINT USING M$;SIR
2600 LPRINT
2610 LPRINT "Return on Investment:";
2620 IF ROI=101 THEN LPRINT "  >100":GOTO 2640
2630 LPRINT USING M$;ROI
2640 LET TP=0
2650 RETURN
2660 REM ************************************************************
2670 REM ************ PRINT INVESTMENT DATA ************************
2680 REM ************************************************************
2690 LPRINT:LPRINT
2700 LPRINT "********** Investment - Assets Data **********"
```

```
2710 LPRINT
2720 LPRINT "Project";TAB(10)"Investment";TAB(25)"Discount";TAB(35)"Present"
2730 LPRINT TAB(2)"Year";TAB(12)"Amount";TAB(26)"Factor";TAB(36)"Value"
2740 LPRINT "-------";TAB(10)"----------";TAB(25)"--------";TAB(34)"---------"
2750 LPRINT
2760 FOR I=1 TO L
2770 LPRINT TAB(4)T(I);TAB(11)I(I);TAB(25)P(T(I));TAB(35)INT(DI(I)+.5)
2780 NEXT I
2790 LPRINT:LPRINT
2800 IF NA=0 THEN 2870
2810 LPRINT "Project";TAB(10)"Exist Asset";TAB(25)"Discount";TAB(35)"Present"
2820 LPRINT TAB(2)"Year";TAB(12)"Value";TAB(26)"Factor";TAB(36)"Value"
2830 LPRINT "-------";TAB(10)"----------";TAB(25)"--------";TAB(34)"---------"
2840 FOR I=1 TO NA
2850 LPRINT TAB(4)YE(I);TAB(11)EE(I);TAB(25)P(YE(I));TAB(35)INT(DE(I)+.5)
2860 NEXT I
2870 LPRINT:LPRINT
2880 IF NR=0 THEN 2960
2890 LPRINT "Project";TAB(10)"Repl Asset";TAB(25)"Discount";TAB(35)"Present"
2900 LPRINT TAB(2)"Year";TAB(12)"Value";TAB(26)"Factor";TAB(36)"Value"
2910 LPRINT "-------";TAB(10)"----------";TAB(25)"--------";TAB(34)"---------"
2920 FOR I=1 TO NR
2930 LPRINT TAB(4)YR(I);TAB(11)CR(I);TAB(25)P(YR(I));TAB(35)INT(RA(I)+.5)
2940 NEXT I
2950 LPRINT:LPRINT
2960 IF NM=0 THEN 3040
2970 LPRINT "Project";TAB(10)"Refurb/Mod";TAB(25)"Discount";TAB(35)"Present"
2980 LPRINT TAB(2)"Year";TAB(12)"Value";TAB(26)"Factor";TAB(36)"Value"
2990 LPRINT "-------";TAB(10)"----------";TAB(25)"--------";TAB(34)"---------"
3000 FOR I=1 TO NM
3010 LPRINT TAB(4)R(I);TAB(11)C(I);TAB(25)P(R(I));TAB(35)INT(ME(I)+.5)
3020 NEXT I
3030 LPRINT:LPRINT
3040 IF AE=0 THEN 3090
3050 LPRINT "Project";TAB(10)"Terminal";TAB(25)"Discount";TAB(35)"Present"
3060 LPRINT TAB(2)"Year";TAB(11)"Value";TAB(26)"Factor";TAB(36)"Value"
3070 LPRINT "-------";TAB(10)"----------";TAB(25)"--------";TAB(34)"---------"
3080 LPRINT TAB(4)L1+1;TAB(11)AE;TAB(25)P(L1+1);TAB(35)INT(TV+.5)
3090 RETURN
```

