



LAKE STATES WOODLANDS

How to Evaluate Forestry Investments



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Woodland owners typically don't have an economic motive in mind when they set out to manage their woods. Most owners are probably not interested in maximizing profit because owning and managing a woodland is often considered a hobby. However, landowners, like the rest of us, don't like to *throw* money away either!

Whether forest management is a hobby or business, *any outlay of funds does represent an investment*. Therefore, knowing your expected returns should be as valuable to you as a landowner as is biological information. You wouldn't think of putting money into a savings account or into bonds if your banker or broker couldn't give you some idea of future returns! And most people wouldn't think of pursuing a hobby without spending their discretionary dollars efficiently.

This publication introduces a number of basic investment concepts and why they are important to you, the forest landowner. Criteria for evaluating forest investments (rate of return and present net value) are explained with the aid of a simple example. The publication also covers the collecting of information and guidelines on what should be included in a typical analysis.

Why Analyze Forestry Investments?

Many woodland owners just want to break even or cover their costs when they conduct forest management activities. Others would like to pay the taxes or avoid losing money, even though maximizing profit is not the main goal. However, there are several reasons for learning more about your forestry financial picture.

Some forestry practices are good investments, whereas others represent a poor use of funds. If you are interested in managing your forest, one important reason for comparing investment options is to *identify*

the most efficient projects. Your capital (cash) available for forestry is probably limited. You can't make all the worthwhile investments you would like. In immature timber stands, cultural practices such as pruning and precommercial thinning, are examples of activities that you should *scrutinize carefully* before undertaking. Analyzing expected cash-flows helps determine whether the added benefits of increased clear-wood volume or faster growth rates, sufficiently outweigh their costs. With such information you can make better management decisions and invest your limited funds more efficiently.

A second reason is the *awareness of incomes you give up* when your goal is something other than maximum economic return. Dollars given up are labeled "opportunity costs" by economists, because they measure what is lost by not choosing the "best" investment opportunity. For example, if your primary goal is to have more ruffed grouse per acre, you might harvest the area in smaller units than if you wanted the maximum financial return. Such a harvest might result in lower stumpage prices for the timber removed. Or, you may decide to delay an aspen harvest 5 or 10 years, just when the risk from disease is highest. An investment analysis helps evaluate the impact of any "lost" revenues from these decisions. You can judge whether additional grouse or standing (but dying) aspen trees are worth it compared to the dollars given up.

Changes in our tax laws, following the Tax Reform Act of 1986, are yet another reason for viewing forestry as an investment. Cash-flow projections will be useful in establishing "a profit motive" in the management of your forest property. Profit motivation is important in demonstrating that your forestry operation is either a business or an investment. Either classification will *usually* result in more favorable income tax treatment than the hobby or passive categories. A cash-flow

statement showing expected costs and incomes over time, along with an estimate of the investment's profitability, will help demonstrate an intent to manage the forest as a business, or as part of a business, and not just as a hobby.

Analyzing an Investment: Basic Concepts

Analyzing a typical forestry investment is not an easy task. The procedures may involve lengthy equations and tedious calculations. Additional complications arise because many variables are difficult to measure or estimate. You must also predict yields and returns from future harvests, in a world with changing levels of inflation, taxes, costs, prices, and other economic/physical factors. Although similar to daily activity in the business community, the extremely long time period required for growing trees makes forest finance more unique and adventuresome.

With these complications, one is tempted to just compare today's costs to the incomes produced. However, doing so ignores a major element — time, and its impact on forestry investments. The time factor is resolved by applying an appropriate interest rate to the problem, along with the proper equations, compound interest tables, and the concepts of compounding and discounting.

Compounding is the process of estimating the future value of an amount invested today. This is what your bank does when it adds interest to your account each month, year, etc. Discounting — the reverse of compounding — is traditionally used for evaluating forestry investments. The unknown is the present value of the investment; what is it worth today? Or stated another way, how much would you have to invest now to receive a specified future amount if the interest rate were say, 7 percent?

The compounding equation for estimating an investment's future value is:

$$FV = PV (1 + i)^n$$

where FV = The future value.
 PV = The present (or current) value of the investment.
 i = The compound interest rate divided by 100.
 n = The length of the investment in years.

Compound interest tables (Appendix A) are often used to obtain the value of $(1 + i)^n$ directly. The present

value equation (for discounting) is obtained by rewriting the future value equation:

$$PV = FV / (1 + i)^n$$

The Interest Rate

The interest rate is a measure of what you gain (or lose) by receiving your money later rather than now. If you receive your money later, as is often the case with forestry projects, you don't have the option of investing it at the current rate. When discounting future returns, this rate is called the discount rate. It is the rate to use for calculating present value. Choosing an appropriate discount rate is one of the first decisions you must make when evaluating forestry investments.

The discount rate that should be used to evaluate your forestry investment is the rate that is *reasonable and appropriate* for *your* situation. Although the decision is somewhat subjective, two approaches are often used.

One recommendation is to use the rate you could receive if you invested your funds elsewhere — if the risks were comparable. If your best alternative is a certificate of deposit paying 6 percent at your local bank, a discount rate of 6 percent would be reasonable when evaluating a forestry investment. A second approach is to use the rate that would be charged if you borrowed the funds to invest in forestry activities.

