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SIMULATION

A Step Toward Better Forest Planning

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PREFACE

This paper has a two-fold objective: first, to introduce the general reader to the idea that simulation can be a useful tool in planning, especially for comparing the probable outcome of forest management alternatives; and second, to make it somewhat easier for readers interested in the technique to submit a problem to the computer.

Part I starts with a brief discussion of planning needs and continues with a review of a simple forest operating unit model that is capable of further refinement. The section ends with a test problem. Part II gives technical details about control cards, subroutines, and the flow charts and listings that will be helpful to those who wish to use or modify the program.

Potential users are encouraged to submit the input data of the test problem on their first run. A comparison of the local and published output will then indicate the degree of success achieved. Readers are also encouraged to consider how this general technique can be used to increase the effectiveness of forest management planning and the process of policy formation.

CONTENTS

SIMULATION

I GENERAL DISCUSSION

The Planning Situation

It has been said that America in the '60s is a nation on the move. Certainly people are moving very rapidly from the country to metropolitan areas. Already over 70 percent of us live in the cities and their suburbs where 97 percent of our population growth took place during the last decade. This shift, coupled with more widespread affluence and education than ever before, is causing urban people to want more and more of the amenities that make a productive life worthwhile. Increasingly city folk look to forest land as a place where open spaces offer many satisfying chances for outdoor living and recreation.

At the same time, our economy is changing rapidly through automation and a burgeoning technology. One result has been to make all basic resources ever more interchangeable in satisfying our needs. Wood utilization research has made it easier to use abundant "weed" species by breaking trees into uniform particles that can be reconstituted into useful structural members. It is now technically possible to consider wood as an abundant source of cheap raw material that can be transformed into a wide variety of useful products.

This joint study was undertaken when Dr. O'Regan was a Bullard Fellow at Harvard University, 1962-63. Ernest M. Gould, Jr. is Lecturer on Biology and Forest Economist at The Harvard Forest. William G. O'Regan is Mathematical Statistician at the Pacific Southwest Forest and Range Experiment Station, U.S. Forest Service, and Lecturer, School of Forestry, University of California, Berkeley, California.

The rise of new social values in the forest and the changing raw material needs resulting from technical innovation both emphasize the uncertainties with which foresters must cope when adjusting the slow processes of nature to the rapidly shifting demands of society. Altogether, more and better planning is needed; not only to keep man's environment reasonably well-attuned to his needs, but also to promote the continued availability of the resources needed for production.

Times like these, however, when change is rapid and relatively unpredictable, place a great strain on foresters' traditional methods of planning the long-run use and development of the resources they manage. To cope with this new situation, "A process of continuous planning is needed to balance the use of forests....predicated on the necessity of meeting relatively uncertain needs by the flexible combination of labor and capital with land, in an expanding and open economy." 1/

A logical first step toward such a new planning-process is the quick and inexpensive analysis of relevant data about forest possibilities. People who weigh the imponderables of the future in order to make planning-decisions depend heavily on timely well-organized information to show the anticipated consequences of any course of action. Although knowledge is never perfect, planners have frequently been forced to use outmoded data and simplified rules-of-thumb simply because it was too much work to use better, more detailed data, and more sophisticated analyses. The decisions thus made are based on information that is less realistic than the best available.

Fortunately, modern electronic computers, a bit of the "hardware"

1/ Forestry and Recreation, by E. M. Gould, Jr., Harvard Forest Papers , Number 6, 1962.

that has made the space age possible, can be used to organize much of the complex data needed to facilitate this phase of planning. Released from the tedious aspects of the technical analyses, planners could devote more energy to problem-identification, choice of options, and getting much-needed information on what actually happens in response to their plans. Hopefully, better information will more sharply define residual uncertainties and thereby promote better decisions that lead not only to better action, but also to a feed-back of data on performance that will up-date the information base for the next decision. Planning may then become a truly dynamic system for making the best possible continuing adjustment between man and his environment.

Simulation Model

A great many problem-solving techniques have been developed to use the capacity that an electronic computer has for the tireless recall of data from its memory, for lightning fast and accurate calculations, and for making simple yes-or-no-type decisions. Simulation is one of these methods that holds great promise for pre-testing the impact that new policies are likely to have on a woodland over many years. A model can be programmed for a computer to imitate the activities of an actual forest enterprise, and this model can then be operated so that in seconds of machine-time it can record the consequences of a policy that would otherwise take decades of real-time to discover by running an actual forest.

Simulation does not search for the optimum solution to a given situation. Optimizing systems often require a more sophisticated mathematical model than foresters are able to provide, because relevant variables and relationships cannot be specified exactly enough.

We can, however, have recourse to a simulator, which, as an added virtue, forces us to state all of our assumptions. Alternative assumptions and policies can then be compared by studying the final impact that important variables have on the path of development over time. 1/

Anyone who has ever folded a sheet of paper into a glider has actually made a model that imitates some of the action of an airplane. We are all aware that this simple model can be developed until it not only looks like a miniature of the real thing, but also may have many of the flight characteristics of a full-scale plane. This fortunate fact has been used extensively to improve the design of aircraft by studying the performance of physical models under controlled conditions in wind tunnels.

An analogous procedure can be used to develop and improve mathematical computer models of a forest enterprise until they reach the point of being helpful in real-life planning. The simulator reported in this paper is based on a model of a forest enterprise that is about as simple as a paper glider. But the techniques used to develop it can lead to more elaborate and more useful programs. For this is one outstanding characteristic of simulation; the designer is never satisfied with his work and continually tries to improve it, based on the insights gained as he goes along. Even without further change, however, this model has value for training students by giving them practice in decision-making.

In order to start as simply as possible, we set out to simulate the

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1/ Simulators are discussed in a large number of articles, including: Guetzkow, H., (Editor), Simulation in the Social Sciences, Prentice-Hall, Englewood Cliffs, New Jersey, 1962. Balderston, F. E., and Hoggatt, A. C., Simulation of Market Processes, Institute of Business and Economic Research, University of California, Berkeley, California, 1962. Simon, H. A., The New Science of Management Decision, Harper & Row Brothers, New York and Evanston, 1960.

forest enterprise carried on by an owner of a small woodlot who raises and sells nothing but sawlogs on the stump. The complicated decisions caused by multiple uses were postponed for later work. Each activity performed in this simple enterprise is programmed separately so that as better data become available the individual "working parts" of the model can be easily replaced without dismantling the whole program. In addition, new components can be added as the need arises.

In this forest simulator the landowner retains his essential function of making policy decisions about how his business will be operated. He must reduce his decisions to rules that instruct the machine what to do each year, much as he would give directives to a real-life manager. The computer mechanically follows his directions, records the results, and gives the information back to the owner. Thus the program imitates the essential features of the proposed planning-process: evaluation of options--decision--action--information feed-back. Humans make the vital evaluations and decisions, while the machine takes care of the routine action and of assembling information.

Options and Decisions

Let us look first at the opportunities for using a forest simply to produce sawlogs, and temporarily postpone any consideration of income. This stripped-down model will let the owner determine sawlog production over time by controlling the acreage harvested each year (area control). Each option can be programmed for machine action by policy decisions that specify the total number of acres that can be cut each year (allowable cut), and the age that trees on an acre must have reached to be eligible for harvest

(rotation age). Although the options that can be explored by manipulating allowable cut and rotation age are severely circumscribed, the situation is not unlike that faced by many owners of small tracts.

Action

A decision about the age and acreage of forest to cut each year is reduced to a program of instruction for the computer. The machine then in effect performs the forester's task of inspecting the growing stock. Starting with the oldest acre, age is checked to see if the trees are eligible to cut, if the answer is, "Yes", then they are harvested; if more acres are still needed the next oldest acre is checked and harvested, and so on, until the allowable cut is satisfied or there are no more eligible acres to cut. Cut-over acres are automatically inserted into the growing stock as "0" years of age. One year is added to the age of each acre, and the whole process is repeated to represent another year's operation. A series of up to 150 of these annual operations can be called for to simulate the passage of time.

Forest Generator

Before any action can be taken to test a policy, forest growing stock must be programmed into the machine so that each acre will grow timber. One of the least complicated concepts of how a forest grows is that of a normal yield table which shows the volume of sawlogs per acre at any given age. Then it is only necessary to know the area in each age-class and to multiply by the volume per acre to determine the volume on the property or the amount cut in any year. What we have called the "forest generator" in this model consists of a system that keeps track of the age of 1000 units of land,

reads a normal yield table, makes the necessary multiplications and accumulates the volumes cut and left standing at each year end. The regeneration and aging system mentioned above complete the forest generator.

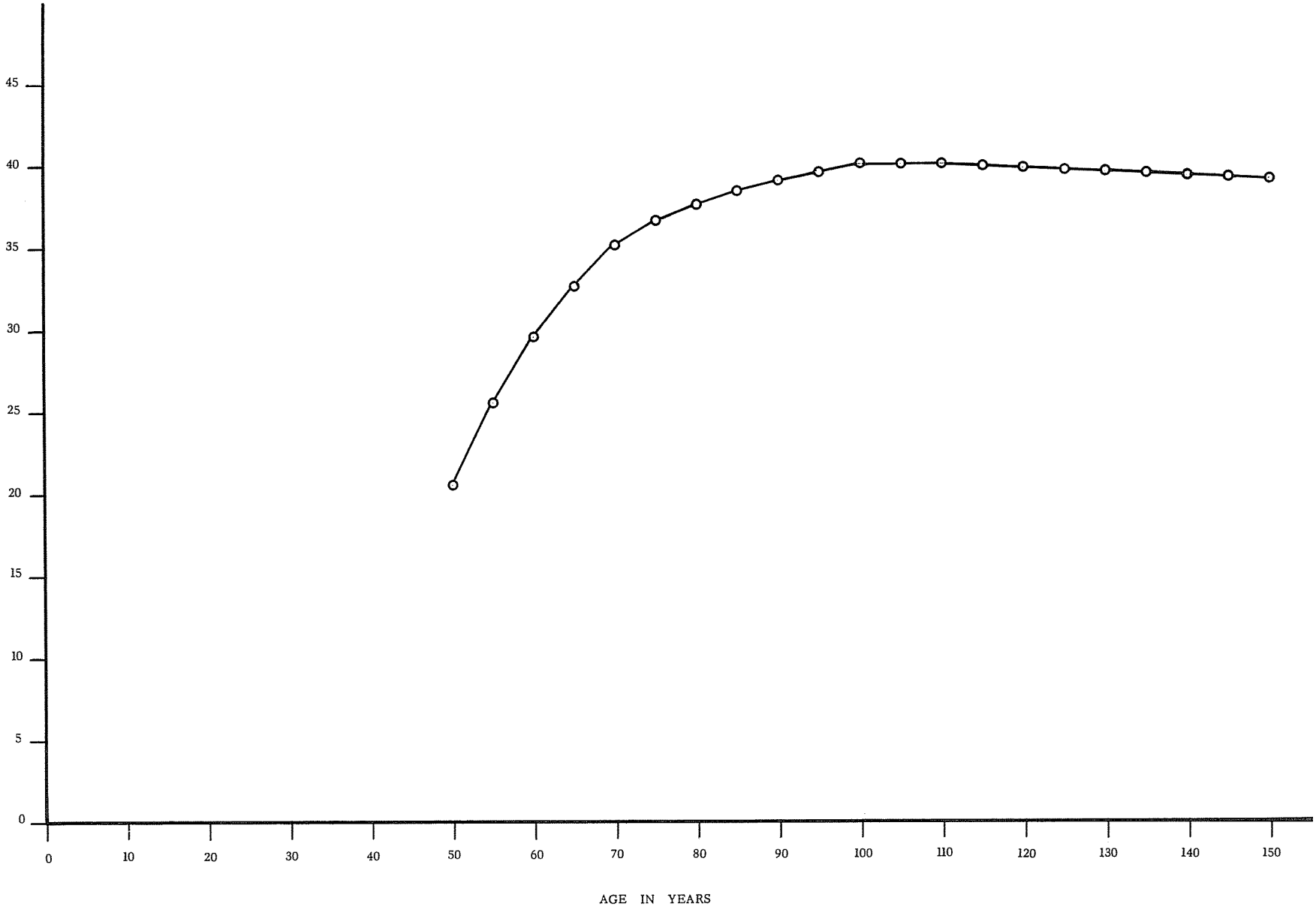
At this stage of development the simulator will accept only one normal yield table. Consequently, it is assumed that all acres support the same uniform forest. In addition, the acreage cut-over is always reproduced in a fully-stocked state without delay. Any or all of these assumptions could be relaxed by appropriate revision of the forest generator part of the program

Figure 1 shows the yield table used to illustrate the program. Information like this can be read into the computer either as a formula or as points on the curve.

This curve has been arbitrarily drawn to have the following characteristics: The volume reached at each age roughly reflects common experience with old-field-white-pine in the Petersham area. The curve reaches a peak at age 100 and gradually declines thereafter. Mean annual increment is greatest at age 70. Any appropriate curve could be used; This one has been useful to illustrate some forest management problems for trainees.

FIGURE 1

YIELD TABLE SHOWING SAWLOG VOLUME PER ACRE 1/



1/ The actual value of each circled point on this curve is listed in the Test Problem.

Information

Because policy makers may need various kinds and amounts of data on performance, the computer can be instructed to print-out parts or all of the information it accumulates. The most detailed data about the distribution of the acreage by age-classes, (Figure 2), are available for each year or for pre-selected years. This information can also be printed in a condensed form along with data on annual operations and the growing stock volume (see Annual Summaries in the Test Problem). Data on operations can also be plotted mechanically. In order to facilitate comparing the results of several policies over time, any of the operating information can also be brought together for each of the several policies tested, as shown in Figure 3 and at the end of the Test Problem .

With the above functions programmed, the model is now complete and ready to trace out the sawlog production consequences of a policy. The following schematic diagram (Figure 4) summarizes the component parts of the model that has been discussed.

Maximum Production and Even-Flow Relationships

Even this simple model may be sufficient to explore a few limited problems of forest production. As usually expounded, sustained yield aims at obtaining maximum long-run productivity by selecting the proper rotation length. In addition, it is customary to include as part of this policy the restraint that periodic harvests shall be as nearly equal in size as possible. When area control and annual cutting are used, this means that the number of acres harvested each year will equal the property acreage divided by the rotation length. 1/

1/ The allowable acreage cut to produce Figure 3 was rounded upward to the nearest whole acre. This leads to a slight irregularity in cutting during some years.

FIGURE 2

Growing Stock

Distribution of Acres by Age[1/]

AGE(DECADE)	A G E (Y E A R) 0	1	2	3	4	5	6	7	8	9	TOTAL
	A C R E S										
0	10	10	10	10	10	10	10	10	10	10	100
1	10	10	10	10	10	10	10	10	10	10	100
2	10	10	10	10	10	10	10	10	10	10	100
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	10	10	10	10	10	100
7	10	10	10	10	10	10	10	10	10	10	100
8	10	10	10	10	10	10	10	10	10	10	100
9	10	10	10	10	10	10	10	10	10	10	100
10	0	0	0	0	0	0	0	0	0	0	0

1/ This perfectly balanced forest is the initial starting condition used in all of the policy tests that follow. See similar table in Test Problem.

FIGURE 3

Comparison of Policies 1/

Total Volume Produced ---------- Thousands of Board Feet

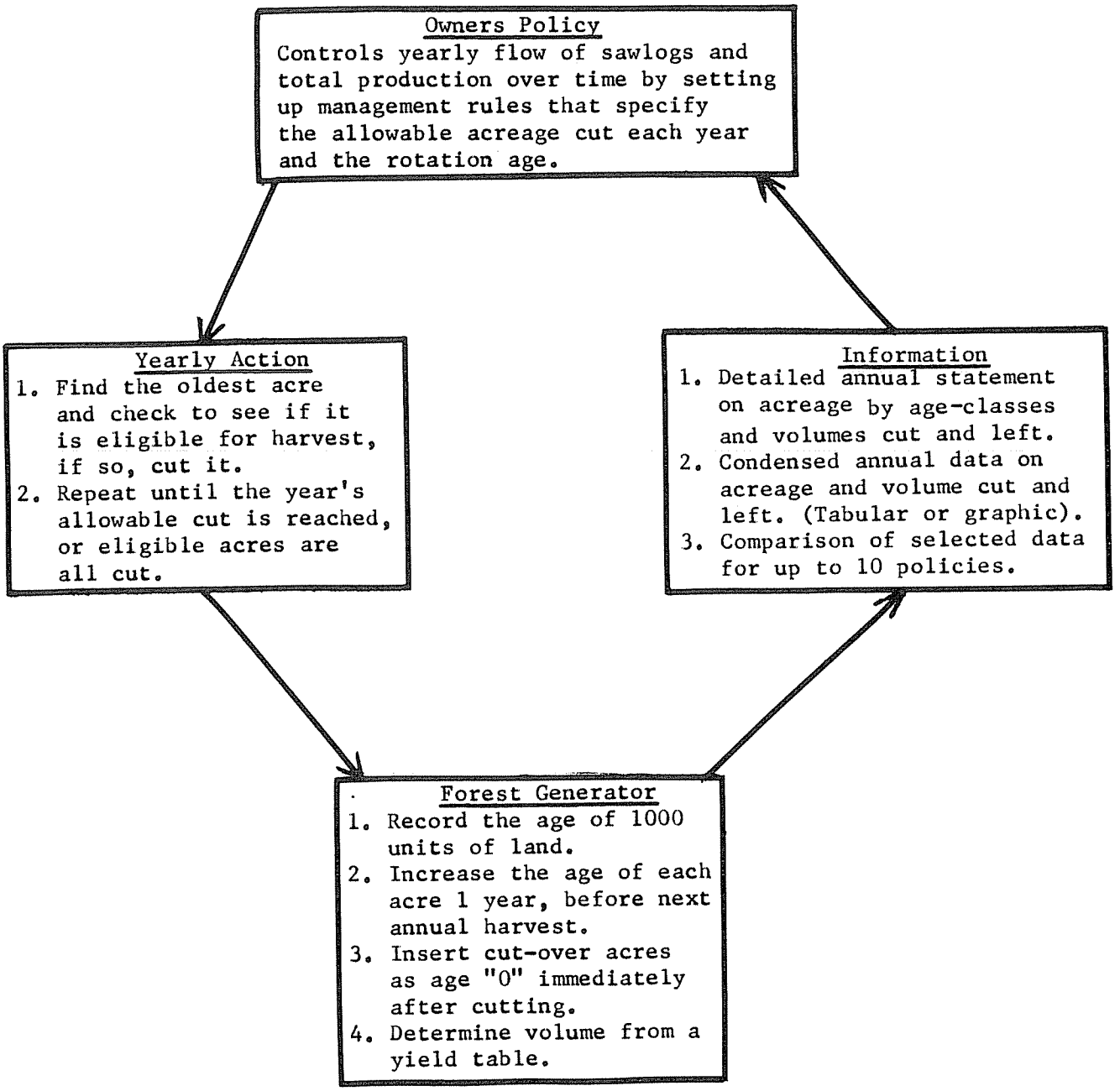
Year	Even Annual Harvests With Rotations of: 50 years	60 Years	70 Years	80 Years	90 Years	100 Years	Uneven Harvests With 70 Year Rotation
1	17500	17500	17499	17500	17500	17500	17500
2	17899	17899	17899	17900	17899	17900	17852
3	18297	18298	18298	18299	18300	18300	18204
4	18694	18695	18697	18698	18699	18700	18556
5	19090	19093	19094	19097	19098	19100	18908
6	19485	19489	19492	19496	19497	19500	19260
7	19879	19885	19889	19893	19896	19900	19612
8	20272	20281	20286	20291	20294	20300	19964
9	20664	20675	20681	20689	20693	20700	20316
10	21055	21068	21077	21086	21091	21100	20668
20	24895	24965	25005	25043	25062	25100	24188
30	28549	28766	28878	28969	29013	29100	27708
40	31825	32430	32677	32865	32944	33100	31228
50	34395	35880	36382	36725	36855	37100	34748
60	38495	40692	41214	41285	41251	41100	46878
70	42595	45707	46343	46014	45795	45100	52192
80	46695	50722	51623	50853	50421	49100	55868
90	50795	55737	56903	55728	55086	53100	59388
100	54895	60752	62183	60603	59766	57100	62908
110	58995	65338	67463	65478	63950	61100	66428
120	63095	70192	71503	70136	67986	65100	69948
130	67195	75207	76414	74182	71940	69100	82078
140	71295	80222	81543	78782	75855	73100	87392
150	75395	85237	86823	83514	80251	77100	91068

1/ This table compares the information in col. 6 for each of 7 policies. During any one run six such tables can be made to compare pre-selected Columns of information about the policies tested. Cumulated Cut (Col.4) + Risidual Growing Stock (Col.5)=Total Volume (Col.6). The column numbers referred to are those that appear in the Annual Summary tables of the Test Problem.

FIGURE 4

Schematic Diagram of Simulator Functions

Sawlog Production Only



If we start with a perfectly even distribution of acreage, such as that shown in Figure 2, and growth like that of the yield table shown in Figure 1, it is easy to test the effect of any rotation length. Figure 3 compares sawlog production over 150 years (cumulated cut plus residual growing stock volume) resulting from policies of even annual harvest and rotation lengths of 50, 60, 70, 80, 90, or 100 years.

It is obvious that a rotation length of 70 years produces more timber after seven decades than any other, and this is exactly the result expected. Accepted theory states that production over time will be greatest if the rotation length is set at the age at which mean annual increment culminates, in this case 70 years.

However, there is another way of putting every acre of the forest on a 70-year rotation, if we relax the restriction of even annual harvests. It would then be possible in the first year to cut all 300 acres that are over 70 years old, and thereafter cut the 10 acres that will reach age 70 each year. This will create a 300-acre "bulge" in our age-class distribution that will gradually get older until it is available for cutting again in the 71st year, the 141st year, and so on. The total volume produced by this policy appears in the last column on the right of Figure 3. To facilitate comparing this result with that of the 70-year rotation with even annual harvests the data have been graphed in Figure 5.

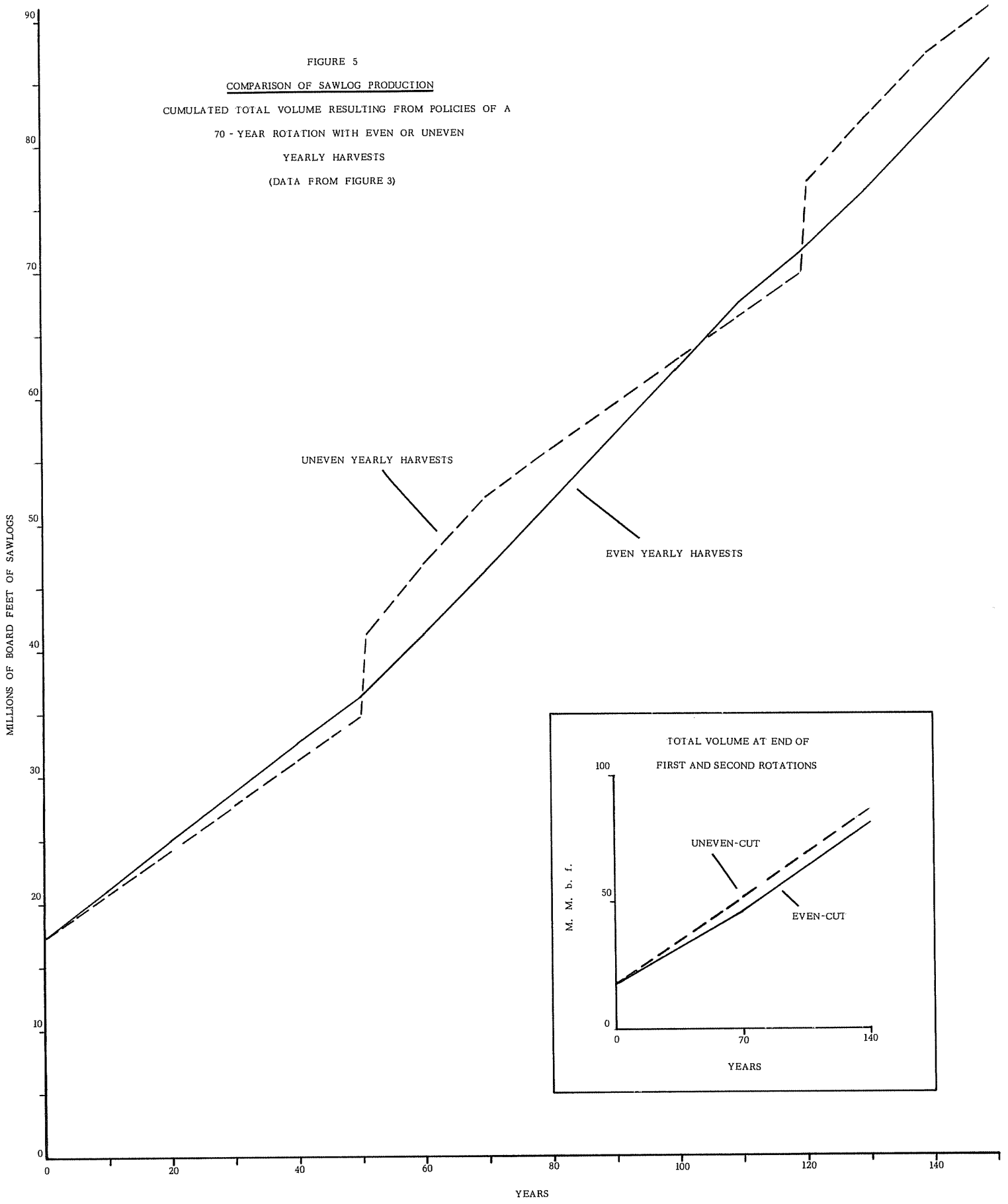
It is apparent, that judging which of the two policies is most productive will depend on the year when they are compared. The uneven-harvest policy has a somewhat lower total volume produced up to age 51, when the 300 acres initially cut are old enough to again support merchantable sawlog volume, according to our volume/age curve. At the end of the first rotation, the uneven-cut policy has produced 5.8 M.M.b.f. more than

FIGURE 5

COMPARISON OF SAWLOG PRODUCTION

CUMULATED TOTAL VOLUME RESULTING FROM POLICIES OF A 70 - YEAR ROTATION WITH EVEN OR UNEVEN YEARLY HARVESTS

(DATA FROM FIGURE 3)



the even-cut policy. Although the size of this gain is partly a function of the age when merchantable volume is first counted, there is some permanent advantage to getting all acres onto the most productive 70-year rotation without the delay needed to get an even distribution of acreage in each age-class. The difference in yield is one measure of the cost of creating a "normal forest", if we start with a significant acreage of over-aged timber. After the first rotation, of course, all acres are on a 70-year rotation and either plan is equally productive. This is illustrated in the small insert on Figure 5 by the fact that the lines diverge during the first rotation and are parallel thereafter.

The chief value of this exercise is to point up the fact that in this model maximum productivity is related to rotation length and not to the evenness of yearly harvests. This independence probably exists in real forests, but discussions of sustained yield have often obscured the fact that some production is sacrificed to stabilize the size of annual cutting. When this happens the opportunity cost of regulation is obscured, along with the need to rationalize proposed levels of productivity per acre and the size of allowable cuts on separate grounds.

Economic Factors

Up to this point our model has dealt only with the physical process of forest production. It gives data about the volume of sawlogs resulting from the landowner's policy decisions, but tells him nothing about the monetary values involved. More component parts are needed to enable the model to translate the physical consequences of a management policy into information about economic returns, so that the owner can broaden his objectives to include not only the physical, but also the financial consequences of his acts. Both prices and unit costs are needed to bring

the model one more step toward reality.

Income

Many woodlot owners incur little, if any, cost in managing their land, but they do realize a stumpage income when they sell standing timber, so we will introduce prices first. If the stumpage market was always the same, so that prices per M.b.f. never varied, then the policy that gave the greatest yield of sawlogs would automatically produce the greatest income. Under these circumstances owners could base their decisions entirely on the kind of physical data developed so far.

Although a great deal of planning is based on the simple assumption that present prices will continue substantially unchanged, experience suggests that this is unlikely to happen. Records show that regional average prices fluctuate considerably, and prices paid an individual owner are likely to vary even more. During its half century of operation, the Harvard Forest has experienced stumpage increases or decreases of more than 10 percent in 46 out of the 50 years, six of these times prices doubled or better in successive years, and four times they fell by one half or more.

Some foresters assume that maintaining an even annual cut in the face of such changing prices will have too little impact on long-run dollar returns to justify their adjusting policy to meet the situation. In practice, however, most small woodlot owners do respond to high prices by selling more stumpage, and to low prices by selling less. The income effect of following a cutting policy that responds to price variation as well as to biological growth can be illustrated by adding a schedule of yearly prices to our model along with a program to keep track of stumpage income and the value of the residual standing timber. For simplicity we

have assumed that sawlog volume, once it is merchantable, has the same unit value regardless of its age. The value of the residual sawtimber is estimated each year as volume times stumpage price minus the harvesting costs discussed later.

For the purpose of illustration we have used a schedule of prices based on the pattern of average white pine stumpage in New England from 1908 to 1957 (solid line in Figure 6).[1/] Although the variation in these prices is much less than that experienced at the Harvard Forest, average prices did follow the same cyclical pattern. This 50-year set has been expanded to 250 years by repeating the data to form the symmetrical waves of successive highs and lows a cycle of which is shown in Figure 6.

The first policy tested is that of strict sustained yield, with a 70-year rotation, and an even annual harvest at all times. The contrasting price-responsive policy keeps the 70-year rotation, but varies the cut so that when prices are $8.00 or less, nothing is harvested, above $8.00 but $10.00 or less, the regular allowable cut of 15 acres is sold, and over $10.00, seventy-five acres may be cut if that much is available. Thus, a reservation price is set below which the owner thinks it isn't worthwhile to sell, and a high cut is allowed to take advantage of prices judged to be very much above normal. Figure 7 compares the volume and financial results produced by each of these policies.

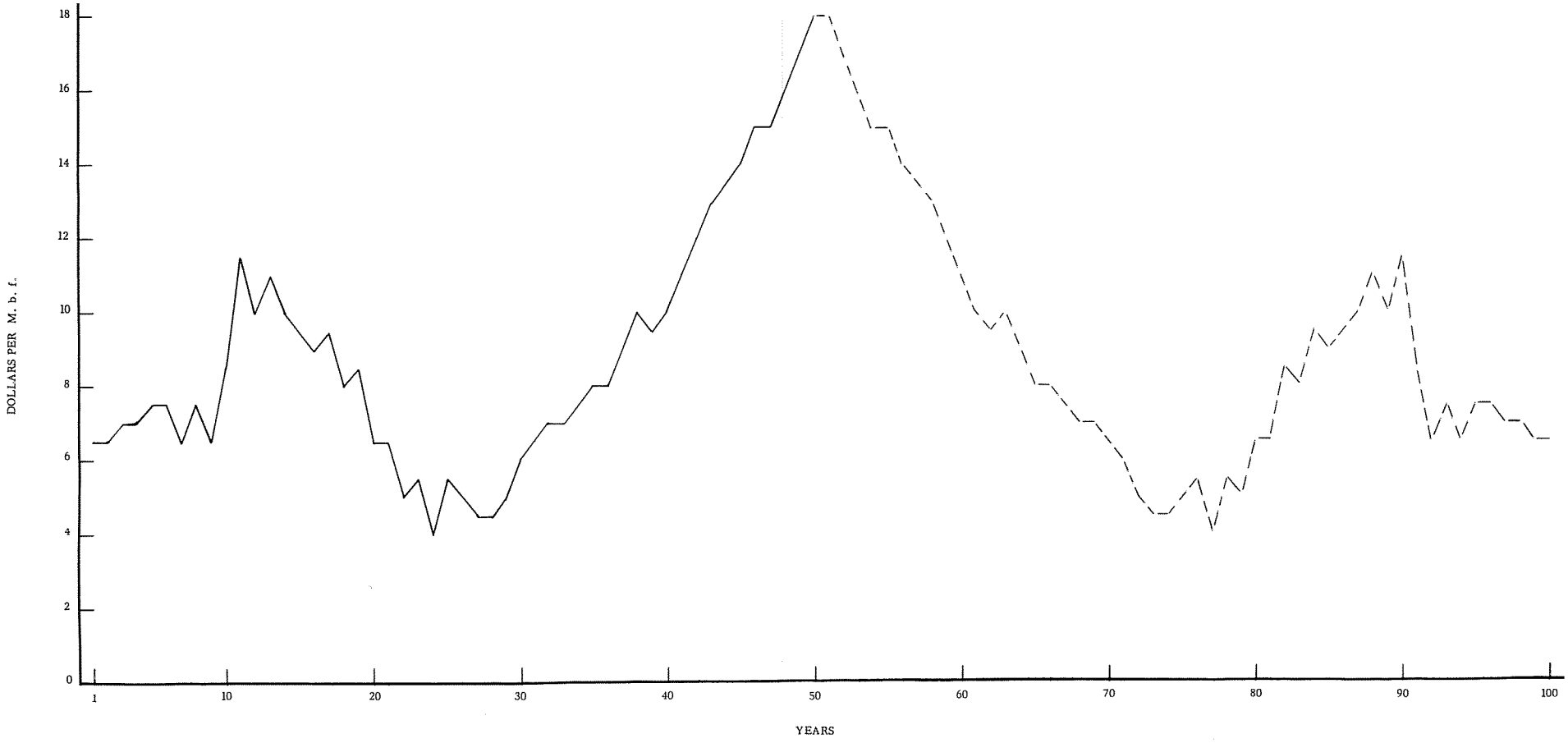
In order to clarify the differences that exist between these two forest policies, Figure 8 shows the above data changed to production indices.

1/ Prices taken from Steer, H.B.,1938, Stumpage Prices of Privately Owned Timber in the United States, U.S. Dept. Agr., Tech. Bull. No. 626, and yearly supplements through 1945. New Hampshire Cooperative Extension Service, Forest Market Reports, 1946 through 1957.

