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Computer Assisted Yarding Cost Analysis

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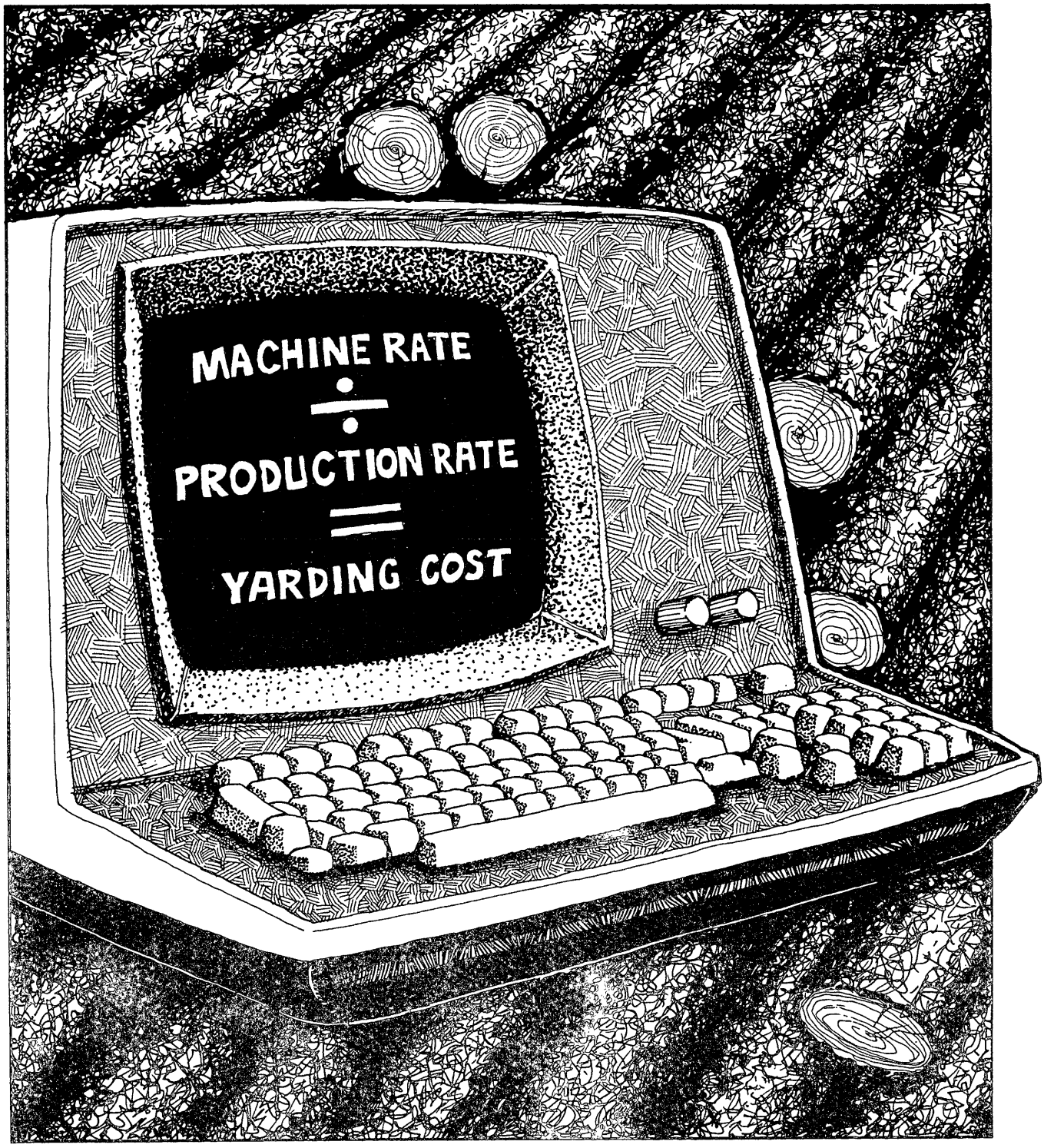

Abstract

Programs for a programable calculator and a desk-top computer are provided for quickly determining yarding cost and comparing the economics of alternative yarding systems. The programs emphasize the importance of the relationship between production rate and machine rate, which is the hourly cost of owning and operating yarding equipment. In addition to generating the data required for analyzing the cost of a yarding operation, the desk-top program plots the yarding cost versus production rate curve. Examples and simple step-by-step operating procedures are included.

Metric Equivalents

1 acre = 0.4047 hectare
1 gallon = 3.785 liters
1 foot = 0.3048 meter

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Introduction

Good logging planning is characterized by a systematic evaluation of alternatives and selection of the yarding system that best meets environmental and silviculture criteria for the least cost. Comprehensive cost analysis is needed in the planning stage to compare acceptable yarding systems.

This report presents programs for a programable calculator and a desk-top computer for determining yarding cost and comparing alternative yarding systems. Both programs are based on the yarding cost structure given by Mifflin and Lysons (1978)1. Cost formulation is automated to enable the planner to quickly compare alternatives.

Nature of the Problem

Selecting low priced equipment to reduce yarding cost may not be the solution to economical yarding. Although equipment prices are high, the cost of owning the equipment is generally overshadowed by operating costs. Ownership and operating costs, when combined and expressed on an hourly basis, make up the machine rate. Mifflin and Lysons (1978) (see footnote 1) presented the breakdown of the cost components which make up machine rate (see figure 1). Production rate is often a more critical factor in determining yarding cost and is generally the most difficult aspect of yarding to predict. Production rate is defined as the volume of timber brought to the landing per unit of time. The cost of road changes (moving the yarder and rigging the lines) and the cost of moving the equipment in and out also affect the yarding cost.

1Mifflin, Ronald W., and Hilton H. Lysons. 1978. Skyline yarding cost estimating guide. USDA For. Serv. Res. Note PNW-325, 19 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

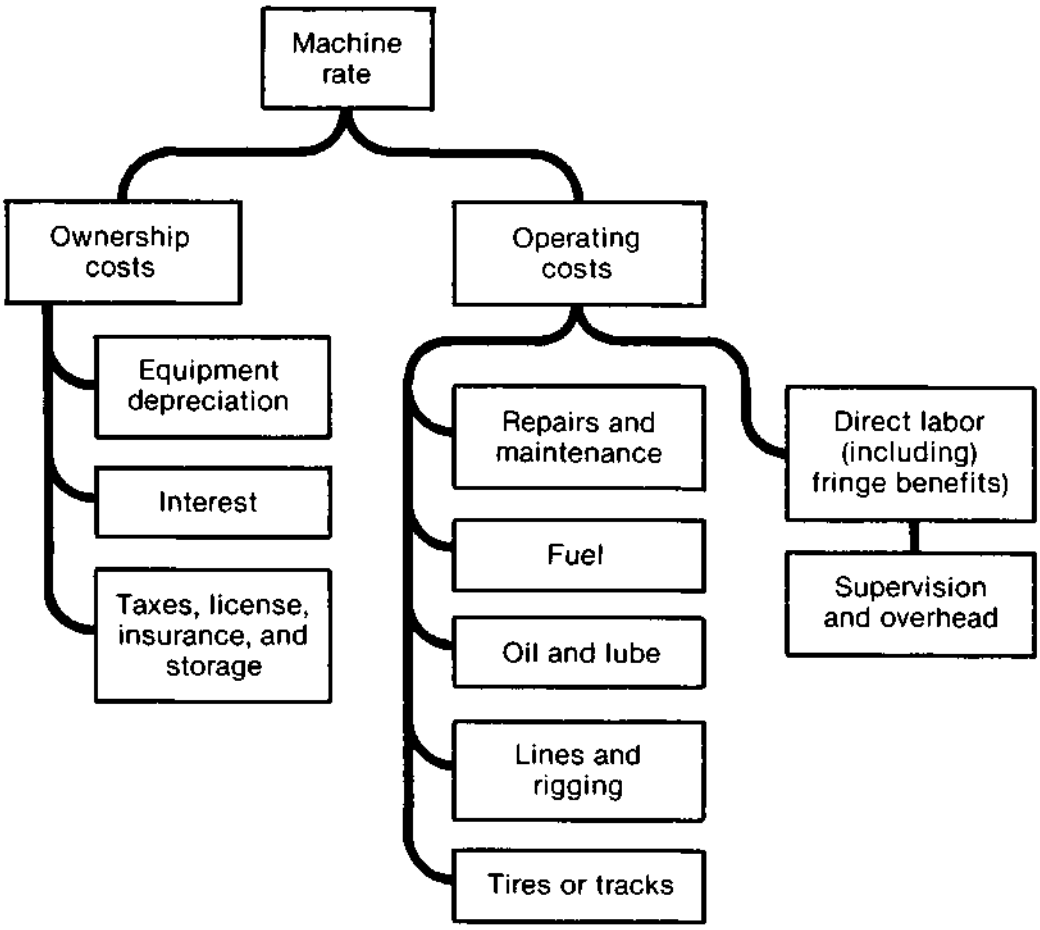

Figure 1.—Machine rate cost elements.

The yarding cost equation is expressed as

$$\text{MACHINE RATE (\$/HOUR)} + \frac{\text{X TOTAL ROAD CHANGE TIME (HOURS)}}{\text{TOTAL AREA (ACRES) X YIELD (VOLUME/ACRE)}} + \frac{\text{MOVE IN AND MOVE OUT COST}}{\text{TOTAL AREA (ACRES) X YIELD (VOLUME/ACRE)}}.$$

The importance of the yarding cost equation is shown in figure 2. The curve is the plot of the equation for a given, constant machine rate.

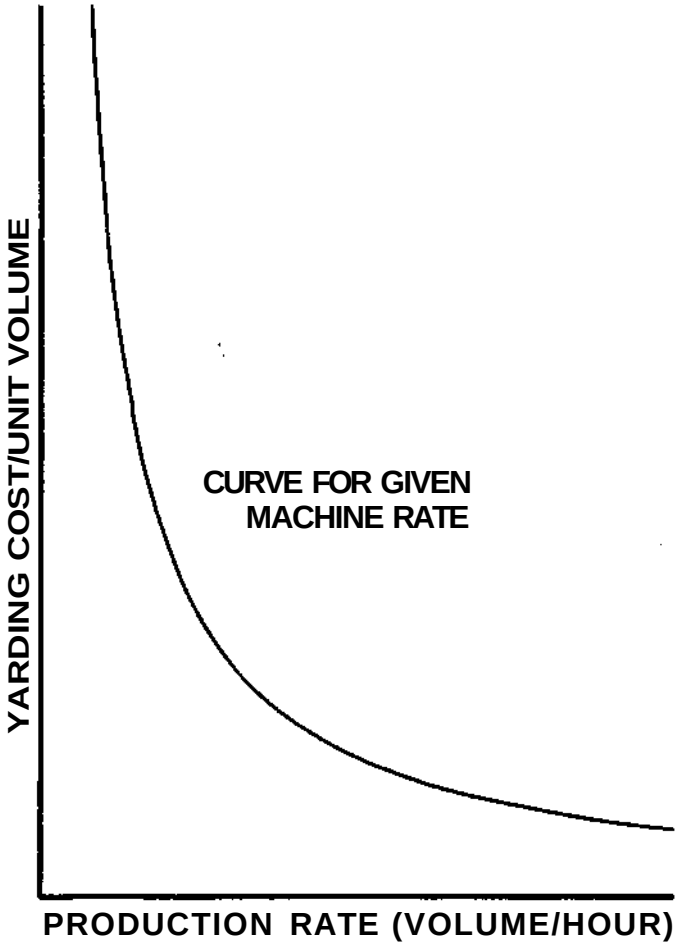

Figure 2.—Yarding cost versus production rate.

The most significant feature of the curve is the sensitivity of yarding cost to changes in production rate. Production rate can be expressed algebraically as follows:

PRODUCTION RATE = AVERAGE LOG VOLUME X LOGS PER TURN X TURNS PER HOUR.

The average number of logs per turn tends to be constant for a system, and is usually determined by the ability to gather scattered logs into a turn. The number of turns per hour is primarily dependent on machine design for a given yarding application. Log volume is therefore the most influential element in the production rate equation. Thus, in figure 2 the lower production rate generally denotes small logs; and the higher rate, or right-hand portion of the curve, denotes larger logs. With the inherently low production rate for small logs, yarding cost is highly sensitive to minor production rate variations due to the steepness of the curve.

The time spent operating in the woods is defined as operating time. Figure 3 shows the components which make up operating time. Productive time is the portion in which yarding takes place; that is, the cycle time. The fixed time elements are normally constant for a particular yarding system on a per setting basis. Hooking and unhooking chokers are independent of yarding distance. The inhaul and outhaul of chokers are directly related to yarding distance and are therefore variable times. Nonproductive time includes road change time (rigging and moving to a new yarding road), move in and move out time, and delay time. No yarding takes place during these times. The following example illustrates the cost sensitivity

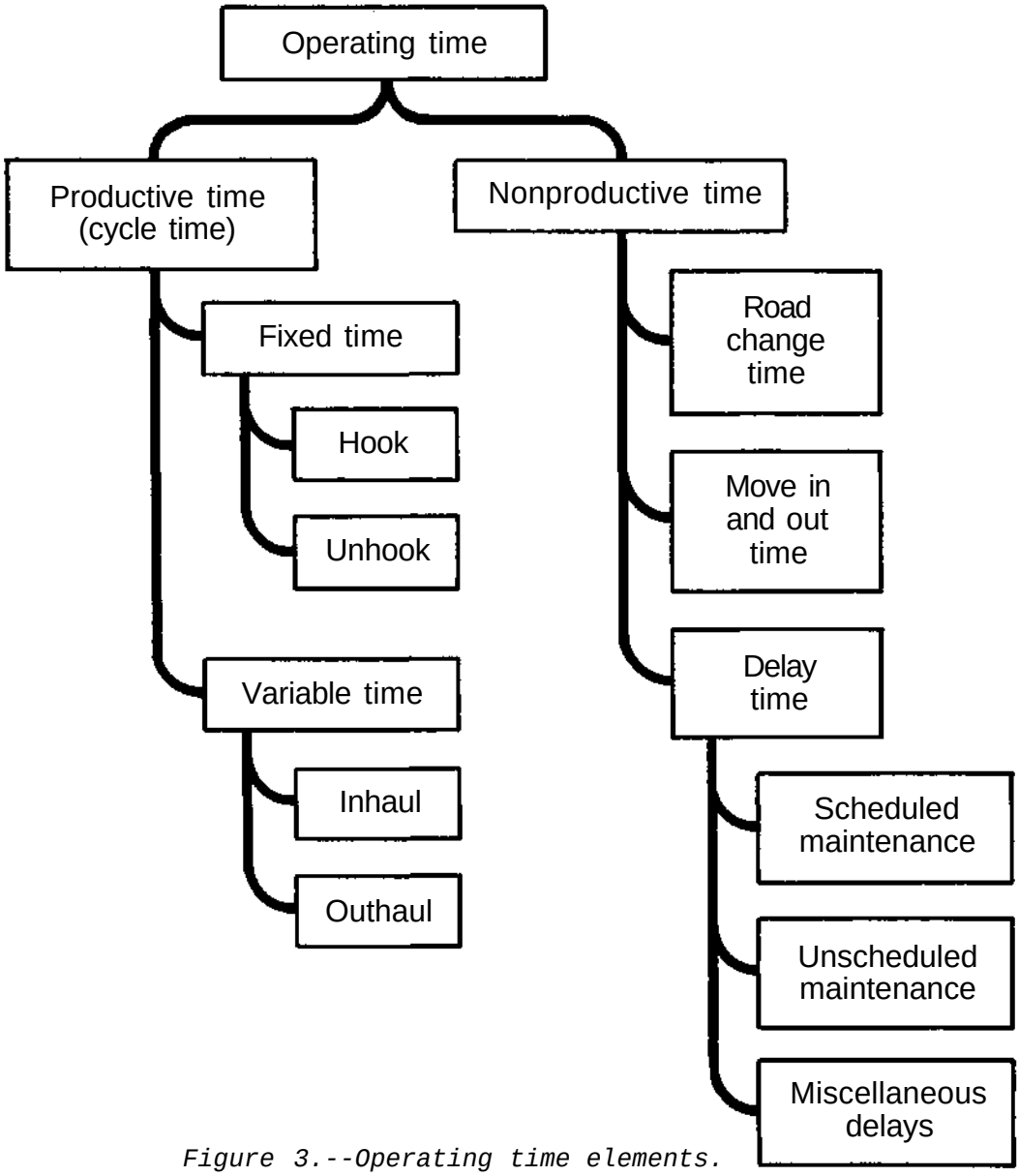

Figure 3.--Operating time elements.

of small-log harvesting and the usefulness of making a detailed cost analysis when comparing alternative yarding systems.

Two small-log yarding systems for use in thinning operations are compared on the basis of cost. Both systems employ skyline yarders operated by a crew of three. Cost and production data are estimated for both yarders and detailed in table 1. The equipment investment for System 1 is $70,000. System 2 equipment is valued at $140,000. The machine rates are $65.59 for System 1 and $79.13 for System 2. Thus, a 100-percent increase in equipment cost results in machine rate increase of only 21 percent.

It is assumed that added design features of the System 2 yarder lower its yarding cycle time and reduce delays. This raises productivity by increasing turns per hour. The production rate for System 2 is 3.5 cunits[2]/hour compared to 2.1 cunits/hour achieved with System 1. Log volume is assumed to be 10 cubic feet (0.1 cunit), and turn size averages 3.5 logs per turn for both systems. The difference in production rate is due to the number of turns per hour: 10 for System 2 and 6 for System 1.

The gain in production rate for System 2 is achieved at the expense of doubling the cost of equipment. On a cost per unit volume basis, however, the cost saving is significant. The yarding cost for System 2 is $24.54/cunit, a 26-percent decrease from the $33.08/cunit cost for System 1. The plot of the yarding cost equation in figure 4 illustrates this situation.