Present Net Value

The Present Net Value (PNV) is one of several methods — along with rate of return, benefit/cost ratio, and others — for comparing investment options. The PNV may be somewhat harder to understand, or to compare with other investments, than the rate of return, but it is much easier to calculate. The PNV is the sum of all discounted incomes minus all discounted costs over the life of an investment. The PNV can be positive, negative, or zero. For example, if you start with the basic equation presented earlier, you would have the following for estimating present net value of an investment having a single cost and a single income:

$$PNV = I / (1 + i)^n - C / (1 + i)^n$$

where: PNV = Present net value.
 I = Future value of the income.
 C = Future value of the cost.
 i = The discount (interest) rate / 100.
 n = The year in the investment period (year 0, year 1, year 20, etc.) when the cost or income occurs.

Typically, forestry investments involve a number of costs and, hopefully, a number of incomes throughout

the investment period, which is often the same as the rotation length. However, the method of estimating PNV remains the same:

- ◆ Divide each cost and income by the appropriate discount factor, which is $(1 + i)^n$.
- ◆ Add all discounted costs and incomes together. Costs should have a negative sign, incomes a positive sign.
- ◆ The resulting sum is the present net value.

Calculating PNV: A Simple Example

Suppose we have the following projected cost and income situation:

Year of Occur.	Cost/Acre	Income/Acre	Activity
0	\$80	0	Planting trees
20	0	\$150	Thinning - pulpwood
50	0	\$750	Harvest - sawtimber

If we use a discount rate of 4 percent, the following calculations are needed to estimate PNV:

Year	Amount (\$/Acre)	Discount Factor	PV (\$/Acre)
0	-\$80	1.0000	-\$80.00

The discount factor is 1.0 for all amounts that occur in the initial year (year 0).

20	\$150	2.1911	\$68.46
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The discount factor for 20 years at 4 percent is 2.1911 (Appendix A); and \$150 divided by 2.1911 = \$68.46.

50	\$750	7.1067	\$105.53
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The discount factor for 50 years at 4 percent is 7.1067 (Appendix A); and \$750 divided by 7.1067 = \$105.53.

The present net value for this example is found by adding together the three present values from above:

$$PNV = \$105.53 + \$68.46 - \$80.00 = \$93.99/\text{Acre}$$

Comparing PNVs

Normally, when comparing PNVs from two or more investments, the option with the highest PNV is the one to choose. However, the size of the investment might also be a factor. For example, if Option A has a PNV of \$400 and Option B a PNV of \$200, you would normally choose A. But, suppose Option A costs \$50,000 over a 20-year period and you know you can't lay your hands on that much cash. In such a case you'll have to settle for Option B! And, there may be other factors causing

you to choose something other than the option with the highest PNV, such as your management goals for the property. In either situation, by comparing PNVs, you'll know the opportunity costs associated with your decision.

The Internal Rate of Return

Often, when investments are discussed, performance is based on rate of return — sometimes called Return on Investment (ROI) or Internal Rate of Return (IRR) — and not present net value. Returns from savings accounts, stocks, and bonds are normally quoted as rates of return in percent. The internal rate of return is a simple concept, even though it may be difficult to compute for most forestry investment scenarios.

The IRR is the compound rate of interest (the discount rate) that makes the present value of all expected future incomes minus the present value of all expected future costs exactly equal to zero; i.e., that makes $PNV = 0$. Stated somewhat differently, it is the rate of interest that makes the sum of all discounted incomes equal to the sum of all discounted costs.

In most cases it is impossible to obtain the IRR by hand in a single step. Generally, a special computer program designed to "solve for i ", the IRR, will be needed. Such programs, WORTH from University of Wisconsin-Extension and CASH from University of Minnesota-Extension, are available for those who have an IBM or compatible computer (see the section "A Final Word" for details). If you have lots of time (and patience) you can estimate the IRR by calculating PNV repeatedly with a number of different discount rates, until you find a rate that gives a PNV equal to, or close to, zero.

The IRR for the short example presented earlier is 6.3 percent, as calculated by program WORTH. As expected, this is higher than the discount rate of 4 percent, since the PNV (\$93.99) was greater than zero at 4 percent.

Comparing IRRs

The option that generates the greatest IRR is normally the preferred investment. However, as with the PNV approach, there may well be other factors that affect your decision. And, when comparing IRRs you must be sure that all of the rates were calculated in a like manner. One possible difference that can be particularly troublesome is when one rate includes the impact of inflation and the other does not. This precaution is covered in the section on "What About Inflation?"

The Real World

In the real world of forestry investments you normally have numerous expenditures at various times throughout the rotation (or investment) period. And, you hope, periodic incomes are received throughout as well. Some of the costs and incomes are incurred annually and must be properly considered in the analysis. Details on these calculations are presented later.

When considering future outcomes, you may also need to estimate cost and price changes caused by inflation and other factors. And sometimes you are interested in the impacts of income taxes on your investment outcome. All of these realities can further complicate the analysis and make calculations more time-consuming. However, the basics, as presented with the simple example, remain unchanged. Therefore, it is important to understand the concepts before beginning your evaluation.

Gathering the Information

Before you start “pushing the pencil” it is important to first collect the information, both physical and financial, that you’ll need. Physical information includes the expected inputs and outputs of man-hours, timber volumes, etc., and the dates you expect them to occur. Financial information includes expected costs, product prices, discount and inflation rates. The cash flows in your analysis should all be in the same terms — usually in dollars per acre. An example may help to show what is needed.

