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## A GENERAL PURPOSE BENEFIT-COST AND COST-EFFECTIVENESS ANALYSIS COMPUTER PROGRAM (BENCOST)

by

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July 1985

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## SUMMARY

This report presents a revision of a Fortran computer program for benefit-cost and cost-effectiveness analysis which runs on the Michigan State University Cyber 750. The program is flexible with large capacity, permitting up to 50 sets of costs and 10 sets of benefits, entered as quantities times price if desired. The program calculates five evaluation measures: the Benefit-Cost Ratio (B/C), the Cost Effectiveness Ratio (C/E, the Internal Rate of Return (IRR), the Net Present Value (NPV), and the Payback Period. It also displays annual cash flows.

The six options available in the program are: 1) data entry choices for costs and benefits as aggregated data, in detailed form, or with automatic replication of repetitious data; 2) changes in scale of costs and benefits for sensitivity tests; 3) a compound rate function to vary prices; 4) separation of capital costs from operating and overhead costs; 5) use of a modified B/C ratio for evaluation of a particular scarce resource; and 6) choice of a printout which summarizes inputs and results (4 tables), or an expanded set of tables which provide complete listings of all the data employed.

## I. INTRODUCTION TO THE USE OF THE PROGRAM\*

### I. Program Features

This mainframe program computes five evaluation measures; the benefit-cost ratio C/B, the cost-effectiveness ratio C/E, the net present value (NPV), the internal rate of return (IRR) and the payback period. It also provides annual cash flows. The benefit-cost ratio for any identified scarce resource may also be obtained by using an option in the program. Thus, if a resource other than capital is considered scarce, such as technically trained manpower, analysis can be focused on this resource. For users of Super Calc on the IBM-PC a similar but more limited program is available as a spreadsheet (Crawford, Ho and Schmid).

Data entry is flexible. Incremental benefits (outputs), can be read in as aggregate benefits or computed in the program from physical units of benefit multiplied by their price, or value. Ten separate sets of benefits are accommodated. Incremental costs (inputs) may be entered as totals or as up to 50 separate sets of physical inputs along with their prices enabling calculation of total cost. Capital costs may be separated from operating costs and overhead costs. The option to enter prices of cost items, or the value (prices) of benefits for each year of the planning horizon permits complete flexibility at the cost of more detailed entry of price data.

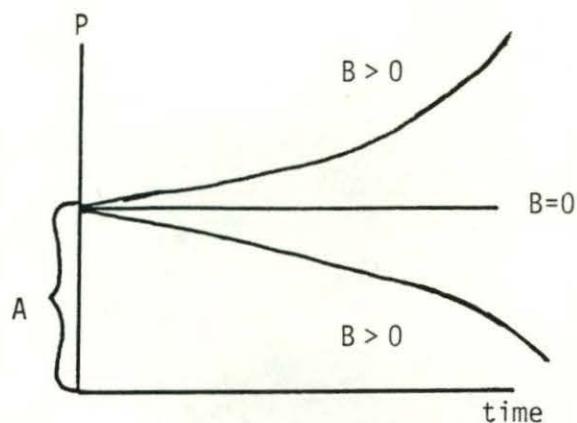
It should be emphasized at this point that all cost and benefit data entered for benefit-cost or cost-effectiveness analysis has to represent incremental costs and benefits, i.e. those additional costs and benefits which are due to the project. Estimates

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\*Robert Ranger indicated that this program grew out of a suggestion by a colleague, Mr. Chong Kwong-Yuan and that Dr. Stevens encouraged and aided in its development. Helpful comments on the manuscript were given by Drs. Liedholm, Schmid, and Staatz. This edition of the program (Revision 3) increased benefit sets from 1 to 10 and has added the cost-effectiveness ratio. The previous versions of this report were AER 149 written in 1969, and a revised edition in 1975. This research has been supported in part by Michigan Agricultural Experiment Station Research Project No. 1079. Michigan Agricultural Experiment Station Journal No. 11855.

of these values are obtained from the difference between costs and benefits with the project and without it.

Prices may be calculated automatically. This feature employs the price function  $P = A(1+B)^t$  ( $t$ =year), values for A and B being specified by the user. Hence, a price may be made constant (with  $B=0$ ), or it may increase or decrease exponentially each year at a specified rate due to inflation, or other factors. (see Figure 1).



Sensitivity analysis can be carried out by using a scale factor to change the level of benefits and costs. Benefits and costs may be set at some fraction of the original values, such as 70 percent or 120 percent.

The standard computer printout from this program contains four tables (Appendix B). Appendix Table 1 and 2 show the inputs to the program. Appendix Table 3 displays year, the sum of benefits, capital costs, operating costs, and shows net present value, cash flow, or incremental net present value, as well as the benefit-cost and cost-effectiveness ratios. Note that discounting starts in the second year in this program. Appendix Table 4 shows the internal rate of return calculated in steps of 2 percent interest rate. Five additional more detailed tables (5-9) may also be obtained. The first two list by year the values of all sets of inputs and outputs, the latter two give even more detail with all sets of inputs and outputs and their prices.

Different projects may be compared using results from the program by plotting net present value as a function of the interest rate to determine whether a ranking problem exists with use of the internal rate of return. A flow chart of the program is provided in Appendix A.

## **II. Background Information About Benefit-Cost and Cost-Effectiveness Analysis**

The history of formal benefit-cost analysis and of cost-effectiveness analysis is relatively short. Until the 1960's most benefit-cost analysis was carried out for the U.S. Corps of Engineers to evaluate water resource projects. Cost-effectiveness terminology has been used generally in the literature of a number of disciplines since the 1960's in a broad sense of an analysis which attempts to assess the cost of producing or providing a unit of benefit. Often, however, these studies have not employed formal cost-effectiveness analyses methodology including discounting. In most of the economic literature the term cost-effectiveness has been reserved to refer to the formal offshoot of benefit-cost analysis. (See especially Thompson, 1980, p. 1 and p. 224). Introduction to the very large benefit-cost and cost-effectiveness appraisal literature may be found in the list of some recent texts in the reference section.

In formal benefit-cost analysis the sum of the dollar values of all benefits of an activity, program, or project, over a series of years is compared with the sum of all costs for the activity, program, or project. All values are discounted with an appropriate interest rate to provide a B/C ratio. In formal cost-effectiveness analysis the sum of all costs of an activity, program, or project, over a series of years is compared with the number of units of benefit. All values are discounted with an appropriate rate to provide a C/E ratio. The specific differences between the two measures and how they relate methodologically can be indicated showing how the benefit-cost equation can be modified to arrive at the cost-effectiveness equation. The benefit-cost formulation (Equation 1) shows that benefits are estimated in dollar values.

### Equation 1. The Benefit-Cost Ratio

$$\frac{B}{C} = \frac{\sum_{t=1}^k \frac{B_i}{(1+h)^t}}{\sum_{t=1}^k \frac{C_j}{(1+h)^t}} = \frac{\sum_{t=1}^k \frac{(O_{it})(P_{it})}{(1+h)^t}}{\sum_{t=1}^k \frac{(I_{jt})(P_{jt})}{(1+h)^t}} = \frac{\frac{(O_{i_1})(P_{i_1})}{1+h}}{\frac{(I_{j_1})(P_{j_1})}{1+h}} + \frac{\frac{(O_{i_2})(P_{i_2})}{(1+h)^2}}{\frac{(I_{j_2})(P_{j_2})}{(1+h)^2}} + \frac{\frac{(O_{i_3})(P_{i_3})}{(1+h)^3}}{\frac{(I_{j_3})(P_{j_3})}{(1+h)^3}} + \dots + \frac{\frac{(O_{ik})(P_{ik})}{(1+h)^k}}{\frac{(I_{jk})(P_{jk})}{(1+h)^k}}$$

Where: B = Benefits =  $(O_{it}) \times (P_{it})$

C = Costs =  $(I_{jt}) \times (P_{jt})$

O = Units of output or benefit (tons of crop, years of life, etc.).

I = Units of input or cost (hours of labor, number of machines, or services and etc.).

P = Price or value of the units of output or input.

h = The rate of interest or the discount rate expressed in decimals.

t = The year of the data.

k = Number of years included in the analysis.

i = 1 to n outputs (sets of benefits) included in analysis.

j = 1 to m outputs (sets of costs) included in analysis.

To obtain the cost-effectiveness ratio, the equation is inverted and no price is assigned to benefits. Thus the expression provides an estimate in dollars, of the cost of providing one unit of benefit (output). (Equation 2).

### Equation 2. The Cost-Effectiveness Ratio

$$\frac{C}{E} = \frac{\sum_{t=1}^k \frac{(I_{jt})(P_{jt})}{(1+h)^t}}{\sum_{t=1}^k \frac{O_{it}}{(1+h)^t}}$$

Note, however, that in cost-effectiveness analysis benefits (outputs) are limited to being measured in quantitative units, such as years of life, or units of activity completed, as no price or value is assigned to the benefits (outputs). All the  $P_{it}$ , thus are dropped from the equation. It follows that cost-effectiveness analysis can usually only be employed in comparing alternative activities, programs, or projects or scalar thereof which are measured in the same quantitative units and involving only the same kind of units of output. Note, also that in cost-effectiveness analysis, the larger the value of the C/E ratio, the higher the cost, or the more resource use required per unit of benefit. Hence the lower the cost-effectiveness of the activity, program or project, the more cost-effective.

### **III. The Five Assessment Measures and Their Use**

Five common measures in benefit-cost and cost-effectiveness analysis are the following:

- A. The Benefit-Cost ratio (B/C)
- B. The Cost-Effectiveness ratio (C/E)
- C. The Internal Rate of Return (IRR)
- D. The Net Present Value (NPV)
- E. The Payback Period

The cost-effectiveness ratio has no meaning in benefit-cost analysis and the four other measures are not used in cost-effectiveness analysis.

#### **A. 1. The Benefit-Cost Ratio B/C**

The benefit-cost ratio (or the alternative synonymous term the cost-benefit ratio) is simply the ratio of discounted benefits to discounted costs as is shown in Equation 1.

The B/C ratio is interpreted as follows. When discounted benefits are greater than discounted costs, the ratio will be larger than one. If the ratio is less than one, discounted benefits are less than discounted costs and there would be a net loss due to the activity or project. It therefore, would usually be undesirable. If the ratio were

equal to one, benefits would just equal costs given the interest rate used in the calculation. The general decision rule for the use of the benefit-cost ratio is to support the program with the highest ratio, when it is greater than one, unless mutually exclusive projects are being compared. In that case if costs are the same one should choose the project with the highest NPV. Note, in all analyses care in choosing the appropriate interest rate is required. For valid comparisons, all analyses have to use the same interest rate.

## **2. The Cost-Effectiveness Ratio C/E**

Cost-effectiveness analysis is a modified form of benefit-cost analysis in which the benefits are measured in physical units such as years of life, units of treatment, immunizations, etc. For ease of use, the equation is inverted so as to estimate the cost per unit of benefit. (See equation 2).

The decision rule for the use of the cost-effectiveness ratio is to choose the program, project, or activity which has the lowest cost per unit of benefit. Comparisons can only be made between activities which have the same units of benefit, such as years of life, or units of a particular service, or which achieve the same objective. For valid comparisons, in any of these analyses the interest rate employed must be the same.

## **3. Internal Rate of Return IRR**

The internal rate of return (IRR) is defined as the interest rate in the benefit-cost calculation which causes discounted costs to equal discounted benefits. If discounted costs are equal to discounted benefits, the B/C ratio equals 1. (Equation 3).

### **Equation 3. The Internal Rate of Return (IRR)**

$$\frac{\sum_{t=1}^k \frac{B_i}{(1+IRR)^t}}{\sum_{t=1}^k \frac{C_i}{(1+IRR)^t}} = 1, \text{ or } \sum_{t=1}^k \frac{B_i - C_i}{(1+IRR)^t} = 0$$

The Internal Rate of Return is interpreted as the interest rate earned by the project. IRR is calculated by solving for NPV with the interest rate changed by steps to reduce the NPV to zero. The program interest rate ( $h$ ) is first adjusted in steps of 2 percent, then adjusted in steps of 0.1 percent up or down until NPV is near zero. The final value of  $h$  is thus an approximation of IRR accurate within 0.1 percent. In some projects more than one value for  $h$  is possible (multiple roots). In this case the program may provide inconsistent results.<sup>1</sup> The decision rule for use of the IRR is, when greater than the appropriate interest rate applicable for the use of the resources in the project, the project would provide a net contribution to the economy. If the IRR were less than the applicable interest rate, the project or activity should be rejected as other uses of the resources would be likely to provide greater benefits. It is perhaps obvious that when the IRR is less than the interest rate  $h$ , the benefit-cost ratio is less than one, and when greater than the interest rate, the benefit-cost ratio is greater than one.

#### **4. The Net Present Value (NPV)**

The net present value estimates the net value in discounted dollars contributed to the economy by the activity, program, or project. (Equation 4).

##### **Equation 4. The Net Present Value**

$$NPV = \sum_{t=1}^K \frac{B_i - C_i}{(1+h)^t}$$

It is the discounted sum of benefits minus costs. If the NPV is negative, the activity, program, or project provides a value in dollars less than the cost of the resources used and it has a benefit-cost ratio less than one. Hence the project would be an undesirable use of the resources. If the NPV is positive, the activity, program, or

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<sup>1</sup>More than one root is possible only if the net present value becomes negative again in later years after becoming positive, due to the pattern of distribution of costs and benefits through time. This may be observed when it occurs in Table 3.

project is estimated to make a positive contribution. It would also have a benefit-cost ratio above 1. If the same amount of resources were used in two projects, the project with the higher NPV would be chosen as it provides more benefits.<sup>2</sup>

### **5. Payback Period**

The payback period is the number of years (t) the project must run until discounted benefits rise high enough to equal discounted costs. The payback period, in years, is identified as the year net present value becomes positive. It may be found by observing the net present value for each year in Table 3, or the printout of the cost-benefit analysis. The payback period, or breakeven period, may be chosen validly as a criterion to choose projects or programs in very limited circumstances. In a risky environment, projects with shorter payback periods might be chosen. Units of government and businesses sometimes use this criterion, particularly when concerned about the time needed to recover expenditures on an investment. The payback period is seldom used as the primary criteria because a project with a short payback period may provide a much lower cost-benefit ratio, or a lower internal rate of return. It would be foolish in many instances to commit to a low return project just because it had a short payback period.

<sup>2</sup>The relationships between NPV, IRR and the B/C ratio can also be shown in the following way. When discounted costs equal discounted benefits then the benefit-cost ratio equals 1.

$$\frac{\sum_{t=1}^k \frac{B}{(1+h)^t}}{\sum_{t=1}^k \frac{C}{(1+h)^t}} = 1, \text{ then } \sum_{t=1}^k \frac{B}{(1+h)^t} = \sum_{t=1}^k \frac{C}{(1+h)^t}, \text{ and } \sum_{t=1}^k \frac{B-C}{(1+h)^t} = 0.$$

The NPV is defined as the difference between discounted benefits and discounted costs.

$$\sum_{t=1}^k \frac{B-C}{(1+h)^t} = NPV$$

When NPV equals 0 the B/C ratio equals 1 (discounted costs equal discounted benefits) and the interest rate (h) in the equation is called the IRR.