FIGURE 6

100 YEAR CYCLE OF

YEARLY STUMPAGE PRICE SCHEDULE.[1/]



[1/] Prices for the test reported in Figure 7 begin at year "1" on this curve
Prices for the Test Problem begin at year 32.

FIGURE 7

Comparison of Dollar Value and Sawlog Volume Resulting from a 70-year Rotation age policy with even annual harvests or with harvest varying with price.

Year	Net Worth 1/		Total Sawlog Production 2/	
	Even Annual Harvests	Price-responsive Harvests	Even Annual Harvests	Price-responsive Harvests
	Dollars		Thousand Board Feet	
1	98150	98150	17499	17500
2	107807	108074	17899	17900
3	110025	110298	18298	18300
4	119676	120750	18697	18700
5	122063	123150	19094	19100
6	109925	108390	19492	19500
7	126303	127950	19889	19900
8	114508	112486	20286	20300
9	144528	150966	20681	20700
10	188716	207838	21077	21100
20	154483	171910	25005	25044
30	167346	192289	28878	29026
40	234623	300549	32677	33026
50	334419	406973	36382	36711
60	339133	401389	41214	39611
70	345009	413620	46343	45182
80	370404	425697	51623	46935
90	427294	486789	56903	50588
100	441781	543725	62183	62786
110	512179	678322	67463	68819
120	506189	623357	71503	71833
130	525513	628392	76414	73085
140	593008	760710	81543	79750
150	713531	858000	86823	81886

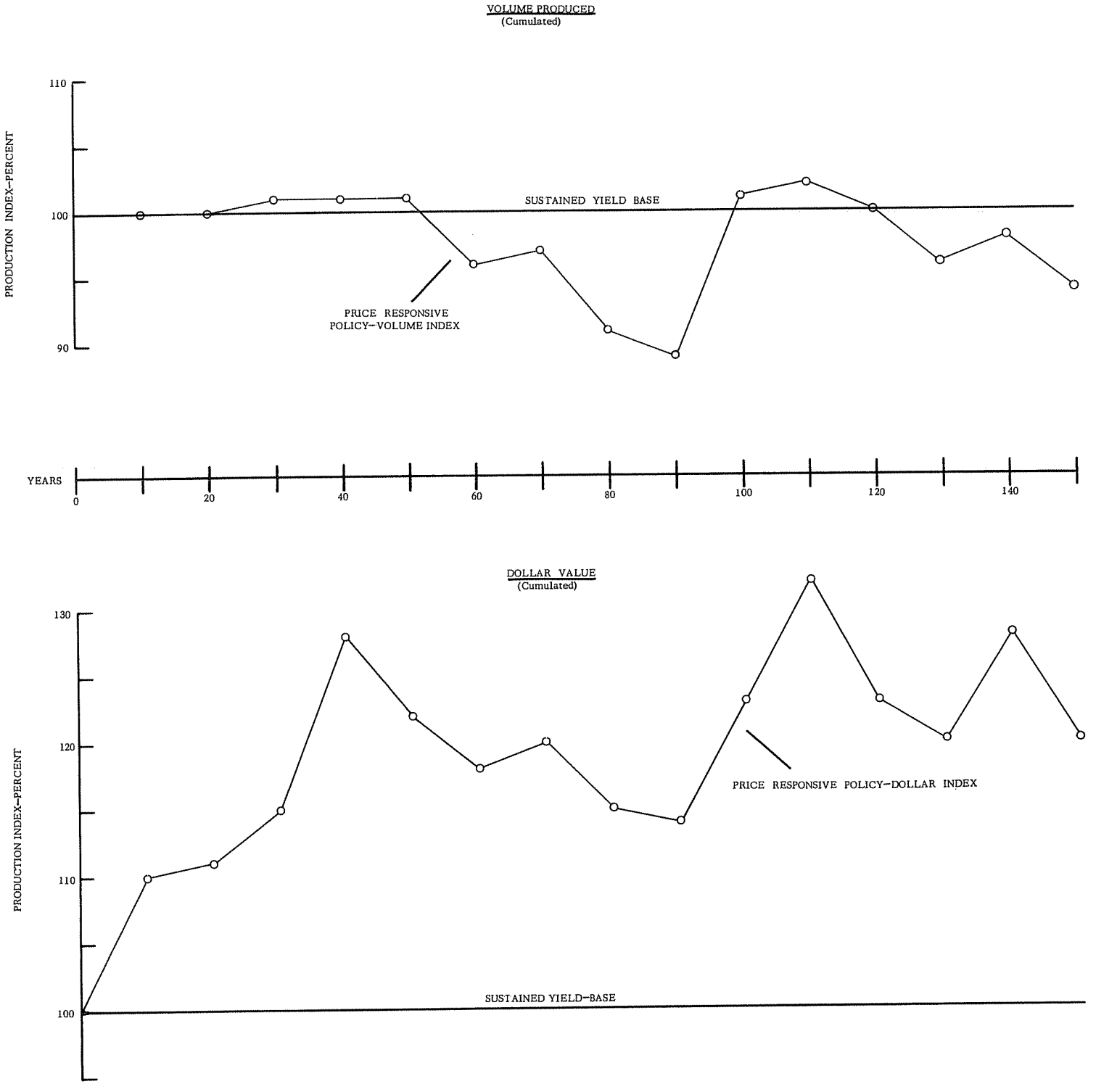
1/ Cumulated Stumpage Income, plus Value of Residual Standing Timber.
2/ Cumulated Volume Cut, plus Volume of Residual Standing Timber.

FIGURE 8

PRODUCTION INDICES FOR TWO 70-YEAR ROTATION POLICIES

SUSTAINED YIELD=100%

(DATA FROM FIGURE 7)



The volume and value produced by a program of even annual harvests is used as a base, and the cumulative result at the end of each decade of the price-responsive program is shown as a percent of this base. Thus the upper half of the graph shows that at age 60 the price-responsive program has produced 4% less total volume than sustained yield, but an 18% greater dollar net worth.

Again it is obvious that any judgment about the relative merits of either program will depend on the year they are compared. However, it is apparent that the price-responsive policy produces total volumes that are within $\pm$ 11% of the volume achieved by sustained yield so that in the long-run either policy will produce nearly the same amount of sawlogs. When this production is translated into dollar income, however, the differences are considerably greater. The net worth resulting from this price-responsive policy is persistently greater than that of sustained yield, and the gain seems to be fluctuating from 15% to 30% above that of sustained yield. Obviously the management choice of strict sustained yield or the price-responsive policy will affect future income flows in an important way without having any appreciable impact on total volume produced over time.

Of course, many variations of these policies would have to be tried out before any final conclusion was drawn. But this simple test suggests that this is an interesting and significant area of exploration where forest managers may have more flexibility for varying their programs than is frequently thought. The proper manipulation of harvesting with price can produce significantly greater values than a policy geared only to rates of growth.

It is also interesting to note that the sustained yield program of even annual harvests does not respond very well to the needs of society, as they are expressed through the market system. When high prices signal

that more sawlogs are needed, nothing extra is produced -- when low prices indicate that less is needed, even-cutting contributes to the current glut.

Expenses

Costs of various kinds can be introduced into the model as another step toward simulating a forest enterprise. In order to do this we have added a subroutine that records the costs incurred each year, deducts the sum from current stumpage income or, if this is not enough, will take any amount needed from accumulated past reserves. This information can be printed to show detailed annual and cumulated expenses, the annual net cash position, and net worth for the operating unit as a whole.

Two kinds of taxes can be specified -- a given amount per acre of land, like an ad valorum tax, plus a severance tax per dollar of stumpage income. General expenses can also be of two kinds, the first a given amount per acre and the second a set sum per unit of volume harvested, which could be used to account for costs of marking, etc. Thus taxes and general expenses are made up of two components, the first part is fixed in total each year and the second will vary in amount with the current year's harvest activity.

This expense subroutine was used in testing the two policies just presented. The income data in Figure 7 therefore, represented net returns after deducting the following:

1) Land tax at 15¢ per acre.
2) Severance tax at 12¢ per dollar of stumpage income.
3) Maintenance costs of 5¢ per acre
4) Harvesting costs of 10¢ per M.b.f.

Loans

The price-responsive policy also illustrates the need for another elaboration of the model. Because prices did not exceed $8.00 M.b.f. until the ninth year of the test period, no sawlogs were harvested. Despite the

lack of income, however, land taxes and maintenance costs continued to mount at the rate of $200 a year and no funds had been accumulated to meet this need. A source of outside capital may be required from time to time to tide the operating unit over such periods of insufficient income.

A third component part, therefore, has been added to the model that allows the owner to borrow money when needed, and also automatically to deduct the interest charges and amortize the note. This subroutine will extend a line-of-credit to the operator whenever annual costs exceed income, and there is no accumulated reserve income from which to pay current expenses. Thus, the owner can borrow up to 75 percent of the stumpage value of his standing timber to meet expenses. In subsequent years annual income will be used first to pay current costs, second to pay the specified interest on the outstanding amount of the loan, and the remainder will be used to amortize the note, before any more income is accumulated in reserve. If the mortgage should at any time exceed 75 percent of the current value of the standing sawtimber, the enterprise will automatically go bankrupt.

Although the loan option was exercised in generating the income of the price-responsive policy reported above, a zero rate of interest was charged for the money. Of course, any appropriate rate could have been used.

Bank Account

The accumulation of past net income as a reserve suggests the desirability of treating this as a savings bank account that will earn a specified interest each year. This feature has been introduced into the model and used to symbolize the opportunity that the owner has to seek alternative uses for the capital represented by his standing sawtimber.

A savings account is an opportunity reasonably available to practically all forest owners.

The power of a seemingly small interest rate such as 4 percent is illustrated by re-running the previous 70-year rotation policies with even or with price-responsive harvests. Costs are those listed above, all net income is deposited in the bank to earn 4 percent. Over a 150-year period the importance of getting a large deposit into the bank early in the game is painfully apparent.

Results at the End of 150 years

70-year Rotation, Even-Cut			70-year Rotation, Price-Responsive Cut		
Stupg. Income	Interest	Net worth	Stupg. Income	Interest	Net worth
$700,916	$34,708,634	$35,422,161	$874,308	$37,951,862	$38,809,860

It is likely that this part of the model gives undue emphasis, in long-run analyses, to the role of interest. Another form of opportunity cost could be built into the model, or some portion of income could deducted for the owner to spend on living expenses. This part of the model will probably be considerably modified as more work progresses and more insight is gained on reasonable options. Meanwhile the bank account mechanism serves as a useful symbol of alternative capital management opportunities.

Natural Hazards and Catastrophes

Finally, subroutines have been added to the model to take account of the physical losses that are a major source of the risk or uncertainty that any owner should consider when setting forest policy. Provision is made to destroy any specified portion of the growing stock by fire or storm. The year of loss must be read into the computer before any test run, together with a description of the land affected, and the stumpage value of any timber salvaged.

In practice, we have used fires to simulate relatively small local losses. All merchantable timber is automatically salvaged and values are set at a specified percent of the year's normal stumpage. If the burn doesn't result in salvaging timber from enough area to satisfy the planned harvest, then enough additional acres of undamaged timber will be cut and sold at regular prices to make up the difference.

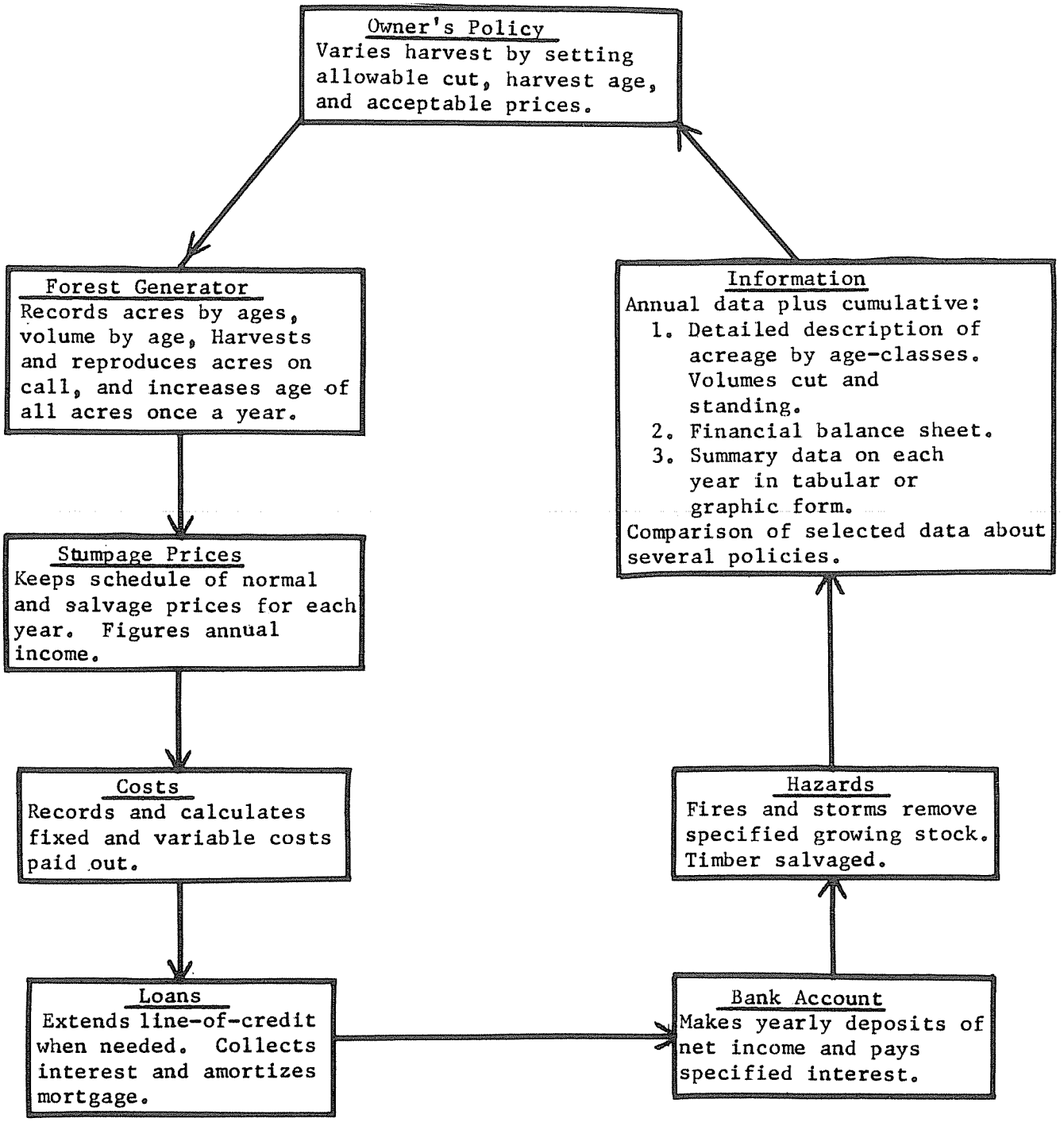
Storms, on the other hand, have been set up to reflect major, widespread catastrophes such as hurricanes, that are severe enough to upset normal markets and radically lower prices. Total destruction is programmed for all trees over a specified age. Regardless of the acreage involved, all the blown-down merchantable timber is salvaged. However, a special price schedule must be read into the computer to return market prices gradually to normal over a five year period.

To review briefly, the model we have developed to simulate a small forest enterprise now performs eight major functions. The first consists of a policy devised by the owner and reduced to a set of operating instructions. The next six component parts keep track of the sawlog volume, costs, and income produced on the property over time, in response to the owner's policy. The final function is to print information of various kinds showing how the enterprise progressed during the period analysed. Then the owner can see how his policy worked out and can make adjustments likely to improve the outcome, on the next trial. The following schematic diagram shows how these major parts fit together to assist the owner explore the consequences of adopting alternative plans.

FIGURE 9

Schematic Diagram of the Functions

Provided for in the Completed Simulator



Test Problem

The following test problem utilizes all the component parts of the model to explore the consequences of forty years of management by two alternative policies. Both set a 70-year rotation limit on harvests; the first aims for sustained yield, and the second is responsive to prices as already discussed. Both start with the normal forest shown in Figure 2, growth is specified by the curve of Figure 1, and cost factors, bank and loan rates are those used earlier. The price series begins at year 32 on Figure 6. There is a fire in year 10 and a severe storm in year 30.

The test problem starts with the control cards, followed by the input data that is normally printed, and ends with various forms of output information. The whole program is exercised except the plotting subroutine. Punched output of the growing stock after fires and storms has also been omitted. With these two exceptions, the following facsimiles of computer pages show the form in which information can be gotten from the machine. Black lines separate normal computer pages, some of those that follow have been truncated to save space.

PARAMETER CARDS FOR THE TEST PROBLEM

CATEGORY A CARDS (READ BY THE MAIN ROUTINE)

CARD TYPE 1
TEST PROBLEM

CARD TYPE 2
1

CATEGORY B CARDS (READ BY SUBROUTINE INPUT2)

CARD TYPE 3
INITIAL NORMAL FOREST

CARD TYPE 4
2 6 1 1

CARD TYPE 5
4 5 6 41 42 45

CARD TYPE 6
10 50. 30 .50

CARD TYPE 7
30 65. 3.00 3.00 5.00 6.00 6.50

CARD TYPE 8B
50 150 21 5 0 0 81

CARD TYPE 9
50. 6. 4. .15 .12 .05 .10 0.0 0.00

CARD TYPE 10
40 -1 1 1

CARD TYPE 11
1800 1700 1600 1500 1500 1400 1350 1300 1200 1100 1000 950 1000 900 800 800
750 700 700 650 600 500 450 450 500 550 400 550 500 650 650 850
800 950 900 950 1000 1100 1000 1150 850 650 750 650 750 750 700 700
650 650 650 650 700 700 750 750 650 750 650 850 1150 1000 1100 1000
950 900 950 800 850 650 650 500 550 400 550 500 450 450 500 600
650 700 700 750 800 800 900 1000 950 1000 1100 1200 1300 1350 1400 1500
1500 1600 1700 1800 1800 1700 1600 1500 1500 1400 1350 1300 1200 1100 1000 950
1000 900 800 800 750 700 700 650 600 500 450 450 500 550 400 550
500 650 650 850 800 950 900 950 1000 1100 1000 1150 850 650 750 650
750 750 700 700 650 650 650 650 700 700 750 750 650 750 650 850
1150 1000 1100 1000 950 900 950 800 850 650 650 500 550 400 550 500
450 450 500 600 650 700 700 750 800 800 900 1000 950 1000 1100 1200
1300 1350 1400 1500 1500 1600 1700 1800 1800 1700 1600 1500 1500 1400 1350 1300
1200 1100 1000 950 1000 900 800 800 750 700 700 650 600 500 450 450
500 550 400 550 500 650 650 850 800 950 900 950 1000 1100 1000 1150
850 650 750 650 750 750 700 700 650 650

CARD TYPE 12
2050 2550 2950 3260 3520 3650 3750 3840 3900 3950 4000 4000 4000 3987 3975 3967
3950 3937 3925 3912 3900

CATEGORY C CARDS (READ BY SUBROUTINE INPUT1)

CARD TYPE 14
70YR ROTATION SUST YIELD

CARD TYPE 15
99.00

CARD TYPE 16
15

CARD TYPE 17
70.

CARD TYPE 14
70YR ROTATION PRICE RESP

CARD TYPE 15
8. 10. 99.

CARD TYPE 16
0 15 75

CARD TYPE 17
149. 70. 70.

THERE ARE NO CARDS IN CATEGORIES D OR E FOR THIS TEST PROBLEM

BATCH TEST PROBLEM

IDENTIFICATION OF BATCH AND CONDITIONS OF THE TEST

THIS BATCH CONSISTS OF 1 TESTS

BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST

THIS TEST CONSISTS OF 2 GAMES

6 COLUMNS WILL BE COMPARED

4 5 6 41 42 45

1 FIRES IN YEARS	10	
AGE CLASS DESTROYED		50.
MAXIMUM ACREAGE DESTROYED		30
PROPORTIONATE REDUCTION IN PRICE		0.50

1 STORMS IN YEARS	30
DESTROYING AGE CLASSES	65.
POST STORM PRICES	3.00
	3.00
	5.00
	6.00
	6.50

BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST

COEFFICIENTS OF VOLUME EQUATION

CONSTANT	-0.
LINEAR	-0.
QUADRATIC	-0.
CUBIC	-0.
CODE	-0.

COSTS AND TAXES

ACREAGE TAX	0.1500
HARVESTING TAX, PER DOLLAR	0.1200
MAINTENANCE COST, PER ACRE	0.0500
HARVESTING COST PER MBF	0.1000

OTHER DATA

LOAN RATE	6.0000
SAVINGS RATE	4.0000
MERCHANTABLE AGE	50.
NUMBER OF PLAYS	40

PRICES

DECADE	YEAR 0	1	2	3	4	5	6	7	8	9
0	7.00	7.00	7.00	7.50	8.00	8.00	9.00	10.00	9.50	10.00
1	11.00	12.00	13.00	13.50	14.00	15.00	15.00	16.00	17.00	18.00
2	18.00	17.00	16.00	15.00	15.00	14.00	13.50	13.00	12.00	11.00
3	10.00	9.50	10.00	9.00	8.00	8.00	7.50	7.00	7.00	6.50
4	6.00	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.									

VOLUME INPUTS	20.50	25.50	29.50	32.60	35.20	36.50	37.50	38.40	39.00	39.50	40.00	40.00	40.00	39.87	39.75	39.67	39.50	39.37
	39.25	39.12	39.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.					

VOLUME TABLE
BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST

VOLUME PER ACRE MBF

DECADE	YEAR 0	1	2	3	4	5	6	7	8	9
0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	20.500	21.500	22.500	23.500	24.500	25.500	26.300	27.100	27.900	28.700
6	29.500	30.120	30.740	31.360	31.980	32.600	33.120	33.640	34.160	34.680
7	35.200	35.460	35.720	35.980	36.240	36.500	36.700	36.900	37.100	37.300
8	37.500	37.680	37.860	38.040	38.220	38.400	38.520	38.640	38.760	38.880
9	39.000	39.100	39.200	39.300	39.400	39.500	39.600	39.700	39.800	39.900
10	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000
11	40.000	39.974	39.948	39.922	39.896	39.870	39.846	39.822	39.798	39.774
12	39.750	39.734	39.718	39.702	39.686	39.670	39.636	39.602	39.568	39.534
13	39.500	39.474	39.448	39.422	39.396	39.370	39.346	39.322	39.298	39.274
14	39.250	39.224	39.198	39.172	39.146	39.120	39.096	39.072	39.048	39.024
15	39.000									

PRICES, DATA, POLICY
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST

FIRST POLICY

CRITICAL PRICES	99.00	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
ALLOWABLE CUT	15	-0	-0	-0	-0	-0	-0	-0	-0	-0
MINIMUM CUTTING AGE	70.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.

INITIAL GROWING STOCK
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	10	10	10	10	10	10	10	10	10	10	100
1	10	10	10	10	10	10	10	10	10	10	100
2	10	10	10	10	10	10	10	10	10	10	100
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	10	10	10	10	10	100
7	10	10	10	10	10	10	10	10	10	10	100
8	10	10	10	10	10	10	10	10	10	10	100
9	10	10	10	10	10	10	10	10	10	10	100
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON STOCKED UNITS 0

NUMBER OF OVER-AGE UNITS 0

VOLUME OF GROWING STOCK 17100.

GROWING STOCK TABLE
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST
THIS PLAY 1
PRICE 7.00
MINIMUM CUTTING AGE 70.
ALLOWABLE CUT 15

SITUATION END OF YEAR 1

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	15	10	10	10	10	10	10	10	10	10	105
1	10	10	10	10	10	10	10	10	10	10	100
2	10	10	10	10	10	10	10	10	10	10	100
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	10	10	10	10	10	100
7	10	10	10	10	10	10	10	10	10	10	100
8	10	10	10	10	10	10	10	10	10	10	100
9	10	10	10	10	10	10	10	10	10	5	95
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON-STOCKED UNITS 0

NUMBER OF OVER-AGE UNITS 0

VOLUME OF GROWING STOCK 16900.

VOLUME CUT THIS PLAY 599.

CUMULATIVE VOLUME CUT 599.

INCOME AND COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST
PLAY NUMBER 1

	ANNUAL	CUMULATIVE
INCOME		
TIMBER, 599.50 MBF, AT 7.00 PER M AND 0. FIRE SALVAGE AT 0. PER M	4196.50	4196.50
INTEREST ON BANK BALANCE OF 0. , AT 4.0000 PER CENT	0.	0.
TOTAL INCOME	4196.50	4196.50
COSTS		
TAXES, LAND, 1000 ACRES, AT 0.1500 PER ACRE	150.00	150.00
TAXES,VALUE OF HARVESTED TIMBER 4196.50, AT 0.1200 PER DOLLAR	503.58	503.58
MAINTENANCE COSTS, 1000 ACRES, AT 0.0500, PER ACRE	50.00	50.00
HARVESTING COSTS, 599.50 MBF, AT 0.1000 PER M	59.95	59.95
INTEREST ON LOANS OF 0. , AT 6.0000 PER CENT	0.	0.
TOTAL COSTS	763.53	763.53
NET INCOME	3432.97	3432.97

NET WORTH STATEMENT

ASSETS		
BANK ACCOUNT	3432.97	
GROWING STOCK 16900. MBF, AT 6.06PER M	102416.91	
TOTAL ASSETS		105849.88
LIABILITIES		
BANK LOANS	0.	
TOTAL LIABILITIES		0.
NET WORTH		105849.88

FIRE REPORT

BATCH TEST PROBLEM
TEST 1
GAME 7CYR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST

NEXT 135
YEAR OF PLAY 10

AGE BURNED 50.

UNITS BURNED 491THROUGH 520

ACREAGE BURNED 30

VOLUME SALVAGED 837.

GROWING STOCK TABLE
BATCH TEST PROBLEM
TEST 1
GAME 7OYR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST
THIS PLAY 10
PRICE 11.00
MINIMUM CUTTING AGE 70.
ALLOWABLE CUT 15

SITUATION AFTER FIRE AND HARVEST YEAR 10

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	30	15	15	15	15	15	15	15	15	15	165
1	10	10	10	10	10	10	10	10	10	10	100
2	10	10	10	10	10	10	10	10	10	10	100
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	0	0	80
6	0	10	10	10	10	10	10	10	10	10	90
7	10	10	10	10	10	10	10	10	10	10	100
8	10	10	10	10	10	10	10	10	10	10	100
9	10	10	10	10	10	10	5	0	0	0	65

NUMBER OF NON-STOCKED UNITS 0

NUMBER OF OVER-AGE UNITS 0

VOLUME OF GROWING STOCK 14847.

VOLUME CUT THIS PLAY 837.

CUMULATIVE VOLUME CUT 6206.

INCOME AND COSTS
BATCH TEST PROBLEM
TEST 1
GAME 7OYR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST
PLAY NUMBER 10

INCOME	ANNUAL	CUMULATIVE
TIMBER, 0. MBF, AT 11.00 PER M AND 837.00FIRE SALVAGE AT 5.50 PER M	4603.50	49926.75
INTEREST ON BANK BALANCE OF 43550.39, AT 4.CCOO PER CENT	1742.02	7744.89
TOTAL INCCME	6345.52	57671.64
COSTS		
TAXES, LAND, 1000 ACRES, AT 0.1500 PER ACRE	150.00	1500.00
TAXES,VALUE OF HARVESTED TIMBER 4603.50, AT 0.12CO PER DOLLAR	552.42	5991.21
MAINTENANCE COSTS, 1000 ACRES, AT 0.0500, PER ACRE	50.00	500.00
HARVESTING COSTS, 837.00 MBF, AT 0.1000 PER M	83.70	620.65
INTEREST ON LOANS OF 0. , AT 6.0CO0 PER CENT	0.	0.
TOTAL COSTS	836.12	8611.86
NET INCOME	5509.40	49059.78

NET WORTH STATEMENT

ASSETS		
BANK ACCOUNT	49059.78	
GROWING STOCK 14847. MBF, AT 9.58PER M	142234.12	
TOTAL ASSETS		191293.90
LIABILITIES		
BANK LOANS	0.	
TOTAL LIABILITIES		0.
NET WORTH		191293.90

GROWING STOCK TABLE
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST
THIS PLAY 30
PRICE 3.00
MINIMUM CUTTING AGE 65.
ALLOWABLE CUT 1000

SITUATION AFTER STORM SALVAGE YEAR 30

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	200	15	15	15	15	15	15	15	15	15	335
1	15	15	15	15	15	15	15	15	15	15	150
2	30	15	15	15	15	15	15	15	15	15	165
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	0	0	0	0	0	50
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON-STOCKED UNITS 0
NUMBER OF OVER-AGE UNITS 0
VOLUME OF GROWING STOCK 4017.
VOLUME CUT THIS PLAY 7243.
CUMULATIVE VOLUME CUT 24611.

INCOME AND COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST
PLAY NUMBER 30

	ANNUAL	CUMULATIVE
INCOME		
TIMBER, 7242.60 MBF, AT 3.00 PER M AND 0. FIRE SALVAGE AT 0. PER M	21727.79	235008.11
INTEREST ON BANK BALANCE OF 306316.59, AT 4.0000 PER CENT	12252.66	138419.46
TOTAL INCOME	33980.45	373427.57
COSTS		
TAXES, LAND, 1000 ACRES, AT 0.1500 PER ACRE	150.00	4500.00
TAXES,VALUE OF HARVESTED TIMBER 21727.79, AT 0.1200 PER DOLLAR	2607.33	28200.97
MAINTENANCE COSTS, 1000 ACRES, AT 0.0500, PER ACRE	50.00	1500.00
HARVESTING COSTS, 7242.60 MBF, AT 0.1000 PER M	724.26	2461.14
INTEREST ON LOANS OF 0. , AT 6.0000 PER CENT	0.	0.
TOTAL COSTS	3531.59	36662.11
NET INCOME	30448.86	336765.44

NET WORTH STATEMENT

ASSETS		
BANK ACCOUNT	336765.44	
GROWING STOCK 4017. MBF, AT 2.54PER M	10203.18	
TOTAL ASSETS		346968.61
LIABILITIES		
BANK LOANS	0.	
TOTAL LIABILITIES		0.
NET WORTH		346968.61

GROWING STOCK TABLE
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST
THIS PLAY 40
PRICE 6.00
MINIMUM CUTTING AGE 70.
ALLOWABLE CUT 15

SITUATION AT END OF GAME

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	10	10	10	10	10	0	0	0	0	0	50
1	200	15	15	15	15	15	15	15	15	15	335
2	15	15	15	15	15	15	15	15	15	15	150
3	30	15	15	15	15	15	15	15	15	15	165
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	10	10	10	10	10	100
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON-STOCKED UNITS 0

NUMBER OF OVER-AGE UNITS 0

VOLUME OF GROWING STOCK 5699.

VOLUME CUT THIS PLAY 352.

CUMULATIVE VOLUME CUT 26371.

