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The Woodland Workbook

Business Management

Forestry Financial Analysis II: Worksheets for How-to-Do-It

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Contents

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In this publication, you will find an explanation of the financial analysis of forestry investments. You will learn the basic principles of financial analysis, and you will be introduced to a series of worksheets for doing your own analysis. The related EC 1148, *Forestry Financial Analysis III: How To Compare Two (or More) Investments*, shows how you can use the worksheets to compare two competing forestry investments.

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What is a financial analysis?

Financial analysis, a method for evaluating the profitability of investments, is an important tool for landowners. As you will see, the analysis itself is an organized procedure for calculating various financial measures of investment worth. Any financial analysis involves the following steps:

1. Describing an investment's activities and the resource inputs and outputs
2. Assigning dollar values to the inputs and outputs

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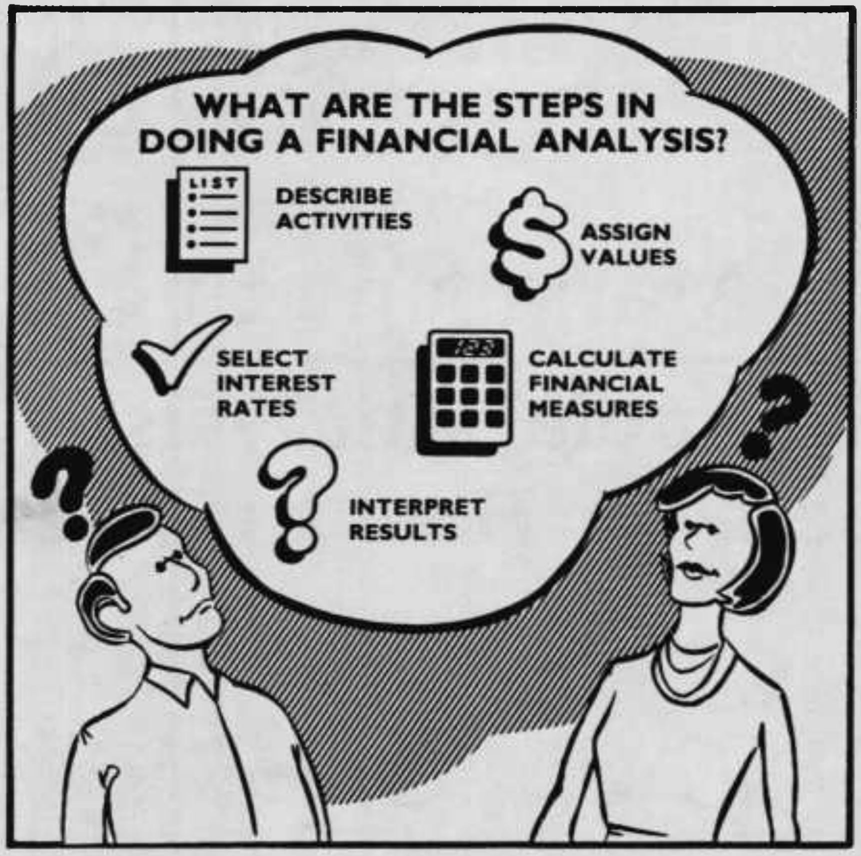

3. Selecting an appropriate rate of interest
4. Calculating the financial performance measure(s)
5. Interpreting the results

In the following pages, we discuss each of these steps, explaining the procedure and how to use it to compute the worth of an investment. Financial analyses can be done on either a before-tax or after-tax basis. It is easier to learn the basic analysis procedure before introducing the complicating aspect of taxes. The worksheets and procedures presented here, however, are flexible and permit either approach.

Describing and valuing activities

The first step in any financial analysis is to describe what the investment's activities are and when they occur. The most useful description will include specifically what physical and financial resources are needed as inputs to the investment *and* what outputs the investment can be expected to produce.

After listing the activities, inputs, and outputs and when they occur, the second step is to assign them dollar values. Estimate the costs of inputs. Also list incomes you anticipate from outputs.

You can list costs and incomes either in terms of your entire property or on a per-acre basis. For example, you may own 25 acres, but you want to investigate planting only a 5-acre portion; you estimate that the total cost will be $1,500. From the "entire property" perspective, the cost is $1,500; from a "per-acre" perspective, it is $300 per acre.

Using the per-acre approach simplifies the analysis and makes it easier to directly compare analyses of separate competing investments. We will use the per-acre approach for all of the examples in this publication.

Interest rate

Next, you must select an interest rate for evaluating the proposed investment. A common approach is to select a rate equal to the rate of return available from your best alternative use for money (the alternative rate of return). If your best alternative is a passbook savings account yielding 7%, use 7% to evaluate the proposed investment.

Similarly, if you could invest in another project expecting a 15% return, use 15% to evaluate the proposed investment. Because situations and investment objectives differ among individuals, there is no *one* correct interest rate to use.

In fact, people frequently complete several analyses at different rates to allow for conditions that may change *during* the life of the investment. You will be shown here how to do an analysis at a 7% rate. To recalculate the same analysis, simply repeat the same procedure with a different rate.

Performance measures

The next step is to select financial performance measures for evaluating the profitability of an investment. Here we use two measures, the net future value (NFV) and the rate of return (ROR).

The NFV is the actual amount of money left at the end of an investment after you subtract all future costs from future incomes. NFVs can be positive, negative, or zero depending on whether future costs are less than, greater than, or equal to future incomes.

The ROR is a ratio of an investment's costs and incomes expressed as a percentage. It reflects the *rate* of return per dollar invested.

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Interpreting results

The final and most important step in the basic analysis is interpretation of the results: "What do these numbers mean?"

Answering this question helps you to decide whether any single investment opportunity represents a prudent use of money (and effort, if you invest your own time as well).

To answer the question, recognize that NFV represents the money left at the end of the investment after you subtract all compounded costs from compounded incomes. You should see an investment with a positive NFV as a *candidate* for acceptance, the "positive" indicating an investment that promises to increase in value at a rate greater than the interest rate used in the worksheet calculations. The ROR shows what this earning rate would be.

A negative NFV indicates an investment that will not perform as well as your best alternative—that is, it increases in value at a rate less than the interest rate and, hence, is not attractive from a purely financial viewpoint. (It may have other nonfinancial, yet desirable aspects.)

Finally, when compounded costs just equal compounded incomes, NFV equals zero, and the proposed investment just breaks even at the interest rate used in the analysis. In other words, it is no more and no less profitable than your best alternative.

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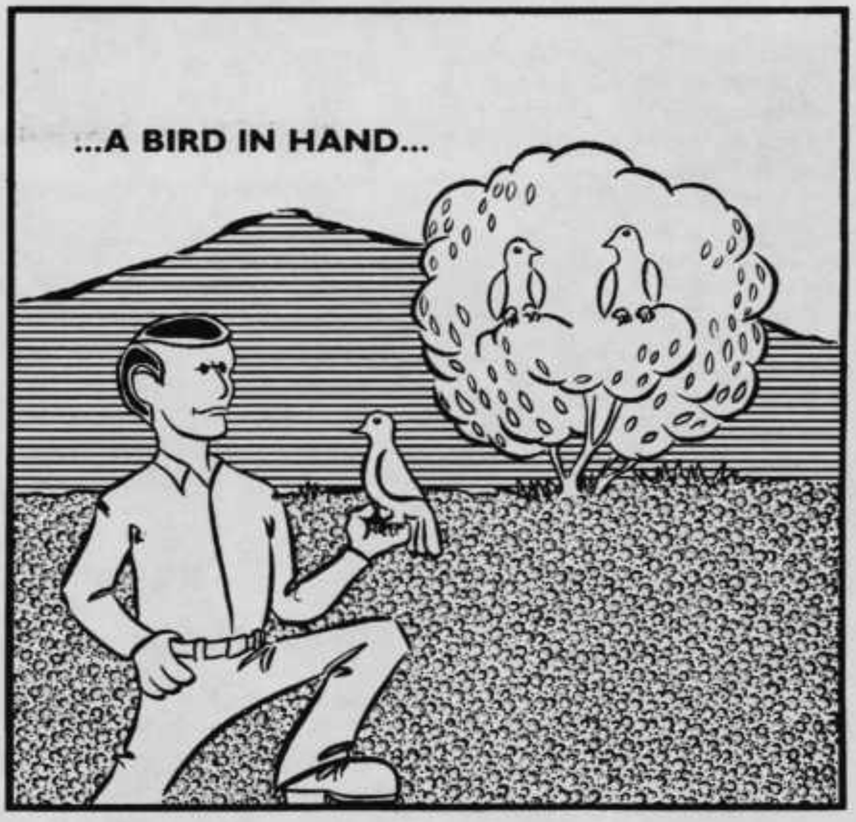
Are there other issues to consider?

Time value of money

Both NFV and ROR incorporate the concept of the time value of money, the notion that a "bird in the hand is worth two in the bush." A dollar received today is more useful than the *promise* of a dollar 5 years from now—you can actually spend, save, or otherwise *use* money available today.



Financial analysis will help you decide if $100 today is worth more than $150 promised 2 years from now. A short example illustrates how to make this decision.

You can arrive at the decision by either of two approaches. Each illustrates the two most basic types of financial calculations, compounding and discounting.

The first way to determine whether $100 today is worth more or less than $150 in 2 years is to choose an interest rate and compound the $100 for 2 years and then compare that end result with $150.

Let's assume you could invest the $100 somewhere at 9% annual interest. At the end of the second year, this would be the result:

Year 1 earnings = 9% x initial investment
= 9% x $100
= $9

If you reinvest the $9 earnings, the principal now becomes $109 and forms the new principal for calculating the second year's earnings.

Year 2 earnings = 9% x new principal
= 9% x $109
= $10

The principal available, then, at the end of the second year is $119 ($109 + $10). The process of multiplying each year's principal by the interest rate and adding the earnings to the original principal is called *compounding*. Compounding finds the *future value* of an amount when it is carried forward at a specific interest rate.

Comparing the new principal after 2 years ($119) with the $150, you can see that at 9% interest, you would be better off to wait for the $150.

The second approach to the decision is by *discounting*. This is a way of determining today's value (*present value*) of a future amount. If you were promised $119 at the end of 2 years, obviously you must wait to get it. You might, however, be willing to settle for less now just to have some money in hand. Exactly how much you would be satisfied with depends on your "time preference," which is indicated by your choice of an interest rate.