```
10 REM FORMAT A-1 ECONOMIC ANALYSIS PROGRAM - "A1BATCH"
20 REM BATCH MODE VARIANT OF PROGRAM "A1"
30 REM AUTHOR: A.A. STAGLIANO
40 REM COST ANALYSIS DIVISION (AV 974-5423)
50 REM WATERVLIET ARSENAL - WATERVLIET, N.Y.
60 CLS:COLOR 10,0
70 LOCATE 12,18:PRINT"*************************************************"
80 LOCATE 13,18:PRINT"****** Program A1 - Economic Analysis Package *******"
90 LOCATE 14,18:PRINT"*************************************************"
100 DIM P(36),O1(36),O2(36),I(36),DI(36),D(36),PD(36),RD(36),DF(36),DS(36)
110 DIM DT(36),ME(36),EE(36),DV(36),M(36),T(36),TV(36),RS(36),ID(36),SD(36)
120 DIM YE(36),CR(36),YR(36),R(36),C(36)
130 INPUT "Enter Name of Input File";F$
140 OPEN F$ FOR INPUT AS #1
150 REM READ TITLE DESCRIPTIONS
160 INPUT#1,A$,D$
170 INPUT#1,PRES$,PROP$
180 REM READ PROJECT LIFE & 1st YEAR OF ECONOMIC LIFE
190 INPUT#1,L1,B
200 LET ECLIFE=L1+1-B
210 REM READ PRESENT & PROPOSED OPERATING COST DATA
220 FOR I=1 TO L1
230 INPUT#1,O1(I)
240 NEXT I
250 FOR I=1 TO L1
260 INPUT#1,O2(I)
270 NEXT I
280 REM READ INVESTMENT DATA
290 INPUT#1,L
300 FOR I=1 TO L
310 INPUT#1,T(I),I(I)
320 NEXT I
330 REM READ EXISTING ASSETS EMPLOYED DATA
340 INPUT#1,NA
350 FOR I=1 TO NA
360 INPUT#1,YE(I),EE(I)
370 NEXT I
380 REM READ EXISTING ASSETS REPLACED DATA
390 INPUT#1,NR
400 FOR I=1 TO NR
410 INPUT#1,YR(I),CR(I)
420 NEXT I
430 REM READ TERMINAL VALUE DATA
440 INPUT#1,AE
450 REM READ REFURB/MOD ELIMINATED DATA
```

```
460 INPUT#1,NM
470 FOR I=1 TO NM
480 INPUT#1,R(I),C(I)
490 NEXT I
500 CLOSE
510 CLS:LOCATE 12,18:PRINT "****************************************"
520 LOCATE 13,18:PRINT "* Processing Data - Please Stand By *"
530 LOCATE 14,18:PRINT "****************************************"
540 REM READ 10% MID-YEAR DISCOUNT FACTORS
550 FOR I=0 TO L1+1
560 READ P(I)
570 NEXT I
580 DATA 1,.954,.867,.788,.717,.652,.592,.538,.489,.445,.405,.368,.334,.304
590 DATA .276,.251,.228,.208,.189,.172,.156,.142,.129,.117,.107,.097,.088
600 DATA .081,.073,.066,.060,.055,.050,.045,.041,.037
610 REM CALCULATE PRESENT ALTERNATIVE OPERATING COST
620 GOSUB 880
630 REM CALCULATE PROPOSED ALTERNATIVE OPERATING COST
640 GOSUB 940
650 REM CALCULATE DIFFERENTIAL OPERATING COST
660 GOSUB 1010
670 REM CALCULATE INVESTMENT COST
680 GOSUB 1110
690 REM EXISTING ASSETS EMPLOYED CALCULATION
700 GOSUB 1190
710 REM EXISTING ASSETS RELACED CALCULATION
720 GOSUB 1270
730 REM TERMINAL VALUE CALCULATION
740 GOSUB 1350
750 REM REFURBISHMENT/MODIFICATION CALCULATIONS
760 GOSUB 1410
770 REM TOTAL NEW PRESENT VALUE OF INVESTMENT
780 LET TNI=TDI+TAE-TAR-TTV
790 REM CALCULATE SAVINGS - INVESTMENT RATIO
800 GOSUB 1490
810 REM CALCULATE RETURN ON INVESTMENT
820 GOSUB 1550
830 REM PRINT RESULTS OF ANALYSIS
840 GOSUB 1800
850 REM PRINT INVESTMENT COSTS
860 GOSUB 2390
870 CLS:PRINT "Program A1 Loaded & Ready for Execution - Press F2 Key":END
880 REM PRESENT ALT. OPERATING COST SUBROUTINE
890 LET TDI=0
900 FOR I=1 TO L1
```