## 2. DETAILED DESCRIPTION OF PROGRAM OPERATION

### I. IDENTIFICATION OF THE PROGRAM

**TITLE:** A General Benefit-Cost and Cost-Effectiveness Analysis Computer Program (BENCOST)

**TYPE:** Fortran Main Program

**DEVELOPED BY:** Robert F. Ranger (original programmer),  
Robert D. Stevens, Roy A. Saper, and  
Ting-Ing Ho

**ORGANIZATION:** Department of Agricultural Economics,  
Michigan State University

**DATE:** July 1985 (Third Revision)

### II. PURPOSE

Computation of the Benefit-Cost ratio, the Cost-Effectiveness ratio, the Internal Rate of Return, the Net Present Value, and display of the Payback Period and the annual cash flow which helps in the economic evaluation of activities, programs and investment projects. Projects are often described by using input-output terminology, where inputs are equivalent to costs and outputs are equivalent to benefits. In this document the terms benefits and costs will be used.

### III. PROGRAM LIMITS AND OPTIONS

#### A. Limits to the scope of the program:

1. The Planning horizon is limited to 100 years.
2. The total number of operating and overhead costs is limited to 50, and the number of capital costs is limited to 10.
3. The number of benefits is limited to 10.
4. The internal rate of return calculation will not operate above 400 percent.
5. The internal rate of return is printed to an accuracy of 0.1 percent.
6. Analyses of smaller data sets cost less than \$1.00 to run.

B. Major program options.

1. Data Entry Options For Each Year (Option BCO=1 and CCO=1).  
Two methods are available for entering sets of costs and benefits.
  - a. Quantities and prices are entered for each year. The total value is then computed as the product of price and quantity.
  - b. Total values for costs and benefits are entered for each year in place of qualities, then the value for price is set at 1.
2. Price Function Option (Option BCO=0 and CCO=0).  
If prices are expected to show a constant yearly trend, they may be expressed in the function  $P = A(1 + B)^t$ . Then A would be used to indicate the price (scale factor) and B would be entered to indicate rate of change in price (i.e., 0.02 = an annual increase in the price of 2 percent).
3. Scaling Option for Price or Value.  
The value, or price, of each cost or benefit may be changed independently to explore the effect of possible changes in the prices of cost items or in the estimates of benefits (for sensitivity analysis). This is accomplished through the use of scale factor, where a value of 1 means no change, 1.5 means a 50% increase, etc. (See E. below).
4. Constant Cost Option (Option C2).  
Quantities of cost that remain the same over the planning horizon need be entered only in the first year. They will be replicated automatically.
5. Separation of Capital Cost, or Scarce Resource, Option (Option C1=1).  
Costs may be separated into operating costs (including overhead costs) and capital costs (or operating costs and scarce resource costs).
6. Benefit/Scarce-Resource-Cost Option (Option C1=C2 and C1=C3).  
Modified benefit/cost ratios may be obtained which provide a Benefit/Cost ratio with one scarce resource in the denominator and other costs netted from the numerator. (NPV Benefits / NPV of a Scarce Resource).
7. Table Printout Options
  - a. Basic Tables for the Analyses
 

Table 1. Explanation of Input Data.  
 Table 2. Printout of Entered Input Data.  
 Table 3. Summary of Benefit-Cost or Cost-Effectiveness Analyses.  
 Table 4. Estimated Internal Rate of Return (IRR) for this Analysis
  - b. More Detailed Tables Which Can be Requested.
 

Table 5. Lists the value of each capital cost item  $(I_{jt}) \times (P_{jt})$  by year.

- Table 6. Lists the value of each operating or overhead cost item  
 $(I_{jt}) \times (P_{jt})$  by year.
- Table 7. Lists the amount of each benefit by year  $(O_{it}) \times (P_{it})$ .
- Table 8. Lists the quantity and price of each operating and overhead cost by year  $(I_{jt}, P_{jt})$ .
- Table 9. Lists the quantity and price (value) of each benefit by year  $(O_{it}, P_{it})$ .

#### **IV. PROGRAM SETUP** (All lines (or cards) begin with Column 1).

PNC	The PNC, user id, and password will be different for each person. These are obtained from the Computer Center when your account is set up.
userid, CM120000, JC500.	
PW=password	
ATTACH,LGO,BENCOST.	To access the BENCOST program.
LGO	Runs the program.
*EOS (For card use only 7/8/9)	Line for End of Section. (On cards a 7, 8, and 9 are all punched in column one).

The set of BENCOST control and data lines go here as described in Section V below.

\*EOI (6/7/8/9) Not needed except when cards are used. (9, 6, 7, 8, and 9 are all punched in Column one of the card).

Note: More than one complete set of control and data statements may be included in a single computer run in order to carry out more than one analysis at a time. For multiple analyses, the last data line in the first set of statements should be followed immediately by the title line for the second analysis with no statements in between.

#### **V. CONTROL AND DATA LINE FORMATS**

Input Format: All data must be right justified with no decimals except as indicated below. Any field left entirely black will be read as a zero.

##### **A. Title Line**

<u>COLUMNS</u>	<u>CONTENTS</u>
----------------	-----------------

1-80	Enter identification title for this analysis.
------	---

**B. Parameter, Program Computation Options and Printout Choices** (See Table 1 and 3).

COLUMNSCONTENTS

- 1-5 Length of planning horizon; the number of years of project life between 2 and 100.
- 6-10 The number of benefits; a value between 1 and 10.
- 11-15 The number of operating and overhead costs; a value between 1 and 50. (Includes capital costs if they are not entered separately).
- 16-20 The number of capital costs; a value between 0 and 10. Enter 0 if capital costs not entered separately.
- 21-25 Interest or discount rate (h), entered with a decimal point, eg. .06 for 6%.
- 30 BCO Incidates how prices of benefits will be entered:  
0 (or blank) - Prices of benefits will be computed using a price function  $P = A (1 + B)^t$ .  
1 - Prices of benefits will be entered as data.
- 35 CCO- Indicated how prices of costs will be entered:  
0 (or blank) - Prices of costs will be computed using a price function  $P = A (1 + B)^t$ .  
1 - Prices of costs will be entered as data.
- 40 C1 - Separation of capital costs and type of benefit-cost ratio to compute.  
0 (or blank) - No separation of capital and operating costs. Conventional B/C ratio. ( $B/C \text{ Ratio} = \sum \text{NPV Benefits} / \sum \text{NPV Costs}$ ).  
1 - Capital and operating costs read in separately Conventional B/C ratio.  
2 - Capital, or scarce resource costs, read in separately. Modified B/C ratio. Used to compute net benefits to scarce resource ratio ( $B/SR \text{ ratio} = \sum \text{Net Present Value Benefit} / \sum \text{Net Present Value Scarce Resource}$ ).  
3 - Capital costs computed internally as excess of benefits over costs in any year. Computes net benefits to scarce resource ratio B/SR ratio.

<u>COLUMNS</u>	<u>CONTENTS</u>
45	C2 - <u>Provides for internal duplication of costs that remain the same each year.</u>  Enter the number of costs that are to remain constant over the life of the project. This number must be less than or equal to the total number of costs (see columns 11-15).
50	0 - <u>Tables 1-4 (always printed)</u> Table 1 Explanation of input data deck Table 2 Printout of Entered Input Data Table 3 Summary of benefit-cost or cost-effectiveness analysis Table 4 Estimated internal rate of return (IRR)
50	1 - <u>Tables 5-9 added to printout</u> Table 5 Value of each capital cost item Table 6 Value of each operating and overhead cost item Table 7 Amount of each benefit Table 8 Quantity and price of each operating and overhead cost Table 9 Quantity and price (value) of each benefit.

#### C. Benefits - Units or Value Data

The data entered on these lines may be either quantities or values. If they are entered as quantities, then the corresponding prices will be entered on the price lines (see F below). If they are values, then all prices should all be entered as 1's unless a function for the increase in the value of benefits is desired, in which case the A's should be 1 and the B's should represent the yearly proportional increase.

<u>COLUMNS</u>	<u>CONTENTS</u>
1-10	Benefit data for first year of the first benefit <u>always entered with a decimal point</u> , eg., 4963.12 or 5700. or 3.0.
11-20	Benefit data for second year of the first benefit and so on in fields of 10 columns, for number of years in planning horizon. (Note: only 8 fields fit on a line so more than one line may be needed.) <u>Data are always entered with a decimal point</u> . If more than one benefit is used, the data for each new benefit should begin in the first field of a new line.

#### D. Cost Data Lines

The data on these lines may be either quantities or values, as explained in C above. If program computation option C1 = 1 or 2 was chosen, these data will be assumed to represent operating costs only, otherwise they will be assumed to include capital costs as well. If internal duplication of costs option was chosen (C2 = 0), then enter only the value for first year on the data line(s) below for each cost which is to remain constant. Leave blank fields for the number of data positions corresponding to the remaining years in the planning horizon. **Note:** automatically duplicated costs must come first. The number of sets of costs must be the same as chosen on the parameter line.

This data is (entered) in the same 10 column field format described above for the benefit data.

#### E. Scale Factor Lines for Benefits and Costs for Sensitivity Tests

The scale factor lines provide a relatively easy way for testing the sensitivity of a project to changes in the prices of benefits or costs. For the initial run the scale factor lines (or cards) can be left blank, which implies a scale of 1 for each benefit and cost. Than on later runs, any or all of the benefits and costs may be given scale factors which will increase or decrease the corresponding prices across the entire planning horizon. For example, a scale factor of .9 would result in a 10% decrease in a price, and a factor of 1.25 would result in a 25% increase.

<u>COLUMNS</u>	<u>CONTENTS</u>
1-10	Scale factor for first benefit. Data entered with decimal.
11-20 etc.	Scale factor for second benefit and so on. After the last benefit's scale factor, start a new line to enter the scale factors for the first cost and use the following fields for the remainder of the costs.

#### F. Price Function Data Lines

The line(s) specifying price changes for benefits must be first, followed by the line(s) giving price changes for costs. The formats for these two sets of lines depend on whether they contain the price function with A and B values or whether they simply contain price data.

Prices can be calculated using the price function  $P = A(1 + B)^t$ , where the A value is the initial price and the B value is the proportional yearly change. So if a particular price starts at \$3.00 and is expected to increase 5% per year, the A value would be 3.0 and B would be .05. The parameter line (described in B above) must specify which way the prices of benefits will be entered and which way costs will be entered.

For cost-effectiveness analysis a price of 1.0 should be entered when prices are entered as data or if the price function is used (A = 1.0 and B = 0.0).

Alternative 0: Use of price function. (BCO=0 and/or CCO=0)

<u>COLUMNS</u>	<u>CONTENTS</u>
1-10	Enter the A value for the first benefit or cost.
11-20 etc.	Enter the A value for the second benefit or cost and so on.

When all the A values have been entered, start a new line for B values, entering them in the same format as the A values.

Alternative 1: Prices entered as data. (BCO = 1 and/or CCO = 1)

<u>COLUMNS</u>	<u>CONTENTS</u>
1-10	Enter the price for the first benefit or cost for the first year.
11-20 etc.	Price for the first benefit or cost for the second year, and so on. If there is more than one benefit or cost, each one should start on a new line.

G. Capital Cost Lines

These lines should be included only if C1 on the parameter line was set to 1 or 2. **Note:** Capital costs, if separated from operating costs and overhead costs, must be entered as values. The quantity and price of capital costs cannot be entered. No scale factor can be applied to capital costs, nor can a price function (with A and B values) be used to calculate capital costs.

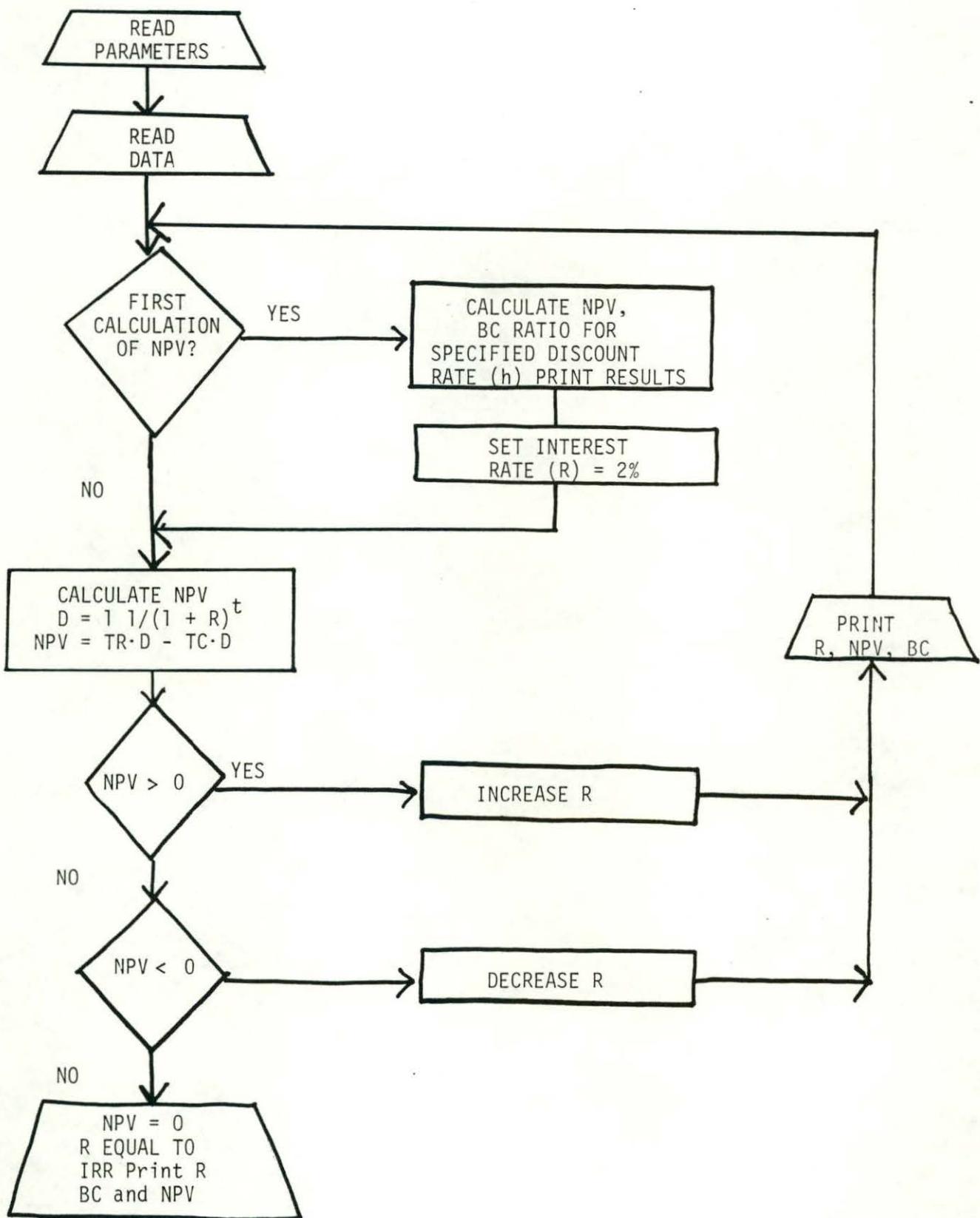
<u>COLUMNS</u>	<u>CONTENTS</u>
1-10	Enter the first capital cost for the first year.
11-20 etc.	Enter the first capital cost for the second year and so on. If there is more than one capital cost, each one should start on a new line.

