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**RANKING
TREATMENT
OPPORTUNITIES IN
EXISTING TIMBER
STANDS ON
WHITE PINE LAND
IN THE
NORTHERN REGION**

by

J. H. Wikstrom and Jack R. Alley

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
Ogden, Utah

This is one of a series of reports published by the Intermountain Forest and Range Experiment Station. These reports are the result of a study initiated in 1962 to evaluate management alternatives on lands capable of growing white pine within National Forests in eastern Washington, northern Idaho, and western Montana. The work was done in cooperation with the Northern Region of the U.S. Forest Service. The following reports are included in the series:

Relations between western white pine site index and tree height of several associated species, by Glenn H. Deitschman and Alan W. Green. U.S. Forest Service Research Paper INT-22, 1965.

Market trends for western white pine, by Robert E. Benson and Larry L. Kirkwold. U.S. Forest Service Research Note INT-65, 1967.

Cost control in timber growing on the National Forests of the Northern Region, by J. H. Wikstrom and J. R. Alley. U.S. Forest Service Research Paper INT-42, 1967.

Evaluating species alternatives for National Forest land capable of growing western white pine, by Alan W. Green and Jack R. Alley. U.S. Forest Service Research Paper INT-43, 1967.

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FOREWORD

A forest typically is made up of a large number of stands differing in stage of development, composition, and condition, and often intermingled with nonstocked areas. The task in developing action programs is to select and fit the pieces of the management puzzle together in the way that best allows the achievement of the management objective. However, before the program can evolve, or, in fact, before a realistic program objective can be developed, there must be an evaluation and ranking of the forest areas in terms of the opportunity they afford to produce specified products. This is part of the information needed for intelligent decision making.

This paper is concerned with the ranking of timber management opportunities in existing stands on National Forest land capable of producing white pine in the Forest Service's Northern Region. Presently management attention is focused on this land, partly because it is such good timber producing land and partly because the presence of blister rust in white pine has forced the Northern Region into a reevaluation of the management of white pine land. However, the evaluation techniques described here are applicable in other forest situations as well, wherever treatment alternatives exist.

INTRODUCTION

Because the Northern Region does not have an effective way to control white pine blister rust, a decision has been made to discontinue regenerating new white pine stands until rust resistant white pine planting stock is available or an economical rust control method is developed. The management problem is broader, however, than the question of what species to regenerate in place of white pine during this interim period. The white pine land¹ is largely stocked with timber, much of which is white pine. Eventually, it is hoped, the extensive research now underway will produce an effective rust control method. In the meantime the question is what to do with these stands and in what order; how to manage them in the interim period when effective control of blister rust is impossible.

This report attempts to answer the question by presenting a general method of approach to the management alternatives. The principal objective is to discuss some of the financial aspects of timber management decision making on public lands. This subject, though basic to the management of stands on white pine land, reaches beyond the problems of white pine forests.

The purpose of timber management planning on public land is, broadly speaking, threefold:

1. To produce, for a given planning period, a specified flow of timber yields consistent with both timber marketing and timber growing opportunities.

2. To select the areas best suited for producing the yields specified and to manage the

selected areas in a way to achieve the most desirable balance between timber growing, recreation, watershed protection, and other forest uses.

3. To accomplish the timber growing objectives in the most economical manner possible.

A consciousness of all three aims of planning is vital to sound policy making and program development. For example, if a manager were to establish a production goal without considering rates of return possible from the forest, he might find his goal and program to be economically unrealistic. Again, if he selected for management only those stands that would individually produce the highest return on the investment, thus achieving the objective of economy, he might find it difficult if not impossible to secure the concomitant objectives of flow of yields and good coordination with other uses.

This discussion is primarily concerned with the financial ranking of stands for management treatment. Common sense dictates that all actions be considered in relation to the specified management objective, that the areas selected for timber growing be those where the objectives can be achieved at least cost, and then that the management action needed be taken in the most efficient manner possible.

Since timber management involves the expenditure of either public or private money, it is clearly desirable to choose from the available stands and management measures those that can accomplish the manager's objectives and at the same time produce the greatest dollar return on the investment. Estimations of rate of return are therefore valuable aids, and will be discussed in the following pages not as ends in themselves, but as steps in management decision making.

¹The term "white pine land" is used throughout this paper to designate land now growing or suitable for growing white pine. Such land is principally in Clearwater, Coeur d'Alene, Colville, Kaniksu, Kootenai, and St. Joe National Forests.

MANAGEMENT POSSIBILITIES

Timber management possibilities in any area are limited by the capacity of the land to produce crops of wood. This capacity varies, to some extent, according to the species grown. Timber management possibilities are also limited by the nature of the stands already existing on the land. This is the primary concern of the present discussion. Land capability and species alternatives are discussed in an earlier publication in the series reporting on this study (Research Paper INT-43). They will be mentioned here only briefly.

YIELD CAPACITY OF WHITE PINE LAND

The 3.5 million acres of white pine land in the National Forests of the Northern Region includes the most productive timberland in the Rocky Mountains and is among the most productive in the United States. The white pine land of the Northern Region is now producing only a quarter to a third of the timber yields that could be realized with more intensive management. This situation exists primarily because only a portion of the forest has been converted to a regulated condition. Conversion of an old-growth forest to a condition in which the growing capacity of the land is efficiently utilized and growing stock is managed to produce a regulated flow of products is a long-term task. What can be accomplished at any one time is limited by economic circumstances and often is complicated by natural catastrophes such as fire, disease, insects, and weather. However, under management adequate to provide for prompt regeneration and stocking control the portion of this land that is site 60 or higher could produce more than 800 board feet per acre per year in an 80-year rotation. About 70 percent of land capable of growing white pine is that good.

The capacity of white pine land to produce trees is indicated in a more specific way by the data in table 1. This table shows average 10-

year diameter growth rates by species for dominant and codominant trees measured on Forest Survey plots on white pine land. The growth rates shown compare favorably with growth rates in wild stands (stands that developed naturally and in which no effort has been made to control stocking) in other high timber-producing areas of the United States.

SPECIES CAPABILITIES

Even though it is not practical at this time to attempt to grow white pine on the land under study, because effective means of blister rust control are lacking, a number of other species can be grown. The most popular species that might be grown are those listed in table 1. Trees of these species now exist on the land, in some places as pure stands, but more often in stands of mixed species, often including white pine. As the growth rate data in table 1 indicate, many of the species listed grow well on white pine land.

The capacity of all the species listed to utilize the land can be influenced through management. The nature of this opportunity is partially reflected by the data in table 1. The standard deviations in growth, which are a measure of the variations in growth rates encountered, show a wide range for all species. Significantly half or more of this variation in growth can be explained by differences in stand density, tree age, and tree vigor (which is influenced by stand density), suggesting that considerable opportunity exists to improve the yield of merchantable wood through well-timed stocking control.

EXISTING STANDS

An important consideration in deciding how and when to bring a particular area or stand under management regulation is the nature of the cover already present on the

**Table 1. — Average 10-year diameter growth rates by species
for trees growing on white pine land**

Species	Average 10-year diameter growth, all sites	Standard deviation of growth	
	<i>Inches</i>	<i>Inches</i>	<i>Percent</i>
White pine	2.378	1.023	43
Ponderosa pine	2.173	.821	38
Grand fir	2.131	1.003	47
Douglas-fir	1.755	.921	52
Cedar-hemlock	1.711	.864	50
Western larch	1.656	.777	47
Spruce-alpine fir	1.508	.746	49
Lodgepole pine	1.468	.782	53

Source: Forest Survey data.

land. The vegetation cover on the white pine land of the Northern Region has changed considerably in this century as a result of man's actions as well as natural factors.

Forest management started in the white pine area in the Northern Region about the turn of the century, on land supporting largely old-growth white pine timber. Since then the Forest Service has been selling timber, gradually converting the unmanaged old-growth forest to a regulated forest condition as economic limitations would permit. During this time a large volume of old-growth timber was destroyed by wildfires, disease, and insects. Today over half the forest area supports stands of sawtimber-size trees. However, sawtimber stands older than 100 years occupy only a little over a third of the area. The forest can be pictured in terms of stand size as follows:²

Stand size	Stand area	
	(Thousand acres)	(Percent of total)
Sawtimber:		
Older than 160 years	586	18.2
100 to 160 years old	523	16.3
Less than 100 years old	741	23.0
Subtotal	1,850	57.5
Poletimber	620	19.2
Seedling and sapling	749	23.3
Subtotal	3,219	100.0
Nonstocked	278	
Total	3,497	

Species composition of stands varies. Although white pine is a component of many of the stands on this land today, as a result of type conversion only 12 percent of the 3.5 million acres of National Forest land capable of growing white pine actually supports stands in which white pine is the principal species. Much of this is sawtimber that can be harvested; however, as the following tabulation shows, there are 125,000 acres of white pine type containing stands of trees that are below sawtimber size:

² All resource data in the tabulation were obtained from Forest Survey. All information except that presented later for young stands originating since 1949 is from surveys conducted in 1958-61. The information for the stands originating since 1949 was updated by the Northern Region from recent stand examination records and stand establishment records.

Stand size	Thousand acres
Sawtimber	303
Poletimber	93
Seedling and sapling	32
Total	428

From even this brief description of the forest occupying white pine land, it is evident that managers hoping to improve timber production must deal with a variety of situations. Stand composition as well as stand size may vary, ranging from almost pure stands of a single species, including white pine, to stands of a variety of species mixtures. Stands may range in age from less than a year to over 200 years, and in condition from vigorous and healthy to heavily diseased and decadent. It is important to recognize also that some stands are on stable soils and gentle slopes so that they are easy to develop, whereas others are on highly unstable soils or steep slopes, or both, and may not be loggable with present technology. There is no simple answer to the management of these stands nor is there a simple solution applicable to all. *Every stand must be evaluated individually.* However, certain general considerations must be recognized with respect to white pine and other merchantable and nonmerchantable stands.

White Pine Stands

Because there is still hope for a practical method of blister rust control and research is going forward to find one, managers may wish to defer action on white pine stands if cost-value relationships would not be materially changed by a delay of a few years. This consideration would apply to mature stands as well as young stands. Again, regardless of how serious losses due to blister rust or other agents may be, it would not be wise to harvest if logging would seriously damage soil or watershed values, or both. It also may be desirable to adjust priorities in treatment planning so as to achieve yield objectives more fully.

Merchantable Stands

Some merchantable stands cannot be logged economically with present technology without undue watershed damage. However, the

major consideration in dealing with merchantable stands, particularly on highly productive land, is mortality. If mortality is very light, the manager will want to defer cutting as long as possible. In stands on good land where mortality rates are high, cutting will need to be accelerated to reduce mortality losses.

Cutting for salvage in high-mortality stands appears particularly urgent in seriously threatened high-value old-growth stands of white pine. With its higher stumpage value, white pine can carry the cost of much of the access development needed to serve a multitude of land use objectives. If the white pine values are lost, large areas may have to remain without access for many years to come.

The opportunity to develop and log an area economically can be quickly lost as mortality increases. The Northern Region has about 150,000 acres of mature white pine timber type in areas largely inaccessible. Much of this timber is in stands yet to be inventoried in sufficient detail to indicate mortality, but in those stands that have been surveyed, 5 to 7 percent of white pine timber has been dying each year.

Data from the Forest Survey indicate the nature of the problem of mortality. The volume of salvable dead timber³ reflects the more recent mortality: 38,000 acres support sawtimber stands containing 1,500 cubic feet (roughly 7,500 board feet) or more in salvable dead trees per acre, as the following tabulation shows:

Volume of salvable dead wood (Cu. ft./acre)	Approximate board feet per acre	Thousand acres
Less than 499	1,250	1,699
500-999	3,750	81
1,000-1,499	6,750	33
1,500-1,999	8,750	18
2,000-2,499	11,250	9
2,500-2,999	13,750	7
Over 3,000	15,000+	4
Total		1,851

³Dead merchantable trees containing 50 percent or more sound wood at the time of measurement.

The harvesting opportunity is limited as well by the volume of timber available per acre and by the cost of road development. In developed areas it is sometimes possible to harvest volumes of 1,000 board feet per acre or less. Data are lacking to show timber available in relation to development cost. Generally speaking, timber can be harvested if the volume available in trees of merchantable size over large areas exceeds 5,000 board feet per acre, unless problems of access and development are severe. Of the 1,850,000 acres of sawtimber in the study area, 1,633,000 acres support 5,000 board feet or more per acre.

One of the more urgent problems facing the Northern Region is to complete an inventory of white pine stands of harvestable size and determine priorities for harvesting.

Nonmerchantable Stands

The nonmerchantable stands, like the merchantable stands, represent a wide range of situations, and each stand has to be considered individually. Also, each stand has to be considered in relation to the operability and quality of the land it is growing on and in relation to the management goals set for the Forest.

Depending on their age, size, vigor, and species composition, and on the quality and character of the land on which they are growing, nonmerchantable stands present a variety of possibilities. Some may offer few management opportunities either because nature alone is doing a good job or because any improvements in the yield would be small in relation to the costs involved. In addition, some of the pure or almost pure white pine stands are so near gone that there is no alternative but to start over with a new stand of some other species or mixture of other species.

The majority of the immature stands, however, are mixed species. If these are overstocked, thinning is always a management possibility. Any diseased white pine trees in these stands can be removed in the thinning treatment.

Stands in the younger age classes (fig. 1) are generally thought to offer the best thinning opportunities, because capabilities for growth response generally decrease with age as well as with increases in stocking and loss of crown. According to surveys made in 1958-61, of the 1,368,000 acres of pole size and smaller timber, 693,000 acres supported stands that originated after 1929, and of these, 121,000 acres supported stands that originated after 1949. Since the 1958-61 survey, an additional 100,000 acres of new stands have been established on white pine land, 52,000 acres by planting and 48,000 by natural regeneration.

For the most part these stands are well stocked with potential crop trees⁴ that will produce good timber products. Many of the 221,000 acres of stands originating since 1949 have already been examined to evaluate thinning opportunities, and data from these examinations suggest that most of this land is well stocked in terms of potential crop trees. These data suggest that if the stands examined are representative of the 221,000 acres, then 190,000 acres have 200 or more potential crop trees per acre, in the following proportions:

Potential crop trees per acre	Thousand acres
Less than 100	2
100 - 199	29
200 - 299	60
300 - 400	86
Over 500	44
Total	221

One of the problems of this area is that the potential crop trees are growing in competition with many trees that are excess to the needs of the stands. Some stands, principally plantations, have relatively few excess trees per acre. However, one-third of the stands that

⁴In stand examinations, potential crop trees are identified with reference to tree quality and distribution. These are the trees that would be featured if the stand were to be thinned.

Figure 1. — Thinning in a young stand of lodgepole pine in the Northern Region.

originated since 1949 have 1,000 or more excess trees per acre, as follows:

Excess trees per acre	Thousand acres
Less than 199	71
200 – 499	44
500 – 999	32
1,000 – 1,999	46
2,000 – 2,999	13
3,000 or more	<u>15</u>
Total	221

Managers may also wish to consider methods of improving wood quality yield by pruning. Pruning might help to control dwarf-mistletoe, which infects some nonmerchable stands.⁵ However, the practicability of this method has yet to be demonstrated in this Region. Dwarfmistletoe might also be controlled through eradication of infected and exposed trees during the thinning process.

⁵Flora, Donald F. *A method of forecasting returns from ponderosa pine dwarfmistletoe control*. U.S. Forest Serv. Res. Pap. PNW-37, 17 pp. 1966.

Some nonmerchable stands are residual stands of cull timber. Included in the forest on white pine land are 83,000 acres supporting stands containing 3,000 cubic feet or more per acre of cull sawtimber. Some of this land is excellent for timber production – site class 80 or better; about half is site index 60 or better:

Site class	Thousand acres
80+	10
70	12
60	17
50	23
40	<u>21</u>
Total	83

The site class for most of this land is based on measurement of old residual cull trees, which usually results in an underestimate of site. In many instances these cull stands can be removed inexpensively under salvage contracts, making the land available to grow a new crop. In others, it may be possible to fell and burn residual stands so that the land can be used.

CONSIDERATIONS IN RANKING TIMBER GROWING OPPORTUNITIES

Financial calculations ranking timber production opportunities are rather complex and have no utility unless performed correctly. Certain aspects of these calculations that must be thoroughly understood are discussed in the paragraphs that follow.

ALL MANAGEMENT MEASURES PLANNED SHOULD BE INCLUDED IN THE EVALUATION

It cannot be emphasized too strongly that the culturing of a crop of trees involves a number of interdependent activities. It is particularly important, therefore, that an evaluation used in comparing timber growing opportunities on different areas or pieces of land should include the entire series of treatments to be carried out. The starting point of the series varies. If the evaluation begins with the establishment of stand cutting priorities, a manager will want to rank each area on the basis of present worth, considering the existing stand and the cutting treatment, as well as all the treatments indicated to make the most of the opportunity for future timber growing. For example, it may be possible to make a greater contribution to revenue by cutting a low-volume decadent stand on high-quality land than by cutting a stand with a greater volume on a low-quality site. If the evaluation begins with regeneration, it will be advantageous to compare alternative management regimes for the entire growing period for each area, and then to compare areas on the basis of the series of treatments most favorable to each. Frequently, the manager will be interested in comparing the desirability of doing no additional management in a stand or of adding a treatment to the management program. To do this he must compare both program levels so that the cost of the management treatment added can be evaluated in relation to the increase in yield to be expected from the treatment.

Certainly a critical time for making an evaluation is when a sale is being planned. The analysis made in conjunction with timber selling should indicate first of all the order in which stands should be cut, and then how timber production on the area might proceed. For stands to be cut, the analysis should indicate whether future timber production (other than what unaided nature might accomplish) should even be considered. Such questions as these might be asked: How much could be spent on regeneration of a timber stand at the minimum interest rate specified? Could regeneration of any species be accomplished for that amount?

If timber production is planned, an analysis should be made that considers alternatives of species, silvicultural systems, and treatment combinations to determine the best way to proceed and the rate of return that would result from the best of the alternatives.

COST MUST BE CONSIDERED DISCRIMINATELY, AND IN RELATION TO THE APPROACH TO MANAGEMENT

For a useful evaluation, it is important that the cost estimates for treatments planned for a stand be as accurate as possible. Many factors influence the cost of timber growing activities and these may vary considerably from stand to stand. Ranking of stands must begin with a discriminating consideration of costs. (Timber growing costs are discussed in another publication in this series, Research Paper INT-42.)

The approach to management can have an important bearing on costs. For example, the size of the cutting blocks laid out in sales planning can have as large an effect on future timber growing costs as on the revenues realized in harvesting. As shown in table 2, when stand reestablishment involves slashing, prescribed burning, and planting, it costs

more than twice as much per acre to establish a new stand on 10-acre blocks as on 80-acre blocks.

Similarly, the way one management task is carried out can affect subsequent management actions. A minimum job of site preparation may be low in cost, but it can result in higher planting costs. The amount of debris on the ground after site preparation may even affect the cost of thinning. It is important, therefore, that costs used in financial calculations be realistic in terms of the quality of the work done and the interrelationships between the actions planned.

VALUE YIELD ESTIMATES MUST BE CONSISTENT

The problem in estimating yields is to predict how crops of trees will develop over time and how value yields will be affected by management. Also, it is necessary to estimate future wood prices.

Procedures for predicting how stands will develop under different assumptions of management are still rather crude. Computer programs have been developed for projecting stands when growth and mortality data are available, but as yet these are crude in themselves and more often than not the growth and mortality data available are inadequate.

Where stand projection programs are lacking it may be necessary to fall back on normal

yield tables. These are thought to give reasonable estimates of the capacity of the land to produce wood. For example, table 3 shows the volume of wood that might be expected from fully stocked stands on white pine land for a range of ages and site classes.

Yield tables can be used for making stand projections. To illustrate, figure 2 shows the development of the average wild fully stocked stand on land in site class 60 in terms of volume in trees of different sizes. From this, some approximations can be made of the influence of stocking control. For example, assuming it is reasonable with thinning to grow stands in which all trees will be 12 inches and larger in diameter at 90 years, then AB = the volume gain at that point attributable to thinning if 12 inches (diameter) is the minimum merchantable tree size. If a series of commercial thinnings is planned, it is essential to estimate also how these are expected to influence yield.

To illustrate further, according to yield tables a fully stocked stand of western larch on site 70 land in the Northern Region should contain dominant and codominant trees averaging 70 feet in height at 50 years of age, and the stand should have a total volume of 4,682 cubic feet of wood. If the stand approaches "normal" in stocking and tree size distribution, 78 percent of the volume should be in trees 5.0 inches d.b.h. and larger and about 47 percent in trees 8 inches and larger. The Northern Region anticipates that with thin-

Table 2. — Cost of selected timber growing activities by size of area

Size of area	Activity			Total
	Slashing	Prescribed burning	Planting	
<i>Acres</i>	<i>Dollars per acre</i>			
10	41.00	26.00	49.50	116.50
20	30.50	23.50	35.00	89.00
40	20.00	19.00	29.00	68.00
80	12.50	13.50	25.00	51.00

Table 3. — Total volume of all trees 0.6 inch d.b.h. and larger
for normal white pine stands

Age	Site index			
	50	60	70	80
----- Cubic feet per acre -----				
40	2,270	2,650	3,030	3,400
50	3,640	4,210	4,830	5,470
60	5,050	5,880	6,710	7,600
70	6,450	7,500	8,560	9,730
80	7,750	9,000	10,350	11,750
90	8,980	10,450	12,000	13,650
100	10,100	11,850	13,500	15,400
110	11,150	13,000	14,800	16,850

Source: Haig, Irvine T. Second growth yield, stand and volume tables for the western white pine type. U.S. Dep. Agr. Tech. Bull. 323, 68 pp. 1932.

ning, fully stocked western larch stands on site 70 land should produce 4,682 cubic feet of wood at age 50 in trees 8 inches and larger and that 8-inch trees can be utilized. In other words, it is expected that an additional 2,500 cubic feet of wood per acre will be available in trees 8 inches and larger at age 50 as a result of thinning. The above information is shown graphically in figure 3.