If you discount the $119 promised in 2 years at a 9% interest rate, it will be equivalent to $100. Thus, *at 9%*, you would be no better off with $119 in 2 years than with $100 now.

Interest tables

You can do all of the compounding and discounting calculations required for a basic analysis with the interest tables included in the Appendix. An inexpensive calculator that will add, subtract, multiply, and divide is helpful but not required.

To use the tables, simply read across the "Years" row to the applicable "Interest Rate" column to find the appropriate compounding or discounting factor.

For the example used here, the interest factor of 1.19, found in Appendix Table 1 (Figure 1), then is multiplied by the $100 principal to find the *compounded* value at the end of the second year, $119.

Discounting to find the *present value* is similar, except that you multiply by a discounting factor from Appendix Table 3. In our example, multiply $119 by the discounting factor, 0.84, to find its equivalent present amount, $100.

Woodland operations generally involve two basic types of costs and incomes, those that occur only once and those that recur annually. You must use different interest tables for yearly items than for one-time amounts.

Use Appendix Tables 2 and 4, respectively, to compound and discount yearly amounts. Use their multipliers in the same manner as those from the one-time Tables 1 and 3.

For example, the future value of a $10 *annual* payment compounded yearly at 9% for 5 years is $60, $10 Ñ 5.98 (Figure 2).

These Appendix interest tables were generated specifically for this publication with a computer program developed by Norman E. Elwood, Extension forestry management specialist, Oregon State University, Corvallis, OR 97331. Since it is impossible to provide interest tables that meet *every* situation, you may find the following publication useful:

Rosen, Lawrence, *The Dow Jones-Erwin Guide to Interest: What You Should Know About the Time Value of Money* (Homewood, IL, 1981: Dow Jones-Irwin).

RATE OF INTEREST

YEARS	3%	5%	7%	9%	11%	13%
1	1.03	1.05	1.07	1.09	1.11	1.13
2	1.06	1.10	1.14	1.19	1.23	1.28
3	1.09	1.16	1.23	1.30	1.37	1.44
4	1.13	1.22	1.31	1.41	1.52	1.63
5	1.16	1.28	1.40	1.54	1.69	1.84

Figure 1.—*Excerpt from Appendix Table 1.*

RATE OF INTEREST

YEARS	3%	5%	7%	9%	11%	13%
1	1.00	1.00	1.00	1.00	1.00	1.00
2	2.03	2.05	2.07	2.09	2.11	2.13
3	3.09	3.15	3.21	3.28	3.34	3.41
4	4.18	4.31	4.44	4.57	4.71	4.85
5	5.31	5.53	5.75	5.98	6.23	6.48

Figure 2.—*Excerpt from Appendix Table 2.*

Timing of costs and incomes

Financial analysis uses some standard procedures for designating the timing of costs and incomes and for compounding and discounting them. A simple example will help explain these procedures and will illustrate how financial accounting will be done in all examples in this publication.

Assume a 4-year investment project with four costs and four incomes. Costs occur at the *beginning* of the year in which the expenditure is made. Incomes occur at the *end* of the year in which the income is received. The investment is diagrammed on a time line (Figure 3).

Time zero (0) always should be thought of as the *beginning* of the project's first year. Time 1 then would refer to the *end* of the project's first year and the beginning of its second year. The diagram shows this configuration with the first year's cost (C_1) occurring at time 0 and the first year's income (I_1) occurring at Time 1.

The pattern continues for the entire investment. Note that no cost is shown at Time 4 since the investment is assumed to end after 4 years.

When using the above system, determining the number of years to compound and discount is easy. Simply use the following methods.

Compounding: Costs and incomes

The number of years to compound equals the investment length minus time of occurrence. Determine the number of years to compound each cost and income to the end of this investment as follows:

Costs	Investment length		Time		Years to compound
C_1	4	-	0	=	4
C_2	4	-	1	=	3
C_3	4	-	2	=	2
C_4	4	-	3	=	1
Returns					
I_1	4	-	1	=	3
I_2	4	-	2	=	2
I_3	4	-	3	=	1
I_4	4	-	4	=	0

Discounting: Costs and incomes

The number of years to discount equals the time of occurrence. Determine the number of years to discount each cost and income to the beginning of this investment as follows:

Costs	Time = Years to discount	Incomes		Time = Years to discount
C_1	0	I_1	=	1
C_2	1	I_2	=	2
C_3	2	I_3	=	3
C_4	3	I_4	=	4

Cash flows

When doing a financial analysis, it frequently is necessary to compound and discount costs and incomes separately. More common, however, is the treatment of *net cash flows* (for example, income minus cost at a given point in time).

The same compounding and discounting rules apply for net cash flows as for individual costs and incomes shown above. When we insert dollar amounts into the 4-year example, the process is apparent (see the following tabulation and Figure 4).

Time	Cost ($)	Income ($)	Net cash flow ($)	Number of years for: Compounding[a]	Number of years for: Discounting[b]
0	(100)		(100)	4	0
1	(10)	+100	+90	3	1
2	(20)	+150	+130	2	2
3	(15)	+200	+185	1	3
4		+300	+300	0	4

[a]Number of years equals investment length (in years) minus time at which activity occurs.

[b]Number of years equals time at which activity occurs.

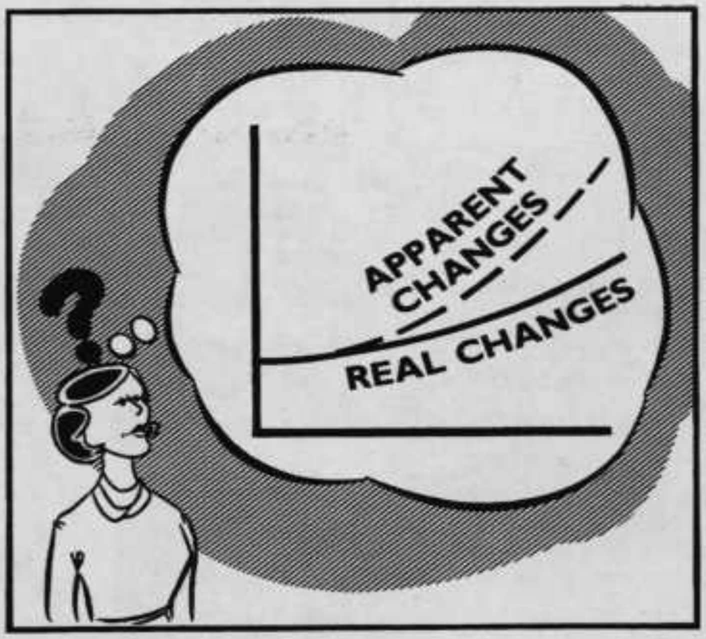
Cost and price stability

Finally, before doing any analysis, you should consider cost and price stability over time. Across the range of possibilities, input costs and output prices can increase, decrease, or remain constant in response to various causes.

Although these influences and their interactions are numerous and complex, for simplicity we distinguish two types: *real*, which arise from basic changes in product demand and supply conditions, and *apparent*, brought about by monetary supply problems that result in inflation or deflation.

Input costs and output prices, under the influence of these two types of factors, may change independently of each other and at different rates. There are, then, nine possible combinations of cost and price changes (Figure 5).

You must decide which combination(s) to examine. Experienced analysts frequently examine several situations to see the effects of different assumptions.



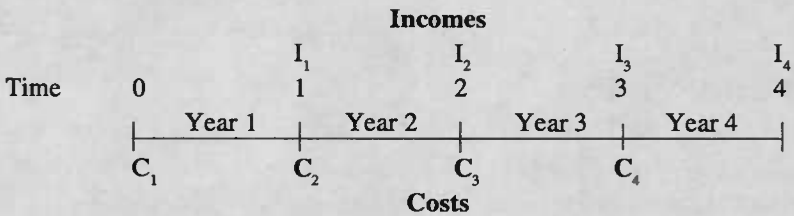


Figure 3.—*Timing of costs and returns for a hypothetical 4-year investment.*

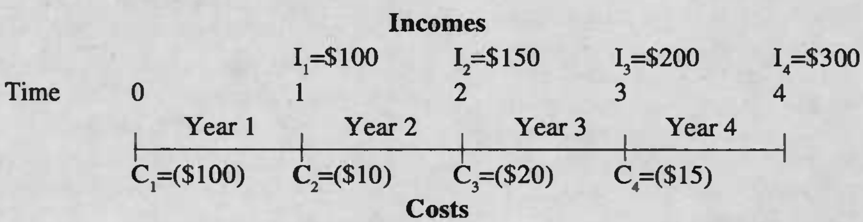


Figure 4.—*Determination and timing of net cash flow for a hypothetical 4-year investment.*

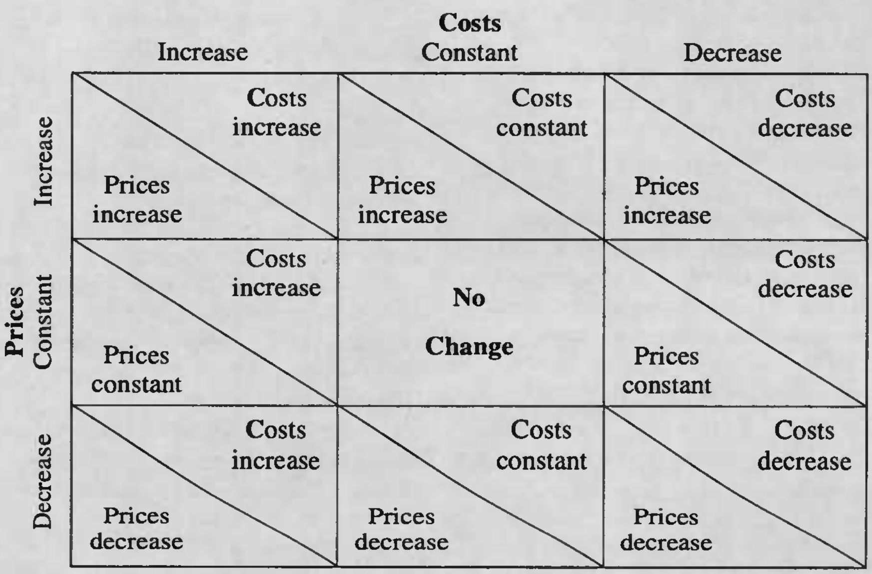


Figure 5.—*Combinations of cost and price changes.*

Historically, because of continuing strong demand for timber, Douglas-fir stumpage price has increased at a rate exceeding inflation. This is a *real* increase.