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## APPENDICES

Appendix A - Flow Chart



## APPENDIX B - Program Table Pinouts

TABLE 1 EXPLANATION OF INPUT DATA LINES

#### A. AND B. CONTROL LINES

YEARS OF PROJECT LIFE = 15  
 SETS OF BENEFITS(OUTPUTS) = 2  
 SETS OF OPERATING COSTS(INPUTS) = 2  
 SETS OF CAPITAL COSTS = 2  
 DISCOUNT RATE = (H) .10  
 BCO, THE WAY IN WHICH PRICE DATA FOR BENEFITS IS ENTERED = 0  
 CCO, THE WAY IN WHICH PRICE DATA FOR COSTS IS ENTERED = 0  
 C1, SEPARATION OF CAPITAL COSTS AND TYPE OF B/C RATIO = 1  
 C2, FOR INTERNAL DUPLICATION OF INPUTS = 0  
 IPRINT, PRINTOUT TABLE CHOICES = 0

C. BENEFITS - UNITS OR VALUE DATA

#### D. COSTS = DATA LINES

#### E. SCALE FACTOR LINES FOR BENEFITS - ONCE OVER CHANGE FOR SENSITIVITY ANALYSIS

1.00 1.00

E. SCALE FACTOR LINES FOR COSTS - ONCE OVER CHANGE FOR SENSITIVITY ANALYSIS

1.00 1.00

#### F. PRICE FUNCTION DATA LINES - A VALUE FOR BENEFIT LINES - A ONCE OVER CHANGE IN PRICES

**200.00**

F. PRICE FUNCTION DATA LINES - B VALUE FOR BENEFIT LINES - A COMPOUND RATE OF INCREASE IN PRICES  
(EX. 0.05 = 5 PERCENT ANNUAL INCREASE IN PRICES)

.00 .00

#### F. PRICE FUNCTION DATA LINES - A VALUE FOR COST LINES - A ONCE OVER CHANGE IN PRICE

1.00 + 1.00

F. PRICE FUNCTION DATA LINES - B VALUE FOR COST LINES - A COMPOUND RATE OF INCREASE IN PRICES  
(EX. 0.05 = 5 PERCENT ANNUAL PRICE INCREASE)

.00 .00

#### G. CAPITAL COST LINES

36405.00	109216.00	103149.00	45507.00	9101.00	.00	.00	35146.00
82007.00	.00	.00	.00	.00	.00	.00	
36405.00	109216.00	103149.00	45507.00	9101.00	.00	.00	35146.00
82007.00	.00	.00	.00	.00	.00	.00	

ANALYSIS TITLE -- TEST RUN OF PROGRAM BENCOST

TABLE 2 SAMPLE PRINTOUT OF DATA INPUT FORMAT

TEST	RUN	OF	PROGRAM	BENCHCOST														
15	2	2	2	.10	0	0	1	0	1									
				0.		100.		300.		500.		700.		1200.		1800.		
				1800.		1800.		1800.		1800.		1800.		1800.		1800.		
				0.		0.		100.		300.		500.		700.		1200.		
				1800.		1800.		1800.		1800.		1800.		1800.		1800.		
				0.		0.		0.		0.		0.		0.		0.		
				44352.		44352.		44352.		44352.		44352.		44352.		44352.		
				0.		0.		0.		7315.		19699.		33754.		44352.		
				44352.		44352.		44352.		44352.		44352.		44352.		44352.		
				1.00		1.00		1.00		7315.		19699.		33754.		44352.		
				1.00		1.00		1.00		44352.		44352.		44352.		44352.		
				200.00		200.00		200.00		44352.		44352.		44352.		44352.		
				0.00		0.00		0.00		1.00		1.00		1.00		1.00		
				36405.00		109216.00		103149.00		45507.00		9101.00		.00		.00		35146.00
				82007.00		0.00		0.00		0.00		0.00		.00		.00		35146.00
				36405.00		109216.00		103149.00		45507.00		9101.00		.00		.00		35146.00
				82007.00		0.00		0.00		0.00		0.00		.00		.00		35146.00

## ANALYSIS TITLE -- TEST RUN OF PROGRAM BENCOST

## TABLE 3 SUMMARY OF BENEFIT-COST OR COST-EFFECTIVENESS ANALYSIS

PLANNING HORIZON IS  
INTEREST RATE (R) IS15 YEARS  
.10 OR 10. PERCENT

## PARAMETER SETTINGS FOR INPUTS &amp; OUTPUTS

SCALE FACTOR FOR BENEFIT SETS (1.0 = NO CHANGE)	1.00	1.00
BENEFIT PRICE FOR ONCE OVER CHANGE (A VALUE)	200.00	200.00
BENEFIT PRICE ANNUAL RATE OF CHANGE (B VALUE)	.00	.00
SCALE FACTOR FOR COST SETS (1.0 = NO CHANGE)	1.00	1.00
COSTS - PRICE FOR ONCE OVER CHANGE (A VALUE)	1.00	1.00
COSTS - PRICE ANNUAL RATE OF CHANGE (B VALUE)	.00	.00

(D) - DISCOUNT IN SPECIFIED YEAR WITH GIVEN INTEREST RATE

(AC) - TOTAL ANNUAL COSTS (OPERATING, OVERHEAD + CAPITAL)

(AB) - TOTAL ANNUAL BENEFITS = UNITS OF BENEFIT (OUTPUT) X PRICE

(APVC) - ANNUAL PRESENT VALUE OF COSTS = (D) X (AC)

(APVB) - ANNUAL PRESENT VALUE OF BENEFITS = (D) X (AB)

(PVTC) - PRESENT VALUE OF TOTAL COSTS = CUMULATIVE SUM OF APVC

(PVTB) - PRESENT VALUE OF TOTAL BENEFITS = CUMULATIVE SUM OF APVB

(NET PV) - CUMULATIVE NET PRESENT VALUE = PVTB - PVTC

CASH FLOW, OR ANNUAL NET BENEFIT = (AB) - (AC)

YEAR FOR SPECIFIED INTEREST RATE (AB)	DISCOUNT (D) 1.0000	TOTAL ANNUAL PRESENT VALUE OF BENEFITS (APVB)	ANNUAL PRESENT VALUE OF BENEFITS (PVTB)	PRESENT TOTAL BENEFITS (PVTB)	ANNUAL CAPITAL COSTS	SUM ANNUAL OPERATING COSTS	TOTAL ANNUAL COST (AC)	ANNUAL PRESENT VALUE TOTAL COSTS (APVC)	PRESENT TOTAL COSTS (PVTC)	NET PRESENT VALUE (NET PV)	CASH FLOW OR ANNUAL NET BENEFIT															
											0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
0	1.0000	.00	.00	.00	72810.00	.00	72810.00	72810.00	72810.00	-72810.00	-72810.00															
1	.9091	.00	.00	.00	218432.00	.00	218432.00	198574.55	271384.55	-271384.55	-218432.00															
2	.8264	40000.00	33057.85	33057.85	206298.00	.00	206298.00	170494.21	441878.76	-408820.91	-166298.00															
3	.7513	120000.00	90157.78	123215.63	91014.00	14630.00	105644.00	79371.90	521250.66	-398035.03	14356.00															
4	.6830	200000.00	136602.69	259818.32	18202.00	39398.00	57600.00	39341.58	560592.24	-300773.92	142400.00															
5	.6209	280000.00	173857.97	433676.29	.00	67508.00	67508.00	41917.16	602509.39	-168833.10	212492.00															
6	.5645	480000.00	270947.49	704623.78	.00	88704.00	88704.00	50071.10	652580.49	52043.29	391296.00															
7	.5132	720000.00	369473.85	1074097.62	70292.00	88704.00	158996.00	81590.09	734170.58	339927.04	561004.00															
8	.4665	720000.00	335885.31	1409982.93	164014.00	88704.00	252718.00	117894.81	852065.39	557917.55	467282.00															
9	.4241	720000.00	305350.29	1715333.22	.00	88704.00	88704.00	37619.16	889684.54	825648.68	631296.00															
10	.3855	720000.00	277591.17	1992924.39	.00	88704.00	88704.00	34199.23	923883.78	1069040.61	631296.00															
11	.3505	720000.00	252355.61	2245280.00	.00	88704.00	88704.00	31090.21	954973.99	1290306.01	631296.00															
12	.3186	720000.00	229414.19	2474694.18	.00	88704.00	88704.00	28263.83	983237.81	1491456.37	631296.00															
13	.2897	720000.00	208558.35	2683252.54	.00	88704.00	88704.00	25694.39	1008932.20	1674320.33	631296.00															
14	.2633	720000.00	189598.50	2872851.04	.00	88704.00	88704.00	23358.54	1032290.74	1840560.30	631296.00															

THE BENEFIT COST RATIO (BC RATIO) COMPILED FROM THE ABOVE DATA IS PVTB/PVTC = 2.78

THE COST-EFFECTIVENESS RATIO IS THE INVERSE OF THE BENEFIT COST RATIO, OR PVTC/PVTB WHICH = .36

THE NET PRESENT VALUE OF THIS PROJECT =  
PRESENT VALUE TOTAL BENEFITS (PVTB) - PRESENT VALUE TOTAL COST (PVTC) OR 1840560.30

## ANALYSIS TITLE -- TEST RUN OF PROGRAM BENCOST

TABLE 4 ESTIMATED INTERNAL RATE OF RETURN (IRR) FOR THIS ANALYSIS

INTEREST RATE	NET PRESENT VALUE	BENEFIT COST RATIO
.020	4143492.03	3.66
.040	3367651.44	3.43
.060	2746546.17	3.20
.080	2246152.29	2.99
.100	1840560.30	2.78
.120	1509904.23	2.59
.140	1238850.66	2.41
.160	1015488.61	2.25
.180	830508.23	2.09
.200	676589.09	1.95
.220	547941.68	1.81
.240	439961.60	1.69
.260	348967.12	1.58
.280	271998.85	1.47
.300	206666.01	1.37
.320	151027.69	1.29
.340	103500.78	1.20
.360	62788.10	1.13
.380	27822.05	1.06
.400	-2279.72	1.00

THE INTERNAL RATE OF RETURN (IRR) OF THIS PROJECT IS .398 OR 39.80 PERCENT  
 THE REMAINING NET PRESENT VALUE USING THIS ESTIMATED IRR IS THEN = 533.47  
 THE BENEFIT COST RATIO USING THIS ESTIMATED IRR = 1.00

ANALYSIS TITLE -- TEST RUN OF PROGRAM BENCOST  
TABLE 5 THE VALUE OF EACH CAPITAL COST FOR ALL YEARS

YEAR	CAPITAL COST 1	CAPITAL COST 2
1	36405.00	36405.00
2	109216.00	109216.00
3	103149.00	103149.00
4	45507.00	45507.00
5	9101.00	9101.00
6	.00	.00
7	.00	.00
8	35146.00	35146.00
9	82007.00	82007.00
10	.00	.00
11	.00	.00
12	.00	.00
13	.00	.00
14	.00	.00
15	.00	.00

## ANALYSIS TITLE -- TEST RUN OF PROGRAM BENCOST

TABLE 6 THE VALUE OF EACH OPERATING COST BY YEAR

## OPERATING OPERATING

YEAR	COST 1	COST 2
1	.00	.00
2	.00	.00
3	.00	.00
4	7315.00	7315.00
5	19699.00	19699.00
6	33754.00	33754.00
7	44352.00	44352.00
8	44352.00	44352.00
9	44352.00	44352.00
10	44352.00	44352.00
11	44352.00	44352.00
12	44352.00	44352.00
13	44352.00	44352.00
14	44352.00	44352.00
15	44352.00	44352.00

## ANALYSIS TITLE -- TEST RUN OF PROGRAM BENCOSt

TABLE 7 THE AMOUNT OF EACH BENEFIT BY YEAR

YEAR BENEFIT 1 BENEFIT 2

1	.00	.00
2	.00	.00
3	20000.00	20000.00
4	60000.00	60000.00
5	100000.00	100000.00
6	140000.00	140000.00
7	240000.00	240000.00
8	360000.00	360000.00
9	360000.00	360000.00
10	360000.00	360000.00
11	360000.00	360000.00
12	360000.00	360000.00
13	360000.00	360000.00
14	360000.00	360000.00
15	360000.00	360000.00

## ANALYSIS TITLE -- TEST RUN OF PROGRAM BENCOST

TABLE 8 QUANTITY AND PRICE OF OPERATING COST INPUTS BY YEAR

	OPERATING COST 1		OPERATING COST 2	
YEAR	UNITS	PRICE	UNITS	PRICE
1	0.	1.00	0.	1.00
2	0.	1.00	0.	1.00
3	0.	1.00	0.	1.00
4	7315.	1.00	7315.	1.00
5	19699.	1.00	19699.	1.00
6	33754.	1.00	33754.	1.00
7	44352.	1.00	44352.	1.00
8	44352.	1.00	44352.	1.00
9	44352.	1.00	44352.	1.00
10	44352.	1.00	44352.	1.00
11	44352.	1.00	44352.	1.00
12	44352.	1.00	44352.	1.00
13	44352.	1.00	44352.	1.00
14	44352.	1.00	44352.	1.00
15	44352.	1.00	44352.	1.00

## ANALYSIS TITLE -- TEST RUN OF PROGRAM BENCOST

TABLE 9 QUANTITY AND PRICE(VALUE) OF BENEFITS BY YEAR

	BENEFIT 1		BENEFIT 2	
YEAR	UNITS	PRICE	UNITS	PRICE
1	0.	200.00	0.	200.00
2	0.	200.00	0.	200.00
3	100.	200.00	100.	200.00
4	300.	200.00	300.	200.00
5	500.	200.00	500.	200.00
6	700.	200.00	700.	200.00
7	1200.	200.00	1200.	200.00
8	1800.	200.00	1800.	200.00
9	1800.	200.00	1800.	200.00
10	1800.	200.00	1800.	200.00
11	1800.	200.00	1800.	200.00
12	1800.	200.00	1800.	200.00
13	1800.	200.00	1800.	200.00
14	1800.	200.00	1800.	200.00
15	1800.	200.00	1800.	200.00

APPENDIX C - BENCOST Program Listing

PROGRAM BENCOS 74/175 OPT=1,ROUND= A/ S/ M/-D,-DS FTN 5.1+587 08/02/85 .11.49.50  
 DO=-LONG/-OT,ARG=-COMMON/-FIXED,CS= USER/-FIXED,DB=-TB/-SB/-SL/ ER/-ID/-PMD/-ST,PL=50000  
 FTN5,LO.