INCOME AND COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST
PLAY NUMBER 40

	ANNUAL	CUMULATIVE
INCOME		
TIMBER, 352.00 MBF, AT 6.00 PER M AND 0. FIRE SALVAGE AT 0. PER M	2112.00	246976.10
INTEREST ON BANK BALANCE OF 486283.20, AT 4.0000 PER CENT	19451.33	300656.09
TOTAL INCOME	21563.33	547632.18
COSTS		
TAXES, LAND, 1000 ACRES, AT 0.1500 PER ACRE	150.00	6000.00
TAXES,VALUE OF HARVESTED TIMBER 2112.00, AT 0.1200 PER DOLLAR	253.44	29637.13
MAINTENANCE COSTS, 1000 ACRES, AT 0.0500, PER ACRE	50.00	2000.00
HARVESTING COSTS, 352.00 MBF, AT 0.1000 PER M	35.20	2637.14
INTEREST ON LOANS OF 0. , AT 6.0000 PER CENT	0.	0.
TOTAL COSTS	488.64	40274.27
NET INCOME	21074.69	507357.89

NET WORTH STATEMENT

ASSETS			
BANK ACCOUNT		507357.89	
GROWING STOCK 5699. MBF, AT 5.18PER M		29520.80	
TOTAL ASSETS			536878.69
LIABILITIES			
BANK LOANS		0.	
TOTAL LIABILITIES			0.
NET WORTH			536878.69

ANNUAL SUMMARY OF TIMBER OPERATIONS
BATCH TEST PROBLEM
TEST 1
GAME 7CYR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST

YEAR	ALWBL CUT (1)	CUTNG AGE (2)	ACT CUT (3)	CUM CUT (4)	CRSTK VOL (5)	TOT VOL (6)	NON STK (7)	AGE CLASSES 0-9 (8)	10-19 (9)	20-29 (10)	30-39 (11)	40-49 (12)	50-59 (13)	60-69 (14)	70-79 (15)	80-89 (16)	90-99 (17)	OVER AGE (18)
0	0	0	0	0	17099	17099	0	100	100	100	100	100	100	100	100	100	100	0
1	15	70	599	599	16900	17499	0	105	100	100	100	100	100	100	100	100	95	0
2	15	70	599	1198	16701	17899	0	110	100	100	100	100	100	100	100	100	90	0
3	15	70	598	1796	16502	18298	0	115	100	100	100	100	100	100	100	100	85	0
4	15	70	597	2394	16303	18697	0	120	100	100	100	100	100	100	100	100	80	0
5	15	70	596	2990	16104	19094	0	125	100	100	100	100	100	100	100	100	75	0
6	15	70	596	3586	15906	19492	0	130	100	100	100	100	100	100	100	100	70	0
7	15	70	595	4181	15708	19889	0	135	100	100	100	100	100	100	100	100	65	0
8	15	70	594	4776	15510	20286	0	140	100	100	100	100	100	100	100	100	60	0
9	15	70	593	5369	15312	20681	0	145	100	100	100	100	100	100	100	100	55	0
10	15	70	837	6206	14847	21053	0	165	100	100	100	100	80	90	100	100	65	0
11	15	70	594	6801	14627	21428	0	165	105	100	100	100	90	80	100	100	60	0
12	15	70	593	7394	14409	21803	0	165	110	100	100	100	100	70	100	100	55	0
13	15	70	593	7987	14193	22180	0	165	115	100	100	100	100	70	100	100	50	0
14	15	70	592	8579	13977	22556	0	165	120	100	100	100	100	70	100	100	45	0
15	15	70	591	9171	13762	22933	0	165	125	100	100	100	100	70	100	100	40	0
16	15	70	590	9761	13547	23308	0	165	130	100	100	100	100	70	100	100	35	0
17	15	70	590	10351	13334	23685	0	165	135	100	100	100	100	70	100	100	30	0
18	15	70	589	10940	13123	24063	0	165	140	100	100	100	100	70	100	100	25	0
19	15	70	588	11529	12911	24440	0	165	145	100	100	100	100	70	100	100	20	0
20	15	70	587	12116	12700	24816	0	150	165	100	100	100	100	80	90	100	15	0
21	15	70	587	12703	12492	25195	0	150	165	105	100	100	100	90	80	100	10	0
22	15	70	586	13289	12286	25575	0	150	165	110	100	100	100	100	70	100	5	0
23	15	70	585	13875	12083	25958	0	150	165	115	100	100	100	100	70	100	0	0
24	15	70	584	14459	11881	26340	0	150	165	120	100	100	100	100	70	95	0	0
25	15	70	584	15043	11679	26722	0	150	165	125	100	100	100	100	70	90	0	0
26	15	70	583	15626	11478	27104	0	150	165	130	100	100	100	100	70	85	0	0
27	15	70	582	16208	11278	27486	0	150	165	135	100	100	100	100	70	80	0	0
28	15	70	581	16789	11078	27867	0	150	165	140	100	100	100	100	70	75	0	0
29	15	70	580	17369	10879	28248	0	150	165	145	100	100	100	100	70	70	0	0
30	1000	65	7243	24611	4017	28628	0	335	150	165	100	100	100	50	0	0	0	0
31	15	70	0	24611	4343	28954	0	320	150	165	105	100	100	60	0	0	0	0
32	15	70	0	24611	4674	29285	0	305	150	165	110	100	100	70	0	0	0	0
33	15	70	0	24611	5011	29622	0	290	150	165	115	100	100	80	0	0	0	0
34	15	70	0	24611	5352	29963	0	275	150	165	120	100	100	90	0	0	0	0
35	15	70	0	24611	5699	30310	0	260	150	165	125	100	100	100	0	0	0	0
36	15	70	352	24963	5699	30662	0	255	150	165	130	100	100	100	0	0	0	0
37	15	70	352	25315	5699	31014	0	250	150	165	135	100	100	100	0	0	0	0
38	15	70	352	25667	5699	31366	0	245	150	165	140	100	100	100	0	0	0	0
39	15	70	352	26019	5699	31718	0	240	150	165	145	100	100	100	0	0	0	0
40	15	70	352	26371	5699	32070	0	50	335	150	165	100	100	100	0	0	0	0

ANNUAL SUMMARY OF GROSS INCOME
BATCH TEST PROBLEM
TEST 1
GAME 7CYR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST

YEAR	PRICE (19)	STUMPAGE INCOME ANNUAL (20)	STUMPAGE INCOME CUMULATED (21)	INTEREST INCOME ANNUAL (22)	INTEREST INCOME CUMULATED (23)	GROSS INCOME ANNUAL (24)	GROSS INCOME CUMULATED (25)
0	7.00	0.	0.	0.	0.	0.	0.
1	7.00	4196.	4196.	0.	0.	4196.	4196.
2	7.00	4193.	8389.	137.	137.	4330.	8527.
3	7.50	4485.	12874.	280.	417.	4765.	13292.
4	8.00	4780.	17654.	439.	856.	5219.	18511.
5	8.00	4772.	22426.	614.	1470.	5386.	23897.
6	9.00	5364.	27790.	796.	2266.	6160.	30057.
7	10.00	5950.	33740.	1007.	3273.	6957.	37013.
8	9.50	5648.	39388.	1246.	4519.	6894.	43907.
9	10.00	5935.	45323.	1484.	6003.	7419.	51326.
10	11.00	4603.	49927.	1742.	7745.	6346.	57672.
11	12.00	7134.	57061.	1962.	9707.	9096.	66768.
12	13.00	7715.	64776.	2282.	11989.	9997.	76765.
13	13.50	8005.	72782.	2634.	14623.	10640.	87405.
14	14.00	8288.	81070.	3011.	17634.	11299.	98704.
15	15.00	8872.	89942.	3413.	21047.	12285.	110989.
16	15.00	8857.	98800.	3851.	24898.	12709.	123697.
17	16.00	9440.	108240.	4307.	29204.	13747.	137444.
18	17.00	10013.	118253.	4801.	34005.	14814.	152258.
19	18.00	10593.	128846.	5335.	39340.	15928.	168186.
20	18.00	10575.	139421.	5911.	45251.	16486.	184672.
21	17.00	9979.	149400.	6509.	51760.	16488.	201160.
22	16.00	9376.	158776.	7110.	58871.	16486.	217646.
23	15.00	8782.	167558.	7715.	66585.	16497.	234143.
24	15.00	8766.	176324.	8322.	74907.	17088.	251231.
25	14.00	8173.	184497.	8953.	83860.	17126.	268358.
26	13.50	7865.	192363.	9589.	93449.	17454.	285811.
27	13.00	7566.	199929.	10239.	103687.	17805.	303616.
28	12.00	6970.	206898.	10904.	114591.	17874.	321490.
29	11.00	6382.	213280.	11575.	126167.	17958.	339447.
30	3.00	21728.	235008.	12253.	138419.	33980.	373428.
31	3.00	0.	235008.	13471.	151890.	13471.	386898.
32	5.00	0.	235008.	14001.	165892.	14001.	400900.
33	6.00	0.	235008.	14554.	180445.	14554.	415453.
34	6.50	0.	235008.	15128.	195573.	15128.	430581.
35	8.00	0.	235008.	15725.	211297.	15725.	446306.
36	7.50	2640.	237648.	16346.	227643.	18986.	465291.
37	7.00	2464.	240112.	17083.	244726.	19547.	484838.
38	7.00	2464.	242576.	17844.	262570.	20308.	505146.
39	6.50	2288.	244864.	18635.	281205.	20923.	526069.
40	6.00	2112.	246976.	19451.	300656.	21563.	547632.

ANNUAL SUMMARY OF COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST

YEAR	LAND TAXES ANNUAL (26)	LAND TAXES CUMULATED (27)	SEVERANCE TAXES ANNUAL (28)	SEVERANCE TAXES CUMULATED (29)	MAINTENANCE COST ANNUAL (30)	MAINTENANCE COST CUMULATED (31)	HARVEST COST ANNUAL (32)	HARVEST COST CUMULATED (33)	INTEREST COST ANNUAL (34)	INTEREST COST CUMULATED (35)	TOTAL COST ANNUAL (36)	TOTAL COST CUMULATED (37)
0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	150.	150.	504.	504.	50.	50.	60.	60.	0.	0.	764.	764.
2	150.	300.	503.	1007.	50.	100.	60.	120.	0.	0.	763.	1527.
3	150.	450.	538.	1545.	50.	150.	60.	180.	0.	0.	798.	2325.
4	150.	600.	574.	2119.	50.	200.	60.	239.	0.	0.	833.	3158.
5	150.	750.	573.	2691.	50.	250.	60.	299.	0.	0.	832.	3990.
6	150.	900.	644.	3335.	50.	300.	60.	359.	0.	0.	903.	4894.
7	150.	1050.	714.	4049.	50.	350.	59.	418.	0.	0.	973.	5867.
8	150.	1200.	678.	4727.	50.	400.	59.	478.	0.	0.	937.	6804.
9	150.	1350.	712.	5439.	50.	450.	59.	537.	0.	0.	972.	7776.
10	150.	1500.	552.	5991.	50.	500.	84.	621.	0.	0.	836.	8612.
11	150.	1650.	856.	6847.	50.	550.	59.	680.	0.	0.	1116.	9727.
12	150.	1800.	926.	7773.	50.	600.	59.	739.	0.	0.	1185.	10913.
13	150.	1950.	961.	8734.	50.	650.	59.	799.	0.	0.	1220.	12133.
14	150.	2100.	995.	9728.	50.	700.	59.	858.	0.	0.	1254.	13386.
15	150.	2250.	1065.	10793.	50.	750.	59.	917.	0.	0.	1324.	14710.
16	150.	2400.	1063.	11856.	50.	800.	59.	976.	0.	0.	1322.	16032.
17	150.	2550.	1133.	12989.	50.	850.	59.	1035.	0.	0.	1392.	17424.
18	150.	2700.	1202.	14190.	50.	900.	59.	1094.	0.	0.	1460.	18884.
19	150.	2850.	1271.	15461.	50.	950.	59.	1153.	0.	0.	1530.	20414.
20	150.	3000.	1269.	16730.	50.	1000.	59.	1212.	0.	0.	1528.	21942.
21	150.	3150.	1197.	17928.	50.	1050.	59.	1270.	0.	0.	1456.	23398.
22	150.	3300.	1125.	19053.	50.	1100.	59.	1329.	0.	0.	1384.	24782.
23	150.	3450.	1054.	20107.	50.	1150.	59.	1387.	0.	0.	1312.	26094.
24	150.	3600.	1052.	21159.	50.	1200.	58.	1446.	0.	0.	1310.	27405.
25	150.	3750.	981.	22140.	50.	1250.	58.	1504.	0.	0.	1239.	28644.
26	150.	3900.	944.	23084.	50.	1300.	58.	1563.	0.	0.	1202.	29846.
27	150.	4050.	908.	23991.	50.	1350.	58.	1621.	0.	0.	1166.	31012.
28	150.	4200.	836.	24828.	50.	1400.	58.	1679.	0.	0.	1094.	32107.
29	150.	4350.	766.	25594.	50.	1450.	58.	1737.	0.	0.	1024.	33131.
30	150.	4500.	2607.	28201.	50.	1500.	724.	2461.	0.	0.	3532.	36662.
31	150.	4650.	0.	28201.	50.	1550.	0.	2461.	0.	0.	200.	36862.
32	150.	4800.	0.	28201.	50.	1600.	0.	2461.	0.	0.	200.	37062.
33	150.	4950.	0.	28201.	50.	1650.	0.	2461.	0.	0.	200.	37262.
34	150.	5100.	0.	28201.	50.	1700.	0.	2461.	0.	0.	200.	37462.
35	150.	5250.	0.	28201.	50.	1750.	0.	2461.	0.	0.	200.	37662.
36	150.	5400.	317.	28518.	50.	1800.	35.	2496.	0.	0.	552.	38214.
37	150.	5550.	296.	28813.	50.	1850.	35.	2532.	0.	0.	531.	38745.
38	150.	5700.	296.	29109.	50.	1900.	35.	2567.	0.	0.	531.	39276.
39	150.	5850.	275.	29384.	50.	1950.	35.	2602.	0.	0.	510.	39786.
40	150.	6000.	253.	29637.	50.	2000.	35.	2637.	0.	0.	489.	40274.

ANNUAL SUMMARY OF NET INCOME AND NET WORTH
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION SUST YIELD
GROWING STOCK INITIAL NORMAL FOREST

YEAR	NET INCOME ANNUAL (38)	NET INCOME CUMULATED (39)	CUMULATED NET OPERATING INCOME (40)	CURRENT VALUE GROWING STOCK (41)	CASH IN BANK (42)	TOTAL ASSETS (43)	BANK LOANS (44)	TOTAL NET WORTH (45)
0	0.	0.	0.	103626.	0.	103626.	0.	103626.
1	3433.	3433.	3433.	102417.	3433.	105850.	0.	105850.
2	3567.	7000.	6863.	101208.	7000.	108208.	0.	108208.
3	3967.	10967.	10550.	107263.	10967.	118230.	0.	118230.
4	4385.	15353.	14497.	113143.	15353.	128495.	0.	128495.
5	4554.	19906.	18436.	111765.	19906.	131672.	0.	131672.
6	5257.	25163.	22897.	124385.	25163.	149548.	0.	149548.
7	5983.	31146.	27873.	136659.	31146.	167806.	0.	167806.
8	5956.	37103.	32584.	128112.	37103.	165215.	0.	165215.
9	6448.	43550.	37548.	133219.	43550.	176769.	0.	176769.
10	5509.	49060.	41315.	142234.	49060.	191294.	0.	191294.
11	7981.	57041.	47333.	152996.	57041.	210037.	0.	210037.
12	8812.	65853.	53864.	163397.	65853.	229249.	0.	229249.
13	9420.	75272.	60649.	167191.	75272.	242463.	0.	242463.
14	10045.	85317.	67683.	170801.	85317.	256119.	0.	256119.
15	10961.	96279.	75232.	180277.	96279.	276555.	0.	276555.
16	11387.	107665.	82768.	177472.	107665.	285137.	0.	285137.
17	12355.	120020.	90816.	186415.	120020.	306435.	0.	306435.
18	13353.	133374.	99368.	195005.	133374.	328378.	0.	328378.
19	14398.	147771.	108431.	203222.	147771.	350994.	0.	350994.
20	14958.	162730.	117479.	199899.	162730.	362629.	0.	362629.
21	15032.	177762.	126001.	185625.	177762.	363387.	0.	363387.
22	15103.	192864.	133994.	171761.	192864.	364625.	0.	364625.
23	15185.	208049.	141464.	158292.	208049.	366341.	0.	366341.
24	15778.	223827.	148919.	155644.	223827.	379470.	0.	379470.
25	15887.	239714.	155853.	142717.	239714.	382431.	0.	382431.
26	16252.	255965.	162516.	135211.	255965.	391176.	0.	391176.
27	16638.	272604.	168916.	127688.	272604.	400492.	0.	400492.
28	16779.	289383.	174791.	115880.	289383.	405263.	0.	405263.
29	16934.	306317.	180150.	104223.	306317.	410539.	0.	410539.
30	30449.	336765.	198346.	10203.	336765.	346969.	0.	346969.
31	13271.	350036.	198146.	11031.	350036.	361067.	0.	361067.
32	13801.	363838.	197946.	20099.	363838.	383937.	0.	383937.
33	14354.	378191.	197746.	25555.	378191.	404146.	0.	404146.
34	14928.	393119.	197546.	30079.	393119.	423198.	0.	423198.
35	15525.	408643.	197346.	39551.	408643.	448194.	0.	448194.
36	18434.	427077.	199434.	37043.	427077.	464121.	0.	464121.
37	19016.	446093.	201367.	34536.	446093.	480629.	0.	480629.
38	19777.	465870.	203300.	34536.	465870.	500406.	0.	500406.
39	20413.	486283.	205078.	32028.	486283.	518312.	0.	518312.
40	21075.	507358.	206702.	29521.	507358.	536879.	0.	536879.

PRICES, DATA, POLICY
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST

SECOND POLICY

CRITICAL PRICES	8.00	10.00	99.00	-0.	-0.	-0.	-0.	-0.	-0.	-0.
ALLOWABLE CUT	0	15	75	-0	-0	-0	-0	-0	-0	-0
MINIMUM CUTTING AGE	149.	70.	70.	-0.	-0.	-0.	-0.	-0.	-0.	-0.

INITIAL GROWING STOCK
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST

	AGE(YEAR)										
AGE(DECADE)	0	1	2	3	4	5	6	7	8	9	TOTAL
0	10	10	10	10	10	10	10	10	10	10	100
1	10	10	10	10	10	10	10	10	10	10	100
2	10	10	10	10	10	10	10	10	10	10	100
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	10	10	10	10	10	100
7	10	10	10	10	10	10	10	10	10	10	100
8	10	10	10	10	10	10	10	10	10	10	100
9	10	10	10	10	10	10	10	10	10	10	100
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON STOCKED UNITS 0

NUMBER OF OVER-AGE UNITS 0

VOLUME OF GROWING STOCK 17100.

GROWING STOCK TABLE
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST
THIS PLAY 1
PRICE 7.00
MINIMUM CUTTING AGE 149.
ALLOWABLE CUT 0

SITUATION END OF YEAR 1

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	0	10	10	10	10	10	10	10	10	10	90
1	10	10	10	10	10	10	10	10	10	10	100
2	10	10	10	10	10	10	10	10	10	10	100
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	10	10	10	10	10	100
7	10	10	10	10	10	10	10	10	10	10	100
8	10	10	10	10	10	10	10	10	10	10	100
9	10	10	10	10	10	10	10	10	10	10	100
10	10	0	0	0	0	0	0	0	0	0	10
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON-STOCKED UNITS 0
NUMBER OF OVER-AGE UNITS 10
VOLUME OF GROWING STOCK 17500.
VOLUME CUT THIS PLAY 0.
CUMULATIVE VOLUME CUT 0.

INCOME AND COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST
PLAY NUMBER 1

	ANNUAL	CUMULATIVE
INCOME		
TIMBER, 0. MBF, AT 7.00 PER M AND 0. FIRE SALVAGE AT 0. PER M	0.	0.
INTEREST ON BANK BALANCE OF 0. , AT 4.0000 PER CENT	0.	0.
TOTAL INCOME	0.	0.
COSTS		
TAXES, LAND, 1000 ACRES, AT 0.1500 PER ACRE	150.00	150.00
TAXES,VALUE OF HARVESTED TIMBER 0. , AT 0.1200 PER DOLLAR	0.	0.
MAINTENANCE COSTS, 1000 ACRES, AT 0.0500, PER ACRE	50.00	50.00
HARVESTING COSTS, 0. MBF, AT 0.1000 PER M	0.	0.
INTEREST ON LOANS OF 0. , AT 6.0000 PER CENT	0.	0.
TOTAL COSTS	200.00	200.00
NET INCOME	-200.00	-200.00

NET WORTH STATEMENT

ASSETS		
BANK ACCOUNT	0.	
GROWING STOCK 17500. MBF, AT 6.06PER M	106049.86	
TOTAL ASSETS		106049.86
LIABILITIES		
BANK LOANS	-200.00	
TOTAL LIABILITIES		-200.00
NET WORTH		105849.86

FIRE REPORT

BATCH TEST PROBLEM
TEST 1
GAME 7CYR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST

NEXT YEAR OF PLAY 60
10

AGE BURNED 50.

UNITS BURNED 491THROUGH 520

ACREAGE BURNED 30

VOLUME SALVAGED 837.

GROWING STOCK TABLE
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST
THIS PLAY 10
PRICE 11.00
MINIMUM CUTTING AGE 70.
ALLOWABLE CUT 75

SITUATION AFTER FIRE AND HARVEST YEAR 10

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	75	15	15	15	15	0	0	0	0	0	135
1	10	10	10	10	10	10	10	10	10	10	100
2	10	10	10	10	10	10	10	10	10	10	100
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	0	0	80
6	0	10	10	10	10	10	10	10	10	10	90
7	10	10	10	10	10	10	10	10	10	10	100
8	10	10	10	10	10	10	10	10	10	10	100
9	10	10	10	10	10	10	10	10	10	5	95
10	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON-STOCKED UNITS 0

NUMBER OF OVER-AGE UNITS 0

VOLUME OF GROWING STOCK 16039.

VOLUME CUT THIS PLAY 2636.

CUMULATIVE VOLUME CUT 5036.

INCOME AND COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST
PLAY NUMBER 10

	ANNUAL	CUMULATIVE
INCOME		
TIMBER, 1799.50 MBF, AT 11.00 PER M AND 837.00FIRE SALVAGE AT 5.50 PER M	24398.00	47498.00
INTEREST ON BANK BALANCE OF 19104.48, AT 4.CC00 PER CENT	764.18	1775.72
TOTAL INCOME	25162.18	49273.72
COSTS		
TAXES, LAND, 1000 ACRES, AT 0.1500 PER ACRE	150.00	1500.00
TAXES,VALUE OF HARVESTED TIMBER 24398.C0, AT 0.12C0 PER DOLLAR	2927.76	5699.76
MAINTENANCE COSTS, 1000 ACRES, AT 0.0500, PER ACRE	50.00	500.00
HARVESTING COSTS, 2636.50 MBF, AT 0.1000 PER M	263.65	503.65
INTEREST ON LOANS OF 0. , AT 6.0C00 PER CENT	0.	195.06
TOTAL COSTS	3391.41	8398.47
NET INCOME	21770.77	40875.24

NET WORTH STATEMENT

ASSETS		
BANK ACCOUNT	40875.24	
GROWING STOCK 16039. MBF, AT 9.58PER M	153658.25	
TOTAL ASSETS		194533.50
LIABILITIES		
BANK LOANS	0.	
TOTAL LIABILITIES		0.
NET WORTH		194533.50

GROWING STOCK TABLE
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST
THIS PLAY 30
PRICE 3.00
MINIMUM CUTTING AGE 65.
ALLOWABLE CUT 1000

SITUATION AFTER STORM SALVAGE YEAR 30

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	60	10	10	10	10	10	10	10	0	0	130
1	0	10	10	10	10	45	75	75	75	75	385
2	75	15	15	15	15	0	0	0	0	0	135
3	10	10	10	10	10	10	10	10	10	10	100
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	0	0	0	0	0	50
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON-STOCKED UNITS 0

NUMBER OF OVER-AGE UNITS 0

VOLUME OF GROWING STOCK 4017.

VOLUME CUT THIS PLAY 2034.

CUMULATIVE VOLUME CUT 24058.

INCOME AND COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST
PLAY NUMBER 30

	ANNUAL	CUMULATIVE
INCOME		
TIMBER, 2034.00 MBF, AT 3.00 PER M ANC 0. FIRE SALVAGE AT 0. PER M	6102.00	284678.23
INTEREST ON BANK BALANCE OF 432759.08, AT 4.CCOO PER CENT	17310.36	213119.88
TOTAL INCCME	23412.36	497798.12
COSTS		
TAXES, LAND, 1000 ACRES, AT 0.1500 PER ACRE	150.00	4500.00
TAXES,VALUE OF HARVESTEC TIMBER 6102.00, AT 0.12CO PER DOLLAR	732.24	34161.39
MAINTENANCE COSTS, 1000 ACRES, AT 0.0500, PER ACRE	50.00	1500.00
HARVESTING COSTS, 2034.00 MBF, AT 0.1C00 PER M	203.40	2405.84
INTEREST ON LOANS OF 0. , AT 6.0C00 PER CENT	0.	195.06
TOTAL CCSTS	1135.64	42762.29
NET INCOME	22276.72	455035.80

NET WORTH STATEMENT

ASSETS		
BANK ACCOUNT	455035.80	
GROWING STOCK 4017. MBF, AT 2.54PER M	10203.18	
TOTAL ASSETS		465238.97
LIABILITIES		
BANK LOANS	0.	
TOTAL LIABILITIES		0.
NET WORTH		465238.97

GROWING STOCK TABLE
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST
THIS PLAY 40
PRICE 6.00
MINIMUM CUTTING AGE 149.
ALLOWABLE CUT 0

SITUATION AT END OF GAME

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	0	0	0	0	0	0	0	0	0	0	0
1	60	10	10	10	10	10	10	10	0	0	130
2	0	10	10	10	10	45	75	75	75	75	385
3	75	15	15	15	15	0	0	0	0	0	135
4	10	10	10	10	10	10	10	10	10	10	100
5	10	10	10	10	10	10	10	10	10	10	100
6	10	10	10	10	10	10	10	10	10	10	100
7	10	10	10	10	10	0	0	0	0	0	50
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0

NUMBER OF NON-STOCKED UNITS 0
NUMBER OF OVER-AGE UNITS 0
VOLUME OF GROWING STOCK 7485.
VOLUME CUT THIS PLAY 0.
CUMULATIVE VOLUME CUT 24058.

INCOME AND COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST
PLAY NUMBER 40

	ANNUAL	CUMULATIVE
INCOME		
TIMBER, 0. MBF, AT 6.00 PER M AND 0. FIRE SALVAGE AT 0. PER M	0.	284678.23
INTEREST ON BANK BALANCE OF 645541.23, AT 4.0000 PER CENT	25821.65	431246.98
TOTAL INCOME	25821.65	715925.19
COSTS		
TAXES, LAND, 1000 ACRES, AT 0.1500 PER ACRE	150.00	6000.00
TAXES,VALUE OF HARVESTED TIMBER 0. , AT 0.1200 PER DOLLAR	0.	34161.39
MAINTENANCE COSTS, 1000 ACRES, AT 0.0500, PER ACRE	50.00	2000.00
HARVESTING COSTS, 0. MBF, AT 0.1000 PER M	0.	2405.84
INTEREST ON LOANS OF 0. , AT 6.0000 PER CENT	0.	195.06
TOTAL COSTS	200.00	44762.28
NET INCOME	25621.65	671162.88

NET WORTH STATEMENT

ASSETS		
BANK ACCOUNT	671162.88	
GROWING STOCK 7485. MBF, AT 5.18PER M	38772.27	
TOTAL ASSETS		709935.15
LIABILITIES		
BANK LOANS	0.	
TOTAL LIABILITIES		0.
NET WORTH		709935.15

ANNUAL SUMMARY OF TIMBER OPERATIONS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST

YEAR	ALWBL CUT (1)	CUTNG AGE (2)	ACT CUT (3)	CUM CUT (4)	GRSTK VOL (5)	TOT VOL (6)	NON STK (7)	AGE CLASSES 0-9 (8)	10-19 (9)	20-29 (10)	30-39 (11)	40-49 (12)	50-59 (13)	60-69 (14)	70-79 (15)	80-89 (16)	90-99 (17)	OVER AGE (18)
0	0	0	0	0	17099	17099	0	100	100	100	100	100	100	100	100	100	100	0
1	0	149	0	0	17500	17500	0	90	100	100	100	100	100	100	100	100	100	10
2	0	149	0	0	17900	17900	0	80	100	100	100	100	100	100	100	100	100	20
3	0	149	0	0	18300	18300	0	70	100	100	100	100	100	100	100	100	100	30
4	0	149	0	0	18700	18700	0	60	100	100	100	100	100	100	100	100	100	40
5	0	149	0	0	19100	19100	0	50	100	100	100	100	100	100	100	100	100	50
6	15	70	600	600	18900	19500	0	55	100	100	100	100	100	100	100	100	100	45
7	15	70	600	1200	18700	19900	0	60	100	100	100	100	100	100	100	100	100	40
8	15	70	600	1800	18500	20300	0	65	100	100	100	100	100	100	100	100	100	35
9	15	70	600	2400	18300	20700	0	70	100	100	100	100	100	100	100	100	100	30
10	75	70	2636	5036	16039	21075	0	135	100	100	100	100	80	90	100	100	95	0
11	75	70	2972	8008	13445	21453	0	210	90	100	100	100	90	80	100	100	30	0
12	75	70	2921	10930	10896	21826	0	285	80	100	100	100	100	70	100	65	0	0
13	75	70	2855	13785	8408	22193	0	360	70	100	100	100	100	70	100	0	0	0
14	75	70	2762	16548	6002	22550	0	435	60	100	100	100	100	70	35	0	0	0
15	75	70	1605	18152	4740	22892	0	480	50	100	100	100	100	70	0	0	0	0
16	75	70	352	18504	4722	23226	0	475	55	100	100	100	100	70	0	0	0	0
17	75	70	352	18856	4705	23561	0	470	60	100	100	100	100	70	0	0	0	0
18	75	70	352	19208	4690	23898	0	465	65	100	100	100	100	70	0	0	0	0
19	75	70	352	19560	4674	24234	0	460	70	100	100	100	100	70	0	0	0	0
20	75	70	0	19560	5011	24571	0	385	135	100	100	100	100	80	0	0	0	0
21	75	70	0	19560	5352	24912	0	310	210	90	100	100	100	90	0	0	0	0
22	75	70	0	19560	5699	25259	0	235	285	80	100	100	100	100	0	0	0	0
23	75	70	352	19912	5699	25611	0	170	360	70	100	100	100	100	0	0	0	0
24	75	70	352	20264	5699	25963	0	105	435	60	100	100	100	100	0	0	0	0
25	75	70	352	20616	5699	26315	0	70	480	50	100	100	100	100	0	0	0	0
26	75	70	352	20968	5699	26667	0	70	475	55	100	100	100	100	0	0	0	0
27	75	70	352	21320	5699	27019	0	70	470	60	100	100	100	100	0	0	0	0
28	75	70	352	21672	5699	27371	0	70	465	65	100	100	100	100	0	0	0	0
29	75	70	352	22024	5699	27723	0	70	460	70	100	100	100	100	0	0	0	0
30	1000	65	2034	24058	4017	28075	0	130	385	135	100	100	100	50	0	0	0	0
31	0	149	0	24058	4343	28401	0	130	310	210	90	100	100	60	0	0	0	0
32	0	149	0	24058	4674	28732	0	130	235	285	80	100	100	70	0	0	0	0
33	0	149	0	24058	5011	29069	0	120	170	360	70	100	100	80	0	0	0	0
34	0	149	0	24058	5352	29410	0	110	105	435	60	100	100	90	0	0	0	0
35	0	149	0	24058	5699	29757	0	100	70	480	50	100	100	100	0	0	0	0
36	0	149	0	24058	6051	30109	0	90	70	475	55	100	100	100	10	0	0	0
37	0	149	0	24058	6406	30464	0	80	70	470	60	100	100	100	20	0	0	0
38	0	149	0	24058	6763	30821	0	70	70	465	65	100	100	100	30	0	0	0
39	0	149	0	24058	7123	31181	0	60	70	460	70	100	100	100	40	0	0	0
40	0	149	0	24058	7485	31543	0	0	130	385	135	100	100	100	50	0	0	0

ANNUAL SUMMARY OF GROSS INCOME
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST

YEAR	PRICE (19)	STUMPAGE ANNUAL (20)	INCOME CUMULATED (21)	INTEREST ANNUAL (22)	INCOME CUMULATED (23)	GROSS ANNUAL (24)	INCOME CUMULATED (25)
0	7.00	0.	0.	0.	0.	0.	0.
1	7.00	0.	0.	0.	0.	0.	0.
2	7.00	0.	0.	0.	0.	0.	0.
3	7.50	0.	0.	0.	0.	0.	0.
4	8.00	0.	0.	0.	0.	0.	0.
5	8.00	0.	0.	0.	0.	0.	0.
6	9.00	5400.	5400.	0.	0.	5400.	5400.
7	10.00	6000.	11400.	132.	132.	6132.	11532.
8	9.50	5700.	17100.	338.	470.	6038.	17570.
9	10.00	6000.	23100.	542.	1012.	6542.	24112.
10	11.00	24398.	47498.	764.	1776.	25162.	49274.
11	12.00	35664.	83162.	1635.	3411.	37299.	86573.
12	13.00	37978.	121140.	2936.	6347.	40914.	127487.
13	13.50	38548.	159688.	4370.	10717.	42918.	170405.
14	14.00	38672.	198360.	5883.	16600.	44555.	214960.
15	15.00	24072.	222432.	7460.	24060.	31532.	246492.
16	15.00	5280.	227712.	8592.	32652.	13872.	260364.
17	16.00	5632.	233344.	9112.	41763.	14744.	275108.
18	17.00	5984.	239328.	9665.	51429.	15649.	290757.
19	18.00	6336.	245664.	10253.	61681.	16589.	307346.
20	18.00	0.	245664.	10877.	72558.	10877.	318222.
21	17.00	0.	245664.	11304.	83862.	11304.	329526.
22	16.00	0.	245664.	11748.	95609.	11748.	341274.
23	15.00	5280.	250944.	12210.	107819.	17490.	358763.
24	15.00	5280.	256224.	12875.	120694.	18155.	376918.
25	14.00	4928.	261152.	13566.	134260.	18494.	395412.
26	13.50	4752.	265904.	14273.	148532.	19025.	414437.
27	13.00	4576.	270480.	15001.	163534.	19577.	434014.
28	12.00	4224.	274704.	15753.	179287.	19977.	453991.
29	11.00	3872.	278576.	16523.	195810.	20395.	474386.
30	3.00	6102.	284678.	17310.	213120.	23412.	497798.
31	3.00	0.	284678.	18201.	231321.	18201.	516000.
32	5.00	0.	284678.	18921.	250243.	18921.	534921.
33	6.00	0.	284678.	19670.	269913.	19670.	554591.
34	6.50	0.	284678.	20449.	290362.	20449.	575041.
35	8.00	0.	284678.	21259.	311621.	21259.	596300.
36	7.50	0.	284678.	22101.	333723.	22101.	618401.
37	7.00	0.	284678.	22978.	356700.	22978.	641379.
38	7.00	0.	284678.	23889.	380589.	23889.	665267.
39	6.50	0.	284678.	24836.	405425.	24836.	690104.
40	6.00	0.	284678.	25822.	431247.	25822.	715925.