It is well to recognize the low state of the art of projecting stands under different levels of management. However, in ranking stands for management treatment, the crudity of stand projection techniques need not be a serious handicap so long as there is no evidence of bias. It is essential only that the procedures and data used produce results that are consistent from stand to stand.

Estimating future wood prices is even more difficult than predicting stand response to treatment. No one can say definitely what wood will be worth 50 or 100 years in the future or how prices will vary between species. After studying price trends, the manager must judge what future prices are likely to be, but he must recognize that his conclusion is largely guesswork.

A recent analysis of wood selling prices (Research Note INT-65 in this series) indicates that the high prices of white pine and ponderosa pine are largely the result of the demand for the clear wood of these species. Unless stands are pruned or rotations are lengthened, the price differences between white and ponderosa pine and other species may be less in the future. It is probable that species price differences will be negligible in stands just achieving merchantable size. However, it is also probable that wood value increases with tree size in some species more than in others.

Even though species price differences have been lessening in recent years, the manager may still wish to recognize some differences in establishing prices to be used in evaluating timber growing opportunities.

Accessibility to market may be a desirable point to consider, and a range of prices by species that reflects distance from principal processing centers might be established. However, if analyses of individual stands are to be comparable, the price estimates applied to similar stands that are to be managed in the same way must be the same.

Figure 2. Volume by tree size class in fully stocked wild stands of white pine, site class 60.

TIME PERIOD ESTIMATES MUST BE CONSISTENT

Two aspects of time are important in financial calculations. First, there are the specific times when incomes are expected or expenditures are to be made. Second, there is the overall time period, the rotation planned for a timber growing operation.

Depending on the circumstances surrounding the management of a Forest, the effects of

a particular management treatment may be immediate or may be realized at some later point in time. To illustrate, if the annual allowable cut were to increase immediately because of some management action, the financial calculations would be based on the net value of the increase in cut for as long as it persisted. On the other hand, if the benefits were not realized until some future date during or at the end of the rotation, the calculation of rate of return would have to take account of the elapsed time.

Figure 3. — Expected development of fully stocked western larch stand with and without stocking control, as represented by volume in different tree size classes.

In both situations, however, the aim is to compare the estimated cost of the management treatment being considered with the expected effect on yield, considering the time that will elapse between the point when the cost is incurred and the point when benefit is realized.

The time period or rotation used is an important element in financial calculations. However, it must be recognized here that there is a certain element of guesswork in the establish-

ment of timber rotations. Circumstances are continually changing in a way that may affect the length of the timber growing period. Harvesting may be required short of the rotations established, to avoid serious loss due to some forest enemy. Similarly, technology or wood values may change, making either a shortening or lengthening of rotations desirable.

The Northern Region has established some tentative rotations and tree-size objectives by

site classes. These are not economic rotations in that they are not supported by economic analysis. They may be longer or shorter than is desirable from a timber growing cost-price point of view. As illustrated in table 4, on the basis of yield data for white pine (site index 70), only under the first of the two price assumptions (which were arbitrarily chosen) is the rate of value increase greater than 5 per cent after age 90. The rate of value increase reflected in either set of price assumptions may or may not be reasonable.

Northern Region tentative tree-size objectives and rotations are as follows:

Site class based on height at 50 years	Average diameter (Inches)	Rotation (Years)
White pine, grand fir, spruce, hemlock		
90+	22	90
70 — 80	20	100
50 — 60	18	110
40 — 50	16	120
Larch, Douglas-fir, ponderosa pine		
90+	20	100
70 — 80	18	110
50 — 60	16	120
40 and less	Cordwood	

Lodgepole pine

60+	16	80
40 — 50	14	100
Less than 40	Cordwood	

In the actual practice of timber growing, the rotation period tends to be indefinite. Quite probably in the future, the termination of stand growing periods will be decided as each stand takes on merchantable value. Some stands may be held for long periods to produce products to meet particular demands. Other stands may be cut as soon as they become merchantable.

Although it is desirable to have available an established scale of economically defensible timber growing periods for broad planning purposes, that question need not be dealt with here since this discussion is concerned only with the ranking of opportunities within a particular locality. In ranking stands or areas for management treatment within a Region or within a Forest, the time periods used need not represent a serious source of bias as long as they are reasonably consistent for the entire area. It is important to recognize that in evaluating long-term production opportunities such as timber growing, consistency in procedure and data is very important.

Table 4. — Rate of stand value increase under two price assumptions — yield data for white pine site index 70

Age	Volume per acre	Assumption 1			Assumption 2		
		Price per M bd. ft.	Stand value per acre	Rate of value increase	Price per M bd. ft.	Stand value per acre	Rate of value increase
	<i>M bd.ft.</i>	— — — — <i>Dollars</i>	— — — —	<i>Percent</i>	— — — — <i>Dollars</i>	— — — —	<i>Percent</i>
50	19.5	4.00	78.00	—	4.00	78.00	—
60	33.8	6.00	202.80	10.0	6.00	202.80	10.0
70	44.8	9.00	403.20	7.5	8.00	358.40	5.9
80	63.5	13.00	825.50	6.5	10.00	635.00	5.7
90	78.0	18.00	1,404.00	5.5	12.00	936.00	4.0
100	90.5	24.00	2,172.00	4.5	14.00	1,267.00	3.1
110	100.9	32.00	3,228.80	4.0	16.00	1,614.40	2.5

Source: Haig, Irvine T. Second growth yield, stand and volume tables for the western white pine type. U.S. Dep. Agr. Tech. Bull. 323, 68 pp. 1932.

RANKING STANDS FOR TREATMENT

The calculation of rate of return is quite complicated when a series of costs as well as a series of returns are involved. Computer programs have been prepared by both Hall and Row⁶ for making present worth and interest rate computations. These programs have been adapted by the Intermountain Station for use on the Forest Service's Northern and Intermountain Regions' computers to handle common evaluation problems of timber growing. Basic adaptations of both Hall's and Row's programs are described by Green and Alley for use in ranking species alternatives (Research Paper INT-42 in this series). The discussion here describes another version of the Clark Row program usable in ranking opportunities in existing stands and in evaluating timber stand improvement programs. Use of the program is illustrated in brief in the pages that follow. Details of the program are presented in the Appendix.

⁶Hall, Otis. *Evaluating complex investments in forestry and other long-term enterprises using a digital computer*. Purdue Univ. Res. Bull. 752, 11 pp. 1962. Row, Clark. *Determining forest investment rates of return by electronic computer*, U.S. Forest Serv. Res. Pap. SO-6, 13 pp. 1963.

RANKING STANDS FOR REPLACEMENT

The program given here is identified as Intermountain Station Investment Analysis Program No. 6. (The program listing is given in the Appendix.) Among other things, this program will compute discounted net worth⁷ of future crops and discounted net worth of the present and future crops combined.

There are two common uses for this feature of the program. First of all, the program can be used to determine, from a financial standpoint, which stands should be considered for immediate cutting. To illustrate, if present net worth for a stand would be increased significantly if the stand were held for another 10-year planning period, considering both the value changes in the present stand and the future growing opportunity, the manager would not want to program it for cutting now. From an economic point of view a manager might want to hold the stand described below:

⁷Discounted net worth is the computed present net value of the area, assuming a specified rate of return.

	Alternative 1 (cut now)	Alternative 2 (cut in 10 years)
Present stand and conversion opportunity		
Estimated merchantable volume (100 cubic feet per acre)	70	80
Quality index	.90	1.10
Future timber growing opportunity		
Site preparation year after cutting (cost, dollars per acre)	5.00	5.00
Regeneration (cost, dollars per acre)	.00	.00
Precommercial thinning 21 years after site preparation (cost, dollars per acre)	22.00	22.00
Intermediate cut 30 years after thinning (100 cubic feet per acre)	25	25

	Alternative 1 (cut now)	Alternative 2 (cut in 10 years)
Quality index for intermediate cut	.35	.35
Harvest cut 30 years after intermediate cut (100 cubic feet per acre)	90	90
Quality index for harvest cut	1.10	1.10
Price assumption		
Net price (dollars per 100 cubic feet)	5.00	5.00
Expected increase in price per year (rate)	.005	.005

Note that for both the present and the future stands the anticipated schedule of investments and yields is listed. In each case quality of yield is indicated.⁸ Note also that it has been assumed that real wood prices will increase slightly in the future (0.5 percent per year). The program provides the opportunity to assign current prices to products and include an estimate of how prices are expected to change over time.

For use with the computer program, the data in the above tabulation must be prepared for computer input. (Instructions for preparing problem input are given in the Appendix.)

The problem solution is shown in figure 4. After printing the program input, the computer lists the discounted net worth of future crops. This listing also reveals the expected internal rate of return in future timber growing if the range of interest rates specified includes the rate at which present worth is \$0.00.

In this case expected internal rate of return on future timber growing is between 5.6 and 5.7 percent. It is between these rates that discounted net worth becomes zero. This listing is included in the output to help the man-

⁸The quality index is the ratio of the estimated price for the specific product to the average price expected for the product.

ager decide whether to consider timber growing on the area if investments are required.

The second listing shows discounted net worth for the present and future stands. This listing shows that present worth for alternative 2 is still greater than for alternative 1 at 3.5 percent rate of return. This may be considered a lower rate of return than is desirable, but because managers in this area have so much timber in need of cutting, they may want to hold this stand and fill cutting budgets from stands for which present worth was decreasing with time, assuming the same rate of return.

In addition to using the investment analysis computer program to check his judgments about what stands to consider for cutting, the manager can also use the program to establish cutting priorities among stands ready for cutting. If a manager were not forced to cut in a specific area to control the spread of some forest infection, he logically would cut in those areas where (again considering present stand value and the future timber growing opportunity) the greatest contribution to revenue could be made. Here, again, costs and values associated with both the present stand and the future stand would be considered.

The present stand and the future timber growing opportunity on two areas described in the following tabulation are used for illustration.

	Area 1	Area 2
Present stand and conversion opportunity		
Merchantable volume per acre (100 cubic feet per acre)	74	59

	Area 1	Area 2
Quality index	.90	.90
Road costs 1 year before logging (dollars per acre)	24.00	22.00
Sales cost 2 years before logging (dollars per acre)	7.00	6.00
Future timber growing opportunity		
Thinning 30 years after logging on poor land, 15 years after logging on good land (dollars per acre)	23.00	23.00
Intermediate yield 45 years after thinning on poor land, 35 years after thinning on good land (100 cubic feet per acre)	--	20.00
Quality index	--	.35
Intermediate cut 50 years after thinning (100 cubic feet per acre)	25.00	30.00
Quality index	.35	.50
Harvest yield 80 years after thinning on poor land, 66 years after thinning on good land (100 cubic feet per acre)	80.00	120.00
Quality index	.90	1.40
Price assumption		
Price (dollars per 100 cubic feet)	7.00	7.00
Expected increase in price per year (rate)	.005	.005

The problem solution is shown in figure 5. The computer lists discounted present worth of future crops for the range of interest rates specified. This listing also reveals the expected internal rate of return in future timber growing. In the case of area 1 it is between 4.8 and 4.9 percent. Between these rates, discounted net worth becomes zero. For area 2 the expected internal rate of return is much higher — between 7.4 and 7.5 percent.

The second listing shows the discounted net worth of the present and future stands. If, in ranking stands, 3.6 percent were set as the point at which stands would be cut, a manager would cut area 2 in preference to area 1 because, as this listing shows, discounted net worth is greater by \$2.64. To the extent that a manager could fill his cutting budget from areas like area 2, he would defer cutting areas like area 1.

RANKING STAND IMPROVEMENT PROJECTS

Investment Analysis Program No. 6 can also be used for evaluating timber stand improvement opportunities when the manager is concerned about cost in relation to the margin of difference resulting from treatment. For example, assume a manager has a heavily overstocked 20-year old stand: if he did nothing the stand would yield a harvest cut of 6,000 cubic feet of merchantable wood (about 30,000 board feet) in 100 years (at age 120). He might wish to know what the advantage would be of precommercial thinning and pruning. With precommercial thinning he might expect two commercial thinnings, one of 1,200 cubic feet (about 5,000 board feet) in 35 years (at age 55), and one of 2,000 cubic

Figure 4. — Problem solution (see problem 4, Appendix).

PROBLEM NO. 4--SAMPLE PROBLEM--STAND REPLACEMENT--CUT NOW OR IN 10 YEARS				PROBLEM NO. 4--SAMPLE PROBLEM--STAND REPLACEMENT--CUT NOW OR IN 10 YEARS			
DISCOUNTED NET WORTH OF FUTURE CROPS				DISCOUNTED NET WORTH OF PRESENT AND FUTURE CROPS			
RATE	ALT-PLAN 1		ALT-PLAN 0	RATE	ALT-PLAN 1		ALT-PLAN 0
	(ROTATION 81)	(ROTATION 81)			(ROTATION 0)	(ROTATION 10)	
1.0	579.90	579.90		1.0	894.90	943.22	
1.1	503.11	503.11		1.1	818.11	865.10	
1.2	439.82	439.82		1.2	754.82	800.41	
1.3	386.91	386.91		1.3	701.91	746.05	
1.4	342.14	342.14		1.4	657.14	699.77	
1.5	303.88	303.88		1.5	618.88	659.94	
1.6	270.90	270.90		1.6	585.90	625.33	
1.7	242.26	242.26		1.7	557.26	595.01	
1.8	217.23	217.23		1.8	532.23	568.25	
1.9	195.22	195.22		1.9	510.22	544.46	
2.0	175.78	175.78		2.0	490.78	523.20	
2.1	158.53	158.53		2.1	473.53	504.09	
2.2	143.17	143.17		2.2	458.17	486.82	
2.3	129.45	129.45		2.3	444.45	471.15	
2.4	117.14	117.14		2.4	432.14	456.86	
2.5	106.08	106.08		2.5	421.08	443.78	
2.6	96.11	96.11		2.6	411.11	431.76	
2.7	87.10	87.10		2.7	402.10	420.68	
2.8	78.95	78.95		2.8	393.95	410.42	
2.9	71.56	71.56		2.9	386.56	400.90	
3.0	64.85	64.85		3.0	379.85	392.03	
3.1	58.75	58.75		3.1	373.75	383.74	
3.2	53.19	53.19		3.2	368.19	375.99	
3.3	48.12	48.12		3.3	363.12	368.70	
3.4	43.50	43.50		3.4	358.50	361.84	
3.5	39.27	39.27		3.5	354.27	355.36	
3.6	35.41	35.41		3.6	350.41	349.23	
3.7	31.87	31.87		3.7	346.87	343.42	
3.8	28.63	28.63		3.8	343.63	337.89	
3.9	25.66	25.66		3.9	340.66	332.63	
4.0	22.94	22.94		4.0	337.94	327.61	
4.1	20.44	20.44		4.1	335.44	322.80	
4.2	18.14	18.14		4.2	333.14	318.20	
4.3	16.04	16.04		4.3	331.04	313.78	
4.4	14.10	14.10		4.4	329.10	309.52	
4.5	12.32	12.32		4.5	327.32	305.43	
4.6	10.69	10.69		4.6	325.69	301.48	
4.7	9.19	9.19		4.7	324.19	297.66	
4.8	7.81	7.81		4.8	322.81	293.97	
4.9	6.54	6.54		4.9	321.54	290.39	
5.0	5.37	5.37		5.0	320.37	286.92	
5.1	4.30	4.30		5.1	319.30	283.55	
5.2	3.31	3.31		5.2	318.31	280.27	
5.3	2.40	2.40		5.3	317.40	277.08	
5.4	1.57	1.57		5.4	316.57	273.97	
5.5	.80	.80		5.5	315.80	270.94	
5.6	.09	.09		5.6	315.09	267.97	
5.7	-0.55	-0.55		5.7	314.45	265.08	
5.8	-1.15	-1.15		5.8	313.85	262.24	
5.9	-1.69	-1.69		5.9	313.31	259.47	
6.0	-2.19	-2.19		6.0	312.81	256.75	
6.1	-2.65	-2.65		6.1	312.35	254.09	
6.2	-3.07	-3.07		6.2	311.93	251.48	
6.3	-3.46	-3.46		6.3	311.54	248.91	
6.4	-3.81	-3.81		6.4	311.19	246.39	
6.5	-4.13	-4.13		6.5	310.87	243.92	
6.6	-4.43	-4.43		6.6	310.57	241.48	
6.7	-4.70	-4.70		6.7	310.30	239.09	
6.8	-4.94	-4.94		6.8	310.06	236.73	
6.9	-5.17	-5.17		6.9	309.83	234.41	
7.0	-5.37	-5.37		7.0	309.63	232.13	

Figure 5. — Problem solution (see problem 5, Appendix).

PROBLEM NO. 5--SAMPLE PROBLEM--STAND REPLACEMENT -COMPARISON OF 2 STANDS				PROBLEM NO. 5--SAMPLE PROBLEM--STAND REPLACEMENT -COMPARISON OF 2 STANDS			
DISCOUNTED NET WORTH OF FUTURE CROPS				DISCOUNTED NET WORTH OF PRESENT AND FUTURE CROPS			
RATE	ALT-PLAN 3 (ROTATION 110)	ALT-PLAN 7 (ROTATION 81)	ALT-PLAN 0 (ROTATION 0)	RATE	ALT-PLAN 3 (ROTATION 3)	ALT-PLAN 7 (ROTATION 3)	ALT-PLAN 0 (ROTATION 0)
1.0	413.13	1438.99		1.0	829.80	1735.34	
1.1	351.73	1252.02		1.1	767.88	1549.23	
1.2	301.59	1097.88		1.2	717.20	1395.89	
1.3	260.11	968.96		1.3	675.13	1267.71	
1.4	225.39	859.84		1.4	639.80	1159.26	
1.5	196.06	766.54		1.5	609.82	1066.59	
1.6	171.09	686.07		1.6	584.19	986.68	
1.7	149.70	616.15		1.7	562.09	917.27	
1.8	131.26	555.00		1.8	542.92	856.57	
1.9	115.29	501.21		1.9	526.19	803.18	
2.0	101.40	453.67		2.0	511.52	755.99	
2.1	89.27	411.45		2.1	498.59	714.07	
2.2	78.65	373.82		2.2	487.14	676.70	
2.3	69.33	340.16		2.3	476.97	643.24	
2.4	61.12	309.96		2.4	467.89	613.20	
2.5	53.88	282.78		2.5	459.76	586.13	
2.6	47.48	258.26		2.6	452.46	561.69	
2.7	41.81	236.09		2.7	445.88	539.55	
2.8	36.79	216.00		2.8	439.92	519.45	
2.9	32.34	197.76		2.9	434.52	501.17	
3.0	28.39	181.18		3.0	429.60	484.50	
3.1	24.87	166.07		3.1	425.11	469.28	
3.2	21.74	152.29		3.2	420.99	455.35	
3.3	18.96	139.71		3.3	417.21	442.58	
3.4	16.48	128.20		3.4	413.73	430.86	
3.5	14.28	117.67		3.5	410.50	420.08	
3.6	12.31	108.02		3.6	407.51	410.15	
3.7	10.56	99.17		3.7	404.73	401.00	
3.8	9.01	91.04		3.8	402.14	392.54	
3.9	7.62	83.58		3.9	399.71	384.73	
4.0	6.38	76.71		4.0	397.42	377.48	
4.1	5.28	70.40		4.1	395.27	370.77	
4.2	4.31	64.59		4.2	393.24	364.54	
4.3	3.44	59.24		4.3	391.31	358.74	
4.4	2.67	54.30		4.4	389.47	353.35	
4.5	1.99	49.76		4.5	387.72	348.32	
4.6	1.38	45.56		4.6	386.05	343.63	
4.7	.85	41.69		4.7	384.45	339.24	
4.8	.38	38.12		4.8	382.90	335.14	
4.9	-0.04	34.83		4.9	381.42	331.30	
5.0	-0.40	31.78		5.0	379.98	327.69	
5.1	-0.72	28.97		5.1	378.58	324.30	
5.2	-1.00	26.37		5.2	377.23	321.12	
5.3	-1.25	23.97		5.3	375.92	318.12	
5.4	-1.46	21.75		5.4	374.63	315.28	
5.5	-1.64	19.69		5.5	373.38	312.61	
5.6	-1.80	17.80		5.6	372.15	310.08	
5.7	-1.93	16.04		5.7	370.95	307.69	
5.8	-2.05	14.42		5.8	369.77	305.42	
5.9	-2.14	12.92		5.9	368.62	303.26	
6.0	-2.22	11.53		6.0	367.48	301.21	

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feet (about 10,000 board feet) in 55 years (at age 75), and a harvest cut of 11,000 cubic feet (70,000 board feet) in 80 years (at age 100).

It is estimated that with pruning the value of the harvest cut would be increased 65 percent. The costs and yields are summarized as follows:

Costs		No management			With management (Dollars)		
Thinning		---			26.00		
Pruning		---			30.00		
Yields		Age	Volume (M bd.ft.)	Quality index	Year	Volume (M bd.ft.)	Quality index
1st thinning		---	---	---	35	5	0.20
2nd thinning							
Without pruning		---	---	---	55	10	.80
With pruning		---	---	---	55	10	.85
Harvest							
Without pruning		100	30.0	.90	80	70	1.10
With pruning		---	---	---	80	70	1.75

Basic stumpage price = \$10 per thousand board feet changing at the rate of 0.5 percent per year.

The questions the manager would want answered are (1) What will the additional merchantable yield resulting from thinning mean in terms of rate of return — in other words, what would be the rate of return on the added expenditure required to do the thinning? and (2) Would the value that could be added by pruning be sufficient to justify the expenditure?

The manager could work the problem out by hand, or he could describe his plans in such a way that they could be submitted for solution by computer. For example, in one comparison a timber growing program requiring thinning only can be compared with a timber growing program requiring no cultural work. A second comparison can be made between a timber growing program that includes both thinning and pruning with one requiring no cultural work.