PAGE 1

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1      PROGRAM BENCOS( INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)          140
2      COMMON PLANHO                                         150
3      DIMENSION A(60), B(60), S(60), X(60,100), P(60,100), KC(60,100), 160
4      + CX(60), TR(100), TC(100), TITLE(10), RX(10), FK(100)           170
5      + OPCOST(60,100), BENEF(10,100), HEAD42(5), HEAD71(9), HEAD81(2) 180
6      REAL I, KC, KC3, IPV                                         190
7      INTEGER YEAR, PLANHO, XO, XI, XKC, BCO, CCO, C1, C2, XIF, XX, XJ 200
8      CHARACTER*130 HEAD41, HEAD42, HEAD51, HEAD6, HEAD71, HEAD72, HEAD81 210
9
10     C XO IS THE NUMBER OF OUTPUTS.                                     220
11     C XI IS THE NUMBER OF INPUTS. C IS FOR CONTROL OF THE FORM PRICE DATA WI 230
12     BE READ IN. O TO READ IN A AND B TO DETERMINE PRICE FOR BOTH OUTPUT AN 240
13     INPUTS. 1 TO READ IN DATA EACH YEAR FOR PY AND A,B FOR INPUTS. 2 A,B 250
14     PY, DATA EACH YEAR FOR INPUTS. 3 DATA EACH YEAR FOR BOTH.          260
15     C1 CONTROL OF COST INPUT FORM AND TYPE OF BC RATIO CALCULATED.    270
16     C2 THE NUMBER OF INPUTS WHICH WILL TAKE THE SAME VALUE EVERY YEAR. 280
17     C XKC IS THE NUMBER SETS OF CAPITAL COST                         290
18     C                                                               300
19     C                                                               310
20     C COLUMN HEADINGS OF TABLE 4 THROUGH TABLE 8                      320
21     C                                                               330
22     DATA HEAD41//          CAPITAL   CAPITAL   CAPITAL   CAPITAL   CAPITAL 340
23     +CAPITAL CAPITAL CAPITAL CAPITAL CAPITAL CAPITAL 350
24     +L CAPITAL//          YEAR      COST 1    COST 2    COST 3    COST 4    360
25     + COST 5   COST 6   COST 7    COST 8    COST 9    COST 10   COS 370
26     +T 11   COST 12//        YEAR      COST 13   COST 14   COST 15   COST 16 380
27     + COST 17   COST 18   COST 19   COST 20   COST 21   COST 22   COS 390
28     +T 23   COST 24//        YEAR      COST 25   COST 26   COST 27   COST 28 400
29     + COST 29   COST 30   COST 31   COST 32   COST 33   COST 34   COS 410
30     +T 35   COST 36//        YEAR      COST 37   COST 38   COST 39   COST 40 420
31     + COST 41   COST 42   COST 43   COST 44   COST 45   COST 46   COS 430
32     +T 47   COST 48//        YEAR      COST 49   COST 50                           440
33
34
35
36
37
38
39
40     DATA HEAD51//          OPERATING OPERATING OPERATING OPERATING OP 500
41     +ERATING OPERATING OPERATING OPERATING OPERATING OPERATING OPERATIN 510
42     +G OPERATING//          YEAR BENEFIT 1 BENEFIT 2 BENEFIT 3 BENEFIT 4 BEN 520
43     +EFIT 5 BENEFIT 6 BENEFIT 7 BENEFIT 8 BENEFIT 9BENEFIT 10//          530
44     DATA HEAD71(1)//        OPERATING COST 1   OPERATING COST 2   OP 540
45     +ERATING COST 3   OPERATING COST 4   OPERATING COST 5   OPERATIN 550
46
47     +G COST 6//            OPERATING COST 7   OPERATING COST 8   OP 560
48     +ERATING COST 9   OPERATING COST 10  OPERATING COST 11  OPERATIN 570
49     +G COST 12//            OPERATING COST 13   OPERATING COST 14   OP 580
50     +ERATING COST 15  OPERATING COST 16  OPERATING COST 17  OPERATIN 590
51
52     +G COST 18//            OPERATING COST 19   OPERATING COST 20   OP 600
53     +ERATING COST 21  OPERATING COST 22  OPERATING COST 23  OPERATIN 610
54     +G COST 24//            OPERATING COST 25   OPERATING COST 26   OP 620
55     +ERATING COST 27  OPERATING COST 28  OPERATING COST 29  OPERATIN 630
56
57     +G COST 30//            OPERATING COST 31   OPERATING COST 32   OP 640
58     +ERATING COST 33  OPERATING COST 34  OPERATING COST 35  OPERATIN 650
59     +G COST 36//            OPERATING COST 37   OPERATING COST 38   OP 660
60     +ERATING COST 39  OPERATING COST 40  OPERATING COST 41  OPERATIN 670
61
62     +G COST 42//            OPERATING COST 43   OPERATING COST 44   OP 680
63     +ERATING COST 45  OPERATING COST 46  OPERATING COST 47  OPERATIN 690
64
65     +G COST 48//            OPERATING COST 49   OPERATING COST 50   OP 700
66     +ERATING COST 3  OPERATING COST 4   OPERATING COST 5   OPERATIN 710
67
68     +G COST 6//            DATA HEAD71(6)//          OPERATING COST 31   OPERATING COST 32   OP 720
69     +ERATING COST 33  OPERATING COST 34  OPERATING COST 35  OPERATIN 730
70     +G COST 36//            OPERATING COST 37   OPERATING COST 38   OP 740
71     +ERATING COST 39  OPERATING COST 40  OPERATING COST 41  OPERATIN 750
72
73     +G COST 42//            OPERATING COST 43   OPERATING COST 44   OP 760
74     +ERATING COST 45  OPERATING COST 46  OPERATING COST 47  OPERATIN 770
75     +G COST 48//            OPERATING COST 49   OPERATING COST 50   OP 780
76     +ERATING COST 3  OPERATING COST 4   OPERATING COST 5   OPERATIN 790
77
78     +G COST 6//            DATA HEAD72//          YEAR UNITS PRICE UNITS PRICE UNITS PR 800
79     + PRICE UNITS PRICE UNITS PRICE UNITS PRICE UNITS PR 810
80
81     +ICE //                BENEFIT 1           BENEFIT 2               820
82     DATA HEAD81(1)//        BENEFIT 1           BENEFIT 2               830
83
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76      +BENEFIT 3          BENEFIT 4          BENEFIT 5          BENEFI    890
77      +T 6               //                BENEFIT 7          BENEFIT 8    900
78      DATA HEAD81(2)//
79      + BENEFIT 9          BENEFIT 10
80      +                   //
81
82      C
83      90      READ (5,91,END=999) (TITLE(J),J = 1,10)
84      *
85      91      FORMAT(10A8 )
86      READ(5,100,END=500) PLANHO, XO, XI, XKC, I, BCO,CCO,C1,C2,LPRINT
87      *
88      *
89      100     FORMAT(4I5,F5.3,5I5)
90      *
91      C CHECKING IF THE PARAMETERS VALUE ARE LEGAL OR NOT
92      C FOR ILLEGAL VALUES, PRINT THE DATA AND STOP THE PROGRAM
93      *
94      IF((PLANHO .LT. 0) .OR. (PLANHO .GT. 100)) THEN
95          WRITE(6,700) PLANHO
96          GO TO 999
97          ELSEIF ((XO .LT. 1) .OR. (XO .GT. 10)) THEN
98              WRITE(6,611) XO
99              GO TO 999
100             ELSEIF ((XI .LT. 1) .OR. (XI .GT. 50)) THEN
101                 WRITE(6,612) XI
102                 GO TO 999
103                 ELSEIF ((XKC .LT. 0) .OR. (XKC .GT. 10)) THEN
104                     WRITE(6,613) XKC
105                     GO TO 999
106                     ELSEIF (I .LT. 0) THEN
107                         WRITE(6,701) I
108                         GO TO 999
109                         ELSEIF ((BCO .LT. 0) .OR. (BCO .GT. 1)) THEN
110                             WRITE(6,702) BCO
111                             GO TO 999
112                             ELSEIF ((CCO .LT. 0) .OR. (CCO .GT. 1)) THEN
113                                 WRITE(6,7022) CCO
114                                 GO TO 999
115                                 ELSEIF ((C1 .LT. 0) .OR. (C1 .GT. 3)) THEN
116                                     WRITE(6,703) C1
117                                     GO TO 999
118                                     ELSEIF ((C2 .LT. 0) .OR. (C2 .GT. 50)) THEN
119                                         WRITE(6,704) C2
120                                         GO TO 999
121                                         ELSEIF ((LPRINT .LT. 0) .OR. (LPRINT .GT. 1)) THEN
122                                             WRITE(6,7044) LPRINT
123                                             GO TO 999
124
125      ENDIF
126
127      611     FORMAT(5X,"***** XO = ",I10.5X," IS OUT OF BOUND ")
128      612     FORMAT(5X,"***** XI = ",I10.5X," IS OUT OF BOUND ")
129      613     FORMAT(5X,"***** XKC = ",I10.5X," IS OUT OF BOUND ")
130      614     FORMAT(5X,"***** NO CAPITAL COST IS EXPECTED, CHECK PARAMETER",
131                  +" C1 *****")
132      700     FORMAT(5X,"***** PLANHO = ",I10.5X," IS OUT OF BOUND ")
133      701     FORMAT(5X,"***** I = ",F10.3.5X,"IS OUT OF BOUND ")
134      702     FORMAT(5X,"***** BCO = ",I10.5X,"IS OUT OF BOUND ")
135      7022    FORMAT(5X,"***** CCO = ",I10.5X,"IS OUT OF BOUND ")
136      703     FORMAT(5X,"***** C1 = ",I10.5X,"IS OUT OF BOUND ")
137      704     FORMAT(5X,"***** C2 = ",I10.5X,"IS OUT OF BOUND ")
138      7044    FORMAT(5X,"***** LPRINT = ",I10.5X,"IS OUT OF BOUND ")
139
140      C DISPLAY INPUT DATA ON TABLE 1
141
142      WRITE(6,156)TITLE
143      WRITE(6,699)
144      WRITE(6,7055)
145      7055    FORMAT(//,T10,"A. AND B. CONTROL LINES")
146      699     FORMAT(1H,20X,"TABLE 1 EXPLANATION OF INPUT DATA LINES ")
147      705     FORMAT(1/5X,"YEARS OF PROJECT LIFE = ",T40,I3)
148      WRITE(6,706)XO
149      706     FORMAT(5X,"SETS OF BENEFITS(OUTPUTS) = ",T40,I3)
150      WRITE(6,707)XI
151      707     FORMAT(5X,"SETS OF OPERATING COSTS(INPUTS) = ",T40,I3)
152      WRITE(6,708)XKC

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153      708  FORMAT(5X,"SETS OF CAPITAL COSTS = ",T40,I3)          1640
154      WRITE(6,709)I                                         1650
155      709  FORMAT(5X,"DISCOUNT RATE = (H) ",T40,F4.2)          1660
156      WRITE(6,710)BCO                                         1670
157      WRITE(6,7100)CCO                                         1680
158      WRITE(6,711)C1                                         1690
159      WRITE(6,712)C2                                         1700
160      WRITE(6,7122)LPRINT                                       1710
161      710  FORMAT(5X,"BCO, THE WAY IN WHICH PRICE DATA FOR BENEFITS ", 1720
162      +"IS ENTERED = ",T64,I2)                                1730
163      7100 FORMAT(5X,"CCO, THE WAY IN WHICH PRICE DATA FOR COSTS IS ", 1740
164      +"ENTERED = ",T64,I2)                                1750
165      711  FORMAT(5X,"C1, SEPARATION OF CAPITAL COSTS AND TYPE OF", 1760
166      +" B/C RATIO = ",T64,I2)                                1770
167      712  FORMAT(5X,"C2, FOR INTERNAL DUPLICATION OF INPUTS = ",T64,I2) 1780
168      7122 FORMAT(5X,"LPRINT, PRINTOUT TABLE CHOICES = ",T64,I2,/)    1790
169      C
170      C DEFINE LINES FOR PRINTING MORE THAN ONE LINES OF INPUT SCALE FACTORS 1800
171      C
172      NRESID=MOD(XI,10)                                         1810
173      LINES=XI/10                                              1820
174      IF(NRESID .GT. 0) LINES=LINES+1                           1830
175      C
176      C XX IS THE NUMBER OF SETS OF INPUT                      1840
177      C
178      XX=XI                                              1850
179      C
180      C REDEFINE XI. XI IS THE SUM OF SETS OF OUTPUT AND INPUT 1860
181      C
182      XI = XI + X0                                         1870
183      C
184      C INITIALIZE SCALE FACTORS TO 0 TO FIT LINE 238.        1880
185      C
186      DO 103 J=1,XI                                         1890
187      S(J)=0.0                                              1900
188      103  CONTINUE                                         1910
189      C
190      C XIF IS THE INDEX NUMBER OF FIRST SET OF INPUT       1920
191      C
192      XIF = X0 + 1                                         1930
193      C
194      C READ OUTPUTS, INPUTS, AND SCALE FACTORS             1940
195      C
196      WRITE(6,713)                                         1950
197      DO 7133 I1=1,X0                                         1960
198      READ(5,106,END=500) (X(I1,J),J=1,PLANHO)           1970
199      WRITE(6,106) (X(I1,J), J=1,PLANHO)                  1980
200      7133  CONTINUE                                         1990
201      713  FORMAT(T10,"C. BENEFITS - UNITS OR VALUE DATA",/) 2000
202      C
203      WRITE(6,714)                                         2010
204      DO 7144 I1=XIF,XI                                     2020
205      READ(5,106,END=500) (X(I1,J), J = 1, PLANHO)        2030
206      WRITE(6,106) (X(I1,J), J = 1, PLANHO)                2040
207      7144  CONTINUE                                         2050
208      714  FORMAT(//,T10,"D. COSTS - DATA LINES",/)        2060
209      C
210      WRITE(6,715)                                         2070
211      READ(5,110,END=500) (S(J), J = 1, X0)               2080
212      WRITE(6,110) (S(J), J = 1, X0)                      2090
213      715  FORMAT(//,T10,"E. SCALE FACTOR LINES FOR BENEFITS ", 2100
214      +"- ONCE OVER CHANGE FOR SENSITIVITY ANALYSIS",/)   2110
215      C
216      WRITE(6,7155)                                         2120
217      READ(5,110,END=500) (S(J), J = XIF, XI)            2130
218      WRITE(6,110) (S(J), J = XIF, XI)                    2140
219      7155 FORMAT(//,T10,"E. SCALE FACTOR LINES FOR COSTS ", 2150
220      +"- ONCE OVER CHANGE FOR SENSITIVITY ANALYSIS",/)   2160
221      106  FORMAT(8F10.0)                                    2170
222      110 FORMAT(8F10.2)                                    2180
223      C
224      C BCO=0-- READ VALUE OF A AND B TO COMPUTE BENEFIT PRICES 2190
225      C
226      IF (BCO .NE. 0) GO TO 120                           2200
227      WRITE(6,716)                                         2210
228      READ(5,110,END=500) (A(J), J = 1, X0)               2220
229