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[2]A cunit is a unit of volume measuring 100 cubic feet.

Table 1--Example cost and production data

Item	Unit	System 1	System 2
Equipment cost	Dollars	70,000	140,000
Residual	Percent equipment cost	20	20
Depreciation period	Years	7	7
Repairs and maintenance	Percent equipment depreciation	50	50
Annual interest rate	Percent	12	12
Tax, license, insurance, and storage	Percent	9	9
Operating season	Days worked/year	200	200
Operating time per day	Hours	8	8
Fuel consumption	Gallons/hour	2	2
Fuel cost	Dollars/gallon	.80	.80
Oil and lube	Percent fuel consumption	5	5
Oil and lube cost	Dollars/gallon	1.50	1.50
Line cost	Dollars	3,600	3,600
Line life	Hours	1600	1600
Rigging cost	Dollars	1,000	1,000
Rigging life	Hours	800	800
Tire or track replacement cost	Dollars	0	0
Total crew wage	Dollars/hour	30	30
Fringe benefits	Percent total crew wage	30	30
Travel time per day	Hours	0	0
Supervision and overhead	Percent direct labor	20	20
Cutting unit area	Acres	35	35
Yield per acre	Cunits	40	40
Average volume per piece as bucked	Cunits	0.1	0.1
Average number of pieces per turn		3.5	3.5
Average number of turns per hour		6	10
Number of yarding roads in unit		10	10
Time per road change	Hours	1	1
Move in and move out cost	Dollars	2,000	2,000
Ownership cost	Dollars/hour	11.04	22.08
Operating cost	Dollars/hour	54.55	1/ 57.05
Machine rate	Dollars/hour	65.59	79.13
Production rate	Cunit/hour	2.1	3.5
Road change cost	Dollars/cunit	0.42	0.51
Move in and move out cost	Dollars/cunit	1.43	1.43
Yarding cost	Dollars/cunit	33.08	24.54

i/The operating costs for the two systems would be equal except that repairs and maintenance cost (a part of operating cost) increases proportionately with an increase in equipment cost.

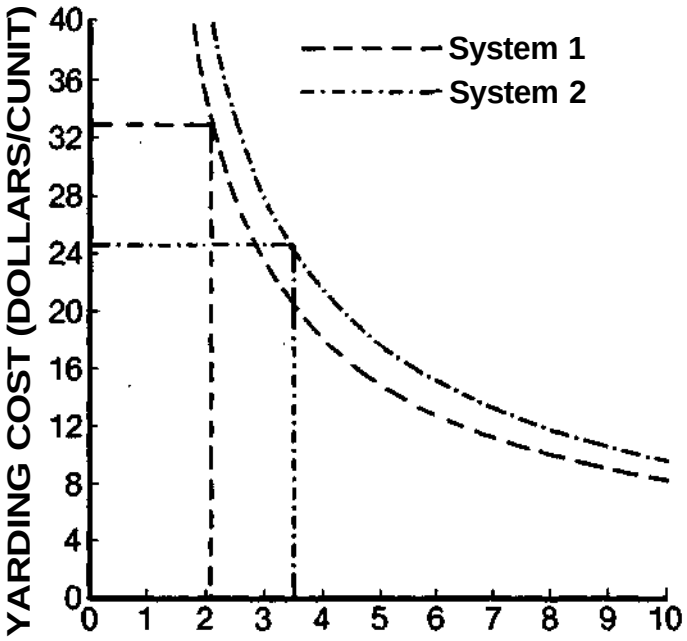

Figure 4.—Yarding cost versus production rate curves for System 1 and System 2.

Application

The programable calculator and desk-top computer programs require inputs relating to ownership cost, operating cost, cruise data, and production rate estimates. These values are entered in a format based on the worksheets developed by Mifflin and Lysons (1978)(see footnote 1). The programs compute yarding cost and production rate using data initially entered as base values. These can be changed and the results of these new values compared to the base values.

The desk-top computer program supplies printed output not available on the calculator. Input values and results are documented. The desk-top program also plots curves to help the planner visualize the sensitivity of the relationship between yarding cost and production rate (figure 4).

The desk-top program, although it may appear complicated or lengthy, is a straight-forward, step-by-step method for determining machine rate and yarding cost. Once that is done, a number of optional steps may be taken to produce a more detailed yarding system cost analysis. The basic functions of the program are shown in figure 5.

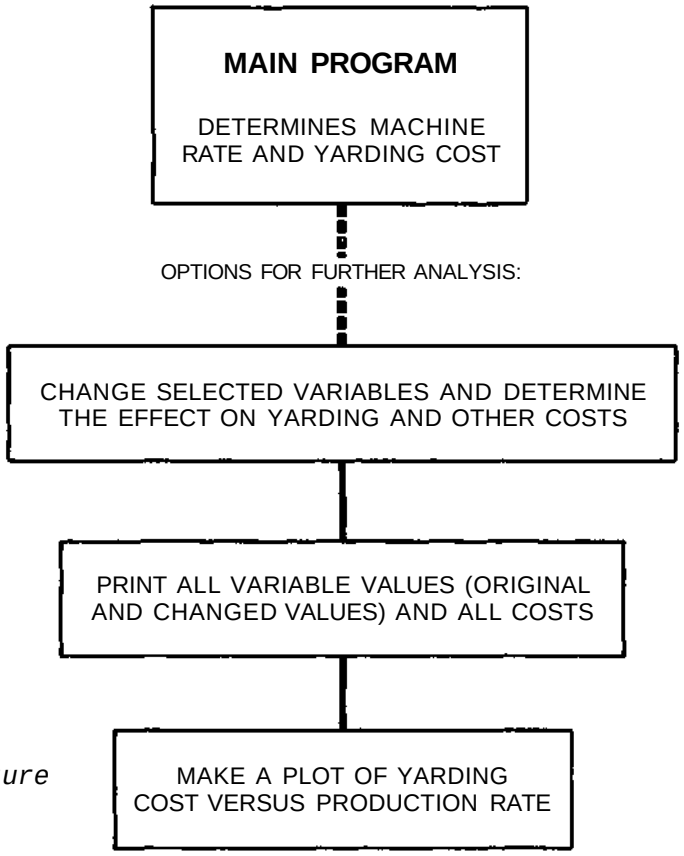

Figure 5.—Basic structure of desk-top computer program.

User's Guide

Operating instructions and program listings are given for a programable calculator and a desk-top computer system. They were developed on, but not limited for use on, a Hewlett-Packard 97[3] or 67 calculator and a 9845A or 9845B desk-top computer using ASCII BASIC language. The desk-top system requires a minimum internal memory capacity of 50,000 bytes. Certain output may be generated on a peripheral plotting device if available, as well as on the CRT screen or internal printer. The program was developed to use the Hewlett-Packard 9872A plotter.

[3] Mention of trade names does not constitute endorsement by the USDA Forest Service over other brands that can do equivalent functions.

Operation of Programable Calculator Program

The following procedures presume a knowledge of the Hewlett-Packard 97/67 or 9845A/B system operation. Only instructions pertaining to the use of these programs will be provided.

The inputs to this program are similar to the worksheets developed by Mifflin and Lysons (1978)(see footnote 1) for determining machine rate, production rate, and yarding cost. The program provides a faster means of computing the same values that can be derived by hand using the worksheets.

General Information

1. This program is comprised of three sections. The first computes ownership cost and is entered through key A. The second computes operating cost and is entered through key C. The third calculates production rates and yarding costs and is entered through key D or key E.

2. Only one piece of equipment at a time may be entered, unlike the desk-top computer program which allows up to nine pieces to be analyzed simultaneously.

3. Values for all variables must be entered. If variables are not applicable or are zero, they must be entered as zero.

4. If a mistake is made while entering values, either continue on through the section and then start the section over, or press "GTO" then ".001," and start the section over.

5. If you desire to change one or more variables in a section, the variables for the entire section must be re-entered. Also, if Section I is redone, Section II must also be redone. Section II or Section 111, however, can be redone alone.

6. Certain machine or production values may be accessed during or after program completion. Table 2 shows what values are stored and where they reside. Values are displayed by pressing "RCL," the recall key, then the appropriate storage register key (A, B, C, D, E or 0-9).

Table 2--Storage register values

Storage register	Value displayed after completion of Section: I	II	III
A	residual value	residual value	residual value
B	equipment depreciation	equipment depreciation	equipment depreciation
C	average annual investment	average annual investment	average annual investment
D	hours worked per day	hours worked per day	hours worked per day
E	hours worked per year	hours worked per year	hours worked per year
0	taxes, license, insurance, and storage cost	taxes, license, insurance, and storage cost	taxes, license, insurance, and storage cost
1	ownership cost (dollars/hour)	ownership cost (dollars/hour)	ownership cost (dollars/hour)
2		operating cost (dollars/hour)	operating cost (dollars/hour)
3		machine rate (dollars/hour)	machine rate (dollars/hour)
4		supervision and overhead (percent)	gross production rate (volume/hour)
5		fuel consumed (gallons/hour)	gross road change cost (dollars/unit volume)
6	depreciable value	depreciable value	gross move in and move out cost (dollars/unit volume)
7	depreciation period	depreciation period	gross yarding cost (dollars/unit volume)
8			(100-percent defect)/l00
9			net yarding cost (dollars/unit volume)

Operating Procedures

1. Set calculator to "run" and "manual" modes.

2. Insert sides 1 and 2 of program card. Display will read 0.00.

A sample response is shown in parentheses following each step. Sample output is shown following all input steps. The relationship between program input and use of the worksheets can be seen by comparing the inputs (shown in parentheses) with the bold-faced values entered on the worksheets, pages 14 through 17.

Section I. Ownership Cost

1. Key in: Equipment cost, press ENTER+ **(140000)**
   Key in: Residual (percent of equipment cost), press ENTER+ **(20)**
   Key in: Depreciation period,(years), press A **(7)**
   Display: equipment depreciation (dollars/year) **16000.00**

2.	Key in:	Annual interest rate (percent), press ENTER+	**(12)**
	Key in:	Taxes, license, insurance, and storage (percent of average annual investment), press ENTER+	**(9)**
	Key in:	Operating season (days worked/year), press ENTER+	**(200)**
	Key in:	Operating time per day (hours), press **A**	**(8)**
		Display and print: ownership cost, dollars/hour	22.08

Section **II.** Operating **Cost**

1.	Key in:	Repairs and maintenance cost (percent of equipment depreciation), press ENTER+	**(50)**
	Key in:	Fuel **consumption,(gallons/hour),** press ENTER+	(2)
	Key in:	Fuel cost (dollar/gallon), press C	**(.80)**
		Display: repairs and maintenance cost, dollars/hour	5.00
2.	Key in:	Oil and lube (percent of fuel consumption), press ENTER+	(5)
	Key in:	Oil and lube cost (dollars/gallon), press ENTER+	(1.50)
	Key in:	Line cost, press ENTER+	(3600)
	Key in:	Line life (hours), press C	(1600)
		Display: oil and lube cost, dollars/hour	0.15
3.	Key in:	Rigging cost, press ENTER+	(1000)
	Key in:	Rigging life (hours), press ENTER+	**(800)**
	Key in:	Tire or track replacement cost, press ENTER?	**(0)**
	Key in:	Tire or track life (hours), press **C**	**(0)**
		Display: rigging cost, dollars/hour	**1.25**
4.	Key in:	Total crew wage, press ENTER\+	**(30)**
	Key in:	Percent fringe benefits, press ENTER+	**(30)**
	Key in:	Travel time (hours/day), press ENTER+	**(0)**
	Key in:	Supervision and overhead (percent of direct labor cost), press C	(20)
		Print: operating cost, dollars/hour	57.05
		Display and print: machine rate, dollars/hour	79.13

Section III. Yarding Costs

Unknown production rate:

1. Key in: Average volume per piece as bucked, press ENTER+ **(.1)**
   Key in: Average number of pieces per turn, press ENTER+ (3.5)
   Key in: Average number of turns per hour, press D (10)
   Display: gross production rate, unit volume/hour 3.50

2. Key in: Percent defect in pieces as yarded, press ENTER+ **(10)**
   Key in: Number of yarding roads in cutting unit, press ENTER+ **(10)**
   Key in: Time per road change (hours), press ENTER+ **(1)**
   Key in: Move in and move out cost, press D **(2000)**
   Display: (100-percent defect)/100 **0.90**

3. Key in: Area of unit, press ENTER+ (35)
   Key in: Yield (unit volume/unit area), press D **(40)**
   Print: remainder of output
   (see Sample Output, p. 13)

Known production rate:

1. Key in: Production rate (unit volume/hour), press E (3.5)
   Display: gross production rate, unit volume/hour 3.50
2. Key in: Percent defect in pieces as yarded, press ENTER+ (10)
   Key in: Number of settings in cutting unit, press ENTER+ (10)
   Key in: Time per setting change (hours), press ENTER+ **(1)**
   Key in: Move in and move out cost, press E (2000)
   Display: (100-percent defect)/100 0.90

3. Key in: Area of unit, press ENTER+ (35)
   Key in: Yield (unit volume/unit area), press E **(40)**
   Print: remainder of output
   (see Sample Output, p. 13)

Sample Output

During execution, costs and production rates are printed on the **HP-97** tape. At completion of the program, the tape output will appear as shown below:

22.08	***	Ownership cost, dollars/hour
57.05	***	Operating cost, dollars/hour
79.13	***	Machine rate, dollars/hour
3.50	***	Gross production rate, unit volume/hour
3.15	***	Net production rate, unit volume/hour
0.51	***	Gross road change cost, dollars/unit volume
1.43	***	Gross move in and out cost, dollars/unit volume
0.57	***	Net road change cost, dollars/unit volume
1.59	***	Net move in and out cost, dollars/unit volume
24.54	***	Gross yarding cost, dollars/unit volume
27.27	***	Net yarding cost, dollars/unit volume

Equipment Ownership Cost

Delivered equipment cost $ 140000

Less line and rigging cost - $ —

Less tire or track replacement cost - $ —

Less residual (salvage) value - $ 2800 (=20%)

Depreciable value $ 112000

Equipment depreciation: (Depreciable value) / (Depreciation period) = ($112000) / (7 yr) $ 16000 /yr

Average annual investment: [(Depreciable value) x (Depreciation period + 1)] / [2 x (Depreciation period)] + (Residual value)

= [($112000) x (8)] / [2 x (7)] + ($28000) = $ 92000 /yr

Interest expense: (Annual interest rate) x (Average annual investment) = (12 %) x ($ 92000 /yr) + $ 11040 /yr

Taxes, license, insurance & storage: ___ % of Average annual investment = (9 %) x ($ 92000 /yr) + $ 8280 /yr

Annual ownership cost: $ 35320 /yr

Annual utilization: (200 days worked/yr) x (8 hours worked/day) = 1600 hr/yr

Ownership cost: (Annual ownership cost) / (Annual utilization) = ($ 35320 /yr) / (1600 hr/yr) $ 22.08 /yr

Equipment Operating Cost

Repairs and maintenance: $\frac{\text{\% of Equipment depreciation}}{\text{Annual utilization}} = \frac{(50\%)x\ (\$\ 1600\ /yr)}{(\ 1600\ hr/yr)}$ $ 5.00 /hr

Fuel: (2 gal/hr) x ($ .80 /gal) + $ 1.60 /hr

Oil & lubricants: (___ % of fuel consumption) x (unit cost) = (5 %) x (____ gal/hr) x ($ 1.50 /gal) + $ 0.15 /hr

Lines: $\frac{\text{(Cost)}}{\text{(Estimated life)}} = \frac{(\$3600)}{(1600\ hr)}$ + $ 2.25 /hr

Rigging: $\frac{\text{(Cost)}}{\text{(Estimated life)}} = \frac{(\$\ 1000)}{(\ 800\ hr)}$ + $ 1.25 /hr

Tires or tracks: $\frac{\text{(Replacement cost)}}{\text{(Estimated life)}} = \frac{(\$\ 0)}{(\ 0\ hr)}$ + $ 0 /hr

Crew position: _____ _____ _____ _____ _____ _____

Base wage: $ 11 /hr + $ 10 /hr + $ 9 /hr + $ ____ /hr + $ ____ /hr + $ ____ /hr

Total crew wage: $ 30 /hr

Direct labor cost: (Total crew wage) x $\left[\frac{(100 + \text{\% fringe benefits})}{100} + \frac{\text{(travel time/day)}}{\text{(operating time/day)}}\right]$

= ($ 30 /hr) x $\left[\frac{(100 + 30\ \%)}{100} + \frac{(\ 0\ hr/day)}{(\ 8\ hr/day)}\right]$ + $ 39.00 /hr

Supervision and overhead: ____ % of direct labor cost = (20%)x($39.00/hr) + $ 7.80 /hr

Operating cost: $ 57.05 /hr

Machine rate: (Ownership cost) + (Operating cost) = ($ 22.08 /hr) + ($ 57.05 /hr) $ 79.13 /hr

Equipment Ownership Cost

Delivered equipment cost $ 140000

Less line and rigging cost - $ —

Less tire or track replacement cost - $ —

Less residual (salvage) value - $ 2800 (=20%)

Depreciable value $ 112000

Equipment depreciation: $\frac{\text{(Depreciable value)}}{\text{(Depreciation period)}} = \frac{(\$112000)}{(7\ \text{yr})}$ $ 16000 /yr

Average annual investment: $\frac{\text{(Depreciable value) x (Depreciation period + 1)}}{2 \times \text{(Depreciation period)}}$ + (Residual value)

$= \frac{(\$112000) \times (8)}{2 \times (7)}$ + ($28000) = $ 92000 /yr

Interest expense: (Annual interest rate) x (Average annual investment) = (12 %) x ($ 92000 /yr) + $ 11040 /yr

Taxes, license, insurance & storage: ___ % of Average annual investment = (9 %) x ($ 92000 /yr) + $ 8280 /yr

Annual ownership cost: $ 35320 /yr

Annual utilization: (200 days worked/yr) x (8 hours worked/day) = 1600 hr/yr

Ownership cost: $\frac{\text{(Annual ownership cost)}}{\text{(Annual utilization)}} = \frac{(\$\ 35320\ /\text{yr})}{(1600\ \text{hr/yr})}$ $ 22.08 /yr

Calculations

Number of turns: $\frac{\text{(Gross volume, VT)}}{\text{(Volume per turn, vt)}} = \frac{(1400\text{cun})}{(3.5\ \text{cunits})} = 4000$

Operating time: $\frac{\text{(Number of turns)}}{\text{(Adjusted turns per hour, c)}} + \text{Total setting change time}$

$= \frac{(4000)}{(10)} + 9\ \text{hr} = 409\ \text{hours}$

Yarding cost: (Machine rate) x (Operating time) = ($79.73/hr) x (409 hr) = $32364.17

Add move-in and move-out cost, M: + $2000.00

Total yarding cost: $34364.17

Yarding cost per gross unit volume: $\frac{\text{(Yarding cost)}}{\text{(Gross volume, VT)}} = \frac{(\$34364.17)}{(1400)} =$ $24.54/cunit

Net volume: (Gross volume, V_T) x $\frac{\text{(100 - \% defect, D)}}{100} = (1400) \times \frac{(100 - 10\ \%)}{100} =$ 1260 cunits

Yarding cost per net unit volume: $\frac{\text{(Yarding cost)}}{\text{(Net volume)}} = \frac{(\$34364.17)}{(1260)} =$ $27.27/cunit

For total logging system cost, add:

Roading cost per net unit volume = + $_____/_____

Felling cost per net unit volume = + $_____/_____

Loading cost per net unit volume = + $_____/_____

Hauling cost per net unit volume = + $_____/_____

Total logging *cost* per net unit volume = $_____

Multiple Equipment

More than one piece of equipment may be analyzed as part of a single yarding operation. For example, a yarder, carriage and rigging hardware can be included in the yarding cost analysis by re-running the program. The steps below should be followed for the second and subsequent pieces of equipment:

1. In Section I, enter the equipment cost, residual and depreciation period.
2. In Section I, re-enter the original values of annual interest rate, taxes, license, insurance, and storage, operating season, and operating time per day.
3. In Section 11, enter repairs and maintenance cost, then enter 0 for the remaining variables.
4. In Section 111, re-enter the original values for all variables except move-in and move-out costs for which the entry is 0.
5. The tape output values corresponding to ownership cost, operating cost, machine rate, road change cost and yarding cost for each piece of equipment should be added together for the total cost.