ANNUAL SUMMARY OF COSTS
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST

YEAR	LAND TAXES ANNUAL (26)	LAND TAXES CUMULATED (27)	SEVERANCE TAXES ANNUAL (28)	SEVERANCE TAXES CUMULATED (29)	MAINTENANCE COST ANNUAL (30)	MAINTENANCE COST CUMULATED (31)	HARVEST COST ANNUAL (32)	HARVEST COST CUMULATED (33)	INTEREST COST ANNUAL (34)	INTEREST COST CUMULATED (35)	TOTAL COST ANNUAL (36)	TOTAL COST CUMULATED (37)
0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	150.	150.	0.	0.	50.	50.	0.	0.	0.	0.	200.	200.
2	150.	300.	0.	0.	50.	100.	0.	0.	12.	12.	212.	412.
3	150.	450.	0.	0.	50.	150.	0.	0.	25.	37.	225.	637.
4	150.	600.	0.	0.	50.	200.	0.	0.	38.	75.	238.	875.
5	150.	750.	0.	0.	50.	250.	0.	0.	52.	127.	252.	1127.
6	150.	900.	648.	648.	50.	300.	60.	60.	68.	195.	976.	2103.
7	150.	1050.	720.	1368.	50.	350.	60.	120.	0.	195.	980.	3083.
8	150.	1200.	684.	2052.	50.	400.	60.	180.	0.	195.	944.	4027.
9	150.	1350.	720.	2772.	50.	450.	60.	240.	0.	195.	980.	5007.
10	150.	1500.	2928.	5700.	50.	500.	264.	504.	0.	195.	3391.	8398.
11	150.	1650.	4280.	9979.	50.	550.	297.	801.	0.	195.	4777.	13175.
12	150.	1800.	4557.	14537.	50.	600.	292.	1093.	0.	195.	5050.	18225.
13	150.	1950.	4626.	19163.	50.	650.	286.	1379.	0.	195.	5111.	23336.
14	150.	2100.	4641.	23803.	50.	700.	276.	1655.	0.	195.	5117.	28453.
15	150.	2250.	2889.	26692.	50.	750.	160.	1815.	0.	195.	3249.	31702.
16	150.	2400.	634.	27325.	50.	800.	35.	1850.	0.	195.	869.	32571.
17	150.	2550.	676.	28001.	50.	850.	35.	1886.	0.	195.	911.	33482.
18	150.	2700.	718.	28719.	50.	900.	35.	1921.	0.	195.	953.	34435.
19	150.	2850.	760.	29480.	50.	950.	35.	1956.	0.	195.	996.	35431.
20	150.	3000.	0.	29480.	50.	1000.	0.	1956.	0.	195.	200.	35631.
21	150.	3150.	0.	29480.	50.	1050.	0.	1956.	0.	195.	200.	35831.
22	150.	3300.	0.	29480.	50.	1100.	0.	1956.	0.	195.	200.	36031.
23	150.	3450.	634.	30113.	50.	1150.	35.	1991.	0.	195.	869.	36900.
24	150.	3600.	634.	30747.	50.	1200.	35.	2026.	0.	195.	869.	37768.
25	150.	3750.	591.	31338.	50.	1250.	35.	2062.	0.	195.	827.	38595.
26	150.	3900.	570.	31909.	50.	1300.	35.	2097.	0.	195.	805.	39400.
27	150.	4050.	549.	32458.	50.	1350.	35.	2132.	0.	195.	784.	40185.
28	150.	4200.	507.	32965.	50.	1400.	35.	2167.	0.	195.	742.	40927.
29	150.	4350.	465.	33429.	50.	1450.	35.	2202.	0.	195.	700.	41627.
30	150.	4500.	732.	34161.	50.	1500.	203.	2406.	0.	195.	1136.	42762.
31	150.	4650.	0.	34161.	50.	1550.	0.	2406.	0.	195.	200.	42962.
32	150.	4800.	0.	34161.	50.	1600.	0.	2406.	0.	195.	200.	43162.
33	150.	4950.	0.	34161.	50.	1650.	0.	2406.	0.	195.	200.	43362.
34	150.	5100.	0.	34161.	50.	1700.	0.	2406.	0.	195.	200.	43562.
35	150.	5250.	0.	34161.	50.	1750.	0.	2406.	0.	195.	200.	43762.
36	150.	5400.	0.	34161.	50.	1800.	0.	2406.	0.	195.	200.	43962.
37	150.	5550.	0.	34161.	50.	1850.	0.	2406.	0.	195.	200.	44162.
38	150.	5700.	0.	34161.	50.	1900.	0.	2406.	0.	195.	200.	44362.
39	150.	5850.	0.	34161.	50.	1950.	0.	2406.	0.	195.	200.	44562.
40	150.	6000.	0.	34161.	50.	2000.	0.	2406.	0.	195.	200.	44762.

ANNUAL SUMMARY OF NET INCOME AND NET WORTH
BATCH TEST PROBLEM
TEST 1
GAME 70YR ROTATION PRICE RESP
GROWING STOCK INITIAL NORMAL FOREST

YEAR	NET INCOME ANNUAL (38)	NET INCOME CUMULATED (39)	CUMULATED NET OPERATING INCOME (40)	CURRENT VALUE GROWING STOCK (41)	CASH IN BANK (42)	TOTAL ASSETS (43)	BANK LOANS (44)	TOTAL NET WORTH (45)
0	0.	0.	0.	103626.	0.	103626.	0.	103626.
1	-200.	-200.	-200.	106050.	0.	106050.	-200.	105850.
2	-212.	-412.	-412.	108474.	0.	108474.	-412.	108062.
3	-225.	-637.	-637.	118950.	0.	118950.	-637.	118313.
4	-238.	-875.	-875.	129778.	0.	129778.	-875.	128903.
5	-252.	-1127.	-1127.	132554.	0.	132554.	-1127.	131426.
6	4424.	3297.	3297.	147798.	3297.	151095.	0.	151095.
7	5152.	8449.	8317.	162690.	8449.	171139.	0.	171139.
8	5094.	13543.	13073.	152810.	13543.	166353.	0.	166353.
9	5562.	19104.	18093.	159210.	19104.	178314.	0.	178314.
10	21771.	40875.	39100.	153658.	40875.	194533.	0.	194533.
11	32522.	73397.	69987.	140632.	73397.	214030.	0.	214030.
12	35865.	109262.	102915.	123561.	109262.	232822.	0.	232822.
13	37807.	147069.	136352.	99044.	147069.	246113.	0.	246113.
14	39438.	186507.	169907.	73343.	186507.	259850.	0.	259850.
15	28283.	214790.	190730.	62089.	214790.	276879.	0.	276879.
16	13003.	227793.	195141.	61858.	227793.	289651.	0.	289651.
17	13833.	241626.	199862.	65781.	241626.	307407.	0.	307407.
18	14696.	256321.	204893.	69690.	256321.	326012.	0.	326012.
19	15593.	271915.	210233.	73572.	271915.	345487.	0.	345487.
20	10677.	282591.	210033.	78867.	282591.	361458.	0.	361458.
21	11104.	293695.	209833.	79534.	293695.	373229.	0.	373229.
22	11548.	305243.	209633.	79672.	305243.	384915.	0.	384915.
23	16621.	321864.	214045.	74657.	321864.	396521.	0.	396521.
24	17286.	339149.	218456.	74657.	339149.	413806.	0.	413806.
25	17667.	356817.	222557.	69642.	356817.	426459.	0.	426459.
26	18219.	375036.	226504.	67134.	375036.	442170.	0.	442170.
27	18793.	393829.	230296.	64627.	393829.	458456.	0.	458456.
28	19235.	413064.	233777.	59612.	413064.	472676.	0.	472676.
29	19695.	432759.	236950.	54596.	432759.	487355.	0.	487355.
30	22277.	455036.	241916.	10203.	455036.	465239.	0.	465239.
31	18001.	473037.	241716.	11031.	473037.	484068.	0.	484068.
32	18721.	491759.	241516.	20099.	491759.	511858.	0.	511858.
33	19470.	511229.	241316.	25955.	511229.	537184.	0.	537184.
34	20249.	531478.	241116.	30079.	531478.	561558.	0.	561558.
35	21059.	552537.	240916.	39551.	552537.	592088.	0.	592088.
36	21901.	574439.	240716.	39331.	574439.	613770.	0.	613770.
37	22778.	597216.	240516.	38818.	597216.	636034.	0.	636034.
38	23689.	620905.	240316.	40983.	620905.	661888.	0.	661888.
39	24636.	645541.	240116.	40029.	645541.	685570.	0.	685570.
40	25622.	671163.	239916.	38772.	671163.	709935.	0.	709935.

COMPARISON OF POLICIES
BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST
COLUMN 4

CUMULATIVE CUT

YEAR	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	GAME 7	GAME 8	GAME 9	GAME 10
1	599.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	1198.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	1796.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	2394.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	2990.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	3586.	600.	0.	0.	0.	0.	0.	0.	0.	0.
7	4181.	1200.	0.	0.	0.	0.	0.	0.	0.	0.
8	4776.	1800.	0.	0.	0.	0.	0.	0.	0.	0.
9	5369.	2400.	0.	0.	0.	0.	0.	0.	0.	0.
10	6206.	5036.	0.	0.	0.	0.	0.	0.	0.	0.
10	6206.	5036.	0.	0.	0.	0.	0.	0.	0.	0.
20	12116.	19560.	0.	0.	0.	0.	0.	0.	0.	0.
30	24611.	24058.	0.	0.	0.	0.	0.	0.	0.	0.
40	26371.	24058.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
70	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
110	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
120	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
130	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
140	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
150	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

COMPARISON OF POLICIES
BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST
COLUMN 5

RESIDUAL GROWING STOCK

YEAR	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	GAME 7	GAME 8	GAME 9	GAME 10
1	16900.	17500.	0.	0.	0.	0.	0.	0.	0.	0.
2	16701.	17900.	0.	0.	0.	0.	0.	0.	0.	0.
3	16502.	18300.	0.	0.	0.	0.	0.	0.	0.	0.
4	16303.	18700.	0.	0.	0.	0.	0.	0.	0.	0.
5	16104.	19100.	0.	0.	0.	0.	0.	0.	0.	0.
6	15906.	18900.	0.	0.	0.	0.	0.	0.	0.	0.
7	15708.	18700.	0.	0.	0.	0.	0.	0.	0.	0.
8	15510.	18500.	0.	0.	0.	0.	0.	0.	0.	0.
9	15312.	18300.	0.	0.	0.	0.	0.	0.	0.	0.
10	14847.	16039.	0.	0.	0.	0.	0.	0.	0.	0.
10	14847.	16039.	0.	0.	0.	0.	0.	0.	0.	0.
20	12700.	5011.	0.	0.	0.	0.	0.	0.	0.	0.
30	4017.	4017.	0.	0.	0.	0.	0.	0.	0.	0.
40	5699.	7485.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
70	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
110	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
120	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
130	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
140	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
150	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

COMPARISON OF POLICIES
BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST
COLUMN 6

TOTAL VOLUME

YEAR	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	GAME 7	GAME 8	GAME 9	GAME 10
1	17499.	17500.	0.	0.	0.	0.	0.	0.	0.	0.
2	17899.	17900.	0.	0.	0.	0.	0.	0.	0.	0.
3	18298.	18300.	0.	0.	0.	0.	0.	0.	0.	0.
4	18697.	18700.	0.	0.	0.	0.	0.	0.	0.	0.
5	19094.	19100.	0.	0.	0.	0.	0.	0.	0.	0.
6	19492.	19500.	0.	0.	0.	0.	0.	0.	0.	0.
7	19889.	19900.	0.	0.	0.	0.	0.	0.	0.	0.
8	20286.	20300.	0.	0.	0.	0.	0.	0.	0.	0.
9	20681.	20700.	0.	0.	0.	0.	0.	0.	0.	0.
10	21053.	21075.	0.	0.	0.	0.	0.	0.	0.	0.
10	21053.	21075.	0.	0.	0.	0.	0.	0.	0.	0.
20	24816.	24571.	0.	0.	0.	0.	0.	0.	0.	0.
30	28628.	28075.	0.	0.	0.	0.	0.	0.	0.	0.
40	32070.	31543.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
70	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
110	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
120	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
130	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
140	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
150	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

COMPARISON OF POLICIES
BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST
COLUMN 41

CASH VALUE OF GROWING STOCK

YEAR	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	GAME 7	GAME 8	GAME 9	GAME 10
1	102417.	106050.	0.	0.	0.	0.	0.	0.	0.	0.
2	101208.	108474.	0.	0.	0.	0.	0.	0.	0.	0.
3	107263.	118950.	0.	0.	0.	0.	0.	0.	0.	0.
4	113143.	129778.	0.	0.	0.	0.	0.	0.	0.	0.
5	111765.	132554.	0.	0.	0.	0.	0.	0.	0.	0.
6	124385.	147798.	0.	0.	0.	0.	0.	0.	0.	0.
7	136659.	162690.	0.	0.	0.	0.	0.	0.	0.	0.
8	128112.	152810.	0.	0.	0.	0.	0.	0.	0.	0.
9	133219.	159210.	0.	0.	0.	0.	0.	0.	0.	0.
10	142234.	153658.	0.	0.	0.	0.	0.	0.	0.	0.
10	142234.	153658.	0.	0.	0.	0.	0.	0.	0.	0.
20	199899.	78867.	0.	0.	0.	0.	0.	0.	0.	0.
30	10203.	10203.	0.	0.	0.	0.	0.	0.	0.	0.
40	29521.	38772.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
70	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
110	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
120	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
130	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
140	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
150	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

COMPARISON OF POLICIES
BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST
COLUMN 42

CASH IN THE BANK

YEAR	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	GAME 7	GAME 8	GAME 9	GAME 10
1	3433.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	7000.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	10967.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	15353.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	19906.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	25163.	3297.	0.	0.	0.	0.	0.	0.	0.	0.
7	31146.	8449.	0.	0.	0.	0.	0.	0.	0.	0.
8	37103.	13543.	0.	0.	0.	0.	0.	0.	0.	0.
9	43550.	19104.	0.	0.	0.	0.	0.	0.	0.	0.
10	49060.	40875.	0.	0.	0.	0.	0.	0.	0.	0.
10	49060.	40875.	0.	0.	0.	0.	0.	0.	0.	0.
20	162730.	282591.	0.	0.	0.	0.	0.	0.	0.	0.
30	336765.	455036.	0.	0.	0.	0.	0.	0.	0.	0.
40	507358.	671163.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
70	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
110	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
120	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
130	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
140	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
150	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

COMPARISON OF POLICIES
BATCH TEST PROBLEM
TEST 1
GROWING STOCK INITIAL NORMAL FOREST
COLUMN 45

TOTAL NET WORTH

YEAR	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	GAME 7	GAME 8	GAME 9	GAME 10
1	105850.	105850.	0.	0.	0.	0.	0.	0.	0.	0.
2	108208.	108062.	0.	0.	0.	0.	0.	0.	0.	0.
3	118230.	118313.	0.	0.	0.	0.	0.	0.	0.	0.
4	128495.	128903.	0.	0.	0.	0.	0.	0.	0.	0.
5	131672.	131426.	0.	0.	0.	0.	0.	0.	0.	0.
6	149548.	151095.	0.	0.	0.	0.	0.	0.	0.	0.
7	167806.	171139.	0.	0.	0.	0.	0.	0.	0.	0.
8	165215.	166353.	0.	0.	0.	0.	0.	0.	0.	0.
9	176769.	178314.	0.	0.	0.	0.	0.	0.	0.	0.
10	191294.	194533.	0.	0.	0.	0.	0.	0.	0.	0.
10	191294.	194533.	0.	0.	0.	0.	0.	0.	0.	0.
20	362629.	361458.	0.	0.	0.	0.	0.	0.	0.	0.
30	346969.	465239.	0.	0.	0.	0.	0.	0.	0.	0.
40	536879.	709935.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
70	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
110	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
120	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
130	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
140	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
150	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

II PROGRAM DETAILS

Introduction

The Harvard Forest Management Simulator (MOD 1) is a 7090 Fortran II program for compilation with the Fortran Monitor System on the IBM 7090. The program consists of a main and thirteen subroutines.

The term "batch" is used throughout this part to mean all the work to be done on a single pass through the machine. A "batch" may contain from 1 to 9,999 "tests." Each "test" has its own specified set of basic prices, costs, interest rates, catastrophes, volume table, and initial growing stock. Up to 10 policies can be tested against these basic conditions, and each policy is called a "game." A "game" may be as long as 150 years, and each simulated harvest year is called a "play."

Annual and summary outputs, graphs, and tables of comparisons of as many as six variables are provided for each game.

Control Cards - Discussion

Control cards are required to specify the basic conditions, to indicate the number of plays, the number of games, the details of the harvesting policy (acreage cut as a function of price and age), the output required, and comparisons to be made. There are 19 types of control cards, in five categories. Not all types or all categories are required in any one game. Blank cards <u>are not</u> inserted when a type or category of card is omitted.

The categories are:

A. Card types 1 and 2 occur once in each batch.

B. Card types 3-13 occur once for each test in the batch.

Categories (cont.)

C. Card types 14-17 occur once for each game of each test.

D. Card type 18 is used for each game for which plotting is required.

E. Card type 19 is used for each graph (of three variables) required in a game.

The Card Types are:

Card type	Purpose
1	Gives name and/or date of the batch.
2	Gives the number of tests to be performed in the batch.
3	Gives the name of the growing stock for this test.
4	Gives i) Number of games to be played on this test. ii) The number of columns (for each game) from OUTPT3 to be summarized in COMPAR (see 10 iii). iii) Number of fires during this test (see 6i). iv) Number of storms during this test (see 7i).
5	Gives column numbers (in OUTPT3) to be summarized in COMPAR. (Not used if no comparisons to be made).
6	Gives i) Year of fire. (No fires allowed in years with storms). ii) Age-class destroyed by fire. iii) Maximum acreage destroyed. iv) Proportionate reduction in normal price for fire-damaged stumpage. (One card of type #6 for each fire. If there are no fires, there are no cards #6).
7	Gives i) Year of storm. (No storms allowed in years with fires.) ii) Lower age limit of destruction due to storm. iii) Prices for year of storm and for four suceeding years. (One card of type #7 for each storm. If there are no storms, there are no cards #7).
8a	Gives i) Coded coefficients of age_volume equation and code. ii) Control for punching growing stock after tenth play.

8a (cont.)

iii) Control for type of initial growing stock.

iv) Used when price series is desired. Designates the point in a series of 250 where the prices for the test will start. Any one of the first 100 in the basic series of 250 prices may be chosen. (See 9 viii).

8b Gives i) First and last years of volume/age curve, increment between years, and number of ordinates given.

ii) Control for punching growing stock after tenth play.

iii) Control for type of initial growing stock.

iv) Used when price series is desired. Designates the point in a series of 250 where the prices for the test will start. Any one of the first 100 in the basic series of 250 prices may be chosen. (See 9 viii).

(Card types 8a and 8b are mutually exclusive, but one card of this type must occur in each test and must be consistent with other control cards as noted below).

9 Gives i) Age at which growing stock first provides merchantable volume.

ii) Rate of interest on bank loans.

iii) Rate of interest on bank account.

iv) Land tax, per acre.

v) Severance tax, per dollar of stumpage.

vi) Maintenance cost, per acre.

vii) Harvesting cost, per MBF cut.

viii) Price of stumpage if this be constant for the test (see 8a iv, 8b iv and 11).

ix) Initial bank account (or bank loan), if any.

10 Gives i) Number of plays (per game) during this test.

ii) Control for printing OUTPT1 and OUTPT2.

iii) Control for constructing the tables of OUTPT3 and calling PLOT1 (see 4ii).

iv) Control for printing OUTPT3. (see 10 iii).

11 Gives 250 basic prices from which the sub-series of (NOPLAY) prices for this test will be taken. (see 9 viii).

12 Gives up to 31 ordinates of volume/age curve. (see 8a and 8b).

13 Gives 151 frequencies in non-stocked and age-classes 0-149 when initial growing stock is not generated by the program. Frequencies must add to 1000. (see 8a and 8b, iii).

14 Gives game name.

15 Gives up to ten prices - the upper limits of the class intervals of price used in setting harvesting policy.

16 Gives up to ten upper limits for acreage to be harvested as a function of price.

17 Gives up to ten lower limits of age of growing stock to be harvested as a function of price. (Cards 15, 16, 17 constitute the harvesting policy for a game and must be mutually consistent. For instance, the first entry on cards 16 and 17 designates the allowable cut and lower age limit of cutting for any price from zero through the price shown as first entry in card 15. The second entry in cards 16 and 17 designates the allowable cut and lower age limit for cutting for any price higher than the first entry in card 15 but not higher than the second entry in that card --- and so on for up to ten class intervals of price).

18 Gives the number of graphs (of three variables each) to be plotted for this game.

19 Gives
- i) Three variables (by column number in OUTPT3)to be plotted on this graph.
- ii) Symbols to be used in plotting.
- iii) Plotting scales -- one for each page of this graph. (A page contains 51 points. Thus, if NOPLAY = 150, there will be three pages per graph).

A more detailed description of the entries required in each type of control card is given in the next section. A flow chart indicating the periodicity in the deck of control cards, and the various options to be exercised, follows these instructions.

Control Cards - Instructions

Card type	Cols.	F'mat	Symbol	Contents
1	1-25	5A5	BATCH(I)	Identification of batch of tests. (I=1,5)
2	1-4	I4	NTESTS	Number of tests to be performed in this batch.
3	1-25	5A5	GSNAM(I)	Identification of growing stock for this test. (I=1,5)
4	1-4	I4	NOGAME	Number of games in this test.
	5-8	I4	IKOL	The number of columns of OUTPT3 to be summarized in COMPAR.
	9-12	I4	NOFIRS	Number of fires occurring during this test. ($0 \leq$ NOFIRS ≤ 5)
	13-16	I4	NOSTMS	Number of storms during this test. ($0 \leq$ NOSTMS ≤ 3)
5*	1-4	I4	KOL(1)	Column of OUTPT3 to be summarized in COMPAR.
	5-8	I4	KOL(2)	Column of OUTPT3 to be summarized in Compar.
	9-12	I4	KOL(3)	Column of OUTPT3 to be summarized in COMPAR.
	13-16	I4	KOL(4)	Column of OUTPT3 to be summarized in COMPAR.
	17-20	I4	KOL(5)	Column of OUTPT3 to be summarized in COMPAR.
	21-24	I4	KOL(6)	Column of OUTPT3 to be summarized in COMPAR.
6*1/	1-4	I4	IFIRE(I)	Year of occurrence of fire. (I=1,NOFIRS)

* Indicates cards for optional operations. If an optional operation is not required, do not submit blank cards.

1/ One card for each of a maximum of five fires. If fewer than five fires are to occur, fewer than five cards will be used.

Card type	Cols.	F'mat	Symbol	Contents
6* cont.				
	5-9	F5.2	FIRAGE(I)	10-year age-class affected by fire. (I=1,NOFIRS)
	10-13	I4	KSIZE(I)	Maximum acreage destroyed. (I=1,NOFIRS)
	14-18	F5.2	FIRPRP(I)	Percentage reduction for price of salvaged stumpage. (I=1,NOFIRS)
7* 1/	1-4	I4	ISTORM(I)	Year of occurrence of storm. (I=1,NOSTMS)
	5-9	F5.2	STMAGE(I)	Lower age limit of destruction. (I=1,NOSTMS)
	10-14	F5.2	STMPRI(I,1)	Price of stumpage in year of storm. (I=1,NOSTMS)
	15-19	F5.2	STMPRI(I,2)	Price of stumpage in year following the storm. (I=1,NOSTMS)
	20-24	F5.2	STMPRI(I,3)	Price of stumpage two years after the storm. (I=1,NOSTMS)
	25-29	F5.2	STMPRI(I,4)	Price of stumpage three years after the storm. (I=1,NOSTMS)
	30-34	F5.2	STMPRI(I,5)	Price of stumpage four years after the storm. (I=1,NOSTMS)
8 2/	1-10	F10.0	BETA0	Coded intercept in volume/age equation. 3/
	11-20	F10.0	BETA1	Coded coefficient of linear term in volume/age equation.
	21-30	F10.0	BETA2	Coded coefficient of quadratic term in volume/age equation.
	31-40	F10.0	BETA3	Coded coefficient of cubic term in volume/age equation.
	41-50	F10.0	CODE	Code for volume/age equation.

1/ One card for each of a maximum of three storms. If there are to be fewer than three storms, fewer than three cards will be used.
2/ Data for volume/age equation and volume/age curve are mutually exclusive.
3/ Coefficients are coded to ensure format F10.0.

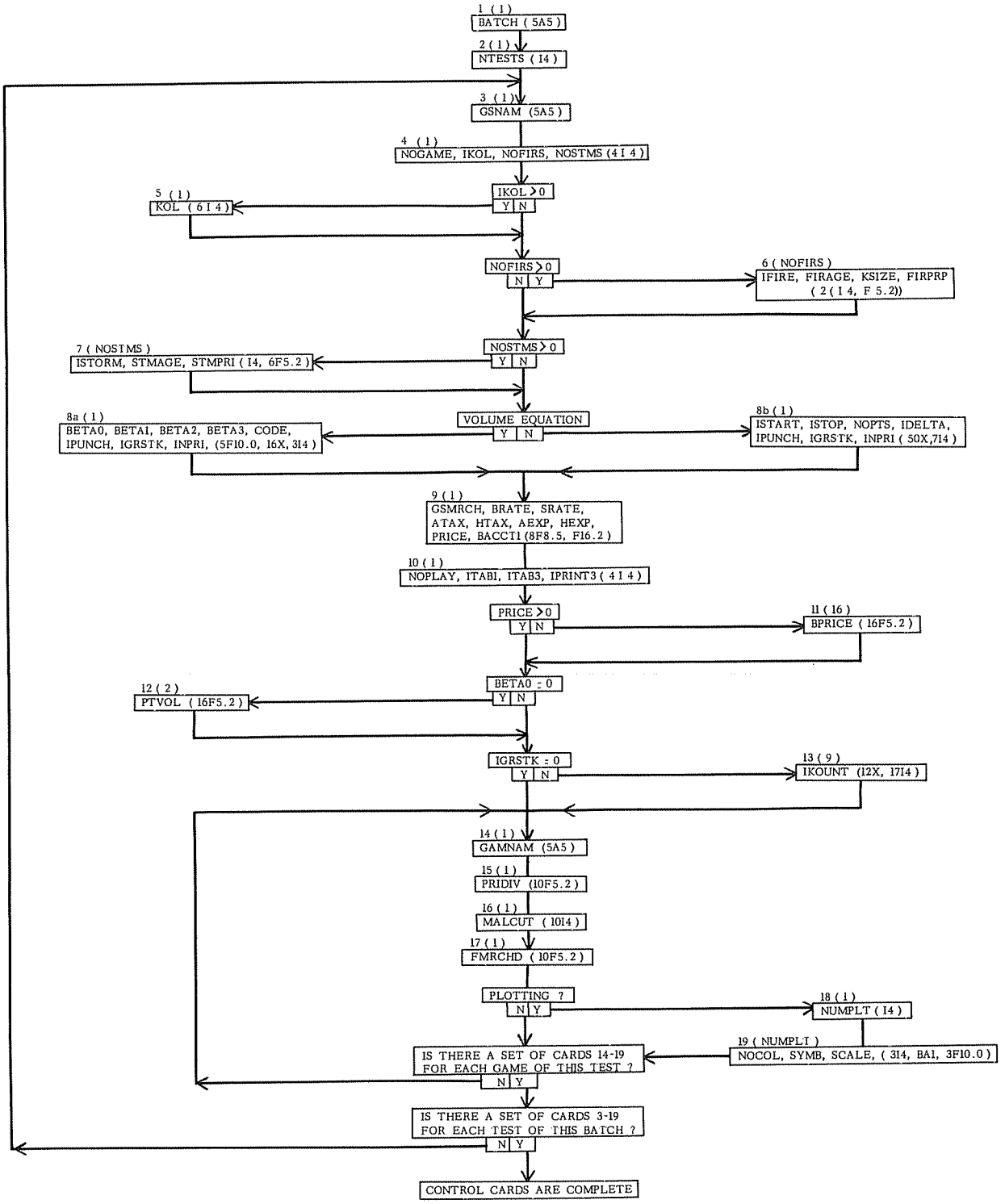
Card type	Cols.	F'mat	Symbol	Contents
8 cont.				
	51-54	I4	ISTART	First year of volume curve to be read in on cards.
	55-58	I4	ISTOP	Final year of volume curve to be read in on cards.
	59-62	I4	NOPTS	Number of volume points to be read in on cards.
	63-66	I4	IDELTA	Years from point to point on volume curve.
	67-70	I4	IPUNCH	Punch control for growing stock after tenth year. 0 Do not punch. 1 Punch 151 frequencies.
	71-74	I4	IGRSTK	Controls generation of initial growing stock. 0 Generate 1000 acres of uniform growing stock (10 acres in each year of age, 00-99). 1 Read growing stock from cards, potential ages from non-stocked to 149 years old.
	75-78	I4	INPRI	Used when a price series is desired. YPRICE(I)=BPRICE(I+INPRI), ($0 \leq$ INPRI ≤ 100)
9	1-8	F8.5	GSMRCH	Minimum age at which growing stock has volume.
	9-16	F8.5	BRATE	Interest rate on bank loans, in percent.
	17-24	F8.5	SRATE	Interest rate on savings, in percent.
	25-32	F8.5	ATAX	Land tax, dollars per acre.
	33-40	F8.5	HTAX	Harvesting tax, proportion of gross stumpage.
	41-48	F8.5	AEXP	Maintenance expense, dollars per acre.
	49-56	F8.5	HEXP	Harvesting expense, dollars per MBF.

Card type	Cols.	F'mat	Symbol	Contents
9 cont.				
	57-64	F8.5	PRICE	If non-zero, constant price of stumpage; if zero, series of 250 prices to be provided on cards of type 11.
	65-80	F16.2	BACCT1	Initial bank account. (Negative if there is an initial bank loan).
10	1-4	I4	NOPLAY	Number of plays in each game of this test.
	5-8	I4	ITAB1	Controls printing of OUTPT1 and OUTPT2. -1 Call OUTPT1 and OUTPT2 on first, tenth, last plays only. 0 Call OUTPT1 and OUTPT2 on first ten and last plays. K Call OUTPT1 and OUTPT2 on first ten, last, and every Kth intervening play. (Note: OUTPT1 and OUTPT2 are called automatically in years of fire or storm. Growing stock is punched following harvesting operations in years of fire or storm).
	9-12	I4	ITAB3	Controls preparation of OUTPT3 and PLOT1. 0 Do not call OUTPT3 or PLOT1. 1 Call OUTPT3 only. 2 Call OUTPT3 and PLOT1. (Note: If OUTPT3 is not called, neither COMPAR nor PLOT1 can be used).
	13-16	I4	IPRNT3	Controls printing of OUTPT3. 0 Do not print OUTPT3. 1 Print OUTPT3.
11*		16F5.2	BPRICE(I)	Sixteen optional cards containing 250 prices. (I=1,250)
12*		16F5.2	PTVOL(I)	One or two cards containing points on the volume curve. (I=1,NOPTS), (NOPTS $\leq$31)
13*		12X17I4	IKOUNT(I)	Nine cards containing 151 frequencies, representing the number of acres in each age from non-stocked to 149 years old. (I=1,151)

Card type	Cols.	F'mat	Symbol	Contents
14		5A5	GAMNAM(I)	Description of each game within a test.(I=1,5)
15		10F5.2	PRIDIV(I)	Control prices to define cutting practices. ($1 \leq I \leq 10$)
16		10I4	MALCUT(I)	Allowable cuts associated with price ranges of card Type 15.($1 \leq I \leq 10$)
17		10F5.2	FMRCHD(I)	Minimum cutting ages associated with price ranges of card Type 15. ($1 \leq I \leq 10$)
18*		I4	NUMPLT	Number of graphs to be plotted -- one card for each game that involves plotting.
19* 1/		I4	NOCOL(1)	First column of OUTPT3 to be plotted.
		I4	NOCOL(2)	Second column of OUTPT3 to be plotted.
		I4	NOCOL(3)	Third column of OUTPT3 to be plotted .
		A1	SYMB(1)	Symbol to be used in plotting first column.
		A1	SYMB(2)	Symbol to be used in plotting second column.
		A1	SYMB(3)	Symbol to be used in plotting third column.
		F10.0	SCALE(1)	Constant to be used in scaling first 50 points.
		F10.0	SCALE(2)	Constant to be used in scaling second 50 points.
		F10.0	SCALE(3)	Constant to be used in scaling third 50 points.

1/ One card for each graph wanted.

FLOW CHART ILLUSTRATING THE PERIODICITY OF THE CONTROL CARDS



NOTE: THE NON-BRACKETED NUMBERS OUTSIDE THE BOXES GIVE CARD TYPE. BRACKETED NAMES OR NUMBERS INDICATE HOW MANY CARDS OF THAT TYPE MUST BE INCLUDED. CARDS 14 AND FOLLOWING ARE MADE FOR EACH GAME OF EACH TEST.

Discussion of Subroutines

The following paragraphs contain a concise description of each subroutine. To obtain a full understanding of the operations of each subroutine and the interrelations among them, it will be necessary to study the Fortran II listings and the flow-charts.

MAIN

The MAIN routine reads BATCH(I) and NTESTS, the description of the batch and the number of tests of basic conditions. This input is also printed. The routine counts tests, games, and plays, and checks various parameters to control the calling sequence for the thirteen subroutines. Fire, storm, and bankruptcy conditions are checked each play to control the use of these special routines. Card types 1 and 2 are read.

INPUT2

INPUT2 reads (and prints) the basic conditions to be set for a test, including type of initial growing stock, number of games to be applied to each of the basic conditions, number and details of fires and storms, the number (and list of numbers) of columns of OUTPT3 to be printed by COMPAR. The data necessary to the construction of the volume table, punching and printing controls, the starting point of the price series (INPRI) if a variable series is used, the constant stumpage price (when appropriate), costs and tax rates, merchantable age of growing stock, and initial bank account are all read and many of these are printed. The number of plays per game and number of games for this test are read by this subroutine. If the initial growing stock is not uniformly distributed, 151 frequencies (IKOUNT) are read. This routine reads card types 3 through 13.

VOLTAB

VOLTAB creates an age-related yield table of 150 entries, from age zero to age 149 and prints the table. The table is produced either from the coefficients of the volume equation or from the data given on the volume curve.

INPUT1

INPUT1 reads the details of a game, including the game name (GAMNAM), the upper limits of the price intervals (PRIDIV), the associated allowable cuts (MALCUT) and minimum cutting age (FMRCHD). Up to ten class intervals are provided. For example, the following might be read:

Card type	Entries									
15	1.00	2.00	4.00	5.00	7.00	8.00	9.00	10.50	11.00	999.99
16	0	15	30	40	50	60	70	100	150	200
17	999.	90.	80.	75.	70.	65.	60.	50.	50.	50.