Influences on timber-growing costs, other than inflation, cannot be measured so easily. So, for simplicity, financial analysts often begin by examining a condition of *constant* production costs (that is, neither inflationary nor real changes) and *increasing* real timber price. Such situations frequently are used as benchmark examples against which analyses based on other assumptions can be compared.

Because of inflation's importance in real-life situations, however, it cannot be totally ignored.

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Table 1.—*Douglas-fir site III investment.*

Time (year)	Activities	Total cost ($/acre)[a]	Cost share payment ($/acre)	Resulting cost to landowner ($/acre)[b]
0	Site preparation	(100)	75	(25)
	Planting	(200)	150	(50)
2	Release spray & animal control	(120)	90	(30)
15	Precommercial thinning	(100)	75	(25)
	Annual operating costs[c]	(1)	0	(1)

		Today's value			
		Volume removed[d] (MBF/acre)	Stumpage price ($/MBF)	Harvesting cost ($/MBF)	Harvesting cost ($/Acre)[e]
30	Commercial thinning	5.0	150	(75)	(375)
40	Commercial thinning	8.7	200	(100)	(870)
50	Final harvest	30.1	300	(150)	(4,515)

[a] For the sake of clarity and to ensure that costs are not confused with returns, all costs shown in this publication are enclosed in parentheses. These numbers are hypothetical. Your costs and returns will vary with your specific situation.

[b] We assumed that maximum (75%) Federal cost-share payments would be taken.

[c] Annual costs (such as taxes, fire control, or insurance) occur each year throughout the investment period.

[d] For more information on timber yield, see any of the following:

Chambers, C., *Empirical Growth and Yield Tables for the Douglas-fir Zone*, DNR Report No. 41, State of Washington Dept. of Natural Resources, 1980.

Curtis, R., G. Clendenen. D. Reukema, and D. Demars, *Yield Tables for Managed Stands of Coast Douglas-fir*, General Technical Report PNW-135, USDA Forest Service Northwest Forest and Range Experiment Station, 1982.

McCardle, R.E., W.H. Meyer, and D. Bruce, *The Yield of Douglas-fir in the Pacific Northwest*, USDA Technical bulletin 201, 1961.

Volume removed (MBF/acre) x Harvesting cost ($/MBF) = Harvesting cost ($/acre).

How do you do a financial analysis?

Now that you have seen what constitutes a financial analysis and learned some of the conventions and procedures commonly used, we next show how an analysis actually is done, with the aid of a practical example.

Table 1 is the diagram for a Douglas-fir timber-growing investment; it is a concise summary of the first two steps in a financial analysis. It shows the activities, inputs, and outputs for this timber-growing example and assigns them appropriate dollar values. This diagram is the source for all the numerical data in the worksheets that follow.

We will assume that your best alternative rate of return is 7% and furthermore, that it is a *real* rate. It excludes inflation, as contrasted to a *market* rate, which includes both a real component and an inflation component. Thus we omit the confounding effect of inflation in this first analysis and reserve that discussion until later, as noted above.

Worksheets explained

Using the four worksheets presented next (pages 8–15) provides a step-by-step procedure that is detailed but fairly simple. You use information about costs and returns drawn from separate *Cost* and *Income Worksheets* to complete a *Cash Flow Worksheet* and summarize the results on an *Investment Performance Worksheet*, where you calculate and interpret the NFV and ROR.

Each worksheet "prompts" you for the required information, provides an organized form for recording it, and uses a straightforward procedure to complete the financial analysis.

We will explain the features of each worksheet, but we leave it to you to follow the numerical development of the example and verify the figures on each worksheet.

A supply of blank worksheets is included in the Appendix for your use in making analyses of your own proposed investments. The key to success in using these worksheets lies in following the instructions and completing them in order.

Costs

When investing, your first question generally is, "How much will this cost me?" The *Cost Worksheet* is used to determine the Gross Future Cost—that is, the gross cost when compounded to the end of the investment. Begin by recording what each activity is, when during the investment it occurs, and Today's Cost.

One-time costs are those normally paid just once during a rotation. Examples are regeneration costs (such as site preparation, planting, and animal control) and post regeneration costs (release spraying, fencing, or special road construction). Yearly costs commonly include such items as road maintenance, taxes, and fire protection.

Next, compound the costs forward to the end of the investment. Because we assume that costs are incurred at the *beginning* of the year in which the expenditure is made, be sure to compound costs from the year they *actually occur* through the *end* of the investment period.

Incomes

Having completed the *Cost Worksheet*, you now must treat incomes similarly. The objective is to find the Gross Future Income. Begin the *Income Worksheet* by recording when each thinning, harvest, or other income-producing activity occurs, Today's Price for stumpage, and the amount of Expected Volume. Before figuring the Expected Income (price x volume), we must say something about stumpage prices.

Since the 1920s, in western Oregon and western Washington, Douglas-fir stumpage prices have shown real increases of between 4 and 6% annually above inflation. Figures show that for all of Oregon, Washington, and California, ponderosa pine's real increase has been between 4 and 8% above inflation each year. Timber investments, therefore, often are analyzed on the basis of annual stumpage price increases.

But since there is no one "correct" figure, a conservative estimate of 3% sometimes is used. Even though the example presented here disregards inflation, such an increase in stumpage price is reasonable since it represents an increase *above* inflation.

A Price Adjustment Factor translates Today's Prices into Future Prices (disregarding inflation) at the time the activity actually occurs. The rate of annual stumpage price increase (in percent) is used with Appendix Table 1 to find the Price Adjustment Factor.

For example, if Today's Price stumpage is $200/MBF *after deducting other costs* and if we use a 3% annual price increase, the Future Price at the first commercial thinning 40 years hence would be $652/MBF ($200 x 3.26 = $652).

You will find the Price Adjustment Factor, 3.26, in Appendix Table 1 reading across the 40 Year's row to the 3% Interest Rate column. You find Future Prices for subsequent thinnings and the final harvest with the same procedure.

Next, multiply Future Price by Expected Volume to get Expected Income. Finally, to find the Gross Future Income, compound the Expected Income to the end of the investment using the *rate of interest.*

Cash flow

Next, calculate the Cash Flow each year in which an activity occurs. Some years will have larger Gross Incomes than Gross Costs, resulting in positive cash flows. In others, Gross Costs will exceed Gross Incomes, resulting in negative cash flows. Whether positive or negative, record each cash flow on the *Cash Flow Worksheet.*

Investment performance

The last worksheet used in the basic analysis provides for the calculation of two financial performance measures, Net Future Value (NFV) and the Rate of Return (ROR).

You must complete all of the previous worksheets before you can fill in this one.

In calculating ROR, use the interest tables in reverse: enter them with a factor to find what interest rate it equates to. The specific procedure is explained on the *Investment Performance Worksheet.*

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Is this example a profitable investment?

After completing all of the worksheets, you still must use the information on them to decide whether or not the investment is profitable. Profitability sometimes is a slippery concept because of what one either includes or excludes in its computation.

For our purposes here, it simply refers to an excess of dollars remaining after specified costs have been paid. You must realize, therefore, that the reliability of this end result depends entirely on the accuracy and completeness of your data.

Moreover, only those costs and incomes measurable in dollars have been included. The results are distorted to the extent that relevant elements were accidentally omitted or that non-market items (not measurable in dollars), such as the sheer enjoyment of growing trees, could not be evaluated.

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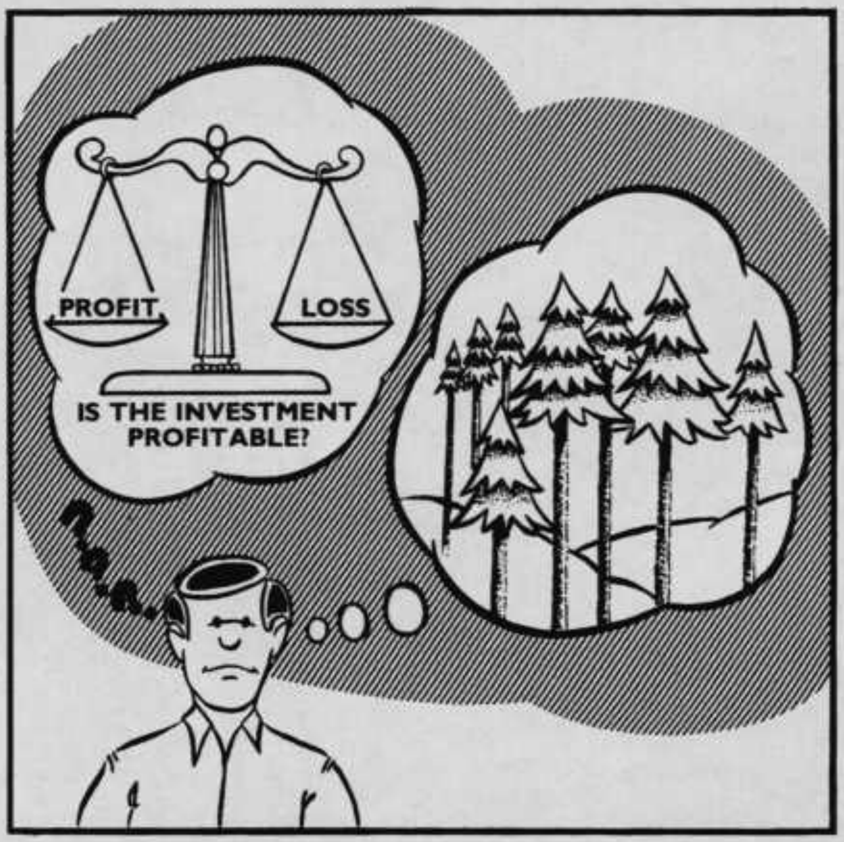

COST WORKSHEET

The COST WORKSHEET is used to determine Gross Future Cost—gross cost when compounded to the end of the investment. Begin by recording each activity, when it occurs, and Today's Cost. Next, carry the cost forward to the end of the investment by multiplying Today's Cost by its Compounding Factor from Appendix Table 1 to get Gross Future Cost. Enclose costs—outlays—in parentheses to distinguish them from positive returns.