Operation of Desk-Top Computer Program

With the program stored on a tape cartridge, it is executed as follows:

Initial Data Entry

1. Enter GET "YCOST" and execute.
2. Press RUN when program is loaded.

From this point on, visual prompts on the CRT screen will guide further input. A sample keyboard response is shown in parentheses following the underscored prompt message.

The CONT key must be pressed after each entry.

3. Want output on the screen? (YES or NO) - If (NO), output will be on the printer. (NO)
   Y or N may always be entered in place of YES or NO.

4. Do you want a heading for all output? (YES or NO) (YES)
   If (NO) skip step 5.

5. Enter heading (in any form desired, up to 70 characters maximum).
(SAMPLE OUTPUT)
The characters entered here will be printed as a single line at the top of each section of output; i.e., the output generated by the initial run and keys 1, 2, 3, 11, 12, 13, 14, and 15.

6. Number of pieces of equipment to depreciate = ? (2)
Up to nine pieces of equipment associated with an operation may be entered. One may represent a yarder, another the carriage, etc. If six or more are entered, the following message will be displayed for 7 seconds:

"Screen output may be incomplete for VARIABLE CHANGES & PRINT ANALYSIS routines:"

Some portion of the results may be missing on the screen due to a lack of buffer space for screen output. Resultant cost values will be correct, however, and output on the printer will be complete.

For various entries, such as above, a non-zero value is required. If zero is entered, a message will indicate so and the original prompt will return to allow the value to be re-entered.

7. For piece #1: Equipment identifier (30 characters maximum) = ? (YARDER)

8. For piece #1: Cost of YARDER (dollars) = ? (125000)

9. For piece #1: Residual value (percent of equipment cost) = ? (20)

10. For piece #1: Depreciation period (years) = ? (7)

11. For piece #1: Repairs and maintenance (percent of equipment depreciation, $14286 per year) = ? (50)
The value shown is the amount of equipment depreciation.

12. For piece #2: Equipment identifier (30 characters maximum) = ? (CARRIAGE)

13. For piece #2: Cost of CARRIAGE. (dollars) = ? (3000)

14. For piece #2: Residual value (percent of equipment cost)= ? (10)

15. For piece #2: Depreciation period (years) = ? (5)

16. For piece #2: Repairs and maintenance (pct of equip. depr., $540 per year) = ? (20)

17. Annual interest rate (percent) = ? (12)

18. Taxes, license, insurance & storage (pct of avg. ann. invest., **$84063)** = ? **(9)**
The value shown is the amount of the average annual investment.

19. Operating season (days worked/year) = ? **(200)**

20. Operating time per day (hours) = ? **(8)**

21. Fuel consumption (gallons/hour) = ? **(3)**

22. Fuel cost (dollars/gallon) = ? **(.80)**

23. Oil and lube consumption (percent of fuel consumption) = ? (5)

24. Oil and lube cost (dollars/gallon) = ? (1.50)

25. Line cost (dollars) = ? **(3600)**
If line cost = **0,** skip step **26.**

26. Estimated line life (hours) = ? **(1600)**

27. Rigging cost (dollars) = ? (1000)
If rigging cost = 0, skip step **28.**

28. Estimated rigging life (hours) = ? **(800)**

29. Tire or track replacement cost (dollars) = ? **(0)**
If tire or track replacement cost = **0,** skip step **30.**

30. Estimated tire or track life (hours) = ?

31. Total crew wage (base wage for all crew members, dollars/hour) = ? **(30)**

32. Fringe benefits (percent of total crew wage) = ? **(30)**

33. Travel time per day (hours) = ? (. **5)**

34. Supervision and overhead (percent of direct labor, $41 per hour) = ? **(20)**

Direct labor is expressed algebraically as

$$(\text{total crew wage}) \times \frac{100 + \%\ \text{fringe benefits}}{100} + \frac{\text{travel time/day}}{\text{operating time/day}}$$

35. Volume units = ? (5 characters maximum) (CUNIT)

36. **Is** known production rate to be entered? (YES or NO) (YES)

Sample output will be shown for both cases. If (NO), continue at step 45.

Known Production Rate - EXAMPLE 1

37. Percent defect in pieces as yarded = ? **(0)**

38. Number of yarding roads in unit = ? **(11)**

Total road change time is calculated by multiplying the time per road change by the number of yarding roads in the cutting unit less one. Set-up for the first or only yarding road is mandatory and considered part of move in.

39. Time per road change (hours) = ? **(1)**

40. Production rate (cunit/hour) = ? **(5)**

41. Move in and move out cost (dollars) = ? (2000)

42. Cutting unit area (acres) = ? (35)

43. Yield per acre (cunit) = ? (40)

Steps 42 and 43 are required to express the road change cost and move in and move out cost in dollars/unit volume. If total road change time and move in and move out cost are zero, area and yield are not needed.

44. Enter identifier (25 characters maximum) (EXAMPLE 1)

If nothing is entered (i.e., only the CONT key is pressed), no identifier will be used.

Note: Skip remaining steps (45-51).

Calculate Production Rate - EXAMPLE 2

45. Average volume per piece as bucked (cunit) = ? (•14)

46. Percent defect in pieces as yarded = ? (6)

47. Number of yarding roads in unit = ? **(1)**
No road change time is required for one setting.

48. Average number of pieces per turn = ? **(3.5)**

49. Average number of turns per hour = ? (12.5)
The value of turns per hour should account for delays.

50. Move in and move out cost (dollars) = ? **(0)**

51. Enter identifier (25 characters maximum) (EXAMPLE **2)**
If nothing is entered (i.e., only the CONT key is pressed), no identifier will be used.

The initial data entry is complete. The results for the two sample outputs are shown in figures 6 and 7. Yarding cost is the machine rate divided by production rate plus road change cost plus move in and move out cost. When percent defect in pieces yarded equals zero, no distinction is made between gross and net values. In figure 7, however, the difference between gross and net values is due to the percent defect in pieces yarded.

Further action must be initiated through the special function keys. The overlay card, figure 8, defines the keys.

```
SAMPLE OUTPUT


YARDING COST PROGRAM


Values are for EXAMPLE 1


OWNERSHIP COST = $   20.30/HOUR
OPERATING COST = $   59.71/HOUR
                    ------------
MACHINE RATE =     $   80.01/HOUR

PRODUCTION RATE =     5.00 CUNIT/HOUR

ROAD CHANGE COST = $    .57/CUNIT
MOVE IN AND OUT COST =  $   1.43/CUNIT


YARDING COST = $   18.00/CUNIT
```

Figure 6.--Printed sample output for known production rate.

```
SAMPLE OUTPUT

YARDING COST PROGRAM

Values are for EXAMPLE 2

OWNERSHIP COST = $   20.30/HOUR
OPERATING COST = $   59.71/HOUR
                    ------------
MACHINE RATE =     $   80.01/HOUR

GROSS PRODUCTION RATE =    6.13 CUNIT/HOUR

NET PRODUCTION RATE =      5.76 CUNIT/HOUR


GROSS YARDING COST = $   13.06/CUNIT

NET YARDING COST =    $   13.90/CUNIT
```

Figure 7.--Printed sample output for calculated production rate.

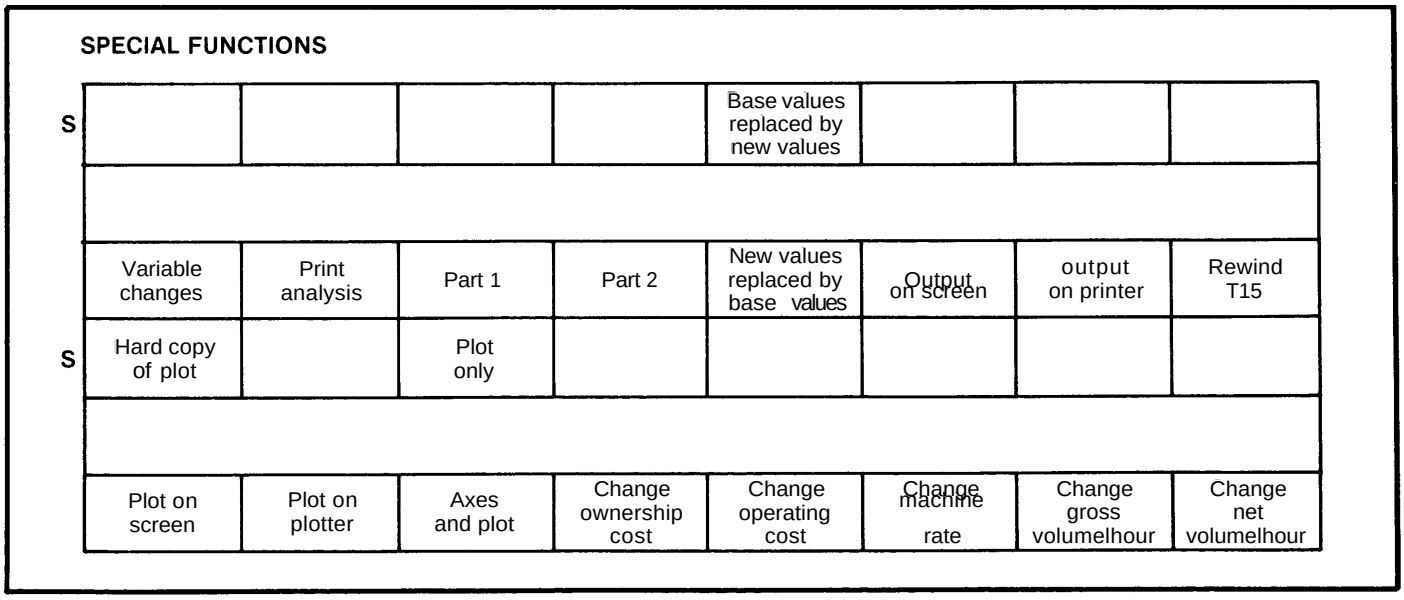

Figure 8.--Special function key overlay.

Key 5 - Output on Screen

All future output will be displayed on the CRT screen.

Key 6 - Output on Printer

All future output will be printed on the internal printer.

Key 1 - Print Analysis

The values of all variables will be displayed along with the resultant costs and production rates. Each variable is numbered, and the "base values" correspond to the initial data entered previously. The "new values" and "percent change" are explained under Key 0 - Variable Changes. Until a variable is changed with Key 0, the "new values" equal the "base values" and "percent change" is zero. Figures 9 and 10 present the base values entered previously as EXAMPLE 1 and EXAMPLE 2.

For output on the screen, the variables up to number 22 will be displayed. Key 3 must be pressed to display the remainder of the analysis.

Key 2 - Part 1

For output on the screen, this key displays the variables up to number 22 exactly as Key 1 does in the output-on-screen mode.

Key 3 - Part 2

For output on the screen, the remainder of the variables and/or the resultant costs and production rates are displayed.

SAMPLE OUTPUT

BASE VALUES = EXAMPLE 1
NEW VALUES = EXAMPLE 1

			BASE VALUES	NEW VALUES	PERCENT CHANGE
1	#1 COST OF yarder	(DOLLARS)	125000	125000	0.0
	#2 COST OF carriage	(DOLLARS)	3000	3000	0.0
2	#1 RESIDUAL (PERCENT OF EQUIPMENT COST)		20	20	0.0
	#2 RESIDUAL (PERCENT OF EQUIPMENT COST)		10	10	0.0
3	#1 DEPRECIATION PERIOD (YEARS)		7	7	0.0
	#2 DEPRECIATION PERIOD (YEARS)		5	5	0.0
4	#1 REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)		50	50	0.0
	#2 REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)		20	20	0.0
5	ANNUAL INTEREST RATE (PERCENT)		12.00	12.00	0.0
6	TAX,LICENSE,INSURANCE, AND STORAGE (PERCENT)		9.00	9.00	0.0
7	OPERATING SEASON (DAYS WORKED/YEAR)		200	200	0.0
8	OPERATING TIME PER DAY (HOURS)		8.0	8.0	0.0
9	FUEL CONSUMPTION (GALLONS/HOUR)		3.00	3.00	0.0
10	FUEL COST (DOLLARS/GALLON)		.80	.80	0.0
11	OIL AND LUBE (PERCENT OF FUEL CONSUMPTION)		5	5	0.0
12	OIL AND LUBE COST (DOLLARS/GALLON)		1.50	1.50	0.0
13	LINE COST (DOLLARS)		3600	3600	0.0
14	LINE LIFE (HOURS)		1600	1600	0.0
15	RIGGING COST (DOLLARS)		1000	1000	0.0
16	RIGGING LIFE (HOURS)		800	800	0.0
17	TIRE OR TRACK REPLACEMENT COST (DOLLARS)		0	0	0.0
18	TIRE OR TRACK LIFE (HOURS)		0	0	0.0
19	TOTAL CREW WAGE (DOLLARS/HOUR)		30.00	30.00	0.0
20	FRINGE BENEFITS (PERCENT OF TOTAL CREW WAGE)		30	30	0.0
21	TRAVEL TIME PER DAY (HOURS)		.50	.50	0.0
22	SUPERVISION AND OVERHEAD (PERCENT OF DIRECT LABOR)		20	20	0.0
23	CUTTING UNIT AREA (ARECE)		35	35	0.0
24	YIELD PER ACRE (CUNIT)		40.00	40.00	0.0
26	DEFECT IN PIECES AS YARDED (PERCENT)		0.00	0.00	0.0
27	NUMBER OF YARDING ROADS IN UNIT		11	11	0.0
30	TIME FER ROAD CHANGE (HOURS)		1.00	1.00	0.0
31	MOVE IN AND MOVE OUT COST (DOLLARS)		2000	2000	0.0
	OWNERSHIP COST (DOLLARS/HOUR)		20.30	28.30	8.0
	OPERATING COST (DOLLARS/HOUR)		59.71	59.71	0.0
	MACHINE RATE (DOLLARS/HOUR)		80.01	80.01	0.0
	PRODUCTION RATE (CUNIT/HOUR)		5.80	5.00	0.0
	ROAD CHANGE COST (DOLLARS/CUNIT)		.57	.57	0.0
	MOVE IN AND OUT COST (DOLLARS/CUNIT)		1.43	1.43	0.0
	YARDING COST (DOLLAR/CUNIT)		18.88	18.00	0.0