These data give a price responsive harvesting policy:

a) If price is $1.00 or less, no harvest is made that year.

b) For price between $1.01 and $2.00, fifteen acres will be harvested if such exist that are 90 years of age or older.

c) For price between $2.01 and $4.00, thirty acres are harvested if such exist that are 80 years of age or older.

d) Finally, for price greater than $11.01, acres 50 years and older are harvested, up to an upper limit of 200 acres.

Oldest acres are always harvested first.

A harvesting policy independent of price could be expressed:

Card type	Entries
15	999.99
16	20(say)
17	50.(say)

One with a threshold price of $3.00 would be expressed:

Card type		Entries
15	2.99	999.99
16	0	20(say)
17	999.	70.(say)

The routine reads card types 14, 15, 16, 17.

GRSTK1

GRSTK1 creates 1000 acres of initial growing stock, either uniformly distributed, ten acres to each age-class from 0 to 99; or distributed according to the entries on card type 13 (IKOUNT), in age-classes non-stocked to 149.

The growing stock is summarized by age, by ten-year age-classes, by age-class 100-149, and is checked to ensure that no stock is greater than 149 years old. Volume is computed and printed along with these frequencies in the various age-classes.

FIRE

FIRE first ascertains if there is acreage in the age-class potentially affected by the fire. If there is, the routine salvages the stumpage, if any, and records the volume salvaged, the acres burned, and the ID number of the first and last acre burned.

There are three possible situations with regard to the sequencing of the ID numbers of the acreage following a fire:

a) The first acre burned has the highest ID number in the oldest age-class of existing stumpage.

b) The last acre burned has the lowest ID number in the youngest age-class of existing stumpage.

c) All other situations.

Under a and b no resequencing of ID numbers is required. The program merely sets all burned acreage to non-stocked category (to become zero-age when PLAY1 is called). Under a the program indicates the new ID number of the next acre to be harvested (by setting NEXT = LAST).

Under b the burned acreage was the youngest acreage available. After burning it is still the youngest acreage available.

Under condition c burned acres are rendered non-stocked and given new ID numbers reflecting the fact that they are now the "youngest" existing acreage. All acreage which, prior to the fire, was younger than the burned acreage are renumbered.

STORM

STORM merely sets an unlimited "allowable cut", sets the minimum cutting-age (salvaging age) to reflect the lower age limit of storm damage and substitutes the specified new prices for the year of the storm and for the next four years in place of the regular price series.

PLAY1

PLAY1 is the harvesting routine. First, the routine advances by one year the age of each acre. Then, the yearly harvest is set by reference to the yearly price and the policy set on cards 15, 16, 17 (as modified by FIRE and STORM).

If cutting is authorized, and if the appropriate acreage is available, timber is harvested up to the limits set by the policy, or by the existing stumpage.

Harvested volume is tallied. Harvested acres are reduced to zero-age. Residual growing stock is tallied by age, ten-year age-classes,

age-class 100-149, and checked for acreage older than 149 years. Residual growing stock volume is computed.

CASH1

CASH1 calculates stumpage and interest income, and cumulative incomes. Current and cumulative interest and other costs, taxes, and net income are computed. Liabilities, assets, and net worth are determined. The "effective" net worth (REDINK) is computed.

OUTPT1

OUTPT1 prints residual growing stock by age, summary of acres by ten-year age-class, age-class 100-149 (overage units), and indicates number of non-stocked units.[1/] Volume harvested this play, cumulative volume harvested, and residual volume in growing stock are also printed. Upon command (IPUNCH and KPUNCH) the existing growing stock is punched -- by frequencies in age-classes non-stocked to 149, with appropriate identifying numbers.

OUTPT2

OUTPT2 prints the current income and cost and net worth statement computed in CASH1.

OUTPT3

OUTPT3 creates and stores for use in PLOT1 and COMPAR (and, possibly, in printing) two arrays of variables. IVAR(I,J) for each year of play (J) stores 18 variables concerned with physical production and growing stock age-frequencies. VAR(I,J) for each year (J) stores 27 variables concerned

---

1/ Newly harvest acreage is shown in zero class. The non-stocked category was inserted for future use.

with financial matters -- gross income, costs, taxes, net income, assets, liabilities, cumulative incomes and costs, and net worth.

If IPRNT3 = 1 at the end of a game, then OUTPT3 prints IVAR(I,J) and VAR(I,J).

COMPAR and PLOT1 can be exercised only if OUTPT3 is called to store IVAR(I,J) and VAR(I,J).

PLOT1

PLOT1, upon command, creates graphs of sets of three of the 45 variables of OUTPT3. (9,999 such graphs can be created for each game.) Variables are referred to by their column number in OUTPT3. A single card (of type 18) for each game tells the program how many (NUMPLT) graphs of three variables are to be created. Each graph consists of 51 coordinate points for each variable. Three pages is the maximum size of a graph.

For each graph a card (of type 19) is required to specify the column numbers of the variables to be plotted, the symbol associated with each variable, and the scaling for each page of the graph. (If fewer than three variables are wanted on a graph, repeat one or more of the column numbers and symbols. If the same scale is wanted on one or more pages of the graph, repeat scaling inputs as required.)

Variables are read from OUTPT3 into storage places, a line (45 values) at a time. The variables to be plotted are chosen, scaled, checked for proper scaling, and plotted. The procedure is repeated until a graph is completed. Improper scaling (ordinate >100) leads to termimation of the plotting of that page of the graph.

PLOT1 reads card types 18 and 19.

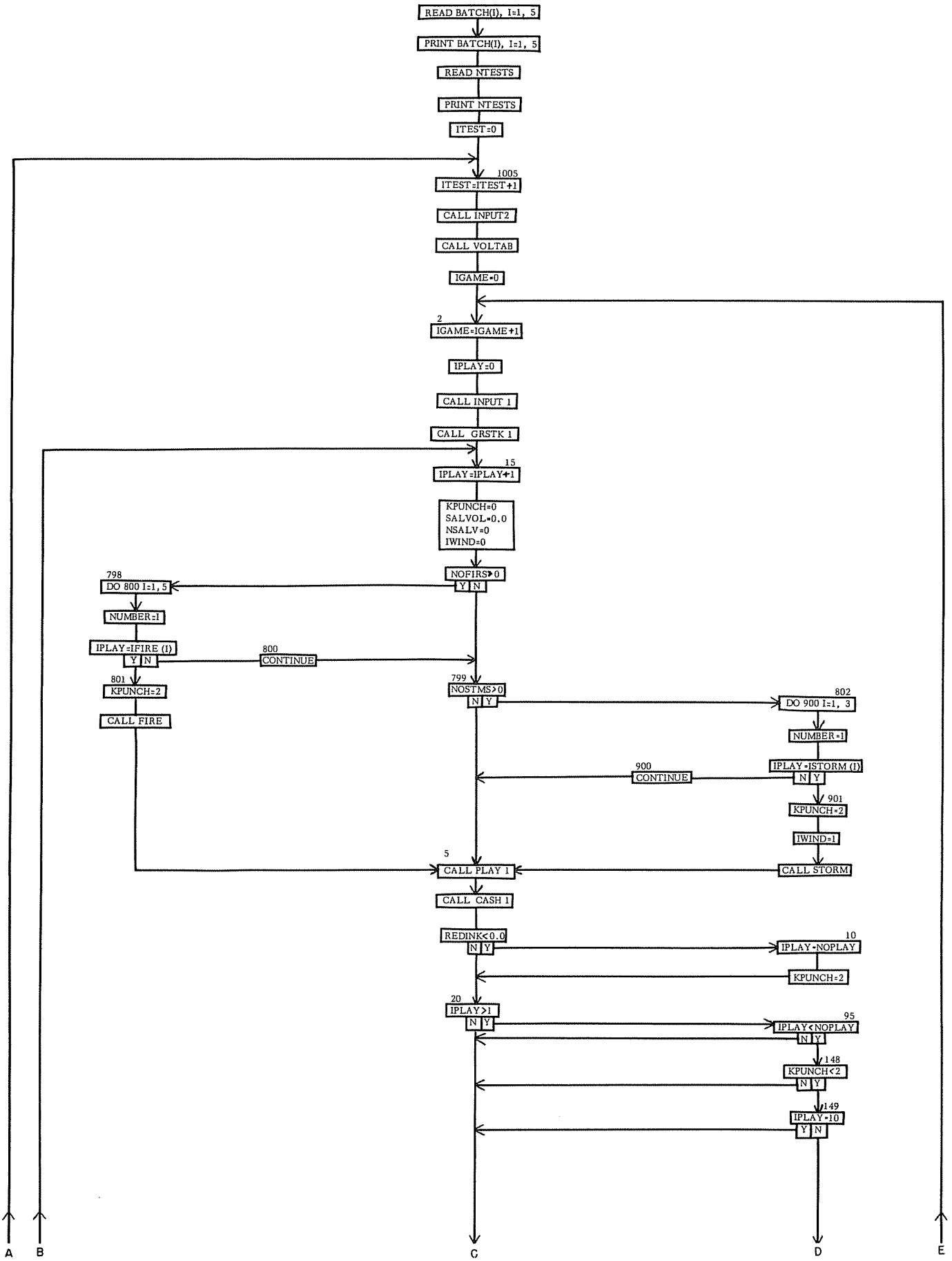
COMPAR

COMPAR stores parts of up to six columns of OUTPT3 for each of as many as ten games and prints these at the end of the test. Values for the first ten plays and for every tenth play thereafter are stored and printed, one variable (for all games) per page.

Flow Charts

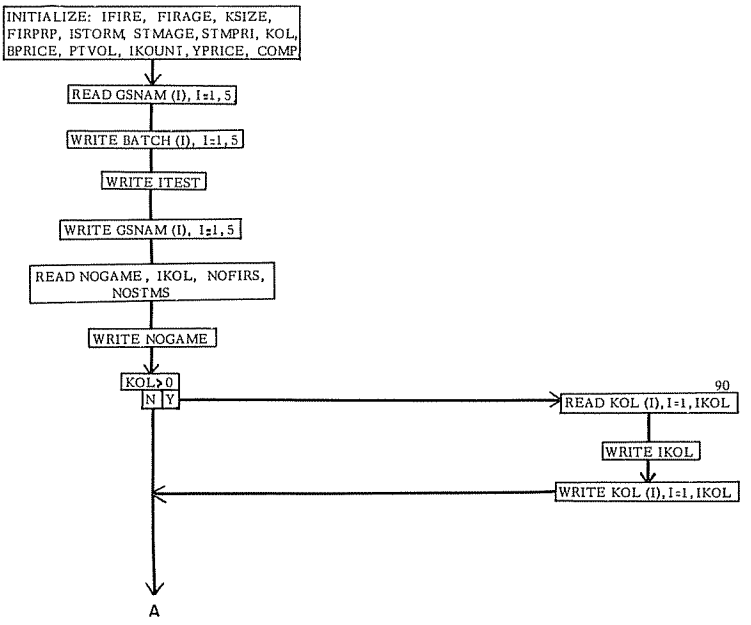
The following flow charts may be useful to those wishing to modify the program as it is presented. Small numbers appearing outside the "boxes" key the flow charts to the program listings.

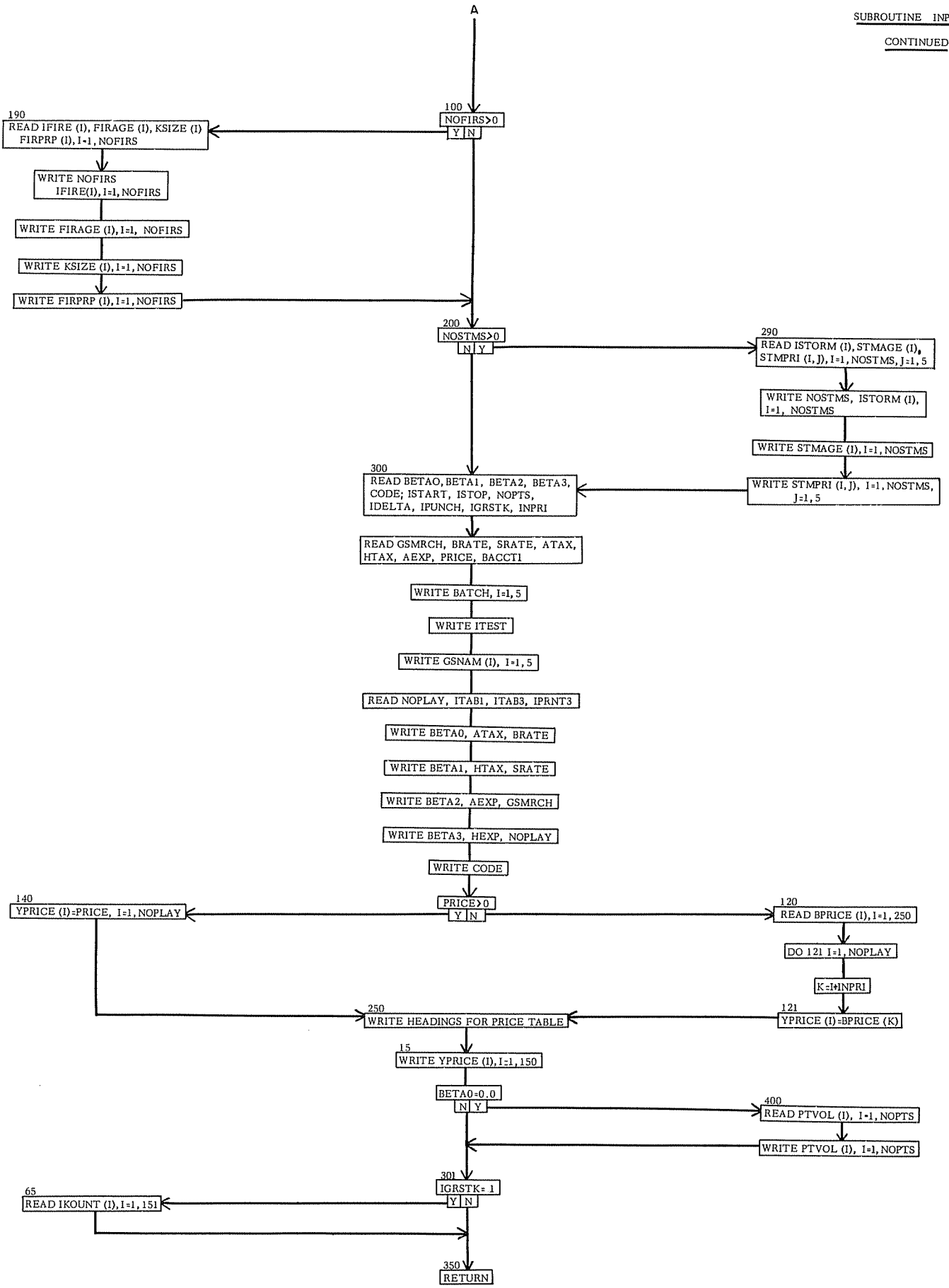
MAIN ROUTINE



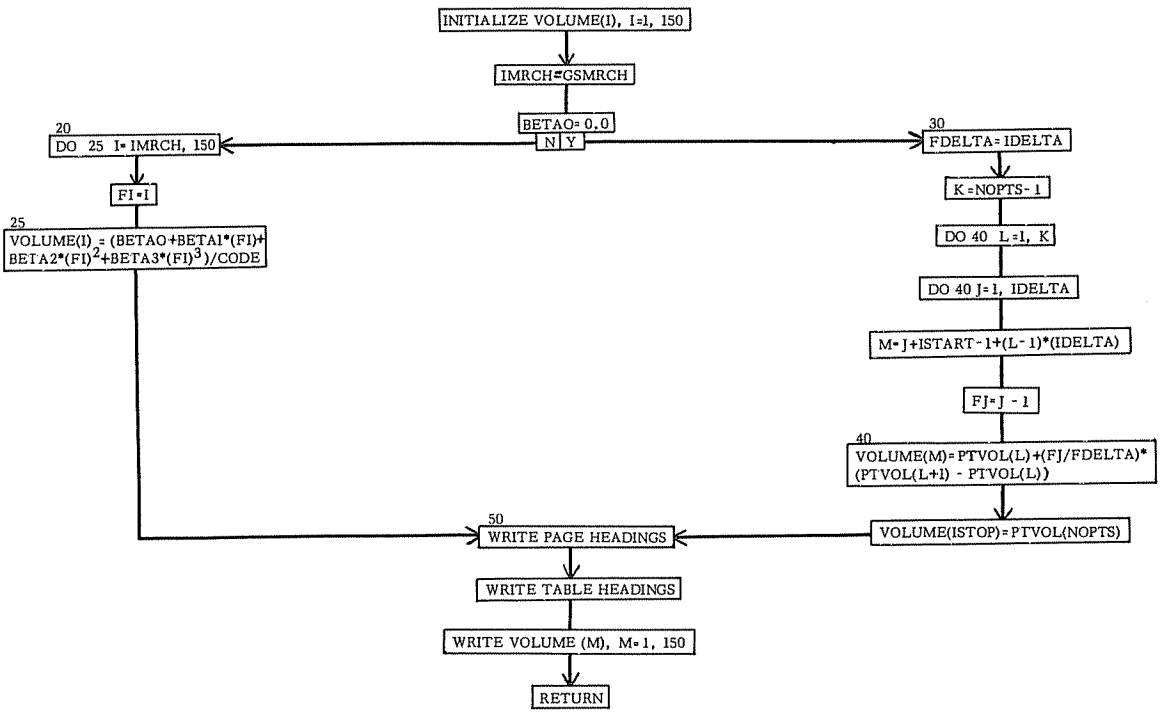
SUBROUTINE INPUT 2

SUBROUTINE INPUT 2

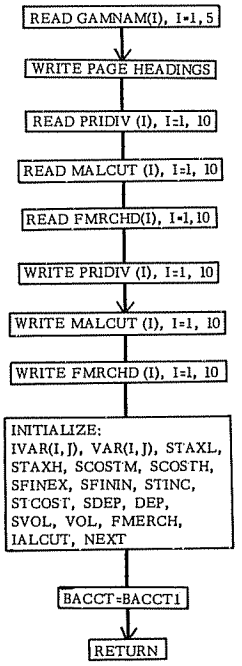



A
100
NOFIRS>0
Y N
190
READ IFIRE (I), FIRAGE (I), KSIZE (I) FIRPRP (I), I=1, NOFIRS
WRITE NOFIRS IFIRE(I), I=1, NOFIRS
WRITE FIRAGE (I), I=1, NOFIRS
WRITE KSIZE (I), I=1, NOFIRS
WRITE FIRPRP (I), I=1, NOFIRS
200
NOSTMS>0
N Y
290
READ ISTORM (I), STMAGE (I), STMPRI (I, J), I=1, NOSTMS, J=1, 5
WRITE NOSTMS, ISTORM (I), I=1, NOSTMS
WRITE STMAGE (I), I=1, NOSTMS
WRITE STMPRI (I, J), I=1, NOSTMS, J=1, 5
300
READ BETA0, BETA1, BETA2, BETA3, CODE; ISTART, ISTOP, NOPTS, IDELTA, IPUNCH, IGRSTK, INPRI
READ GSMRCH, BRATE, SRATE, ATAX, HTAX, AEXP, PRICE, BACCT1
WRITE BATCH, I=1, 5
WRITE ITEST
WRITE GSNAM (I), I=1, 5
READ NOPLAY, ITAB1, ITAB3, IPRNT3
WRITE BETA0, ATAX, BRATE
WRITE BETA1, HTAX, SRATE
WRITE BETA2, AEXP, GSMRCH
WRITE BETA3, HEXP, NOPLAY
WRITE CODE
PRICE>0
Y N
140
YPRICE (I)=PRICE, I=1, NOPLAY
120
READ BPRICE (I), I=1, 250
DO 121 I=1, NOPLAY
K=I+INPRI
121
YPRICE (I)=BPRICE (K)
250
WRITE HEADINGS FOR PRICE TABLE
15
WRITE YPRICE (I), I=1, 150
BETA0=0.0
N Y
400
READ PTVOL (I), I=1, NOPTS
WRITE PTVOL (I), I=1, NOPTS
301
IGRSTK=1
Y N
65
READ IKOUNT (I), I=1, 151
350
RETURN