Name of Investment Project[a] Douglas-fir

Length of Investment 50 years Date Analyzesd 1-2-97

Interest Rate 7 % Inflation Rate 0 %

Activity	Time (Year) Activity Occurs	Today's Cost ($/Acre)		Compounding Factor[b]		Gross Future Cost ($/Acre)
ONE-TIME						
Site preparation	0	(25)	x	29.46	= $	(737)
Planting	0	(50)	x	29.46	= $	(1473)
Release spray	2	(30)	x	25.70	= $	(771)
Precommercial thinning	15	(25)	x	10.68	= $	(267)
Commercial thinning	30	(375)	x	3.87	= $	(1451)
Commercial thinning	40	(870)	x	1.97	= $	(1714)
Final harvest	50	(4515)	x	-	= $	(4515)
YEARLY						
Operating costs	YEARLY	(1)				
	Total YEARLY Cost	(1)	x	406.53	= $	(407)

Footnotes for cost worksheet

[a]When analyzing projects, identify clearly the set of worksheets for each project, first by project name and then by recording the interest, inflation, and price-change assumptions used in each project. Be sure that these assumptions are the same throughout each set of worksheets.

[b]Assume that costs will be incurred at the beginning of the year in which you make an expenditure. Therefore, to determine the number of years to compound a cost to the end of an investment, simply subtract the time that it occurs from the length of the investment. In a 50-year investment, a cost occurring at Time 15 would be compounded 35 years to the end of the project.

Always use Appendix Table1 to compound "one-time" items such as regeneration and post-regeneration costs. You can add *yearly* costs and then compound them as a single item. The interest factors in Appendix Table 2 adjust for the fact that these occur *each year* rather than just once during the rotation. *Always use Appendix Table 2 to compound yearly costs.*

INCOME WORKSHEET

Use this worksheet to find Gross Future Income. Begin by recording each Activity, the Time that it occurs, Today's Price, and the Expected Volume. Then enter the Price Adjustment Factor from Appendix Table 1 to calculate Future Price, which when multiplied by Expected Volume gives Expected Income. Multiply Expected Income by its Compounding Factor from Appendix Table 1 to get Gross Future Income.

Name of Investment Project Douglas-fir

Length of Investment 50 years Date Analyzed 1-2-97

Interest Rate 7 % Inflation Rate 0 %

Real Product Price Change 3 %

Activity	Time Activity Occurs	Today's Stumpage Price ($/Unit)		Price Adjustment Factor[a]		Future Price[b] ($/Unit)		Expected Volume Per Acre[c]		Expected Income[d] ($/Acre)		Compounding Factor		Gross Future Income ($/Acre)
Commercial thinning	30	150	x	2.43	=	365	x	5.0	=	1825	x	3.87	=	$ 7,063
			x		=		x		=		x		=	$
Commercial thinning	40	200	x	3.26	=	652	x	8.7	=	5672	x	1.97	=	$ 11,174
			x		=		x		=		x		=	$
Final harvest	50	300	x	4.38	=	1314	x	30.1	=	39,551	x	—	=	$ 39,551
			x		=		x		=		x		=	$
			x		=		x		=		x		=	$
			x		=		x		=		x		=	$
			x		=		x		=		x		=	$

Footnotes for income worksheet

[a]We can make an analysis assuming that stumpage prices remain *constant* (equal to Today's Price) or that they *increase* or *decrease* each year. Throughout history, stumpage prices have tended to increase at a rate exceeding inflation. When you assume that prices will increase annually, you must adjust Today's Price to a Future Price that reflects a rate of annual price increase *and* a period of time from the start of the analysis to when the activity actually occurs. The procedure is to compound Today's Price by a Price Adjustment Factor for the appropriate length of time. Price Adjustment Factors operate like interest factors used to compound "one-time" costs. Obtain these from Appendix Table 1 for the appropriate time period and rate of price increase.

[b]If stumpage prices are held constant and not assumed to increase each year, then the Future Price will be the same as Today's Price. In this case, simply transfer Today's Price to the Future Price column.

[c]You can use any unit of volume measurement (MBF, cords, tons, etc.) as long as it is consistent with prices (e.g., $/MBF x MBF is acceptable, but $/MBF x cords is not). By keeping price consistent with volume measurements, you can incorporate different units of volume measurements in the same analysis. For example, you might measure one harvest in MBF and another in cords. You can include both in the same analysis as long as you use them with their appropriate prices ($/MBF and $/cord, respectively).

[d]Now compound the Expected Income to the end of the investment using interest factors from Appendix Table 1. Incomes generally are assumed to be received at the *end* of the year. The number of years to compound an income to the investment's end, then, is equal to the length of the investment minus the Time the income occurs. In a 50-year project, an income occurring at Time 30 (that is, at the *end* of the *29th* year) would be compounded for 20 years (50 - 30 = 20) to the end of the investment. Incomes received in the final project year, then, are not compounded; their values simply are entered in the Gross Future Income column.

CASH FLOW WORKSHEET

Use this worksheet to calculate an investment's cash flow. Enter each activity and the Time it occurs. Next, enter its Expected Income and Today's Cost (from COST and INCOME WORKSHEETS) in the appropriate column below. For the annual costs, record their Time of occurrence as Yearly and their sum (from COST WORKSHEET) in the Expected Cost column. Complete this worksheet by subtracting Expected Cost from Expected Income to get the Net Cost or Net Income. This can be either *positive* or *negative* depending on whether incomes are greater or less than costs in a given year.

Name of Investment Project Douglas-fir

Length of Investment 50 years Date Analyzed 1-2-97

Interest Rate 7 % Inflation Rate 0 %

Real Product Price Change 3 %

Activity	Time Activity Occurs	Expected Income ($) *Copy from INCOME WORKSHEET*		Expected Cost ($) *Copy from COST WORKSHEET*		Net Cost or Net Income ($/Acre)
Regeneration Activities	0	0	-	(75)	=	(75)
Release Spray	2	0	-	(30)	=	(30)
Precommercial Thinning	15	0	-	(25)	=	(25)
Fire Protection	yearly	0	-	(1)	=	(1)
			-		=	
Commercial Thinning	30	1825	-	(375)	=	1450
Commercial Thinning	40	5672	-	(870)	=	4802
Final Harvest	50	39,551	-	(4515)	=	35,036
			-		=	

INVESTMENT PERFORMANCE WORKSHEET 1

NET FUTURE VALUE (NFV)

The NFV reflects the amount of money available at the end of an investment. It is calculated by subtracting NET FUTURE COST (NFC) from NET FUTURE INCOME (NFI), as shown below. Begin by transferring each Net Cost and Net Income from the CASH FLOW WORKSHEET to the appropriate table below. Then, compound each Net Cost and Net Income from when it occurs to the end of the investment.

Name of Investment Project Douglas-fir

Length of Investment 50 years Date Analyzed 1-2-97

Interest Rate 7 % Inflation Rate 0 %

Real Product Price Change 3 %

NET FUTURE COST (NFC)

Time	Net Cost ($/Acre)		Compounding Factor[a]		Net Future Cost ($/Acre)
0	(75)	x	29.46	=	(2210)
2	(30)	x	25.70	=	(771)
15	(25)	x	10.68	=	(267)
yearly	(1)	x	406.53	=	(407)
		x		=	

NFC = $ (3,655)
(Sum Column)

NET FUTURE INCOME (NFI)

Time	Net Income ($/Acre)		Compounding Factor[a]		Net Future Income ($/Acre)
30	1450	x	3.87	=	$ 5,612
40	4802	x	1.97	=	$ 9,460
50	35,036	x	–	=	$ 35,036
		x		=	$
		x		=	$ 50,108

NFC = $
(Sum Column)

[a]Net Cost or Net Income is thought of as occurring at the end of the year. To carry it to the end of the investment, compound it for a time period equal to the Length of Investment minus the Time the Activity occurs. A net amount occurring at the end of Time 30 would be compounded 20 years to the end of a 50-year investment. Use interest factors from Appendix Table 1 for one-time amounts and those from Appendix Table 2 for yearly amounts.

Finally, NFV is calculated:

NFV = NFI - NFC

NFV = $ 50,108 - $ (3,655)

NFV=$+ 46,453 /Acre or, if negative NFV=$- /Acre

INVESTMENT PERFORMANCE WORKSHEET 2

NFV can be either positive, zero, or negative. A positive NFV shows that the investment has more future income than future cost, and that it has earned more than the rate of interest used in the problem (what we assume could be earned in some alternative investment). In the unlikely event that NFV = 0 (i.e., future income = future cost), then the investment and its hypothetical alternative both earn the same rate of interest—that used in the problem. When NFV is negative, future cost exceeds future income, and the investment earns less than the interest rate used.

RATE OF RETURN (ROR)

The ROR of a particular investment is the rate, expressed as a percent, at which the investment earns or loses money. Calculate the ROR in the following three steps:

Name of Investment Project Douglas-fir

Length of Investment 50 years Date Analyzed 1-2-97

Interest Rate 7 % Inflation Rate 0 %

Real Product Price Change 3 %

Step 1:

To find NET PRESENT COST (NPC), transfer each Net Cost, and Time it occurs, from the CASH FLOW WORKSHEET to the table below. Then discount each Net Cost from the Time it occurs back to the beginning of the investment (use Appendix Table 3 for one-time discount factors and Appendix Table 4 for yearly items). Finally, add the Net Present Cost column to get NPC.

NET PRESENT COST (NPC)

Time	Net Cost ($/Acre)		Discounting Factor[a]		Net Present Cost ($/Acre)
0	(75)	x	—	= $	(75)
2	(30)	x	.87	= $	(26)
15	(25)	x	.36	= $	(9)
yearly	(1)	x	13.80	= $	(14)
		x		= $	
				NPC = $	(124)

[a]To discount a Net Cost to the beginning of the investment, discount the cost for a time period equal to the Time it occurs. A net amount at Time 1 would be discounted 1 year, and a net amount at Time 15, 15 years.

INVESTMENT PERFORMANCE WORKSHEET 3

Step 2:

Next, find an investment Accumulation Factor by using NFI from INVESTMENT PERFORMANCE WORKSHEET 1 and NPC from Step 1.