Figure 6 shows the output and illustrates the nature of the machine calculation. Present discounted net worth for each timber growing program, in the comparisons for the range of interest rates specified, is shown first. The program then computes the present discounted net worth of the difference due to the added treatment for the range of interest rates specified. The interest rate shown at the point where present worth of the difference changes from a positive to a negative value is the rate earned. In the case of thinning compared with a plan of management that did not include thinning, the rate of return on the input for thinning is between 5.2 and 5.3 percent. The input for thinning and pruning in the second comparison would earn between 4.5 and 4.6 percent indicating that pruning only lessened the financial value of the timber growing opportunity.

Figure 6. - Problem solution (see problem 6, Appendix).

PROBLEM NO. 4--SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS				PROBLEM NO. 4--SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS			
DISCOUNTED NET WORTH--FIRST TSI PLAN		DISCOUNTED NET WORTH--FIRST TSI PLAN		DISCOUNTED NET WORTH--FIRST TSI PLAN		DISCOUNTED NET WORTH--FIRST TSI PLAN	
ALT-PLAN 1 (ROTATION 100)		ALT-PLAN 2 (ROTATION 100)		ALT-PLAN 1 (ROTATION 100)		ALT-PLAN 2 (ROTATION 100)	
RATE	ALT-PLAN 0 (ROTATION 0)	RATE	ALT-PLAN 0 (ROTATION 0)	RATE	ALT-PLAN 1 (ROTATION 100)	RATE	ALT-PLAN 2 (ROTATION 100)
1.0	149.73	149.73	149.73	6.4	.82	6.4	.82
1.1	135.62	135.62	135.62	6.5	.75	6.5	.75
1.2	122.86	122.86	122.86	6.6	.68	6.6	.68
1.3	111.30	111.30	111.30	6.7	.62	6.7	.62
1.4	100.85	100.85	100.85	6.8	.56	6.8	.56
1.5	91.38	91.38	91.38	6.9	.51	6.9	.51
1.6	82.81	82.81	82.81	7.0	.47	7.0	.47
1.7	75.05	75.05	75.05	7.1	.43	7.1	.43
1.8	68.03	68.03	68.03	7.2	.39	7.2	.39
1.9	61.66	61.66	61.66	7.3	.35	7.3	.35
2.0	55.90	55.90	55.90	7.4	.32	7.4	.32
2.1	50.69	50.69	50.69	7.5	.29	7.5	.29
2.2	45.96	45.96	45.96	7.6	.27	7.6	.27
2.3	41.68	41.68	41.68	7.7	.24	7.7	.24
2.4	37.80	37.80	37.80	7.8	.22	7.8	.22
2.5	34.28	34.28	34.28	7.9	.20	7.9	.20
2.6	31.10	31.10	31.10	8.0	.18	8.0	.18
2.7	28.21	28.21	28.21	8.1	.17	8.1	.17
2.8	25.59	25.59	25.59	8.2	.15	8.2	.15
2.9	23.22	23.22	23.22	8.3	.14	8.3	.14
3.0	21.07	21.07	21.07	8.4	.13	8.4	.13
3.1	19.12	19.12	19.12	8.5	.12	8.5	.12
3.2	17.36	17.36	17.36	8.6	.11	8.6	.11
3.3	15.76	15.76	15.76	8.7	.10	8.7	.10
3.4	14.30	14.30	14.30	8.8	.09	8.8	.09
3.5	12.98	12.98	12.98	8.9	.08	8.9	.08
3.6	11.79	11.79	11.79	9.0	.07	9.0	.07
3.7	10.70	10.70	10.70	9.1	.07	9.1	.07
3.8	9.72	9.72	9.72	9.2	.06	9.2	.06
3.9	8.83	8.83	8.83	9.3	.06	9.3	.06
4.0	8.02	8.02	8.02	9.4	.05	9.4	.05
4.1	7.28	7.28	7.28	9.5	.05	9.5	.05
4.2	6.62	6.62	6.62	9.6	.04	9.6	.04
4.3	6.01	6.01	6.01	9.7	.04	9.7	.04
4.4	5.46	5.46	5.46	9.8	.04	9.8	.04
4.5	4.96	4.96	4.96	9.9	.03	9.9	.03
4.6	4.51	4.51	4.51	10.0	.03	10.0	.03
4.7	4.10	4.10	4.10				
4.8	3.73	3.73	3.73				
4.9	3.39	3.39	3.39				
5.0	3.08	3.08	3.08				
5.1	2.80	2.80	2.80				
5.2	2.55	2.55	2.55				
5.3	2.32	2.32	2.32				
5.4	2.11	2.11	2.11				
5.5	1.92	1.92	1.92				
5.6	1.74	1.74	1.74				
5.7	1.58	1.58	1.58				
5.8	1.44	1.44	1.44				
5.9	1.31	1.31	1.31				
6.0	1.19	1.19	1.19				
6.1	1.09	1.09	1.09				
6.2	.99	.99	.99				
6.3	.90	.90	.90				

PROBLEM NO. 6--SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS

DISCOUNTED NET WORTH--SECOND TSI PLAN			
RATE	ALT-PLAN 1 (ROTATION R0)	ALT-PLAN 2 (ROTATION R0)	ALT-PLAN 0 (ROTATION 0)
1.0	540.05	794.88	
1.1	499.20	732.18	
1.2	461.40	674.20	
1.3	426.41	620.60	
1.4	394.01	571.02	
1.5	364.01	525.17	
1.6	336.23	482.75	
1.7	310.50	443.51	
1.8	286.67	407.21	
1.9	264.58	373.61	
2.0	244.12	342.51	
2.1	225.15	313.73	
2.2	207.57	287.09	
2.3	191.27	262.41	
2.4	176.15	239.57	
2.5	162.13	218.41	
2.6	149.12	198.81	
2.7	137.06	180.66	
2.8	125.86	163.84	
2.9	115.47	148.25	
3.0	105.82	133.80	
3.1	96.86	120.41	
3.2	88.54	108.00	
3.3	80.81	96.49	
3.4	73.63	85.81	
3.5	66.96	75.91	
3.6	60.76	66.73	
3.7	54.99	58.21	
3.8	49.63	50.30	
3.9	44.65	42.96	
4.0	40.01	36.15	
4.1	35.69	29.83	
4.2	31.68	23.95	
4.3	27.94	18.50	
4.4	24.46	13.43	
4.5	21.22	8.73	
4.6	18.20	4.36	
4.7	15.39	.29	
4.8	12.77	-3.49	
4.9	10.32	-7.00	
5.0	8.05	-10.26	
5.1	5.92	-13.30	
5.2	3.94	-16.13	
5.3	2.09	-18.76	
5.4	.36	-21.20	
5.5	-1.25	-23.48	
5.6	-2.76	-25.60	
5.7	-4.16	-27.57	
5.8	-5.47	-29.41	
5.9	-6.70	-31.12	
6.0	-7.85	-32.72	
6.1	-8.92	-34.20	
6.2	-9.93	-35.59	
6.3	-10.87	-36.88	

PROBLEM NO. 6--SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS

DISCOUNTED NET WORTH--SECOND TSI PLAN			
RATE	ALT-PLAN 1 (ROTATION R0)	ALT-PLAN 2 (ROTATION R0)	ALT-PLAN 0 (ROTATION 0)
6.4	-11.75	-38.09	
6.5	-12.57	-39.21	
6.6	-13.34	-40.26	
6.7	-14.07	-41.24	
6.8	-14.74	-42.15	
6.9	-15.38	-43.01	
7.0	-15.97	-43.80	
7.1	-16.53	-44.55	
7.2	-17.05	-45.24	
7.3	-17.55	-45.89	
7.4	-18.01	-46.50	
7.5	-18.44	-47.07	
7.6	-18.85	-47.60	
7.7	-19.23	-48.09	
7.8	-19.59	-48.56	
7.9	-19.93	-49.00	
8.0	-20.25	-49.40	
8.1	-20.55	-49.78	
8.2	-20.83	-50.14	
8.3	-21.10	-50.48	
8.4	-21.35	-50.79	
8.5	-21.58	-51.09	
8.6	-21.81	-51.36	
8.7	-22.02	-51.62	
8.8	-22.21	-51.86	
8.9	-22.40	-52.09	
9.0	-22.58	-52.31	
9.1	-22.74	-52.51	
9.2	-22.90	-52.70	
9.3	-23.05	-52.88	
9.4	-23.19	-53.04	
9.5	-23.32	-53.20	
9.6	-23.45	-53.35	
9.7	-23.57	-53.49	
9.8	-23.68	-53.62	
9.9	-23.79	-53.74	
10.0	-23.89	-53.86	

PROBLEM NO. 6--SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS

DISCOUNTED NET WORTH OF ADDED TSI INVESTMENT			
RATE	ALT-PLAN 1 (ROTATION 80)	ALT-PLAN 2 (ROTATION 80)	ALT-PLAN 0 (ROTATION 0)
1.0	390.32	645.15	
1.1	363.58	596.55	
1.2	338.54	551.34	
1.3	315.10	509.29	
1.4	293.16	470.17	
1.5	272.63	433.79	
1.6	253.42	399.94	
1.7	235.45	368.46	
1.8	218.64	339.18	
1.9	202.92	311.94	
2.0	188.22	286.61	
2.1	174.47	263.05	
2.2	161.61	241.13	
2.3	149.59	220.74	
2.4	138.35	201.77	
2.5	127.85	184.13	
2.6	118.03	167.72	
2.7	108.85	152.45	
2.8	100.26	138.24	
2.9	92.24	125.03	
3.0	84.74	112.73	
3.1	77.73	101.29	
3.2	71.18	90.64	
3.3	65.05	80.73	
3.4	59.33	71.51	
3.5	53.97	62.93	
3.6	48.97	54.94	
3.7	44.29	47.50	
3.8	39.91	40.58	
3.9	35.82	34.13	
4.0	31.99	28.13	
4.1	28.41	22.54	
4.2	25.06	17.34	
4.3	21.93	12.49	
4.4	19.00	7.97	
4.5	16.26	3.76	
4.6	13.69	-0.16	
4.7	11.24	-3.81	
4.8	9.04	-7.21	
4.9	6.94	-10.39	
5.0	4.97	-13.34	
5.1	3.12	-16.10	
5.2	1.39	-18.67	
5.3	-0.23	-21.07	
5.4	-1.74	-23.31	
5.5	-3.16	-25.39	
5.6	-4.50	-27.34	
5.7	-5.75	-29.16	
5.8	-6.92	-30.85	
5.9	-8.01	-32.43	
6.0	-9.04	-33.91	
6.1	-10.01	-35.29	
6.2	-10.92	-36.58	
6.3	-11.77	-37.78	

PROBLEM NO. 6--SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS

DISCOUNTED NET WORTH OF ADDED TSI INVESTMENT			
RATE	ALT-PLAN 1 (ROTATION 80)	ALT-PLAN 2 (ROTATION 80)	ALT-PLAN 0 (ROTATION 0)
6.4	-12.57	-38.91	
6.5	-13.32	-39.96	
6.6	-14.02	-40.94	
6.7	-14.68	-41.86	
6.8	-15.31	-42.72	
6.9	-15.89	-43.52	
7.0	-16.44	-44.27	
7.1	-16.96	-44.97	
7.2	-17.44	-45.63	
7.3	-17.90	-46.24	
7.4	-18.33	-46.82	
7.5	-18.73	-47.36	
7.6	-19.12	-47.86	
7.7	-19.48	-48.34	
7.8	-19.81	-48.78	
7.9	-20.13	-49.20	
8.0	-20.43	-49.59	
8.1	-20.72	-49.95	
8.2	-20.98	-50.30	
8.3	-21.24	-50.62	
8.4	-21.47	-50.92	
8.5	-21.70	-51.20	
8.6	-21.91	-51.47	
8.7	-22.11	-51.72	
8.8	-22.30	-51.95	
8.9	-22.48	-52.17	
9.0	-22.65	-52.38	
9.1	-22.81	-52.58	
9.2	-22.96	-52.76	
9.3	-23.11	-52.93	
9.4	-23.24	-53.09	
9.5	-23.37	-53.25	
9.6	-23.49	-53.39	
9.7	-23.61	-53.53	
9.8	-23.72	-53.65	
9.9	-23.82	-53.77	
10.0	-23.92	-53.89	

APPENDIX

INVESTMENT ANALYSIS PROGRAM NO. 6

This program is a modification of the program prepared originally by Clark Row⁹ and later revised by Robert Marty et al.¹⁰ The basic changes made in this version of the program are as follows:

1. Change in input requirements so that periodic and annual incomes can be handled in addition to periodic and annual costs. Cost items are identified in the input with a minus sign (-) preceding the amount of the cost. Final value, treated as a separate item in the original program, is handled as a periodic income in this version of the program.

2. Change in input requirements so that the program can be used with and without product evaluations. That is, if only periodic costs and incomes are involved, the only control cards needed are those associated with periodic costs. If both periodic and annual costs and incomes are included in the problem, only those control cards associated with periodic and annual costs and incomes are required. If product evaluations are included in the problem, additional control cards are required.

3. Addition of an option for evaluating timber stand replacement priorities. This option requires two sets of control cards: one set shows costs and incomes associated with the future timber growing opportunity; a second set shows costs and incomes associated with the present stand conversion opportunity. The future timber growing opportunity and the

present stand conversion opportunity are evaluated separately and then together.

4. Addition of an option for evaluating timber stand improvement (TSI) programs. This option is used to evaluate timber stand improvement program levels and is particularly useful where the program differences to be evaluated affect the yield in a complex way. For example, the inclusion of thinning in the timber growing program may affect the quality, quantity, and timing of intermediate cuts as well as the final cut.

Two sets of control cards are used: one describes the minimum program considered, and a second describes the program with one or more other timber practices included. Each of the programs is evaluated separately and then the effect of the practices added is evaluated.

INPUT REQUIREMENTS IN BRIEF

Up to 15 different cards or card types (groups of repeated cards) are used, depending on the nature of the problem and the way the program is being used. Whenever the program is used to evaluate stand replacement or timber stand improvement programs, cards or card types 7 through 13 are repeated as needed to form the second set of control cards mentioned above.

These 15 different cards or card types may also be grouped into four classes.

CLASS I includes cards 1, 2, and 3. These are used to identify the program user and are required only with the first problem when a user is submitting a number of problems.

CLASS II includes cards 4, 6, and 7 (and 5 where used), which are problem descriptions and general control cards required with every problem.

⁹Row, Clark. *Determining forest investment rates of return by electronic computer*. U.S. Forest Serv. Res. Pap. SO-6, 13 pp. 1963.

¹⁰Marty, Robert, Charles Rendt, and John Fedkiw. *A guide for evaluating reforestation and stand improvement projects in timber management on the National Forests*. U.S. Dep. Agr., Agr. Handbook 304, 24 pp. 1966.

CLASS III includes cards or card types 8, 9, 10, 11, 12, and 13. These are used only as needed to enter cost, income, product, and price information.

CLASS IV includes cards 14 and 15, which are problem termination cards. Card 14 is always required. Card 15 is required when the problem of another user is to be entered.

CONTROL CARD FUNCTIONS

Class I Cards

(Required with the first problem in each series of problems submitted)

Card 1. Name of National Forest or organization. — This card, with cards 2 and 3, puts the name of the user and his organization into the computer so that they can be printed on the output to facilitate identification and handling.

Card 2. Name of unit or branch.

Card 3. Name of user.

Class II Cards

(Required for every problem)

Card 4. Number and/or name of problem and number of descriptive cards. — This card puts the problem identification into the computer for use as a label on output information.

Card 5. This card type is used to put into the computer additional descriptive information that the user wants to have on the output. — For example, if two or more alternatives are being compared, the user may wish to include a description of each alternative on the computer output.

Card 6. Interest rates and program and output options. — This program utilizes the iteration procedure of calculation; that is, the user specifies the minimum and maximum interest rates he will consider, and the increment of change the computer is to use. Also the program permits three options:

1. A general option for computing internal rate of return and present worth at specified interest rates.
2. An option to evaluate timber stand replacement opportunities.

3. An option to evaluate timber stand improvement opportunities.

The above are specified on the 6th card.

Card 7. General problem control card. — This card describes the details of the problem to the computer. Nine types of information are included on this card:

1. The number of alternatives or plans to be evaluated. The program will handle up to six alternatives or plans at once, provided they utilize the same program and output options (specified on card 6). This information type tells the computer how many alternatives or plans are included in the problem.
2. Numbers identifying each alternative or plan to be evaluated.
3. The time period (rotation) specified for each plan.
4. If product evaluations are included, the maximum number of products (0-3) in any alternative or plan for which dollar yield must be figured.
5. If periodic costs and incomes are included, the maximum number and the number in each plan or alternative.
6. If annual costs are included, the maximum number and the number in each plan or alternative.
7. The type of terminal calculation the computer is to use for each plan or alternative (that is, a perpetual series or a terminating series).
8. More specific instructions if the problem involves the evaluation of stand replacement or a comparison of TSI programs.
9. The number of sets of product prices, if product evaluations are included in the problem, so that the problem can be repeated under all the price assumptions specified.

Class III Cards

(Used only as needed)

Card 8. Periodic costs and incomes. — This card type is used whenever periodic costs and

incomes are included in any of the alternatives or plans in the problem, and it can be repeated as many times as needed (maximum 99) to include all periodic costs and incomes. In order to minimize the number of cards required, one periodic cost or income for each of the six possible alternatives or plans can be entered on each card. A periodic cost or income for alternative or plan 1 is entered first on the card, followed in order by one each for alternatives or plans 2, 3, 4, 5, and 6.

Card 9. Annual costs and incomes. — This *card type* is used whenever annual costs and incomes are included in any of the alternatives or plans in the problem. One card is required for each alternative or plan in which annual costs or incomes are included, and four annual costs or incomes for the particular alternative or plan can be entered on the card.

Card 10. Product evaluation control card. — This card and card types 11, 12, and 13 are used only when product evaluations are included in any of the alternatives or plans in the problem. This specific card gives the computer the following information:

1. The maximum number of product 1 returns in any alternative or plan as well as the number in each specific alternative or plan.
2. The maximum number of product 2 returns in any alternative or plan as well as the specific number in each alternative or plan.
3. The maximum number of product 3 returns in any alternative or plan as well as the specific number in each alternative or plan.

Card 11. Product names and units of measure. — This card gives the computer the names and units of measure of each product.

Card 12. Product yields. — This *card type* is used to feed product yield information into the computer; it can be repeated as necessary (maximum 99) to include all yield data. It gives the computer the year the product is harvested, and the volume and quality harvested; the product is identified from the order in which the cards are entered. Product 1 cards are entered first, followed by the cards for products 2 and 3. To minimize the number of cards required, data describing one yield for each of the six possible alternatives or plans is entered on each card *provided the data applies to the same product*. This information is entered in the same order described for card type 8.

Card 13. Product prices. — This *card type* is for feeding product price information into the computer. Each card contains a set of product prices, one for each product. Also, it gives the rate at which each product price is expected to change with time (if the rate is constant). If the problem is to be evaluated under a number of different price assumptions (maximum 9), this card can be repeated. The number of times it will be repeated is that specified in the last entry on card 7.

Class IV Cards

(Card 14 required, card 15 as needed)

Card 14. Problem termination card. — This card is required with every problem. It tells the computer if (1) another problem by the same user follows, (2) a problem by another user follows (card 15 is to be read), or (3) this is the last problem by this user and no other problems follow.

Card 15. NEW USER card. — This card is used *only* when a problem of another user follows. It signals the computer to read cards 1, 2, and 3 for the new user's location and identity.