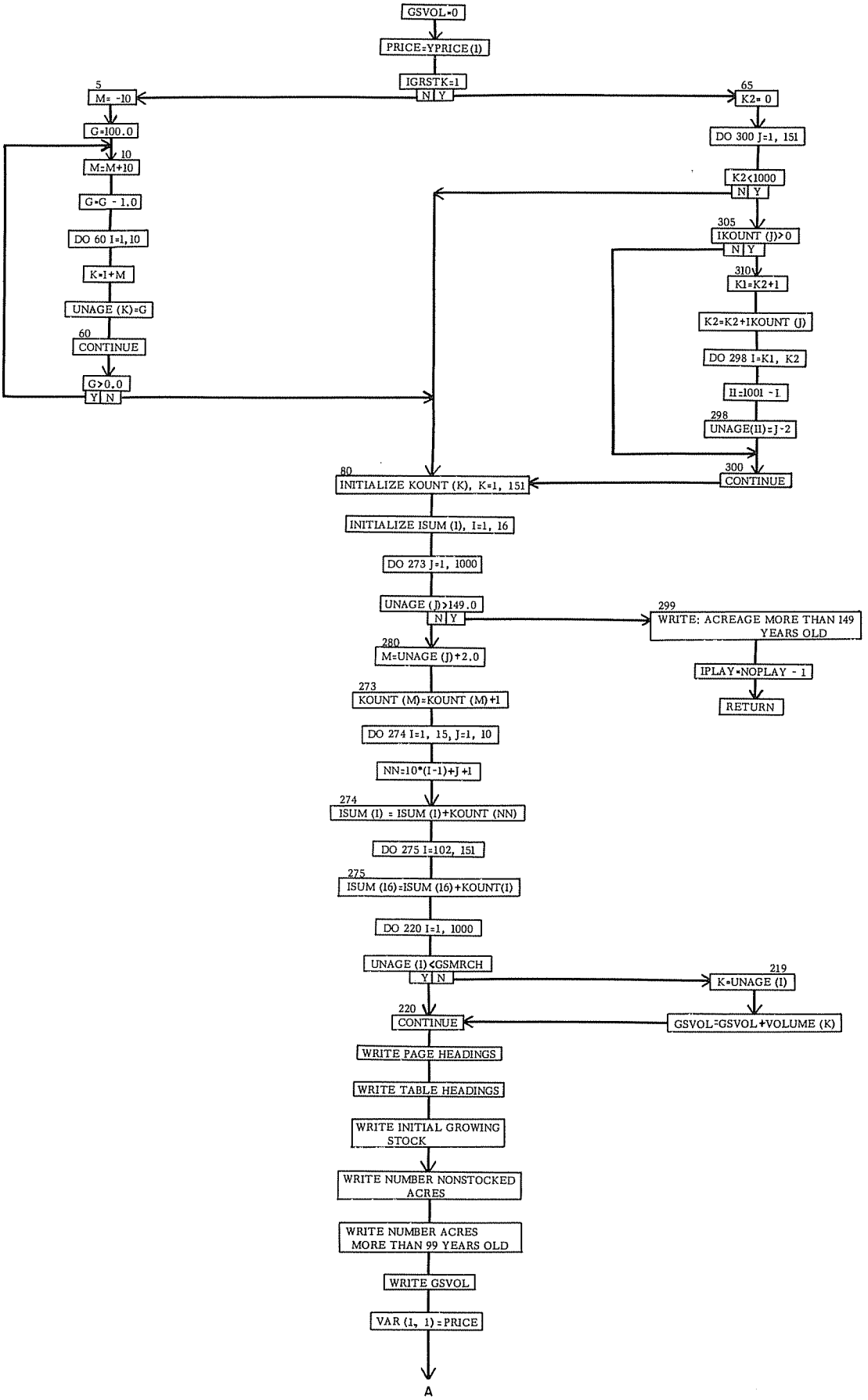
SUBROUTINE VOLTAB

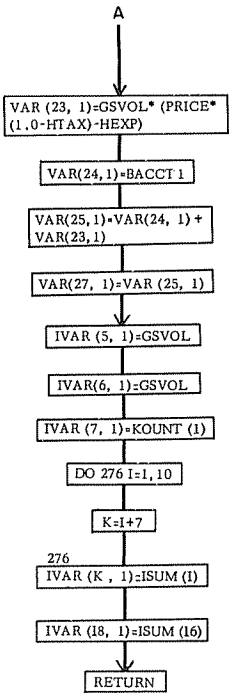


SUBROUTINE INPUT 1

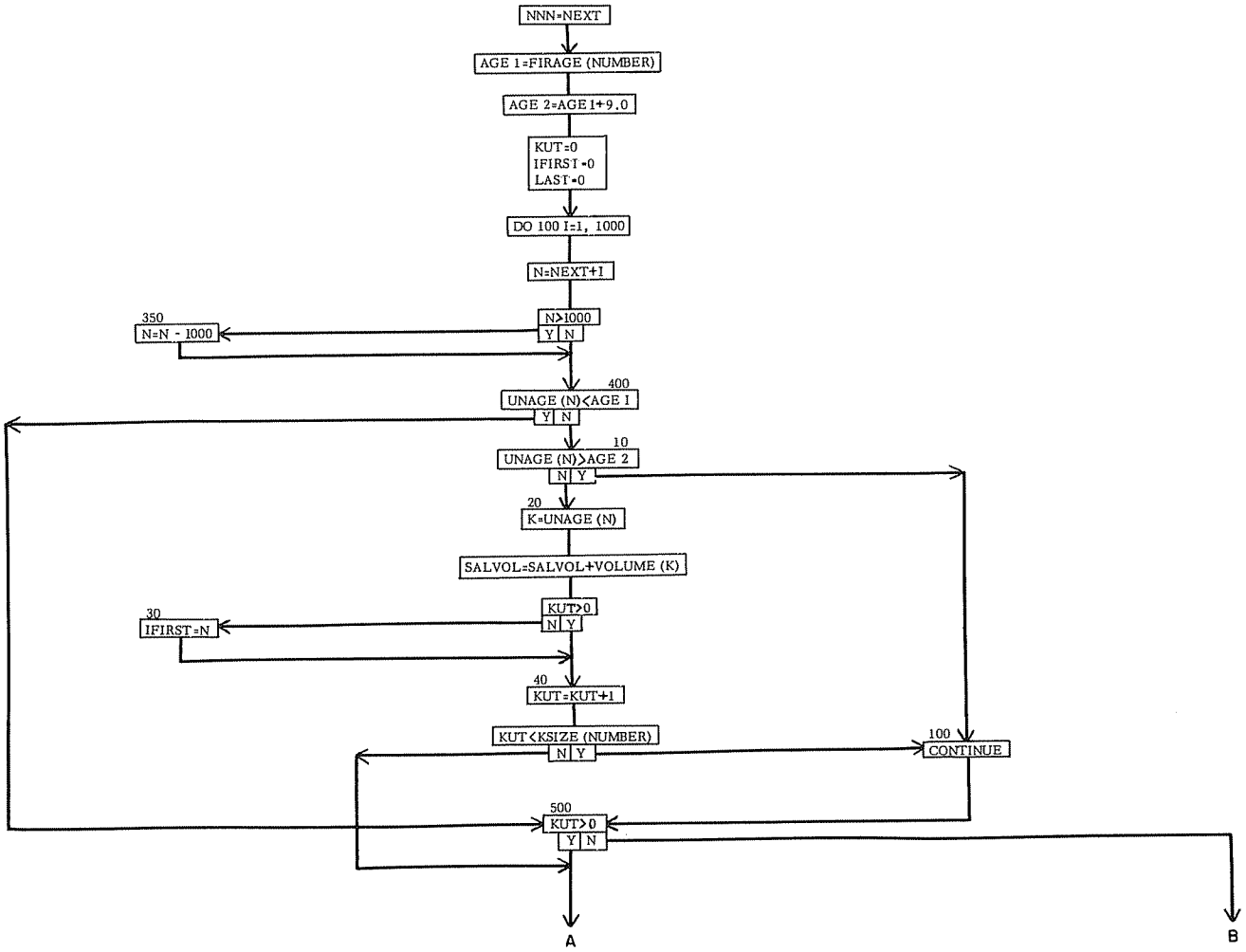


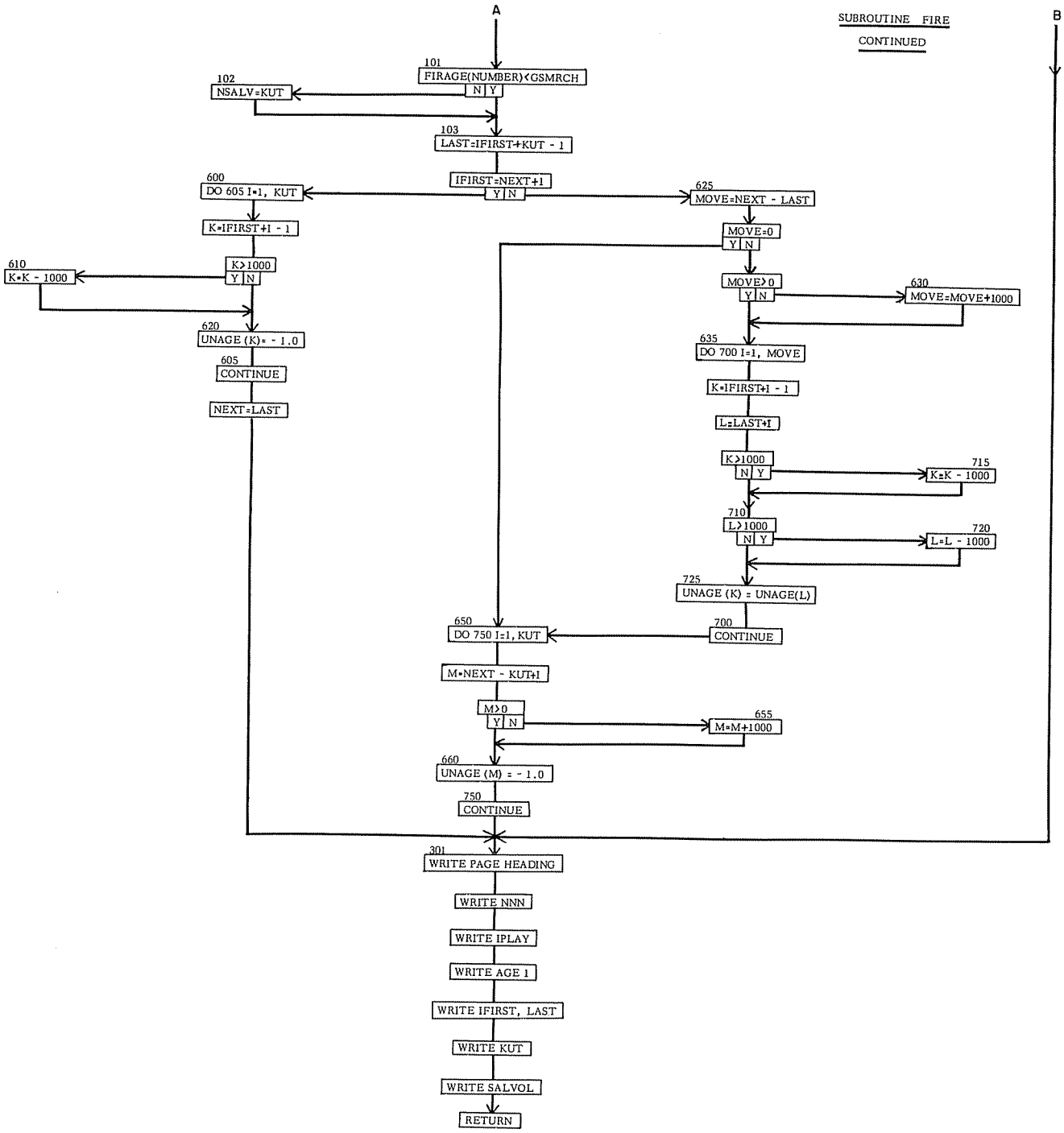
SUBROUTINE GRSTK 1





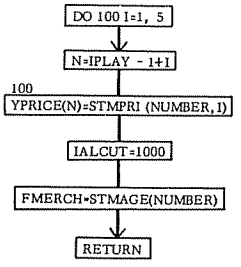
SUBROUTINE FIRE



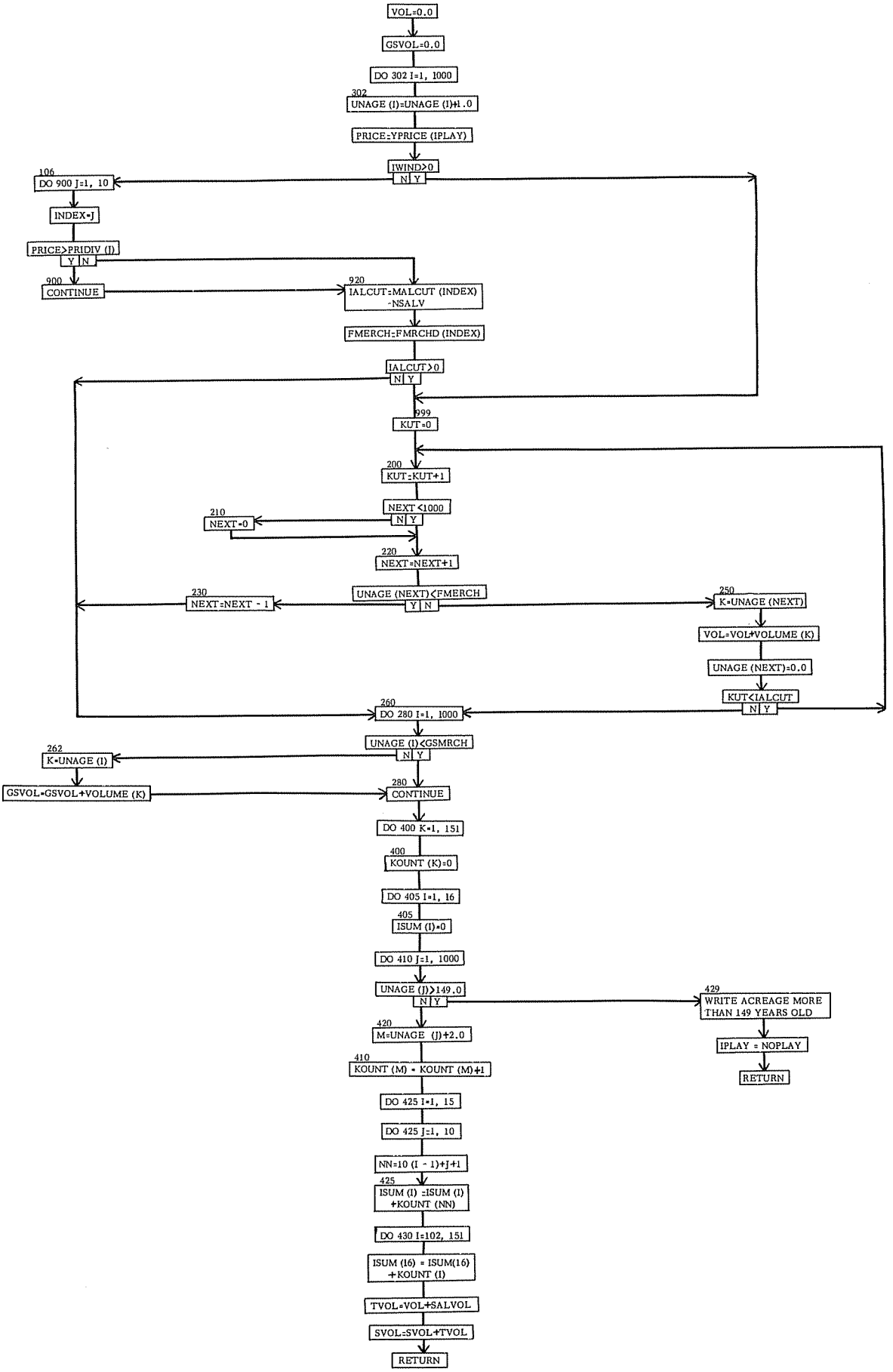


SUBROUTINE STORM

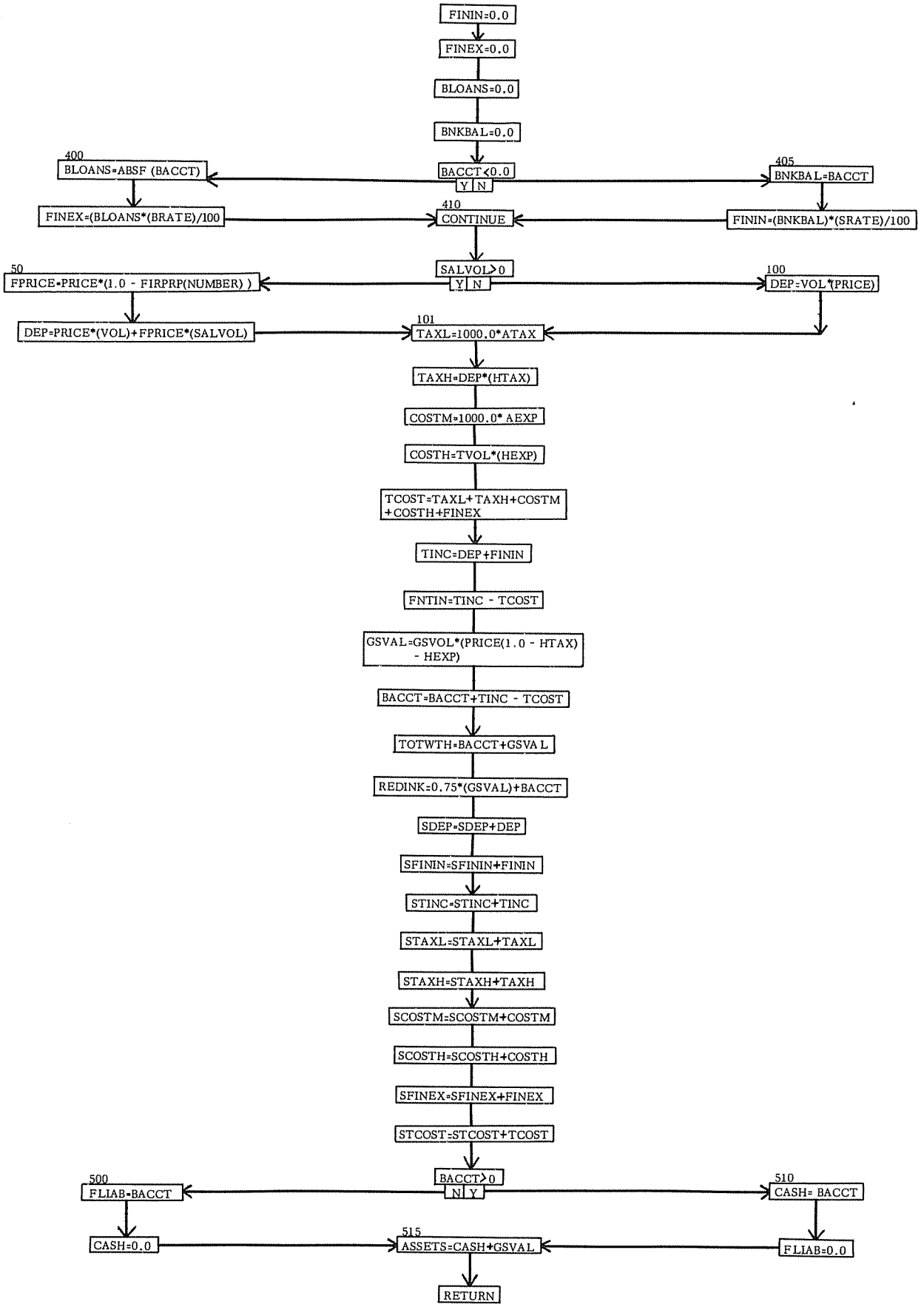
SUBROUTINE STORM



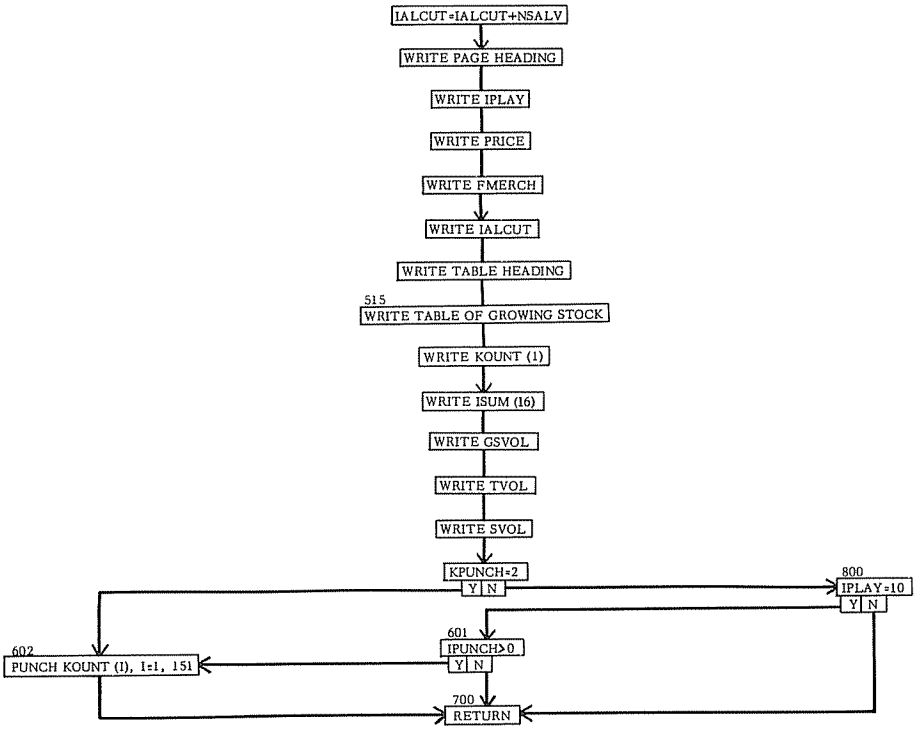
SUBROUTINE PLAY 1



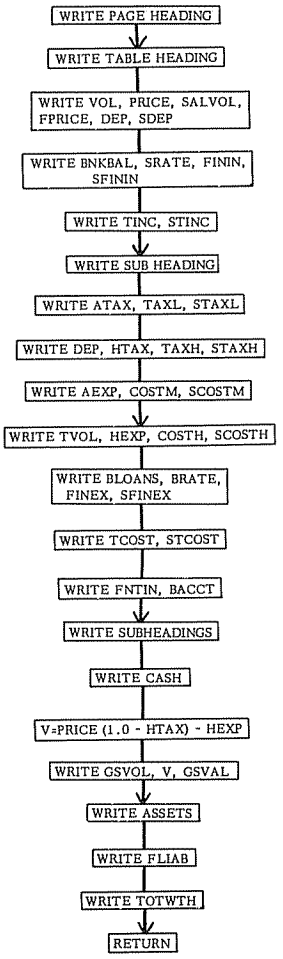
SUBROUTINE CASH 1



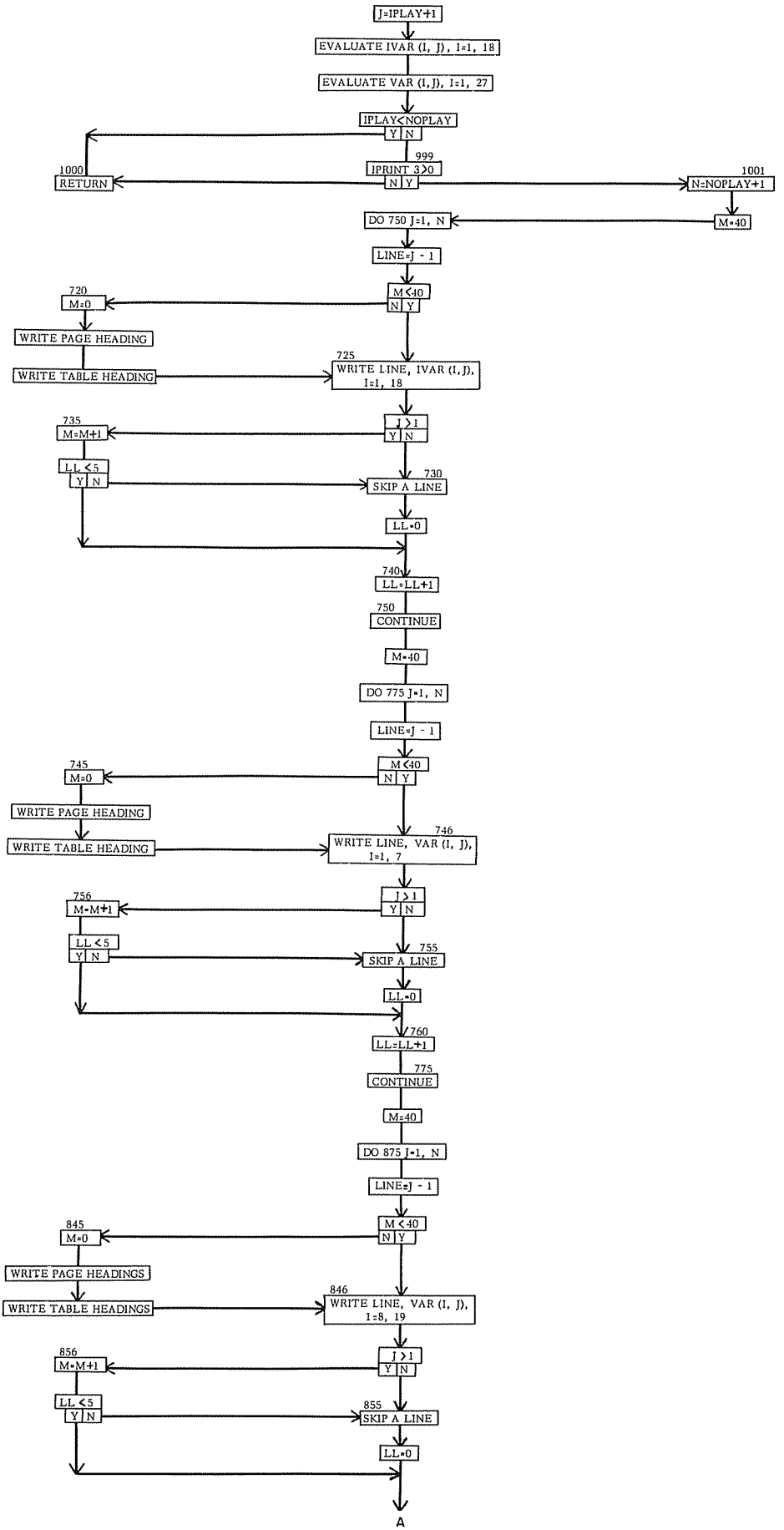
SUBROUTINE OUTPUT 1

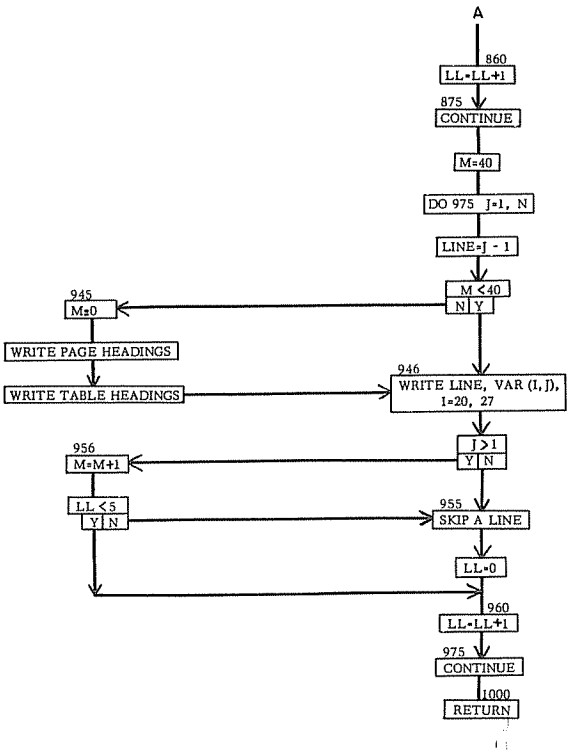


SUBROUTINE OUTPUT 2

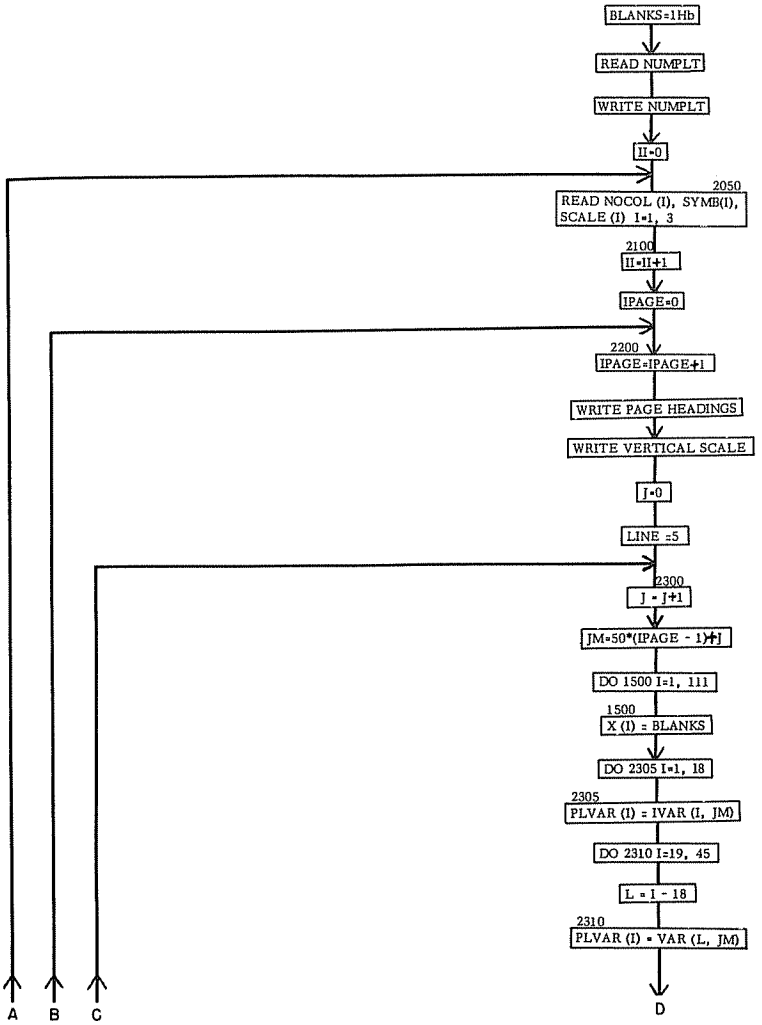


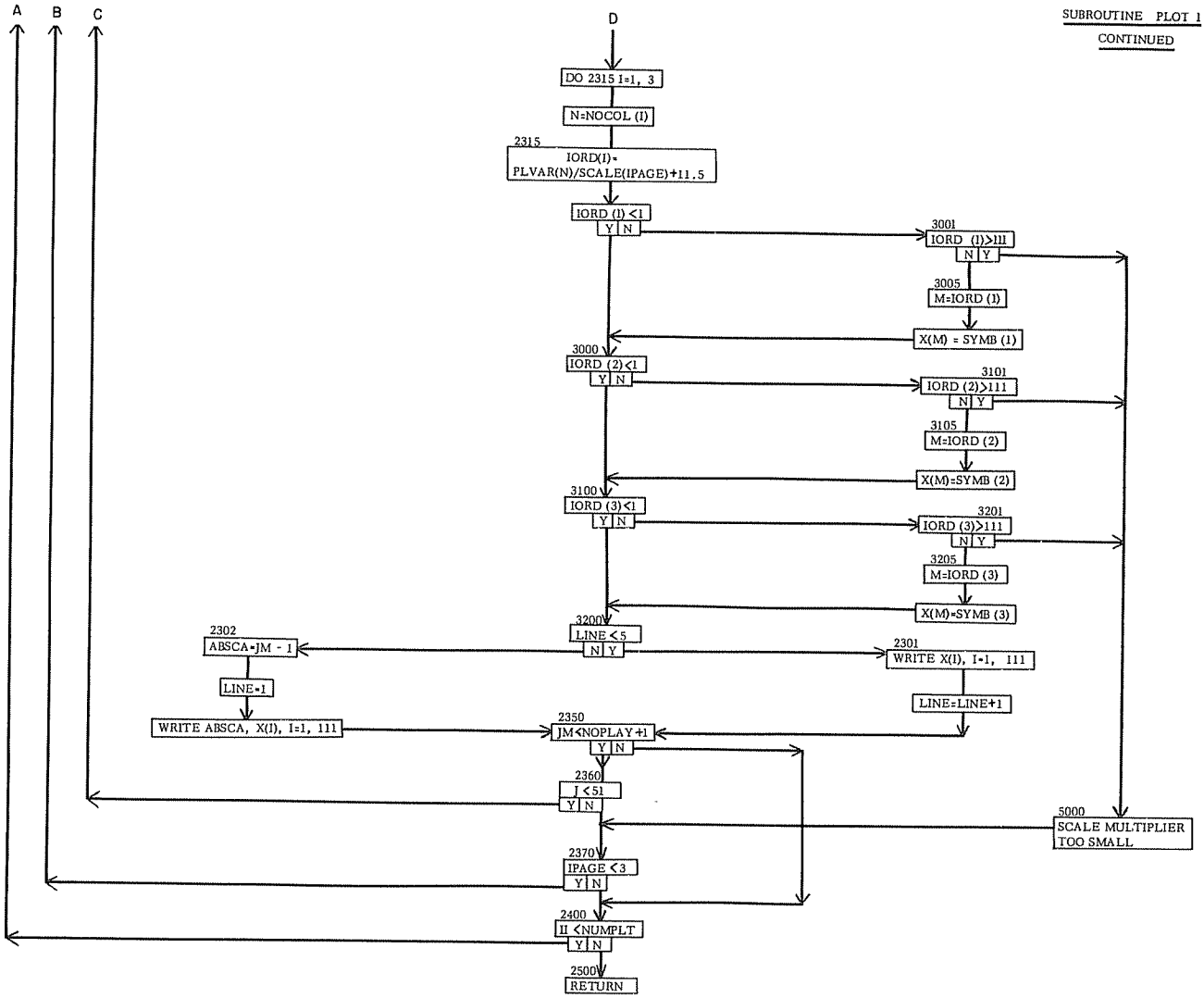
SUBROUTINE OUTPUT 3

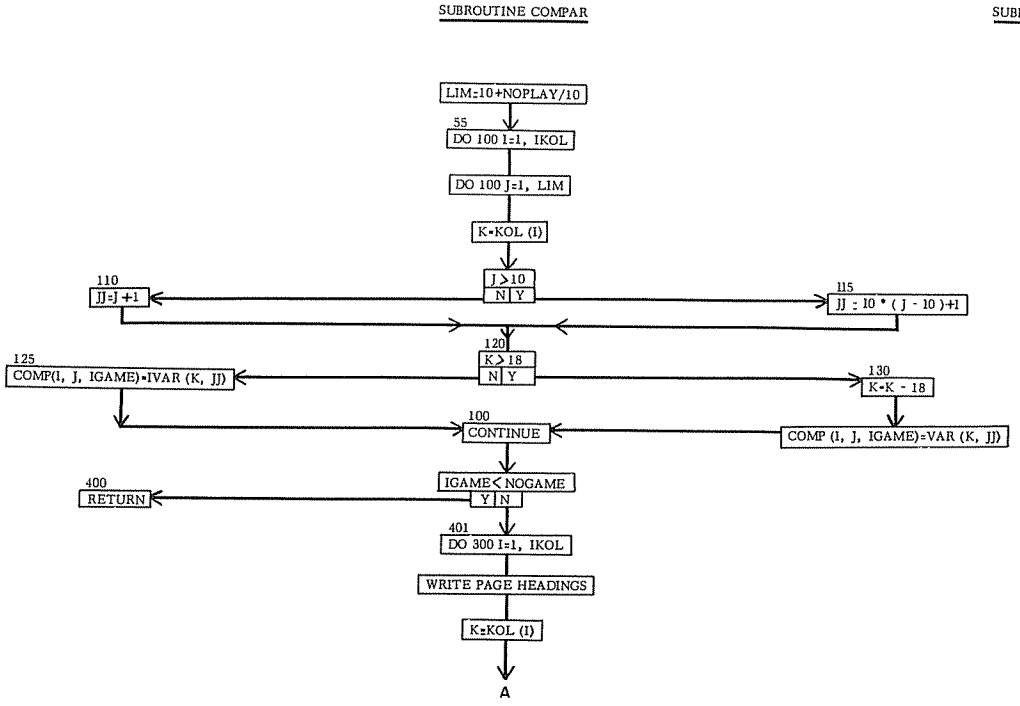


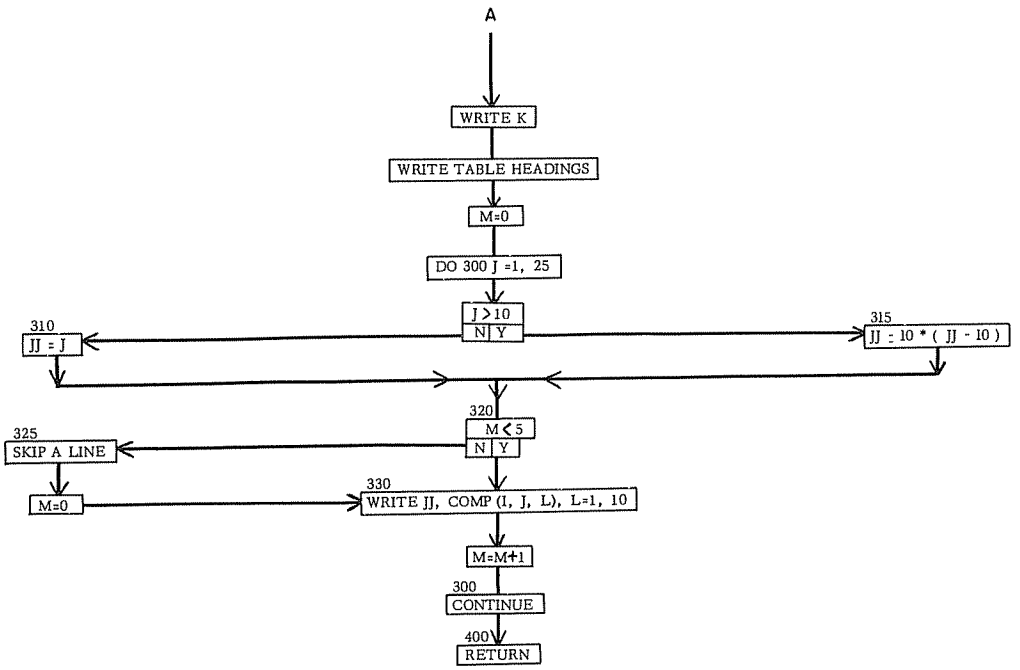


SUBROUTINE PLOT 1




A
B
C
D
SUBROUTINE PLOT 1
CONTINUED
DO 2315 I=1, 3
N=NOCOL (I)
2315
IORD(I)=
PLVAR(N)/SCALE(IPAGE)+11.5
IORD (I) <1
Y N
3001
IORD (I)>111
N Y
3005
M=IORD (I)
X(M) = SYMB (I)
3000
IORD (2)<1
Y N
3101
IORD (2)>111
N Y
3105
M=IORD (2)
X(M)=SYMB (2)
3100
IORD (3)<1
Y N
3201
IORD (3)>111
N Y
3205
M=IORD (3)
X(M)=SYMB (3)
3200
LINE <5
N Y
2302
ABSCA=JM - 1
LINE=1
WRITE ABSCA, X(I), I=1, 111
2301
WRITE X(I), I=1, 111
LINE=LINE+1
2350
JM<NOPLAY+1
Y N
2360
J <51
Y N
5000
SCALE MULTIPLIER
TOO SMALL
2370
IPAGE <3
Y N
2400
II <NUMPLT
Y N
2500
RETURN


SUBROUTINE COMPAR
SUBROUTINE COMPAR
LIM=10+NOPLAY/10
55
DO 100 I=1, IKOL
DO 100 J=1, LIM
K=KOL (I)
J >10
N Y
110
JJ=J +1
115
JJ = 10 * (J - 10)+1
120
K > 18
N Y
125
COMP(I, J, IGAME)=IVAR (K, JJ)
130
K=K - 18
100
CONTINUE
COMP (I, J, IGAME)=VAR (K, JJ)
IGAME< NOGAME
Y N
400
RETURN
401
DO 300 I=1, IKOL
WRITE PAGE HEADINGS
K=KOL (I)
A


A
WRITE K
WRITE TABLE HEADINGS
M=0
DO 300 J =1, 25
J > 10
N Y
310
JJ = J
315
JJ = 10 * (JJ - 10)
320
M < 5
N Y
325
SKIP A LINE
M=0
330
WRITE JJ, COMP (I, J, L), L=1, 10
M=M+1
300
CONTINUE
400
RETURN