Suppose you consider planting red pine, with the idea of getting one or two intermediate yields of pulpwood, followed by a final harvest of sawlogs. It is helpful first to prepare a time line to focus on the needed information (compare to previous example):

YEAR	ACTIVITY
1990	Tree planting costs in year 0.
1993	Herbicide release costs at age 3.
2010	First thinning at age 20; for pulpwood.
2020	Second thinning at age 30; for pulpwood.
2040	Final harvest at age 50; for sawtimber

The ages and years shown are just examples, and would vary for each situation. It is important to identify when you expect the events to occur, and then develop the information needed. In this example you

would need to determine how many trees to plant per acre, the cost per acre of planting stock, and the cost of planting. Deciding whether to plant trees by hand, use a rented tree planter, or hire the job done, will affect the cost you assign to planting. When assigning herbicide costs for 1993, estimate the costs of both the chemical and the application. Will you apply it yourself or hire the job done?

Estimating Harvest and Thinning Incomes is a Two-Step Process:

- ◆ *First*, estimate the physical output of cords and board feet per acre. You can use yield tables or growth equations for red pine. However, you should get your forester’s help with these figures. Thinning yields are affected by past growth rates and the amount removed, so estimating output is not always a straightforward task.
- ◆ *Second*, assign dollar values to the physical yields. What is the appropriate price per cord and MBF? You could use current values from the Wisconsin Forest Products Price Review or from local sources; however, you may feel these will change over time. If so, you will need to estimate the magnitude and direction of the changes, and adjust prices accordingly (more on this in a later section).

Other Costs or Cost Factors to Consider

In some forestry investment evaluations *annual expenses* for administration, property taxes, etc., may need to be included. And, you may have a hunting lease on the property, and the income might be part of your forestry investment. The costs of obtaining a *management plan, timber cruise, marking of trees*, etc., are often included in the analysis. Whether to include these and other items is sometimes not clear. Costs, such as property taxes, that would be incurred even if you didn’t pursue the forestry project can usually be ignored.

The question of whether to include *land costs* is often raised. If you already own or are in the process of buying the land you can ignore these costs because they are not a direct result of the forestry project you are considering. However, if you would have to purchase or lease land specifically for forestry, include such costs.

Another difficult question is whether to include the *costs of your own labor*. It depends a lot on how you view your forestry operation. If it is indeed a business, or if you have to give up other income producing

activity when working in the woods, then assign your labor a value and include it in the analysis. Even if it's a hobby, you may still wish to include all labor costs so that you can properly compare forestry to other investment options. If the activity is viewed as purely recreational, and you're willing to write off your time, then exclude the value of your labor.

If you must borrow money to undertake the forestry project, this *cost of capital* should be included (i.e. periodic interest charges, loan fees, etc.). If you receive *cost share payments*, deduct these from your estimated costs in the appropriate year.

You should include the costs of *all tools, equipment, supplies, and services* that have been purchased or leased specifically for the forestry project. Large items that would have utility for other projects, both forestry and non-forestry, could be amortized over all of these projects.

Should *income taxes* be included? Do you want a before-tax or after-tax analysis? Considering the tax consequences of each forestry investment item should not be taken lightly; it is no easy task! The formulas must be modified, and not all in the same way. If the consequences would be similar for the various projects and options you are comparing, there is no need to consider income taxes. Doing so would not change the *relative* ranking of your various investment opportunities. However, if the tax consequences would differ greatly among the various projects, you may need to do the more complicated after-tax analysis.

If you are considering whether to perform a management practice, or do nothing at all, you can usually omit many costs and returns because they won't be relevant to the decision. For example, should you perform timber stand improvement or do nothing in your hard maple poletimber stand? In this case you can ignore all past costs (purchase costs, earlier treatments, previous tax payments, etc.) because they don't relate directly to the proposed practice. With such "*marginal decisions*" you only need to include treatment expenses and other relevant costs and incomes that will occur in the future.

In many cases, you will find that reliable data are not available to set cost and income values with the certainty you would like. Often you are forced to make educated estimates based on limited information, particularly with the long time periods that are typical of forestry. However, these assumptions *must* be made using the best available information and guidelines. You simply must remember that your answers are also estimates, and view them as *expected*, rather than *absolute* outcomes.

Including an Annual Cost or Income

Sometimes you need to include costs or incomes that occur in *every* year of the investment period. You could estimate their PV by discounting each yearly amount separately, but fortunately there is an easier way. The discounted present value of annual costs or incomes is determined in a single step with a different equation. Before using the equation it is convenient to first determine your *Net Annual Return* (either positive or negative). Add up such things as property taxes, administrative costs, insurance, income from hunting leases, etc — anything that occurs *every* year. Costs are negative and incomes are positive. Discount the net annual return with the following equation to obtain the present value of all annual costs and incomes:

$$PV_a = \frac{NAR [(1 + i)^t - 1]}{i [(1 + i)^t]}$$

Where: PV_a = Present value of all annual costs and incomes.

NAR = Net annual return.

i = The discount rate divided by 100.

t = The length of the investment period (years).

Values for $(1 + i)^t$ can be found from the tables in Appendix A.

For example, let's now add an annual cost of \$6/acre/year for property taxes, and an annual income of \$4/acre/year from a hunting lease to the sample problem:

The net annual return of the lease (income) and taxes (cost) is $\$4.00 - \$6.00 = -\$2.00$ per acre per year for 50 years.