```
910 LET TO1=TO1+O1(I)
920 NEXT I
930 RETURN
940 REM PROPOSED ALT. OPERATING COST SUBROUTINE
950 LET TO2=0
960 FOR I=1 TO L1
970 LET TO2=TO2+O2(I)
980 LET TP=TP+P(I)
990 NEXT I
1000 RETURN
1010 REM DIFFERENTIAL & P.V. DIFFERENTIAL COST SUBROUTINE
1020 LET S=0:TDS=0
1030 FOR I=1 TO L1
1040 LET D(I)=O1(I)-O2(I)
1050 LET S=S+D(I)
1060 LET DS(I)=D(I)*P(I)
1070 LET TDS=TDS+INT(DS(I)+.5)
1080 LET RS(I)=D(I)
1090 NEXT I
1100 RETURN
1110 REM INVESTMENT COST SUBROUTINE
1120 LET TDI=0
1130 FOR I=1 TO L
1140 LET DI(I)=I(I)*P(T(I))
1150 LET TDI=TDI+DI(I)
1160 LET RD(T(I))=I(I)
1170 NEXT I
1180 RETURN
1190 REM EXISTING ASSETS EMPLOYED SUBROUTINE
1200 LET TAE=0
1210 FOR I=1 TO NA
1220 LET DE(I)=EE(I)*P(YE(I))
1230 LET TAE=TAE+DE(I)
1240 LET RD(YE(I))=RD(YE(I))+EE(I)
1250 NEXT I
1260 RETURN
1270 REM EXISTING ASSETS REPLACED SUBROUTINE
1280 LET TAR=0
1290 FOR I=1 TO NR
1300 LET RA(I)=CR(I)*P(YR(I))
1310 LET TAR=TAR+RA(I)
1320 LET RD(YR(I))=RD(YR(I))-CR(I)
1330 NEXT I
1340 RETURN
1350 REM TERMINAL VALUE SUBROUTINE
```

Appendix III (cont.)

```
1360 LET TTV=0
1370 LET TV=AE*P(L1+1)
1380 LET TTV=TTV+TV
1390 LET RD(L1+1)=RD(L1+1)-AE
1400 RETURN
1410 REM REFUBISHMENT - MODIFICATION ELIMINATED SUBROUTINE
1420 LET TMR=0
1430 FOR I=1 TO NM
1440 LET ME(I)=C(I)*P(R(I))
1450 LET TMR=TMR+ME(I)
1460 LET RS(R(I))=RS(R(I))+C(I)
1470 NEXT I
1480 RETURN
1490 REM SAVINGS - INVESTMENT SUBROUTINE
1500 LET SAV=0:INV=0:SIR=0
1510 LET SAV=TDS+TMR
1520 LET INV=TNI
1530 LET SIR=SAV/INV
1540 RETURN
1550 REM ROI SUBROUTINE
1560 IF SIR=1 THEN GOTO 1780
1570 LET F=1
1580 GOSUB 1670
1590 IF NSIR>=1 THEN LET ROI=101:GOTO 1790
1600 LET DELTA=-.32
1610 LET F=F+DELTA
1620 GOSUB 1670
1630 IF NSIR>1 AND DELTA<0 THEN DELTA=(-DELTA/2)
1640 IF NSIR<1 AND DELTA>0 THEN DELTA=(-DELTA/2)
1650 IF ABS(DELTA)<.0005 THEN ROI=F*100:GOTO 1790
1660 GOTO 1610
1670 FOR Y=0 TO L1+1
1680 LET DF(Y)=((1/((1+F)^(Y-1)))+(1/((1+F)^Y)))/2
1690 LET ID(Y)=RD(Y)*DF(Y)
1700 LET TID=TID+ID(Y)
1710 LET SD(Y)=RS(Y)*DF(Y)
1720 LET TSD=TSD+SD(Y)
1730 NEXT Y
1740 LET NSIR=TSD/TID
1750 LET TID=0
1760 LET TSD=0
1770 RETURN
1780 LET ROI=10
1790 RETURN
1800 REM PRINT RESULTS
```

Appendix III (cont.)