INSTRUCTIONS FOR PREPARING CONTROL CARDS
INVESTMENT PROGRAM NO. 6

Card	Columns	Item	Field	Label
1	1-20	Name of Forest or organization		NAME
2	1-20	Name of unit		
3	1-20	Name of user		
4	1-76	Number and/or name of problem		
	79-80	Number of description cards (when used)	XX	ID
5	1-80	Problem description		IDEN
6	1-4	Minimum rate of interest to be considered	.XXX	RINT
	5-8	Interest rate increment	.XXX	
	9-12	Maximum rate of interest to be considered	.XXX	
	13-14	Program options		
		01 = General evaluation of alternatives – Computation of internal rate of return and present worth	XX	JPR
		02 = Evaluation of stand replacement alternatives		
		03 = For TSI planning – Computation of internal rate of return and present worth for programs compared and differences between them		
7	1-2	Number of alternatives or plans	XX	LX
	3-4	Number identifying alternative or plan 1	XX	LI(L)
	5-6	Number identifying alternative or plan 2	XX	
	7-8	Number identifying alternative or plan 3	XX	
	9-10	Number identifying alternative or plan 4	XX	
	11-12	Number identifying alternative or plan 5	XX	
	13-14	Number identifying alternative or plan 6	XX	
	15-17	Time period, alternative or plan 1	XXX	LY(L)
	18-20	Time period, alternative or plan 2	XXX	
	21-23	Time period, alternative or plan 3	XXX	
	24-26	Time period, alternative or plan 4	XXX	
	27-29	Time period, alternative or plan 5	XXX	
	30-32	Time period, alternative or plan 6	XXX	
	33-34	Maximum number of products in any alternative or plan (0-3)	XX	KX
	35-36	Maximum number of periodic costs or incomes in any alternative or plan	XX	KCXX

Card	Columns	Item	Field	Label
	37-38	Number of periodic costs or incomes, alternative or plan 1	XX	KCX(L)
	39-40	Number of periodic costs or incomes, alternative or plan 2	XX	
	41-42	Number of periodic costs or incomes, alternative or plan 3	XX	
	43-44	Number of periodic costs or incomes, alternative or plan 4	XX	
	45-46	Number of periodic costs or incomes, alternative or plan 5	XX	
	47-48	Number of periodic costs or incomes, alternative or plan 6	XX	
	49-50	Maximum number of annual costs or incomes in any alternative or plan	XX	JXX
	51-52	Number of annual costs or incomes, alternative or plan 1	XX	JX(L)
	53-54	Number of annual costs or incomes, alternative or plan 2	XX	
	55-56	Number of annual costs or incomes, alternative or plan 3	XX	
	57-58	Number of annual costs or incomes, alternative or plan 4	XX	
	59-60	Number of annual costs or incomes, alternative or plan 5	XX	
	61-62	Number of annual costs or incomes, alternative or plan 6	XX	
	63-64	Type of terminal calculation 00 = perpetual series for all alternatives or plans 01 = terminating series for at least 1 alternative or plan	XX	NZZ
	65-66	Type of terminal calculation, alternative or plan 1 00 = perpetual series 01 = terminating series	XX	NZ(L)
	67-68	Type of terminal calculation, alternative or plan 2	XX	
	69-70	Type of terminal calculation, alternative or plan 3	XX	
	71-72	Type of terminal calculation, alternative or plan 4	XX	

Card	Columns	Item	Field	Label
	73-74	Type of terminal calculation, alternative or plan 5	XX	
	75-76	Type of terminal calculation, alternative or plan 6	XX	
	77-78	Used only with program options 2 and 3 Option 2 01 = future stands 02 = present stands Option 3 01 = initial plan 02 = second TSI plan	XX	IST
	79-80	Number of sets of product prices (0-9)	XX	MX
8	(This card is used where KCXX (columns 35-36 on card 7) is greater than 00; it is for listing periodic costs and incomes. One cost or income for each of 6 alternatives or plans can be entered on each card. Card can be repeated 99 times. All cost items are preceded by a minus sign (-).)			
	1-3	Year of i^{th} cost or income, alternative or plan 1	XXX	NC(L,KC)
	4-12	Amount of i^{th} cost or income, alternative or plan 1	XXXXXX.XX	PECO(L,KC)
	13-15	Year of i^{th} cost or income, alternative or plan 2	XXX	
	16-24	Amount of i^{th} cost or income, alternative or plan 2	XXXXXX.XX	
	25-27	Year of i^{th} cost or income, alternative or plan 3	XXX	
	28-36	Amount of i^{th} cost or income, alternative or plan 3	XXXXXX.XX	
	37-39	Year of i^{th} cost or income, alternative or plan 4	XXX	
	40-48	Amount of i^{th} cost or income, alternative or plan 4	XXXXXX.XX	
	49-51	Year of i^{th} cost or income, alternative or plan 5	XXX	
	52-60	Amount of i^{th} cost or income, alternative or plan 5	XXXXXX.XX	
	61-63	Year of i^{th} cost or income, alternative or plan 6	XXX	
	64-72	Amount of i^{th} cost or income, alternative or plan 6	XXXXXX.XX	

Card	Columns	Item	Field	Label
9	(This card is used when JXX (columns 49-50 on card 7) is greater than 00; it is for listing annual costs or incomes. As many as 4 annual costs or incomes for an alternative or plan can be listed on 1 card. The limit is 1 card for each alternative. All cost items are preceded by a minus sign (-).)			
	1-3	Starting year of 1st annual item	XXX	NI(J)
	4-6	Terminating year of 1st annual item	XXX	NT(J)
	7-14	Amount of 1st annual item	XXXXXX.XX	AN(II,J)
	15-20	Change in 1st annual item (If change is a decrease, a minus sign (-) precedes the amount)	XX.XXX	CAN(II,J)
	21-23	Starting year of 2nd annual item	XXX	
	24-26	Terminating year of 2nd annual item	XXX	
	27-34	Amount of 2nd annual item	XXXXXX.XX	
	35-40	Change in 2nd annual item	XX.XXX	
	41-43	Starting year of 3rd annual item	XXX	
	44-46	Terminating year of 3rd annual item	XXX	
	47-54	Amount of 3rd annual item	XXXXXX.XX	
	55-60	Change in 3rd annual item	XX.XXX	
	61-63	Starting year of 4th annual item	XXX	
	64-66	Terminating year of 4th annual item	XXX	
	67-74	Amount of 4th annual item	XXXXXX.XX	
	75-80	Change in 4th annual item	XX.XXX	
	(Cards 10, 11, 12, and 13 are used only when product values are to be computed — KX (columns 33-34 on card 7) is greater than 00.)			
10	1-2	Maximum number of product 1 returns in any alternative or plan	XX	K1XX
	3-4	Number of product 1 returns, alternative or plan 1	XX	K1X(L)
	5-6	Number of product 1 returns, alternative or plan 2	XX	
	7-8	Number of product 1 returns, alternative or plan 3	XX	
	9-10	Number of product 1 returns, alternative or plan 4	XX	
	11-12	Number of product 1 returns, alternative or plan 5	XX	
	13-14	Number of product 1 returns, alternative or plan 6	XX	

Card	Columns	Item	Field	Label
	15-16	Maximum number of product 2 returns in any alternative or plan	XX	K2XX
	17-18	Number of product 2 returns, alternative or plan 1	XX	K2X(L)
	19-20	Number of product 2 returns, alternative or plan 2	XX	
	21-22	Number of product 2 returns, alternative or plan 3	XX	
	23-24	Number of product 2 returns, alternative or plan 4	XX	
	25-26	Number of product 2 returns, alternative or plan 5	XX	
	27-28	Number of product 2 returns, alternative or plan 6	XX	
	29-30	Maximum number of product 3 returns in any alternative or plan	XX	K3XX
	31-32	Number of product 3 returns, alternative or plan 1	XX	K3X(L)
	33-34	Number of product 3 returns, alternative or plan 2	XX	
	35-36	Number of product 3 returns, alternative or plan 3	XX	
	37-38	Number of product 3 returns, alternative or plan 4	XX	
	39-40	Number of product 3 returns, alternative or plan 5	XX	
	41-42	Number of product 3 returns, alternative or plan 6	XX	
11	1-20	Name and unit of measure, product 1		A
	21-40	Name and unit of measure, product 2		
	41-60	Name and unit of measure, product 3		
12	1-3	Year of j^{th} return, k^{th} product, alternative or plan 1	XXX	N1(L,K1)
	4-8	Volume of j^{th} yield, k^{th} product, alternative or plan 1	XXXXX ¹¹	JLD1(L,K1)
	9-12	Quality index, j^{th} yield, k^{th} product, alternative or plan 1	XXXX ¹²	JUAL1(L,K1)

¹¹Decimal implied before last digit (127.3 punches 01273).

¹²Decimal implied before 3rd digit (1.15 punches 0115).

Card	Columns	Item	Field	Label
	13-15	Year of j^{th} return, k^{th} product, alternative or plan 2	XXX	N2(L,K2)
	16-20	Volume of j^{th} yield, k^{th} product, alternative or plan 2	XXXXX ¹¹	JLD2(L,K2)
	21-24	Quality of j^{th} yield, k^{th} product, alternative or plan 2	XXXX ¹²	JUAL2(L,K2)
	25-27	Year of j^{th} return, k^{th} product, alternative or plan 3	XXX	N3(L,K3)
	28-32	Volume of j^{th} yield, k^{th} product, alternative or plan 3	XXXXX ¹¹	JLD3(L,K3)
	33-36	Quality of j^{th} yield, k^{th} product, alternative or plan 3	XXXX ¹²	JUAL3(L,K3)
	37-39	Year of j^{th} return, k^{th} product, alternative or plan 4	XXX	N4(L,K4)
	40-44	Volume of j^{th} return, k^{th} product, alternative or plan 4	XXXXX ¹¹	JLD4(L,K4)
	45-48	Quality of j^{th} return, k^{th} product, alternative or plan 4	XXXX ¹²	JUAL4(L,K4)
	49-51	Year of j^{th} return, k^{th} product, alternative or plan 5	XXX	N5(L,K5)
	52-56	Volume of j^{th} return, k^{th} product, alternative or plan 5	XXXXX ¹¹	JLD5(L,K5)
	57-60	Quality of j^{th} return, k^{th} product, alternative or plan 5	XXXX ¹²	JUAL5(L,K5)
	61-63	Year of j^{th} return, k^{th} product, alternative or plan 6	XXX	N6(L,K6)
	64-68	Volume of j^{th} return, k^{th} product, alternative or plan 6	XXXXX ¹¹	JLD6(L,K6)
	69-72	Quality of j^{th} return, k^{th} product, alternative or plan 6	XXXX ¹²	JUAL6(L,K6)

(Card 12 may be repeated 49 times if necessary to include all product returns.)

13	1-9	i^{th} unit price assumption, product 1	XXXXX.XXX	PR1(M)
	10-18	i^{th} change in unit price, product 1	XXXXX.XXX	CPR1(M)
	19-27	i^{th} unit price assumption, product 2	XXXXX.XXX	PR2(M)
	28-36	i^{th} change in unit price, product 2	XXXXX.XXX	CPR2(M)
	37-45	i^{th} unit price assumption, product 3	XXXXX.XXX	PR3(M)

¹¹Decimal implied before last digit (127,3 punches 01273).

¹²Decimal implied before 3rd digit (1.15 punches 0115).

Card	Columns	Item	Field	Label
	46-54	<i>i</i> th change in unit price, product 3	XXXXX.XXX	CPR3(M)
	(Card 13 may be repeated 8 times if additional price assumptions are needed.)			
14	1-2	Terminal (punch 98 or 99) Punch 98 if another problem follows Punch 99 if last problem		
15	1-10	NEW FOREST – used only if problem that follows is from a new user		

SAMPLE PROBLEMS

Following are seven sample problems prepared as input by a single user. The data input forms for the seven problems are shown in figures 7-13.

Problem 1 illustrates use of the general evaluation option with two alternatives or plans in which only periodic costs and incomes are involved.

Problem 2 again illustrates the general option but with periodic and annual costs and incomes. The problem is treated first as a perpetuated series and second as a terminating series.

Problem 3 is the same as problem 1 but the job of figuring product yields is left to the computer.

Problem 4 illustrates use of the stand replacement option. The problem here is to evaluate the financial advantage of cutting a stand now over holding it another 10 years.

Problem 5 is another illustration of the stand replacement option, but this time two stands are compared.

Problem 6 illustrates use of the timber stand improvement (TSI) program option. Two comparisons are made: In the first a plan calling for no TSI work is compared with a plan including thinning, and in the second, a plan calling for no TSI work is compared with a plan calling for pruning in addition to thinning.

Problem 7 illustrates use of the program in timber sale planning.

A Word About the Input

Problem 1. Note that in addition to user identification and problem title and description, only seven cards are required – one card giving interest rate and program and output specifications, one card for general program control data, and five cards for periodic cost and income data.

Problem 2. This problem contains both periodic and annual costs and incomes. It requires the same type of input as problem 1 except that nine cards are required to enter all the periodic cost and income information and two cards are required to enter the annual costs.

Problem 3. This problem utilizes the product evaluation option and requires a product option control card, a card identifying the product and unit of measure, six cards to feed in product data, and a card giving product price. Note that the product control card specifies a maximum of six products, with six in alternative or plan 1 and four in alternative or plan 2. Note also that product price is expected to increase at the rate of .005 percent per year.

Problem 4. This problem, which utilizes the stand replacement option, requires one set of cards describing the future timber growing opportunity and a second set describing the present stand conversion opportunity. In this problem, which is to evaluate the financial advantage of cutting a stand now or holding it another 10 years, the future timber growing opportunity is assumed to be the same in

both cases. The second set of cards (beginning with card or card type 6 in the classification given earlier) contains the cost and income data for the present crop. In this problem it is assumed that all development is accomplished, so only the product evaluation option is utilized in the second card set. Note that in this problem the future timber growing opportunity is evaluated as a perpetual series, whereas the present stand conversion opportunity is terminated.

Problem 5. In this problem (stand replacement) two areas are compared to see which offers the best stand conversion and timber growing opportunity. One is a relatively poor piece of land supporting a stand that contains 7,400 cubic feet of usable wood. The other is an area of good land supporting a highly defective overmature stand of less usable volume.

Problem 6. This problem looks into a TSI program. In this problem even if the manager does nothing in the way of cultural work he expects a certain result. He could thin, but he needs to know what the result would be in terms of return on the thinning investment. Or, he could thin and prune. Under alternative or plan 1, thinning is compared with no cultural work. Under alternative or plan 2, a program of thinning and pruning is compared with a program involving no cultural work. Again, two card sets are required, one for each

set of management assumptions being compared under the two alternatives or plans.

Problem 7. This problem is a comparison of four timber growing alternatives on a proposed sale area made in conjunction with silvicultural planning for the area. The proposed sale is on a good site capable of producing a harvest yield of 35,000 board feet per acre in 55 years or 70,000 board feet in 85 years with stocking control. Comparisons are made using both 55- and 85-year rotations.

Plan 1. Leave one seed tree group averaging one-fourth acre in size and containing 10 Mbf for every 5 acres cut. Seed tree losses in slash disposal and site preparation are expected to be 20 percent. The per-acre cost of added work required to protect seed trees in slash disposal and site preparation is estimated to be \$10.00.

Plan 2. Clearcut and plant following slash disposal, with planting expected to be necessary on half the area.

Plan 3. Clearcut with natural regeneration. This plan assumes a good seed year prior to cutting.

Plan 4. Clearcut and seed, with seeding expected to be necessary on half the area.

The costs used in this problem are shown in table 5. The yields expected are shown in table 6.

Table 5. — Average costs per acre for the problem area as a whole according to activity and plan

Activity	Plan 1	Plan 2	Plan 3	Plan 4
----- Dollars -----				
Site preparation	10.00			
Value of seed trees	20.00			
Cost of seed tree salvage sale	.40			
Cost of seed tree sale	4.00			
Planting		19.00		
Seeding				9.00
Thinning	25.00	15.00	25.00	22.00
Stage 2 surveys	.50	.50	.50	.50

Table 6. — Expected yields per acre according to type of cut and plan

Type of cut	Plan 1	Plan 2	Plan 3	Plan 4
— — — — — <i>—Thousand board feet—</i> — — — — —				
Seed tree salvage	.4			
Seed tree harvest	1.6			
Harvest at age 55	28.0	35.0	31.0	31.0
Intermediate cut at age 50	8.0	10.0	9.0	9.0
Harvest cut at age 85	65.0	70.0	68.0	68.0

Figure 8. — Computer input, Problem 2.

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Figure 10. — Computer input, Problem 4.

INPUT DATA CODING FORM		UNIT	JOB DESCRIPTION		SYSTEM	PROGRAM	JOB NUMBER	DATE
FIELD DESCRIPTIONS								
LINE NO	1	2	3	4	5	6	7	8
1	4	5	6	7	8	9	10	11
2	12	13	14	15	16	17	18	19
3	20	21	22	23	24	25	26	27
4	28	29	30	31	32	33	34	35
5	36	37	38	39	40	41	42	43
6	44	45	46	47	48	49	50	51
7	52	53	54	55	56	57	58	59
8	60	61	62	63	64	65	66	67
9	68	69	70	71	72	73	74	75
10	76	77	78	79	80			
11	1	2	3	4	5	6	7	8
12	9	10	11	12	13	14	15	16
13	17	18	19	20	21	22	23	24
14	25	26	27	28	29	30	31	32
15	33	34	35	36	37	38	39	40
16	41	42	43	44	45	46	47	48
17	49	50	51	52	53	54	55	56
18	57	58	59	60	61	62	63	64
19	65	66	67	68	69	70	71	72
20	73	74	75	76	77	78	79	80
21	1	2	3	4	5	6	7	8
22	9	10	11	12	13	14	15	16
23	17	18	19	20	21	22	23	24
24	25	26	27	28	29	30	31	32
25	33	34	35	36	37	38	39	40
	41	42	43	44	45	46	47	48
	49	50	51	52	53	54	55	56
	57	58	59	60	61	62	63	64
	65	66	67	68	69	70	71	72
	73	74	75	76	77	78	79	80

Figure 11. -- Computer input, Problem 5.

INPUT DATA CODING FORM		UNIT	JOB DESCRIPTION	SYSTEM	PROGRAM	JOB NUMBER	DATE
FIELD DESCRIPTIONS							
LINE NO	1	2	3	4	5	6	7
1	5	1	1	1	1	1	1
2	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1
15	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1
17	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1
19	1	1	1	1	1	1	1
20	1	1	1	1	1	1	1
21	1	1	1	1	1	1	1
22	1	1	1	1	1	1	1
23	1	1	1	1	1	1	1
24	1	1	1	1	1	1	1
25	1	1	1	1	1	1	1

Figure 12. - Computer input, Problem 6.

INPUT DATA CODING FORM		UNIT	JOB DESCRIPTION	SYSTEM	PROGRAM	JOB NUMBER	DATE
FIELD DESCRIPTIONS							
LINE NO.	1	2	3	4	5	6	7
1	61-SAMPLE	1	1	1	1	1	1
2	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1
15	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1
17	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1
19	1	1	1	1	1	1	1
20	1	1	1	1	1	1	1
21	1	1	1	1	1	1	1
22	1	1	1	1	1	1	1
23	1	1	1	1	1	1	1
24	1	1	1	1	1	1	1
25	1	1	1	1	1	1	1

Figure 13. — Computer input, Problem 7.

INPUT DATA CODING FORM		UNIT	JOB DESCRIPTION		SYSTEM	PROGRAM	JOB NUMBER	DATE
FIELD DESCRIPTIONS								
LINE NO.	1	2	3	4	5	6	7	8
1	71A	-	C	OMP	A	R	I	S
2	11	-	P	L	A	M	1	1
3	11	-	P	L	A	M	2	1
4	11	-	P	L	A	M	3	1
5	11	-	P	L	A	M	4	1
6	10	1	0	1	1	1	1	1
7	04	1	0	2	3	0	4	1
8	00	0	1	1	1	0	1	1
9	00	0	1	1	1	0	1	1
10	00	1	1	1	1	0	1	1
11	00	2	1	1	1	0	1	1
12	01	1	0	1	1	1	1	1
13	01	1	4	1	1	1	1	1
14	01	1	5	1	1	1	1	1
15	03	0	3	0	1	1	1	1
16	S	A	W	T	I	M	B	E
17	00	1	1	1	1	1	1	1
18	01	1	0	1	1	1	1	1
19	05	5	1	1	1	1	1	1
20	11	1	0	1	1	1	1	1
21	9	8	1	1	1	1	1	1
22	1	1	1	1	1	1	1	1
23	1	1	1	1	1	1	1	1
24	1	1	1	1	1	1	1	1
25	1	1	1	1	1	1	1	1

A Word About the Output

The computer output for the seven problems is shown in figures 14-20. Note that all the input is printed on the output. Control cards 6 and 7, and 11 when used, are labeled along with the information they contain. This is to facilitate the search for errors in input should any occur. Thus, when KX (control card 7) is greater than 0, product evaluations are to be made. If KX is 0 and product control cards are included in the problem, an error message results and the computer aborts the problem.

When KCXX (control card 7) is greater than 0, periodic costs and incomes are read. The number under each of the six KCX's indicates the number of periodic costs and incomes included in each of the six alternatives or plans that can be read simultaneously.

When JXX (control card 7) is greater than 0, annual costs and incomes are read. The number under each of the six JX's indicates the number of annual costs and incomes to be read in each of the six possible alternatives or plans.

When NZZ is greater than 0 (it will be either 0 or 1), at least one of the alternatives or plans is to be treated as a terminated series. A 0 or 1 under the JX's indicates how each of the six possible alternatives or plans is to be evaluated:

0 = perpetual series

1 = terminated series

The IST is used only with program options 2 and 3 to indicate which evaluation is to be made. It is coded 1 on the first card set, and 2 on the second.

When KX is greater than 0, MX (control card 7) must also be greater than 0. MX indicates the number of price assumptions to be read. If MX is 2, there must be two cards of card type 13.

General option output. — The internal rate of return and present discounted net worth

are given for the range of interest rates specified on control card 6.

Stand replacement option. — The output for this option first gives present discounted net worth for the future timber growing opportunity for the range of interest rates specified. Internal rate of return can be read from this. For problem 4, it is between 5.6 and 5.7 percent. For problem 5, it is between 4.8 and 4.9 percent for alternative or plan 1 and between 7.4 and 7.5 percent for alternative or plan 2.

Second, the output gives present discounted net worth for the future timber growing plan and present stand conversion plan combined. In interpreting this information, the user must specify the minimum acceptable return. If a 3.5 percent return is acceptable, in the case of problem 4 the manager would be financially ahead (present discounted net worth is greater) to hold the stand for another 10 years because present worth is greater under this plan. In the case of problem 5, if 3.6 percent return was acceptable it would be financially advantageous to cut the poor stand on the better land.

TSI option. — The output for this option includes the present discounted net worth for the two TSI plans compared under each of the six possible alternatives or plan comparisons. In addition it gives the present discounted net worth due to the difference between the plans compared. In the case of thinning compared with no cultural work, the internal rate of return for the thinning investment is between 5.2 and 5.3 percent. In the case of a program of thinning and pruning, internal rate of return on investment is between 4.5 and 4.6 percent indicating that pruning only lessened the financial opportunity.

Problem 7. It is obvious from this analysis that there is no financial advantage in leaving seed trees (plan 1). The calculations suggest the manager should evaluate closely seed production on the area prior to cutting. For obvious reasons he could not wait to see what the seed crop was likely to be before planning for future timber growing. However, financing for timber growing could be planned on the basis of plan 4 or plan 2.

Figure 14. — Computer output, Problem 1.

INVESTMENT ANALYSIS PROGRAM NO.6. INT. STA.

PROBLEM NO. 1--SAMPLE PROBLEM -PERIODIC COSTS AND INCOMES--

PLAN 1--113 YEAR ROTATION

PLAN 2--100 YEAR ROTATION

GENERAL EVALUATION OF ALTERNATIVES

	RINT	RINT	RINT	JPR														
CONTROL CARD 6	.020	.001	.040	1														
	LX	LI	LI	LI	LI	LI	LI	LY	LY	LY	LY	LY	LY	KX	KCXX	KCX	KCX	
CONTROL CARD 7	2	1	2	0	0	0	0	113	100	0	0	0	0	0	5	5	5	
	JXX	JX	JX	JX	JX	JX	JX	NZZ	NZ	NZ	NZ	NZ	NZ	NZ	IST	MX		
CONTROL CARD 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

ROTATION LENGTH IN YEARS

1	2
113	100

PERIODIC COSTS AND INCOMES

YEAR	COST	YEAR	COST	YEAR	COST	YEAR	COST	YEAR
0	-3.00	0	-11.00					
1	-15.00	1	-25.00					
18	-35.00	16	-20.00					
60	97.20	60	145.80					
113	456.00	100	414.00					

PROBLEM NO. 1--SAMPLE PROBLEM -PERIODIC COSTS AND INCOMES--

INTERNAL RATE OF RETURN FOR SCHEDULE 0001 IS BETWEEN 2.7 AND 2.8
WITH PRESENT WORTHS OF 2.99 AND -0.23 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0002 IS BETWEEN 2.9 AND 3.0
WITH PRESENT WORTHS OF 2.14 AND -1.53 RESPECTIVELY.