Using the equation for discounting the net annual return gives the following present value:

$$PV_a = \frac{-2.00 [(1 + .04)^{50} - 1]}{.04 [(1 + .04)^{50}]}$$

$$PV_a = \frac{-2.00 [7.1067 - 1]}{.04 [7.1067]}$$

$$PV_a = -2.00 [21.4822]$$

$$PV_a = -\$42.96$$

If you add this present value to the original PNV, the new PNV = $\$93.99 - \$42.96 = \$51.03$.

The IRR for this modified example is now 5.2 percent.

What About Inflation?

Because inflation can substantially affect long-term future values, the question arises as to whether investment analyses should include these impacts. When the inflation rate was low, it was usually ignored in forestry analyses and few problems arose. However, when inflation reached record heights in the late 1970s, the picture changed. If double-digit inflation was included in one investment and not in another, comparing IRRs could lead to the wrong conclusion.

Therefore, it is extremely important to make sure that inflation is treated the same way in all investment options when you calculate and compare rates of return. Either include the inflation rate in each, or exclude it in each; *be consistent.* This point cannot be overemphasized! Once you are sure that inflation was treated consistently among the various projects, you can properly compare rates of return.

When inflation is excluded, the resulting IRR is a *real* rate of return. When inflation is included, as with quoted returns from savings accounts and CDs, the rate of return is in *nominal* terms. For example, if a CD earns a nominal rate of 7 percent, and inflation is 3 percent, the real IRR would be 4 percent. A valid comparison of IRRs is possible only when they are *all real rates, or all nominal rates.* Failure to make this distinction between real and nominal rates has frequently undervalued forestry options compared to other investments.

When PNVs are used to compare investments the issue is moot. Present net values, *when properly calculated,* are the same regardless of whether inflation was included or not. For the sake of simplicity, ignore inflation when calculating PNVs.

Real Changes in Prices or Costs

Often a particular income or cost item may increase (or decrease) in real terms over time. These changes are greater (or less) than the impact of general inflation. Real changes are normally caused by shifts in resource supplies or consumer demand. For example, red oak sawtimber stumpage prices increased about 4.5 percent per year (compound interest) in real terms over the past 20 years in Wisconsin. This was due primarily to increasing demand for oak products at a time when supplies of high-quality oak were declining. However, during the previous 20-year period (1948-68) the real price of red oak stumpage declined, at a compound rate of -0.9 percent per year.

If you believe that real changes will occur, adjust your estimates of future returns accordingly. The accepted method is to estimate the annual compound rate of

change expected and then use the Future-Value equation, along with the present value of the item, to estimate the future return. For example, suppose you believe that sawtimber stumpage prices will increase at the rate of 1 percent per year above inflation in the sample problem. Instead of a final income of \$750/acre, the future value (income) would be:

$$FV = \$750 (1 + .01)^{50}$$

$$FV = \$750 (1.6446) = \$1233.47/\text{acre}$$

This new value would then be discounted as before when calculating PNV.

Expanding the Example Problem

If the example problem included all of the modifications discussed here, the combined cash-flow would be:

Year of Occur.	Cost/ Acre	Income/ Acre	Activity
0	\$80	0	Planting trees
3	40	0	Herbicide release
20	0	\$150	Thinning - pulpwood
30	0	\$120	Thinning - pulpwood
50	0	\$1233.47	Harvest - sawtimber

Annual cost = \$6.00/acre for taxes.

Annual income = \$4.00/acre from a hunting lease.

Sawtimber stumpage prices will increase at 1 percent per year.

If you again use a discount rate of 4 percent, the PNV is calculated as before:

Year	Amount (\$/Acre)	Discount Factor	PV (\$/Acre)
0	-\$80	1.0000	-\$80.00
3	-\$40	1.1249	-\$35.56

The discount factor for 3 years at 4 percent is 1.1249 (Appendix A); and \$40 divided by 1.1249 = \$35.56.

20	\$150	2.1911	\$68.46
30	\$120	3.2434	\$37.00

The discount factor for 30 years at 4 percent is 3.2434 (Appendix A); and \$120 divided by 3.2434 = \$37.00.

50	\$1233.47	7.1067	\$173.56
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The final return of \$750/acre is expected to grow at the rate of 1 percent per year above inflation to \$1233.47/acre. The discount factor for 50 years at 4 percent is 7.1067 (Appendix A); and \$1233.47 divided by 7.1067 = \$173.56.

1-50	-\$2	21.4822	-\$42.96
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The annual cost of \$6.00/acre and the annual income of \$4.00/acre generate an annual net return of -\$2.00/

acre and when multiplied by the discount factor of 21.4822 yield a PV = -\$42.96.

The present net value is found by adding together the individual present values:

$$\text{PNV} = \$173.56 + \$37.00 + \$68.46 - \$35.56 - \$80.00 - \$42.96 = \$120.50/\text{acre}$$

The internal rate of return for this expanded example is 5.8 percent, and presents what may seem to be an inconsistency. The new PNV is higher than the initial PNV of \$93.99/acre, but the new IRR is lower than the initial IRR of 6.3 percent. How come? The reason involves the change in size of the investment. Because of greater costs and incomes the scale of the investment increased in magnitude and resulted in a higher level of PNV, even though the earning power, as measured in percentage terms by the IRR, went down.