```
1810 LPRINT:LPRINT:LPRINT
1820 LPRINT "*************** Economic Analysis - Format A-1 ***************"
1830 LPRINT:LPRINT
1840 LPRINT "Project Title: ";A$
1850 LPRINT "Date of Analysis: ";D$
1860 LPRINT "Present Alternative: ";PRES$
1870 LPRINT "Proposed Alternative: ";PROP$
1880 LPRINT TAB(1)"Project Life :";TAB(19)L1;TAB(24)"Years"
1890 LPRINT TAB(1)"Economic Life :";TAB(19)ECLIFE;TAB(24)"Years"
1900 LPRINT
1910 LPRINT "Project";TAB(12)"Operations";TAB(28)"Differential";TAB(41)"Discount";TAB(51)"Present Value"
1920 LPRINT TAB(2)"Year";TAB(9)"Present";TAB(19)"Proposed";TAB(32)"Cost";TAB(43)"Factor";TAB(52)"Diff. Cost"
1930 LPRINT "-------";TAB(9)"-------";TAB(19)"--------";TAB(28)"-----------";TAB(41)"--------";TAB(51)"------------"
1940 LPRINT
1950 FOR I= 1 TO L1
1960 LET O(I)=INT(O(I)+.5)
1970 LET OS(I)=INT(OS(I)+.5)
1980 LPRINT TAB(2)I;TAB(7)O1(I);TAB(17)O2(I);TAB(29)O(I);TAB(41)P(I);TAB(53)OS(I)
1990 NEXT I
2000 LPRINT
2010 LET S=INT(S+.5)
2020 LPRINT "Total";TAB(53)TOS
2030 REM PRINT SAVINGS - INVESTMENT DATA
2040 LPRINT
2050 LET K$="**********"
2060 LET M$="###,###"
2070 LPRINT"Total Present Value of New Investment:";
2080 LPRINT USING K$;TOI
2090 LPRINT
2100 LPRINT"Value of Existing Assets Employed:";
2110 LPRINT USING K$;TAE
2120 LPRINT
2130 LPRINT "Value of Existing Assets Replaced:";
2140 LPRINT USING K$;TAR
2150 LPRINT
2160 LPRINT "Discounted Terminal Value of Investment:";
2170 LPRINT USING K$;TTV
2180 LPRINT
2190 LPRINT "Total New Present Value of Investment:";
2200 LPRINT USING K$;TNI
2210 LPRINT
2220 LPRINT "Present Value of Cost Savings (Operations):";
2230 LPRINT USING K$;TOS
2240 LPRINT
2250 LPRINT "P.V. Cost of Refurb. or Mod. Eliminated:";
```

Appendix III (cont.)

```
2260 LPRINT USING K$;TMR
2270 LPRINT
2280 LPRINT "Total Present Value of Savings:";
2290 LPRINT USING K$;SAV
2300 LPRINT
2310 LPRINT "Savings/Investment Ratio:";
2320 LPRINT USING M$;SIR
2330 LPRINT
2340 LPRINT "Return on Investment:";
2350 IF ROI=101 THEN LPRINT "  >100":GOTO 2370
2360 LPRINT USING M$;ROI
2370 LET TP=0
2380 RETURN
2390 REM ************************************************************
2400 REM ************ PRINT INVESTMENT DATA ************************
2410 REM ************************************************************
2420 LPRINT:LPRINT
2430 LPRINT "********** Investment - Assets Data **********"
2440 LPRINT
2450 LPRINT "Project";TAB(10)"Investment";TAB(25)"Discount";TAB(35)"Present"
2460 LPRINT TAB(2)"Year";TAB(12)"Amount";TAB(26)"Factor";TAB(36)"Value"
2470 LPRINT "-------";TAB(10)"----------";TAB(25)"--------";TAB(34)"---------"
2480 LPRINT
2490 FOR I=1 TO L
2500 LPRINT TAB(4)T(I);TAB(11)I(I);TAB(25)P(T(I));TAB(35)INT(DI(I)+.5)
2510 NEXT I
2520 LPRINT:LPRINT
2530 IF NA=0 THEN 2600
2540 LPRINT "Project";TAB(10)"Exist Asset";TAB(25)"Discount";TAB(35)"Present"
2550 LPRINT TAB(2)"Year";TAB(12)"Value";TAB(26)"Factor";TAB(36)"Value"
2560 LPRINT "-------";TAB(10)"-----------";TAB(25)"--------";TAB(34)"---------"
2570 FOR I=1 TO NA
2580 LPRINT TAB(4)YE(I);TAB(11)EE(I);TAB(25)P(YE(I));TAB(35)INT(DE(I)+.5)
2590 NEXT I
2600 LPRINT:LPRINT
2610 IF NR=0 THEN 2690
2620 LPRINT "Project";TAB(10)"Repl Asset";TAB(25)"Discount";TAB(35)"Present"
2630 LPRINT TAB(2)"Year";TAB(12)"Value";TAB(26)"Factor";TAB(36)"Value"
2640 LPRINT "-------";TAB(10)"----------";TAB(25)"--------";TAB(34)"---------"
2650 FOR I=1 TO NR
2660 LPRINT TAB(4)YR(I);TAB(11)CR(I);TAB(25)P(YR(I));TAB(35)INT(RA(I)+.5)
2670 NEXT I
2680 LPRINT:LPRINT
2690 IF NM=0 THEN 2770
2700 LPRINT "Project";TAB(10)"Refurb/Mod";TAB(25)"Discount";TAB(35)"Present"
```