PRESENT DISCOUNTED NET WORTH AT GIVEN ALTERNATIVE RATES OF INTEREST

RATE	ALT-PLAN 1 (ROTATION 113)	ALT-PLAN 2 (ROTATION 100)	ALT-PLAN 0 (ROTATION 0)	ALT-PLAN 0 (ROTATION 0)
2.0	40.38	59.75		
2.1	32.86	50.16		
2.2	26.25	41.63		
2.3	20.41	34.02		
2.4	15.25	27.22		
2.5	10.67	21.11		
2.6	6.61	15.61		
2.7	2.99	10.66		
2.8	-0.23	6.19		
2.9	-3.10	2.14		
3.0	-5.67	-1.53		
3.1	-7.96	-4.85		
3.2	-10.01	-7.87		
3.3	-11.85	-10.62		
3.4	-13.49	-13.12		
3.5	-14.96	-15.40		
3.6	-16.27	-17.48		
3.7	-17.45	-19.38		
3.8	-18.50	-21.11		
3.9	-19.44	-22.69		
4.0	-20.28	-24.14		

INDEX 2

PROBLEM NO. 2--SAMPLE PROBLEM--PERIODIC AND ANNUAL COSTS AND INCOMES

PLAN 1--PERPETUATED SERIES
PLAN 2--TERMINATED SERIES

GENERAL EVALUATION OF ALTERNATIVES

	RINT	RINT	RINT	JPR
CONTROL CARD 6	.005	.001	.100	1

LX	LI	LI	LI	LI	LI	LY	LY	LY	KX	KCXX	KCX	KCX	KCX	KCX
CONTROL CARD 7	2	1	2	0	0	0	40	0	0	9	9	0	0	0

[illegible]

ROTATION LENGTH IN YEARS

1040

204

PERIODIC COSTS AND INCOMES

[illegible]

ANNUAL COSTS AND RETURNS--ALT. OR PLAN	
1ST YEAR	END YEAR
0	40
\$	\$

ANNUAL COSTS AND RETURNS--ALT. OR PLAN		2
1ST YEAR	0	END YEAR
	40	\$

PROBLEM NO. 2--SAMPLE PROBLEM--PERIODIC AND ANNUAL COSTS AND INCOMES

INTERNAL RATE OF RETURN FOR SCHEDULE 0001 IS BETWEEN 6.0 AND 6.1 WITH PRESENT WORTHS OF .30 AND -.1.86 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0002 IS BETWEEN 6.0 AND 6.1 WITH PRESENT WORTHS OF .27 AND -.1.68 RESPECTIVELY.

PRESENT DISCOUNTED NET WORTH AT GIVEN ALTERNATIVE RATES OF INTEREST

RATE	ALT-PLAN 1		ALT-PLAN 2		RATE	ALT-PLAN 1		ALT-PLAN 2	
	(ROTATION 40)	(ROTATION 0)	(ROTATION 40)	(ROTATION 0)		(ROTATION 40)	(ROTATION 0)	(ROTATION 40)	(ROTATION 0)
.5	2095.98		379.08		5.2	21.79		18.92	
.6	1703.84		362.59		5.3	18.63		16.27	
.7	1424.13		346.75		5.4	15.62		13.72	
.8	1214.69		331.52		5.5	12.76		11.26	
.9	1052.09		316.89		5.6	10.03		8.89	
1.0	922.28		302.83		5.7	7.42		6.61	
1.1	816.31		289.31		5.8	4.94		4.42	
1.2	728.23		276.32		5.9	2.57		2.31	
1.3	653.91		263.84		6.0	.30		.27	
1.4	590.39		251.84		6.1	-1.86		-1.68	
1.5	535.52		240.31		6.2	-3.92		-3.57	
1.6	487.67		229.22		6.3	-5.90		-5.39	
1.7	445.61		218.56		6.4	-7.79		-7.14	
1.8	408.37		208.32		6.5	-9.60		-8.82	
1.9	375.18		198.47		6.6	-11.32		-10.45	
2.0	345.44		188.99		6.7	-12.98		-12.01	
2.1	318.66		179.89		6.8	-14.56		-13.52	
2.2	294.42		171.13		6.9	-16.08		-14.97	
2.3	272.41		162.71		7.0	-17.53		-16.36	
2.4	252.33		154.61		7.1	-18.93		-17.71	
2.5	233.96		146.83		7.2	-20.26		-19.01	
2.6	217.10		139.34		7.3	-21.54		-20.25	
2.7	201.58		132.14		7.4	-22.77		-21.46	
2.8	187.26		125.21		7.5	-23.94		-22.62	
2.9	174.00		118.55		7.6	-25.07		-23.73	
3.0	161.71		112.14		7.7	-26.15		-24.81	
3.1	150.29		105.97		7.8	-27.19		-25.84	
3.2	139.66		100.04		7.9	-28.19		-26.84	
3.3	129.75		94.34		8.0	-29.15		-27.80	
3.4	120.48		88.85		8.1	-30.07		-28.73	
3.5	111.81		83.57		8.2	-30.95		-29.62	
3.6	103.69		78.49		8.3	-31.79		-30.48	
3.7	96.06		73.60		8.4	-32.61		-31.31	
3.8	88.90		68.90		8.5	-33.39		-32.11	
3.9	82.16		64.38		8.6	-34.14		-32.88	
4.0	75.81		60.02		8.7	-34.86		-33.62	
4.1	69.83		55.83		8.8	-35.56		-34.34	
4.2	64.18		51.80		8.9	-36.22		-35.02	
4.3	58.84		47.92		9.0	-36.86		-35.69	
4.4	53.79		44.18		9.1	-37.48		-36.33	
4.5	49.01		40.59		9.2	-38.07		-36.94	
4.6	44.49		37.13		9.3	-38.64		-37.54	
4.7	40.20		33.80		9.4	-39.18		-38.11	
4.8	36.13		30.59		9.5	-39.71		-38.66	
4.9	32.26		27.50		9.6	-40.22		-39.19	
5.0	28.59		24.53		9.7	-40.70		-39.70	
5.1	25.11		21.67		9.8	-41.17		-40.19	
					9.9	-41.62		-40.67	
					10.0	-42.05		-41.12	

Figure 16. - Computer output, Problem 3.

PROBLEM NO. 3--SAMPLE PROBLEM--PERIODIC COSTS AND INCOMES AND YIELD CALCULATIONS ID= 1

SAME AS PROBLEM 1 BUT WITH PRODUCT YIELDS COMPUTED BY THE MACHINE

GENERAL EVALUATION OF ALTERNATIVES

CONTROL CARD	6	RINT	RINT	RINT	JPR
		.020	.001	.040	1
	LX	LI	LI	LI	LI
CONTROL CARD 7	2	1	2	0	0
	JXX	JX	JX	JX	JX
CONTROL CARD 7	0	0	0	0	0

ROTATION LENGTH IN YEARS

1 2
113 100

PERIODIC COSTS AND INCOMES

YEAR	COST	YEAR	COST	YEAR	COST	YEAR	COST	YEAR	COST
0	-3.00	0	-11.00	0	-11.00	0	-11.00	0	-11.00
1	-15.00	1	-25.00	1	-25.00	1	-25.00	1	-25.00
18	-35.00	16	-20.00	16	-20.00	16	-20.00	16	-20.00

CONTROL CARD	11	K1XX	K1X	K1X	K1X	K1X	K1X	K1X	K1X
		6	6	4	0	0	0	0	0
CONTROL CARD 11		K2XX	K2X	K2X	K2X	K2X	K2X	K2X	K2X
		0	0	0	0	0	0	0	0
CONTROL CARD 11		K3XX	K3X	K3X	K3X	K3X	K3X	K3X	K3X
		0	0	0	0	0	0	0	0

PERIODIC RETURNS FROM SAWTIMBER--CU FT

YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL
60	9720	60	60	12150	50	60	12150	50	60	12150	50
60	3240	50	60	12150	70	60	12150	70	60	12150	70
60	3240	70	100	38000	50	100	38000	50	100	38000	50
113	51600	60	100	32000	70	100	32000	70	100	32000	70
113	12200	50	0	0	0	0	0	0	0	0	0
113	12200	70	0	0	0	0	0	0	0	0	0

PRODUCT PRICES

PRODUCT NO.1 PRODUCT NO.2 PRODUCT NO.3

\$.100 CH 0

PROBLEM NO. 3--SAMPLE PROBLEM--PERIODIC COSTS AND INCOMES AND YIELD CALCULATIONS

INTERNAL RATE OF RETURN FOR SCHEDULE 0001 IS BETWEEN 2.7 AND 2.8 WITH PRESENT WORTHS OF 2.99 AND -0.23 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0002 IS BETWEEN 2.9 AND 3.0 WITH PRESENT WORTHS OF 2.14 AND -1.53 RESPECTIVELY.

PRESENT DISCOUNTED NET WORTH AT GIVEN ALTERNATIVE RATES OF INTEREST

RATE	ALT-PLAN 1 (ROTATION 113)	ALT-PLAN 2 (ROTATION 100)	ALT-PLAN 0 (ROTATION 0)	ALT-PLAN 0 (ROTATION 0)	ALT-PLAN 0 (ROTATION 0)
2.0	40.38	59.75			
2.1	32.86	50.16			
2.2	26.25	41.63			
2.3	20.41	34.02			
2.4	15.25	27.22			
2.5	10.67	21.11			
2.6	6.61	15.61			
2.7	2.99	10.66			
2.8	-0.23	6.19			
2.9	-3.10	2.14			
3.0	-5.67	-1.53			
3.1	-7.96	-4.85			
3.2	-10.01	-7.87			
3.3	-11.85	-10.62			
3.4	-13.49	-13.12			
3.5	-14.96	-15.40			
3.6	-16.27	-17.48			
3.7	-17.45	-19.38			
3.8	-18.50	-21.11			
3.9	-19.44	-22.69			
4.0	-20.28	-24.14			

ID= 3

PROBLEM NO. 4--SAMPLE PROBLEM--STAND REPLACEMENT--CUT NOW OR IN 10 YEARS

PLAN 1--CUT NOW
PLAN 2--CUT IN 10 YEARS
SAME FUTURE TIMBER GROWING PROGRAM IN BOTH PLANS

EVALUATION OF STAND REPLACEMENT PRIORITIES

	RINT	RINT	RINT	JPR
CONTROL CARD 6	.010	.001	.070	2

CONTROL CARDS FOR FUTURE STANDARDS*****

	LX	LI	LI	LI	LI	LI	LI	LY	LY	LY	LY	LY	KX	KX	KX	KX	KX	KX	KX
CONTROL CARD 7	2	1	2	0	0	0	0	81	0	0	0	0	1	2	2	2	0	0	0

[illegible]

ROTATION LENGTH IN YEARS

1812

PERIODIC COSTS AND INCOMES

YEAR	COST	YEAR	COST	YEAR	COST	YEAR	COST
1	-5.00	1	-5.00				
21	-22.00	21	-22.00				

[illegible]

PERIODIC RETURNS FROM SAWTIMBER--100 CU FT

	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL
	51	250	35		51	250	35					
	81	900	110		81	900	110					

PRODUCT PRICES

PRODUCT NO. 2

\$ 5.000 CH .005

PROBLEM NO. 4--SAMPLE PROBLEM--STAND REPLACEMENT--CUT NOW OR IN 10 YEARS

DISCOUNTED NET WORTH OF FUTURE CROPS

RATE	ALI-PLAN 1		ALI-PLAN 2		ALI-PLAN 0		RATE	ALI-PLAN 1		ALI-PLAN 2	
	(ROTATION	81)	(ROTATION	81)	(ROTATION	0)		(ROTATION	81)	(ROTATION	81)
1.0	579.90		579.90		579.90		5.7	-0.55		-0.55	
1.1	503.11		503.11		503.11		5.8	-1.15		-1.15	
1.2	439.82		439.82		439.82		5.9	-1.69		-1.69	
1.3	386.91		386.91		386.91		6.0	-2.19		-2.19	
1.4	342.14		342.14		342.14		6.1	-2.65		-2.65	
1.5	303.88		303.88		303.88		6.2	-3.07		-3.07	
1.6	270.90		270.90		270.90		6.3	-3.46		-3.46	
1.7	242.26		242.26		242.26		6.4	-3.81		-3.81	
1.8	217.23		217.23		217.23		6.5	-4.13		-4.13	
1.9	195.22		195.22		195.22		6.6	-4.43		-4.43	
2.0	175.78		175.78		175.78		6.7	-4.70		-4.70	
2.1	158.53		158.53		158.53		6.8	-4.94		-4.94	
2.2	143.17		143.17		143.17		6.9	-5.17		-5.17	
2.3	129.45		129.45		129.45		7.0	-5.37		-5.37	
2.4	117.14		117.14		117.14						
2.5	106.08		106.08		106.08						
2.6	96.11		96.11		96.11						
2.7	87.10		87.10		87.10						
2.8	78.95		78.95		78.95						
2.9	71.56		71.56		71.56						
3.0	64.85		64.85		64.85						
3.1	58.75		58.75		58.75						
3.2	53.19		53.19		53.19						
3.3	48.12		48.12		48.12						
3.4	43.50		43.50		43.50						
3.5	39.27		39.27		39.27						
3.6	35.41		35.41		35.41						
3.7	31.87		31.87		31.87						
3.8	28.63		28.63		28.63						
3.9	25.66		25.66		25.66						
4.0	22.94		22.94		22.94						
4.1	20.44		20.44		20.44						
4.2	18.14		18.14		18.14						
4.3	16.04		16.04		16.04						
4.4	14.10		14.10		14.10						
4.5	12.32		12.32		12.32						
4.6	10.69		10.69		10.69						
4.7	9.19		9.19		9.19						
4.8	7.81		7.81		7.81						
4.9	6.54		6.54		6.54						
5.0	5.37		5.37		5.37						
5.1	4.30		4.30		4.30						
5.2	3.31		3.31		3.31						
5.3	2.40		2.40		2.40						
5.4	1.57		1.57		1.57						
5.5	.80		.80		.80						
5.6	.09		.09		.09						

CONTROL CARDS 7♦ FOR PRESENT STANO♦♦♦♦♦

[illegible][illegible]

ROTATION LENGTH IN YEARS

10 20

[illegible]

PERIODIC RETURNS FROM SAWTIMBER--100 CU FT

	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL
	0	700	90		10	800	110					

PRODUCT PRICES

PRODUCT NO. 3

PRODUCT NO. 2

PRODUCT NO.1

\$ 5.000 CH .005

PROBLEM NO. 4--SAMPLE PROBLEM--STAND REPLACEMENT--CUT NOW OR IN 10 YEARS

DISCOUNTED NET WORTH OF PRESENT AND FUTURE CROPS

RATE	ALT-PLAN 1		ALT-PLAN 2	
	(ROTATION 0)	(ROTATION 10)	(ROTATION 0)	(ROTATION 10)
1.0	894.90	943.22	5.7	314.45
1.1	818.11	865.10	5.8	313.85
1.2	754.82	800.41	5.9	313.31
1.3	701.91	746.05	6.0	312.81
1.4	657.14	699.77	6.1	312.35
1.5	618.88	659.94	6.2	311.93
1.6	585.90	625.33	6.3	311.54
1.7	557.26	595.01	6.4	311.19
1.8	532.23	568.25	6.5	310.87
1.9	510.22	544.46	6.6	310.57
2.0	490.78	523.20	6.7	310.30
2.1	473.53	504.09	6.8	310.06
2.2	458.17	486.82	6.9	309.83
2.3	444.45	471.15	7.0	309.63
2.4	432.14	456.86		
2.5	421.08	443.78		
2.6	411.11	431.76		
2.7	402.10	420.68		
2.8	393.95	410.42		
2.9	386.56	400.90		
3.0	379.85	392.03		
3.1	373.75	383.74		
3.2	368.19	375.99		
3.3	363.12	368.70		
3.4	358.50	361.84		
3.5	354.27	355.36		
3.6	350.41	349.23		
3.7	346.87	343.42		
3.8	343.63	337.89		
3.9	340.66	332.63		
4.0	337.94	327.61		
4.1	335.44	322.80		
4.2	333.14	318.20		
4.3	331.04	313.78		
4.4	329.10	309.52		
4.5	327.32	305.43		
4.6	325.69	301.48		
4.7	324.19	297.66		
4.8	322.81	293.97		
4.9	321.54	290.39		
5.0	320.37	286.92		
5.1	319.30	283.55		
5.2	318.31	280.27		
5.3	317.40	277.08		
5.4	316.57	273.97		
5.5	315.80	270.94		
5.6	315.09	267.97		

Figure 18. -- Computer output, Problem 5.

PROBLEM NO. 5--SAMPLE PROBLEM--STAND REPLACEMENT -COMPARISON OF 2 STANDS ID= 2

PLAN 1--CUT HIGHEST VOLUME STAND ON POOR LAND
PLAN 2--CUT LOW VOLUME STAND ON GOOD LAND

EVALUATION OF STAND REPLACEMENT PRIORITIES

CONTROL CARD 6 RINT RINT RINT JPR
.010 .001 .100 2

CONTROL CARDS FOR FUTURE STANDS*****

	LX	LI	LI	LI	LI	LI	LI	LI	LI	LI	LI	LI	LI	LI	LY	LY	LY	LY	LY	LY	KX	KCXX	KCX	KCX	KCX	KCX	KCX	KCX	
CONTROL CARD 7	2	3	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
CONTROL CARD 7	JXX	JX	JX	JX	JX	JX	JX	JX	JX	JX	JX	JX	JX	JX	NZ	NZ	NZ	NZ	NZ	NZ	1	1	1	0	0	0	0	0	0

ROTATION LENGTH IN YEARS

3 7
110 81

PERIODIC COSTS AND INCOMES

YEAR	COST	YEAR	COST	YEAR	COST	YEAR	COST	YEAR	COST
30	-25.00	15	-25.00						

CONTROL CARD 11	K1XX	K1X	K1X	K1X	K1X	K1X	K1X
2	2	2	0	0	0	0	0
CONTROL CARD 11	K2XX	K2X	K2X	K2X	K2X	K2X	K2X
0	0	0	0	0	0	0	0
CONTROL CARD 11	K3XX	K3X	K3X	K3X	K3X	K3X	K3X
0	0	0	0	0	0	0	0

PERIODIC RETURNS FROM SAWTIMBER--100 CU FT

YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL
75	200	35	50	300	50						
110	800	90	81	1200	140						

PRODUCT PRICES

PRODUCT NO.1 PRODUCT NO.2 PRODUCT NO.3

\$ 7.000 CH .005

PROBLEM NO. 5--SAMPLE PROBLEM--STAND REPLACEMENT -COMPARISON OF 2 STANDS

DISCOUNTED NET WORTH OF FUTURE CROPS

RATE	ALT-PLAN 3 (ROTATION 110)	ALT-PLAN 7 (ROTATION 111)
1.0	413.13	1438.99
1.1	351.73	1252.02
1.2	301.59	1097.88
1.3	260.11	968.96
1.4	225.39	859.84
1.5	196.06	766.54
1.6	171.09	686.07
1.7	149.70	616.15
1.8	131.26	555.00
1.9	115.29	501.21
2.0	101.40	453.67
2.1	89.27	411.45
2.2	78.65	373.82
2.3	69.33	340.16
2.4	61.12	309.96
2.5	53.88	282.78
2.6	47.48	258.26
2.7	41.81	236.09
2.8	36.79	216.00
2.9	32.34	197.76
3.0	28.39	181.18
3.1	24.87	166.07
3.2	21.74	152.29
3.3	18.96	139.71
3.4	16.48	128.20
3.5	14.28	117.67
3.6	12.31	108.02
3.7	10.56	99.17
3.8	9.01	91.04
3.9	7.62	83.58
4.0	6.38	76.71
4.1	5.28	70.40
4.2	4.31	64.59
4.3	3.44	59.24
4.4	2.67	54.30
4.5	1.99	49.76
4.6	1.38	45.56
4.7	.85	41.69
4.8	.38	38.12
4.9	-0.04	34.83
5.0	-0.40	31.78
5.1	-0.72	28.97
5.2	-1.00	26.37
5.3	-1.25	23.97
5.4	-1.46	21.75
5.5	-1.64	19.69
5.6	-1.80	17.80

RATE	ALT-PLAN 3 (ROTATION 110)	ALT-PLAN 7 (ROTATION 111)
5.7	-1.93	16.04
5.8	-2.05	14.42
5.9	-2.14	12.92
6.0	-2.22	11.53
6.1	-2.28	10.25
6.2	-2.33	9.06
6.3	-2.37	7.96
6.4	-2.40	6.95
6.5	-2.42	6.01
6.6	-2.43	5.14
6.7	-2.43	4.34
6.8	-2.43	3.60
6.9	-2.42	2.92
7.0	-2.41	2.29
7.1	-2.39	1.71
7.2	-2.37	1.17
7.3	-2.34	.68
7.4	-2.32	.22
7.5	-2.29	-0.20
7.6	-2.25	-0.59
7.7	-2.22	-0.94
7.8	-2.18	-1.27
7.9	-2.15	-1.57
8.0	-2.11	-1.84
8.1	-2.07	-2.10
8.2	-2.03	-2.33
8.3	-1.99	-2.54
8.4	-1.96	-2.73
8.5	-1.92	-2.91
8.6	-1.88	-3.07
8.7	-1.84	-3.21
8.8	-1.80	-3.34
8.9	-1.76	-3.46
9.0	-1.72	-3.57
9.1	-1.68	-3.66
9.2	-1.64	-3.75
9.3	-1.61	-3.82
9.4	-1.57	-3.89
9.5	-1.53	-3.95
9.6	-1.50	-4.00
9.7	-1.46	-4.04
9.8	-1.43	-4.08
9.9	-1.39	-4.11
10.0	-1.36	-4.14