This demonstrates why the two criteria may rank investments differently in some cases if the size of the investments vary. However, this doesn't mean that one is necessarily right and the other wrong. Some people place greater emphasis on additions to net worth (total wealth), others are more concerned with return on capital, and some individuals simply have more (or fewer) resources to invest than do others. These and other factors all affect whether the PNV or the IRR is the preferred criterion.

Both criteria yield the same answer when used to evaluate whether an investment is *profitable*. That is, when PNV is greater than zero, the IRR is greater than the discount rate and vice versa.

Comparing Investments of Unequal Length

Sometimes you may want to compare two or more investments that differ in length; e.g. one is 50 years in length and the other may be 25 years long. If you use the IRR criterion for these comparisons you have no problem; however, if PNV is used the discounted value for all but the longest alternative will be underestimated. To avoid this problem, the investments should be rescaled to an equal length.

A common method for rescaling investment options of different lengths is to repeat complete cycles of the projects until the total time spans used are equal. The number of repetitions depends on the lengths of the projects. If the longer option's length (in years) divided by the shorter option's length is a whole number, simply repeat the shorter option that many times. For example, suppose you want to compare the 50-year sample problem (as originally presented) with an

investment having a length of 100 years; all items in the sample problem should be repeated for a second cycle as follows:

Year of Occur.	Cost/ Acre	Income/ Acre	Activity
0	\$80	0	Planting trees
20	0	\$150	Thinning - pulpwood
50	0	\$750	Harvest - sawtimber
50	\$80	0	Planting trees
70	0	\$150	Thinning - pulpwood
100	0	\$750	Harvest - sawtimber

The calculations would be performed as before, resulting in an adjusted PNV of \$107.22. As indicated the IRR would remain at 6.3 percent, unchanged from the original single-cycle solution.

If the longer option's length is not a whole-number multiple (e.g. 2,3, etc.) of the shorter one, then you must rescale both options. You would need to use the shortest common time period that is a whole-number multiple of each option's length.

Asking "What If" Questions

As mentioned before, you are often faced with estimating future costs and returns based on little hard evidence. So, do the best you can. However, there is a technique that can shed some light on how serious your errors of estimation might be. If you solve the calculations repeatedly for several different values of the same item, you can see how sensitive PNV or the IRR is to these changes.

For example, suppose you change the sawtimber stumpage price by 20 percent and it only changes the PNV by 5 percent. This indicates that an error in estimating future stumpage prices would not be too serious when computing PNV; the PNV is not very sensitive to stumpage prices. However, suppose a 10 percent change in the cost of herbicide caused an 8 percent change in PNV. This might indicate that considerable care should be taken when estimating herbicide costs; the sensitivity is fairly high.

To do much of this requires many repetitions of the same basic calculations. Obviously this is not for the faint of heart, or more probably, not for one without a computer and proper software.

A Few Rules of Thumb

A few rules of thumb may be useful when evaluating forestry investments:

- ◆ Costs or returns that occur early in the investment period usually have a greater impact on PNV and

the IRR than do those that occur near the end of the period.

- ◆ The larger the dollar amount of a cost or return, the greater its impact on PNV and IRR.
- ◆ The higher the discount rate used, the more favorable will be investment options that have early incomes; low discount rates allow incomes to be postponed longer.

A Final Word

Because forestry opportunities differ greatly in financial potential, it is important for you to analyze your investment situations individually. Published guidelines may be helpful in providing some general direction, but you and your forester, or investment advisor, need to *look closely at your specific situation*.

See the list of selected references for *other publications* available on forestry investments. And, be sure to check with your forester to learn more about the subject. For those readers with a microcomputer (IBM or compatible), *computer programs for forestry investments* are available. These programs will remove the drudgery from investment analysis calculations.

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APPENDIX A

Compound Interest TableValues of $(1 + i)^n$

Years	Where i (in percent form) =					
n	0.5	0.75	1.0	1.25	1.5	1.75
1	1.0050	1.0075	1.0100	1.0125	1.0150	1.0175
2	1.0100	1.0151	1.0201	1.0252	1.0302	1.0353
3	1.0151	1.0227	1.0303	1.0380	1.0457	1.0534
4	1.0202	1.0303	1.0406	1.0509	1.0614	1.0719
5	1.0253	1.0381	1.0510	1.0641	1.0773	1.0906
6	1.0304	1.0459	1.0615	1.0774	1.0934	1.1097
7	1.0355	1.0537	1.0721	1.0909	1.1098	1.1291
8	1.0407	1.0616	1.0829	1.1045	1.1265	1.1489
9	1.0459	1.0696	1.0937	1.1183	1.1434	1.1690
10	1.0511	1.0776	1.1046	1.1323	1.1605	1.1894
11	1.0564	1.0857	1.1157	1.1464	1.1779	1.2103
12	1.0617	1.0938	1.1268	1.1608	1.1956	1.2314
13	1.0670	1.1020	1.1381	1.1753	1.2136	1.2530
14	1.0723	1.1103	1.1495	1.1900	1.2318	1.2749
15	1.0777	1.1186	1.1610	1.2048	1.2502	1.2972
16	1.0831	1.1270	1.1726	1.2199	1.2690	1.3199
17	1.0885	1.1354	1.1843	1.2351	1.2880	1.3430
18	1.0939	1.1440	1.1961	1.2506	1.3073	1.3665
19	1.0994	1.1525	1.2081	1.2662	1.3270	1.3904
20	1.1049	1.1612	1.2202	1.2820	1.3469	1.4148
25	1.1328	1.2054	1.2824	1.3642	1.4509	1.5430
30	1.1614	1.2513	1.3478	1.4516	1.5631	1.6828
35	1.1907	1.2989	1.4166	1.5446	1.6839	1.8353
40	1.2208	1.3483	1.4889	1.6436	1.8140	2.0016
45	1.2516	1.3997	1.5648	1.7489	1.9542	2.1830
50	1.2832	1.4530	1.6446	1.8610	2.1052	2.3808
55	1.3156	1.5083	1.7285	1.9803	2.2679	2.5965
60	1.3489	1.5657	1.8167	2.1072	2.4432	2.8318
65	1.3829	1.6253	1.9094	2.2422	2.6320	3.0884
70	1.4178	1.6872	2.0068	2.3859	2.8355	3.3683
75	1.4536	1.7514	2.1091	2.5388	3.0546	3.6735
80	1.4903	1.8180	2.2167	2.7015	3.2907	4.0064
85	1.5280	1.8873	2.3298	2.8746	3.5450	4.3694
90	1.5666	1.9591	2.4486	3.0588	3.8189	4.7654
95	1.6061	2.0337	2.5735	3.2548	4.1141	5.1972
100	1.6467	2.1111	2.7048	3.4634	4.4320	5.6682