Figure 9.--Printed output from **key 1** *(Print analysis) for EXAMPLE 1.*

SAMPLE OUTPUT

ANALYSIS OF VARIABLE CHANGES

BASE VALUES = EXAMPLE 2
NEW VALUES = EXAMPLE 2

			BASE VALUES	NEW VALUES	PERCENT CHANGE
1	#1 COST OF yarder	(DOLLARS)	125000	125000	0.0
	#2 COST OF carriage	(DOLLARS)	3000	3000	0.0
2	#1 RESIDUAL (PERCENT OF EQUIPMENT COST)		20	20	0.0
	#2 RESIDUAL (PERCENT OF EQUIPMENT COST)		10	10	0.0
3	#1 DEPRECIATION PERIOD (YEARS)		7	7	0.0
	#2 DEPRECIATION PERIOD (YEARS)		5	5	0.0
4	#1 REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)		50	50	0.0
	#2 REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)		20	20	0.0
5	ANNUAL INTEREST RATE (PERCENT)		12.00	12.00	0.0
6	TAX,LICENSE,INSURANCE, AND STORAGE (PERCENT)		9.00	9.00	0.0
7	OPERATING SEASON (DAYS WORKED/YEAR)		200	200	0.0
8	OPERATING TIME PER DAY (HOURS)		8.0	8.0	0.0
9	FUEL CONSUMPTION (GALLONS/HOUR)		3.00	3.00	0.0
10	FUEL COST (DOLLARS/GALLON)		.80	.80	0.0
11	OIL AND LUBE (PERCENT OF FUEL CONSUMPTION)		5	5	0.0
12	OIL AND LUBE COST (DOLLARS/GALLON)		1.50	1.50	0.0
13	LINE COST (DOLLARS)		3600	3600	0.0
14	LINE LIFE (HOURS)		1600	1600	0.0
15	RIGGING COST (DOLLARS)		1000	1000	0.0
16	RIGGING LIFE (HOURS)		800	800	0.0
17	TIRE OR TRACK REPLACEMENT COST (DOLLARS)		0	0	0.0
18	TIRE OR TRACK LIFE (HOURS)		0	0	0.0
19	TOTAL CREW WAGE (DOLLARS/HOUR)		30.00	30.00	0.0
20	FRINGE BENEFITS (PERCENT OF TOTAL CREW WAGE)		30	30	0.0
21	TRAVEL TIME PER DAY (HOURS)		.50	.50	0.0
22	SUPERVISION AND OVERHEAD (PERCENT OF DIRECT LABOR)		20	20	0.0
25	AVG. VOLUME/PIECE AS BUCKED (CUNIT)		.14	.14	0.0
26	DEFECT IN PIECES AS YARDED (PERCENT)		6.00	6.00	0.0
27	NUMBER OF YARDING ROADS IN UNIT		1	1	0.0
28	AVERAGE NUMBER OF PIECES PER TURN		3.50	3.50	0.0
29	AVERAGE NUMBER OF TURNS PER HOUR		12.50	12.50	0.0
30	TIME PER ROAD CHANGE (HOURS)		0.00	0.00	0.0
31	MOVE IN AND MOVE OUT COST (DOLLARS)		0	0	0.0
	OWNERSHIP COST (DOLLARS/HOUR)		20.30	20.30	0.0
	OPERATING COST (DOLLARS/HOUR)		59.71	59.71	0.0
	MACHINE RATE (DOLLARS/HOUR)		80.01	80.01	0.0
	GROSS PRODUCTION RATE (CUNIT/HOUR)		6.13	6.13	0.0
	NET PRODUCTION RATE (CUNIT/HOUR)		5.76	5.76	0.0
	GROSS YARDING COST (DOLLARS/CUNIT)		13.06	13.06	0.0
	NET YARDING COST (DOLLARS/CUNIT)		13.90	13.90	0.0

Figure 10.--Printed output from key 1 (Print analysis) for EXAMPLE 2.

Key 0 - Variable Changes

This routine allows changes to be made in the initial or "base values" and computes the resulting costs. The procedure, with sample input corresponding to **EXAMPLE** 2, **is** as follows:

1. The number of the variable to be changed = ? **(1)**
   This is the number that corresponds to each variable as shown in figure 8 or 9. In this case, equipment cost.

2. For what piece (#) of equipment? **(1)**
   The yarder cost will be changed.

3. Do you want to delete this piece of equipment **(YES** or NO) **(NO)**

4. **BASE VALUE** = 125000 **LAST VALUE** = 125000 **NEW VALUE** = ? **(200000)**
   LAST VALUE refers to the previous new value entered. **It** equals the base value unless a new value has been entered.

5. ***Any*** more variable changes desired? **(YES** or NO) **(YES)**

6. The number of the variable to be changed = ? (21)

   It is desired to change travel time per day (variable number 21).

7. **BASE VALUE = .50** LAST **VALUE = .50** NEW **VALUE** = ? **(0)**

8. ***Any*** more variable changes desired **(YES** or NO) **(YES)**

9. The number of the variable to be changed = ? **(1)**
   It is desired to change equipment cost.

10. For what piece (#) of equipment? (2)
    The carriage cost will be changed.

11. Do you want to delete this piece of equipment? **(YES** or NO) **(YES)**

12. **Any** more variable changes desired **(YES** or NO) **(YES)**

13. The number of the variable to be changed = ? **(1)**

14. **For** what piece (#) of equipment? (4)
    It is desired to add a piece of equipment to the existing pieces in the base values. Since there are only two, and pieces are only added in sequence, the following message will be displayed:
    "Note: the piece # you selected is changed to **3.**
    Press CONT to proceed."

15. Equipment identifier (30 characters maximum) for piece #3 = ?
(RIGGING HARDWARE)

16. For piece #3: Cost of RIGGING HARDWARE (dollars) = ?
(5000)

17. For piece #3: Residual value (percent of equipment cost) = ?
(10)

18. For piece #3: Depreciation period (years) = ? **(0)**
A depreciation period of zero years is not allowed, and the following message is displayed for **6** seconds:
"The value of 0 may not be entered for this variable!
It must be re-entered."

19. For piece #3: Depreciation period (years) = ? **(4)**

20. For piece #3: Repairs and maintenance (percent of equipment depreciation = ? **(0)**

21. ***Any*** more variable changes desired? **(YES** or NO) (NO)

22. Enter identifier for NEW VALUES (25 characters maximum)
(EXAMPLE 2 UPDATE)
If nothing is entered (i.e., only the CONT key is pressed), the identifier for the new values will be the same as that for the base values. However, once an identifier is entered, when step 22 is encountered in a subsequent VARIABLE CHANGES routine and nothing is entered, the identifier for the new values will remain unchanged.

23. Enter a new headinq for all output (70 characters maximum)
If nothing is entered (i.e., only the CONT key is pressed), the existing heading will remain unchanged.

The variable changes are complete. Output can be obtained by pressing key **1,** key 2, or key 3. For output on the printer, pressing key **1** yields the results shown in figure **11.**

SAMPLE OUTPUT

ANALYSIS OF VARIABLE CHANGES

BASE VALUES = EXAMPLE 2
NEW VALUES = EXAMPLE 2 UPDATE

			BASE VALUES	NEW VALUES	PERCENT CHANGE
1	#1 COST OF yarder	(DOLLARS)	125000	200000	60.0
	#2 COST OF carriage	(DOLLARS)	3000	0	-100.0
	#3 COST OF rigging hardware	(DOLLARS)	0	5000	100.0
2	#1 RESIDUAL (PERCENT OF EQUIPMENT COST)		20	20	0.0
	#2 RESIDUAL (PERCENT OF EQUIPMENT COST)		10	0	-100.0
	#3 RESIDUAL (PERCENT OF EQUIPMENT COST)		0	10	100.0
3	#1 DEPRECIATION PERIOD (YEARS)		7	7	0.0
	#2 DEPRECIATION PERIOD (YEARS)		5	0	-100.0
	#3 DEPRECIATION PERIOD (YEARS)		0	4	100.0
4	#1 REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)		50	50	0.0
	#2 REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)		20	0	-100.0
	#3 REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)		0	0	0.0
5	ANNUAL INTEREST RATE (PERCENT)		12.00	12.00	0.0
6	TAX,LICENSE,INSURANCE, AND STORAGE (PERCENT)		9.00	9.00	0.0
7	OPERATING SEASON (DAYS WORKED/YEAR)		200	200	0.0
8	OPERATING TIME PER DAY (HOURS)		8.0	8.0	0.0
9	FUEL CONSUMPTION (GALLONS/HOUR)		3.00	3.00	0.0
10	FUEL COST (DOLLARS/GALLON)		.80	.80	0.0
11	OIL AND LUBE (PERCENT OF FUEL CONSUMPTION)		5	5	0.0
12	OIL AND LUBE COST (DOLLARS/GALLON)		1.50	1.50	0.0
13	LINE COST (DOLLARS)		3600	3600	0.0
14	LINE LIFE (HOURS)		1600	1600	0.0
15	RIGGING COST (DOLLARS)		1000	1000	0.0
16	RIGGING LIFE (HOURS)		800	800	0.0
17	TIRE OR TRACK REPLACEMENT COST (DOLLARS)		0	0	0.0
18	TIRE OR TRACK LIFE (HOURS)		0	0	0.0
19	TOTAL CREW WAGE (DOLLARS/HOUR)		30.00	30.00	0.0
20	FRINGE BENEFITS (PERCENT OF TOTAL CREW WAGE)		30	30	0.0
21	TRAVEL TIME PER DAY (HOURS)		.50	0.00	-100.0
22	SUPERVISION AND OVERHEAD (PERCENT OF DIRECT LABOR)		20	20	0.0
25	AVG. VOLUME/PIECE AS BUCKED (CUNIT)		.14	.14	0.0
26	DEFECT IN PIECES AS YHRDED (PERCENT)		6.00	6.00	0.0
27	NUMBER OF YARDING ROADS IN UNIT		1	1	0.0
28	AVERAGE NUMBER OF PIECES PER TURN		3.50	3.50	0.0
29	AVERAGE NUMBER OF TURNS PER HOUR		12.50	12.50	0.0
30	TIME FER ROAD CHANGE (HOURS)		0.00	0.00	0.0
31	MOVE IN AND MOVE OUT COST (DOLLARS)		0	0	0.0
	OWNERSHIP COST (DOLLARS/HOUR)		20,30	32.67	61.0
	OPERATING COST (DOLLARS/HOUR)		59.71	60.07	.6
	MHCHINE HATE (DOLLHRS/HOUR)		88.81	92.74	15.9
	GROSS PRODUCTION RATE (CUNIT/HOUR)		6.13	6.13	0.0
	NET PRODUCTION RATE (CUNIT/HOUR)		5.76	5.76	0.0
	GROSS YARDING COST (DOLLARS/CUNIT)		13.06	15.14	15.9
	NET YARDING COST (DOLLARS/CUNIT)		13.98	16.11	15.9

Figure 11.--Printed output from key 1 (Print analysis) for EXAMPLE 2.

Keys **11,** 12, 13, 14 and 15

The values of ownership cost, operating cost, machine rate, gross volume/hour (i.e., gross production rate), and net volume/hour (i.e., net production rate) can be changed with these keys. **As** an example, the output in figure **11 is** modified by pressing **key 14** and changing gross volume/hour as follows:

1. **GROSS** VOLUME/HR: BASE VALUE = 6.13 LAST VALUE = 6.13
   NEW VALUE = ? **(8)**

2. Enter identifier for NEW VALUES (25 characters maximum)
   If nothing is entered (i.e., **only** the CONT key is pressed), the existing identifier for the new values will remain unchanged.

3. Enter a new heading for all output (25 characters maximum)
   If nothing is entered (i.e., only the CONT key is pressed), the existing heading will remain unchanged.

For output on the printer, the results shown in figure 12 are generated.

SAMPLE OUTPUT

ANALYSIS WITH NEW VALUE OF GROSS VOLUME/HR

BASE VALUES = EXAMPLE 2
NEW VALUES = EXAMPLE 2 UPDATE

	BASE VALUES	NEW VALUES	PERCENT CHANGE
OWNERSHIP COST (DOLLARS/HOUR)	20.30	32.67	61.0
OPERATING COST (DOLLARS/HOUR)	59.71	60.07	.6
MACHINE RATE (DOLLARS/HOUR)	80.01	92.74	15.9
GROSS PRODUCTION RATE (CUNIT/HOUR)	6.13	8.00	30.6
NET PRODUCTION RATE (CUNIT/HOUR)	5.76	5.76	0.0
GROSS YARDING COST (DOLLARS/CUNIT)	13.06	11.59	-11.3
NET YARDING COST (DOLLARS/CUNIT)	13.90	16.11	15.9

Figure 12.--Printed output from key 14 (Change gross volume/hour) for EXAMPLE 2.

Key 8 - Plot on Screen

When a peripheral plotter is not available or it is desired to first view the yarding cost-production rate curve on the screen, this key must be pressed. Key 10 or key 26 must be pressed to make the actual plot.

Key 9 - Plot on Plotter

The yarding cost-production rate curve will be plotted directly on the plotter. Physical plotting limits should be set to 6-1/4 inches horizontally and vertically. Key 10 or key 26 must be pressed to make the actual plot.

If this key is pressed, the plotter must be turned on before proceeding.

Key 10 - Axes and Plot

This key is used to construct the axes, label them, and plot the yarding cost-production rate curves. Key 8 or key 9 must be pressed before this key. The procedures, with sample inputs corresponding to EXAMPLE 2 UPDATE (figure 12) follow. It is assumed that key 8 has been pressed.

1. Do you want to plot gross rather than net values? (YES or NO) *(YES)*
   Step 1 is skipped if gross and net values are equal: i.e., if percent defects is zero.

2. Want to define range of production rate and yarding cost other than 10 and 20 (YES/NO)? (YES)
   The values displayed represent the limits of the X and Y axes respectively, rounded up to the nearest whole value of 10.

   If (NO) is answered, skip step 3.

3. Enter: maximum production rate (X axis), maximum yarding cost (Y axis) (10, 30)
   Any values may be entered but the limits will be rounded up to the nearest whole value of 10. This input is useful for changing the scale of the plot, or when subsequent curves will be added to the current plot (key 26 - Plot only).

4. Enter: 0 to plot BASE VALUES; 1 to plot NEW VALUES; 2 to plot both (2)
   Either or both curves can be plotted on the axes.

Key **26** - Plot Only

Up to nine curves can be plotted on the same axes. The original curve(s) plotted with key 10 (Axes and Plot) and any other curves plotted with key **26** (Plot only) are replotted along with the current base and/or new values on the axes originally defined in step **4**, key 10. Each curve is plotted using a different line type. Input is made in response to the following prompt message:

Enter: 0 to plot BASE **VALUES; 1** to plot NEW VALUES; **2** to plot both

A new curve can be generated only if one or more changes are made through key 0, **11,** 12, 13, **14,** or 15 prior to pressing this key.

Key **24** - Hard Copy of Plot

A hard copy on the internal printer is made if the yarding cost-production rate curve was plotted on the screen. The curves representing the new and base values from **EXAMPLE** 2 **UPDATE** (fig. **12)** are reproduced on the internal printer as shown in figure 13.

Key **4** - New Values Replaced by Base Values

The new values are replaced by the base values, including identifier and resultant costs and production rates. The cost and production rate changes made with keys **11, 12, 13,** 14, and 15 act on the new value, not the base value. Thus, if it is desired to see the effect on yarding cost of changing only ownership cost and subsequently to see the effect of changing only operating cost, key **4** must be pressed after key **11** and before key 12.

Key 20 - Base Values Replaced by New Values

The base values are replaced by the new values, including identifier and resultant costs and production rates.

Key 7 - Rewind T15

Rewind the T15 tape cartridge.

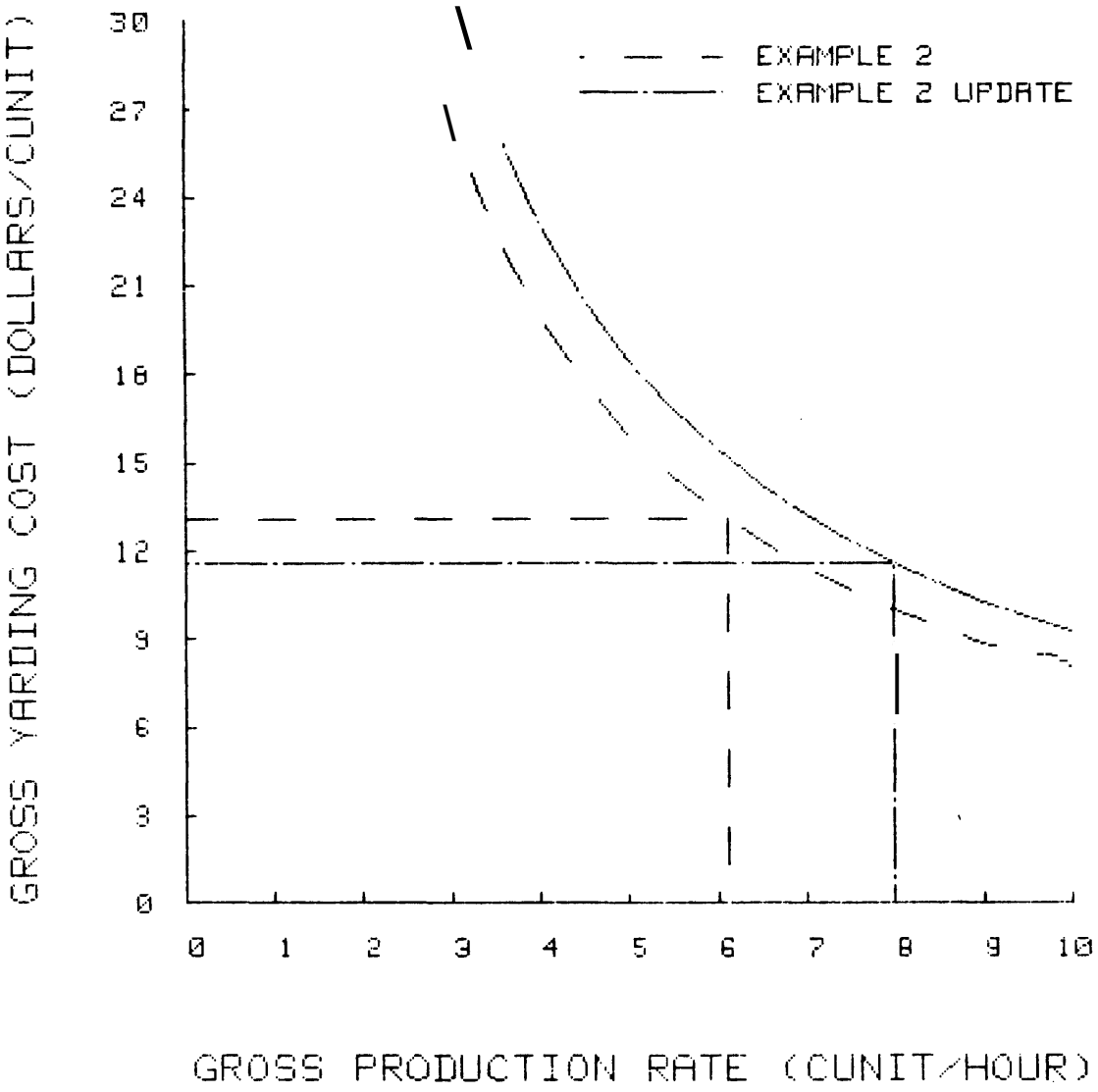

Figure 13.--Printed output** from **key 24 (Hard copy** of **plot)** for **EXAMPLE 2.