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230      WRITE(6,110) (A(J), J = 1, XO)                                2420
231      716  FORMAT(//,T10,"F. PRICE FUNCTION DATA LINES - A VALUE FOR", 2430
232          +" BENEFIT LINES - A ONCE OVER CHANGE IN PRICES"./)        2440
233          READ(5,110,END=500) (B(J), J = 1, XO)                      2460
234          WRITE(6,717)                                              2470
235          WRITE(6,7170)                                             2471
236          WRITE(6,110) (B(J), J = 1, XO)                                2480
237          717  FORMAT(//,T10,"F. PRICE FUNCTION DATA LINES - B VALUE FOR ", 2490
238          +" BENEFIT LINES - A COMPOUND RATE OF INCREASE IN PRICES")   2500
239          7170 FORMAT(T14."(EX. 0.05 = 5 PERCENT ANNUAL INCREASE IN PRICES)"./) 2510
240          GO TO 125                                                 2520
241
242      C BCO=1-- READ PRICE OF OUTPUT AND READ A AND B TO COMPUTE INPUT PRICE 2530
243      C
244          120  WRITE(6,718)
245              DO 7188 I1=1,XO
246                  READ(5,110,END=500) (P(I1,J), J = 1, PLANHO)
247                  WRITE(6,110) (P(I1,J), J = 1, PLANHO)
248          CONTINUE
249          718  FORMAT(//,T10,"F. PRICES OF BENEFIT(OUTPUT) LINES - ", 2610
250          +"IF PARAMETER BCO = 1"/)
251          125 IF(CCO .NE. 0) GO TO 140
252
253      C
254          READ(5,110,END=500)(A(J), J = XIF, XI)
255          WRITE(6,719)
256          WRITE(6,110)(A(J), J = XIF, XI)                                2650
257          719  FORMAT(//,T10,"F. PRICE FUNCTION DATA LINES - A VALUE FOR ", 2680
258          +"COST LINES - A ONCE OVER CHANGE IN PRICE"./)                 2690
259          READ(5,110,END=500) (B(J), J = XIF, XI)
260          WRITE(6,720)
261          WRITE(6,7200)
262          WRITE(6,110) (B(J), J = XIF, XI)                                2730
263          720  FORMAT(//,T10,"F. PRICE FUNCTION DATA LINES - B VALUE FOR ", 2740
264          +"COST LINES - A COMPOUND RATE OF INCREASE IN PRICES")       2750
265          7200 FORMAT(T14."(EX. 0.05 = 5 PERCENT ANNUAL PRICE INCREASE)"./) 2760
266          GO TO 145                                                 2770
267
268      C CCO=0
269
270      C
271          140  WRITE(6,723)
272              DO 7233 I1=XIF,XI
273                  READ(5,110,END=500)(P( I1,J), J = 1, PLANHO)
274                  WRITE(6,110)(P( I1,J), J = 1, PLANHO)
275          CONTINUE
276          723  FORMAT(//,T10,"F. PRICES OF INPUTS(COST(S)) LINES - ", 2860
277          +"IF PARAMETER CO = 2"/)
278          145 IF( C1 .EQ. 0 .OR. C1 .EQ. 3 ) GO TO 150
279
280      C IF C1=1 OR 2, READ CAPITAL COSTS
281
282      C
283          WRITE(6,725)
284          IF (XKC .EQ. 0) GO TO 500
285          DO 7255 I1=1,XKC
286              READ(5,110,END=500) (KC(I1,J), J = 1, PLANHO )
287              WRITE(6,110) (KC(I1,J), J = 1, PLANHO )
288          CONTINUE
289          725  FORMAT(//,T10,"G. CAPITAL COST LINES"./)
290
291      C GENERATES SCALE FACTORS OF 1.0 IF BLANK DATA CARD INSERTED.
292
293          150 DO 151 J = 1, XI
294              IF(S(J) .NE. 0.0) GO TO 155
295          151 CONTINUE
296              DO 152 J = 1, XI
297                  152 S(J) = 1.0
298
299      C TITLE HEADING
300
301          155 WRITE(6,156)TITLE
302
303          3000 FORMAT(1H ,30X,"TABLE 2 SAMPLE PRINTOUT OF DATA INPUT FORMAT",///)
304
305          3050 WRITE(6,3050)TITLE
306          3050 FORMAT(1H ,10AB)

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307      C COMPUTE ORIGINAL SETS OF OUTPUT
308      XJ = XI - XO
309      C
310      WRITE(6,3100)PLANHO,XO,XJ,XKC,I,BCO,CCO,C1,C2,LPRINT
311      FORMAT(4I3,F4.2,5I2)
312      C
313      DO 3200 I1=1,XO
314          WRITE(6,106) (X(I1,J), J=1,PLANHO)
315      CONTINUE
316      C
317      DO 3250 I1=XIF,XI
318          WRITE(6,106) (X(I1,J), J=1,PLANHO)
319      CONTINUE
320      C
321      WRITE(6,110) {S(J); J=1,XO}
322      WRITE(6,110) {S(J); J=XIF,XI}
323      WRITE(6,110) {A(J); J=1,XO}
324      WRITE(6,110) {B(J); J=1,XO}
325      C
326      C
327      WRITE(6,110) (A(J),J=XIF,XI)
328      C
329      WRITE(6,110) (B(J), J=XIF,XI)
330      C
331      C
332      DO 3500 I1 = 1,XKC
333          WRITE(6,110) (KC(I1,J),J=1,PLANHO)
334      CONTINUE
335      C
336      C TITLE HEADING
337      C
338      Z1=I*100.
339      WRITE(6,156)TITLE
340      FORMAT(1H1,30X,"ANALYSIS TITLE -- ",10A8./)
341      WRITE(6,157)
342      FORMAT(1H,30X,"TABLE 3 SUMMARY OF BENEFIT-COST OR",
343             +" COST-EFFECTIVENESS ANALYSIS",//)
344      WRITE(6,160)PLANHO,I,21
345      FORMAT(1H,20X,"PLANNING HORIZON",
346             " IS",T71,14," YEARS",/,21X,"INTEREST RATE (R) IS",T71,F4.2,
347             +" OR ",F4.0,
348             " PERCENT")
349      WRITE(6,1601)
350      FORMAT(1H,T55,"PARAMETER SETTINGS FOR INPUTS & OUTPUTS",/)
351      WRITE(6,161) (S(I1),I1=1,XO)
352      FORMAT(1H,20X,"SCALE FACTOR FOR BENEFIT SETS (1.0 = NO CHANGE)",
353             +(T71,10F7.2))
354      C
355      C SUPPRESS PRINTING OF A AND B VALUES IF THE PRICES OF OUTPUT ARE
356      C PUNCHED DIRECTLY. IF IT IS COMPUTED IN THE PROGRAM, PRINT A AND B.
357      C
TRIVIAL * RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE
358      IF(BCO .EQ. 1)GO TO 1613
359      WRITE(6,1611) (A(J),J=1,XO)
360      1611 FORMAT(1H,20X,"BENEFIT PRICE FOR ONCE OVER CHANGE (A VALUE)",
361             +(T71,10F7.2))
362      RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE
363      WRITE(6,1612) (B(J),J=1,XO)
364      1612 FORMAT(1H,20X,"BENEFIT PRICE ANNUAL RATE OF CHANGE (B VALUE)",
365             +(T71,10F7.2))
366      C
367      C IF (XX GT 10) THEN SCALE FACTOR VALUES WILL BE CONTINUED ON THE,
368      C FOLLOWING LINES
369      C
TRIVIAL * RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE
370      1613 IF(XX GT. 10) THEN
371          NEWXIF=XIF+9
372          WRITE(6,162) (S(JJ),JJ=XIF,NEWXIF)
373          162 FORMAT(1H,20X,"SCALE FACTOR FOR COST SETS (1.0 = NO CHANGE)",
374             + T71,10F7.2)
375      RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE
376      NEWXIF=NEWXIF+1
377      LEND=NEWXIF+9
378      *
379      DO 164 II=2,LINE
380          WRITE(6,1640) (S(JJ),JJ=NEWXIF,LEND)
381          1640 FORMAT(T71,10F4.1)

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1 380          NEWXIF=LEND+1                                3510
1 381          LEND=NEWXIF+9                                3520
1 382          164    CONTINUE                                3530
1 383          ELSE                                     3540
1 384          WRITE(6,162) (S(JJ),JJ=XIF,XI)             3550
1 385          END IF                                    3560
1 386          C  SUPPRESS PRINTING, IF THE PRICES OF INPUT ARE PUNCHED DIRECTLY, 3570
1 387          C  IF PRICES ARE COMPUTED IN THE PROGRAM, PRINT THE VALUES OF A AND B. 3580
1 388          C  IF(CCO .EQ. 1) GO TO 165                  3590
1 389          C  IF(XX .GT. 10) THEN                      3600
1 390          C  NEWXIF=XIF+9                                3610
1 391          C  WRITE(6,1641) (A(JJ),JJ=XIF,NEWXIF)        3620
1 392          C  1641  FORMAT(1H,,20X,"COSTS - PRICE FOR ONCE OVER CHANGE ", 3630
1 393          C  +(A VALUE),T71,10F7.2)                   3640
1 394          C  RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE 3650
1 395          C  1642  FORMAT(1H,,20X,"COSTS - PRICE ANNUAL RATE OF CHANGE (B VALUE)", 3660
1 396          C  +T71,10F7.2)                         3670
TRIVIAL *      RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE 3680
1 397          C  NEWXIF=NEWXIF+1                            3690
1 398          C  1643  FORMAT(T67,10F7.1)                  3700
TRIVIAL *      NEWXIF=NEWXIF+1                            3710
1 400          C  1644  II=2,LINES                         3720
1 401          C  DO 1644 II=2,LINES                      3730
1 402          C  WRITE(6,1643) (A(JJ),JJ=NEWXIF,LEND)       3740
1 403          C  1643  FORMAT(T67,10F7.1)                  3750
1 404          C  NEWXIF=LEND+1                            3760
1 405          C  LEND=NEWXIF+9                            3770
1 406          C  1644  CONTINUE                           3780
1 407          C  C  REPEAT SAME PROCEDURE FOR B VALUE 3790
1 408          C  C  NEWXIF=XIF+9                                3800
1 409          C  WRITE(6,1642) (B(JJ),JJ=XIF,NEWXIF)        3810
1 410          C  NEWXIF=NEWXIF+1                            3820
1 411          C  LEND=NEWXIF+9                            3830
1 412          C  1645  II=2,LINES                         3840
1 413          C  DO 1645 II=2,LINES                      3850
1 414          C  LINES=LINES-1                            3860
1 415          C  WRITE(6,1643) (B(JJ),JJ=NEWXIF,LEND)       3870
1 416          C  NEWXIF=LEND+1                            3880
1 417          C  LEND=NEWXIF+9                            3890
1 418          C  1645  CONTINUE                           3900
1 419          C  1645  ELSE                                3910
1 420          C  WRITE(6,1641) (A(JJ),JJ=XIF,XI)           3920
1 421          C  WRITE(6,1642) (B(JJ),JJ=XIF,XI)           3930
1 422          C  END IF                                 3940
1 423          C  * 165  WRITE(6,166)                         3950
1 424          C  166  FORMAT(1H,,T2,"(D) - DISCOUNT IN SPECIFIED YEAR WITH GIVEN ", 3960
1 425          C  +"INTEREST RATE",                         3970
1 426          C  +T70,"(AC) - TOTAL ANNUAL COSTS (OPERATING, OVERHEAD + CAPITAL)", 3971
1 427          C  +//,T2,"(AB) - TOTAL ANNUAL BENEFITS = UNITS OF BENEFIT ", 3980
1 428          C  +(OUTPUT) X PRICE",                     3990
1 429          C  +T70,"(APVC) - ANNUAL PRESENT VALUE OF COSTS = (D) X (AC)", //, 4000
1 430          C  +T2,"(APVB) - ANNUAL PRESENT VALUE OF BENEFITS = (D) X (AB)", //, 4010
1 431          C  +T70,"(PVTc) - PRESENT VALUE OF TOTAL COSTS = CUMULATIVE ", 4020
1 432          C  +"SUM OF APVC", //,                         4030
1 433          C  +T2,"(PVTB) - PRESENT VALUE OF TOTAL BENEFITS = CUMULATIVE ", 4040
1 434          C  +"SUM OF APVB", //,                         4050
1 435          C  +T70,"(NET PV) - CUMULATIVE NET PRESENT VALUE = PVTB - PVTc", //, 4060
1 436          C  +T70,"CASH FLOW, OR ANNUAL NET BENEFIT = (AB) - (AC)"        4070
1 437          C  IF(XO .GT. 1) GO TO 178                  4080
1 438          C  IF(C1 .NE. 0 ) GO TO 175                  4090
1 439          C  C COLUMN HEADING IF C1 = 0 (NO SEPARATION OF CAPITAL AND OPERATING COST 4100
1 440          C  C  WRITE(6,170)                         4110
1 441          C  170  FORMAT(1HO,T23,"TOTAL_OUTPUTS",T42,"TOTAL",T52,"ANNUAL",T78, 4120
1 442          C  +"TOTAL",T88,"ANNUAL",/,                 4130
1 443          C  +7X,"DISCOUNT (D) 5X,"(BENEFITS)",7X,"ANNUAL",4X,"PRESENT", 4140
1 444          C  16X,"PRESENT",5X,"ANNUAL",5X,"PRESENT",6X,"PRESENT", 4150
1 445          C  +6X,"NET",5X,"CASH FLOW OR",/ ,            4160
1 446          C  2" YEAR FOR SPECIFIED UNITS PRICE OR",4X,"BENEFITS", 4170
1 447          C  33X,"VALUE OF VALUE TOTAL",5X,"COST",7X,"VALUE",5X,"VALUE ", 4180
1 448          C  4"TOTAL PRESENT",5X,"ANNUAL"/,6X,"INTEREST RATE (O)",3X, 4190
1 449          C  +"VALUE (P)",                           4200
1 450          C  55X,"(AB)",6X,"BENEFITS BENEFITS",8X,"(AC)",4X,"TOTAL COSTS",5X, 4210
1 451          C  4220
1 452          C  4230
1 453          C  4240