Compound Interest TableValues of $(1 + i)^n$

Years	Where i (in percent form) =					
n	2.0	2.5	3.0	3.5	4.0	4.5
1	1.0200	1.0250	1.0300	1.0350	1.0400	1.0450
2	1.0404	1.0506	1.0609	1.0712	1.0816	1.0920
3	1.0612	1.0769	1.0927	1.1087	1.1249	1.1412
4	1.0824	1.1038	1.1255	1.1475	1.1699	1.1925
5	1.1041	1.1314	1.1593	1.1877	1.2167	1.2462
6	1.1262	1.1597	1.1941	1.2293	1.2653	1.3023
7	1.1487	1.1887	1.2299	1.2723	1.3159	1.3609
8	1.1717	1.2184	1.2668	1.3168	1.3686	1.4221
9	1.1951	1.2489	1.3048	1.3629	1.4233	1.4861
10	1.2190	1.2801	1.3439	1.4106	1.4802	1.5530
11	1.2434	1.3121	1.3842	1.4600	1.5395	1.6229
12	1.2682	1.3449	1.4258	1.5111	1.6010	1.6959
13	1.2936	1.3785	1.4685	1.5640	1.6651	1.7722
14	1.3195	1.4130	1.5126	1.6187	1.7317	1.8519
15	1.3459	1.4483	1.5580	1.6753	1.8009	1.9353
16	1.3728	1.4845	1.6047	1.7340	1.8730	2.0224
17	1.4002	1.5216	1.6528	1.7947	1.9479	2.1134
18	1.4282	1.5597	1.7024	1.8575	2.0258	2.2085
19	1.4568	1.5987	1.7535	1.9225	2.1068	2.3079
20	1.4859	1.6386	1.8061	1.9898	2.1911	2.4117
25	1.6406	1.8539	2.0938	2.3632	2.6658	3.0054
30	1.8114	2.0976	2.4273	2.8068	3.2434	3.7453
35	1.9999	2.3732	2.8139	3.3336	3.9461	4.6673
40	2.2080	2.6851	3.2620	3.9593	4.8010	5.8164
45	2.4379	3.0379	3.7816	4.7024	5.8412	7.2482
50	2.6916	3.4371	4.3839	5.5849	7.1067	9.0326
55	2.9717	3.8888	5.0821	6.6331	8.6464	11.2563
60	3.2810	4.3998	5.8916	7.8781	10.5196	14.0274
65	3.6225	4.9780	6.8300	9.3567	12.7987	17.4807
70	3.9996	5.6321	7.9178	11.1128	15.5716	21.7841
75	4.4158	6.3722	9.1789	13.1986	18.9453	27.1470
80	4.8754	7.2096	10.6409	15.6757	23.0498	33.8301
85	5.3829	8.1570	12.3357	18.6179	28.0436	42.1585
90	5.9431	9.2289	14.3005	22.1122	34.1193	52.5371
95	6.5617	10.4416	16.5782	26.2623	41.5114	65.4708
100	7.2446	11.8137	19.2186	31.1914	50.5049	81.5885