	LX	LI	LI	LI	LI	LI	LI	LI	LY	LY	LY	LY	LY	KCXX	KCX	KCX	KCX	KCX	KCX
CONTROL CARD 7	2	3	7	0	0	0	0	3	3	0	0	0	0	2	2	2	0	0	0
	JXX	JX	JX	JX	JX	JX	JX	NZZ	NZ	NZ	NZ	NZ	NZ	IST	MX				
CONTROL CARD 7	0	0	0	0	0	0	0	1	1	1	0	0	0	2	1				

33 73

ROTATION LENGTH IN YEARS

PERIODIC COSTS AND INCOMES		
YEAR	COST	YEAR
1	-7.00	1
2	-24.00	2

YEAR	COST	YEAR	COST
1950	100	1950	100
1951	105	1951	105
1952	110	1952	110
1953	115	1953	115
1954	120	1954	120
1955	125	1955	125
1956	130	1956	130
1957	135	1957	135
1958	140	1958	140
1959	145	1959	145
1960	150	1960	150
1961	155	1961	155
1962	160	1962	160
1963	165	1963	165
1964	170	1964	170
1965	175	1965	175
1966	180	1966	180
1967	185	1967	185
1968	190	1968	190
1969	195	1969	195
1970	200	1970	200
1971	205	1971	205
1972	210	1972	210
1973	215	1973	215
1974	220	1974	220
1975	225	1975	225
1976	230	1976	230
1977	235	1977	235
1978	240	1978	240
1979	245	1979	245
1980	250	1980	250
1981	255	1981	255
1982	260	1982	260
1983	265	1983	265
1984	270	1984	270
1985	275	1985	275
1986	280	1986	280
1987	285	1987	285
1988	290	1988	290
1989	295	1989	295
1990	300	1990	300
1991	305	1991	305
1992	310	1992	310
1993	315	1993	315
1994	320	1994	320
1995	325	1995	325
1996	330	1996	330
1997	335	1997	335
1998	340	1998	340
1999	345	1999	345
2000	350	2000	350
2001	355	2001	355
2002	360	2002	360
2003	365	2003	365
2004	370	2004	370
2005	375	2005	375
2006	380	2006	380
2007	385	2007	385
2008	390	2008	390
2009	395	2009	395
2010	400	2010	400
2011	405	2011	405
2012	410	2012	410
2013	415	2013	415
2014	420	2014	420
2015	425	2015	425
2016	430	2016	430
2017	435	2017	435
2018	440	2018	440
2019	445	2019	445
2020	450	2020	450
2021	455	2021	455
2022	460	2022	460
2023	465	2023	465
2024	470	2024	470
2025	475	2025	475
2026	480	2026	480
2027	485	2027	485
2028	490	2028	490
2029	495	2029	495
2030	500	2030	500
2031	505	2031	505
2032	510	2032	510
2033	515	2033	515
2034	520	2034	520
2035	525	2035	525
2036	530	2036	530
2037	535	2037	535
2038	540	2038	540
2039	545	2039	545

K1XX	K1X	K1X	K1X	K1X	K1X
CONTROL CARD 11	1	1	0	0	0
	K2XX	K2X	K2X	K2X	K2X
CONTROL CARD 11	0	0	0	0	0
	K3XX	K3X	K3X	K3X	K3X
CONTROL CARD 11	0	0	0	0	0

PERIODIC RETURNS FROM SAWTIMBER--100 CU FT	
YEAR	YIELD QUAL
3	740 90
3	590 90

YEAR	YIELD	QUAL	YEAR	YIELD	QUAL
1950	100	100	1950	100	100
1951	100	100	1951	100	100
1952	100	100	1952	100	100
1953	100	100	1953	100	100
1954	100	100	1954	100	100
1955	100	100	1955	100	100
1956	100	100	1956	100	100
1957	100	100	1957	100	100
1958	100	100	1958	100	100
1959	100	100	1959	100	100
1960	100	100	1960	100	100
1961	100	100	1961	100	100
1962	100	100	1962	100	100
1963	100	100	1963	100	100
1964	100	100	1964	100	100
1965	100	100	1965	100	100
1966	100	100	1966	100	100
1967	100	100	1967	100	100
1968	100	100	1968	100	100
1969	100	100	1969	100	100
1970	100	100	1970	100	100
1971	100	100	1971	100	100
1972	100	100	1972	100	100
1973	100	100	1973	100	100
1974	100	100	1974	100	100
1975	100	100	1975	100	100
1976	100	100	1976	100	100
1977	100	100	1977	100	100
1978	100	100	1978	100	100
1979	100	100	1979	100	100
1980	100	100	1980	100	100
1981	100	100	1981	100	100
1982	100	100	1982	100	100
1983	100	100	1983	100	100
1984	100	100	1984	100	100
1985	100	100	1985	100	100
1986	100	100	1986	100	100
1987	100	100	1987	100	100
1988	100	100	1988	100	100
1989	100	100	1989	100	100
1990	100	100	1990	100	100
1991	100	100	1991	100	100
1992	100	100	1992	100	100
1993	100	100	1993	100	100
1994	100	100	1994	100	100
1995	100	100	1995	100	100
1996	100	100	1996	100	100
1997	100	100	1997	100	100
1998	100	100	1998	100	100
1999	100	100	1999	100	100
2000	100	100	2000	100	100
2001	100	100	2001	100	100
2002	100	100	2002	100	100
2003	100	100	2003	100	100
2004	100	100	2004	100	100
2005	100	100	2005	100	100
2006	100	100	2006	100	100
2007	100	100	2007	100	100
2008	100	100	2008	100	100
2009	100	100	2009	100	100
2010	100	100	2010	100	100
2011	100	100	2011	100	100
2012	100	100	2012	100	100
2013	100	100	2013	100	100

PRODUCT PRICES

PRODUCT NO.1 PRODUCT NO.2 PRODUCT NO.3

\$ 7.000 CH .005

PROBLEM NO. 5--SAMPLE PROBLEM--STAND REPLACEMENT -COMPARISON OF 2 STANDS

DISCOUNTED NET WORTH OF PRESENT AND FUTURE CROPS

RATE	ALT-PLAN 3		RATE	ALT-PLAN 3		ALT-PLAN 7 (ROTATION 3)	ALT-PLAN 7 (ROTATION 3)
	(ROTATION 3)			(ROTATION 3)			
1.0	829.80	1735.34	5.7	370.95	307.69		
1.1	767.88	1549.23	5.8	369.77	305.42		
1.2	717.20	1395.89	5.9	368.62	303.26		
1.3	675.13	1267.71	6.0	367.48	301.21		
1.4	639.80	1159.26	6.1	366.35	299.25		
1.5	609.82	1066.59	6.2	365.24	297.39		
1.6	584.19	986.68	6.3	364.15	295.61		
1.7	562.09	917.27	6.4	363.07	293.91		
1.8	542.92	856.57	6.5	362.00	292.27		
1.9	526.19	803.18	6.6	360.94	290.71		
2.0	511.52	755.99	6.7	359.89	289.20		
2.1	498.59	714.07	6.8	358.85	287.76		
2.2	487.14	676.70	6.9	357.82	286.36		
2.3	476.97	643.24	7.0	356.80	285.02		
2.4	467.89	613.20	7.1	355.78	283.72		
2.5	459.76	586.13	7.2	354.77	282.46		
2.6	452.46	561.69	7.3	353.77	281.24		
2.7	445.88	539.55	7.4	352.77	280.06		
2.8	439.92	519.45	7.5	351.78	278.91		
2.9	434.52	501.17	7.6	350.80	277.80		
3.0	429.60	484.50	7.7	349.82	276.71		
3.1	425.11	469.28	7.8	348.84	275.65		
3.2	420.99	455.35	7.9	347.87	274.62		
3.3	417.21	442.58	8.0	346.90	273.61		
3.4	413.73	430.86	8.1	345.94	272.63		
3.5	410.50	420.08	8.2	344.98	271.66		
3.6	407.51	410.15	8.3	344.03	270.72		
3.7	404.73	401.00	8.4	343.08	269.79		
3.8	402.14	392.54	8.5	342.13	268.88		
3.9	399.71	384.73	8.6	341.18	267.98		
4.0	397.42	377.48	8.7	340.24	267.11		
4.1	395.27	370.77	8.8	339.31	266.24		
4.2	393.24	364.54	8.9	338.37	265.39		
4.3	391.31	358.74	9.0	337.44	264.55		
4.4	389.47	353.35	9.1	336.51	263.72		
4.5	387.72	348.32	9.2	335.59	262.91		
4.6	386.05	343.63	9.3	334.67	262.10		
4.7	384.45	339.24	9.4	333.75	261.31		
4.8	382.90	335.14	9.5	332.83	260.52		
4.9	381.42	331.30	9.6	331.92	259.74		
5.0	379.98	327.69	9.7	331.01	258.97		
5.1	378.58	324.30	9.8	330.10	258.21		
5.2	377.23	321.12	9.9	329.20	257.46		
5.3	375.92	318.12	10.0	328.30	256.71		
5.4	374.63	315.28					
5.5	373.38	312.61					
5.6	372.15	310.08					

Figure 19. – Computer output, Problem 6.

PROBLEM NO. 6--SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS

100 = 2

PLAN 1--COMPARE THINNING WITH NO TREATMENT

PLAN 2--COMPARE THINNING AND PRUNING WITH NO TREATMENT

EVALUATION OF TIMBER STAND IMPROVEMENT PROGRAMS

	RINT	RINT	RINT	JPR
CONTROL CARD 6	.010	.001	.150	3

CONTROL CARDS FOR FIRST TSI PLAN*****

	LX	LI	LI	LI	LI	LI	LY	LY	LY	LY	LY	KX	KX	KX	KX	KX	KX	KX	KX
CONTROL CARD 7	2	1	2	0	0	0	100	100	0	0	0	0	1	0	0	0	0	0	0

[illegible]

ROTATION LENGTH IN YEARS

1
100

[illegible]

PERIODIC RETURNS FROM SAWTIMBER--MAF

YEAR	YIELD	QUAL	YEAR	YIELD	QUAL
100	300	90	100	300	90

	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL
1	1980	100	100	1981	100	100	1982	100	100
2	1983	100	100	1984	100	100	1985	100	100
3	1986	100	100	1987	100	100	1988	100	100
4	1989	100	100	1990	100	100	1991	100	100
5	1992	100	100	1993	100	100	1994	100	100
6	1995	100	100	1996	100	100	1997	100	100
7	1998	100	100	1999	100	100	2000	100	100
8	2001	100	100	2002	100	100	2003	100	100
9	2004	100	100	2005	100	100	2006	100	100
10	2007	100	100	2008	100	100	2009	100	100
11	2010	100	100	2011	100	100	2012	100	100
12	2013	100	100	2014	100	100	2015	100	100
13	2016	100	100	2017	100	100	2018	100	100
14	2019	100	100	2020	100	100	2021	100	100
15	2022	100	100	2023	100	100	2024	100	100
16	2025	100	100	2026	100	100	2027	100	100
17	2028	100	100	2029	100	100	2030	100	100
18	2031	100	100	2032	100	100	2033	100	100
19	2034	100	100	2035	100	100	2036	100	100
20	2037	100	100	2038	100	100	2039	100	100
21	2040	100	100	2041	100	100	2042	100	100
22	2043	100	100	2044	100	100	2045	100	100
23	2046	100	100	2047	100	100	2048	100	100
24	2049	100	100	2050	100	100	2051	100	100
25	2052	100	100	2053	100	100	2054	100	100
26	2055	100	100	2056	100	100	2057	100	100
27	2058	100	100	2059	100	100	2060	100	100
28	2061	100	100	2062	100	100	2063	100	100
29	2064	100	100	2065	100	100	2066	100	100
30	2067	100	100	2068	100	100	2069	100	100
31	2070	100	100	2071	100	100	2072	100	100
32	2073	100	100	2074	100	100	2075	100	100
33	2076	100	100	2077	100	100	2078	100	100
34	2079	100	100	2080	100	100	2081	100	100
35	2082	100	100	2083	100	100	2084	100	100
36	2085	100	100	2086	100	100	2087	100	100
37	2088	100	100	2089	100	100	2090	100	100
38	2091	100	100	2092	100	100	2093	100	100
39	2094	100	100	2095	100	100	2096	100	100
40	2097	100	100	2098	100	100	2099	100	100
41	2100	100	100	2101					

PRODUCT PRICES

PRODUCT NO. 2

8 10.000 CH .005

PROBLEM NO. 6---SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS

DISCOUNTED NET WORTH--FIRST TSI PLAN

RATE	ALT-PLAN 1		ALT-PLAN 2	
	(ROTATION 100)		(ROTATION 100)	
1.0	149.73		149.73	
1.1	135.62		135.62	
1.2	122.86		122.86	
1.3	111.30		111.30	
1.4	100.85		100.85	
1.5	91.38		91.38	
1.6	82.81		82.81	
1.7	75.05		75.05	
1.8	68.03		68.03	
1.9	61.66		61.66	
2.0	55.90		55.90	
2.1	50.69		50.69	
2.2	45.96		45.96	
2.3	41.68		41.68	
2.4	37.80		37.80	
2.5	34.28		34.28	
2.6	31.10		31.10	
2.7	28.21		28.21	
2.8	25.59		25.59	
2.9	23.22		23.22	
3.0	21.07		21.07	
3.1	19.12		19.12	
3.2	17.36		17.36	
3.3	15.76		15.76	
3.4	14.30		14.30	
3.5	12.98		12.98	
3.6	11.79		11.79	
3.7	10.70		10.70	
3.8	9.72		9.72	
3.9	8.83		8.83	
4.0	8.02		8.02	
4.1	7.28		7.28	
4.2	6.62		6.62	
4.3	6.01		6.01	
4.4	5.46		5.46	
4.5	4.96		4.96	
4.6	4.51		4.51	
4.7	4.10		4.10	
4.8	3.73		3.73	
4.9	3.39		3.39	
5.0	3.08		3.08	
5.1	2.80		2.80	
5.2	2.55		2.55	
5.3	2.32		2.32	
5.4	2.11		2.11	
5.5	1.92		1.92	
5.6	1.74		1.74	

RATE	ALT-PLAN 1		ALT-PLAN 2	
	(ROTATION 100)		(ROTATION 100)	
5.7	1.58		1.58	
5.8	1.44		1.44	
5.9	1.31		1.31	
6.0	1.19		1.19	
6.1	1.09		1.09	
6.2	.99		.99	
6.3	.90		.90	
6.4	.82		.82	
6.5	.75		.75	
6.6	.68		.68	
6.7	.62		.62	
6.8	.56		.56	
6.9	.51		.51	
7.0	.47		.47	
7.1	.43		.43	
7.2	.39		.39	
7.3	.35		.35	
7.4	.32		.32	
7.5	.29		.29	
7.6	.27		.27	
7.7	.24		.24	
7.8	.22		.22	
7.9	.20		.20	
8.0	.18		.18	
8.1	.17		.17	
8.2	.15		.15	
8.3	.14		.14	
8.4	.13		.13	
8.5	.12		.12	
8.6	.11		.11	
8.7	.10		.10	
8.8	.09		.09	
8.9	.08		.08	
9.0	.07		.07	
9.1	.07		.07	
9.2	.06		.06	
9.3	.06		.06	
9.4	.05		.05	
9.5	.05		.05	
9.6	.04		.04	
9.7	.04		.04	
9.8	.04		.04	
9.9	.03		.03	
10.0	.03		.03	

CONTROL CARDS 7♦ FOR SECOND TSI PLAN*****

LX	LI	LI	LI	LI	LI	LY	LY	LY	KY	KCXX	KCX	KCX	KCX	KCX
7	2	1	2	0	0	80	80	0	0	1	2	1	2	0
CONTROL CARD														

[illegible]

ROTATION, LENGTH IN YEARS

06
1

PERIODIC COSTS AND INCOMES

YEAR	COST	YEAR	COST	YEAR	COST	YEAR	COST
0	-26.00	0	-26.00	0	-26.00	0	-26.00
0	0	0	0	0	-30.00	0	-30.00

[illegible]

PERIODIC RETURNS FROM SAWTIMBER--MHF

	YEAR	YIELD	QUAL	YEAR	YIELD	QUAL
1950	35	50	50	35	50	35
	55	100	80	55	100	85
	80	700	110	80	700	175

PRODUCT PRICES

	PRODUCT NO.1	PRODUCT NO.2	PRODUCT NO.3
\$	10.000 CH .005		

PROBLEM NO. 6---SAMPLE PROBLEM---TSI OPTION WITH 2 COMPARISONS

DISCOUNTED NET WORTH---SECOND TSI PLAN

RATE	ALT-PLAN 1		ALT-PLAN 2	
	(ROTATION 80)		(ROTATION 80)	
1.0	540.05		794.88	
1.1	499.20		732.18	
1.2	461.40		674.20	
1.3	426.41		620.60	
1.4	394.01		571.02	
1.5	364.01		525.17	
1.6	336.23		482.75	
1.7	310.50		443.51	
1.8	286.67		407.21	
1.9	264.58		373.61	
2.0	244.12		342.51	
2.1	225.15		313.73	
2.2	207.57		287.09	
2.3	191.27		262.41	
2.4	176.15		239.57	
2.5	162.13		218.41	
2.6	149.12		198.81	
2.7	137.06		180.66	
2.8	125.86		163.84	
2.9	115.47		148.25	
3.0	105.82		133.80	
3.1	96.86		120.41	
3.2	88.54		108.00	
3.3	80.81		96.49	
3.4	73.63		85.81	
3.5	66.96		75.91	
3.6	60.76		66.73	
3.7	54.99		58.21	
3.8	49.63		50.30	
3.9	44.65		42.96	
4.0	40.01		36.15	
4.1	35.69		29.83	
4.2	31.68		23.95	
4.3	27.94		18.50	
4.4	24.46		13.43	
4.5	21.22		8.73	
4.6	18.20		4.36	
4.7	15.34		.29	
4.8	12.77		-3.49	
4.9	10.32		-7.00	
5.0	8.05		-10.26	
5.1	5.92		-13.30	
5.2	3.94		-16.13	
5.3	2.09		-18.76	
5.4	.36		-21.20	
5.5	-1.25		-23.48	
5.6	-2.76		-25.60	

RATE	ALT-PLAN 1		ALT-PLAN 2	
	(ROTATION 80)		(ROTATION 80)	
5.7	-4.16		-27.57	
5.8	-5.47		-29.41	
5.9	-6.70		-31.12	
6.0	-7.85		-32.72	
6.1	-8.92		-34.20	
6.2	-9.93		-35.59	
6.3	-10.87		-36.88	
6.4	-11.75		-38.09	
6.5	-12.57		-39.21	
6.6	-13.34		-40.26	
6.7	-14.07		-41.24	
6.8	-14.74		-42.15	
6.9	-15.38		-43.01	
7.0	-15.97		-43.80	
7.1	-16.53		-44.55	
7.2	-17.05		-45.24	
7.3	-17.55		-45.89	
7.4	-18.01		-46.50	
7.5	-18.44		-47.07	
7.6	-18.85		-47.60	
7.7	-19.23		-48.09	
7.8	-19.59		-48.56	
7.9	-19.93		-49.00	
8.0	-20.25		-49.40	
8.1	-20.55		-49.78	
8.2	-20.83		-50.14	
8.3	-21.10		-50.48	
8.4	-21.35		-50.79	
8.5	-21.58		-51.09	
8.6	-21.81		-51.36	
8.7	-22.02		-51.62	
8.8	-22.21		-51.86	
8.9	-22.40		-52.09	
9.0	-22.58		-52.31	
9.1	-22.74		-52.51	
9.2	-22.90		-52.70	
9.3	-23.05		-52.88	
9.4	-23.19		-53.04	
9.5	-23.32		-53.20	
9.6	-23.45		-53.35	
9.7	-23.57		-53.49	
9.8	-23.68		-53.62	
9.9	-23.79		-53.74	
10.0	-23.89		-53.86	

PROBLEM NO. 6--SAMPLE PROBLEM--TSI OPTION WITH 2 COMPARISONS

DISCOUNTED NET WORTH OF ADDED TSI INVESTMENT		
RATE	ALT-PLAN 1 (ROTATION 80)	ALT-PLAN 2 (ROTATION 80)
1.0	390.32	645.15
1.1	363.58	596.55
1.2	338.54	551.34
1.3	315.10	509.29
1.4	293.16	470.17
1.5	272.63	433.79
1.6	253.42	399.94
1.7	235.45	368.46
1.8	218.64	339.18
1.9	202.92	311.94
2.0	188.22	286.61
2.1	174.47	263.05
2.2	161.61	241.13
2.3	149.59	220.74
2.4	138.35	201.77
2.5	127.85	184.13
2.6	118.03	167.72
2.7	108.85	152.45
2.8	100.26	138.24
2.9	92.24	125.03
3.0	84.74	112.73
3.1	77.73	101.29
3.2	71.18	90.64
3.3	65.05	80.73
3.4	59.33	71.51
3.5	53.97	62.93
3.6	48.97	54.94
3.7	44.29	47.50
3.8	39.91	40.58
3.9	35.82	34.13
4.0	31.99	28.13
4.1	28.41	22.54
4.2	25.06	17.34
4.3	21.93	12.49
4.4	19.00	7.97
4.5	16.26	3.76
4.6	13.69	-0.16
4.7	11.29	-3.81
4.8	9.04	-7.21
4.9	6.94	-10.39
5.0	4.97	-13.34
5.1	3.12	-16.10
5.2	1.39	-18.67
5.3	-0.23	-21.07
5.4	-1.74	-23.31
5.5	-3.16	-25.39
5.6	-4.50	-27.34

RATE	ALT-PLAN 1 (ROTATION 80)	ALT-PLAN 2 (ROTATION 80)
5.7	-5.75	-29.16
5.8	-6.92	-30.85
5.9	-8.01	-32.43
6.0	-9.04	-33.91
6.1	-10.01	-35.29
6.2	-10.92	-36.58
6.3	-11.77	-37.78
6.4	-12.57	-38.91
6.5	-13.32	-39.96
6.6	-14.02	-40.94
6.7	-14.68	-41.86
6.8	-15.31	-42.72
6.9	-15.89	-43.52
7.0	-16.44	-44.27
7.1	-16.96	-44.97
7.2	-17.44	-45.63
7.3	-17.90	-46.24
7.4	-18.33	-46.82
7.5	-18.73	-47.36
7.6	-19.12	-47.86
7.7	-19.48	-48.34
7.8	-19.81	-48.78
7.9	-20.13	-49.20
8.0	-20.43	-49.59
8.1	-20.72	-49.95
8.2	-20.98	-50.30
8.3	-21.24	-50.62
8.4	-21.47	-50.92
8.5	-21.70	-51.20
8.6	-21.91	-51.47
8.7	-22.11	-51.72
8.8	-22.30	-51.95
8.9	-22.48	-52.17
9.0	-22.65	-52.38
9.1	-22.81	-52.58
9.2	-22.96	-52.76
9.3	-23.11	-52.93
9.4	-23.24	-53.09
9.5	-23.37	-53.25
9.6	-23.49	-53.39
9.7	-23.61	-53.53
9.8	-23.72	-53.65
9.9	-23.82	-53.77
10.0	-23.92	-53.89

PROBLEM NO. 7A--COMPARISON OF TIMBER GROWING ALTERNATIVES--55 YEAR ROTATION

INTERNAL RATE OF RETURN FOR SCHEDULE 0001 IS BETWEEN 3.5 AND 3.6 WITH PRESENT WORTHS OF 1.42 AND -0.39 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0002 IS BETWEEN 4.8 AND 4.9 WITH PRESENT WORTHS OF .82 AND -0.44 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0003 IS BETWEEN 6.0 AND 6.1 WITH PRESENT WORTHS OF .10 AND -0.32 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0004 IS BETWEEN 4.8 AND 4.9 WITH PRESENT WORTHS OF .37 AND -0.55 RESPECTIVELY.