```
2710 LPRINT TAB(2)"Year";TAB(12)"Value";TAB(26)"Factor";TAB(36)"Value"
2720 LPRINT "-------";TAB(10)"----------";TAB(25)"--------";TAB(34)"---------"
2730 FOR I=1 TO NM
2740 LPRINT TAB(4)R(I);TAB(11)C(I);TAB(25)P(R(I));TAB(35)INT(ME(I)+.5)
2750 NEXT I
2760 LPRINT:LPRINT
2770 IF AE=0 THEN 2820
2780 LPRINT "Project";TAB(10)"Terminal";TAB(25)"Discount";TAB(35)"Present"
2790 LPRINT TAB(2)"Year";TAB(12)"Value";TAB(26)"Factor";TAB(36)"Value"
2800 LPRINT "-------";TAB(10)"--------";TAB(25)"--------";TAB(34)"---------"
2810 LPRINT TAB(4)L1+1;TAB(11)AE;TAB(25)P(L1+1);TAB(35)INT(TV+.5)
2820 RETURN
```

Appendix III (cont.)

```
A:eqlin batch1
New file
*i
      1:*"Modification of the M355 Armament System","4 June FYxx"
      2:*"Brush & Scrape"
      3:*"Automatic Dip Tanks"
      4:*10,3
      5:*908480,908480,908480,1051560,1058560,1058560,1058560,1058560,
1058560,1058560
      6:*908480,908480,759660,759660,759660,759660,759660,759660,759660,
759660
      7:*3
      8:*1.229900,2.97000,8.28000
      9:*1
     10:*0,182425
     11:*1
     12:*2,130843
     13:*14000
     14:*0
     15:*'C

*e
```

```
BASICA
LOAD"a1
OK
RUN
**********************************************************
****** Program A1 - Economic Analysis Package *******
**********************************************************
Project Title? Modification of the M355 Armament System
Today's Date? 4 June FYXX
Present Alternative: ? brush & Scrape
Proposed Alternative: ? Automatic Dip Tanks
Number of Project Years? 10
Project Year Economic Life Begins? 3
Are Present And/Or Proposed Operating Costs Constant (y or n)? n
Enter Present Cost For Project Year 1
? 908480
Enter Present Cost For Project Year 2
? 908480
Enter Present Cost For Project Year 3
? 908480
Enter Present Cost For Project Year 4
? 1051560
Enter Present Cost For Project Year 5
? 1058560
Enter Present Cost For Project Year 6
? 1058560
Enter Present Cost For Project Year 7
? 1058560
Enter Present Cost For Project Year 8
? 1058560
Enter Present Cost For Project Year 9
? 1058560
Enter Present Cost For Project Year 10
? 1058560
Enter Proposed Cost For Project Year 1
? 908480
Enter Proposed Cost For Project Year 2
? 908480
Enter Proposed Cost For Project Year 3
? 759660
Enter Proposed Cost For Project Year 4
? 759660
Enter Proposed Cost For Project Year 5
? 759660
Enter Proposed Cost For Project Year 6
? 759660
Enter Proposed Cost For Project Year 7
? 759660
Enter Proposed Cost For Project Year 8
? 759660
Enter Proposed Cost For Project Year 9
? 759660
Enter Proposed Cost For Project Year 10
? 759660
```

```
How Many Years of Investment? 3
Enter Project Year of Investment & Investment Value? 1,229900
Enter Project Year of Investment & Investment Value? 2,97000
Enter Project Year of Investment & Investment Value? 8,28000
Are Existing Assets Employed on this Project(y or n)? y
Number of Items Under Consideration? 1
Project Year Employed & Net Value of Existing Assets Employed? 0,182425
Will Existing Assets Be Replaced(y or n)? y
How Many Items Will Be Replaced? 1
Project Year Asset Replaced & Net Value of Replaced Asset? 2,130843
Is Terminal Value Claimed(y or n)? y
Terminal Value? 14000
Have Refurbishment or Modification Costs Been Eliminated(y or n)? n
**************************************
* Processing Data - Please Stand By *
**************************************
^C
Break in 1310
Ok



LOAD"a1batch
Ok
RUN
************************************************************
****** Program A1 - Economic Analysis Package *******
************************************************************
Enter Name of Input File? batch1
**************************************
# Processing Data - Please Stand By *
**************************************
```

Appendix V (cont.)

END

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