Length of Investment = 50 years

Accumulation Factor = NFI ÷ NPC

Accumulation Factor = 50,108[a] ÷ (124)

Accumulation Factor = 404.10

[a]If NFI is negative, the accumulation factor calculation still is valid; however, the resulting ROR then will represent the rate at which money is lost rather than gained, signifying an unprofitable investment.

[b]Since the *exact* Accumulation Factor seldom appears in the table, you may have to read "between the columns" (interpolate) to locate the factor in the table. You also would, then, interpolate between the corresponding interest rates at the head of the columns. For instance, because an Accumulation Factor of 404.1 over a 50-year rotation falls nearer the 13% factor (450.74) than the 11% factor (184.56), the ROR is estimated as 13.0%, as shown in the excerpt from Appendix Table 1.

Step 3:

Finally, estimate the ROR by using Appendix Table 1. Start on the YEARS row corresponding to the Length of the Investment and read *across* the row to find the number closest to the Accumulation Factor just calculated. Then, read *up* the column to find the RATE OF INTEREST.[b] This RATE OF INTEREST is the approximate ROR.

For the Accumulation Factor found in Step 2, the ROR is:

$\boxed{\text{ROR} = 13.0\ \%}$

Table 1. FACTORS FOR COMPOUNDING ONE-TIME AMOUNTS. (excerpt)

	RATE OF INTEREST			
YEARS	9%	11%	13%	15%
1	1.09	1.11	1.13	1.15
2	1.19	1.23	1.28	1.32
3	1.30	1.37	1.44	1.52
4	1.41	1.52	1.63	1.75
5	1.54	1.69	1.84	2.01
6	1.68	1.87	2.08	2.31
7	1.83	2.08	2.35	2.66
8	1.99	2.30	2.66	3.06
9	2.17	2.56	3.00	3.52
10	2.37	2.84	3.39	4.05
45	48.33	109.53	244.64	538.77
50	74.36	184.56	450.74	1083.66

For our timber-growing example, we can conclude from the NFV and ROR calculations that, *given the data on which it is based*, it constitutes a profitable use for our money. The NFV tells us that at the end of the investment period, we would have $46,452 left after all costs were covered.

The ROR gives us another interpretation: If we were to invest in this timber-growing project, our funds would earn a 13% return. Since our 7% interest rate used in the analysis represented the best available earning rate for our money before evaluating this investment, we now discover that growing Douglas-fir would give us an even better return (or income).

Although this completes the basic financial analysis, you should not necessarily stop here. At this point, you have completed only *one* analysis to examine only *one* set of conditions, which likely will change over time. Before making an investment decision, then, we recommend that you do several analyses using different input data.

Changing a cost, income, or an interest rate, and recalculating the results provides important information about how an investment reacts—how sensitive it is—to changes in your initial assumptions (or values).

Knowing this *before* making an investment can remove considerable uncertainty about a project.

Knowing the value of this particular investment, you might be interested in comparing it with other potential investment opportunities. This, in fact, is the purpose of EC 1148 (see "Summary"). In it you will see that, like so many things in daily experience, direct comparisons are not a simple matter.

An example in EC 1148 (page 3) shows how to rescale for differences in lengths of investments and to adjust for differing sizes (cost outlays) before you can compare the relative profitability of several potential investment projects—and, therefore, which one(s) you should prefer over the others.

$ $ $

Summary

This publication has presented a set of financial analysis worksheets suitable for evaluating many types of investments in a stepwise approach. When completed, the worksheets generate an investment's Net Future Value and Rate of Return.

The procedure is flexible, easily accommodating both short- and long-term investment, having either few or many activities, on either a before-tax or after-tax basis. The Appendix includes the interest tables you'll need to complete a basic analysis.

EC 1148, *Forestry Financial Analysis III : How to Compare Two (or More) Investments*, shows how to use the worksheets to compare two competing investments.

$ $ $

For further reading

EC 1146, *Forestry Financial Analysis: An Introduction for Landowners*, by N.E. Elwood and R.O. McMahon (Oregon State University, Corvallis, reprinted 1992). $1.00

EC 1148, *Forestry Financial Analysis III: How to Compare Two (or More) Investments*, by N.E. Elwood and R.O. McMahon (Oregon State University, Corvallis, reprinted 1993). $4.00

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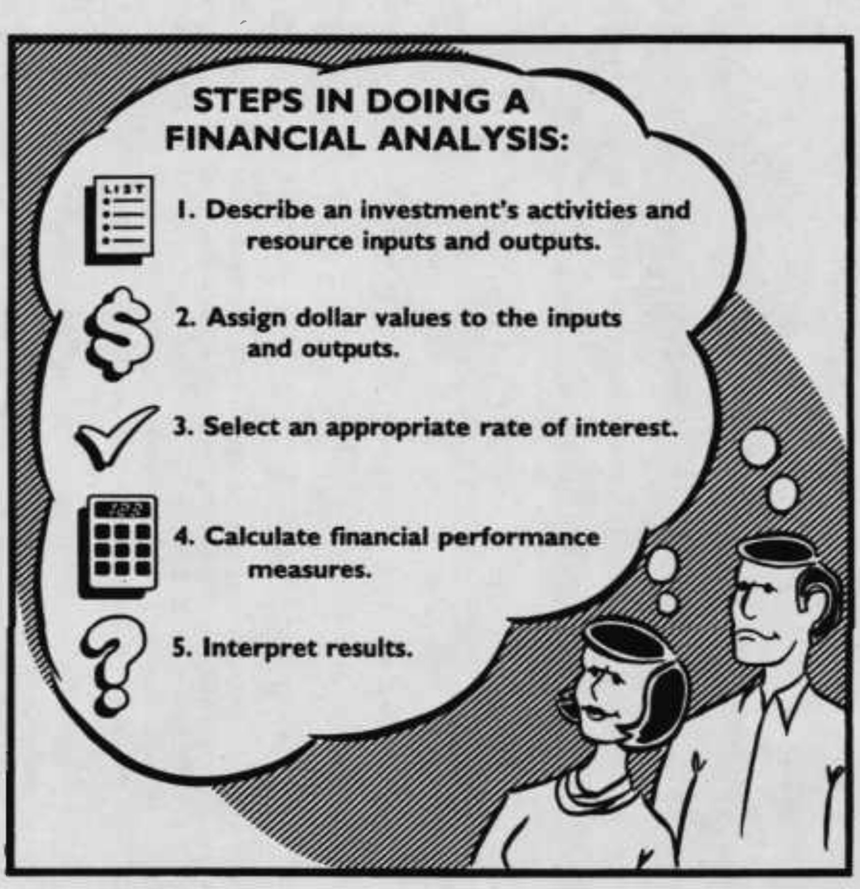

Appendix Table 1.—*Factors for compounding one-time amounts.*

RATE OF INTEREST

YEARS	3%	5%	7%	9%	11%	13%	15%	20%	25%	30%
1	1.03	1.05	1.07	1.09	1.11	1.13	1.15	1.20	1.25	1.30
2	1.06	1.10	1.14	1.19	1.23	1.28	1.32	1.44	1.56	1.69
3	1.09	1.16	1.23	1.30	1.37	1.44	1.52	1.73	1.95	2.20
4	1.13	1.22	1.31	1.41	1.52	1.63	1.75	2.07	2.44	2.86
5	1.16	1.28	1.40	1.54	1.69	1.84	2.01	2.49	3.05	3.71
6	1.19	1.34	1.50	1.68	1.87	2.08	2.31	2.99	3.81	4.83
7	1.23	1.41	1.61	1.83	2.08	2.35	2.66	3.58	4.77	6.27
8	1.27	1.48	1.72	1.99	2.30	2.66	3.06	4.30	5.96	8.16
9	1.30	1.55	1.84	2.17	2.56	3.00	3.52	5.16	7.45	10.60
10	1.34	1.63	1.97	2.37	2.84	3.39	4.05	6.19	9.31	13.79
11	1.38	1.71	2.10	2.58	3.15	3.84	4.65	7.43	11.64	17.92
12	1.43	1.80	2.25	2.81	3.50	4.33	5.35	8.92	14.55	23.30
13	1.47	1.89	2.41	3.07	3.88	4.90	6.15	10.70	18.19	30.29
14	1.51	1.98	2.58	3.34	4.31	5.53	7.08	12.84	22.74	39.37
15	1.56	2.08	2.76	3.64	4.78	6.25	8.14	15.41	28.42	51.19
16	1.60	2.18	2.95	3.97	5.31	7.07	9.36	18.49	35.53	66.54
17	1.65	2.29	3.16	4.33	5.90	7.99	10.76	22.19	44.41	86.50
18	1.70	2.41	3.38	4.72	6.54	9.02	12.38	26.62	55.51	112.46
19	1.75	2.53	3.62	5.14	7.26	10.20	14.23	31.95	69.39	146.19
20	1.81	2.65	3.87	5.60	8.06	11.52	16.37	38.34	86.74	190.05
21	1.86	2.79	4.14	6.11	8.95	13.02	18.82	46.01	108.42	247.06
22	1.92	2.93	4.43	6.66	9.93	14.71	21.64	55.21	135.53	321.18
23	1.97	3.07	4.74	7.26	11.03	16.63	24.89	66.25	169.41	417.54
24	2.03	3.23	5.07	7.91	12.24	18.79	28.63	79.50	211.76	542.80
25	2.09	3.39	5.43	8.62	13.59	21.23	32.92	95.40	264.70	705.64
26	2.16	3.56	5.81	9.40	15.08	23.99	37.86	114.48	330.87	917.33
27	2.22	3.73	6.21	10.25	16.74	27.11	43.54	137.37	413.59	1192.53
28	2.29	3.92	6.65	11.17	18.58	30.63	50.07	164.84	516.99	1550.29
29	2.36	4.12	7.11	12.17	20.62	34.62	57.58	197.81	646.23	2015.38
30	2.43	4.32	7.61	13.27	22.89	39.12	66.21	237.38	807.79	2620.00
31	2.50	4.54	8.15	14.46	25.41	44.20	76.14	284.85	1009.74	3405.99
32	2.58	4.76	8.72	15.76	28.21	49.95	87.57	341.82	1262.18	4427.79
33	2.65	5.00	9.33	17.18	31.31	56.44	100.70	410.19	1577.72	5756.13
34	2.73	5.25	9.98	18.73	34.75	63.78	115.80	492.22	1972.15	7482.97
35	2.81	5.52	10.68	20.41	38.57	72.07	133.18	590.67	2465.19	9727.86
36	2.90	5.79	11.42	22.25	42.82	81.44	153.15	708.80	3081.49	12646.22
37	2.99	6.08	12.22	24.25	47.53	92.02	176.12	850.56	3851.86	16440.08
38	3.07	6.39	13.08	26.44	52.76	103.99	202.54	1020.67	4814.82	21372.11
39	3.17	6.70	13.99	28.82	58.56	117.51	232.92	1224.81	6018.53	27783.74
40	3.26	7.04	14.97	31.41	65.00	132.78	267.86	1469.77	7523.16	36118.86
45	3.78	8.99	21.00	48.33	109.53	244.64	538.77	3657.26	22958.87	134106.82
50	4.38	11.47	29.46	74.36	184.56	450.74	1083.66	9100.44	70064.92	497929.22
55	5.08	14.64	41.32	114.41	311.00	830.45	2179.62	22644.80	213821.18	1000000.00
60	5.89	18.68	57.95	176.03	524.06	1530.05	4384.00	56347.51	652530.45	1000000.00
65	6.83	23.84	81.27	270.85	883.07	2819.02	8817.79	140210.65	1000000.00	1000000.00
70	7.92	30.43	113.99	416.73	1488.02	5193.87	17735.72	348888.96	1000000.00	1000000.00
75	9.18	38.83	159.88	641.19	2507.40	9569.37	35672.87	868147.37	1000000.00	1000000.00
80	10.64	49.56	224.23	986.55	4225.11	17630.94	71750.88	1000000.00	1000000.00	1000000.00
85	12.34	63.25	314.50	1517.93	7119.56	32483.86	144316.65	1000000.00	1000000.00	1000000.00
90	14.30	80.73	441.10	2335.53	11996.87	59849.42	290272.33	1000000.00	1000000.00	1000000.00
95	16.58	103.03	618.67	3593.50	20215.43	110268.67	583841.33	1000000.00	1000000.00	1000000.00
100	19.22	131.50	867.72	5529.04	34064.18	203162.87	1000000.00	1000000.00	1000000.00	1000000.00