PRESENT DISCOUNTED NET WORTH AT GIVEN ALTERNATIVE RATES OF INTEREST

RATE	ALT-PLAN 1 (ROTATION 55)	ALT-PLAN 2 (ROTATION 55)	ALT-PLAN 3 (ROTATION 55)	ALT-PLAN 4 (ROTATION 55)	ALT-PLAN 0 (ROTATION 0)	ALT-PLAN 0 (ROTATION 0)
1.0	103.78	173.88	137.60	131.18		
1.1	96.34	163.15	129.45	122.99		
1.2	89.31	153.01	121.74	115.25		
1.3	82.67	143.43	114.46	107.94		
1.4	76.40	134.37	107.59	101.03		
1.5	70.47	125.80	101.10	94.50		
1.6	64.86	117.71	94.97	88.33		
1.7	59.57	110.05	89.17	82.50		
1.8	54.56	102.81	83.70	77.00		
1.9	49.83	95.97	78.54	71.80		
2.0	45.36	89.50	73.66	66.89		
2.1	41.13	83.38	69.05	62.25		
2.2	37.14	77.60	64.70	57.86		
2.3	33.37	72.13	60.59	53.72		
2.4	29.80	66.97	56.71	49.81		
2.5	26.43	62.08	53.04	46.12		
2.6	23.24	57.46	49.58	42.63		
2.7	20.23	53.09	46.32	39.33		
2.8	17.39	48.96	43.24	36.22		
2.9	14.70	45.06	40.33	33.28		
3.0	12.16	41.37	37.58	30.50		
3.1	9.76	37.88	34.99	27.88		
3.2	7.49	34.58	32.54	25.41		
3.3	5.35	31.47	30.23	23.07		
3.4	3.33	28.52	28.05	20.87		
3.5	1.42	25.73	26.00	18.79		
3.6	-0.39	23.10	24.06	16.82		
3.7	-2.10	20.61	22.23	14.97		
3.8	-3.71	18.26	20.51	13.22		
3.9	-5.23	16.04	18.88	11.57		
4.0	-6.67	13.94	17.35	10.01		
4.1	-8.03	11.96	15.90	8.55		
4.2	-9.31	10.08	14.54	7.16		
4.3	-10.52	8.31	13.26	5.85		
4.4	-11.66	6.64	12.05	4.62		
4.5	-12.74	5.06	10.91	3.46		
4.6	-13.76	3.56	9.84	2.37		
4.7	-14.72	2.15	8.83	1.34		
4.8	-15.63	.82	7.88	.37		

PRESENT DISCOUNTED NET WORTH AT GIVEN ALTERNATIVE RATES OF INTEREST

RATE ALT-PLAN 1 ALT-PLAN 2 ALT-PLAN 3 ALT-PLAN 4 ALT-PLAN 0 ALT-PLAN 0

(ROTATION 55) (ROTATION 55) (ROTATION 55) (ROTATION 55) (ROTATION 0) (ROTATION 0)

4.9	-16.49	-0.44	6.99	-0.55		
5.0	-17.30	-1.62	6.15	-1.41		
5.1	-18.06	-2.74	5.36	-2.22		
5.2	-18.78	-3.80	4.62	-2.98		
5.3	-19.46	-4.80	3.92	-3.70		
5.4	-20.10	-5.74	3.26	-4.37		
5.5	-20.70	-6.63	2.65	-5.01		
5.6	-21.27	-7.47	2.07	-5.60		
5.7	-21.80	-8.26	1.53	-6.16		
5.8	-22.31	-9.00	1.02	-6.69		
5.9	-22.78	-9.71	.55	-7.18		
6.0	-23.23	-10.37	.10	-7.65		
6.1	-23.65	-10.99	-0.32	-8.08		
6.2	-24.05	-11.58	-0.71	-8.49		
6.3	-24.42	-12.13	-1.07	-8.87		
6.4	-24.78	-12.65	-1.41	-9.23		
6.5	-25.11	-13.14	-1.73	-9.57		
6.6	-25.42	-13.60	-2.03	-9.88		
6.7	-25.71	-14.03	-2.31	-10.17		
6.8	-25.99	-14.44	-2.56	-10.45		
6.9	-26.24	-14.82	-2.80	-10.70		
7.0	-26.49	-15.18	-3.03	-10.94		
7.1	-26.71	-15.52	-3.23	-11.16		
7.2	-26.93	-15.84	-3.42	-11.37		
7.3	-27.13	-16.13	-3.60	-11.56		
7.4	-27.31	-16.41	-3.76	-11.74		
7.5	-27.49	-16.67	-3.91	-11.90		
7.6	-27.65	-16.92	-4.05	-12.05		
7.7	-27.81	-17.14	-4.18	-12.19		
7.8	-27.95	-17.36	-4.30	-12.32		
7.9	-28.09	-17.55	-4.40	-12.44		
8.0	-28.21	-17.74	-4.50	-12.55		
8.1	-28.33	-17.91	-4.59	-12.65		
8.2	-28.44	-18.07	-4.67	-12.75		
8.3	-28.54	-18.22	-4.74	-12.83		
8.4	-28.63	-18.36	-4.80	-12.91		
8.5	-28.72	-18.49	-4.86	-12.98		
8.6	-28.80	-18.61	-4.91	-13.04		
8.7	-28.88	-18.72	-4.95	-13.10		
8.8	-28.95	-18.82	-4.99	-13.15		
8.9	-29.02	-18.91	-5.03	-13.19		
9.0	-29.08	-19.00	-5.05	-13.23		
9.1	-29.13	-19.08	-5.08	-13.26		
9.2	-29.18	-19.15	-5.09	-13.29		
9.3	-29.23	-19.21	-5.11	-13.32		
9.4	-29.27	-19.27	-5.12	-13.34		
9.5	-29.31	-19.33	-5.12	-13.36		
9.6	-29.35	-19.38	-5.13	-13.37		
9.7	-29.38	-19.42	-5.13	-13.38		
9.8	-29.41	-19.46	-5.12	-13.39		
9.9	-29.43	-19.49	-5.12	-13.39		
10.0	-29.46	-19.52	-5.11	-13.39		

PROBLEM NO. 7B--COMPARISON OF TIMBER GROWING ALTERNATIVES--85 YEAR ROTATION

INTERNAL RATE OF RETURN FOR SCHEDULE 0001 IS BETWEEN 4.1 AND 4.2
WITH PRESENT WORTHS OF .18 AND -2.27 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0002 IS BETWEEN 4.7 AND 4.8
WITH PRESENT WORTHS OF 1.26 AND -0.53 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0003 IS BETWEEN 5.7 AND 5.8
WITH PRESENT WORTHS OF .20 AND -0.44 RESPECTIVELY.

INTERNAL RATE OF RETURN FOR SCHEDULE 0004 IS BETWEEN 4.9 AND 5.0
WITH PRESENT WORTHS OF .46 AND -0.85 RESPECTIVELY.

PRESENT DISCOUNTED NET WORTH AT GIVEN ALTERNATIVE RATES OF INTEREST

RATE	ALT-PLAN 1 (ROTATION 85)	ALT-PLAN 2 (ROTATION 85)	ALT-PLAN 3 (ROTATION 85)	ALT-PLAN 4 (ROTATION 85)	ALT-PLAN 0 (ROTATION 0)	ALT-PLAN 0 (ROTATION 0)
1.0	367.29	441.10	406.86	400.44		
1.1	335.58	404.57	373.66	367.20		
1.2	306.42	370.96	343.13	336.64		
1.3	279.60	340.04	315.06	308.53		
1.4	254.94	311.59	289.24	282.68		
1.5	232.25	285.40	265.50	258.90		
1.6	211.38	261.30	243.67	237.03		
1.7	192.19	239.11	223.58	216.91		
1.8	174.52	218.68	205.11	198.40		
1.9	158.27	199.87	188.11	181.37		
2.0	143.31	182.54	172.47	165.70		
2.1	129.55	166.59	158.08	151.28		
2.2	116.88	151.89	144.84	138.00		
2.3	105.21	138.35	132.65	125.79		
2.4	94.47	125.88	121.44	114.54		
2.5	84.59	114.39	111.12	104.19		
2.6	75.49	103.79	101.62	94.66		
2.7	67.10	94.03	92.87	85.88		
2.8	59.38	85.03	84.82	77.81		
2.9	52.28	76.74	77.41	70.37		
3.0	45.73	69.09	70.59	63.52		
3.1	39.69	62.04	64.31	57.21		
3.2	34.14	55.54	58.53	51.40		
3.3	29.02	49.55	53.21	46.05		
3.4	24.30	44.02	48.31	41.13		
3.5	19.96	38.92	43.80	36.59		
3.6	15.95	34.22	39.65	32.41		
3.7	12.26	29.88	35.83	28.57		
3.8	8.86	25.87	32.31	25.02		
3.9	5.73	22.18	29.07	21.76		
4.0	2.84	18.77	26.09	18.76		
4.1	.18	15.63	23.35	15.99		
4.2	-2.27	12.73	20.82	13.44		
4.3	-4.53	10.05	18.50	11.09		
4.4	-6.62	7.58	16.36	8.93		
4.5	-8.54	5.30	14.40	6.95		
4.6	-10.31	3.20	12.59	5.12		
4.7	-11.94	1.26	10.93	3.43		
4.8	-13.44	-0.53	9.40	1.88		

PRESENT DISCOUNTED NET WORTH AT GIVEN ALTERNATIVE RATES OF INTEREST

RATE	ALT-PLAN 1 (ROTATION 85)	ALT-PLAN 2 (ROTATION 85)	ALT-PLAN 3 (ROTATION 85)	ALT-PLAN 4 (ROTATION 85)	ALT-PLAN 0 (ROTATION 0)
4.9	-14.82	-2.18	7.99	.46	
5.0	-16.10	-3.71	6.70	-0.85	
5.1	-17.28	-5.11	5.52	-2.06	
5.2	-18.36	-6.41	4.43	-3.17	
5.3	-19.36	-7.61	3.43	-4.18	
5.4	-20.27	-8.71	2.52	-5.12	
5.5	-21.12	-9.73	1.68	-5.98	
5.6	-21.90	-10.66	.91	-6.77	
5.7	-22.62	-11.53	.20	-7.49	
5.8	-23.27	-12.32	-0.44	-8.15	
5.9	-23.88	-13.06	-1.03	-8.76	
6.0	-24.44	-13.73	-1.57	-9.32	
6.1	-24.95	-14.35	-2.06	-9.83	
6.2	-25.42	-14.93	-2.51	-10.29	
6.3	-25.86	-15.45	-2.92	-10.72	
6.4	-26.26	-15.94	-3.29	-11.11	
6.5	-26.62	-16.38	-3.63	-11.46	
6.6	-26.96	-16.79	-3.93	-11.78	
6.7	-27.26	-17.16	-4.21	-12.07	
6.8	-27.55	-17.50	-4.46	-12.34	
6.9	-27.80	-17.82	-4.68	-12.58	
7.0	-28.04	-18.11	-4.89	-12.80	
7.1	-28.25	-18.37	-5.07	-13.00	
7.2	-28.45	-18.61	-5.23	-13.17	
7.3	-28.63	-18.83	-5.37	-13.33	
7.4	-28.79	-19.03	-5.50	-13.47	
7.5	-28.94	-19.21	-5.61	-13.60	
7.6	-29.08	-19.37	-5.71	-13.71	
7.7	-29.20	-19.52	-5.80	-13.81	
7.8	-29.31	-19.65	-5.87	-13.90	
7.9	-29.41	-19.77	-5.93	-13.98	
8.0	-29.50	-19.88	-5.99	-14.04	
8.1	-29.58	-19.98	-6.03	-14.10	
8.2	-29.66	-20.07	-6.07	-14.15	
8.3	-29.72	-20.14	-6.09	-14.19	
8.4	-29.78	-20.21	-6.11	-14.22	
8.5	-29.83	-20.27	-6.13	-14.24	
8.6	-29.88	-20.32	-6.13	-14.26	
8.7	-29.92	-20.36	-6.13	-14.28	
8.8	-29.95	-20.40	-6.13	-14.28	
8.9	-29.98	-20.43	-6.12	-14.29	
9.0	-30.01	-20.45	-6.11	-14.29	
9.1	-30.03	-20.47	-6.09	-14.28	
9.2	-30.05	-20.49	-6.07	-14.27	
9.3	-30.06	-20.50	-6.05	-14.26	
9.4	-30.07	-20.50	-6.02	-14.24	
9.5	-30.08	-20.51	-5.99	-14.22	
9.6	-30.09	-20.50	-5.96	-14.20	
9.7	-30.09	-20.50	-5.93	-14.18	
9.8	-30.09	-20.49	-5.89	-14.15	
9.9	-30.09	-20.48	-5.85	-14.12	
10.0	-30.09	-20.47	-5.81	-14.09	

Figure 21. — Investment Analysis Program No. 6.

31/32/3300 FORTRAN (2.1)/MSOS 02/02/68

PROGRAM INVEST6	INV 10
C INVESTMENT ANALYSIS PROGRAM--DECEMBER 1967	INV 20
C	INV 30
C J. H. WIKSTROM	INV 40
C INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION	INV 50
C	INV 60
C THIS PROGRAM IS AN ADAPTATION OF CLARK ROWS INVEST PROGRAM	INV 70
C IT CAN BE USED WITH OR WITHOUT PRODUCT VALUES	INV 80
C IT HANDLES BOTH PERIODIC AND ANNUAL COSTS AND INCOMES	I INV 90
C EXTRA CONTROL CARDS ARE NEEDED FOR PRODUCT RETURNS	INV 100
C FINAL VALUE IS HANDLED AS A PERIODIC INCOME	INV 110
C	INV 120
C PROGRAM CONTAINS 3 OPTIONS---	INV 130
C GENERAL OPTION FOR INTERNAL RATE OF RETURN-PRESENT WORTH	INV 140
C OPTION FOR STAND REPLACEMENT PRIORITIES	INV 150
C OPTION TO EVALUATE TIMBER STAND IMPROVEMENT ALTERNATIVES	INV 160
C	INV 170
C RE-ROW--USFS RESEARCH PAPER 50-6	INV 180
C RE-MARTY, ETAL--USDA HANDBOOK 304	INV 190
C	INV 200
C	INV 210
DIMENSION AN(6,4),CAN(6,4),NC(6,100),PECO(6,100),N1(6,100),JLD1(6,	INV 220
150),JUAL1(6,50),N2(6,100),JLD2(6,50),JUAL2(6,50),N3(6,100),JLD3(6,	INV 230
250),JUAL3(6,50),PR(3,3),CPR(3,3),FVAL(6,1),RATE(100),RTLOG(100),	INV 240
3VALIN(6,100),FCROP(6,100),LY(6),KCX(6),K1X(6),K2X(6),K3X(6),NZ(6)	INV 250
DIMENSION NI(6,4),NT(6,4),A(12),LI(6),JX(6,10),RINT(3),NAME(20)	INV 260
DIMENSION IDEN(20)	INV 270
C	INV 280
C FORMATS USED	INV 290
C	INV 300
10 FORMAT (8A4)	INV 310
11 FORMAT(19H1NATIONAL FOREST ,8A4)	INV 320
12 FORMAT(8H0UNIT - ,8A4)	INV 330
13 FORMAT(13H0ATTENTION - ,8A4/1H-)	INV 340
14 FORMAT(1H0,38X,44HINVESTMENT ANALYSIS PROGRAM NO.6, INT. STA.,/)	INV 350
15 FORMAT(19A4,2X,12)	INV 360
16 FORMAT(15H0PROBLEM NO. ,19A4,4X,4HID= ,12,/1H-)	INV 370
17 FORMAT(20A4)	INV 380
18 FORMAT (1H04X,20A4)	INV 390
19 FORMAT(3F4.3, 12)	INV 400
20 FORMAT(1H0,44X,34HGENERAL EVALUATION OF ALTERNATIVES)	INV 410
21 FORMAT(1H0,40X,42HEVALUATION OF STAND REPLACEMENT PRIORITIES)	INV 420
22 FORMAT(1H0,38X,47HEVALUATION OF TIMBER STAND IMPROVEMENT PROGRAMS)	INV 430
23 FORMAT(1H0,16X,3(2X4HRINT),1X,3HJPR)	INV 440
24 FORMAT(17H0CONTROL CARD 6 ,3(F6.3),2X,12)	INV 450
25 FORMAT(37H0CONTROL CARDS FOR FUTURE STANDS*****)	INV 460
26 FORMAT(38H0CONTROL CARDS FOR FIRST TSI PLAN*****)	INV 470
27 FORMAT(7I2,6I3,24I2)	INV 480
28 FORMAT(1H016X,2HLX,6(2X,2HLI),6(3X,2HLY),2X,2HKX,1X,4HKCXX,6(1X,	INV 490
13HKCX))	INV 500
29 FORMAT(17HMCONTROL CARD 7 ,I2,6(2X,12),6(2X,13),2X,I2,3X,I2,6(2X,	INV 510
1I2))	INV 520
30 FORMAT(1H015X,3HJXX,6(2X,2HJX),1X,3HNZZ,6(2X,2HNZ),1X,3HIST,2X,	INV 530
12HMX)	INV 540
31 FORMAT(17HMCONTROL CARD 7 , I2,15(2X,I2))	INV 550
32 FORMAT(1H0,49X,24HROTATION LENGTH IN YEARS)	INV 560
33 FORMAT (8X,I3,5(17X,I3))	INV 570
34 FORMAT(27H0PERIODIC COSTS AND INCOMES,/2X,6(14HYEAR COST,6X))	INV 580
35 FORMAT(6(I3,F9.2))	INV 590
36 FORMAT (2X,6(14,1X,F9.2,6X))	INV 600
37 FORMAT(4(2I3,F8.2,F6.3))	INV 610
38 FORMAT(39H0ANNUAL COSTS AND RETURNS--ALT. OR PLAN,I4)	INV 620
39 FORMAT(10X,8H1ST YEAR,1XI3,2X,8HEND YEAR,1X,I3,2X,1H\$,F9.2,2X,6HCH	INV 630
1ANGE,F7.3)	INV 640
40 FORMAT(41H0NO ANNUAL COSTS OR RETURNS--ALT. OR PLAN,I4)	INV 650
41 FORMAT(2I2)	INV 660
42 FORMAT(1H017X,4HK1XX,6(2X,3HK1X))	INV 670
43 FORMAT(17HMCONTROL CARD 11 ,12(2X,I3))	INV 680