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455      6"COST",7X,"VALUE",4X,"NET BENEFIT",/,T53,"(APVB)",T63,"(PVTB)",    4250
456      +T89,"(APVC)",T102,"(PVTC)",T112,"(NET PV)"    4260
457      GO TO 200    4270
458
459      C COLUMN HEADING IF CAPITAL COSTS ARE SEPARATE FROM OPERATING COSTS    4280
460
461      175 WRITE(6,176)    4290
462      176 FORMAT(1HO,T22,"TOTAL OUTPUTS",T37,"TOTAL",    4300
463      +T45,"ANNUAL",T78,"SUM",T86,"TOTAL",T95,"ANNUAL",/,    4310
464      +6X,"DISCOUNT(D)",4X,"(BENEFITS)",3X,"ANNUAL",3X,    4320
465      +"PRESENT",4X,"PRESENT",3X,"ANNUAL",    4330
466      +4X,"ANNUAL",4X,"ANNUAL",3X,"PRESENT",4X,"PRESENT",4X,"NET",6X,    4340
467      +"CASH FLOW",1X,"OR"/"YEAR FOR SPECIFIED UNITS PRICE OR",1X,    4350
468      +"BENEFITS",1X,"VALUE OF",1X,    4360
469      +"VALUE TOTAL CAPITAL OPERATING COST",5X,"VALUE",    4370
470      +3X,"VALUE TOTAL PRESENT",4X,"ANNUAL"/6X,"INTEREST RATE",    4380
471      +1X,"(O)",3X,"VALUE(P)",2X,"(AB)",3X,"BENEFITS",3X,"BENEFITS",    4390
472      +3X,"COSTS",5X,"COST",    4400
473      +6X,"(AC)",2X,"TOTAL COST",3X,"COSTS",6X,"VALUE",4X,"NET BENEFIT",    4410
474      +/T46,"(APVB)",T57,"(PVTB)",T95,"(APVC)",T106,    4420
475      +"(PVTC)",T116,"(NET PV)"    4430
476      GO TO 200    4440
477      178 IF(C1.NE.0) GO TO 181    4450
478
479      C COLUMN HEADING IF C1=0 AND MORE THAN ONE SETS OF OUTPUT    4460
480      WRITE(6,180)    4470
481      180 FORMAT(1HO,T23,"TOTAL",T33,"ANNUAL",T58,"TOTAL",T68,"ANNUAL",/,    4480
482      +6X,"DISCOUNT(D)",3X,"ANNUAL",5X,"PRESENT",6X,    4490
483      +"PRESENT",5X,"ANNUAL",    4500
484      +3X,"PRESENT",7X,"PRESENT",5X,"NET",6X,"CASH FLOW OR/",    4510
485      +"YEAR FOR SPECIFIED",2X,"BENEFITS VALUE OF VALUE TOTAL",    4520
486      +4X,"COSTS",5X,"VALUE VALUE TOTAL",2X,"PRESENT",6X,"ANNUAL",/.,    4530
487      +6X,"INTEREST RATE",4X,"(AB)",5X,"BENEFITS BENEFITS",5X,    4540
488      +"(AC)",2X,"TOTAL COSTS",6X,"COSTS",6X,"VALUE",4X,"NET BENEFIT",/.,    4550
489      +T34,"(APVB)",T46,"(PVTB)",T68,"(APVC)",T81,"(PVTC)",    4560
490      +T91,"(NET PV)"    4570
491      GO TO 200    4580
492
493      C COLUMN HEADING IF C1 IS NOT EQUAL TO 0 AND OUTPUTS ARE MORE THAN ONE    4590
494      C SETS    4600
495      181 WRITE(6,183)    4610
496      183 FORMAT(1HO,T22,"TOTAL",T32,    4620
497      +"ANNUAL",T68,"SUM",T80,"TOTAL",T90,"ANNUAL",/,    4630
498      +7X,"DISCOUNT(D)",2X,"ANNUAL",4X,"PRESENT",4X,"PRESENT",    4640
499      +5X,"ANNUAL",6X,    4650
500      +"ANNUAL",6X,"ANNUAL",5X,"PRESENT",5X,"PRESENT",6X,"NET",    4660
501      +4X,"CASH FLOW","OR",/1X,    4670
502      +"YEAR FOR SPECIFIED",1X,"BENEFITS VALUE OF",2X,"VALUE TOTAL",    4680
503      +3X,"CAPITAL",4X,"OPERATING",5X,"COST",7X,"VALUE",4X,"VALUE",    4690
504      +"TOTAL",2X,"PRESENT",4X,"ANNUAL",/7X,"INTEREST RATE",1X,    4700
505      +(AB),5X,"BENEFITS",3X,"BENEFITS",5X,"COSTS",8X,"COSTS",7X,    4710
506      +"(AC)",    4720
507      +5X,"TOTAL COSTS COSTS",5X,"VALUE",3X,"NET BENEFIT",    4730
508      +/T32,"(APVB)",T43,"(PVTB)",T90,"(APVC)",T103,"(PVTC)",    4740
509      +T113,"(NET PV)"    4750
510      200 IF(C2.EQ.0) GO TO 208    4760
511
512      C DUPLICATES VALUE FOR INPUT DATA WHEN IT IS SAME EACH YEAR. (C2.NE.0)    4770
513
514      LC2 = C2 + X0    4780
515      LPH = PLANHO - 1    4790
516      DO 206 J = XIF,LC2    4800
517      DO 205 K = 1,LPH    4810
518      205 X(J,K+1) = X(J,K)    4820
519      206 CONTINUE    4830
520
521      C L COUNTS NUMBER OF TIMES NPV IS CALCULATED    4840
522
523      208 L = 0    4850
524
525      C INITIALIZE OPERATING COSTS AND BENEFITS    4860
526
527      DO 213 N=1,PLANHO    4870
528      DO 211 J=1,XI    4880
529      OPCOST(J,N)=0.    4890
530
531      211 CONTINUE    4900
532      DO 212 J=1,XO    4910

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```

532      BENEF(J,N)=0.          5020
533      212      CONTINUE    5030
534      213      CONTINUE    5040
535      C
536      C R SET EQUAL TO I FOR FIRST NPV CALCULATION 5050
537      C
538      R = I          5060
539      R1 = 0.0        5070
540      R2 = 0.0        5080
541      R3 = .02        5090
542
543      C PREVENTS DIVISION BY ZERO 5100
544      C
545      210 IF(R.LE.-1.0) GO TO 350 5110
546      SUMPVC = 0.0        5120
547      SUMPVR = 0.0        5130
548      SUM NPV = 0.0        5140
549      SUMPVK = 0.0        5150
550
551      C LOOP TO STATEMENT 270 CALCULATES NPV 5160
552      C DO 270 N = 1, PLANHO 5170
553      YEAR = N-1        5180
554      YR = YEAR        5190
555      IF(L.GE. 1) GO TO 254 5200
556      DC = 0.0          5210
557
558      C COMPUTE PRICE OF OUTPUTS, P=A*((1+B)**YEAR) 5220
559      C
560      IF(BCO.EQ. 1) GO TO 217 5230
561      DO 215 II=1,XO        5240
562      P(II,N)=A(II)*((1+B(II))**YR) 5250
563      215 IF(CC0.EQ. 1) GO TO 230 5260
564
565      C COMPUTE PRICE OF INPUTS, P=A*((1+B)**YEAR) 5270
566      C
567      DO 220 J = XIF, XI 5280
568      P(J,N) = A(J)*((1+B(J))**YR) 5290
569      220 IF(C1.NE. 0.AND. C1.NE. 3) GO TO 237 5300
570      DO 236 J=1,XX        5310
571      236 KC(J,N)=0.0        5320
572
573      C COMPUTE CAPITAL COSTS AND OPERATING COSTS 5330
574
575      C DO 240 J = XIF, XI 5340
576      CX(J) = P(J,N)*X(J,N) * S(J) 5350
577      OPCOST(J,N)=CX(J) 5360
578      240 OC = OC + CX(J) 5370
579      TKC(N)=0.0          5380
580      DO 241 J=1,XKC        5390
581      241 TKC(N)=TKC(N)+KC(J,N) 5400
582
583      C TOTAL COST IS OPERATING COST + CAPITAL COST 5410
584
585      C TC(N) = OC + TKC(N) 5420
586
587      C COMPUTE TOTAL REVENUE 5430
588      TTR=0.0          5440
589      IF (XO.EQ. 1) GO TO 247 5450
590      DO 245 J=1,XO        5460
591      RX(J)=P(J,N)*X(J,N)*S(J) 5470
592      BENEF(J,N)=RX(J)        5480
593
594      245 TTR=TTR+RX(J)        5490
595      TR(N)=TTR        5500
596      GO TO 253        5510
597
598      C TOTAL REVENUE IS PRICE * OUTPUT ,ONLY ONE SET OF OUTPUT 5520
599      C
600      247 Y = X(1,N)*S(1) 5530
601      TR(N) = P(1,N) * Y 5540
602      BENEF(1,N)=TR(N)        5550
603      253 IF(C1.NE. 3) GO TO 254 5560
604
605      C DETERMINES CAPITAL COST AS EXCESS OF COST OVER RETURNS 5570
606      C
607      KC3 = TR(N) - TC(N) 5580
608      IF(KC3.LT. 0.0) TKC(N) = KC3 + (-1.0) 5590

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```

609      OC = OC - TKC(N)          5790
610      TC(N) = OC + TKC(N)      5800
611
612      C DETERMINE DISCOUNT    5810
613      C
614      254 D = 1. / { 1. + R } ** YR  5820
615      IF(D.LT.0) D=D*(-1)        5830
616
617      C DISCOUNT * TOTAL REVENUE=PRESENT VALUE TOTAL REVENUE (PVTR) 5840
618      C
619      PVTR = D * TR(N)          5850
620      SUMPVR = SUMPVR + PVTR   5860
621
622      C DISCOUNT * TOTAL COST=PRESENT VALUE TOTAL COST (PVTC)       5870
623      C
624      PVTC = TC(N) * D          5880
625      SUMPVC = SUMPVC + PVTC   5890
626      SUM NPV = SUMPVR - SUMPVC 5900
627      IPV=TR(N)-TC(N)         5910
628      IF( C1 .EQ. 0 .OR. C1 .EQ. 1 ) GO TO 256 5920
629
630      C COMPUTE SCARCE RESOURCE 5930
631      C
632      PVKC = D * TKC(N)          5940
633      SUMPVK = SUMPVK + PVKC   5950
634
635      C DETAILED PRINT OUT ONLY ON FIRST NPV CALCULATION 5960
636      C
637      256 IF(L .GE. 1 ) GO TO 270 5970
638      IF(C1 .EQ. 0 ) GO TO 267 5980
639      IF(XO .GT. 1 ) GO TO 257 5990
640      WRITE(6,258) YEAR, D, Y, P(1,N),TR(N),PVTR,SUMPVR,TKC(N),OC, 6000
641      1TC(N),PVTC,SUMPVC, SUM NPV,IPV 6010
642      GO TO 270 6020
643      WRITE(6,259) YEAR,D,TR(N),PVTR,SUMPVR,TKC(N),OC,TC(N),PVTC, 6030
644      +SUMPVC,SUM NPV,IPV 6040
645      GO TO 270 6050
646      258 FORMAT(1HO,I3,F10.4,F10.2,F8.3,BF10.2,2F12.2) 6060
647      259 FORMAT(1HO,1X,I3,F8.4,2X,F12.2,F10.2,6F12.2) 6070
648      267 IF(XO .GT. 1 ) GO TO 263 6080
649      260 WRITE(6,261) YEAR,D,Y,P(1,N),TR(N),PVTR,SUMPVR,TC(N),PVTC, 6090
650      1 SUMPVC, SUM NPV,IPV 6100
651      GO TO 270 6110
652      263 WRITE(6,264)YEAR,D,TR(N),PVTR,SUMPVR,TC(N),PVTC, 6120
653      +SUMPVC SUM NPV,IPV 6130
654      261 FORMAT(1HO,I3,F11.4,F12.2,F8.3,8F12.2) 6140
655      264 FORMAT(1HO,I3,F11.4,8F12.2) 6150
656      270 CONTINUE 6160
657      IF(C1 .EQ. 0 .OR. C1 .EQ. 1 ) .GO TO 275 6170
658      IF(SUMPVK .EQ. 0.0 ) GO TO 272 6180
659
660      C MODIFIED BC RATIO (C1.EQ.2.OR.C1.EQ.3) 6190
661      C
662      BC = SUM NPV / SUMPVK 6200
663      GO TO 276 6210
664      272 WRITE(6,273) 6220
665      273 FORMAT(1H,"CAPITAL COSTS ARE EQUAL TO ZERO. DIVISION BY ZERO IS 6230
666      1NOT PERMITTED, SO THE CONVENTIONAL BC RATIO WAS COMPUTED.") 6240
667
668      C CONVENTIONAL BC RATIO (C1.EQ.0.OR.C1.EQ.1) 6250
669      C
670      275 BC = SUMPVR / SUMPVC 6260
671      276 IF( L .GE. 1 ) GO TO 300 6270
672      WRITE(6,280) BC 6280
673      280 FORMAT(1HO,8X," THE BENEFIT COST RATIO (BC RATIO) COMPILED FROM T 6290
674      2HE ABOVE DATA IS PVTB/PVTC = ",F5.2) 6300
675      CEFF=1/BC 6310
676      WRITE(6,282)CEFF 6320
677      282 FORMAT(1HO,9X,"THE COST-EFFECTIVENESS RATIO IS THE", 6330
678      +" INVERSE OF THE BENEFIT COST RATIO, OR PVTC/PVTB", 6340
679      +" WHICH = ",F8.2) 6350
680      WRITE(6,285) SUM NPV 6360
681      285 FORMAT(1HO,8X," THE NET PRESENT VALUE OF THIS PROJECT = ",.T14, 6370
682      +"PRESENT VALUE TOTAL BENEFITS (PVTB) - PRESENT VALUE ", 6380
683      +"TOTAL COST (PVTC) OR ",F15.2) 6390
684      WRITE(6,156)TITLE 6400
685      WRITE(6,2851) 6410

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686      2851 FORMAT(1H ,T30, "TABLE 4 ESTIMATED INTERNAL RATE",      6560
687          2" OF RETURN (IRR) FOR THIS ANALYSIS")                  6570
688          R = .02                                              6580
689          IF(C1.EQ. 0 .OR. C1.EQ. 1 ) GO TO 289                  6590
690          WRITE(6,288)                                           6600
691          288 FORMAT(1H-,40X,"R",6X,"NET PV",8X,"BC/KC RATIO")   6610
692          GO TO 292                                           6620
693          289 WRITE(6,290)                                         6630
694          290 FORMAT(1H-,33X,"INTEREST",7X,"NET",14X,"BENEFIT",./,36X, 6640
695          +"RATE",4X,"PRESENT VALUE",7X,"COST RATIO")           6650
696          292 L = 1                                             6660
697          GO TO 210                                           6670
698          300 L = L + 1                                         6680
699
700      C LIMIT OF 400 PER CENT ON PROGRAM                      6690
701      C IF(L .GE. 200) GO TO 350                           6700
702      C IF(L .GE. 200) GO TO 350                           6710
703      C PRINT OUT ONLY FOR 2 PER CENT INCREASES IN R        6720
704      C IF(R3 .EQ. .001 ) GO TO 315                           6730
705      C IF(R3 .EQ. .001 ) GO TO 315                           6740
706      C IF(R3 .EQ. .001 ) GO TO 315                           6750
707      C IF(R3 .EQ. .001 ) GO TO 315                           6760
708      C WRITE(6,310) R, SUM NPV, BC                         6770
709      C 310 FORMAT(1HO,28X,F11.3,3X,F12.2,13X,F4.2)         6780
710
711      C DETERMINE WHETHER R SHOULD BE INCREASED OR DECREASED TO REDUCE NPV TO 6790
712
713      C 315 IF(SUM NPV) 320, 350, 330                      6800
714      C 320 R2 = R2 + 1,                                     6810
715          IF(R1 .GE. 1. .AND. R2 .GE. 1.) GO TO 340          6820
716          R = R - R3                                       6830
717          GO TO 210                                         6840
718          330 R1 = R1 + 1,                                     6850
719          IF(R1 .GE. 1. .AND. R2 .GE. 1.) GO TO 340          6860
720          R = R + R3                                       6870
721          GO TO 210                                         6880
722          340 IF(R3 .EQ. .001) GO TO 350                     6890
723
724      C VICINITY OF SOLUTION . CHANGE R IN STEPS OF .001 TILL NPV NEAR ZERO 6900
725
726      C R3 = .001                                           6910
727      C R1 = 0                                              6920
728      C R2 = 0                                              6930
729      C GO TO 210                                         6940
730      C 350 CONTINUE                                         6950
731          W=R*100.                                         6960
732          IF(C1 .EQ. 0 .OR. C1 .EQ. 1 ) GO TO 359          6970
733          WRITE(6,355)R,W,SUM NPV, BC                      6980
734          355 FORMAT(1HO,6X,"THE INTERNAL RATE OF RETURN (IRR) OF THIS PROJECT I 6990
735          2S", F7.3, " OR" F8.2, " PERCENT"/7X,"THE REMAINING NET PRESENT VALUE 7000
736          3USING THIS ESTIMATED IRR IS THEN = ",E15.2/7X,"THE BC/KC RATIO USI 7010
737          4NG THIS ESTIMATED IRR IS = ",F5.2)                7020
738          GO TO 362                                         7030
739          359 WRITE(6,360)R,W, SUM NPV, BC                   7040
740          360 FORMAT(1HO,6X,"THE INTERNAL RATE OF RETURN (IRR) OF THIS PROJECT I 7050
741          2S", F7.3, " OR" F8.2, " PERCENT"/7X,"THE REMAINING NET PRESENT VALUE 7060
742          3USING THIS ESTIMATED IRR IS THEN = ",F12.2/7X,"THE BENEFIT COST 7070
743          4RATIO USING THIS ESTIMATED IRR = ",F5.2)            7080
744          362 IF( L .LT. 200) GO TO 370                     7090
745          WRITE(6,365)
746          365 FORMAT(1H-, "THE LIMIT OF THE PROGRAM IS 400 PER CENT AND HAS 7100
747          1 BEEN EXCEEDED. THE INTERNAL RATE OF RETURN IS THEREFORE INCORRECT 7110
748          2."/* CHECK THE DATA CARDS FOR ERRORS.")           7120
749          370 CONTINUE                                         7130
750          ****
751          * PRINTING CAPITAL COST TABLE                      7140
752          ****
753
754      C CHECK VARIABLE LPRINT. DECIDE TO PRINT TABLE 4 THOU TABLE 8 OR NOT 7150
755
756      C IF(LPRINT .EQ. 0) GO TO 516                         7160
757
758      C IF (C1 .EQ. 1 .OR. C1 .EQ. 2.) THEN                 7170
759          WRITE(6,156)TITLE                                7180
760          WRITE(6,1100)                                    7190
761          1100 FORMAT(1H ,T30, "TABLE 5 THE VALUE OF EACH CAPITAL ", 7200
762          +"COST FOR ALL YEARS",//)                         7210