TO ESTIMATE COMPOUNDING FACTORS FOR MISSING YEARS, SELECT 2 YEARS (AS NEARLY EQUAL AS POSSIBLE) WHOSE SUM IS THE YEAR TO BE ESTIMATED. MULTIPLY THEIR RESPECTIVE COMPOUNDING FACTORS. FOR EXAMPLE, CALCULATE THE 7% FACTOR FOR 48 YEARS, AS FOLLOWS:

24 YEARS = 5.07
+ 24 YEARS = X 5.07
48 YEARS = 25.70

Appendix Table 2.—*Factors for compounding yearly amounts.*

RATE OF INTEREST

YEARS	3%	5%	7%	9%	11%	13%	15%	20%	25%	30%
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	2.03	2.05	2.07	2.09	2.11	2.13	2.15	2.20	2.25	2.30
3	3.09	3.15	3.21	3.28	3.34	3.41	3.47	3.64	3.81	3.99
4	4.18	4.31	4.44	4.57	4.71	4.85	4.99	5.37	5.77	6.19
5	5.31	5.53	5.75	5.98	6.23	6.48	6.74	7.44	8.21	9.04
6	6.47	6.80	7.15	7.52	7.91	8.32	8.75	9.93	11.26	12.76
7	7.66	8.14	8.65	9.20	9.78	10.40	11.07	12.92	15.07	17.58
8	8.89	9.55	10.26	11.03	11.86	12.76	13.73	16.50	19.84	23.86
9	10.16	11.03	11.98	13.02	14.16	15.42	16.79	20.80	25.80	32.01
10	11.46	12.58	13.82	15.19	16.72	18.42	20.30	25.96	33.25	42.62
11	12.81	14.21	15.78	17.56	19.56	21.81	24.35	32.15	42.57	56.41
12	14.19	15.92	17.89	20.14	22.71	25.65	29.00	39.58	54.21	74.33
13	15.62	17.71	20.14	22.95	26.21	29.98	34.35	48.50	68.76	97.63
14	17.09	19.60	22.55	26.02	30.09	34.88	40.50	59.20	86.95	127.91
15	18.60	21.58	25.13	29.36	34.41	40.42	47.58	72.04	109.69	167.29
16	20.16	23.66	27.89	33.00	39.19	46.67	55.72	87.44	138.11	218.47
17	21.76	25.84	30.84	36.97	44.50	53.74	65.08	105.93	173.64	285.01
18	23.41	28.13	34.00	41.30	50.40	61.73	75.84	128.12	218.04	371.52
19	25.12	30.54	37.38	46.02	56.94	70.75	88.21	154.74	273.56	483.97
20	26.87	33.07	41.00	51.16	64.20	80.95	102.44	186.69	342.94	630.17
21	28.68	35.72	44.87	56.76	72.27	92.47	118.81	225.03	429.68	820.22
22	30.54	38.51	49.01	62.87	81.21	105.49	137.63	271.03	538.10	1067.28
23	32.45	41.43	53.44	69.53	91.15	120.20	159.28	326.24	673.63	1388.46
24	34.43	44.50	58.18	76.79	102.17	136.83	184.17	392.48	843.03	1806.00
25	36.46	47.73	63.25	84.70	114.41	155.62	212.79	471.98	1054.79	2348.80
26	38.55	51.11	68.68	93.32	128.00	176.85	245.71	567.38	1319.49	3054.44
27	40.71	54.67	74.48	102.72	143.08	200.84	283.57	681.85	1650.36	3971.78
28	42.93	58.40	80.70	112.97	159.82	227.95	327.10	819.22	2063.95	5164.31
29	45.22	62.32	87.35	124.14	178.40	258.58	377.17	984.07	2580.94	6714.60
30	47.58	66.44	94.46	136.31	199.02	293.20	434.75	1181.88	3227.17	8729.99
31	50.00	70.76	102.07	149.58	221.91	332.32	500.96	1419.26	4034.97	11349.98
32	52.50	75.30	110.22	164.04	247.32	376.52	577.10	1704.11	5044.71	14755.98
33	55.08	80.06	118.93	179.80	275.53	426.46	664.67	2045.93	6306.89	19183.77
34	57.73	85.07	128.26	196.98	306.84	482.90	765.37	2456.12	7884.61	24939.90
35	60.46	90.32	138.24	215.71	341.59	546.68	881.17	2948.34	9856.76	32422.87
36	63.28	95.84	148.91	236.12	380.16	618.75	1014.35	3539.01	12321.95	42150.73
37	66.17	101.63	160.34	258.38	422.98	700.19	1167.50	4247.81	15403.44	54796.95
38	69.16	107.71	172.56	282.63	470.51	792.21	1343.62	5098.37	19255.30	71237.03
39	72.23	114.10	185.64	309.07	523.27	896.20	1546.17	6119.05	24070.12	92609.14
40	75.40	120.80	199.64	337.88	581.83	1013.70	1779.09	7343.86	30088.66	120392.88
45	92.72	159.70	285.75	525.86	986.64	1874.16	3585.13	18281.31	91831.50	447019.39
50	112.80	209.35	406.53	815.08	1668.77	3459.51	7217.72	45497.19	280255.69	1000000.00
55	136.07	272.71	575.93	1260.09	2818.20	6380.40	14524.15	113219.01	855280.71	1000000.00
60	163.05	353.58	813.52	1944.79	4755.07	11761.95	29219.99	281732.57	1000000.00	1000000.00
65	194.33	456.80	1146.76	2998.29	8018.79	21677.11	58778.58	701048.23	1000000.00	1000000.00
70	230.59	588.53	1614.13	4619.22	13518.36	39945.15	118231.47	1000000.00	1000000.00	1000000.00
75	272.63	756.65	2269.66	7113.23	22785.44	73602.83	237812.45	1000000.00	1000000.00	1000000.00
80	321.36	971.23	3189.06	10950.57	38401.03	135614.93	478332.53	1000000.00	1000000.00	1000000.00
85	377.86	1245.09	4478.58	16854.80	64714.19	249868.19	962104.31	1000000.00	1000000.00	1000000.00
90	443.35	1594.61	6287.19	25939.18	109053.40	460372.43	1000000.00	1000000.00	1000000.00	1000000.00
95	519.27	2040.69	8823.85	39916.63	183767.55	848212.84	1000000.00	1000000.00	1000000.00	1000000.00
100	607.29	2610.03	12381.66	61422.68	309665.23	1000000.00	1000000.00	1000000.00	1000000.00	1000000.00