Program Listings

HP 97/67 Program

001	*LBLA	21 11	057	X≷Y	-41	113	SPC	16-11	169	STOA	35 11
002	STOD	35 14	058	STO2	35 02	114	RCL5	36 05	170	R↓	-31
003	R↓	-31	059	×	-35	115	+	-55	171	R↓	-31
004	ENT↑	-21	060	STO0	35 00	116	STO6	35 06	172	RCLB	36 12
005	R↓	-31	061	R↓	-31	117	PRTX	-14	173	X≷Y	-41
006	R↓	-31	062	RCLC	36 13	118	SPC	16-11	174	÷	-24
007	ENT↑	-21	063	%	55	119	SPC	16-11	175	STOB	35 12
008	R↑	16-31	064	RCL9	36 09	120	RTN	24	176	GTO8	22 08
009	%	55	065	÷	-24	121	*LBL1	21 01	177	*LBL2	21 02
010	STO6	35 06	066	ST+0	35-55 00	122	ST+0	35-55 00	178	0	00
011	-	-45	067	RTN	24	123	R↓	-31	179	STOA	35 11
012	STOB	35 12	068	*LBLC	21 13	124	GTO2	22 02	180	STOB	35 12
013	RCLD	36 14	069	X=0?	16-43	125	*LBL3	21 03	181	*LBL8	21 08
014	÷	-24	070	GTO1	22 01	126	ST+0	35-55 00	182	RCL6	36 06
015	STOC	35 13	071	÷	-24	127	R↓	-31	183	RCLD	36 14
016	RTN	24	072	ST+0	35-55 00	128	GTO4	22 04	184	PRTX	-14
017	*LBLA	21 11	073	*LBL2	21 02	129	*LBLD	21 14	185	÷	-24
018	STO4	35 04	074	R↓	-31	130	X²	-35	186	STO1	35 01
019	X≷Y	-41	075	%	55	131	×	-35	187	RCLD	36 14
020	×	-35	076	RCL2	36 02	132	STOD	35 14	188	RCLC	36 13
021	STO9	35 09	077	×	-35	133	RTN	24	189	×	-35
022	R↓	-31	078	ST+0	35-55 00	134	*LBLD	21 14	190	PRTX	-14
023	RCLD	36 14	079	RTN	24	135	GTO6	22 06	191	SPC	16-11
024	1	01	080	*LBLC	21 13	136	*LBLE	21 15	192	RCL6	36 06
025	+	-55	081	X=0?	16-43	137	STOD	35 14	193	X≷Y	-41
026	RCLB	36 12	082	GTO3	22 03	138	RTN	24	194	÷	-24
027	×	-35	083	÷	-24	139	*LBLE	21 15	195	STO2	35 02
028	2	02	084	ST+0	35-55 00	140	*LBL6	21 06	196	RCLB	36 12
029	÷	-24	085	*LBL4	21 04	141	STOA	35 11	197	PRTX	-14
030	RCLD	36 14	086	R↓	-31	142	R↓	-31	198	ST+1	35-55 01
031	÷	-24	087	X=0?	16-43	143	X≷Y	-41	199	RCLA	36 11
032	RCL8	36 08	088	GTO5	22 05	144	1	01	200	PRTX	-14
033	+	-55	089	÷	-24	145	-	-45	201	SPC	16-11
034	STOA	35 11	090	*LBL5	21 05	146	×	-35	202	ST+1	35-55 01
035	X≷Y	-41	091	ST+0	35-55 00	147	RCL6	36 06	203	RCLC	36 13
036	1	01	092	RTN	24	148	×	-35	204	R↓	-31
037	%	55	093	*LBLC	21 13	149	STOB	35 12	205	X≷Y	-41
038	X≷Y	-41	094	STO1	35 01	150	R↑	16-31	206	RCLC	36 13
039	R↓	-31	095	R↓	-31	151	1	01	207	÷	-24
040	×	-35	096	RCL4	36 04	152	%	55	208	PRTX	-14
041	STO0	35 00	097	÷	-24	153	1	01	209	ST+2	35-55 02
042	R↓	-31	098	X≷Y	-41	154	X≷Y	-41	210	R↓	-31
043	1	01	099	1	01	155	-	-45	211	RCLC	36 13
044	%	55	100	%	55	156	STOC	35 13	212	÷	-24
045	RCL^	36 11	101	X≷Y	-41	157	RTN	24	213	PRTX	-14
046	×	-35	102	R↓	-31	158	*LBLE	21 15	214	ST+2	35-55 02
047	RCLC	36 13	103	1	01	159	*LBL9	21 09	215	SPC	16-11
048	RCL0	36 00	104	+	-55	160	×	-35	216	SPC	16-11
049	+	-55	105	+	-55	161	X=0?	16-43	217	RCL1	36 01
050	+	-55	106	×	-35	162	GTO7	22 07	218	PRTX	-14
051	RCL9	36 09	107	RCL1	36 01	163	ENT↑	-21	219	RCL2	36 02
052	÷	-24	108	%	55	164	RCLA	36 11	220	PRTX	-14
053	STO5	35 05	109	+	-55	165	X≷Y	-41	221	SPC	16-11
054	PRTX	-14	110	ST+0	35-55 00	166	ENT↑	-21	222	RTN	24
055	RTN	24	111	RCL0	36 00	167	R↓	-31	223	*LBLD	21 14
056	*LBLC	21 13	112	PRTX	-14	168	÷	-24	224	GTO9	22 09