Listings

The following section contains a dictionary of terms defining the variables used in the program, and a listing of the Fortran II main routine and thirteen subroutines.

```
C                 DEFINITION OF VARIABLES
C
C        THE FOLLOWING IS A LIST OF THE MORE IMPORTANT
C        VARIABLES OCCURING IN THE PROGRAM. SOME VAR-
C        IABLES HAVE BEEN OMITTED FROM THE LIST. DIMEN-
C        SIONED VARIABLES HAVE THE MAXIMUM SIZE OF THE
C        ARRAY IN PARENTHESES FOLLOWING THE DEFINITION.
C        INPUT VARIABLES HAVE MODE AND FIELD DEFINITION
C        ADDED. (REMOVE MOST IF NOT ALL COMMENT CARDS
C        BEFORE COMPILING)
C
C     AEXP     ANNUAL MAINTENANCE EXPENSES IN DOLLARS PER
C              ACRE (F8.5)
C     AGE1     LOWER AGE LIMIT OF STUMPAGE BURNED BY A FIRE
C     AGE2     UPPER AGE LIMIT OF STUMPAGE BURNED BY A FIRE
C              (AGE1 +9.0)
C     ASSETS   ASSETS OF FIRM (CASH IN BANK PLUS VALUE OF
C              GROWING STOCK)
C     ATAX     ANNUAL LAND TAX IN DOLLARS PER ACRE (F8.5)
C     BACCT    BANK ACCOUNT
C     BACCT1   INITIAL BANK ACCOUNT (F16.2)
C     BATCH    IDENTIFICATION FOR BATCH (5)(A5)
C     BETA0    INTERCEPT, VOLUME EQUATION (F10.0)
C     BETA1    LINEAR COEFFICIENT, VOLUME EQUATION (F10.0)
C     BETA2    QUADRATIC COEFFICIENT, VOLUME EQUATION
C              (F10.0)
C     BETA3    CUBIC COEFFICIENT, VOLUME EQUATION (F10.0)
C     BLOANS   BANK LOANS
C     BNKBAL   BANK BALANCE
C     BPRICE   A SET OF BASIC PRICES TO BE USED TO CREATE A
C              PRICE SERIES (250)(F5.2)
C                    YPRICE(I) = BPRICE(I + INPRI)
C     BRATE    INTEREST RATE ON BANK LOANS,IN PERCENT
C              (F8.5)
C     CASH     SAME AS BACCT, WHEN BACCT IS POSITIVE
C     CODE     CONSTANT TO REPOSITION DECIMAL POINT IN
C              CODED VOLUME COEFFICIENTS (F10.0)
C     COMP     A STORAGE ARRAY FOR VARIABLE TO BE PRINTED
C              BY COMPAR (6X25X10)
C     COSTH    ANNUAL HARVESTING COSTS (F8.5)
C     COSTM    ANNUAL MAINTENANCE COSTS(F8.5)
C     DEP      DEPOSITS (ANNUAL GROSS STUMPAGE)
C     FINEX    ANNUAL INTEREST EXPENSE
C     FININ    ANNUAL INTEREST INCOME
C     FIRAGE   AGE CLASS AFFECTED BY FIRE(5) (F5.2)
C     FIRPRP   PROPORTIONATE REDUCTION IN PRICE OF FIRE
C              DAMAGED STUMPAGE (5)(F5.2)
C     FLIAB    LIABILITIES (NEGATIVE BANK BALANCE)
C     FMERCH   USED TO SET MINIMUM AGE OF CUTTING EACH YEAR
C     FMRCHD   SETS ANNUAL MINIMUM CUTTING AGE IN RESPONSE
C              TO PRICE POLICY (10)(F5.2)
C     FNTIN    ANNUAL NET INCOME
C     FPRICE   PRICE OF FIRE DAMAGED STUMPAGE
C     GAMNAM   IDENTIFICATION FOR A GAME (5)(A5)
C     GSMRCH   AGE AT WHICH GROWING STOCK BECOMES
C              MERCHANTABLE.(F8.5)
C     GSNAM    IDENTIFICATION FOR GROWING STOCK (5)(A5)
C     GSVOL    GROWING STOCK VOLUME
C     GSVAL    CONVERTED VALUE OF GROWING STOCK
C     HEXP     COST (IN DOLLARS PER MBF) OF HAVESTING
C              (F8.5)
C     HTAX     HARVESTING TAX,IN PROPORTION OF GROSS
C              STUMPAGE(F8.5)
C     IALCUT   USED TO SET ANNUAL ALLOWABLE CUT
C     IDELTA   POINT SPACING ON VOLUME CURVE
C     IFIRE    YEARS OF FIRE OCCURENCE (5)(I4)
C     IGRSTK   CONTROLS CREATION OF INITIAL GROWING STOCK
C              (I4)
C     IGAME    A GAME COUNTER
C     IKOL     NUMBER OF COLUMNS OF OUTPT3 TO BE PRINTED BY
C              COMPAR(I4)
C     IKOUNT   INITIAL FREQUENCIES IN ANNUAL AGES WHEN
C              GROWING STOCK READ IN  (151)(I4)
C     INPRI     USED TO SET STATRTING POINT OF YPRICE
C                 SERIES IN BPRICE  (I4)
C                    YPRICE(I) = BPRICE(I + INPRI)
C     IORD     USED TO SET ABSCISSA VALUES IN PLOT1 (3)
C     IPLAY    A PLAY COUNTER
C     IPUNCH   CONTROLS THE PUNCHING OF RESIDUAL GROWING
C              STOCK (AT THE END OF TENTH PLAY) (I4)
C     ISTART   YEAR AT WHICH VOLUME CURVE FIRST HAS NON-
C              ZERO VOLUME
C     ISTOP    TERMINAL YEAR OF VOLUME CURVE
C     ISTORM   YEARS OF STORM OCCURENCE (3)(I4)
C     ISUM     COUNTERS FOR DETERMINING ACREAGE IN AGE
C              CLASSES(16)
C     ITAB1    CONTROLS PRINTING OF OUTPT1 AND OUTPT2 (I4)
C     ITAB3    CONTROLS CALLING OF OUTPT3 AND PLAT1  (I4)
C     ITEST    COUNTS TESTS
C     IPRNT3   CONTROL FOR PRINTING OUTPT3 (I4)
C     IVAR     VARIABLES TO BE PRINTED ON FIRST PAGE OF
C              OUTPT3 (18X151)
C     IWIND    USED TO SET HARVESTING POLICY AFTER A STORM
C     KOL      COLUMNS OF OUTPT3 TO BE PRINTED BY OUTPT3
C              (6)(I4)
C     KOUNT    NUMBER OF ACRES IN EACH AGE (151)
C     KPUNCH   SET TO TWO AFTER FIRE, STORM, OR BANKRUPTCY.
C              CAUSES RESIDUAL GROWING STOCK TO BE PUNCHED
C     KSIZE    MAXIMUM ACREAGE DESTROYED BY FIRE (5) (I4)
C     KUT      COUNTS HARVESTED ACREAGE IN PLAY1 AND FIRE
C     MALCUT   SETS ANNUAL ALLOWABLE CUT IN RESPONSE TO
C              PRICE (10)(I4)
C     NEXT     USED TO RECORD UNITS HARVESTED. BETWEEN
C              HARVESTS NEXT IS THE UNIT NUMBER OF THE LAST
C              UNIT HARVESTED
C     NOCOL    USED TO INDICATE COLUMNS OF OUTPT3 TO BE
C              PLOTTED (3)(I4)
C     NOFIRS   NUMBER OF FIRES DURING THIS BATCH (I4)
C     NOGAME   NUMBER OF GAMES IN A TEST (I4)
C     NOPLAY   NUMBER OF PLAYS (YEARS) IN A GAME (CONSTANT
C              FOR A TEST UNLESS A GAME IS INTERRUPTED)
C              (I4)
C     NOPTS    NUMBER OF COORDINATE POINTS PROVIDED
C              (BY CARD) FOR VOLUME CURVE (31 MAXIMUM)
C     NOSTMS   NUMBER OF STORMS DURING THIS BATCH(I4)
C     NSALV    NUMBER OF ACRES ON WHICH VOLUME SALVAGED
C              AFTER FIRE
C     NTESTS   CONTROLS THE NUMBER OF TESTS (OF BASIC
C              CONDITIONS) TO BE RUN IN A BATCH (I4)
```

```
C     NUMBER   USED TO SET FIRE OF STORM INDEX WHEN
C              REQUIRED
C     PLVAR    AN INTERMEDIATE STORAG VARIABLE IN PLOT1 (3)
C     PRICE    ANNUAL PRICE, TAKEN FROM THE PRICE SERIES
C              (IF ANNUAL PRICE IS A CONSTANT, THIS
C              CONSTANT ENTERED ON CARD 15) (F8.5)
C     PRIDIV   UPPER LIMITS OF CLASS INTERVALS OF PRICES
C              USED IN SETTING POLICY FOR A GAME (10)(F5.2)
C     PTVOL    VOLUMES ALONG THE VOLUME CURVE (31)(F5.2)
C     REDINK   A VARIABE USED TO GUAGE SOLVENCY
C     SALVOL   SALVAGED VOLUME AFTER A FIRE
C     SCALE    ASSIGNS SCALE FACTORS(BY PAGE) TO GRAPHS (3)
C              (F10.0)
C     SCOSTH   CUMULATIVE HARVESTING COST
C     SCOSTM   CUMULATIVE MAINTENANCE COST
C     SDEP     CUMULATIVE DEPOSITS
C     SFINEX   CUMULATIVE INTEREST EXPENSE
C     SFININ   CUMULATIVE INTEREST INCOME
C     SRATE    INTEREST ON DEPOSITS
C     STAXH    CUMULATIVE HARVESTING TAXES
C     STAXL    CUMULATIVE LAND TAXES
C     STCOST   CUMULATIVE TOTAL COST
C     STINC    CUMULATIVE TOTAL INCOME
C     STMAGE   LOWER AGE LIMIT OF GROWING STOCK DESTROYED
C              BY STORM (3)(I4)
C     STMPRI   FIVE YEAR SERIES OF STUMPAGE PRICES
C              FOLLOWING A STORM (3X5)(F5.2)
C     SVOL     CUMULATIVE VOLUME HARVESTED
C     SYMB     ASSIGNS SYMBOLS TO VARIABLES FOR PLOTTING
C              (3)(A1)
C     TAXH     HARVESTING TAX
C     TAXL     LAND TAX
C     TCOST    TOTAL COST
C     TINC     TOTAL INCOME
C     TOTWTH   TOTAL WORTH OF THE ENTERPRISE
C     TVOL     VOL + SALVOL
C     UNAGE    ACRE-UNIT AGE (1000)
C     VAR      VARIABLES TO BE PRINTED ON PAGES TWO, THREE
C              , AND FOUR OF OUTPT3 (27X151)
C     VOL      VOLUME HARVESTED
C     VOLUME   ENTRIES IN THE VOLUME TABLE (150)
C     YPRICE   A CONSTRUCTED SERIES (FROM BPRICE) OF
C              STUMPAGE PRICES (150)
C                    YPRICE(I) = BPRICE(I + INPRI)
C
C
C     MAIN PROGRAM
C
C
      DIMENSION KOUNT(151),UNAGE(1000),ISUM(16),IVAR(18,151),VAR(27,151)
     1,PRIDIV(10),MALCUT(10),FMRCHD(10),YPRICE(150),
     2NOCOL(3),SYMB(3),SCALE(3),PLVAR(45),IORD(3),GAMNAM(5),GSNAM(5),
     3PTVOL(31),VOLUME(150),COMP(6,25,10),KOL(29),ISTORM(3),STMAGE(3),ST
     4MPRI(3,5),IFIRE(5),FIRAGE(5),KSIZE(5),FIRPRP(5),IKOUNT(151),
     5BATCH(5),BPRICE(250)
      COMMON NTESTS,ITEST,IPRNT3,IKOUNT,BATCH,BACCT1,INPRI,BPRICE
      COMMON AEXP,ASSETS,ATAX,BACCT,BETA0,BETA1,BETA2,BETA3,BLOANS,BNKBA
     1L,BRATE,CODE,DEP,COSTH,COSTM,FINEX,FININ,FLIAB,FMERCH,FMRCHD,FNTIN
     2,GAMNAM,GSMRCH,GSNAM,GSVOL,GSVAL,HEXP,HTAX,IALCUT,IGAME,IOVRAG,IPL
     3AY,ISUM,ITAB1,ITAB2,ITAB3,IVAR,KOUNT,MALCUT,NOGAME,NONSTK,NOPLAY,P
     4RICE,PRIDIV,REDINK,SCOSTH,SCOSTM,SDEP,SFINEX,SFININ,SRATE,STAXL,ST
     5AXH,STCOST,STINC,SVOL,TAXH,TAXL,TCOST,TINC,TOTWTH,UNAGE,VAR,VOL,YP
     6RICE,CASH,NEXT,KUT,IORD,NOCOL,SYMB,SCALE,PLVAR,ISTART,ISTOP,NOPTS,
     7IDELTA,PTVOL,IPUNCH,KPUNCH,IGRSTK,VOLUME,COMP,IKOL,KOL,ISTORM,STMA
     8GE,STMPRI,IFIRE,FIRAGE,KSIZE,FIRPRP,SALVOL,NSALV,NUMBER,IWIND,AGE1
     9,AGE2,IEND,TVOL,FPRICE,NOFIRS,NOSTMS
 1001 FORMAT(46X22HTHIS BATCH CONSISTS OF16,6H TESTS)
 1002 FORMAT(1H145X7HBATCH  5A5//////////)
C
C               BATCH(I)  = IDENTIFICATION OF SET OF BASIC CONDITIONS TO
C                           BE TESTED
C               NTESTS    = NUMBER OF TESTS (BASIC CONDITIONS) TO BE
C                           TESTED IN THIS BATCH
C
  502 FORMAT(16A5)
      READ INPUT TAPE 5,502,(BATCH(I) , I = 1,5)
      WRITE OUTPUT TAPE 6,1002, (BATCH(I), I=1,5)
 1000 FORMAT(20I4)
      READ INPUT TAPE 5,1000, NTESTS
      WRITE OUTPUT TAPE 6,1001, NTESTS
      ITEST = 0
 1005 ITEST = ITEST + 1
      CALL INPUT2
      CALL VOLTAB
      IGAME = 0
    2 IGAME = IGAME + 1
      IPLAY = 0
      CALL INPUT1
      CALL GRSTK1
   15 IPLAY = IPLAY + 1
      KPUNCH = 0
      SALVOL = 0.0
      NSALV = 0
      IWIND = 0
      FPRICE = 0.0
C
C                                     IS THERE A FIRE THIS YEARO
C
      IF(NOFIRS - 0)799,799,798
  798 DO 800 I = 1,5
      NUMBER = I
      IF(IPLAY - IFIRE(I))800,801,800
  800 CONTINUE
      GO TO 799
  801 KPUNCH = 2
      CALL FIRE
      GO TO 5
C
C                                     IS THERE A STORM THIS YEARO
  799 IF(NOSTMS - 0)5,5,802
  802 DO 900 I = 1,3
      NUMBER = I
      IF(IPLAY - ISTORM(I))900,901,900
```

```
  900 CONTINUE
      GO TO 5
  901 KPUNCH = 2
      IWIND = 1
      CALL STORM
    5 CALL PLAY1
      CALL CASH1
C
C                                     ARE WE BANKRUPT0
C
    9 IF (REDINK -0.0) 10,20,20
   10 IPLAY = NOPLAY
      KPUNCH = 2
C
C                                     CALL OUTPT1 AND OUTPT20
C
   20 IF(IPLAY - 1)105,105,95
   95 IF(IPLAY - NOPLAY)148,105,105
  148 IF(KPUNCH - 2)149,105,105
  149 IF(IPLAY -10)150,105,150
  150 IF(ITAB1 - (-1))11,11,160
  160 IF(IPLAY -10) 105,105,170
  170 IF(ITAB1 - 0)11,11,180
  180 IF(ICOUNT - ITAB1)110,105,105
  105 ICOUNT = 0
      CALL OUTPT1
      CALL OUTPT2
  110 ICOUNT = ICOUNT + 1
C
C                                     CALL OUTPT3 0
C
   11 IF (ITAB3 - 0)13,13,12
   12 CALL OUTPT3
   13 IF (IPLAY - NOPLAY)15,14,14
C
C                                     CALL PLOT10
C
   14 IF (ITAB3 - 1)17,17,16
   16 CALL PLOT1
C
C                                     CALL COMPAR0
C
   17 IF(IKOL - 0)201,201,200
  200 CALL COMPAR
  201 IF(IGAME - NOGAME)2,18,18
   18 IF(NTESTS-ITEST) 19,19,1005
   19 CALL EXIT
      END
```

SUBROUTINE INPUT2

```
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
    4 FORMAT(1H /////49X22HTHIS TEST CONSISTS OF I4,6H GAMES///)
    5 FORMAT(30XI4,25H COLUMNS WILL BE COMPARED///)
    6 FORMAT(30X20I4)
    7 FORMAT(30XI4,16H STORMS IN YEARS 11X3I5//)
    8 FORMAT(30X22HDESTROYING AGE CLASSES9X3F5.0//)
    9 FORMAT(30X17HPOST STORM PRICES14X5F5.2//)
   10 FORMAT(61X5F5.2//)
   11 FORMAT(30X///I4,15H FIRES IN YEARS 12X5I5//)
   12 FORMAT(30X19HAGE CLASS DESTROYED12X5F5.0//)
   13 FORMAT(30X25HMAXIMUM ACREAGE DESTROYED6X5I5//)
   14 FORMAT(30X32HPROPORTIONATE REDUCTION IN PRICE5F5.2//)
   60 FORMAT(4I5)
  103 FORMAT (1H 55X6HPRICES//)
  104 FORMAT (1H 56X4HYEAR/)
  105 FORMAT (1H 4X6HDECADE8X1H0 9X1H19X1H29X1H39X1H49X1H59X1H69X1H79X1H8
     19X1H9//)
  106 FORMAT (1H I10,F11.2,9F10.2)
  107 FORMAT (1H //////)
  108 FORMAT (32H COEFFICIENTS OF VOLUME EQUATION10X15HCOSTS AND TAXES33
     1X10HOTHER DATA//)
  109 FORMAT (5X8HCONSTANTF19.0,15X11HACREAGE TAXF22.4,15X9HLOAN RATEF16
     1.4)
  110 FORMAT (5X6HLINEARF21.0,15X26HHARVESTING TAX, PER DOLLARF7.4,15X12
     1HSAVINGS RATEF13.4)
  111 FORMAT (5X9HQUADRATICF18.0,15X26HMAINTENANCE COST, PER ACREF7.4,15
     1X16HMERCHANTABLE AGEF9.0)
  112 FORMAT (5X5HCUBICF22.0,15X23HHARVESTING COST PER MBFF10.4,15X15HNU
     1MBER OF PLAYSI10)
  113 FORMAT (5X4HCODEF23.0//////)
  118 FORMAT(1H 6HVOLUME4X18F6.2)
  119 FORMAT(1H 6HINPUTS5X13F6.2)
  501 FORMAT(1H1)
 1026 FORMAT(46X7HBATCH  5A5)
 1027 FORMAT(46X4HTESTI4)
 1028 FORMAT(46X15HGROWING STOCK  5A5)
      DO 1000 I = 1,5
      IFIRE(I)=0
      FIRAGE(I) = 0.0
      KSIZE(I) = 0
 1000 FIRPRP(I) = 0.0
      DO 2000 I = 1,3
      ISTORM(I) = 0
      STMAGE(I) = 0.0
      DO 2000 J = 1,5
 2000 STMPRI(I,J) = 0.0
      DO 3000 I = 1,29
 3000  KOL(I) = 0
      DO 4000 I = 1,250
 4000 BPRICE(I) = 0.0
      DO 5000 I = 1,31
 5000 PTVOL(I) = 0.0
      DO 6000 I = 1,151
 6000 IKOUNT(I) = 0
      DO 700 I = 1,150
  700 YPRICE(I) = 0.0
      DO 600 I = 1,6
      DO 600 J = 1,25
      DO 600 K = 1,10
  600 COMP(I,J,K) = 0.0
C
C               GSNAM(I)  = DESCRIPTION OF GROWING STOCK FOR THIS TEST
```

```
  502 FORMAT(16A5)
      READ INPUT TAPE 5,502,(GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,501
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,1028,(GSNAM(I),I = 1,5)
C
C               NOGAME    = NUMBER OF GAMES (POLICIES) IN THIS TEST
C               IKOL      = NUMBER OF VARIABLES TO BE PRINTED BY COMPAR
C                           AT END OF TEST
C               NOFIRS    = NUMBER OF FIRES IN BASIC CONDITIONS OF THIS
C                           TEST
C               NOSTMS    = NUMBER OF STORMS IN BASIC CONDITIONS OF THIS
C                           TEST
C
    1 FORMAT(20I4)
      READ INPUT TAPE5,1,NOGAME,IKOL,NOFIRS,NOSTMS
      WRITE OUTPUT TAPE6,4,NOGAME
      IF(IKOL - 0)100,100,90
C
C               KOL(I)    = VARIABLES (BY COLUMN OF OUTPT3)TO BE PRINTED
C                           BY COMPAR
C
   90 READ INPUT TAPE5,1,(KOL(I),I = 1,IKOL)
      WRITE OUTPUT TAPE6,5,IKOL
      WRITE OUTPUT TAPE6,6,(KOL(I),I = 1,IKOL)
  100 IF(NOFIRS - 0)200,200,190
  190 DO 195 I = 1,NOFIRS
C
C               IFIRE(I)  = YEARS IN WHICH FIRES OCCUR
C               FIRAGE(I) = AGES IN WHICH FIRES OCCUR
C               KSIZE(I)  = MAXIMUM SIZES OF FIRES
C               FIRPRP(I) = PROPORTIONATE REDUCTION IN PRICE OF FIRE
C                           DAMAGED STUMPAGE, (MUST LIE BETWEEN 0.0 AI
C
    3 FORMAT(2(I4,F5.2))
  195 READ INPUT TAPE5,3,IFIRE(I),FIRAGE(I),KSIZE(I),FIRPRP(I)
      WRITE OUTPUT TAPE 6,107
      WRITE OUTPUT TAPE6,11,NOFIRS,(IFIRE(I),I = 1,NOFIRS)
      WRITE OUTPUT TAPE6,12,(FIRAGE(I),I = 1,NOFIRS)
      WRITE OUTPUT TAPE6,13,(KSIZE(I),I = 1,NOFIRS)
      WRITE OUTPUT TAPE6,14,(FIRPRP(I),I = 1,NOFIRS)
  200 IF(NOSTMS - 0)300,300,290
  290 DO 295 I = 1,NOSTMS
C
C               ISTORM(I) = YEARS IN WHICH STORMS OCCUR
C               STMAGE(I) = LOWER AGE LIMIT OF GROWING STOCK DESTROYED
C                           BY STORM
C             STMPRI(I,J) = PRICE SERIES FOR FIVE YEARS FOLLOWING STORM
    2 FORMAT(I4,6F5.2)
  295 READ INPUT TAPE5,2,ISTORM(I),STMAGE(I),(STMPRI(I,J),J = 1,5)
      WRITE OUTPUT TAPE 6,107
      WRITE OUTPUT TAPE6,7,NOSTMS,(ISTORM(I),I = 1,NOSTMS)
      WRITE OUTPUT TAPE6,8,(STMAGE(I),I = 1,NOSTMS)
      WRITE OUTPUT TAPE6,9,(STMPRI(I,1),I = 1,NOSTMS)
      DO 296 J = 2,5
  296 WRITE OUTPUT TAPE6,10,(STMPRI(I,J),I = 1,NOSTMS)
C
C               BETA0     = INTERCEPT OF VOLUME EQUATION (CODED)
C               BETA1     = LINEAR COEFFICIENT OF VOLUME EQUATION
C                           (CODED)
C               BETA2     = QUADRATIC COEFFICIENT OF VOLUME EQUATION
C                           (CODED)
C               BETA3     = CUBIC COEFFICIENT OF VOLUME EQUATION (CODED)
C               CODE      = CONSTANT TO DECODE VOLUME COEFFICIENTS
C
C  THE NEXT FOUR FIELDS MUST BE BLANK IF A VOLUME EQUATION IS USED
C
C               ISTART    = FIRST YEAR OF VOLUME/AGE CURVE
C               ISTOP     = LAST YEAR OF VOLUME/AGE CURVE
C               NOPTS     = NUMBER OF VOLUMES TO BE READ FOR VOLUME/AGE
C                           CURVE
   20 FORMAT(8F8.5,F16.2)
      READ INPUT TAPE 5,20,GSMRCH,BRATE,SRATE,ATAX,HTAX,AEXP,HEXP,PRICE,
     1BACCT1
      WRITE OUTPUT TAPE 6,501
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,1028,(GSNAM(I),I = 1,5)
C
C               NOPLAY    = NUMBER OF PLAYS IN EACH GAME OF THIS TEST
C               ITAB1     = CONTROL FOR PRINTING OUTPT1 AND OUTPT2
C
C                         -1  CALL OUTPT1 AND OUTPT2 ON FIRST,
C                             TENTH AND LAST PLAYS
C
C                          0  CALL OUTPT1 AND OUTPT2 ON FIRST TEN
C                             AND LAST PLAYS
C
C                          K  CALL OUTPT1 AND OUTPT2 ON FIRST TEN,
C                             LAST, AND EVERY KTH INTERVENING PLAY
C
C               ITAB3     = CONTROL FOR MAKING OUTPT3AND PLOT1
C
C                          0  DO NOT CALL OUTPT3 OR PLOT1
C                          1  CALL OUTPT3
C                          2  CALL OUTPT3 AND PLOT1
C
C               IPRNT3    = CONTROL FOR PRINTING OUTPT3
C
C                          0  DO NOT PRINT OUTPT3
C
C                          1  PRINT OUTPT3 FOR EACH GAME OF TEST.
C
      READ INPUT TAPE 5,1,NOPLAY,ITAB1,ITAB3,IPRNT3
      WRITE OUTPUT TAPE 6,107
      WRITE OUTPUT TAPE 6,108
      WRITE OUTPUT TAPE 6,109,BETA0,ATAX,BRATE
      WRITE OUTPUT TAPE 6,110,BETA1,HTAX,SRATE
      WRITE OUTPUT TAPE 6,111,BETA2,AEXP,GSMRCH
      WRITE OUTPUT TAPE 6,112,BETA3,HEXP,NOPLAY
      WRITE OUTPUT TAPE 6,113,CODE
      IF (PRICE - 0.0)120,120,140
  140 DO 145 I = 1,NOPLAY
  145 YPRICE(I) = PRICE
      GO TO 250
C
C               BPRICE(I) = SET OF 250 PRICES AS BASES FOR YPRICE(I)
```

```
 16 FORMAT(16F5.2)
120 READ INPUT TAPE 5,16,(BPRICE(I),I = 1,250)
    DO 121 I = 1,NOPLAY
    K = I + INPRI
121 YPRICE(I) = BPRICE(K)
250 WRITE OUTPUT TAPE 6,103
    WRITE OUTPUT TAPE 6,104
    WRITE OUTPUT TAPE 6,105
    K = 0
    WRITE OUTPUT TAPE 6,106,K,YPRICE(1),(YPRICE(I),I = 1,9)
    DO 15 J = 1,14
    KON = 10 * J
 15 WRITE OUTPUT TAPE 6,106,J,YPRICE(KON),YPRICE(KON + 1),YPRICE(KON +
   1 2),YPRICE(KON + 3),YPRICE(KON + 4),YPRICE(KON + 5),YPRICE(KON + 6
   2),YPRICE(KON + 7),YPRICE(KON + 8),YPRICE(KON + 9)
    J = 15
    WRITE OUTPUT TAPE 6,106,J,YPRICE(150)
    WRITE OUTPUT TAPE 6,107
    IF(BETA0 - 0.0)301,400,301
C
C              PTVOL(I)  = POINTS ON VOLUME CURVE
C
400 READ INPUT TAPE 5,16,(PTVOL(I),I = 1,NOPTS)
    WRITE OUTPUT TAPE 6,118,(PTVOL(I), I = 1,18)
    WRITE OUTPUT TAPE 6,119,(PTVOL(I), I = 19,31)
301 IF(IGRSTK  - 1)350,65,350
C
C              IKOUNT(I) = SET OF 151 FREQUENCIES (OF NUMBER OF ACRES
C                          OF A PARTICULAR AGE
C
500 FORMAT(12X,17I4)
 65 READ INPUT TAPE 5,500,(IKOUNT(I),I = 1,151)
350 RETURN
    END
```

SUBROUTINE VOLTAB

```
C     INSERT COMMON AND DIMENSION STATEMENTS
C
100 FORMAT(1H1/////40X12HVOLUME TABLE)
1026 FORMAT(41X7HBATCH  5A5)
1027 FORMAT(41X4HTEST I4)
102 FORMAT(1H 40X15HGROWING STOCK  5A5/////)
103 FORMAT(1H 50X19HVOLUME PER ACRE MBF///)
104 FORMAT(1H 56X4HYEAR/)
105 FORMAT(1H 4X6HDECADE8X1H09X1H19X1H29X1H39X1H49X1H59X1H69X1H79X1H89
   1X1H9//)
106 FORMAT(1H I10,F11.3,9F10.3)
    DO 10 I = 1,150
C                                   CREATE A VOLUME TABLE FROM A VOL-
C                                   UME EQUATION
C
 10 VOLUME(I) = 0.0
    IMRCH = GSMRCH
    IF(BETA0 - 0.0) 20,30,20
 20 DO 25 I = IMRCH,150
    FI = I
 25 VOLUME(I) =(BETA0 + BETA1*FI + BETA2*FI**2 + BETA3*FI**3)/CODE
    GO TO 50
C                                   CREATE A VOLUME TABLE FROM A VOL-
C                                   UME CURVE
C
 30 FDELTA = IDELTA
    K = NOPTS - 1
    DO 40 L = 1,K
    DO 40 J = 1,IDELTA
    M = J + ISTART - 1 + (L - 1)*IDELTA
    FJ = J - 1
 40 VOLUME(M) = PTVOL(L) + (FJ/FDELTA)*(PTVOL(L + 1) - PTVOL(L))
    VOLUME (ISTOP) = PTVOL(NOPTS)
 50 WRITE OUTPUT TAPE6,100
    WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
    WRITE OUTPUT TAPE 6,1027,ITEST
    WRITE OUTPUT TAPE6,102,(GSNAM(I), I = 1,5)
    WRITE OUTPUT TAPE6,103
    WRITE OUTPUT TAPE6,104
    WRITE OUTPUT TAPE6,105
    K = 0
    WRITE OUTPUT TAPE 6,106,K,VOLUME(1),(VOLUME(I),I = 1,9)
    DO 60 J = 1,14
    KON = 10*J
 60 WRITE OUTPUT TAPE 6, 106, J,VOLUME(KON),VOLUME(KON + 1), VOLUME(KO
   1N + 2),VOLUME(KON+3),VOLUME(KON+4),VOLUME(KON+5),VOLUME(KON+6),VOL
   2UME(KON+7),VOLUME(KON+8),VOLUME(KON+9)
    J = 15
    WRITE OUTPUT TAPE 6, 106, J, VOLUME(150)
    RETURN
    END
```

SUBROUTINE INPUT1

```
C     INSERT COMMON AND DIMENSION STATEMENTS
C
100 FORMAT (1H1//40X20HPRICES, DATA, POLICY)
101 FORMAT (1H 40X6HGAME  5A5)
102 FORMAT (1H 40X15HGROWING STOCK  5A5//)
107 FORMAT(1X//////////)
115 FORMAT (1H 15HCRITICAL PRICES14X10F9.2)
116 FORMAT (1H 13HALLOWABLE CUT11X10I9)
117 FORMAT (1H 19HMINIMUM CUTTING AGE5X10F9.0)
1026 FORMAT(41X7HBATCH  5A5)
1027 FORMAT(41X4HTEST I4)
C
C              GAMNAM(I) = IDENTIFICATION OF A GAME (POLICY)
C
 40 FORMAT(5A5)
    READ INPUT TAPE 5,40,(GAMNAM(I),I = 1,5)
    WRITE OUTPUT TAPE 6,100
    WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
    WRITE OUTPUT TAPE 6,1027,ITEST
    WRITE OUTPUT TAPE 6,101,(GAMNAM(I),I = 1,5)
    WRITE OUTPUT TAPE 6,102,(GSNAM(I),I = 1,5)
C
C              PRIDIV(I) = LIMITS OF CLASS INTERVALS OF PRICE FOR
C                          SETTING ANNUAL CUTTING PLAN
C
  2 FORMAT(16F5.2)
    READ INPUT TAPE 5,2,(PRIDIV(I),I = 1,10)
C
C              MALCUT(I) = ANNUAL ALLOWABLE CUT AS A FUNCTION OF PRICE
C
  4 FORMAT(20I4)
    READ INPUT TAPE 5,4,(MALCUT(I),I = 1,10)
C
C              FMRCHD(I) = LOWER AGE LIMIT OF ANNUAL CUT AS A FUNCTION
C                          OF PRICE
C
    READ INPUT TAPE 5, 2,(FMRCHD(I),I = 1,10)
    WRITE OUTPUT TAPE 6,107
    WRITE OUTPUT TAPE 6,115,(PRIDIV(I),I = 1,10)
    WRITE OUTPUT TAPE 6,116,(MALCUT(I),I = 1,10)
    WRITE OUTPUT TAPE 6,117,(FMRCHD(I),I = 1,10)
350 DO 230 I = 1,18
    DO 230 J = 1,151
230 IVAR(I,J) = 0
    DO 240 I = 1,27
    DO 240 J = 1,151
240 VAR(I,J) = 0.0
    STAXL = 0.0
    STAXH = 0.0
    SCOSTM = 0.0
    SCOSTH = 0.0
    SFINEX = 0.0
    SFININ = 0.0
    STINC = 0.0
    STCOST = 0.0
    SDEP = 0.0
    DEP = 0.0
    SVOL = 0.0
    VOL = 0.0
    FMERCH = 0.0
    IALCUT = 0
    NEXT = 0
    BACCT = BACCT1
    RETURN
    END
```