44	FORMAT(1H017X,4HK2XX,6(2X,3HK2X))	INV 690
45	FORMAT(1H017X,4HK3XX,6(2X,3HK3X))	INV 700
46	FORMAT(14A5)	INV 710
47	FORMAT(23H0PERIODIC RETURNS FROM ,4A5)	INV 720
48	FORMAT(1H0,2X,6(15HYEAR YIELD QUAL,5X))	INV 730
49	FORMAT (6(I3,I5,I4))	INV 740
50	FORMAT(I7,I6,I5,5(I9,I6,I5))	INV 750
51	FORMAT(16H0 PRODUCT PRICES)	INV 760
52	FORMAT(14X,12HPRODUCT NO.1,14X,12HPRODUCT NO.2,14X12HPRODUCT NO.3,	INV 770
	1/)	INV 780
53	FORMAT(6(F9.3))	INV 790
54	FORMAT(1H0(8X,1H\$,F9.3,2X,2HCH,F7.3))	INV 800
55	FORMAT(1H07X,6(9X,9HALT-PLAN ,I2))	INV 810
58	FORMAT(1H036HDISCOUNTED NET WORTH OF FUTURE CROPS)	INV 820
59	FORMAT(1H139HCONTROL CARDS 7+ FOR PRESENT STAND*****)	INV 830
60	FORMAT(1H048HDISCOUNTED NET WORTH OF PRESENT AND FUTURE CROPS)	INV 840
65	FORMAT(1H1,12HPROBLEM NO. ,19A4,/))	INV 850
66	FORMAT (1H0,37HINTERNAL RATE OF RETURN FOR SCHEDULE ,A4,12H IS BET	INV 860
	1WEEN ,F5.1,5H AND ,F5.1/1H ,23HWITH PRESENT WORTHS OF ,F6.2,5H AND	INV 870
	2 ,F6.2,15H RESPECTIVELY.)	INV 880
67	FORMAT(1H0,37HINTERNAL RATE OF RETURN FOR SCHEDULE ,A4,32H IS NOT	INV 890
	1INCLUDED IN THE PROBLEM.)	INV 900
68	FORMAT(1H0,37HINTERNAL RATE OF RETURN FOR SCHEDULE ,A4,4H IS ,F7.	INV 910
	11/)	INV 920
69	FORMAT(1H02X,67HPRESENT DISCOUNTED NET WORTH AT GIVEN ALTERNATIVE	INV 930
	1RATES OF INTEREST)	INV 940
70	FORMAT (8H0 RATE,6(6X,10H(ROTATION ,I3,1H))/)	INV 950
72	FORMAT (1H ,F7.1,6F20.2)	INV 960
75	FORMAT(1H036HDISCOUNTED NET WORTH--FIRST TSI PLAN)	INV 970
76	FORMAT(1H141HCONTROL CARDS 7+ FOR SECOND TSI PLAN*****)	INV 980
77	FORMAT(1H037HDISCOUNTED NET WORTH--SECOND TSI PLAN)	INV 990
78	FORMAT(1H044HDISCOUNTED NET WORTH OF ADDED TSI INVESTMENT)	INV1000
99	FORMAT(23H0 ERROR IN INPUT CARDS)	INV1010
610	FORMAT(1H1)	INV1020
C		INV1030
C		INV1040
C		INV1050
C	READ NAME OF NATIONAL FOREST OR ORGANIZATION	INV1060
	1 READ (60,10)(NAME(I),I=1,8)	INV1070
	WRITE (61,11)(NAME(I),I=1,8)	INV1080
C		INV1090
C	READ NAME OF UNIT	INV1100
	READ(60,10)(NAME(I),I=1,8)	INV1110
	WRITE(61,12)(NAME(I),I=1,8)	INV1120
C		INV1130
C	READ NAME OF USER	INV1140
	READ (60,10)(NAME(I),I=1,8)	INV1150
	WRITE (61,13)(NAME(I),I=1,8)	INV1160
	WRITE (61,14)	INV1170
C		INV1180
C	READ CARD 4, PROBLEM TITLE	INV1190
	100 READ (60,15)(NAME(I),I=1,19),ID	INV1200
	GO TO (910,105)EOFCKF(60)	INV1210
	105 IF (NAME(1).EQ.4HNEW)1,106	INV1220
	106 WRITE(61,16)(NAME(I),I=1,19),ID	INV1230
C		INV1240
C	READ CARD 5, PROBLEM DESCRIPTION CARDS	INV1250
	IF(ID.GT.0)107,110	INV1260
	107 DO 109 J=1,ID	INV1270
	READ(60,17)(IDEN(I),I=1,20)	INV1280
	109 WRITE(61,18)(IDEN(I),I=1,20)	INV1290
C		INV1300
C	CONTROL CARD 6, INTEREST RATES AND PROGRAM OPTION	INV1310
	110 READ(60,19)(RINT(I),I=1,3),JPR	INV1320
	IF (JPR-2)111,112,113	INV1330
	111 WRITE(61,20)	INV1340
	GO TO 114	INV1350
	112 WRITE(61,21)	INV1360
	GO TO 114	INV1370
	113 WRITE(61,22)	INV1380
	114 WRITE(61,23)	INV1390
	WRITE(61,24)(RINT(I),I=1,3),JPR	INV1400

C		INV1410
C	READ CARD 7, GENERAL CONTROL CARD	INV1420
	IF (JPR-2) 1000, 115, 116	INV1430
115	WRITE (61, 25)	INV1440
	GO TO 1000	INV1450
116	WRITE (61, 26)	INV1460
1000	READ (60, 27) LX, (LI(L), L=1, 6), (LY(L), L=1, 6), KX, KCXX, (KCX(L), L=1, 6)	INV1470
	1), JXX, (JX(L), L=1, 6), NZZ, (NZ(L), L=1, 6), IST, MX	INV1480
	WRITE (61, 28)	INV1490
	WRITE (61, 29) LX, (LI(L), L=1, 6), (LY(L), L=1, 6), KX, KCXX, (KCX(L), L=1, 6)	INV1500
	WRITE (61, 30)	INV1510
	WRITE (61, 31) JXX, (JX(L), L=1, 6), NZZ, (NZ(L), L=1, 6), IST, MX	INV1520
	WRITE (61, 32)	INV1530
	WRITE (61, 33) (LI(L), L=1, LX)	INV1540
	WRITE (61, 33) (LY(L), L=1, LX)	INV1550
	IF (KCXX) 135, 135, 120	INV1560
120	WRITE (61, 34)	INV1570
C		INV1580
C	READ CARD 8, PERIODIC COSTS AND INCOMES	INV1590
	DO 130 KC=1, KCXX	INV1600
	READ (60, 35) (NC(L, KC), PECO(L, KC), L=1, 6)	INV1610
130	WRITE (61, 36) (NC(L, KC), PECO(L, KC), L=1, LX)	INV1620
C		INV1630
C	READ CARD 9, ANNUAL COSTS AND INCOMES	INV1640
135	IF (JXX) 140, 140, 136	INV1650
136	DO 140 L=1, LX	INV1660
	IF (JX(L)) 138, 138, 137	INV1670
137	JXL=JX(L)	INV1680
	LIL=LI(L)	INV1690
	READ (60, 37) (NI(L, I2), NT(L, I2), AN(L, I2), CAN(L, I2), I2=1, JXL)	INV1700
	WRITE (61, 38) LIL	INV1710
	WRITE (61, 39) (NI(L, I2), NT(L, I2), AN(L, I2), CAN(L, I2), I2=1, JXL)	INV1720
	GO TO 140	INV1730
138	WRITE (61, 40) LIL	INV1740
140	CONTINUE	INV1750
C		INV1760
C	READ CARD 10, PRODUCT EVALUATION CONTROL CARD	INV1770
	IF (KX) 200, 200, 150	INV1780
150	READ (60, 41) K1XX, (K1X(L), L=1, 6), K2XX, (K2X(L), L=1, 6), K3XX, (K3X(L), L=1, 6)	INV1790
	WRITE (61, 42)	INV1800
	WRITE (61, 43) K1XX, (K1X(L), L=1, 6)	INV1810
	WRITE (61, 44)	INV1820
	WRITE (61, 43) K2XX, (K2X(L), L=1, 6)	INV1830
	WRITE (61, 45)	INV1840
	WRITE (61, 43) K3XX, (K3X(L), L=1, 6)	INV1850
C		INV1860
C	READ CARD 11, PRODUCT NAMES	INV1870
	READ (60, 46) (A(1), I=1, 12)	INV1880
	IF (K1XX) 170, 170, 162	INV1890
162	WRITE (61, 47) (A(1), I=1, 4)	INV1900
	WRITE (61, 48)	INV1910
C		INV1920
C	READ CARD 12, PRODUCT 1 RETURNS	INV1930
	DO 165 K1=1, K1XX	INV1940
	READ (60, 49) (N1(L, K1), JLD1(L, K1), JUAL1(L, K1), L=1, 6)	INV1950
165	WRITE (61, 50) (N1(L, K1), JLD1(L, K1), JUAL1(L, K1), L=1, LX)	INV1960
170	IF (K2XX) 180, 180, 172	INV1970
172	WRITE (61, 47) (A(1), I=5, 8)	INV1980
	WRITE (61, 48)	INV1990
C		INV2000
C	READ CARD 12, PRODUCT 2 RETURNS	INV2010
	DO 175 K2=1, K2XX	INV2020
	READ (60, 49) (N2(L, K2), JLD2(L, K2), JUAL2(L, K2), L=1, 6)	INV2030
175	WRITE (61, 50) (N2(L, K2), JLD2(L, K2), JUAL2(L, K2), L=1, LX)	INV2040
180	IF (K3XX) 190, 190, 182	INV2050
182	WRITE (61, 47) (A(1), I=9, 12)	INV2060
	WRITE (61, 48)	INV2070
C		INV2080
C	READ CARD 12, PRODUCT 3 RETURNS	INV2090
	DO 185 K3=1, K3XX	INV2100
	READ (60, 49) (N3(L, K3), JLD3(L, K3), JUAL3(L, K3), L=1, 6)	INV2110
185	WRITE (61, 50) (N3(L, K3), JLD3(L, K3), JUAL3(L, K3), L=1, LX)	INV2120
		INV2130

190 CONTINUE	INV2140
C	INV2150
C READ CARD 13, PRODUCT PRICES	INV2160
WRITE(61,51)	INV2170
WRITE(61,52)	INV2180
DO 197 M=1,MX	INV2190
READ(60,53) (PR(K,M),CPR(K,M),K=1,KX)	INV2200
WRITE(61,54) (PR(K,M),CPR(K,M),K=1,KX)	INV2210
197 CONTINUE	INV2220
200 CONTINUE	INV2230
C	INV2240
C BEGIN PROCESSING DATA.	INV2250
C	INV2260
RATE(1)=RINT(1)	INV2270
DO 210 I=2,100	INV2280
IF (RATE(I-1)-RINT(3)) 202,203,203	INV2290
202 RATE(I)=RATE(I-1)+RINT(2)	INV2300
GO TO 210	INV2310
203 LENGTH=I-1	INV2320
IF (LENGTH-(LENGTH/2)*2) 204,205,204	INV2330
204 LLNGTH=(LENGTH+1)/2	INV2340
GO TO 215	INV2350
205 LLNGTH=LENGTH/2	INV2360
GO TO 215	INV2370
210 CONTINUE	INV2380
215 DO 216 I=1,LENGTH	INV2390
216 RTLOG(I)=1.+RATE(I)	INV2400
C	INV2410
C DO COMPUTATIONS	INV2420
C	INV2430
IF (KX) 218,218,217	INV2440
217 DO 600 M=1,MX	INV2450
218 DO 300 L=1,LX	INV2460
DO 300 I=1,LENGTH	INV2470
KCXA=KCX(L)	INV2480
K1XA=K1X(L)	INV2490
K2XA=K2X(L)	INV2500
K3XA=K3X(L)	INV2510
DAN=DCAN=0.0	INV2520
DKC= 0.0	INV2530
DK1=DK2=DK3=0.0	INV2540
RTLOI=RTLOG(I)	INV2550
LYL= LY(L)	INV2560
DISCO=RTLOI**LYL	INV2570
C	INV2580
C COMPUTE DISCOUNTED PERIODIC COSTS AND INCOMES	INV2590
C	INV2600
IF (KCXX) 226,226,220	INV2610
220 IF (KCXA) 226,226,221	INV2620
221 DO 225 KC=1,KCXA	INV2630
KXLY=NC(L,KC)	INV2640
DISC=RTLOI ** KXLY	INV2650
225 DKC=DKC+PECO(L,KC)/DISC	INV2660
C	INV2670
C COMPUTE DISCOUNTED ANNUAL COSTS AND INCOMES	INV2680
C	INV2690
226 IF (JXX) 240,240,230	INV2700
230 IF (JX(L)) 240,240,231	INV2710
231 JXL=JX(L)	INV2720
DO 240 I2=1,JXL	INV2730
NLT=(NT(L,I2)-NI(L,I2))	INV2740
NIL= NI(L,I2)	INV2750
IF (AN(L,I2)) 232,240,232	INV2760
232 SISCO= RTLOI**NLT	INV2770
FISCO= RTLOI**NIL	INV2780
BBN=(AN(L,I2)*(SISCO-1.))/(RATE(I)*SISCO)	INV2790
IF (NIL.GT.0) 233,234	INV2800
233 BAN=(BBN/(RATE(I)*FISCO))	INV2810
GO TO 235	INV2820
234 BAN= BBN	INV2830
235 DAN= DAN + BAN	INV2840
IF (CAN(L,I2)) 236,240,236	INV2850
236 CCAN=(CAN(L,I2)*AN(L,I2)*(SISCO-NLT * RATE(I)-1.))/(RATE(I)**2*SISCO	INV2860

1)	IF (NIL.GT.0) 237,238	INV2870
237	BCAN=(CCAN/(RATE(I)*FISCO))	INV2880
	GO TO 239	INV2890
238	BCAN= CCAN	INV2900
239	DCAN= DCAN + BCAN	INV2910
240	CONTINUE	INV2920
C		INV2930
C	COMPUTE DISCOUNTED PRODUCT VALUES	INV2940
C		INV2950
	IF (KX) 280,280,250	INV2960
250	IF (K1XA) 260,260,251	INV2970
251	DO 255 K1=1,K1XA	INV2980
	KXLY=N1(L,K1)	INV2990
	QUAL1=JUAL1(L,K1) * .01	INV3000
	DISC=RTLOI ** KXLY	INV3010
	YLD1=JLD1(L,K1) * .1	INV3020
255	DK1=DK1+(YLD1*PR(1,M)*QUAL1*(1.+CPR(1,M)*N1(L,K1))/DISC)	INV3030
260	IF (K2XA) 270,270,261	INV3040
261	DO 265 K2=1,K2XA	INV3050
	KXLY=N2(L,K2)	INV3060
	DISC=RTLOI ** KXLY	INV3070
	QUAL2=JUAL2(L,K2) * .01	INV3080
	YLD2=JLD2(L,K2) * .1	INV3090
265	DK2=DK2+(YLD2*PR(2,M)*QUAL2*(1.+CPR(2,M)*N2(L,K2))/DISC)	INV3100
270	IF (K3XA) 280,280,271	INV3110
271	DO 275 K3=1,K3XA	INV3120
	KXLY=N3(L,K3)	INV3130
	DISC=RTLOI ** KXLY	INV3140
	QUAL3=JUAL3(L,K3) * .01	INV3150
	YLD3=JLD3(L,K3) * .1	INV3160
275	DK3=DK3+(YLD3*PR(3,M)*QUAL3*(1.+CPR(3,M)*N3(L,K3))/DISC)	INV3170
C		INV3180
C	SUMMARIZE (FILL VALIN ARRAY)	INV3190
C		INV3200
280	IF (NZZ) 295,295,290	INV3210
290	IF (NZ(L)) 295,295,292	INV3220
292	TDVAL=DK1+DK2+DK3+ DAN+ DCAN+ DKC	INV3230
	VALIN(I,I)=IDVAL	INV3240
	GO TO 300	INV3250
295	TDVAL=DK1+DK2+DK3+ DAN+ DCAN+ DKC	INV3260
	VALIN(L,I)=TDVAL*(1.+ 1. /(DISCO-1.))	INV3270
300	CONTINUE	INV3280
C		INV3290
	IF (JPR-2) 303,302,301	INV3300
301	GO TO 400	INV3310
302	GO TO 350	INV3320
303	CONTINUE	INV3330
C		INV3340
C	COMPLETE OUTPUT FOR GENERAL OPTION	INV3350
C		INV3360
	WRITE(61,65) (NAME(I),I=1,19)	INV3370
	DO 304 I=1,LENGTH	INV3380
	RATE (I)= RATE(I)*100.0	INV3390
304	CONTINUE	INV3400
	DO 320 L=1,LX	INV3410
	DO 310 I=1,LENGTH	INV3420
	IF (VALIN(L,I).GT.0.0) 310,305	INV3430
305	IF (VALIN(L,I).EQ.0.0) 308,306	INV3440
306	IF (I.EQ.1) 311,307	INV3450
307	WRITE(61,66) LI(L),RATE(I-1),RATE(I),VALIN(L,I-1),VALIN(L,I)	INV3460
	GO TO 320	INV3470
308	WRITE(61,68) LI(L),RATE(I)	INV3480
	GO TO 320	INV3490
310	CONTINUE	INV3500
311	WRITE(61,67) LI(L)	INV3510
320	CONTINUE	INV3520
	WRITE(61,69)	INV3530
	WRITE(61,55) (LI(L),L=1,6)	INV3540
	WRITE(61,70) (LY(L),L=1,6)	INV3550
	DO 321 I=1,LENGTH	INV3560
	WRITE(61,72) RATE(I), (VALIN(L,I),L=1,LX)	INV3570
321	CONTINUE	INV3580
		INV3590

DO 325 I=1,LENGTH	INV3600
RATE (I)=RATE(I)/100.0	INV3610
325 CONTINUE	INV3620
GO TO 600	INV3630
C	INV3640
C CONTINUE WITH PROGRAM OPTION 2	INV3650
C	INV3660
350 IF (IST.EQ.1) 351,360	INV3670
351 DO 355 L=1,LX	INV3680
DO 355 I=1,LENGTH	INV3690
355 FCROP(L,I)=VALIN(L,I)	INV3700
VALIN(L,I)=0.0	INV3710
WRITE(61,65) (NAME(I),I=1,19)	INV3720
WRITE(61,58)	INV3730
DO 356 I=1,LENGTH	INV3740
356 RATE (I)=RATE(I)*100.0	INV3750
WRITE(61,55) (LI(L),L=1,6)	INV3760
WRITE(61,70) (LY(L),L=1,6)	INV3770
DO 357 I=1,LENGTH	INV3780
WRITE (61,72) RATE(I), (FCROP(L,I),L=1,LX)	INV3790
357 CONTINUE	INV3800
DO 358 I=1,LENGTH	INV3810
RATE (I)= RATE(I)/100.0	INV3820
358 CONTINUE	INV3830
WRITE(61,59)	INV3840
GO TO 1000	INV3850
360 DO 361 L=1,LX	INV3860
DO 361 I=1,LENGTH	INV3870
LYL=LY(L)	INV3880
DISCO=RTLOG(I)*LYL	INV3890
VALIN(L,I)=VALIN(L,I)+(FCROP(L,I) /DISCO)	INV3900
361 CONTINUE	INV3910
WRITE(61,65) (NAME(I),I=1,19)	INV3920
WRITE(61,60)	INV3930
DO 362 I=1,LENGTH	INV3940
RATE (I)=RATE (I)*100	INV3950
362 CONTINUE	INV3960
WRITE(61,55) (LI(L),L=1,6)	INV3970
WRITE(61,70) (LY(L),L=1,6)	INV3980
DO 363 I=1,LENGTH	INV3990
WRITE(61,72) RATE(I), (VALIN(L,I),L=1,LX)	INV4000
363 CONTINUE	INV4010
GO TO 600	INV4020
400 CONTINUE	INV4030
C	INV4040
C CONTINUE WITH PROGRAM OPTION 3	INV4050
C	INV4060
IF (IST.EQ.1) 401,410	INV4070
401 DO 402 L=1,LX	INV4080
DO 402 I=1,LENGTH	INV4090
402 FCROP(L,I)=VALIN(L,I)	INV4100
VALIN(L,I)=0.0	INV4110
WRITE(61,65) (NAME(I),I=1,19)	INV4120
WRITE(61,75)	INV4130
DO 403 I=1,LENGTH	INV4140
403 RATE(I)=RATE(I)*100.0	INV4150
WRITE(61,55) (LI(L),L=1,6)	INV4160
WRITE(61,70) (LY(L),L=1,6)	INV4170
DO 404 I=1,LENGTH	INV4180
WRITE(61,72) RATE(I), (FCROP(L,I),L=1,LX)	INV4190
404 CONTINUE	INV4200
DO 405 I=1,LENGTH	INV4210
RATE(I)=RATE(I)/100.0	INV4220
405 CONTINUE	INV4230
WRITE(61,76)	INV4240
GO TO 1000	INV4250
410 CONTINUE	INV4260
WRITE(61,65) (NAME(I),I=1,19)	INV4270
WRITE(61,77)	INV4280
DO 411 I=1,LENGTH	INV4290
411 RATE(I)=RATE(I)*100.0	INV4300
WRITE(61,55) (LI(L),L=1,6)	INV4310
WRITE(61,70) (LY(L),L=1,6)	INV4320

DO 412 I=1,LENGTH	INV4330
WRITE(61,72) RATE(I),(VALIN(L,I),L=1,LX)	INV4340
412 CONTINUE	INV4350
WRITE(61,65) (NAME(I),I=1,19)	INV4360
WRITE(61,78)	INV4370
DO 413 L=1,LX	INV4380
DO 413 I=1,LENGTH	INV4390
413 VALIN(L,I)=VALIN(L,I)-FCROP(L,I)	INV4400
WRITE(61,55) (LI(L),L=1,6)	INV4410
WRITE(61,70) (LY(L),L=1,6)	INV4420
DO 415 I=1,LENGTH	INV4430
WRITE(61,72) RATE(I),(VALIN(L,I),L=1,LX)	INV4440
415 CONTINUE	INV4450
GO TO 600	INV4460
600 CONTINUE	INV4470
VALIN(L,I)=0.0 \$FCROP(L,I)=0.0	INV4480
WRITE(61,610)	INV4490
C READ CARD 12,END OF PROBLEM	INV4500
READ(60,27)IEND	INV4510
IF (IEND-98)900,100,910	INV4520
900 WRITE(61,99)	INV4530
910 STOP	INV4540
END	INV4550

3200 FORTRAN DIAGNOSTIC RESULTS - FOR INVEST6

Wikstrom, J. H., and Jack R. Alley.

1968. Ranking treatment opportunities in existing timber stands on white pine land in the Northern Region. U.S. Forest Serv., Intermountain Forest and Range Exp. Sta., Ogden, Utah. 75 pp., illus. (U.S. Forest Serv. Res. Pap. INT-46)

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The considerations in such an evaluation are discussed in relation to management of white pine land, and sample problems are presented. An EDP investment analysis program containing options usable in ranking stand replacement and timber stand improvement priorities is given, along with instructions for use.

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Headquarters for the Intermountain Forest and Range Experiment Station are in Ogden, Utah. Project headquarters are also at:

Boise, Idaho

Bozeman, Montana (in cooperation with Montana State University)

Logan, Utah (in cooperation with Utah State University)

Missoula, Montana (in cooperation with University of Montana)

Moscow, Idaho (in cooperation with the University of Idaho)

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The Forest Service of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's Forest Resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.