9845 Program

```
10   ! ***** YCOST ***** RON MIFFLIN ***** PNW-SEATTLE,USFS ***** NOV,1979 *****
20   !
30   LOAD KEY "K-COST"
40   INPUT "Want output on the screen? (YES or NO)  -  If NO, output will be on
the printer.",B$
50   IF B$[1,1]="Y" THEN 90
60   IF B$[1,1]<>"N" THEN 40
70   P1=0
80   GOTO 100
90   P1=16
100  B$=""
110  PRINTER IS P1
120  A(32)=B(32)=1
130  DATA 1,3,5,7,8,9,10,11,12,19,23,24,25,27,28,29
140  GCLEAR
150  SHORT A(39),B(39),C(9,7),D(9,7),E(40),Z7(2),Z8(2)
160  SHORT A,A1,A2,A3,A4,A5,A6,A7,A8,A9,B,D,E,F,H,H1,I,J,K,K1,K2,K3,L,M,M1,N,N1,
P,P1,Q,R,S2,T,U,W,W1,X,X1,Z5
170  DIM A$[100],B$[100],C$[100],D$[100],E$[15],F$[100],G$(9)[100],H$[100]
180  DEFAULT ON
190  INPUT "Do you want a heading for all output? (YES or NO)",B$
200  IF B$[1,1]="Y" THEN 240
210  IF B$[1,1]<>"N" THEN 190
220  H$=B$=""
230  GOTO 330
240  INPUT "Enter heading (in any form desired up to 70 characters maximum).",H$
250  IF LEN(H$)<=70 THEN 310
260  BEEP
270  FIXED 0
280  DISP "Sorry, you're";LEN(H$)-70;"characters over the limit of 70!  Try agai
n: heading = ";
290  INPUT H$
300  GOTO 250
310  B$=""
320  PRINT H$,LIN(2)
330  PRINT "YARDING COST PROGRAM",LIN(2)
340  INPUT "Number of pieces of equipment to depreciate = ?",U
350  M=U
360  IF U<=9 THEN 400
370  BEEP
380  INPUT "9 pieces maximum! Try again: number of pieces of equipment to deprec
iate = ?",U
390  GOTO 350
400  IF U<>0 THEN 440
410  BEEP
420  INPUT "Min. of 1 required! Try again: number of pieces of equipment to depr
eciate = ?",U
430  GOTO 350
440  IF U<6 THEN 480
450  BEEP
460  DISP "Screen output may be incomplete for VARIABLE CHANGES & PRINT ANALYSIS
 routines!"
```

```
470  WAIT 7000
480  FIXED 0
490  IF U>1 THEN 680
500  INPUT "Enter equipment identifier (30 characters maximum).",G$(1)
510  IF LEN(G$(1))<=30 THEN 550
520  BEEP
530  INPUT "30 characters maximum!  Try again: enter equipment identifer.",G$(1)
540  GOTO 510
550  DISP "Cost of ";G$(1);" (dollars) = ";
560  INPUT C(1,1)
570  IF C(1,1)<>0 THEN 600
580  GOSUB 2230
590  GOTO 500
600  INPUT "Residual (percent of equipment cost) = ?",C(1,2)
610  INPUT "Depreciation period (years) = ?",C(1,3)
620  IF C(1,3)<>0 THEN 650
630  GOSUB 2230
640  GOTO 610
650  DISP "Repairs and maintenance (percent of equipment depreciation,$";C(1,1)*
(100-C(1,2))/100/C(1,3);"per year) =";
660  INPUT C(1,4)
670  GOTO 910
680  FOR X=1 TO U
690  DISP "For piece #";X;":  Equipment identifier (30 characters maximum) = ";
700  INPUT G$(X)
710  IF LEN(G$(X))<=30 THEN 760
720  BEEP
730  DISP "30 characters maximum!  Try again: for piece #";X;": equipment identi
fier = ";
740  INPUT G$(X)
750  GOTO 710
760  DISP "For piece #";X;":  Cost of ";G$(X);" (dollars) = ";
770  INPUT C(X,1)
780  IF C(X,1)<>0 THEN 810
790  GOSUB 2230
800  GOTO 760
810  DISP "For piece #";X;":  Residual value (percent of equipment cost) = ";
820  INPUT C(X,2)
830  DISP "For piece #";X;":  Depreciation period (years) = ";
840  INPUT C(X,3)
850  IF C(X,3)<>0 THEN 880
860  GOSUB 2230
870  GOTO 830
880  DISP "For piece #";X;":  Repairs & maintenance (pct of equip. depr., $";C(X
,1)*(100-C(X,2))/100/C(X,3);"per yr)=";
890  INPUT C(X,4)
900  NEXT X
910  INPUT "Annual interest rate (percent) = ?",A(5)
920  MAT D=C
930  A=D=M1=0
940  FOR X=1 TO U
950  D(X,5)=D(X,1)*(100-D(X,2))/100     ! depreciable value
960  IF D(X,3)<>0 THEN 990
```

```
970  D(X,6)=0
980  GOTO 1000
990  D(X,6)=D(X,5)/D(X,3)      ! equipment depreciation
1000 D=D+D(X,6)      ! total equipment depreciation
1010 IF D(X,3)<>0 THEN 1040
1020 D(X,7)=D(X,1)*D(X,2)/100      ! average annual investment
1030 GOTO 1050
1040 D(X,7)=D(X,5)*(D(X,3)+1)/(2*D(X,3))+D(X,1)*D(X,2)/100  ! avg annual invest.
1050 A=A+D(X,7)      ! total average annual investment
1060 IF P=0 THEN 1080
1070 M1=M1+D(X,4)*D(X,6)/(B(7)*B(8)*100)      ! total repairs & maintenance cost
1080 NEXT X
1090 IF P=1 THEN 2470      ! go to routine to calculate production rate & costs
1100 DISP "Taxes,license,insurance, & storage (pct of avg. ann. invest., #";A;"p
er yr)=";
1110 INPUT A(6)
1120 INPUT "Operating season (days worked/year) = ?",A(7)
1130 IF A(7)<>0 THEN 1160
1140 GOSUB 2230
1150 GOTO 1120
1160 INPUT "Operating time per day (hours) = ?",A(8)
1170 IF A(8)<>0 THEN 1200
1180 GOSUB 2230
1190 GOTO 1160
1200 INPUT "Fuel consumption (gallons/hour) = ?",A(9)
1210 IF A(9)<>0 THEN 1240
1220 GOSUB 2230
1230 GOTO 1200
1240 INPUT "Fuel cost (dollars/gallon) = ?",A(10)
1250 IF A(10)<>0 THEN 1280
1260 GOSUB 2230
1270 GOTO 1240
1280 INPUT "Oil and lube consumption (percent of fuel consumption) = ?",A(11)
1290 IF A(11)<>0 THEN 1320
1300 GOSUB 2230
1310 GOTO 1280
1320 INPUT "Oil and lube cost (dollars/gallon) = ?",A(12)
1330 IF A(12)<>0 THEN 1360
1340 GOSUB 2230
1350 GOTO 1320
1360 INPUT "Line cost (dollars) = ?",A(13)
1370 IF A(13)=0 THEN 1390
1380 INPUT "Estimated line life (hours) = ?",A(14)
1390 INPUT "Rigging cost (dollars) = ?",A(15)
1400 IF A(15)=0 THEN 1420
1410 INPUT "Estimated rigging life (hours) = ?",A(16)
1420 INPUT "Tire or track replacement cost (dollars) = ?",A(17)
1430 IF A(17)=0 THEN 1450
1440 INPUT "Estimated tire or track life (hours) = ?",A(18)
1450 INPUT "Total crew wage (base wage for all crew members, dollars/hour) = ?",
A(19)
1460 IF A(19)<>0 THEN 1490
1470 GOSUB 2230
```

```
1480 GOTO 1450
1490 INPUT "Fringe benefits (percent of total crew wage) = ?",A(20)
1500 INPUT "Travel time per day (hours) = ?",A(21)
1510 DISP "Supervision and overhead (percent of direct labor, $";A(19)*(1+A(20)/
100+A(21)/A(8));"per hour) = ";
1520 INPUT A(22)
1530 INPUT "Volume units = ? (5 characters maximum)",A$
1540 IF LEN(A$)<=5 THEN 1580
1550 BEEP
1560 INPUT "5 characters maximum! Try again: volume units = ?",A$
1570 GOTO 1540
1580 INPUT "Is known production rate to be entered? (YES or NO)",B$
1590 IF B$[1,1]="N" THEN 1980
1600 IF B$[1,1]<>"Y" THEN 1580
1610 INPUT "Percent defect in pieces as yarded = ?",A(26)
1620 INPUT "Number of yarding roads in unit = ?",A(27)
1630 IF A(27)>1 THEN 1670
1640 IF A(27)<>0 THEN 1680
1650 GOSUB 2230
1660 GOTO 1620
1670 INPUT "Time per road change (hours) = ?",A(30)
1680 B$=""
1690 DISP "Production rate (";LWC$(A$);"/hour) = ";
1700 INPUT A(36)      ! gross production rate
1710 IF A(36)<>0 THEN 1740
1720 GOSUB 2230
1730 GOTO 1680
1740 B(36)=A(36)
1750 A(37)=B(37)=A(36)*(100-A(26))/100      ! net production rate
1760 INPUT "Move in and move out cost (dollars) = ?",A(31)
1770 IF A(31)=0 THEN 1780
1780 IF (A(27)>1) AND (A(30)<>0) THEN 1800
1790 IF A(31)=0 THEN 1960
1800 GOSUB 1830
1810 GOTO 1960
1820 !
1830 ! Subroutine for entering area & yield
1840 !
1850 INPUT "Cutting unit area (acres) = ?",A(23)
1860 IF A(23)<>0 THEN 1890
1870 GOSUB 2230
1880 GOTO 1830
1890 DISP "Yield per acre (";LWC$(A$);") = ";
1900 INPUT A(24)
1910 IF A(24)<>0 THEN 1940
1920 GOSUB 2230
1930 GOTO 1890
1940 RETURN
1950 !
1960 Z5=1     ! flag to print production data
1970 GOTO 2290
1980 B$=""
1990 DISP "Average volume per piece as bucked (";LWC$(A$);") = ";
```

```
2000 INPUT A(25)
2010 IF A(25)<>0 THEN 2040
2020 GOSUB 2230
2030 GOTO 1990
2040 INPUT "Percent defect in pieces as yarded = ?",A(26)
2050 INPUT "Number of yarding roads in unit = ?",A(27)
2060 IF A(27)<>0 THEN 2090
2070 GOSUB 2230
2080 GOTO 2050
2090 INPUT "Average number of pieces per turn = ?",A(28)
2100 IF A(28)<>0 THEN 2130
2110 GOSUB 2230
2120 GOTO 2090
2130 INPUT "Average number of turns per hour = ?",A(29)
2140 IF A(29)<>0 THEN 2170
2150 GOSUB 2230
2160 GOTO 2130
2170 IF A(27)<=1 THEN 2190
2180 INPUT "Time per road change (hours) = ?",A(30)
2190 INPUT "Move in and move out cost (dollars) = ?",A(31)
2200 IF (A(27)>1) AND (A(30)<>0) OR (A(31)<>0) THEN GOSUB 1830
2210 GOTO 2290
2220 !
2230 ! routine to warn against input of 0 for variable value
2240 BEEP
2250 DISP "The value of 0 may not be entered for this variable! It must be re-en
tered."
2260 WAIT 5000
2270 RETURN
2280 !
2290 IF A(31)<>0 THEN 2320
2300 Z7(1)=Z7(2)=0      ! move cost
2310 GOTO 2330
2320 Z7(1)=Z7(2)=A(31)/A(23)/A(24)      ! move cost
2330 INPUT "Enter identifier (25 characters maximum)",C$
2340 IF LEN(C$)<=25 THEN 2380
2350 BEEP
2360 INPUT "25 characters maximum! Try again: enter identifier.",C$
2370 GOTO 2340
2380 D$=C$
2390 MAT B=A     ! new values = base values
2400 MAT D=C      ! new values = base values
2410 FOR X=1 TO U
2420 C(X,5)=C(X,1)*(100-C(X,2))/100      ! depreciable value
2430 C(X,6)=C(X,5)/C(X,3)      ! equipment depreciation
2440 M1=M1+C(X,4)*C(X,6)/(A(7)*A(8)*100)      ! total repairs & maintenance cost
2450 NEXT X
2460 !
2470 ! Routine to caluculate production rate and costs
2480 !
2490 B(33)=(D+A*(B(5)+B(6))/100)/B(7)/B(8)      ! ownership cost
2500 L=R=T=0
2510 IF (B(13)=0) OR (B(14)=0) THEN 2530
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```
2520 L=B(13)/B(14)
2530 IF (B(15)=0) OR (B(16)=0) THEN 2550
2540 R=B(15)/B(16)
2550 IF (B(17)=0) OR (B(18)=0) THEN 2570
2560 T=B(17)/B(18)
2570 Q=(1+B(22)/100)*(B(19)*(1+B(20)/100+B(21)/B(2)))
2580 B(34)=M1+B(9)*B(10)+B(11)*B(9)*B(12)/100+L+R+T+Q
2590 B(35)=B(33)+B(34)      ! machine rate
2600 IF (B(30)=0) OR (B(27)<=1) THEN 2630
2610 Z8(2)=(B(27)-1)*B(30)*B(35)/B(23)/B(24)      ! setting change cost
2620 GOTO 2640
2630 Z8(2)=0      ! setting change cost
2640 IF B(31)=0 THEN 2670
2650 Z7(2)=B(31)/B(23)/B(24)      ! move cost
2660 GOTO 2680
2670 Z7(2)=0      ! move cost
2680 IF Z5=1 THEN 2700
2690 B(36)=B(25)*B(28)*B(29)      ! gross prod. rate if prod. rate unknown
2700 B(37)=B(36)*(100-B(26))/100      ! net production rate
2710 B(38)=B(35)/B(36)+Z7(2)+Z8(2)      ! gross yarding cost
2720 B(39)=B(35)/B(37)+(Z7(2)+Z8(2))/((100-B(26))/100)      ! net yarding cost
2730 IF P=1 THEN 5210  ! return to VARIABLE CHANGES routine
2740 MAT A=B
2750 Z7(1)=Z7(2)
2760 Z8(1)=Z8(2)
2770 IF C$="" THEN 2800
2780 IMAGE "Values are for ",18A,/
2790 PRINT USING 2780;C$
2800 IMAGE /,"OWNERSHIP COST = $",4D.DD,"/HOUR"
2810 PRINT USING 2800;A(33)
2820 IMAGE "OPERATING COST = $",4D.DD,"/HOUR"
2830 PRINT USING 2820;A(34)
2840 PRINT SPA(17),"--------------"
2850 IMAGE "MACHINE RATE =   $",4D.DD,"/HOUR"
2860 PRINT USING 2850;A(35)
2870 IF (A(26)<>0) OR (B(26)<>0) THEN 2990
2880 IMAGE /,"PRODUCTION RATE =",4D.DDX,5A,"/HOUR",/
2890 PRINT USING 2880;A(36),A$
2900 IF (A(30)=0) OR (A(27)=1) THEN 2930      ! ie, no setting change time
2910 IMAGE "ROAD CHANGE COST = $",3D.DD,"/",5A
2920 PRINT USING 2910;Z8(1),A$
2930 IF A(31)=0 THEN 2960
2940 IMAGE "MOVE IN AND OUT COST =  $",3D.DD,"/",5A
2950 PRINT USING 2940;Z7(1),A$
2960 IMAGE /,/,"YARDING COST = $",4D.DD,"/",5A
2970 PRINT USING 2960;A(38),A$
2980 GOTO 3210
2990 IMAGE /,"GROSS PRODUCTION RATE =",4D.DDX,5A,"/HOUR"
3000 PRINT USING 2990;A(36),A$
3010 IMAGE /,"NET PRODUCTION RATE =  ",4D.DDX,5A,"/HOUR",/
3020 PRINT USING 3010;A(37),A$
3030 IF (A(30)=0) OR (A(27)=1) THEN 3060
3040 IMAGE "GROSS ROAD CHANGE COST =   $",3D.DD,"/",5A
```

```
3050 PRINT USING 3040;Z8(1),A$
3060 IF A(31)=0 THEN 3090
3070 IMAGE "GROSS MOVE IN AND OUT COST = $",3D.DD,"/",5A
3080 PRINT USING 3070;Z7(1),A$
3090 IF (A(30)=0) OR (A(27)=1) THEN 3120
3100 IMAGE /,"NET ROAD CHANGE COST =   $",3D.DD,"/",5A
3110 PRINT USING 3100;Z8(1)/(100-A(26))*100,A$
3120 IF A(31)=0 THEN 3170
3130 IF (A(30)<>0) AND (A(27)<>1) THEN 3150
3140 PRINT
3150 IMAGE "NET MOVE IN AND OUT COST = $",3D.DD,"/",5A
3160 PRINT USING 3150;Z7(1)/(100-A(26))*100,A$
3170 IMAGE /,/,"GROSS YARDING COST = $",4D.DD,"/",5A
3180 PRINT USING 3170;A(38),A$
3190 IMAGE /,"NET YARDING COST =   $",4D.DD,"/",5A
3200 PRINT USING 3190;A(39),A$
3210 IF P1=16 THEN 3230
3220 PRINT USING "/,/,/,/'
3230 PAUSE
3240 GOTO 3230
3250 !
3260 ! ********** KEY 0 (VARIABLE CHANGES) *****
3270 !
3280 PRINTER IS 16
3290 PRINT "VARIABLE CHANGES Routine",LIN(2)
3300 PRINTER IS P1
3310 B$=""
3320 F=0
3330 INPUT "The number of the variable to be changed = ?  N
3340 FOR X=1 TO 15
3350 READ B      ! read data from statement 65
3360 IF N<>B THEN 3390
3370 F=1
3380 GOTO 3400
3390 NEXT X
3400 RESTORE 130
3410 IF Z5=0 THEN 3470
3420 IF (N<>25) AND (N<>28) AND (N<>29) THEN 3470
3430 BEEP
3440 DISP "This variable cannot be changed in the 'known production' rate mode!"
3450 WAIT 6000
3460 GOTO 3320
3470 IF (N<=31) AND (N>0) THEN 3520
3480 BEEP
3490 INPUT "Variables are numbered 1-31! Try again: number of the variable to be
 changed = ?",N
3500 F=0
3510 GOTO 3340
3520 IF N>4 THEN 4020
3530 INPUT "For what piece (#) of equipment ?",N1
3540 IF (N1<=9) AND (N>0) THEN 3580
3550 BEEP
```

```
3560 INPUT "Equipment pieces are numbered 1-9! Try again: for what piece (#) of
equipment ?",N1
3570 GOTO 3540
3580 IF N1<=U THEN 3770      ! see if a new piece is to be added
3590 IF N1-U=1 THEN 3640      ! see if new piece # follows last piece #
3600 BEEP
3610 FIXED 0
3620 DISP "Note: the piece # you selected is changed to";U+1;". Press CONT to pr
ocede."
3630 PAUSE
3640 N1=U=U+1
3650 IF N1<6 THEN 3690
3660 BEEP
3670 DISP "Screen output may be incomplete for VARIABLE CHANGES & PRINT ANALYSIS
 routines!"
3680 WAIT 7000
3690 IF N<>1 THEN 3890
3700 FIXED 0
3710 DISP "Equipment identifier (30 characters maximum) for piece #";N1;"= ";
3720 INPUT G$(N1)
3730 IF LEN(G$(N1))<=30 THEN 3890
3740 BEEP
3750 INPUT "30 characters maximum!  Try again: enter equipment identifier.",G$(N
1)
3760 GOTO 3730
3770 IF N<>1 THEN 3890
3780 IF (N1<=M) AND (D(N1,1)=0) THEN 3890
3790 ! Routine to allow equipment to be deleted
3800 !
3810 INPUT "Do you want to delete this piece of equipment? (YES or NO)",B$
3820 IF B$[1,1]="N" THEN 3890
3830 IF B$[1,1]<>"Y" THEN 3810
3840 D(N1,1)=D(N1,2)=D(N1,3)=D(N1,4)=0
3850 IF U<=M THEN 4480      ! see if deleted piece was previously an added piece
3860 U=U-1      ! reduce number of pieces by one
3870 GOTO 4480
3880 !
3890 IF (D(N1,1)<>0) OR (D(N1,2)<>0) OR (D(N1,3)<>0) OR (D(N1,4)<>0) THEN 3920
3900 GOSUB 4670
3910 GOTO 4480
3920 FIXED 0
3930 DISP "BASE VALUE =";C(N1,N);"   LAST VALUE =";D(N1,N);"   NEW VALUE = ";
3940 INPUT J
3950 IF (F<>0) AND (J=0) THEN 3980
3960 D(N1,N)=J
3970 GOTO 4480
3980 BEEP
3990 DISP "The value of 0 may not be entered for this variable!  It must be re-e
ntered."
4000 WAIT 6000
4010 GOTO 3920
4020 FIXED 2
4030 DISP "BASE VALUE =";A(N);"   LAST VALUE =";B(N);"   NEW VALUE = ";
```

```
4040 INPUT J
4050 IF (F<>0) AND (J=0) THEN 4080
4060 B(N)=J
4070 GOTO 4160
4080 IF (N<>23) AND (N<>24) THEN 4120
4090 IF (B(27)>1) AND (B(30)<>0) THEN 4120
4100 IF B(31)<>0 THEN 4120
4110 GOTO 4060
4120 BEEP
4130 DISP "A value of 0 may not be entered for this variable!  It must be re-ant
ered."
4140 WAIT 6000
4150 GOTO 4020
4160 IF (N<>27) AND (N<>30) AND (N<>31) THEN 4480
4170 IF N<>27 THEN 4240
4180 IF (B(30)<>0) OR (B(27)<=1) THEN 4320
4190 INPUT "Time per setting change (hours) = ?",B(30)
4200 IF B(30)>0 THEN 4320
4210 BEEP
4220 INPUT "You must enter a value greater than 0!  Try again: time per setting
chg (hr) = ?",B(30)
4230 GOTO 4200
4240 IF N<>30 THEN 4320
4250 IF (B(27)>1) OR (B(30)=0) THEN 4320
4260 INPUT "Number of settings in unit = ?",B(27)
4270 IF B(27)>1 THEN 4320
4280 BEEP
4290 INPUT "A value of 2 or more must be entered!  Try again: number of settings
 in unit = ?",B(27)
4300 GOTO 4270
4310 !
4320 ! Routine to supply values for area & yield if needed
4330 !
4340 IF (B(27)<=1) OR (B(30)=0) THEN 4480
4350 IF (B(23)<>0) AND (B(24)<>0) THEN 4480
4360 INPUT "Cutting unit area (acres) = ?",B(23)
4370 IF B(23)>0 THEN 4410
4380 BEEP
4390 INPUT "You must enter a value greater than 0!  Try again: cutting unit area
 (acres) = ?",B(23)
4400 GOTO 1884
4410 DISP "Yield per acre ( ;L C$(A$); ) =  ;
4420 INPUT B(24)
4430 IF B(24)>0 THEN 4480
4440 BEEP
4450 INPUT "You must enter a value greater than 0!  Try again: yield per acre =
?",B(24)
4460 GOTO 4430
4470 !
4480 INPUT "Any more variable changes desired ? (YES or NO)",B$
4490 IF B$[1,1]="Y" THEN 3300
4500 IF B$[1,1]<>"N" THEN 4480
4510 B$=""
```

```
4520 IF (B(27)>1) AND (B(30)<>0) THEN 4540
4530 IF B(31)=0 THEN 5040
4540 IF (B(23)<>0) AND (B(24)<>0) THEN 5040
4550 INPUT "Cutting unit area (acres) = ?",B(23)
4560 IF B(23)>0 THEN 4600
4570 BEEP
4580 INPUT "You must enter a value greater than 0!  Try again: cutting unit area
 (acres) = ?",B(23)
4590 GOTO 4560
4600 DISP "Yield per acre (";LWC$(A$);") = ";
4610 INPUT B(24)
4620 IF B(24)>0 THEN 5040
4630 BEEP
4640 INPUT "You must enter a value greater than 0!  Try again: yield per acre =
?",B(24)
4650 GOTO 4620
4660 !
4670 ! Routine to insure that variables # 1,2,3 & 4 have all been given values
4680 ! when a new piece of equipment is added
4690 !
4700 FIXED 0
4710 FOR X=1 TO 4
4720 ON N GOTO 4730,4740,4750,4760
4730 ON X GOTO 4770,4890,4920,4990
4740 ON X GOTO 4890,4770,4920,4990
4750 ON X GOTO 4920,4770,4890,4990
4760 ON X GOTO 4990,4770,4890,4920
4770 IF X<=M THEN 4840
4780 DISP "Equipment identifier (30 characters maximum) for piece #";N1;"= ";
4790 INPUT G$(N1)
4800 IF LEN(G$(N1))<=30 THEN 4840
4810 BEEP
4820 INPUT "30 characters maximum!  Try again: enter equipment identifier.",G$(N
1)
4830 GOTO 4800
4840 DISP "For piece #";N1;":  Cost of ";G$(N1);" (dollars) = ";
4850 INPUT D(N1,1)
4860 IF D(N1,1)<>0 THEN 5010
4870 GOSUB 3760
4880 GOTO 4840
4890 DISP "For piece #";N1;":  Residual value (percent of equipment cost) = ";
4900 INPUT D(N1,2)
4910 GOTO 5010
4920 DISP "For piece #";N1;":  Depreciation period (years) = ";
4930 INPUT D(N1,3)
4940 IF D(N1,3)<>0 THEN 5010
4950 BEEP
4960 DISP "The value of 0 may not be entered for this variable!  It must be re-e
ntered."
4970 WAIT 6000
4980 GOTO 4920
4990 DISP "For piece #";N1;":  Repairs and maintenance (percent of equipment dep
reciation) = ";
```

```
5000 INPUT D(N1,4)
5010 NEXT X
5020 RETURN
5030 !
5040 A=D=M1=0
5050 K=1
5060 INPUT "Enter identifier for NEW VALUES (25 characters maximum).",D$
5070 IF LEN(D$)<=25 THEN 5110
5080 BEEP
5090 INPUT "25 characters maximum! Try again: enter identifier for NEW VALUES.",
D$
5100 GOTO 5010
5110 INPUT "Enter a new heading for all output (70 characters maximum).".H$
5120 IF LEN(H$)<=70 THEN 5180
5130 BEEP
5140 FIXED 0
5150 DISP "Sorry, you're";LEN(H$)-70;"characters over the limit of 70!  Try agai
n: heading = ";
5160 INPUT H$
5170 GOTO 5120
5180 FIXED 2
5190 P=1
5200 GOTO 930     ! calculate basis of ownership cost
5210 PAUSE
5220 GOTO 5210
5230 !
5240 ! ********** KEY 2 (PART 1) **********
5250 !
5260 S=1
5270 !
5280 ! ********** KEY 1 (PRINT ANALYSIS) **********
5290 !
5300 IF P1<>0 THEN 5400
5310 IF H$="" THEN 5330
5320 PRINT H$,LIN(2)
5330 IF (C$="") AND (D$="") THEN 5380
5340 IMAGE "ANALYSIS OF VARIABLE CHANGES            BASE VALUES = ",25A,/,40X,"N
EW VALUES  = ",25A,/
5350 PRINT USING 5340;C$,D$
5360 PRINT TAB(56),"BASE     NEW     PERCENT"
5370 GOTO 5470
5380 PRINT USING "28A,/,55X,4A,5X,3A,5X,7A";"ANALYSIS OF VARIABLE CHANGES","BASE
","NEW","PERCENT"
5390 GOTO 5470
5400 IF H$="" THEN 5420
5410 PRINT H$,LIN(2)
5420 IF (C$="") AND (D$="") THEN 5460
5430 IMAGE "ANALYSIS OF VARIABLE CHANGES            BASE VALUES = ",25A,/,"(PART
 1)",32X,"NEW VALUES  = ",18A,/
5440 PRINT USING 5430;C$,D$
5450 GOTO 5360
5460 PRINT USING "28A,/,8A,31X,4A,10X,3A,6X,7A";"ANALYSIS OF VARIABLE CHANGES","
(PART 1)","BASE","NEW","PERCENT"
```

```
5470 PRINT TAB(55),"VALUES    VALUES   CHANGE",LIN(1)
5480 IF U>1 THEN 5770
5490 E=1
5500 GOSUB 5670
5510 IMAGE "1  COST OF ",30A,"  (DOLLARS)",8D,10D,6D.D
5520 PRINT USING 5510;LWC$(G$(1)),C(1,1),D(1,1),W
5530 E=2
5540 GOSUB 5670
5550 IMAGE "2  RESIDUAL (PERCENT OF EQUIPMENT COST)",21D,10D,6D.D
5560 PRINT USING 5550;C(1,2),D(1,2),W
5570 E=3
5580 GOSUB 5670
5590 IMAGE "3  DEPRECIATION PERIOD (YEARS)",30D,10D,6D.D
5600 PRINT USING 5590;C(1,3),D(1,3),W
5610 E=4
5620 GOSUB 5670
5630 IMAGE "4  REPAIRS AND MAINTENANCE (PERCENT OF DEPRECIATION)",8D,10D,6D.D
5640 PRINT USING 5630;C(1,4),D(1,4),W
5650 GOTO 6300
5660 !
5670 ! subroutine to compute % change
5680 IF C(1,E)<>0 THEN 5740
5690 IF D(1,E)<>0 THEN 5720
5700 W=0
5710 RETURN
5720 W=100
5730 RETURN
5740 W=100*(D(1,E)-C(1,E))/C(1,E)
5750 RETURN
5760 !
5770 IMAGE "1 #1 COST OF ",30A,"(DOLLARS)",8D,10D,6D.D
5780 PRINT USING 5770;LWC$(G$(1)),C(1,1),D(1,1),100*(D(1,1)-C(1,1))/C(1,1)
5790 FOR X=2 TO U
5800 IF C(X,1)>0 THEN 5860
5810 IF D(X,1)=0 THEN 5840
5820 W=100
5830 GOTO 5870
5840 W=0
5850 GOTO 5870
5860 W=100*(D(X,1)-C(X,1))/C(X,1)
5870 IMAGE "  #",D," COST OF ",30A,"(DOLLARS)",8D,10D,6D.D
5880 PRINT USING 5870;X,LWC$(G$(X)),C(X,1),D(X,1),W
5890 NEXT X
5900 IMAGE "2 #1 RESIDUAL (PERCENT OF EQUIPMENT COST)",19D,10D,6D.D
5910 PRINT USING 5900;C(1,2),D(1,2),100*(D(1,2)-C(1,2))/C(1,2)
5920 FOR X=2 TO U
5930 IF C(X,2)>0 THEN 5990
5940 IF D(X,2)=0 THEN 5970
5950 W=100
5960 GOTO 6000
5970 W=0
5980 GOTO 6000
5990 W=100*(D(X,2)-C(X,2))/C(X,2)
```

```
6000 IMAGE "  #",D," RESIDUAL (PERCENT OF EQUIPMENT COST)",19D,10D,6D.D
6010 PRINT USING 6000;X,C(X,2),D(X,2),W
6020 NEXT X
6030 IMAGE "3 #1 DEPRECIATION PERIOD (YEARS)",28D,10D,6D.D
6040 PRINT USING 6030;C(1,3),D(1,3),100*(D(1,3)-C(1,3))/C(1,3)
6050 FOR X=2 TO U
6060 IF C(X,3)>0 THEN 6120
6070 IF D(X,3)=0 THEN 6100
6080 W=100
6090 GOTO 6130
6100 W=0
6110 GOTO 6130
6120 W=100*(D(X,3)-C(X,3))/C(X,3)
6130 IMAGE "  #",D," DEPRECIATION PERIOD (YEARS)",28D,10D,6D.D
6140 PRINT USING 6130;X,C(X,3),D(X,3),W
6150 NEXT X
6160 IMAGE "4 #1 REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)",8D,10D,6D.D
6170 PRINT USING 6160;C(1,4),D(1,4),100*(D(1,4)-C(1,4))/C(1,4)
6180 FOR X=2 TO U
6190 IF C(X,4)>0 THEN 6250
6200 IF D(X,4)=0 THEN 6230
6210 W=100
6220 GOTO 6260
6230 W=0
6240 GOTO 6260
6250 W=100*(D(X,4)-C(X,4))/C(X,4)
6260 IMAGE "  #",D," REPAIRS & MAINTENANCE (PERCENT OF DEPRECIATION)",8D,10D,6D.
D
6270 PRINT USING 6260;X,C(X,4),D(X,4),W
6280 NEXT X
6290 H=1
6300 FOR X=5 TO 39
6310 IF A(X)<>0 THEN 6370
6320 IF B(X)<>0 THEN 6350
6330 E(X)=0
6340 GOTO 6380
6350 E(X)=100
6360 GOTO 6380
6370 E(X)=100*(B(X)-A(X))/A(X)
6380 NEXT X
6390 IF H1=1 THEN 6960
6400 IMAGE "5  ANNUAL INTEREST RATE (PERCENT)",24D.DD,7D.DD,6D.D
6410 PRINT USING 6400;A(5),B(5),E(5)
6420 IMAGE "6  TAX,LICENSE,INSURANCE, AND STORAGE (PERCENT)",10D.DD,7D.DD,6D.D
6430 PRINT USING 6420;A(6),B(6),E(6)
6440 IMAGE "7  OPERATING SEASON (DAYS WORKED/YEAR)",22D,10D,6D.D
6450 PRINT USING 6440;A(7),B(7),E(7)
6460 IMAGE "8  OPERATING TIME PER DAY (HOURS)",25D.D,8D.D,6D.D
6470 PRINT USING 6460;A(8),B(8),E(8)
6480 IMAGE "9  FUEL CONSUMPTION (GALLONS/HOUR)",23D.DD,7D.DD,6D.D
6490 PRINT USING 6480;A(9),B(9),E(9)
6500 IMAGE "10 FUEL COST (DOLLARS/GALLON)",28D.DD,7D.DD,6D.D
6510 PRINT USING 6500;A(10),B(10),E(10)
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6520 IMAGE "11 OIL AND LUBE (PERCENT OF FUEL CONSUMPTION)",15D,10D,6D.D
6530 PRINT USING 6520;A(11),B(11),E(11)
6540 IMAGE "12 OIL AND LUBE COST (DOLLARS/GALLON)",20D.DD,7D.DD,6D.D
6550 PRINT USING 6540;A(12),B(12),E(12)
6560 IMAGE "13 LINE COST (DOLLARS)",38D,10D,6D.D
6570 PRINT USING 6560;A(13),B(13),E(13)
6580 IMAGE "14 LINE LIFE (HOURS)",40D,10D,6D.D
6590 PRINT USING 6580;A(14),B(14),E(14)
6600 IMAGE "15 RIGGING COST (DOLLARS)",35D,10D,6D.D
6610 PRINT USING 6600;A(15),B(15),E(15)
6620 IMAGE "16 RIGGING LIFE (HOURS)",37D,10D,6D.D
6630 PRINT USING 6620;A(16),B(16),E(16)
6640 IMAGE "17 TIRE OR TRACK REPLACEMENT COST (DOLLARS)",17D,10D,6D.D
6650 PRINT USING 6640;A(17),B(17),E(17)
6660 IMAGE "18 TIRE OR TRACK LIFE (HOURS)",31D,10D,6D.D
6670 PRINT USING 6660;A(18),B(18),E(18)
6680 IMAGE "19 TOTAL CREW WAGE (DOLLARS/HOUR)",24D.DD,7D.DD,6D.D
6690 PRINT USING 6680;A(19),B(19),E(19)
6700 IMAGE "20 FRINGE BENEFITS (PERCENT OF TOTAL CREW WAGE)",13D,10D,6D.D
6710 PRINT USING 6700;A(20),B(20),E(20)
6720 IMAGE "21 TRAVEL TIME PER DAY (HOURS)",27D.DD,7D.DD,6D.D
6730 PRINT USING 6720;A(21),B(21),E(21)
6740 IMAGE "22 SUPERVISION AND OVERHEAD (PERCENT OF DIRECT LABOR)",7D,10D,6D.D
6750 PRINT USING 6740;A(22),B(22),E(22)
6760 IF S=1 THEN 6780
6770 IF P1=0 THEN 6930
6780 PRINT LIN(4)
6790 IF P1=0 THEN 6810
6800 PRINT "****** PRESS KEY 3 ('PART 2') TO DISPLAY REMAINDER OF ANALYSIS *****
*"
6810 S=0
6820 PAUSE
6830 GOTO 6810
6840 !
6850 ! ********** KEY 3 (PRINT ANALYSIS - PART 2) **********
6860 !
6870 S=2
6880 IF H$="" THEN 6900
6890 PRINT H$,LIN(2)
6900 IMAGE "ANALYSIS OF VARIABLE CHANGES            BASE VALUES = ",25A,/,"(PART
 2)",32X,"NEW VALUES  = ",25A,/
6910 PRINT USING 6900;C$,D$
6920 PRINT TAB(56),"BASE     NEW     PERCENT",LIN(1),TAB(55),"VALUES    VALUES
 CHANGE",LIN(1)
6930 IF H=1 THEN 6960
6940 H1=1
6950 GOTO 6290
6960 H=H1=0
6970 IF (P1=16) OR (S=2) THEN 6990
6980 PRINT LIN(2)
6990 S=0
7000 IF (Z7(1)=0) AND (Z7(2)=0) AND (Z8(1)=0) AND (Z8(2)=0) THEN 7050
7010 IMAGE "23 CUTTING UNIT AREA (ACRES)",32D,10D,6D.D
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7020 PRINT USING 7010;A(23),B(23),E(23)
7030 IMAGE "24 YIELD PER ACRE (",5A,")",32D.DD,7D.DD,6D.D
7040 PRINT USING 7030;A$,A(24),B(24),E(24)
7050 IF Z5=1 THEN 7080      ! known production rate
7060 IMAGE "25 AVG. VOLUME/PIECE AS BUCKED ("5A,")",19D.DD,7D.DD,6D.D
7070 PRINT USING 7060;A$,A(25),B(25),E(25)
7080 IMAGE "26 DEFECT IN PIECES AS YARDED (PERCENT)",18D.DD,7D.DD,6D.D
7090 PRINT USING 7080;A(26),B(26),E(26)
7100 IF (Z5=0) OR (A(27)=0) THEN 7120       !A(27)=0 only if known p.r. includes
7110 IF (A(27)<=1) AND (B(27)<=1) THEN 7140                  !setting change time
7120 IMAGE "27 NUMBER OF YARDING ROADS IN UNIT",26D,10D,6D.D
7130 PRINT USING 7120;A(27),B(27),E(27)
7140 IF Z5=1 THEN 7190      ! known production rate
7150 IMAGE "28 AVERAGE NUMBER OF PIECES PER TURN",21D.DD,7D.DD,6D.D
7160 PRINT USING 7150;A(28),B(28),E(28)
7170 IMAGE "29 AVERAGE NUMBER OF TURNS PER HOUR",22D.DD,7D.DD,6D.D
7180 PRINT USING 7170;A(29),B(29),E(29)
7190 IF (Z5=0) OR (A(27)=0) THEN 7210
7200 IF (A(30)=0) AND (B(30)=0) THEN 7230
7210 IMAGE "30 TIME PER ROAD CHANGE (HOURS)",26D.DD,7D.DD,6D.D
7220 PRINT USING 7210;A(30),B(30),E(30)
7230 IMAGE "31 MOVE IN AND MOVE OUT COST (DOLLARS)",22D,10D,6D.D
7240 PRINT USING 7230;A(31),B(31),E(31)
7250 PRINT
7260 PRINT
7270 IMAGE /,/,"OWNERSHIP COST (DOLLARS/HOUR)",28D.DD,7D.DD,6D.D
7280 PRINT USING 7270;A(33),B(33),E(33)
7290 IMAGE "OPERATING COST (DOLLARS/HOUR)",28D.DD,7D.DD,6D.D
7300 PRINT USING 7290;A(34),B(34),E(34)
7310 PRINT SPA(54),"------    ------"
7320 IMAGE "MACHINE RATE (DOLLARS/HOUR)",30D.DD,7D.DD,6D.D
7330 PRINT USING 7320;A(35),B(35),E(35)
7340 IF (A(26)<>0) OR (B(26)<>0) THEN 7610
7350 IMAGE /,"PRODUCTION RATE (",5A,"/HOUR)",29D.DD,7D.DD,6D.D
7360 PRINT USING 7350;A$,A(36),B(36),E(36)
7370 IF (A(30)<>0) AND (A(27)>1) THEN 7390
7380 IF (B(30)=0) OR (B(27)<=1) THEN 7480
7390 IMAGE "ROAD CHANGE COST (DOLLARS/",5A,")",25D.DD,7D.DD,6D.D
7400 IF Z8(1)<>0 THEN 7460
7410 IF Z8(2)=0 THEN 7440
7420 W=100
7430 GOTO 7470
7440 W=0
7450 GOTO 7470
7460 W=(Z8(2)-Z8(1))/Z8(1)*100
7470 PRINT USING 7390;A$,Z8(1),Z8(2),W
7480 IF (A(31)=0) AND (B(31)=0) THEN 7580
7490 IMAGE "MOVE IN AND OUT COST (DOLLARS/",5A,")",21D.DD,7D.DD,6D.D
7500 IF Z7(1)<>0 THEN 7560
7510 IF Z7(2)=0 THEN 7540
7520 W=100
7530 GOTO 7570
7540 W=0
```