Appendix Table 3.—*Factors for discounting one-time amounts.*

YEARS	RATE OF INTEREST 3%	5%	7%	9%	11%	13%	15%	20%	25%	30%
1	.97	.95	.93	.92	.90	.88	.87	.83	.80	.77
2	.94	.91	.87	.84	.81	.78	.76	.69	.64	.59
3	.92	.86	.82	.77	.73	.69	.66	.58	.51	.46
4	.89	.82	.76	.71	.66	.61	.57	.48	.41	.35
5	.86	.78	.71	.65	.59	.54	.50	.40	.33	.27
6	.84	.75	.67	.60	.53	.48	.43	.33	.26	.21
7	.81	.71	.62	.55	.48	.43	.38	.28	.21	.16
8	.79	.68	.58	.50	.43	.38	.33	.23	.17	.12
9	.77	.64	.54	.46	.39	.33	.28	.19	.13	.09
10	.74	.61	.51	.42	.35	.29	.25	.16	.11	.07
11	.72	.58	.48	.39	.32	.26	.21	.13	.09	.06
12	.70	.56	.44	.36	.29	.23	.19	.11	.07	.04
13	.68	.53	.41	.33	.26	.20	.16	.09	.05	.03
14	.66	.51	.39	.30	.23	.18	.14	.08	.04	.03
15	.64	.48	.36	.27	.21	.16	.12	.06	.04	.02
16	.62	.46	.34	.25	.19	.14	.11	.05	.03	.02
17	.61	.44	.32	.23	.17	.13	.09	.05	.02	.01
18	.59	.42	.30	.21	.15	.11	.08	.04	.02	.01
19	.57	.40	.28	.19	.14	.10	.07	.03	.01	.01
20	.55	.38	.26	.18	.12	.09	.06	.03	.01	.01
21	.54	.36	.24	.16	.11	.08	.05	.02	.01	.00
22	.52	.34	.23	.15	.10	.07	.05	.02	.01	.00
23	.51	.33	.21	.14	.09	.06	.04	.02	.01	.00
24	.49	.31	.20	.13	.08	.05	.03	.01	.00	.00
25	.48	.30	.18	.12	.07	.05	.03	.01	.00	.00
26	.46	.28	.17	.11	.07	.04	.03	.01	.00	.00
27	.45	.27	.16	.10	.06	.04	.02	.01	.00	.00
28	.44	.26	.15	.09	.05	.03	.02	.01	.00	.00
29	.42	.24	.14	.08	.05	.03	.02	.01	.00	.00
30	.41	.23	.13	.08	.04	.03	.02	.00	.00	.00
31	.40	.22	.12	.07	.04	.02	.01	.00	.00	.00
32	.39	.21	.11	.06	.04	.02	.01	.00	.00	.00
33	.38	.20	.11	.06	.03	.02	.01	.00	.00	.00
34	.37	.19	.10	.05	.03	.02	.01	.00	.00	.00
35	.36	.18	.09	.05	.03	.01	.01	.00	.00	.00
36	.35	.17	.09	.04	.02	.01	.01	.00	.00	.00
37	.33	.16	.08	.04	.02	.01	.01	.00	.00	.00
38	.33	.16	.08	.04	.02	.01	.00	.00	.00	.00
39	.32	.15	.07	.03	.02	.01	.00	.00	.00	.00
40	.31	.14	.07	.03	.02	.01	.00	.00	.00	.00
45	.26	.11	.05	.02	.01	.00	.00	.00	.00	.00
50	.23	.09	.03	.01	.01	.00	.00	.00	.00	.00
55	.20	.07	.02	.01	.00	.00	.00	.00	.00	.00
60	.17	.05	.02	.01	.00	.00	.00	.00	.00	.00
65	.15	.04	.01	.00	.00	.00	.00	.00	.00	.00
70	.13	.03	.01	.00	.00	.00	.00	.00	.00	.00
75	.11	.03	.01	.00	.00	.00	.00	.00	.00	.00
80	.09	.02	.00	.00	.00	.00	.00	.00	.00	.00
85	.08	.02	.00	.00	.00	.00	.00	.00	.00	.00
90	.07	.01	.00	.00	.00	.00	.00	.00	.00	.00
95	.06	.01	.00	.00	.00	.00	.00	.00	.00	.00
100	.05	.01	.00	.00	.00	.00	.00	.00	.00	.00

TO ESTIMATE DISCOUNTING FACTORS FOR MISSING YEARS, SELECT 2 YEARS (AS NEARLY EQUAL AS POSSIBLE) WHOSE SUM IS THE YEAR TO BE ESTIMATED. MULTIPLY THEIR RESPECTIVE DISCOUNTING FACTORS. FOR EXAMPLE, CALCULATE THE 7% FACTOR FOR 48 YEARS, AS FOLLOWS:

24 YEARS	=	.20
+ 24 YEARS	= X	.20
48 YEARS	=	.04

Appendix Table 4.—*Factors for discounting yearly amounts.*

	RATE OF INTEREST									
YEARS	3%	5%	7%	9%	11%	13%	15%	20%	25%	30%
1	.97	.95	.93	.92	.90	.88	.87	.83	.80	.77
2	1.91	1.86	1.81	1.76	1.71	1.67	1.63	1.53	1.44	1.36
3	2.83	2.72	2.62	2.53	2.44	2.36	2.28	2.11	1.95	1.82
4	3.72	3.55	3.39	3.24	3.10	2.97	2.85	2.59	2.36	2.17
5	4.58	4.33	4.10	3.89	3.70	3.52	3.35	2.99	2.69	2.44
6	5.42	5.08	4.77	4.49	4.23	4.00	3.78	3.33	2.95	2.64
7	6.23	5.79	5.39	5.03	4.71	4.42	4.16	3.60	3.16	2.80
8	7.02	6.46	5.97	5.53	5.15	4.80	4.49	3.84	3.33	2.92
9	7.79	7.11	6.52	6.00	5.54	5.13	4.77	4.03	3.46	3.02
10	8.53	7.72	7.02	6.42	5.89	5.43	5.02	4.19	3.57	3.09
11	9.25	8.31	7.50	6.81	6.21	5.69	5.23	4.33	3.66	3.15
12	9.95	8.86	7.94	7.16	6.49	5.92	5.42	4.44	3.73	3.19
13	10.63	9.39	8.36	7.49	6.75	6.12	5.58	4.53	3.78	3.22
14	11.30	9.90	8.75	7.79	6.98	6.30	5.72	4.61	3.82	3.25
15	11.94	10.38	9.11	8.06	7.19	6.46	5.85	4.68	3.86	3.27
16	12.56	10.84	9.45	8.31	7.38	6.60	5.95	4.73	3.89	3.28
17	13.17	11.27	9.76	8.54	7.55	6.73	6.05	4.77	3.91	3.29
18	13.75	11.69	10.06	8.76	7.70	6.84	6.13	4.81	3.93	3.30
19	14.32	12.09	10.34	8.95	7.84	6.94	6.20	4.84	3.94	3.31
20	14.88	12.46	10.59	9.13	7.96	7.02	6.26	4.87	3.95	3.32
21	15.42	12.82	10.84	9.29	8.08	7.10	6.31	4.89	3.96	3.32
22	15.94	13.16	11.06	9.44	8.18	7.17	6.36	4.91	3.97	3.32
23	16.44	13.49	11.27	9.58	8.27	7.23	6.40	4.92	3.98	3.33
24	16.94	13.80	11.47	9.71	8.35	7.28	6.43	4.94	3.98	3.33
25	17.41	14.09	11.65	9.82	8.42	7.33	6.46	4.95	3.98	3.33
26	17.88	14.38	11.83	9.93	8.49	7.37	6.49	4.96	3.99	3.33
27	18.33	14.64	11.99	10.03	8.55	7.41	6.51	4.96	3.99	3.33
28	18.76	14.90	12.14	10.12	8.60	7.44	6.53	4.97	3.99	3.33
29	19.19	15.14	12.28	10.20	8.65	7.47	6.55	4.97	3.99	3.33
30	19.60	15.37	12.41	10.27	8.69	7.50	6.57	4.98	4.00	3.33
31	20.00	15.59	12.53	10.34	8.73	7.52	6.58	4.98	4.00	3.33
32	20.39	15.80	12.65	10.41	8.77	7.54	6.59	4.99	4.00	3.33
33	20.77	16.00	12.75	10.46	8.80	7.56	6.60	4.99	4.00	3.33
34	21.13	16.19	12.85	10.52	8.83	7.57	6.61	4.99	4.00	3.33
35	21.49	16.37	12.95	10.57	8.86	7.59	6.62	4.99	4.00	3.33
36	21.83	16.55	13.04	10.61	8.88	7.60	6.62	4.99	4.00	3.33
37	22.17	16.71	13.12	10.65	8.90	7.61	6.63	4.99	4.00	3.33
38	22.49	16.87	13.19	10.69	8.92	7.62	6.63	5.00	4.00	3.33
39	22.81	17.02	13.26	10.73	8.94	7.63	6.64	5.00	4.00	3.33
40	23.11	17.16	13.33	10.76	8.95	7.63	6.64	5.00	4.00	3.33
45	24.52	17.77	13.61	10.88	9.01	7.66	6.65	5.00	4.00	3.33
50	25.73	18.26	13.80	10.96	9.04	7.68	6.66	5.00	4.00	3.33
55	26.77	18.63	13.94	11.01	9.06	7.68	6.66	5.00	4.00	3.33
60	27.68	18.93	14.04	11.05	9.07	7.69	6.67	5.00	4.00	3.33
65	28.45	19.16	14.11	11.07	9.08	7.69	6.67	5.00	4.00	3.33
70	29.12	19.34	14.16	11.08	9.08	7.69	6.67	5.00	4.00	3.33
75	29.70	19.48	14.20	11.09	9.09	7.69	6.67	5.00	4.00	3.33
80	30.20	19.60	14.22	11.10	9.09	7.69	6.67	5.00	4.00	3.33
85	30.63	19.68	14.24	11.10	9.09	7.69	6.67	5.00	4.00	3.33
90	31.00	19.75	14.25	11.11	9.09	7.69	6.67	5.00	4.00	3.33
95	31.32	19.81	14.26	11.11	9.09	7.69	6.67	5.00	4.00	3.33
100	31.60	19.85	14.27	11.11	9.09	7.69	6.67	5.00	4.00	3.33

Extra worksheets

Cost Worksheet

Income Worksheet

Cash Flow Worksheet

Investment Performance Worksheets

COST WORKSHEET

The COST WORKSHEET is used to determine Gross Future Cost—gross cost when compounded to the end of the investment. Begin by recording each activity, when it occurs, and Today's Cost. Next, carry the cost forward to the end of the investment by multiplying Today's Cost by its Compounding Factor from Appendix Table 1 to get Gross Future Cost. Enclose costs—outlays—in parentheses to distinguish them from positive returns.

Name of Investment Project[a] ____________________

Length of Investment __________ Date Analyzesd ____________

Interest Rate _______ % Inflation Rate ______________ %

Activity	Time (Year) Activity Occurs	Today's Cost ($/Acre)		Compounding Factor[b]		Gross Future Cost ($/Acre)
ONE-TIME						
________	________	________	x	________	=	$________
________	________	________	x	________	=	$________
________	________	________	x	________	=	$________
________	________	________	x	________	=	$________
________	________	________	x	________	=	$________
________	________	________	x	________	=	$________
________	________	________	x	________	=	$________
YEARLY						
________	YEARLY	________				
________		________				
________		________				
	Total YEARLY Cost	________	x	________	=	$________

Footnotes for cost worksheet

[a]When analyzing projects, identify clearly the set of worksheets for each project, first by project name and then by recording the interest, inflation, and price-change assumptions used in each project. Be sure that these assumptions are the same throughout each set of worksheets.

[b] Assume that costs will be incurred at the beginning of the year in which you make an expenditure. Therefore, to determine the number of years to compound a cost to the end of an investment, simply subtract the time that it occurs from the length of the investment. In a 50-year investment, a cost occurring at Time 15 would be compounded 35 years to the end of the project.