Compound Interest TableValues of $(1 + i)^n$

Years

Where i (in percent form) =

n	5.0	5.5	6.0	6.5	7.0	7.5
1	1.0500	1.0550	1.0600	1.0650	1.0700	1.0750
2	1.1025	1.1130	1.1236	1.1342	1.1449	1.1556
3	1.1576	1.1742	1.1910	1.2079	1.2250	1.2423
4	1.2155	1.2388	1.2625	1.2865	1.3108	1.3355
5	1.2763	1.3070	1.3382	1.3701	1.4026	1.4356
6	1.3401	1.3788	1.4185	1.4591	1.5007	1.5433
7	1.4071	1.4547	1.5036	1.5540	1.6058	1.6590
8	1.4775	1.5347	1.5938	1.6550	1.7182	1.7835
9	1.5513	1.6191	1.6895	1.7626	1.8385	1.9172
10	1.6289	1.7081	1.7908	1.8771	1.9672	2.0610
11	1.7103	1.8021	1.8983	1.9992	2.1049	2.2156
12	1.7959	1.9012	2.0122	2.1291	2.2522	2.3818
13	1.8856	2.0058	2.1329	2.2675	2.4098	2.5604
14	1.9799	2.1161	2.2609	2.4149	2.5785	2.7524
15	2.0789	2.2325	2.3966	2.5718	2.7590	2.9589
16	2.1829	2.3553	2.5404	2.7390	2.9522	3.1808
17	2.2920	2.4848	2.6928	2.9170	3.1588	3.4194
18	2.4066	2.6215	2.8543	3.1067	3.3799	3.6758
19	2.5270	2.7656	3.0256	3.3086	3.6165	3.9515
20	2.6533	2.9178	3.2071	3.5236	3.8697	4.2479
25	3.3864	3.8134	4.2919	4.8277	5.4274	6.0983
30	4.3219	4.9840	5.7435	6.6144	7.6123	8.7550
35	5.5160	6.5138	7.6861	9.0623	10.6766	12.5689
40	7.0400	8.5133	10.2857	12.4161	14.9745	18.0442
45	8.9850	11.1266	13.7646	17.0111	21.0025	25.9048
50	11.4674	14.5420	18.4202	23.3067	29.4570	37.1897
55	14.6356	19.0058	24.6503	31.9322	41.3150	53.3907
60	18.6792	24.8398	32.9877	43.7498	57.9464	76.6492
65	23.8399	32.4646	44.1450	59.9411	81.2729	110.040
70	30.4264	42.4299	59.0759	82.1245	113.989	157.977
75	38.8327	55.4542	79.0569	112.518	159.876	226.796
80	49.5614	72.4764	105.796	154.159	224.234	325.595
85	63.2544	94.7238	141.579	211.211	314.500	467.433
90	80.7304	123.800	189.465	289.377	441.103	671.061
95	103.035	161.802	253.546	396.472	618.670	963.394
100	131.501	211.469	339.302	543.201	867.716	1383.08

Compound Interest TableValues of $(1 + i)^n$

Years

Where i (in percent form) =

n	8.0	8.5	9.0	9.5	10.0	10.5
1	1.0800	1.0850	1.0900	1.0950	1.1000	1.1050
2	1.1664	1.1772	1.1881	1.1990	1.2100	1.2210
3	1.2597	1.2773	1.2950	1.3129	1.3310	1.3492
4	1.3605	1.3859	1.4116	1.4377	1.4641	1.4909
5	1.4693	1.5037	1.5386	1.5742	1.6105	1.6474
6	1.5869	1.6315	1.6771	1.7238	1.7716	1.8204
7	1.7138	1.7701	1.8280	1.8876	1.9487	2.0116
8	1.8509	1.9206	1.9926	2.0669	2.1436	2.2228
9	1.9990	2.0839	2.1719	2.2632	2.3579	2.4562
10	2.1589	2.2610	2.3674	2.4782	2.5937	2.7141
11	2.3316	2.4532	2.5804	2.7137	2.8531	2.9991
12	2.5182	2.6617	2.8127	2.9715	3.1384	3.3140
13	2.7196	2.8879	3.0658	3.2537	3.4523	3.6619
14	2.9372	3.1334	3.3417	3.5629	3.7975	4.0464
15	3.1722	3.3997	3.6425	3.9013	4.1772	4.4713
16	3.4259	3.6887	3.9703	4.2719	4.5950	4.9408
17	3.7000	4.0023	4.3276	4.6778	5.0545	5.4596
18	3.9960	4.3425	4.7171	5.1222	5.5599	6.0328
19	4.3157	4.7116	5.1417	5.6088	6.1159	6.6663
20	4.6610	5.1120	5.6044	6.1416	6.7275	7.3662
25	6.8485	7.6868	8.6231	9.6684	10.8347	12.1355
30	10.0627	11.5583	13.2677	15.2203	17.4494	19.9926
35	14.7853	17.3796	20.4140	23.9604	28.1024	32.9367
40	21.7245	26.1330	31.4094	37.7194	45.2593	54.2614
45	31.9204	39.2951	48.3273	59.3793	72.8905	89.3928
50	46.9016	59.0863	74.3575	93.4773	117.391	147.270
55	68.9139	88.8455	114.408	147.156	189.059	242.619
60	101.257	133.593	176.031	231.658	304.482	399.702
65	148.780	200.878	270.846	364.685	490.371	658.488
70	218.606	302.052	416.730	574.101	789.747	1084.82
75	321.205	454.182	641.191	903.772	1271.90	1787.19
80	471.955	682.935	986.552	1422.75	2048.40	2944.30
85	693.456	1026.90	1517.93	2239.75	3298.97	4850.58
90	1018.92	1544.10	2335.53	3525.91	5313.02	7991.07
95	1497.12	2321.80	3593.50	5550.62	8556.68	13164.9
100	2199.76	3491.19	5529.04	8738.00	13780.6	21688.4