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7550 GOTO 7570
7560 W=(Z7(2)-Z7(1))/Z7(1)*100
7570 PRINT USING 7490;A$,Z7(1),Z7(2),W
7580 IMAGE /,/,"YARDING COST (DOLLARS/",5A,")",29D.DD,7D.DD,6D.D
7590 PRINT USING 7580;A$,A(38),B(38),E(38)
7600 GOTO 7990
7610 IMAGE /,"GROSS PRODUCTION RATE (",5A,"/HOUR)",23D.DD,7D.DD,6D.D
7620 PRINT USING 7610;A$,A(36),B(36),E(36)
7630 IMAGE /,"NET PRODUCTION RATE (",5A,"/HOUR)",25D.DD,7D.DD,6D.D
7640 PRINT USING 7630;A$,A(37),B(37),E(37)
7650 IF (A(30)<>0) AND (A(27)>1) THEN 7670
7660 IF (B(30)=0) OR (B(27)<=1) THEN 7760
7670 IMAGE "GROSS ROAD CHANGE COST (DOLLARS/",5A,")",19D.DD,7D.DD,6D.D
7680 IF Z8(1)<>0 THEN 7740
7690 IF Z8(2)=0 THEN 7720
7700 W=100
7710 GOTO 7750
7720 W=0
7730 GOTO 7750
7740 W=(Z8(2)-Z8(1))/Z8(1)*100
7750 PRINT USING 7670;A$,Z8(1),Z8(2),W
7760 IF (A(31)=0) AND (B(31)=0) THEN 7860
7770 IMAGE "GROSS MOVE IN AND OUT COST (DOLLARS/",5A,")",15D.DD,7D.DD,6D.D
7780 IF Z7(1)<>0 THEN 7840
7790 IF Z7(2)=0 THEN 7820
7800 W1=100
7810 GOTO 7850
7820 W1=0
7830 GOTO 7850
7840 W1=(Z7(2)-Z7(1))/Z7(1)*100
7850 PRINT USING 7770;A$,Z7(1),Z7(2),W1
7860 IF (A(30)<>0) AND (A(27)>1) THEN 7880
7870 IF (B(30)=0) OR (B(27)<=1) THEN 7900
7880 IMAGE /,"NET ROAD CHANGE COST (DOLLARS/",5A,")",21D.DD,7D.DD,6D.D
7890 PRINT USING 7880;A$,Z8(1)/(100-A(26))*100,Z8(2)/(100-A(26))*100,W
7900 IF (A(31)=0) AND (B(31)=0) THEN 7950
7910 IF (A(30)<>0) AND (B(30)<>0) AND (A(27)>1) AND (B(27)>1) THEN 7930
7920 PRINT
7930 IMAGE "NET MOVE IN AND OUT COST (DOLLARS/",5A,")",17D.DD,7D.DD,6D.D
7940 PRINT USING 7930;A$,Z7(1)/(100-A(26))*100,Z7(2)/(100-A(26))*100,W1
7950 IMAGE /,/,"GROSS YARDING COST (DOLLARS/",5A,")",23D.DD,7D.DD,6D.D
7960 PRINT USING 7950;A$,A(38),B(38),E(38)
7970 IMAGE /,"NET YARDING COST (DOLLARS/",5A,")",25D.DD,7D.DD,6D.D
7980 PRINT USING 7970;A$,A(39),B(39),E(39)
7990 IF P1=16 THEN 8010
8000 PRINT USING "/,/,/,/"
8010 PAUSE
8020 GOTO 8010
8030 !
8040 ! ********** KEYS 11,12,13,14 & 15 (CHANGE OWNERSHIP COST, OPERATING COST,
8050 !             MACHINE RATE, GROSS VOL/HR & NET VOL/HR) **********
8060 !
8070 N=33                    ! key 11
```

```
8080 E$="OWNERSHIP COST"
8090 GOTO 8250
8100 N=34                    ! key 12
8110 E$="OPERATING COST"
8120 GOTO 8250
8130 N=35                    ! key 13
8140 E$="MACHINE RATE"
8150 GOTO 8250
8160 N=36                    ! key 14
8170 IF Z5=0 THEN 8200
8180 E$="VOLUME/HR"
8190 GOTO 8250
8200 E$="GROSS VOLUME/HR"
8210 GOTO 8250
8220 IF Z5=1 THEN 8160       ! key 15
8230 N=37
8240 E$="NET VOLUME/HR"
8250 FIXED 2
8260 PRINTER IS 16
8270 PRINT USING "6A,X,15A,X,7A,/,/";"CHANGE",E$,"Routine"
8280 PRINTER IS P1
8290 DISP E$;":  BASE VALUE =";A(N);"   LAST VALUE =";B(N);"   NEW VALUE = ";
8300 INPUT B(N)
8310 INPUT "Enter identifier for NEW VALUES (25 characters maximum)",F$
8320 IF F$="" THEN 8380
8330 IF LEN(F$)<=25 THEN 8370
8340 BEEP
8350 INPUT "25 characters maximum! Try again: enter identifier for NEW VALUES.",
F$
8360 GOTO 8320
8370 D$=F$
8380 INPUT "Enter a new heading for all output (70 characters maximum).",H$
8390 IF LEN(H$)<=70 THEN 8460
8400 BEEP
8410 FIXED 0
8420 DISP "Sorry, you're";LEN(H$)-70;"characters over the limit of 70!  Try agai
n: heading = ";
8430 INPUT H$
8440 FIXED 2
8450 GOTO 8390
8460 K=1
8470 IF N=35 THEN 8490
8480 B(35)=B(33)+B(34)       ! machine rate
8490 IF (B(30)=0) OR (B(27)<=1) THEN 8520
8500 Z8(2)=(B(27)-1)*B(30)*B(35)/B(23)/B(24)      ! setting change cost
8510 GOTO 8530
8520 Z8(2)=0
8530 IF Z5=1 THEN 8570
8540 IF N=36 THEN 8580
8550 B(36)=B(25)*B(28)*B(29)      ! gross prod. rate if prod. rate unknown
8560 IF N=37 THEN 8580
8570 B(37)=B(36)*(100-B(26))/100      ! net production rate
8580 B(38)=B(35)/B(36)+Z7(2)+Z8(2)      ! gross yarding cost
```