SUBROUTINE GRSTK1

```
C     INSERT COMMON AND DIMENSION STATEMENTS
C
200 FORMAT (1H1////45X21HINITIAL GROWING STOCK)
201 FORMAT (1H 45X4HGAME5A5)
202 FORMAT (1H 45X13HGROWING STOCK5A5/////)
203 FORMAT (1H 55X9HAGE(YEAR))
204 FORMAT (1H 4X11HAGE(DECADE)7X1H07X1H17X1H27X1H37X1H47X1H57X1H67X1H
   177X1H87X1H91OX5HTOTAL///)
205 FORMAT (1H I11,5X10I8,I15//)
206 FORMAT (1H 45X27HNUMBER OF NON STOCKED UNITSI7///)
207 FORMAT (1H 45X24HNUMBER OF OVER-AGE UNITSI10///)
208 FORMAT (1H145X31HACREAGE MORE THAN 149 YEARS OLD)
209 FORMAT (1H 45X23HVOLUME OF GROWING STOCKF11.0)
1026 FORMAT(46X7HBATCH  5A5)
1027 FORMAT(46X4HTEST I4)
    GSVOL = 0.0
    PRICE = YPRICE(1)
    IF(IGRSTK - 1)5,65,5
C                                   CREATE 1000 ACRES OF UNIFORMLY AGE-
C                                   DISTRIBUTED GROWING STOCK
C
  5 M = - 10
    G = 100.0
 10 M = M + 10
    G = G - 1.0
    DO 60 I = 1,10
    K = I + M
    UNAGE(K) = G
 60 CONTINUE
    IF(G - 0.0)80,80,10
C                                   CREATE 1000 ACRES OF GROWING STOCK
C                                   WITH AGE DISTRIBUTION SPECIFIED ON
C                                   INPUT CARDS
C
 65 K2 = 0
    DO 300 J = 1,151
    IF(K2 - 1000)305,80,80
305 IF(IKOUNT(J) - 0)300,300,310
310 K1 = K2 + 1
    K2 = K2 + IKOUNT(J)
    DO 298 I = K1,K2
    II = 1001 - I
298 UNAGE(II) = J - 2
300 CONTINUE
 80 DO 271 K = 1,151
271 KOUNT(K) = 0
    DO 272 I = 1,16
272 ISUM(I) = 0
C                                   MAKE FREQUENCY DISTRIBUTION OF
C                                   ACREAGE BY AGE. CHECK FOR ACREAGE
C                                   GREATER THAN 149 YEARS OLD
C
    DO 273 J = 1,1000
    IF (UNAGE(J) - 149.0)280,280,299
299 WRITE OUTPUT TAPE 6,208
    IPLAY = NOPLAY - 1
    RETURN
280 M = UNAGE(J) + 2.0
273 KOUNT(M) = KOUNT(M) + 1
```

```
C
C                                     COUNT ACREAGE BY TEN YEAR AGE CLASS
C
      DO 274 I = 1,15
      DO 274 J = 1,10
      NN = 10 * (I - 1) + J + 1
  274 ISUM(I) = ISUM(I) + KOUNT(NN)
C
C                                     COUNT ACREAGE OVER 99 YEARS OLD
C
      DO 275 I = 102,151
  275 ISUM(16) = ISUM(16) + KOUNT(I)
C
C                                     COMPUTE VOLUME OF GROWING STOCK
C
      DO 220 I = 1,1000
      IF(UNAGE(I) - GSMRCH)220,219,219
  219 K = UNAGE(I)
      GSVOL = GSVOL + VOLUME(K)
  220 CONTINUE
      WRITE OUTPUT TAPE 6,200
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,201,(GAMNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,202,(GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,203
      WRITE OUTPUT TAPE 6,204
      DO 277 J = 1,15
      MM = J - 1
      KON = 10 * MM + 1
  277 WRITE OUTPUT TAPE 6,205,MM,KOUNT(KON + 1),KOUNT(KON + 2),KOUNT(KON
     1 + 3),KOUNT(KON + 4),KOUNT(KON + 5),KOUNT(KON + 6),KOUNT(KON + 7),
     2KOUNT(KON + 8),KOUNT(KON + 9),KOUNT(KON + 10),ISUM(J)
      WRITE OUTPUT TAPE 6,206, KOUNT(1)
      WRITE OUTPUT TAPE 6,207, ISUM(16)
      WRITE OUTPUT TAPE 6,209, GSVOL
      VAR(1,1) = PRICE
      VAR(23,1) = GSVOL*(PRICE*(1.0-HTAX)-HEXP)
      VAR(24,1) = BACCT1
      VAR(25,1) = VAR(24,1) + VAR(23,1)
      VAR(27,1) = VAR(25,1)
      IVAR(5,1) = GSVOL
      IVAR(6,1) = GSVOL
      IVAR(7,1) = KOUNT(1)
      DO 276 I = 1,10
      K = I + 7
  276 IVAR(K,1) = ISUM(I)
      IVAR(18,1) = ISUM(16)
      RETURN
      END
```

```
      SUBROUTINE FIRE
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
    1 FORMAT(1H145X11HFIRE REPORT///)
    2 FORMAT(46X7HBATCH  5A5)
    3 FORMAT(46X4HTESTI4)
    4 FORMAT(46X6HGAME  5A5)
    5 FORMAT(46X15HGROWING STOCK  5A5/////)
    6 FORMAT(30X12HYEAR OF PLAY3XI6/////)
    7 FORMAT(30X12HUNITS BURNED3XI6,7HTHROUGHI6/////)
    8 FORMAT(30X15HACREAGE BURNED I6/////)
    9 FORMAT(30X15HVOLUME SALVAGEDF6.0)
 1000 FORMAT(30X10HAGE BURNED5XF6.0/////)
 1001 FORMAT(30X4HNEXT 11XI6)
      NNN = NEXT
      AGE1 = FIRAGE(NUMBER)
      AGE2 = AGE1 + 9.0
      KUT = 0
      IFIRST = 0
      LAST = 0
C
C                                     HAS ACREAGE BURNED IN THIS FIREO
C
      DO 100 I = 1,1000
      N=NEXT+I
      IF(N - 1000)400,400,350
  350 N = N - 1000
  400 IF(UNAGE(N) - AGE1)500,10,10
   10 IF(UNAGE(N) - AGE2)20,20,100
   20 K = UNAGE(N)
C
C                                     COMPUTE ACREAGE BURNED AND VOLUME
C                                     SALVAGED.RECORD I.D. NUMBERS OF
C                                     FIRST AND LAST ACPE  BURNED
C
      SALVOL = SALVOL + VOLUME(K)
      IF(KUT - 0)30,30,40
   30 IFIRST = N
   40 KUT = KUT + 1
      IF(KUT - KSIZE(NUMBER))100,101,101
  100 CONTINUE
  500 IF(KUT - 0)301,301,101
  101 IF(FIRAGE(NUMBER)- GSMRCH)103,102,102
  102 NSALV = KUT
C
C                                     IF NECESSARY RENUMBER UNAGE(K) TO
C                                     PUT BURNED ACREAGE IN PROPER AGE
C                                     SEQUENCE
C
  103 LAST = IFIRST + KUT - 1
      IF(IFIRST - NEXT - 1)625,600,625
  600 DO 605 I = 1,KUT
      K = IFIRST + I - 1
      IF(K - 1000)620,620,610
  610 K = K - 1000
  620 UNAGE(K) = -1.0
  605 CONTINUE


      NEXT = LAST
      GO TO 301
  625 MOVE = NEXT - LAST
      IF(MOVE - 0)630,650,635
  630 MOVE = MOVE + 1000
  635 DO 700 I = 1,MOVE
      K = IFIRST + I - 1
      L = LAST + I
      IF(K - 1000)710,710,715
  715 K = K - 1000
  710 IF(L - 1000)725,725,720
  720 L = L - 1000
  725 UNAGE(K) = UNAGE(L)
  700 CONTINUE
  650 DO 750 I = 1,KUT
      M = NEXT - KUT + I
      IF(M - 0)655,655,660
  655 M = M + 1000
  660 UNAGE(M) = - 1.0
  750 CONTINUE
  301 WRITE OUTPUT TAPE 6,1
      WRITE OUTPUT TAPE 6,2,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,3,ITEST
      WRITE OUTPUT TAPE 6,4,(GAMNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,5,(GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1001,NNN
      WRITE OUTPUT TAPE 6,6,IPLAY
      WRITE OUTPUT TAPE 6,1000,AGE1
      WRITE OUTPUT TAPE 6,7,IFIRST,LAST
      WRITE OUTPUT TAPE 6,8,KUT
      WRITE OUTPUT TAPE 6,9,SALVOL
      RETURN
      END
```

```
      SUBROUTINE STORM
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
      DO 100 I = 1,5
      N = IPLAY - 1 + I
  100 YPRICE(N) = STMPRI(NUMBER,I)
      IALCUT = 1000
      FMERCH = STMAGE(NUMBER)
      RETURN
      END
```

```
      SUBROUTINE PLAY1
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
 1000 FORMAT(1H145X31HACREAGE MORE THAN 149 YEARS OLD)
      VOL = 0.0
      GSVOL = 0.0
C
C                                     INCREASE BY ONE YEAR AGE OF EACH
C                                     ACRE OF GROWING STOCK
C
  300 DO 302 I = 1,1000
  302 UNAGE(I) = UNAGE(I)  + 1.0
C
C                                     SET PRICE. ASCERTAIN ALLOWABLE CUT
C                                     AND MINIMUM AGE AT CUTTING
C
      PRICE = YPRICE(IPLAY)
      IF(IWIND - 0)100,100,999
  100 DO 900 J = 1,10
      INDEX = J
      IF(PRICE - PRIDIV(J))920,920,900
  900 CONTINUE
  920 IALCUT = MALCUT(INDEX) - NSALV
      FMERCH = FMRCHD(INDEX)
      IF(IALCUT - 0)260,260,999
C
C                                     HARVEST. REDUCE CUT ACREAGE TO AGE
C                                     ZERO.    RECORD ID OF LAST ACRE CUT
C                                     RECORD VOLUME HARVESTED
C
  999 KUT = 0
  200 KUT = KUT + 1
      IF(NEXT - 1000)220,210,210
  210 NEXT = 0
  220 NEXT = NEXT + 1
      IF (UNAGE(NEXT) - FMERCH)230,250,250
  230 NEXT = NEXT - 1
      GO TO 260
  250 K = UNAGE(NEXT)
      VOL = VOL + VOLUME(K)
      UNAGE(NEXT) = 0.0
      IF(KUT - IALCUT)200,260,260
C
C                                     COMPUTE VOLUME OF RESIDUAL GROWING
C                                     STOCK
C
  260 DO 280 I = 1,1000
      IF(UNAGE(I) - GSMRCH)280,262,262
  262 K = UNAGE(I)
      GSVOL = GSVOL + VOLUME(K)
  280 CONTINUE
      DO 400 K = 1,151
  400 KOUNT(K) = 0
      DO 405 I = 1,16
  405 ISUM(I) = 0
C
C                                     IS ANY GROWING STOCK OVER 149 YEARS

C                                     OLDO
C                                     TALLY FREQUENCIES BY AGE AND BY TEN
C                                     YEAR  AGE CLASSES.
C
      DO 410 J = 1,1000
      IF(UNAGE(J) - 149.0)420,420,429
  429 WRITE OUTPUT TAPE 6,1000
      IPLAY = NOPLAY
      RETURN
```

```
  420 M = UNAGE(J) + 2.0
  410 KOUNT(M) = KOUNT(M) + 1
      DO 425 I = 1,15
      DO 425 J = 1,10
      NN = 10*(I -1) + J + 1
  425 ISUM(I) = ISUM(I) + KOUNT(NN)
C
C                                     TALLY FREQUENCY OF GROWING STOCK
C                                     OVER 99 YEARS OLD
C
      DO 430 I = 102,151
  430 ISUM(16) = ISUM(16) + KOUNT(I)
      TVOL = VOL + SALVOL
      SVOL = SVOL + TVOL
      RETURN
      END
```

```
      SUBROUTINE CASH1
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
      FININ = 0.0
      FINEX = 0.0
      BLOANS = 0.0
      BNKBAL = 0.0
C
C                                     CALCULATE INTEREST INCOME OR INTER-
C                                     EST EXPENSE
C
      IF (BACCT - 0.0)400,405,405
  400 BLOANS = ABSF(BACCT)
      FINEX = BLOANS * BRATE/100.0
      GO TO 410
  405 BNKBAL = BACCT
      FININ = BNKBAL * SRATE/100.0
  410 CONTINUE
      IF(SALVOL - 0.0)100,100,50
   50 FPRICE = PRICE*(1.0 - FIRPRP(NUMBER))
      DEP = PRICE * VOL + FPRICE * SALVOL
      GO TO 101
  100 DEP = VOL * PRICE
  101 TAXL = 1000.0 * ATAX
      TAXH = DEP * HTAX
      COSTM = 1000.0 * AEXP
      COSTH = (TVOL) * HEXP
      TCOST = TAXL + TAXH + COSTM + COSTH + FINEX
      TINC = DEP + FININ
      FNTIN = TINC - TCOST
      GSVAL = GSVOL * (PRICE * (1.0 - HTAX) - HEXP)
      BACCT = BACCT + TINC - TCOST
      TOTWTH = BACCT + GSVAL
      REDINK = 0.75 * GSVAL + BACCT
      SDEP = SDEP + DEP
      SFININ = SFININ + FININ
      STINC = STINC + TINC
      STAXL = STAXL + TAXL
      STAXH = STAXH + TAXH
      SCOSTM = SCOSTM + COSTM
      SCOSTH = SCOSTH + COSTH
      SFINEX = SFINEX + FINEX
      STCOST = STCOST + TCOST
      IF (BACCT - 0.0)500,500,510
  500 FLIAB = BACCT
      CASH = 0.0
      GO TO 515
  510 CASH = BACCT
      FLIAB = 0.0
  515 ASSETS = CASH + GSVAL
      RETURN
      END
```

```
      SUBROUTINE OUTPT1
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
  500 FORMAT (1H1//45X19HGROWING STOCK TABLE)
  501 FORMAT (1H 45X4HGAME5A5)
  502 FORMAT (1H 45X13HGROWING STOCK5A5)
  503 FORMAT (1H 45X5HPRICEF24.2)
  504 FORMAT (1H 45X19HMINIMUM CUTTING AGEF10.0)
  505 FORMAT (1H 45X13HALLOWABLE CUTI16)
  506 FORMAT(1H /)
  507 FORMAT (1H 55X9HAGE(YEAR))
  508 FORMAT (1H 4X11HAGE(DECADE)7X1H07X1H17X1H27X1H37X1H47X1H57X1H67X1H
     177X1H87X1H910X5HTOTAL///)
  509 FORMAT (1H I11,5X10I8,I15//)
  510 FORMAT (46X27HNUMBER OF NON-STOCKED UNITSI7//)
  511 FORMAT (46X24HNUMBER OF OVER-AGE UNITSI10//)
  513 FORMAT (1H 45X21HCUMULATIVE VOLUME CUT F13.0)
  512 FORMAT (46X20HVOLUME CUT THIS PLAY F14.0//)
  514 FORMAT (1H 45X9HTHIS PLAYI6)
  516 FORMAT(46X23HVOLUME OF GROWING STOCK F11.0//)
  517 FORMAT(I2,I3,I4,I3,17I4)
 1026 FORMAT(46X7HBATCH  5A5)
 1027 FORMAT(46X4HTESTI4)
      IALCUT = IALCUT + NSALV
      WRITE OUTPUT TAPE 6,500
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,501,(GAMNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,502,(GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,514,IPLAY
      WRITE OUTPUT TAPE 6,503,PRICE
      WRITE OUTPUT TAPE 6,504,FMERCH
      WRITE OUTPUT TAPE 6,505,IALCUT
      WRITE OUTPUT TAPE 6,506
      WRITE OUTPUT TAPE 6,507
      WRITE OUTPUT TAPE 6,508
      DO 515 J = 1,15
      MM = J - 1
      KON = 10 * MM + 1
  515 WRITE OUTPUT TAPE 6,509,MM,KOUNT(KON + 1),KOUNT(KON + 2),KOUNT(KON
     1 + 3),KOUNT(KON + 4),KOUNT(KON + 5),KOUNT(KON + 6),KOUNT(KON + 7),
     2KOUNT(KON + 8),KOUNT(KON + 9),KOUNT(KON + 10),ISUM(J)
      WRITE OUTPUT TAPE 6,506
      WRITE OUTPUT TAPE 6,510,KOUNT(1)
      WRITE OUTPUT TAPE 6,511,ISUM(16)
      WRITE OUTPUT TAPE 6,516,GSVOL
      WRITE OUTPUT TAPE6,512,TVOL
      WRITE OUTPUT TAPE 6,513,SVOL
      IF(KPUNCH - 2)800,602,800
  800 IF(IPLAY - 10)700,601,700
  601 IF(IPUNCH -1)700,602,602
  602 DO 650 I=1, 8
      K=17*(I-1)+1
      M=K+ 16
  650 WRITE OUTPUT TAPE 7,517,ITEST,IGAME,IPLAY,I,(KOUNT(N),N=K,M)
      I=9
      WRITE OUTPUT TAPE 7,517,ITEST,IGAME,IPLAY,I,(KOUNT(N),N = 137,151)
  700 RETURN
      END
```

```
      SUBROUTINE OUTPT2
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
 1000 FORMAT (1H1145X16HINCOME AND COSTS)
 1001 FORMAT (46X4HGAME5A5)
 1002 FORMAT (46X13HGROWING STOCK5A5)
 1003 FORMAT (46X11HPLAY NUMBERI5///)
 1004 FORMAT (7H INCOME77X6HANNUAL10X10HCUMULATIVE//)
 1005 FORMAT(5X7HTIMBER,F8.2,8H MBF, ATF6.2,10H PER M ANDF8.2,15HFIRE SA
     1LVAGE ATF6.2,6H PER MF11.2,F20.2)
 1006 FORMAT (5X27HINTEREST ON BANK BALANCE OFF15.2,4H, ATF8.4,9H PER CE
     1NTF22.2,F20.2//)
 1007 FORMAT (15X12HTOTAL INCOMEF63.2,F20.2///)
 1008 FORMAT (6H COSTS//)
 1009 FORMAT (5X27HTAXES, LAND, 1000 ACRES, ATF8.4,9H PER ACREF41.2,F20.
     12)
 1010 FORMAT (5X31HTAXES,VALUE OF HARVESTED TIMBER,F10.2,4H, ATF8.4,11H
     1PER DOLLARF21.2,F20.2)
 1011 FORMAT(5X33HMAINTENANCE COSTS, 1000 ACRES, ATF8.4,10H, PER ACRE
     1F34.2,F20.2)
 1012 FORMAT (5X17HHARVESTING COSTS,F8.2,8H MBF, ATF8.4,6H PER MF38.2,F2
     10.2)
 1013 FORMAT (5X20HINTEREST ON LOANS OFF10.2,4H, ATF8.4,9H PER CENTF34.2
     1,F20.2//)
 1014 FORMAT (15X11HTOTAL COSTSF64.2,F20.2////)
 1015 FORMAT (11H NET INCOMEF79.2,F20.2/////)
 1016 FORMAT (40X19HNET WORTH STATEMENT///)
 1017 FORMAT (15X6HASSETS//)
 1018 FORMAT (20X12HBANK ACCOUNTF48.2)
 1019 FORMAT (20X13HGROWING STOCKF8.0,8H MBF, ATF6.2,5HPER MF20.2//)
 1020 FORMAT (40X12HTOTAL ASSETSF48.2///)
 1021 FORMAT (15X11HLIABILITIES//)
 1022 FORMAT (20X10HBANK LOANSF50.2//)
 1023 FORMAT (40X17HTOTAL LIABILITIESF43.2///)
 1024 FORMAT (15X9HNET WORTHF76.2)
 1025 FORMAT (1H /////)
 1026 FORMAT(46X7HBATCH  5A5)
 1027 FORMAT(46X4HTESTI4)
      WRITE OUTPUT TAPE 6,1000
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,1001,(GAMNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1002,(GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1003,IPLAY
      WRITE OUTPUT TAPE 6,1004
      WRITE OUTPUT TAPE6,1005,VOL,PRICE,SALVOL,FPRICE,DEP,SDEP
      WRITE OUTPUT TAPE 6,1006,BNKBAL,SRATE,FININ,SFININ
      WRITE OUTPUT TAPE 6,1007,TINC,STINC
      WRITE OUTPUT TAPE 6,1008
      WRITE OUTPUT TAPE 6,1009,ATAX,TAXL,STAXL
      WRITE OUTPUT TAPE 6,1010,DEP,HTAX,TAXH,STAXH
      WRITE OUTPUT TAPE 6,1011,AEXP,COSTM,SCOSTM
      WRITE OUTPUT TAPE6,1012,TVOL,HEXP,COSTH,SCOSTH
      WRITE OUTPUT TAPE 6,1013,BLOANS,BRATE,FINEX,SFINEX
      WRITE OUTPUT TAPE 6,1014,TCOST,STCOST
      WRITE OUTPUT TAPE 6,1015,FNTIN,BACCT
      WRITE OUTPUT TAPE 6,1025
      WRITE OUTPUT TAPE 6,1016
      WRITE OUTPUT TAPE 6,1017
      WRITE OUTPUT TAPE 6,1018,CASH
      V = PRICE * (1.0 - HTAX) - HEXP
      WRITE OUTPUT TAPE 6,1019,GSVOL,V,GSVAL
      WRITE OUTPUT TAPE 6,1020,ASSETS
      WRITE OUTPUT TAPE 6,1021
      WRITE OUTPUT TAPE 6,1022,FLIAB
      WRITE OUTPUT TAPE 6,1023,FLIAB
      WRITE OUTPUT TAPE 6,1024,TOTWTH
      RETURN
      END
```

```
      SUBROUTINE OUTPT3
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
  712 FORMAT (1H 45X7HGAME   5A5)
  713 FORMAT (1H 45X16HGROWING STOCK   5A5///)
  703 FORMAT (1H /)
  711 FORMAT (1H1  45X35HANNUAL SUMMARY OF TIMBER OPERATIONS)
  700 FORMAT (8X46HALWBL CUTNG    ACT     CUM GRSTK     TOT   NON23X13HA
```

```
     1GE   CLASSES24X6H  OVER)
  701 FORMAT (120H   YEAR   CUT   AGE    CUT     CUT   VOL     VOL   STK
     1   0-9 10-19 20-29 30-39 40-49 50-59 60-69 70-79 80-89 90-99   AGE
     2)
  780 FORMAT(1H 9X3H(1)3X3H(2)4X3H(3) 5X3H(4)3X3H(5)4X3H(6)3X3H(7)3X3H(8
     1)3X3H(9)2X4H(10)2X4H(11)2X4H(12)2X4H(13)2X4H(14)2X4H(15)2X4H(16)
     22X4H(17)2X4H(18)// )
  702 FORMAT (1H 3I6,I7,I8,I6,I8,12I6)
  714 FORMAT(1H145X30HANNUAL SUMMARY OF GROSS INCOME)
  704 FORMAT(25X8HSTUMPAGE6X6HINCOME16X8HINTEREST6X6HINCOME18X5HGROSS7X6
     1HINCOME)
  705 FORMAT(12H YEAR  PRICE12X6HANNUAL9X9HCUMULATED12X6HANNUAL9X9HCUMUL
     1ATED12X6HANNUAL9X9HCUMULATED)
  781 FORMAT(8X4H(19)14X4H(20)14X4H(21)14X4H(22)14X4H(23)14X4H(24)14X4H(
     125)//)
  706 FORMAT(1H I4,F7.2,6F18.0)
  715 FORMAT(1H145X23HANNUAL SUMMARY OF COSTS)
  782 FORMAT(120H              LAND TAXES    SEVERANCE  TAXES  MAINTENANC
     1E  COST   HARVEST  COST    INTEREST  COST     TOTAL      COST     )
  783 FORMAT(119H YEAR  ANNUAL  CUMULATED  ANNUAL  CUMULATED  ANNUAL  CU
     1MULATED  ANNUAL  CUMULATED  ANNUAL  CUMULATED  ANNUAL  CUMULATED)
  784 FORMAT(9X4H(26)7X4H(27)4X4H(28)7X4H(29)4X4H(30)7X4H(31)4X4H(32)7X4
     1H(33)4X4H(34)7X4H(35)4X4H(36)7X4H(37)//)
  785 FORMAT(1H I4,6(F8.0,F11.0))
  716 FORMAT(1H145X42HANNUAL SUMMARY OF NET INCOME AND NET WORTH)
  786 FORMAT(14X44HNET  INCOME     CUMULATED NET  CURRENT VALUE)
  787 FORMAT(117H YEAR   ANNUAL  CUMULATED  OPERATING INCOME  GROWING ST
     1OCK   CASH IN BANK   TOTAL ASSETS  BANK LOANS  TOTAL NET WORTH)
  788 FORMAT(10X4H(38)7X4H(39)14X4H(40)11X4H(41)11X4H(42)11X4H(43)8X4H(4
     14)13X4H(45)//)
  789 FORMAT(1H I4,F9.0,F11.0,F18.0,3F15.0,F12.0,F17.0)
 1026 FORMAT(46X7HBATCH  5A5)
 1027 FORMAT(46X4HTESTI4)
      J = IPLAY + 1
      IVAR(1,J) = IALCUT
      IVAR(2,J) = FMERCH
      IVAR(3,J) = TVOL + 0.5
      IVAR(4,J) = SVOL + 0.5
      IVAR(5,J) = GSVOL + 0.5
      IVAR(6,J) = IVAR(4,J) + IVAR(5,J)
      IVAR(7,J) = KOUNT(1)
      DO 710 I = 1,10
      K = I + 7
  710 IVAR(K,J) = ISUM(I)
      IVAR(18,J) = ISUM(16)
      VAR(1,J) = PRICE
      VAR(2,J) = DEP
      VAR(3,J) = SDEP
      VAR(4,J) = FININ
      VAR(5,J) = SFININ
      VAR(6,J) = TINC
      VAR(7,J) = STINC
      VAR(8,J) = TAXL
      VAR(9,J) = STAXL
      VAR(10,J) = TAXH
      VAR(11,J) = STAXH
      VAR(12,J) = COSTM
      VAR(13,J) = SCOSTM
      VAR(14,J) = COSTH
      VAR(15,J) = SCOSTH
      VAR(16,J) = FINEX
      VAR(17,J) = SFINEX
      VAR(18,J) = TCOST
      VAR(19,J) = STCOST
      VAR(20,J) = FNTIN
      VAR(21,J) = BACCT
      VAR(22,J) = SDEP - STCOST
      VAR(23,J) = GSVAL
      VAR(24,J) = CASH
      VAR(25,J) = ASSETS
      VAR(26,J) = FLIAB
      VAR(27,J) = TOTWTH
      IF (IPLAY - NOPLAY)1000,999,999
  999 IF(IPRNT3 - 1)1000,1001,1001
C
C                                     PRINT FIRST PAGE
C
 1001 N = NOPLAY + 1
      M = 40
      DO 750 J = 1,N
      LINE = J - 1
      IF (M - 40) 725,720,720
  720 M = 0
      WRITE OUTPUT TAPE 6,711
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,712,(GAMNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,713,(GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,700
      WRITE OUTPUT TAPE 6,701
      WRITE OUTPUT TAPE 6,780
  725 WRITE OUTPUT TAPE 6,702,LINE,(IVAR(I,J),I = 1,18)
      IF(J - 1)730,730,735
  735 M = M + 1
      IF(LL - 5)740,730,730
  730 WRITE OUTPUT TAPE 6,703
      LL = 0
  740 LL = LL + 1
  750 CONTINUE
C
C                                     PRINT SECOND PAGE
C
      M = 40
      DO 775 J = 1,N
      LINE = J - 1
       IF(M - 40)746,745,745
  745 M = 0
      WRITE OUTPUT TAPE 6,714
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,712,(GAMNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,713,(GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,704
      WRITE OUTPUT TAPE 6,705
      WRITE OUTPUT TAPE 6,781
  746 WRITE OUTPUT TAPE 6,706,LINE,(VAR(I,J), I = 1,7)
      IF(J - 1)755,755,756
  756 M = M + 1
      IF(LL - 5)760,755,755
  755 WRITE OUTPUT TAPE 6,703
      LL = 0
  760 LL = LL + 1
  775 CONTINUE
C
C                                     PRINT THIRD PAGE
C
      M = 40
      DO 875 J = 1,N
      LINE = J - 1
      IF(M - 40)846,845,845
  845 M = 0
      WRITE OUTPUT TAPE 6,715
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,712, (GAMNAM (I), I = 1,5)
      WRITE OUTPUT TAPE 6, 713, (GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,782
      WRITE OUTPUT TAPE 6, 783
      WRITE OUTPUT TAPE 6,784
  846 WRITE OUTPUT TAPE 6,785,LINE,(VAR(I,J), I = 8,19)
      IF(J - 1)855,855,856
  856 M = M + 1
      IF(LL - 5)860,855,855
  855 WRITE OUTPUT TAPE 6, 703
      LL = 0
  860 LL = LL + 1
  875 CONTINUE
C
C                                     PRINT FOURTH PAGE
C
      M = 40
      DO 975 J = 1,N
      LINE = J - 1
      IF(M - 40)946,945,945
  945 M = 0
      WRITE OUTPUT TAPE 6,716
      WRITE OUTPUT TAPE 6,1026,(BATCH(I),I = 1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
       WRITE OUTPUT TAPE 6, 712, (GAMNAM(I), I = 1,5)
      WRITE OUTPUT TAPE 6, 713, (GSNAM(I), I = 1,5)
      WRITE OUTPUT TAPE 6,786
      WRITE OUTPUT TAPE 6,787
      WRITE OUTPUT TAPE 6,788
  946 WRITE OUTPUT TAPE 6,789,LINE,(VAR(I,J), I = 20,27)
      IF(J - 1)955,955,956
  956 M = M + 1
      IF(LL - 5)960,955,955
  955 WRITE OUTPUT TAPE 6, 703
      LL = 0
  960 LL = LL + 1
  975 CONTINUE
 1000 RETURN
      END
```

```
      SUBROUTINE PLOT1
      DIMENSION X(111)
C
C     INSERT COMMON AND DIMENSION STATEMENTS
C
  202 FORMAT(1H I3,1H.)
  203 FORMAT(45X26HSCALE MULTIPLIER TOO SMALL)
  204 FORMAT(1H )
 1000 FORMAT(1XF4.0,111A1)
 1001 FORMAT(4X1H,111A1)
 2002 FORMAT(1H 10X4HGAME5A5,30X13HGROWING STOCK5A5  )
 2003 FORMAT (1H 10X12HSAVINGS RATEF6.3,10H  PER CENT10X9HLOAN RATEF6.3,
     110H  PER CENT20X15HNUMBER OF PLAYSI6//)
 2004 FORMAT (1H 10X16HPLOTTING SYMBOLS 5X6HCOLUMNI4,3H,  A6, 5X6HCOLUMN
     1I4,3H,  A6, 5X6HCOLUMNI4,3H,  A6,5X5HSCALEF9.0//)
 2007 FORMAT(1H 3X3H-108X1H024X2H2523X2H5023X2H7523X3H100)
 2008 FORMAT(1H 4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4
     1X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.4X1H.)
 6000 FORMAT(1H1//////////40X33HNUMBER OF GRAPHS TO BE PLOTTED IS14)
 7000 FORMAT(1H110X7HBATCH  5A5,27X4HTESTI6)
      BLANKS = 1H
C
C               NUMPLT    = NUMBER OF GRAPHS (OF THREE VARIABLES EACH)
C                           TO BE PLOTTED THIS GAME.
C
 2000 FORMAT(I4)
      READ INPUT TAPE 5,2000,NUMPLT
      WRITE OUTPUT TAPE 6,7000,(BATCH(I),I = 1,5),ITEST
      WRITE OUTPUT TAPE 6,6000,NUMPLT
      II = 0
C
C               NOCOL(I)  = VARIABLES (BY COLUMN NUMBER IN OUTPT3) TO BE
C                           PLOTTED ON THIS GRAPH
C               SYMB(I)   = PLOTTING SYMBOLS
C               SCALE(I)  = SCALING FACTOR (PLOTTED VALUE MUST LIE
C                           BETWEEN -10 AND +100)FOR EACH SET OF FIFTY
C                           POINTS
C
 2001 FORMAT(3I4,3A1,3F10.0)
 2050 READ INPUT TAPE 5,2001,(NOCOL(I),I = 1,3),(SYMB(I),I = 1,3),(SCALE
     1(I),I = 1,3)
 2100 II = II + 1
      IPAGE = 0
 2200 IPAGE = IPAGE + 1
C
C                                     PRINT PAGE HEADINGS,LABEL FOR VER-
C                                     TICAL AXIS, SCALE.
C
      WRITE OUTPUT TAPE 6,7000,(BATCH(I),I = 1,5),ITEST
      WRITE OUTPUT TAPE 6,2002,(GAMNAM(I),I = 1,5),(GSNAM(I),I = 1,5)
      WRITE OUTPUT TAPE 6,2003,SRATE,BRATE,NOPLAY
      WRITE OUTPUT TAPE 6,2004,(NOCOL(I),SYMB(I),I = 1,3),SCALE(IPAGE)
      WRITE OUTPUT TAPE 6,2007
      WRITE OUTPUT TAPE 6,2008
 2299 J = 0
C
C                                     SET LINE COUNTER FOR PRINTING EVERY
C                                     FIFTH ABSCISSA
```

```
C
      LINE = 5
 2300 J = J + 1
      JM = 50*(IPAGE - 1) + J
C
C                                     RENDER X(I) BLANK (NOT ZERO,BUT
C                                     BLANK)
C
      DO 1500 I = 1,111
 1500 X(I) = BLANKS
C
C                                     READ INTO PLVAR(I) THE JMTH LINE
C                                     OF OUTPT3
C
      DO 2305 I = 1,18
 2305 PLVAR(I) = IVAR(I,JM)
      DO 2310 I = 19,45
      L = I - 18
 2310 PLVAR(I) = VAR(L,JM)
C
C                                     SCALE, ROUND, AND CHANGE MODE OF
C                                     PLVAR(N)
C
      DO 2315 I = 1,3
      N = NOCOL(I)
 2315 IORD(I) = PLVAR(N)/SCALE(IPAGE) + 11.5
C
C                                     CHECK IORD(I) SCALING, AND INSERT
C                                     SYMB(I) IN ARRAY X(M).THREE ORDI-
C                                     NATES PLOTTED ON EACH LINE
C
      IF(IORD(1) - 1)3000,3001,3001
 3001 IF(IORD(1) - 111)3005,3005,5000
 3005 M = IORD(1)
      X(M) = SYMB(1)
 3000 IF(IORD(2) - 1)3100,3101,3101
 3101 IF(IORD(2) -111)3105,3105,5000
 3105 M = IORD(2)
      X(M) = SYMB(2)
 3100 IF(IORD(3) - 1)3200,3201,3201
 3201 IF(IORD(3) - 111)3205,3205,5000
 3205 M = IORD(3)
      X(M) = SYMB(3)
 3200 IF (LINE - 5)2301,2302,2302
C
C                                     CALCULATE VALUE OF ABSCISSA
C
 2302 ABSCA = JM - 1
      LINE = 1
C
C                                     PRINT X(M) (AND ABSCISSA EVERY
C                                     FIFTH LINE)
C
      WRITE OUTPUT TAPE 6,1000,ABSCA,(X(I), I = 1,111)
      GO TO 2350
 2301 WRITE OUTPUT TAPE 6,1001,(X(I), I = 1,111)
      LINE = LINE + 1
C
C                                     FINISHED PLOTTING THIS GRAPH,
C                                     THIS PAGE, FOR THIS GAMEO
C
 2350 IF(JM- (NOPLAY + 1))2360,2400,2400
 2360 IF(J - 51)2300,2370,2370
 5000 WRITE OUTPUT TAPE 6,203
 2370 IF(IPAGE - 3)2200,2400,2400
 2400 IF (II - NUMPLT)2050,2500,2500
 2500 RETURN
      END
```

```
      SUBROUTINE COMPAR
      DIMENSION KOUNT(151),UNAGE(1000),ISUM(16),IVAR(18,151),VAR(27,151)
     1,PRIDIV(10),MALCUT(10),FMRCHD(10),YPRICE(150),
     2NOCOL(3),SYMB(3),SCALE(3),PLVAR(45),IORD(3),GAMNAM(5),GSNAM(5),
     3PTVOL(31),VOLUME(150),COMP(6,25,10),KOL(29),ISTORM(3),STMAGE(3),ST
     4MPRI(3,5),IFIRE(5),FIRAGE(5),KSIZE(5),FIRPRP(5),IKOUNT(151),
     5BATCH(5),BPRICE(250)
      COMMON NTESTS,ITEST,IPRNT3,IKOUNT,BATCH,BACCT1,INPRI,BPRICE
      COMMON AEXP,ASSETS,ATAX,BACCT,BETA0,BETA1,BETA2,BETA3,BLOANS,BNKBA
     1L,BRATE,CODE,DEP,COSTH,COSTM,FINEX,FININ,FLIAB,FMERCH,FMRCHD,FNTIN
     2,GAMNAM,GSMRCH,GSNAM,GSVOL,GSVAL,HEXP,HTAX,IALCUT,IGAME,IOVRAG,IPL
     3AY,ISUM,ITAB1,ITAB2,ITAB3,IVAR,KOUNT,MALCUT,NOGAME,NONSTK,NOPLAY,P
     4RICE,PRIDIV,REDINK,SCOSTH,SCOSTM,SDEP,SFINEX,SFININ,SRATE,STAXL,ST
     5AXH,STCOST,STINC,SVOL,TAXH,TAXL,TCOST,TINC,TOTWTH,UNAGE,VAR,VOL,YP
     6RICE,CASH,NEXT,KUT,IORD,NOCOL,SYMB,SCALE,PLVAR,ISTART,ISTOP,NOPTS,
     7IDELTA,PTVOL,IPUNCH,KPUNCH,IGRSTK,VOLUME,COMP,IKOL,KOL,ISTORM,STMA
     8GE,STMPRI,IFIRE,FIRAGE,KSIZE,FIRPRP,SALVOL,NSALV,NUMBER,IWIND,AGE1
     9,AGE2,IEND,TVOL,FPRICE,NOFIRS,NOSTMS
  10 FORMAT(6I5)
  20 FORMAT(1H1//40X22HCOMPARISON OF POLICIES    )
  40 FORMAT(1H 40X15HGROWING STOCK  5A5    )
  50 FORMAT(1H 40X8HCOLUMN  I3///)
  60 FORMAT(120H      YEAR     GAME 1     GAME 2     GAME 3     GAME 4
     1    GAME 5     GAME 6     GAME 7     GAME 8     GAME 9    GAME 10/
     2/)
  70 FORMAT(1H //)
  80 FORMAT(1H I9,10F11.0)
1026 FORMAT(41X7HBATCH  5A5)
1027 FORMAT(41X4HTESTI4)
      LIM = 10 + NOPLAY/10
  55 DO 100 I = 1,IKOL
      DO 100 J = 1,LIM
      K = KOL(I)
      IF(J - 10)110,110,115
 110 JJ = J + 1
      GO TO 120
 115 JJ = 10*(J - 10) + 1
 120 IF(K - 18)125,125,130
 125 COMP(I,J,IGAME) = IVAR(K,JJ)
      GO TO 100
 130 K = K - 18
      COMP(I,J,IGAME) = VAR(K,JJ)
 100 CONTINUE
      IF(IGAME - NOGAME)400,401,401
 401 DO 300 I = 1,IKOL
      WRITE OUTPUT TAPE 6,20
      WRITE OUTPUT TAPE 6,1026,(BATCH(L),L=1,5)
      WRITE OUTPUT TAPE 6,1027,ITEST
      WRITE OUTPUT TAPE 6,40, (GSNAM(L), L = 1,5)
      K = KOL(I)
      WRITE OUTPUT TAPE 6,50,K
      WRITE OUTPUT TAPE 6,60
      M = 0
      DO 300 J = 1,25
      IF(J - 10)310,310,315
 310 JJ = J
      GO TO 320
 315 JJ = 10 * (J - 10)
 320 IF(M - 5)330,325,325
 325 WRITE OUTPUT TAPE 6,70
      M = 0
 330 WRITE OUTPUT TAPE 6,80,JJ,(COMP(I,J,L),L = 1,10)
      M = M + 1
 300 CONTINUE
 400 RETURN
      END
```