Compound Interest TableValues of $(1 + i)^n$

Years

Where i (in percent form) =

n	11.0	11.5	12.0	12.5	13.0	14.0
1	1.1100	1.1150	1.1200	1.1250	1.1300	1.1400
2	1.2321	1.2432	1.2544	1.2656	1.2769	1.2996
3	1.3676	1.3862	1.4049	1.4238	1.4429	1.4815
4	1.5181	1.5456	1.5735	1.6018	1.6305	1.6890
5	1.6851	1.7234	1.7623	1.8020	1.8424	1.9254
6	1.8704	1.9215	1.9738	2.0273	2.0820	2.1950
7	2.0762	2.1425	2.2107	2.2807	2.3526	2.5023
8	2.3045	2.3889	2.4760	2.5658	2.6584	2.8526
9	2.5580	2.6636	2.7731	2.8865	3.0040	3.2519
10	2.8394	2.9699	3.1058	3.2473	3.3946	3.7072
11	3.1518	3.3115	3.4785	3.6532	3.8359	4.2262
12	3.4985	3.6923	3.8960	4.1099	4.3345	4.8179
13	3.8833	4.1169	4.3635	4.6236	4.8980	5.4924
14	4.3104	4.5904	4.8871	5.2016	5.5348	6.2613
15	4.7846	5.1183	5.4736	5.8518	6.2543	7.1379
16	5.3109	5.7069	6.1304	6.5833	7.0673	8.1372
17	5.8951	6.3632	6.8660	7.4062	7.9861	9.2765
18	6.5436	7.0949	7.6900	8.3319	9.0243	10.5752
19	7.2633	7.9108	8.6128	9.3734	10.1974	12.0557
20	8.0623	8.8206	9.6463	10.5451	11.5231	13.7435
25	13.5855	15.2010	17.0001	19.0026	21.2305	26.4619
30	22.8923	26.1967	29.9599	34.2433	39.1159	50.9502
35	38.5749	45.1461	52.7996	61.7075	72.0685	98.1002
40	65.0009	77.8027	93.0510	111.199	132.782	188.884
45	109.530	134.082	163.988	200.384	244.641	363.679
50	184.565	231.070	289.002	361.099	450.736	700.233
55	311.002	398.215	509.321	650.712	830.452	1348.24
60	524.057	686.265	897.597	1172.60	1530.05	2595.92
65	883.067	1182.68	1581.87	2113.07	2819.02	4998.22
70	1488.02	2038.17	2787.80	3807.82	5193.87	9623.64
75	2507.40	3512.49	4913.06	6861.82	9569.37	18529.5
80	4225.11	6053.26	8658.48	12365.2	17630.9	35677.0
85	7119.56	10431.9	15259.2	22282.5	32483.9	68693.0
90	11996.9	17977.9	26891.9	40153.8	59849.4	132262
95	20215.4	30982.2	47392.8	72358.5	110269	254660
100	34064.2	53393.3	83522.3	130392	203163	490326

Compound Interest TableValues of $(1 + i)^n$

Years

Where i (in percent form) =

n	15.0	16.0	17.0	18.0	19.0	20.0
1	1.1500	1.1600	1.1700	1.1800	1.1900	1.2000
2	1.3225	1.3456	1.3689	1.3924	1.4161	1.4400
3	1.5209	1.5609	1.6016	1.6430	1.6852	1.7280
4	1.7490	1.8106	1.8739	1.9388	2.0053	2.0736
5	2.0114	2.1003	2.1924	2.2878	2.3864	2.4883
6	2.3131	2.4364	2.5652	2.6996	2.8398	2.9860
7	2.6600	2.8262	3.0012	3.1855	3.3793	3.5832
8	3.0590	3.2784	3.5115	3.7589	4.0214	4.2998
9	3.5179	3.8030	4.1084	4.4355	4.7854	5.1598
10	4.0456	4.4114	4.8068	5.2338	5.6947	6.1917
11	4.6524	5.1173	5.6240	6.1759	6.7767	7.4301
12	5.3503	5.9360	6.5801	7.2876	8.0642	8.9161
13	6.1528	6.8858	7.6987	8.5994	9.5964	10.6993
14	7.0757	7.9875	9.0075	10.1472	11.4198	12.8392
15	8.1371	9.2655	10.5387	11.9737	13.5895	15.4070
16	9.3576	10.7480	12.3303	14.1290	16.1715	18.4884
17	10.7613	12.4677	14.4265	16.6722	19.2441	22.1861
18	12.3755	14.4625	16.8790	19.6733	22.9005	26.6233
19	14.2318	16.7765	19.7484	23.2144	27.2516	31.9480
20	16.3665	19.4608	23.1056	27.3930	32.4294	38.3376
25	32.9190	40.8742	50.6578	62.6686	77.3881	95.3962
30	66.2118	85.8499	111.065	143.371	184.675	237.376
35	133.176	180.314	243.503	327.997	440.701	590.668
40	267.864	378.721	533.869	750.378	1051.67	1469.77
45	538.769	795.444	1170.48	1716.68	2509.65	3657.26
50	1083.66	1670.70	2566.22	3927.36	5988.91	9100.44
55	2179.62	3509.05	5626.29	8984.84	14291.7	22644.8
60	4384.00	7370.20	12335.4	20555.1	34105.0	56347.5
65	8817.79	15479.9	27044.6	47025.2	81386.5	140210
70	17735.7	32513.2	59293.9	107582	194217	348889
75	35672.9	68288.8	129999	246122	463471	868147
80	71750.9	143430	285016	563068	1106004	2160228
85	144317	301251	624882	1288162	2639318	5375340
90	290272	632731	1370022	2947004	6298346	13375565
95	583841	1328951	3003702	6742030	15030081	33282687
100	1174313	2791251	6585461	15424132	35867090	82817975

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