```
8590 B(39)=B(35)/B(37)+Z7(2)+Z8(2)      ! ret yarding cost
8600 IF H$="" THEN 8620
8610 PRINT H$,LIN(2)
8620 IF (C$="") AND (D$="") THEN 8660
8630 IMAGE "ANALYSIS WITH NEW VALUE OF",14X,"BASE VALUES = ",25A,/,20A,20X,"NEW
VALUES =  ",25A,/
8640 PRINT USING 8630;C$,E$,D$
8650 GOTO 8680
8660 IMAGE "ANALYSIS WITH NEW VALUE OF",/,20A
8670 PRINT USING 8660;E$
8680 PRINT SPA(55);"BASE";SPA(4);"NEW";SPA(4);"PERCENT";LIN(1);SPA(54);"VALUES";
SPA(4);"VALUES";SPA(3);"CHANGE"
8690 FOR X=33 TO 39
8700 IF A(X)<>0 THEN 8760
8710 IF B(X)<>0 THEN 8740
8720 E(X)=0
8730 GOTO 8770
8740 E(X)=100
8750 GOTO 8770
8760 E(X)=100*(B(X)-A(X))/A(X)
8770 NEXT X
8780 GOTO 7270
8790 !
8800 ! ********** KEY 4 (NEW VALUES REPLACED BY BASE VALUES) **********
8810 !
8820 FOR X=5 TO 39
8830 B(X)=A(X)
8840 NEXT X
8850 D$=C$
8860 Z7(2)=Z7(1)
8870 Z8(2)=Z8(1)
8880 MAT D=C
8890 U=M
8900 PAUSE
8910 GOTO 8900
8920 !
8930 ! ********** KEY 20 (BASE VALUES REPLACED BY NEW VALUES) **********
8940 !
8950 FOR X=5 TO 39
8960 A(X)=B(X)
8970 NEXT X
8980 C$=D$
8990 Z7(1)=Z7(2)
9000 Z8(1)=Z8(2)
9010 !
9020 ! routine to remove any deleted pieces of equipment
9030 !
9040 FOR X=1 TO U
9050 IF (D(X,1)=0) AND (D(X,2)=0) AND (D(X,3)=0) AND (D(X,4)=0) THEN 9080
9060 NEXT X
9070 GOTO 9230
9080 U=U-1
9090 D(X,1)=D(X+1,1)
```

```
9100 D(X,2)=D(X+1,2)
9110 D(X,3)=D(X+1,3)
9120 D(X,4)=D(X+1,4)
9130 G$(X)=G$(X+1)
9140 FOR X1=X+1 TO U
9150 D(X1,1)=D(X1+1,1)
9160 D(X1,2)=D(X1+1,2)
9170 D(X1,3)=D(X1+1,3)
9180 D(X1,4)=D(X1+1,4)
9190 NEXT X1
9200 D(X1,1)=D(X1,2)=D(X1,3)=D(X1,4)=0
9210 GOTO 9040
9220 !
9230 MAT C=D
9240 M=U
9250 PAUSE
9260 GOTO 9250
9270 !
9280 ! ********** KEY 6 (OUTPUT ON PRINTER) ******;**
9290 !
9300 P1=0
9310 GOTO 9360
9320 !
9330 ! ********** KEY 5 (OUTPUT ON PLOTTER) *********
9340 !
9350 P1=16
9360 PRINTER IS P1
9370 PAUSE
9380 GOTO 9370
9390 !
9400 ! ********** KE, ; (PLOT ON SCREEN) ********
9410 !
9420 A7=1
9430 DISP "PLOT ON SCREEN"
9440 PAUSE
9450 GOTO 9440
9460 !
9470 ! ********** KEY 9 (PLOT ON PLOTTER) *********
9480 !
9490 A7=2
9500 DISP "PLOT ON PLOTTER  -  Plotter must be turned on."
9510 PAUSE
9520 GOTO 9510
9530 !
9540 ! ********** KEY 10 (AXES & PLOT) ********:
9550 !
9560 A8=S2=0
9570 I=1
9580 IF A7=1 THEN 9680      ! plot on screen
9590 IF A7=0 THEN 10750     ! plot on plotter
9600 !
9610 ! plot on plotter routine
9620 !
```

```
9630 PLOTTER IS "GRAPHICS"
9640 PLOTTER IS 7,5,"9872A"              ! SET PLOTTER LIMITS TO 6.25 X 6.25 INCHES
9650 PLOTTER 7,5 IS ON                   !
9660 GOTO 9720
9670 !
9680 ! plot on screen routine
9690 !
9700 PLOTTER IS 13,"GRAPHICS"
9710 GRAPHICS
9720 IF A8=1 THEN 10800
9730 !
9740 ! axes & plot
9750 !
9760 IF A7<>0 THEN 9780
9770 GOTO 10750
9780 IF (A(26)<>0) OR (B(26)<>0) THEN 9810
9790 K3=1      ! flag to suppress 'net' or 'gross' label
9800 GOTO 9890
9810 INPUT "Do you want to plot gross rather that net values? (YES or NO)",B$
9820 IF B$[1,1]="Y" THEN 9880
9830 IF B$[1,1]<>"N" THEN 9810
9840 K3=2      ! flag to print 'net' label
9850 K1=37      ! net values will be plotted
9860 K2=39
9870 GOTO 9910
9880 K3=3      ! flag to print 'gross' label
9890 K1=36      ! gross values will be plotted
9900 K2=38
9910 B$=""
9920 IF S2=1 THEN 10740
9930 LOCATE 16,96,16,96
9940 PEN 1
9950 A5=2
9960 A6=4
9970 !
9980 ! routine to automatically caluclate ranges for horizontal & vertical axes
9990 !
10000 IF A(K1)>=B(K1) THEN 10030
10010 A1=B(K1)
10020 GOTO 10040
10030 A1=A(K1)
10040 IF A(K2)>=B(K2) THEN 10070
10050 A2=B(K2)
10060 GOTO 10110
10070 A2=A(K2)
10080 !
10090 ! routine to round off axes values to nearest higher value of 10
10100 !
10110 IF A1 MOD 10<>0 THEN 10140
10120 IF A2 MOD 10<>0 THEN 10160
10130 GOTO 10170
10140 A1=(A1 DIV 10+1)*10
10150 GOTO 10120
```

```
10160 A2=(A2 DIV 10+1)*10
10170 FIXED 0
10180 IF B$[1,1]="Y" THEN 10280
10190 !
10200 DISP "Want to define range of prod. rate & yarding cost other than";A1;"&"
;A2;" (YES/NO)";
10210 INPUT B$
10220 FIXED 2
10230 IF B$[1,1]="Y" THEN 10260
10240 IF B$[1,1]<>"N" THEN 10200
10250 GOTO 10280
10260 INPUT "Enter: maximum production rate (X-axis), maximum yarding cost (Y-ax
is)",A1,A2
10270 GOTO 10110
10280 B$=""
10290 A9=A2*1.2
10300 SCALE 0,A1,0,A2
10310 AXES A1/10,A2/10,0,0
10320 LOCATE 0,100,0,100
10330 SCALE 0,A1/5*6.25,0,A2/5*6.25
10340 CSIZE 3
10350 DEG
10360 LDIR 0
10370 LORG 6
10380 FOR X=A1/5 TO A1/5*6 STEP A1/10    ! label horizontal axis
10390 MOVE X,A2*.8/5
10400 LABEL USING "DD";X-A1/5
10410 NEXT X
10420 LORG 8
10430 FOR X=A2/5 TO A2/5*6 STEP A2/10    ! label vertical axis
10440 MOVE A1*.8/5,X
10450 LABEL USING "DD";X-A2/5
10460 NEXT X
10470 LORG 1
10480 CSIZE 4
10490 MOVE A1/5*1.05,0
10500 ON K3 GOTO 10510,10540,10570
10510 IMAGE "   PRODUCTION RATE (",5A,"/HOUR)"
10520 LABEL USING 10510;A$
10530 GOTO 10590
10540 IMAGE " NET PRODUCTION RATE (",5A,"/HOUR)"
10550 LABEL USING 10540;A$
10560 GOTO 10590
10570 IMAGE "GROSS PRODUCTION RATE (",5A,"/HOUR)"
10580 LABEL USING 10570;A$
10590 LDIR 90
10600 MOVE A1*.03,A2/5*1
10610 ON K3 GOTO 10620,10650,10680
10620 IMAGE "   YARDING COST (DOLLARS/",5A,")"
10630 LABEL USING 10620;A$
10640 GOTO 10800
10650 IMAGE " NET YARDING COST (DOLLARS/",5A,")"
10660 LABEL USING 10650;A$
```

```
10670 GOTO 10800
10680 IMAGE "GROSS YARDING COST (DOLLARS/",5A,")"
10690 LABEL USING 10680;A$
10700 GOTO 10800
10710 !
10720 ! plot
10730 !
10740 IF A7<>0 THEN 10770
10750 DISP "You must press key 8 or key 9 first."
10760 PAUSE
10770 IF S2=1 THEN 10800
10780 A8=1
10790 GOTO 9580
10800 LOCATE 0,100,0,100
10810 SCALE 0,A1/5*6.25,0,A2/5*6.25
10820 LOCATE 16,96,16,96
10830 INPUT "Enter: 0 to plot BASE VALUES; 1 to plot NEW VALUES; 2 to plot
 both",A3
10840 !
10850 ! routine to set line type
10860 !
10870 A5=A5+2
10880 IF A5<>10 THEN 10930
10890 A6=A6+2
10900 IF A6=10 THEN 11380
10910 A5=2
10920 GOTO 10870
10930 LINE TYPE A5,A6
10940 !
10950 ! routine to draw curve
10960 !
10970 A9=A9-A2*.04
10980 IF S2=0 THEN 11000
10990 GRAPHICS
11000 IF A3=1 THEN 11300
11010 !
11020 ! PLOT BASE VALUES
11030 !
11040 FOR X=A1 TO .5 STEP -.5
11050 A4=Z7(1)+Z8(1)+A(35)/X
11060 PLOT X+A1/5,A4+A2/5
11070 NEXT X
11080 !
11090 ! routine to draw lines & label
11100 !
11110 PENUP
11120 MOVE A(K1)+A1/5,A2/5
11130 PLOT A(K1)+A1/5,A(K2)+A2/5,-1
11140 PLOT A1/5,A(K2)+A2/5,2
11150 CSIZE 3
11160 MOVE A1*.65,A9
11170 DRAW A1*.81,A9
11180 MOVE A1*.85,A9
```

```
11190 LORG 2
11200 LDIR 0
11210 LINE TYPE 1
11220 LABEL C$
11230 IF (A(K1)<>B(K1)) OR (A(K2)<>B(K2)) OR (A3<>2) THEN 11280
11240 A9=A9-A2*.04
11250 MOVE A1*.81,A9
11260 LABEL "& ";D$
11270 GOTO 11670
11280 IF A3=0 THEN 11670
11290 !
11300 ! PLOT NEW VALUES
11310 !
11320 ! routine to set line type
11330 !
11340 A5=A5+2
11350 IF A5<>10 THEN 11420
11360 A6=A6+2
11370 IF A6<>10 THEN 5690
11380 DISP "No more plots allowed!"
11390 PAUSE
11400 A5=2
11410 GOTO 11340
11420 IF A3=1 THEN 11480
11430 LINE TYPE A5,A6
11440 !
11450 ! routine to draw curve
11460 !
11470 A9=A9-A2*.04
11480 FOR X=A1 TO .5 STEP -.5
11490 A4=Z7(2)+Z8(2)+B(35)/X
11500 PLOT X+A1/5,A4+A2/5
11510 NEXT X
11520 !
11530 ! routine to draw lines & label
11540 !
11550 PENUP
11560 MOVE B(K1)+A1/5,A2/5
11570 PLOT B(K1)+A1/5,B(K2)+A2/5,-1
11580 PLOT A1/5,B(K2)+A2/5,2
11590 CSIZE 3
11600 MOVE A1*.65,A9
11610 DRAW A1*.81,A9
11620 MOVE A1*.85,A9
11630 LORG 2
11640 LDIR 0
11650 LINE TYPE 1
11660 LABEL D$
11670 MOVE A1*1.2,A2*1.2
11680 K=0
11690 PAUSE
11700 GOTO 11690
11710 !
```

```
11720 ! ********** KEY 24 (HARD COPY OF PLOT) **********
11730 !
11740 IF I=1 THEN 11780
11750 BEEP
11760 DISP "No hard copy can be made!  You must plot something first."
11770 PAUSE
11780 IF A7=1 THEN 11820
11790 BEEP
11800 DISP "No hard copy can be made!  Your plot was made on the plotter."
11810 PAUSE
11820 DUMP GRAPHICS
11830 GCLEAR
11840 PAUSE
11850 GOTO 11840
11860 !
11870 ! ********** KEY 26 (PLOT ONLY) **********
11880 !
11890 IF I=1 THEN 11940
11900 BEEP
11910 DISP "You must make a plot with axes first!  Access key 10 before this key
."
11920 PAUSE
11930 GOTO 11920
11940 IF K=1 THEN 11990
11950 BEEP
11960 DISP "You must make one or more changes through key 0,11,12,13,14 or 15 fi
rst!"
11970 PAUSE
11980 GOTO 11970
11990 S2=1
12000 GOTO 9910
12010 END
12020 PLOTTER IS "GRAPHICS"
12030 PLOTTER IS 7,5,"9872A"
12040 PLOTTER 7,5 IS ON
12050 X=0
12060 FOR X1=1 TO 7
12070 FOR X2=1 TO 3
12080 LINE TYPE X1+3,2+2*X2
12090 X=X+1
12100 MOVE 0,2*X
12110 DRAW 60,2*X
12120 NEXT X2
12130 NEXT X1
12140 PAUSE
```

```
KEY 0
  -Clear
  CONT3260
  -Execute
KEY 1
  -Clear
  CONT5280
  -Execute
KEY 2
  -Clear
  CONT5240
  -Execute
KEY 3
  -Clear
  CONT6850
  -Execute
KEY 4
  -Clear
  CONT3800
  -Execute
KEY 5
  -Clear
  CONT9330
  -Execute
KEY 6
  -Clear
  CONT9290
  -Execute
KEY 7
  -Clear line
  REWIND ":T15"
  -Execute
KEY 8
  -Clear
  CONT9400
  -Execute
KEY 9
  -Clear
  CONT9470
  -Execute
KEY 10
  -Clear
  CONT9540
  -Execute
KEY 11
  -Clear
  CONT8070
  -Execute
KEY 12
  -Clear
  CONT8100
  -Execute
KEY 13
  -Clear
  CONT8130
  -Execute
KEY 14
  -Clear
  CONT8160
  -Execute
KEY 15
  -Clear
  CONT8220
  -Execute
KEY 20
  -Clear
  CONT8930
  -Execute
KEY 24
  -Clear
  CONT11720
  -Execute
KEY 26
  -Clear
  CONT11870
  -Execute
```

Description of Variables – 9845 Program

A$	Volume unit description
A()	Base variable values
A	Total average annual investment
A1	Maximum value of production rate for plot
A2	Maximum value of yarding cost for plot
A3	Flag to indicate if plot is for base values, new values, or both
A4	Flag to indicate if yarding cost is to be plotted
A5	Line type identification number for plot
A6	Line type length for plot
A7	Flag to indicate if plot is on the screen or printer
A8	Flag to indicate if axes and plot or plot only is to be drawn
A9	Vertical distance to the plot and to the label of line type and identifier
B$	"YES" or **"NO"** response to visual prompts
B()	New variable values
B	Dummy to read DATA
C$	Identifier for base values
C()	Base variable values
D$	Identifier for new values
D()	New variable values
D	Total equipment depreciation
E$	Variable type description
E()	Percent change between base value and new value
E	Counter
F$	Temporary identifier for new values
F	Flag for determining if test for variable value equal to zero is required
G$()	Equipment identifier
H$	Heading
H	Flag to determine if part 1 of Print analysis routine has been accessed
H1	Flag to route program if part 2 of Print analysis routine **is** accessed prior to part 1
I	Flag to determine if key 10 has been pressed before key 26
J	Temporary storage for New Value
K	Flag to determine if key 26 can be accessed or not
K1	Value to allow plot of gross or net production rate
K2	Value to allow plot of gross or net yarding cost
K3	Flag to select plot labels
L	Line cost/hour
M	Number of base pieces of equipment
M1	Total repairs and maintenance cost
N	Number of the variable that is to be changed
N1	Number of the equipment piece
P	Flag to route to calculations for production rate and costs if VARIABLE CHANGES routine is accessed
P1	Printer mode (CRT or internal thermal printer)
Q	Direct labor cost plus supervision and overhead cost
R	Rigging cost/hour

S	Flag to indicate which part of Print analysis routine has been accessed
s2	Flag to indicate if key **26** (Plot only) is accessed
T	Tire or track cost/hour
U	Current number of base or new pieces of equipment (whichever is greater)
W	Percent change from base value to new value
W1	Percent change from base value to new value
X	Counter
X1	Counter
z5	Flag to indicate if production rate is known (Z5=1) or unknown (Z5=0)
Z7()	Move in and move out cost (dollars/gross unit volume)
Z8()	Total setting change cost (dollars/gross unit volume)

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