Always use Appendix Table1 to compound "one-time" items such as regeneration and post-regeneration costs. You can add *yearly* costs and then compound them as a single item. The interest factors in Appendix Table 2 adjust for the fact that these occur *each year* rather than just once during the rotation. *Always use Appendix Table 2 to compound yearly costs.*

INCOME WORKSHEET

Use this worksheet to find Gross Future Income. Begin by recording each Activity, the Time that it occurs, Today's Price, and the Expected Volume. Then enter the Price Adjustment Factor from Appendix Table 1 to calculate Future Price, which when multiplied by Expected Volume gives Expected Income. Multiply Expected Income by its Compounding Factor from Appendix Table 1 to get Gross Future Income.

Name of Investment Project ____________________

Length of Investment ____________ Date Analyzed ____________

Interest Rate __________ % Inflation Rate ____________ %

Real Product Price Change ______________ %

Activity	Time Activity Occurs	Today's Stumpage Price ($/Unit)		Price Adjustment Factor[a]		Future Price[b] ($/Unit)		Expected Volume Per Acre[c]		Expected Income[d] ($/Acre)		Compounding Factor		Gross Future Income ($/Acre)
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______
______	______	______	x	______	=	______	x	______	=	______	x	______	=	$______

Footnotes for income worksheet

[a]We can make an analysis assuming that stumpage prices remain *constant* (equal to Today's Price) or that they *increase* or *decrease* each year. Throughout history, stumpage prices have tended to increase at a rate exceeding inflation. When you assume that prices will increase annually, you must adjust Today's Price to a Future Price that reflects a rate of annual price increase *and* a period of time from the start of the analysis to when the activity actually occurs. The procedure is to compound Today's Price by a Price Adjustment Factor for the appropriate length of time. Price Adjustment Factors operate like interest factors used to compound "one-time" costs. Obtain these from Appendix Table 1 for the appropriate time period and rate of price increase.

[b]If stumpage prices are held constant and not assumed to increase each year, then the Future Price will be the same as Today's Price. In this case, simply transfer Today's Price to the Future Price column.

[c]You can use any unit of volume measurement (MBF, cords, tons, etc.) as long as it is consistent with prices (e.g., $/MBF x MBF is acceptable, but $/MBF x cords is not). By keeping price consistent with volume measurements, you can incorporate different units of volume measurements in the same analysis. For example, you might measure one harvest in MBF and another in cords. You can include both in the same analysis as long as you use them with their appropriate prices ($/MBF and $/cord, respectively).

[d]Now compound the Expected Income to the end of the investment using interest factors from Appendix Table 1. Incomes generally are assumed to be received at the *end* of the year. The number of years to compound an income to the investment's end, then, is equal to the length of the investment minus the Time the income occurs. In a 50-year project, an income occurring at Time 30 (that is, at the *end* of the *29th* year) would be compounded for 20 years (50 - 30 = 20) to the end of the investment. Incomes received in the final project year, then, are not compounded; their values simply are entered in the Gross Future Income column.

CASH FLOW WORKSHEET

Use this worksheet to calculate an investment's cash flow. Enter each activity and the Time it occurs. Next, enter its Expected Income and Today's Cost (from COST and INCOME WORKSHEETS) in the appropriate column below. For the annual costs, record their Time of occurrence as Yearly and their sum (from COST WORKSHEET) in the Expected Cost column. Complete this worksheet by subtracting Expected Cost from Expected Income to get the Net Cost or Net Income. This can be either *positive* or *negative* depending on whether incomes are greater or less than costs in a given year.

Name of Investment Project______________________

Length of Investment____________ Date Analyzed____________

Interest Rate_________% Inflation Rate___________%

Real Product Price Change______________%

Activity	Time Activity Occurs	Expected Income($) *Copy from INCOME WORKSHEET*		Expected Cost ($) *Copy from COST WORKSHEET*		Net Cost or Net Income ($/Acre)
________	________	________	-	________	=	________
________	________	________	-	________	=	________
________	________	________	-	________	=	________
________	________	________	-	________	=	________
________	________	________	-	________	=	________
________	________	________	-	________	=	________
________	________	________	-	________	=	________
________	________	________	-	________	=	________
________	________	________	-	________	=	________

INVESTMENT PERFORMANCE WORKSHEET 1

NET FUTURE VALUE (NFV)

The NFV reflects the amount of money available at the end of an investment. It is calculated by subtracting NET FUTURE COST (NFC) from NET FUTURE INCOME (NFI), as shown below. Begin by transferring each Net Cost and Net Income from the CASH FLOW WORKSHEET to the appropriate table below. Then, compound each Net Cost and Net Income from when it occurs to the end of the investment.

Name of Investment Project______________________

Length of Investment____________ Date Analyzed____________

Interest Rate_________% Inflation Rate___________%

Real Product Price Change______________%

NET FUTURE COST (NFC)

Time	Net Cost ($/Acre)		Compounding Factor[a]		Net Future Cost ($/Acre)
________	______	x	______	=	________
________	______	x	______	=	________
________	______	x	______	=	________
________	______	x	______	=	________
________	______	x	______	=	________

NFC = $________
(Sum Column)

NET FUTURE INCOME (NFI)

Time	Net Income ($/Acre)		Compounding Factor[a]		Net Future Income ($/Acre)
_______	_________	x	_______	=	$____________
_______	_________	x	_______	=	$____________
_______	_________	x	_______	=	$____________
_______	_________	x	_______	=	$____________
_______	_________	x	_______	=	$____________

NFC = $
(Sum Column)

[a]Net Cost or Net Income is thought of as occurring at the end of the year. To carry it to the end of the investment, compound it for a time period equal to the Length of Investment minus the Time the Activity occurs. A net amount occurring at the end of Time 30 would be compounded 20 years to the end of a 50-year investment. Use interest factors from Appendix Table 1 for one-time amounts and those from Appendix Table 2 for yearly amounts.

Finally, NFV is calculated:

NFV = NFI - NFC

NFV = $__________ - $__________

NFV=$+ /Acre	or, if negative	NFV=$- /Acre

INVESTMENT PERFORMANCE WORKSHEET 2

NFV can be either positive, zero, or negative. A positive NFV shows that the investment has more future income than future cost, and that it has earned more than the rate of interest used in the problem (what we assume could be earned in some alternative investment). In the unlikely event that NFV = 0 (i.e., future income = future cost), then the investment and its hypothetical alternative both earn the same rate of interest—that used in the problem. When NFV is negative, future cost exceeds future income, and the investment earns less than the interest rate used.

RATE OF RETURN (ROR)

The ROR of a particular investment is the rate, expressed as a percent, at which the investment earns or loses money. Calculate the ROR in the following three steps:

Name of Investment Project______________________________

Length of Investment________________ Date Analyzed_______________

Interest Rate_____________% Inflation Rate______________%

Real Product Price Change________________%

Step 1:

To find NET PRESENT COST (NPC), transfer each Net Cost, and Time it occurs, from the CASH FLOW WORKSHEET to the table below. Then discount each Net Cost from the Time it occurs back to the beginning of the investment (use Appendix Table 3 for one-time discount factors and Appendix Table 4 for yearly items). Finally, add the Net Present Cost column to get NPC.

NET PRESENT COST (NPC)

Time	Net Cost ($/Acre)		Discounting Factor[a]		Net Present Cost ($/Acre)
________	____________	x	____________	=	$____________
________	____________	x	____________	=	$____________
________	____________	x	____________	=	$____________
________	____________	x	____________	=	$____________
________	____________	x	____________	=	$____________
				NPC =	$____________

[a]To discount a Net Cost to the beginning of the investment, discount the cost for a time period equal to the Time it occurs. A net amount at Time 1 would be discounted 1 year, and a net amount at Time 15, 15 years.

INVESTMENT PERFORMANCE WORKSHEET 3

Step 2:

Next, find an investment Accumulation Factor by using NFI from INVESTMENT PERFORMANCE WORKSHEET 1 and NPC from Step 1.

Length of Investment = ____________________

Accumulation Factor = NFI + NPC

Accumulation Factor = ________[a] + ________

Accumulation Factor = ____________________

[a]If NFI is negative, the accumulation factor calculation still is valid; however, the resulting ROR then will represent the rate at which money is lost rather than gained, signifying an unprofitable investment.

[b]Since the *exact* Accumulation Factor seldom appears in the table, you may have to read "between the columns" (interpolate) to locate the factor in the table. You also would, then, interpolate between the corresponding interest rates at the head of the columns. For instance, because an Accumulation Factor of 404.1 over a 50-year rotation falls nearer the 13% factor (450.74) than the 11% factor (184.56), the ROR is estimated as 13.0%, as shown in the excerpt from Appendix Table 1.

Step 3:

Finally, estimate the ROR by using Appendix Table 1. Start on the YEARS row corresponding to the Length of the Investment and read *across* the row to find the number closest to the Accumulation Factor just calculated. Then, read *up* the column to find the RATE OF INTEREST.[b] This RATE OF INTEREST is the approximate ROR.

For the Accumulation Factor found in Step 2, the ROR is:

ROR = %

Table 1. FACTORS FOR COMPOUNDING ONE-TIME AMOUNTS. (excerpt)

	RATE OF INTEREST			
YEARS	9%	11%	13%	15%
1	1.09	1.11	1.13	1.15
2	1.19	1.23	1.28	1.32
3	1.30	1.37	1.44	1.52
4	1.41	1.52	1.63	1.75
5	1.54	1.69	1.84	2.01
6	1.68	1.87	2.08	2.31
7	1.83	2.08	2.35	2.66
8	1.99	2.30	2.66	3.06
9	2.17	2.56	3.00	3.52
10	2.37	2.84	3.39	4.05
45	48.33	109.53	244.64	538.77
50	74.36	184.56	450.74	1083.66

The Woodland Workbook is a collection of publications prepared by the Oregon State University Extension Service specifically for owners and managers of private, nonindustrial woodlands. The Workbook is organized into separate sections, containing information of long-range and day-to-day value for anyone interested in wise management, conservation, and use of woodland properties. It's available in a 3-ring binder with tabbed dividers for each section.

For information about how to order, and for a current list of titles and prices, inquire at the office of the OSU Extension Service that serves your county.

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