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1 763      **
1 764      **
1 765      IF(XKC .LE. 12) THEN          7330
1 766      NREM1=0                      7340
2 767      C NEWKC DEFINES THE END OF COLUMN HEADING STRING 7350
2 768      NEWKC=(XKC+1)*10               7360
2 769      CALL SINGL(NEWKC,HEAD41,HEAD42,1,KC,1,XKC)        7370
2 770      ELSE                           7380
2 771      * MORE THAN ONE TABLES ARE NEEDED TO PRINT OUT THE WHOLE CAPITAL * 7390
2 772      * COST DATA                   7400
2 773      NREM1=MOD(XKC,12)             7410
2 774      LINE1=XKC/12                 7420
2 775      NSTAR=1                      7430
2 776      *
2 777      DO 422 KK=1,LINE1            7440
2 778      LAST1=NSTAR+11              7450
2 779      WRITE(6,1200) HEAD41         7460
2 780      WRITE(6,1200) HEAD42(KK)       7470
2 781      1200 FORMAT(1HO,A)           7480
2 782      DO 421 N=1,PLANHO          7490
2 783      WRITE(6,1210)N,(KC(J,N),J=NSTAR,LAST1)        7500
2 784      1210 FORMAT(1HO,6X,I3,12F10.1)        7510
2 785      421 CONTINUE                  7520
2 786      IF (KK .LT. LINE1) WRITE(6,1270)        7530
2 787      1270 FORMAT(1HO,T65,"CONTINUED")        7540
2 788      IF((KK .EQ. LINE1) .AND. (NREM1 .NE. 0)) WRITE(6,1270)        7550
2 789      NSTAR=LAST1+1                7560
2 790      422 CONTINUE                  7570
2 791      END IF                       7580
2 792      **
2 793      C PRINT OUT THE LAST PART OF THE TABLE        7590
2 794      C
2 795      IF(NREM1 .GT. 0) THEN          7600
2 796      LINE1=LINE1+1                7610
2 797      NEWXX=(NREM1+1)*10            7620
2 798      CALL SINGL(NEWXX,HEAD41,HEAD42,LINE1,KC,NSTAR,XKC)        7630
2 799      END IF                       7640
2 800      *
2 801      END IF                       7650
1 802      ****
1 803      * PRINTING OPERATING COST TABLE          7660
1 804      ****
1 805      ****
1 806      WRITE(6,156)TITLE             7670
1 807      WRITE(6,1500)
1 808      1500 FORMAT(1H,T30,"TABLE 6 THE VALUE OF EACH",        7680
1 809      +" OPERATING COST BY YEAR",//)          7690
1 810      **
1 811      **
1 812      IF (XX .LE. 12)THEN          7700
1 813      * PRINT OUT PARTIAL TABLE          7710
1 814      NREM2=0                      7720
1 815      NEWXX=(XX+1)*10              7730
1 816      CALL SINGL(NEWXX,HEAD51,HEAD42,1,OPCOST,XIF,XI)        7740
1 817      ELSE                           7750
1 818      *
1 819      NREM2=MOD(XX,12)             7760
1 820      LINE2=XX/12                 7770
1 821      NSTAR=XIF                   7780
1 822      DO 432 KK=1,LINE2            7790
1 823      LAST1=NSTAR+11              7800
1 824      WRITE(6,1200) HEAD51         7810
1 825      WRITE(6,1200) HEAD42(KK)       7820
1 826      DO 431 N=1,PLANHO          7830
1 827      WRITE(6,1210)N,(OPCOST(J,N),J=NSTAR,LAST1)        7840
1 828      431 CONTINUE                  7850
1 829      IF (KK .LT. LINE2) WRITE(6,1270)        7860
1 830      IF((KK .EQ. LINE2) .AND. (NREM2 .NE. 0)) WRITE(6,1270)        7870
1 831      NSTAR=LAST1+1                7880
1 832      432 CONTINUE                  7890
1 833      END IF                       7900
1 834      **
1 835      **
1 836      IF (NREM2 .GT. 0) THEN          7910
1 837      LINE2=LINE2+1                7920
1 838      NEWXX=(NREM2+1)*10            7930
1 839      CALL SINGL(NEWXX,HEAD51,HEAD42,LINE2,OPCOST,NSTAR,XI)        7940
1

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1 840      END IF
1 841      ****
1 842      * PRINTING BENEFIT TABLE
1 843      ****
1 844      WRITE(6,156)TITLE
1 845      WRITE(6,1600)
1 846      1600 FORMAT(1H ,T30,"TABLE 7 THE AMOUNT OF EACH",
1 847      +" BENEFIT BY YEAR",//)
1 848      NEWXO=(XO+1)*10
1 849      WRITE(6,1610) HEAD6(1:NEWXO)
1 850      1610 FORMAT(1HO,A,/ )
1 851      DO 486 N=1,PLANHO
1 852      WRITE(6,1620) N,(BENEF(J,N),J=1,XO)
1 853      FORMAT(1HO,6X,I3,10F10.2)
1 854      486 CONTINUE
1 855      ****
1 856      * PRINTING OPERATIONAL COST PER UNIT
1 857      ****
1 858      WRITE(6,156)TITLE
1 859      WRITE(6,1700)
1 860      1700 FORMAT(1H ,T30,"TABLE 8 QUANTITY AND PRICE OF OPERATING ",
1 861      +"COST INPUTS BY YEAR",//)
1 862      IF(XX .LE. 6) THEN
1 863      NREM3=0
1 864      INDEX1=(XX*20)+5
1 865      WRITE(6,1200) HEAD71(1)(1:INDEX1)
1 866      WRITE(6,1200) HEAD72(1:INDEX1)
1 867      DO 487 N=1,PLANHO
1 868      WRITE(6,1710) N,(X(J,N),P(J,N),J=XIF,XI)
1 869      FORMAT(1HO,I3,6(F10.0,F10.2))
1 870      487 CONTINUE
1 871      *
1 872      ELSE
1 873      *
1 874      NREM3=MOD(XX,6)
1 875      LINE3=XX/6
1 876      NSTAR=XIF
1 877      DO 489 KK=1,LINE3
1 878      LAST1=NSTAR+5
1 879      WRITE(6,1200) HEAD71(KK)
1 880      WRITE(6,1200) HEAD72
1 881      DO 488 N=1,PLANHO
1 882      WRITE(6,1710) N,(X(J,N),P(J,N),J=NSTAR,LAST1)
1 883      488 CONTINUE
1 884      IF (KK .LT. LINE3) WRITE(6,1270)
1 885      IF((KK .EQ. LINE3) .AND. (NREM3 .NE. 0)) WRITE(6,1270)
1 886      NSTAR=LAST1+1
1 887      489 CONTINUE
1 888      END IF
1 889      IF (NREM3 .GT. 0) THEN
1 890      LINE3=LINE3+1
1 891      NEWXX=(NREM3*20)+5
1 892      WRITE(6,1200) HEAD71(LINE3)(1:NEWXX)
1 893      WRITE(6,1200) HEAD72(1:NEWXX)
1 894      DO 511 N=1,PLANHO
1 895      WRITE(6,1710) N,(X(J,N),P(J,N),J=NSTAR,XI)
1 896      511 CONTINUE
1 897      END IF
1 898      ****
1 899      * PRINTING BENEFIT PER UNIT
1 900      ****
1 901      WRITE(6,156)TITLE
1 902      WRITE(6,1800)
1 903      1800 FORMAT(1H ,T30,"TABLE 9 QUANTITY AND PRICE(VALUE) OF",
1 904      +" BENEFITS BY YEAR",//)
1 905      IF (XO .LE. 6) THEN
1 906      NREM4=0
1 907      INDEX2=(XO*20)+5
1 908      WRITE(6,1200) HEAD81(1)(1:INDEX2)
1 909      WRITE(6,1200) HEAD72(1:INDEX2)
1 910      DO 512 N=1,PLANHO
1 911      WRITE(6,1710) N,(X(J,N),P(J,N),J=1,XO)
1 912      512 CONTINUE
1 913      *
1 914      ELSE
1 915      *
1 916      NREM4=MOD(XO,6)

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1      LINE4=X0/6
1      NSTAR=1
1      DO 514 KK=1,LINE4
1          LAST1=NSTAR+5
1          WRITE(6,1200) HEAD81(KK)
1          WRITE(6,1200) HEAD72
1          DO 513 N=1,PLANHO
1              WRITE(6,1710)N,(X(J,N),P(J,N),J=1,LAST1)
1
1      513      CONTINUE
1          IF (KK .LT. LINE4) WRITE(6,1270)
1          IF((KK .EQ. LINE4) .AND. (NREM4 .NE. 0)) WRITE(6,1270)
1          NSTAR=LAST1+1
1
1      514      CONTINUE
1      END IF
1      IF(NREM4 .GT. 0) THEN
1          NEWXO=(NREM4*20)+5
1
1      *
1          WRITE(6,1200) HEAD81(2)(1:NEWXO)
1          WRITE(6,1200) HEAD72(1:NEWXO)
1          DO 515 N=1,PLANHO
1              WRITE(6,1710)N,(X(J,N),P(J,N),J=NSTAR,XO)
1
1      515      CONTINUE
1      END IF
1      ****
1      516      IF ((XKC.GT.0).AND.((C1.EQ.0).OR.(C1.EQ.3)))THEN
1          WRITE(6,614)
1          GO TO 999
1      END IF
1      GO TO 90
1
1      C
1      C DATA IS NOT COMPLETE
1      C
1      500      WRITE(6,600)
1      600      FORMAT(///,5X,"***** EOF OCCURS, INPUT DATA IS NOT COMPLETE *****")
1      C
1      999      END

```

--VARIABLE MAP-- (LR=A/B)

-NAME--		-ADDRESS--		-BLOCK----		-PROPERTIES-----		-TYPE-----		-SIZE--		-REFERENCES-		-R=READ, S=STORE, U=I/O UNIT, W=WRITE			
A	6211B					REAL	60	3	229/R	230/W	253/R	255/W	323/W	327/W	359/W	394/W	
B	6305B					REAL	60	402/W 3	421/W 233/R	564 236/W	570 258/R	261/W	324/W	329/W	362/W	411/W	
BC	70655B					REAL		662/S 7	670/S 86/R	564 672/W	570 675	708/W 109	733/W 110/W	739/W 156/W	227		
BCO	70470B					INTEGER		562							310/W	358	
BENEF	66171B					REAL	1000	3	532/S 86/R	593/S 112	602/S 112	852/W 113/W	157/W	251	310/W	390	
CCO	70471B					INTEGER		565									
CEFF	70656B					REAL		675/S	676/W								
CX	51615B					REAL		3	578/S 86/R	579 115	580 115	116/W	158/W	276	276	310/W	
C1	70472B					INTEGER	60	7	440	477	571 571	603	628	628	638	657	
C2	70473B					INTEGER		657	689	689	732	732	758	758	941	941	
D	70651B					REAL		7	86/R	118	118	119/W	159/W	310/W	510	514	
HEAD41	70477B					CHAR*130		614/S 649/W	615 652/W	615	615/S 619	619	624	632	640/W	643/W	
HEAD42	70141B					CHAR*130	5	8	22/I 3	769/A 816/A	779/W 825/W	799/A 839/A					
HEAD51	70514B					CHAR*130		799/A	816/A	816/A	824/W	839/A					
HEAD6	70531B					CHAR*130		8	40/I 43/I	849/W 849/W							
HEAD71	70242B					CHAR*130	9	3	43/I 66/I	45/I 69/I	48/I 865/W	51/I 879/W	54/I 892/W	57/I 909/W	60/I 922/W	63/I 935/W	
HEAD72	70546B					CHAR*130		8	72/I 3	866/W 75/I	880/W 78/I	893/W 908/W	909/W 921/W	922/W 934/W	935/W		
HEAD81	70427B					CHAR*130	2	3	8	75/I 86/R	908/W 106	921/W 107/W	934/W 154/W	935/W 310/W	934/W 338	344/W	539
I	70461B					REAL		6	86/R	106	107/W	154/W	310/W	338			
II	70616B					INTEGER		351	377/C	401/C	415/C	563/C	564	564			
INDEX1	70700B					INTEGER		864/S	865	866							
INDEX2	70712B					INTEGER		907/S	908	909							
IPV	70463B					REAL		6	627/S 198/C	640/W 199	643/W 200	649/W 205/C	652/W 206	207	245/C	246	
II	70567B					INTEGER		270/C	271	272	283/C	284	285	313/C	314	247	
J	70563B					INTEGER		318	332/C	333						317/C	
								82	186/C	187	199/C	199	200/C	200	206/C	206	



--PROCEDURES--(LO=A/R) D=DEF LINE OF STMT FUNC  
-NAME----TYPE-----ARGS---CLASS-----REFERENCES- A=ACTUAL ARGUMENT

MOD	GENERIC	2	INTRINSIC	172	773	819	874	916
SINGL		7	SUBROUTINE	769	799	816	839	

D=DEF LINE OF STMT FUNC  
A=ACTUAL ARGUMENT

--STATEMENT LABELS--(LO=A/R)  
-LABEL--ADDRESS---PROPERTIES----DEF--REFERENCES-  
A=ASSIGN STMT, D=DO STMT,  
R=READ, W=WRITE, L=LABEL



PROGRAM BENCOS

74/175 OPT=1,ROUND= A/ S/ M/-D,-DS

FTN 5.1+587

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-LABEL--ADDRESS---PROPERTIES----DEF--REFERENCES-

699	3371B	FORMAT	146	142/W	146/L
700	3312B	FORMAT	131	95/W	131/L
701	3320B	FORMAT	132	107/W	132/L
702	3326B	FORMAT	133	110/W	133/L
703	3342B	FORMAT	135	116/W	135/L
704	3350B	FORMAT	136	119/W	136/L
705	3400B	FORMAT	147	144/W	147/L
706	3405B	FORMAT	149	148/W	149/L
707	3413B	FORMAT	151	150/W	151/L
708	3421B	FORMAT	153	152/W	153/L
709	3426B	FORMAT	155	154/W	155/L
710	3433B	FORMAT	161	156/W	161/L
711	3455B	FORMAT	165	158/W	165/L
712	3466B	FORMAT	167	159/W	167/L
713	3504B	FORMAT	202	197/W	202/L
714	3512B	FORMAT	209	204/W	209/L
715	3517B	FORMAT	214	211/W	214/L
716	3551B	FORMAT	231	228/W	231/L
717	3565B	FORMAT	237	234/W	237/L
718	3611B	FORMAT	249	244/W	249/L
719	3622B	FORMAT	256	254/W	256/L
720	3636B	FORMAT	262	259/W	262/L
723	3661B	FORMAT	274	269/W	274/L
725	3672B	FORMAT	287	281/W	287/L
999	3234B		952	82/R	96
1100	5000B	FORMAT	761	760/W	761/L
1200	5011B	FORMAT	781	779/W	780/W
				781/L	824/W
				934/W	825/W
				935/W	865/W
					866/W
					879/W
					880/W
					892/W
					893/W
					908/W
					909/W
1210	5013B	FORMAT	784	783/W	784/L
1270	5016B	FORMAT	787	786/W	787/L
1500	5022B	FORMAT	808	807/W	808/L
1600	5033B	FORMAT	846	845/W	846/L
1601	3750B	FORMAT	350	349/W	350/L
1610	5043B	FORMAT	850	849/W	850/L
1611	3770B	FORMAT	360	359/W	360/L
1612	4000B	FORMAT	363	362/W	363/L
1613	1214B		369	358	369/L
1620	5045B	FORMAT	853	852/W	853/L
1640	4021B	FORMAT	379	378/W	379/L
1641	4024B	FORMAT	395	394/W	395/L
1642	4035B	FORMAT	397	397/L	421/W
1643	4045B	FORMAT	403	402/W	403/L
1644	INACTIVE	DO-TERM	406	401/D	406/L
1645	INACTIVE	DO-TERM	419	415/D	419/L
1700	5050B	FORMAT	860	859/W	860/L
1710	5062B	FORMAT	869	868/W	869/L
1800	5066B	FORMAT	903	902/W	903/L
2851	4635B	FORMAT	686	685/W	686/L
3000	3677B	FORMAT	302	301/W	302/L
3050	3707B	FORMAT	305	304/W	305/L
3100	3711B	FORMAT	311	310/W	311/L
3200	INACTIVE	DO-TERM	315	313/D	315/L
3250	INACTIVE	DO-TERM	319	317/D	319/L
3500	INACTIVE	DO-TERM	334	332/D	334/L
7022	3334B	FORMAT	134	113/W	134/L
7044	3356B	FORMAT	137	122/W	137/L
7055	3364B	FORMAT	145	143/W	145/L
7100	3444B	FORMAT	163	157/W	163/L
7122	3475B	FORMAT	168	160/W	168/L
7133	INACTIVE	DO-TERM	201	198/D	201/L
7144	INACTIVE	DO-TERM	208	205/D	208/L
7155	3532B	FORMAT	220	217/W	220/L
7170	3602B	FORMAT	239	235/W	239/L
7188	INACTIVE	DO-TERM	248	245/D	248/L
7200	3652B	FORMAT	264	260/W	264/L
7233	INACTIVE	DO-TERM	273	270/D	273/L
7255	INACTIVE	DO-TERM	286	283/D	286/L

--ENTRY POINTS--(LO=A/R)

-NAME---ADDRESS--ARGS-----REFERENCES-

D=DEFINITION, R=RETURN

BENCOS 20B 0 1/D

PROGRAM BENCOS

74/175 OPT=1,ROUND= A/ S/ M/-D,-DS

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--I/O UNITS--(LO=A/R)

-NAME--- PROPERTIES-----REFERENCES-

R=READ, W=WRITE

TAPE5 FMT/SEQ	82/R	86/R	199/R	206/R	212/R	218/R	229/R	233/R	246/R	253/R	258/R	271/R	284/R
TAPE6 FMT/SEQ	95/W	98/W	101/W	104/W	107/W	110/W	113/W	116/W	119/W	122/W	141/W	142/W	143/W
	148/W	150/W	152/W	154/W	156/W	157/W	158/W	159/W	160/W	197/W	200/W	204/W	207/W
	213/W	217/W	219/W	228/W	230/W	234/W	235/W	236/W	244/W	247/W	254/W	255/W	259/W
	261/W	269/W	272/W	281/W	285/W	299/W	301/W	304/W	310/W	314/W	318/W	321/W	322/W
	324/W	327/W	329/W	333/W	339/W	341/W	344/W	349/W	351/W	359/W	362/W	371/W	378/W
	394/W	402/W	411/W	416/W	421/W	422/W	425/W	444/W	461/W	479/W	495/W	640/W	643/W
	652/W	664/W	672/W	676/W	680/W	684/W	685/W	690/W	693/W	708/W	733/W	739/W	745/W
	760/W	779/W	780/W	783/W	786/W	788/W	806/W	807/W	824/W	825/W	827/W	829/W	830/W
	845/W	849/W	852/W	858/W	859/W	865/W	866/W	868/W	879/W	880/W	882/W	884/W	885/W
	893/W	895/W	901/W	902/W	908/W	909/W	911/W	921/W	922/W	924/W	926/W	927/W	934/W
	937/W	942/W	949/W										935/W

--STATISTICS--

PROGRAM-UNIT LENGTH 70723B = 29139  
 CM BLANK COMMON LENGTH 1B = 1  
 CM STORAGE USED 64500B = 26944  
 COMPILE TIME 2.363 SECONDS

6 TRIVIAL ERRORS IN BENCOS

FWA OF THE LOAD 111  
LWA+1 OF THE LOAD 104316

TRANSFER ADDRESS -- BENCOS 131

PROGRAM ENTRY POINTS -- BENCOS 131

## PROGRAM AND BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE	PROCSR	VER	LEVEL	HARDWARE	COMMENTS
BENCOS	111	70723	LGO	08/02/85	FTN	5.1	587	C5CX I	PROGRAMOPT=1,ROUND= A/ S/ M
SINGL	71034	153	LGO	08/02/85	FTN	5.1	587	C5CX I	SUBROUTINEOPT=1,ROUND= A/ S/ M
/FCL.C./	71207	36							
/STP.END/	71245	1							
/Q5.IO./	71246	351							
Q5NTRY=	71617	36	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FCL5 - INITIALIZE FCL5 RUN TIME LIBRARY.LSD 53.
CHMOVE=	71655	171	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		CHARACTER MOVE AND CONCATENATE
/FCL=ENT/	72046	100							
COMIO=	72146	55	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		COMMON CODED I/O ROUTINES AND CONSTANTS.63-CHAR
FCL=FDL	72223	63	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FCL CAPSULE LOADING
FEIFST=	72306	3	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		CONVERTED DATA STORAGE.
FLTOUT=	72311	323	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		COMMON FLOATING OUTPUT CODE
/AP.IO./	72634	17							
FMTAP=	72653	642	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		CRACK APLIST AND FORMAT FOR KODER/KRAKER.
FORUTL=	73515	200	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FCL MISC. UTILITIES.
FVS=	73715	20	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FORM VARIABLE SUBSTRING.
GETFIT=	73735	176	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		GETFIT= - LOCATE A FIT GIVEN A UNIT DESCRIPTOR
INCOM=	74133	177	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		COMMON INPUT FORMATTING CODE
INPC=	74332	256	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FORMATTED READ FORTRAN RECORD.
KODER=	74610	677	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		OUTPUT FORMAT INTERPRETER.
OUTCOM=	75507	161	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		COMMON OUTPUT CODE
Q5RPV=	75670	14	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FCL5 - ABORT RECOVERY INITIALIZATION.
SP5=	75704	12	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		SUBSTITUTE PARAMETER ADDRESSES.
ALOG.	75716	64	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		COMPUTE COMMON AND NATURAL LOGARITHMS. OPT=ALL.
EXP.	76002	70	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		EXPONENTIAL FUNCTION. E TO POWER X. OPT=ALL.
SYS=1ST	76072	70	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		MATH LIBRARY LINK TO ERROR MESSAGE PROCESSOR.
CPL=	76162	6	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FTN5 - COPY PARAMETER LIST
FAR=	76170	25	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FCL5 - FORM ARRAY REFERENCE.
FAS=	76215	16	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FCL5 - FORM ARRAY SUBSTRING.
FCD=	76233	22	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FCL5 - FORM CHARACTER DESCRIPTOR.
FECMSK=	76255	41	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		INITIALIZE CONSTANTS.
FLTIN=	76316	156	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		COMMON FLOATING INPUT CONVERTER.
FORSYS=	76474	1553	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FORTRAN OBJECT LIBRARY UTILITIES.
KRAKER=	100247	507	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		PROCESS FORMATTED FORTRAN INPUT.
OUTC=	100756	226	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		FORMATTED WRITE FORTRAN RECORD.
EXP MSG	101204	16	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		COMMON ERROR MESSAGES FOR EXPONENTIATION.
SYSID=	101222	1	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		LINK BETWEEN SYS=AID AND INITIALIZATION CODE.
SYS=AID	101223	7	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		AUXILIARY MATH LIBRARY LINK FOR ERRORS.
XTOY	101232	33	SL-FTN5LIB	06/07/85	COMPASS	3.6	587		REAL BASE TO REAL POWER. OPT=ALL.
CMF.ÄLF	101265	163	SL-SYSLIB	11/08/84	COMPASS	3.6	587		CMM V1.1 - ALLOCATE FIXED.
CMF.CSF	101450	6	SL-SYSLIB	11/08/84	COMPASS	3.6	587		CMM V1.1 - CHANGE SPECS FIXED.
CMF.FFA	101456	14	SL-SYSLIB	11/08/84	COMPASS	3.6	587		CMM V1.1 - FIXED FREE ALGORITHM.
CMF.FRF	101472	36	SL-SYSLIB	11/08/84	COMPASS	3.6	587		CMM V1.1 - FREE FIXED.
CMF.GSS	101530	22	SL-SYSLIB	11/08/84	COMPASS	3.6	587		CMM V1.1 - GET SUMMARY STATISTICS.
CMM.MEM	101552	7	SL-SYSLIB	11/08/84	COMPASS	3.6	587		
CMM.R	101561	210	SL-SYSLIB	11/08/84	COMPASS	3.6	587		CMM V1.1 - RESIDENT SUBROUTINES.
CMF.SLF	101771	22	SL-SYSLIB	11/08/84	COMPASS	3.6	587		CMM V1.1 - SHRINK AT LWA FIXED.
CTL\$RM	102013	476	SL-SYSLIB	12/09/84	COMPASS	3.6	587		CRM CONTROLLING ROUTINE.
CTL\$WR	102511	44	SL-SYSLIB	12/09/84	COMPASS	3.6	587		CRM CONTROLLER - WEOX, REWIND
ERR\$RM	102555	25	SL-SYSLIB	12/09/84	COMPASS	3.6	587		CRM ERROR PROCESSOR ENTRY.
LIST\$RM	102602	67	SL-SYSLIB	12/09/84	COMPASS	3.6	587		CRM - ALLOCATE SPACE FOR LIST OF FILES
/FDL.COM/	102671	23							
FDL.MMI	102714	402	SL-SYSLIB	02/01/85	COMPASS	3.6	587		LSD 53.27 FDL MEMORY MANAGER INTERFACE.
MVE=	103316	64	SL-SYSLIB	06/13/85	COMPASS	3.6	587		LSD 53.43 MOVE BLOCK OF DATA.
SYS=	103402	40	SL-SYSLIB	06/13/85	COMPASS	3.6	587		PROCESS SYSTEM REQUEST. LSD 53.43
CTL\$SKP	103442	57	SL-SYSLIB	12/09/84	COMPASS	3.6	587		CRM CONTROLLER - SKIP PHYSICAL/FILE.
RM\$SYS=	103521	5	SL-SYSLIB	12/09/84	COMPASS	3.6	587		CRM - POST RA+1 REQUEST
RECOVR	103526	355	SL-SYSLIB	12/09/84	COMPASS	3.6	587		RECOVR - V2.0, USER INTERFACE TO *RPV*.
FDL.RES	104103	212	SL-SYSLIB	1					
//	104315	1							

SUBROUTINE SINGL 74/175 OPT=1,ROUND= A/ S/ M/-D,-DS FTN 5.1+587 08/02/85 .11.49.50  
 DO=-LONG/-DT,ARG=-COMMON/-FIXED,CS= USER/-FIXED,DB=-TB/-SB/-SL/ ER/-ID/-PMD/-ST,PL=50000  
 FTNS5,LO.

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1      *          9230
2      *          9240
3      *          9250
4      *          9260
5      *          9270
6      *          9280
7      *          9290
8      *          9300
9      *          9310
10     *          9320
11     *          9330
12     *          9340
13     *          9350
14     *          9360
15     *          9370
16     *          9380
17     *          9390
18     *          9400
19     *          9410
20     *          9420
21     *          9430
22     *          9440
23     *          9450

C      SUBROUTINE SINGL(ISTRING,CHAR3,CHAR4,M2,XVAL,IMPOR,LASTX)          9270
C      SUBROUTINE SINGL PRINTS PARTIAL LENGTH OF TABLE SEGMENT          9280
C      THE LENGTH OF TABLE SEGMENT DEPENDS ON THE NUMBER OF DATA          9290
C      SETS          9300
C      COMMON PLANHO          9310
10    DIMENSION CHAR4(9),XVAL(60,100)          9320
11    CHARACTER*130 CHAR3,CHAR4          9330
12    INTEGER PLANHO          9340
13
14    *          9350
15    WRITE(6,5100) CHAR3(1:ISTRING)          9360
16    WRITE(6,5100) CHAR4(M2)(1:ISTRING)          9370
17    5100 FORMAT(1HO,A)          9380
18    DO 789 N=1,PLANHO          9390
19    WRITE(6,5180)N,(XVAL(J,N),J=IMPOR,LASTX)          9400
20    5180 FORMAT(1HO,6X,I3,12F10.2)          9410
21    789 CONTINUE          9420
22    RETURN          9430
23    END          9440
                                9450

```

--VARIABLE MAP--(LO=A/R)  
 -NAME---ADDRESS --BLOCK----PROPERTIES-----TYPE-----SIZE---REFERENCES-

A=ARGLIST, C=CTRL OF DO, I=DATA INIT.  
 R=READ, S=STORE, U=I/O UNIT, W=WRITE

CHAR3	2	DUMMY-ARG	CHAR* 130		4	12	15/W	
CHAR4	3	DUMMY-ARG	CHAR* 130	9	4	11	12	16/W
IMPOR	6	DUMMY-ARG	INTEGER		4	19/C		
ISTRING	1	DUMMY-ARG	INTEGER		4	15	16	
J	142B		INTEGER		19	19		
LASTX	7	DUMMY-ARG	INTEGER		4	19/C		
M2	4	DUMMY-ARG	INTEGER		4	16		
N	140B		INTEGER		18/C	19/W	19	19
PLANHO	OB	/	INTEGER		10	13	18/C	
XVAL	5	DUMMY-ARG	REAL	6000	4	11	19/W	

--STATEMENT LABELS--(LO=A/R)  
 -LABEL--ADDRESS--PROPERTIES----DEF--REFERENCES-

A=ASSIGN STMT, D=DO STMT.  
 R=READ, W=WRITE, L=LABEL

789	INACTIVE	DO-TERM	21	18/D	21/L	
5100	63B	FORMAT	17	15/W	16/W	17/L
5180	65B	FORMAT	20	19/W	20/L	

--ENTRY POINTS--(LO=A/R)  
 -NAME---ADDRESS--ARGS-----REFERENCES-

D=DEFINITION, R=RETURN

SINGL 4B 7 4/D 22/R

--I/O UNITS--(LO=A/R)  
 -NAME--- PROPERTIES-----REFERENCES-

R=READ, W=WRITE

TAPE6 FMT/SEQ 15/W 16/W 19/W

--STATISTICS--

PROGRAM-UNIT LENGTH	153B = 107	
CM BLANK COMMON LENGTH	1B = 1	
CM STORAGE USED	60600B = 24960	
COMPILE TIME	0.072 SECONDS	