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FORVAL: Computer software package for forestry investment analysis

T. J. Straka

Steven H. Bullard
Stephen F. Austin State University, Arthur Temple College of Forestry and Agriculture, bullardsh@sfasu.edu

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Thomas J. Straka[1] and Steven H. Bullard[2]

Introduction

The valuation of forestry investments and projects presents challenging analysis problems. Calculations range from specialized problems like bare land value to standard criteria like net present value and rate of return. Financial calculators are fine for simple analyses, but forestry investments tend to be complex and often require the use of a computer investment analysis program. Most of these packages are not particularly user-friendly and few are free.

Described below is a user-friendly, free, menu-driven forestry and natural resources investment analysis computer package. FORVAL is equally applicable to industrial forestry, nonindustrial private forestry, and public forestry. Ease-of-use has made it a very popular software package.

Model Description

FORVAL (FORest VALuation) is a computer program for discounted cash flow analysis of forestry and natural resources investments. FORVAL is designed for use without a manual. Users simply answer questions displayed on the computer screen. The program can be downloaded directly from a site (http://www.cfr.msstate.edu/fwrc/products/software/Iforval.htm) or an on-line version is available for immediate use (http://www.cfr.msstate.edu/forval). A 14 page users manual with examples can be directly downloaded from the first site (Bullard et al. 1999). The user is first prompted to choose one of four options: financial criteria, monthly or annual payment, pre-commercial timber values, or projected stumpage price.

Financial Criteria

This option is used for standard financial calculations. Any cash flow or forestry investment can be analyzed. The financial criteria option requires the user to choose the type of financial calculations to make. The program presents the following financial criteria: **net present value** (the present value of all revenues minus the present value of all costs), **rate of return** (the interest rate that makes the net present value equal to zero, or the rate of return actually earned by the investment), **equal annual income** (the annual sum of money that is equivalent to a projected stream of costs and revenues), **benefit/cost ratio** (indicates a projects return per dollar of investment, it is the present value of revenues divided by the present value of costs), **all of the above** (calculates net present value, rate of return, equal annual income and benefit/cost ratio simultaneously), **land expectation value** (it is the value of land in perpetual forest production and is also called bare land value or soil expectation value), and **future value** (the value of a single cash flow at a future date).

FORVAL uses the standard assumption that all cash flows occur at the end of the year. An exception is Year 0, which represents now or today. Sometimes site preparation and tree planting occur immediately and this equates to Year 0. Besides basic **single sum** payments or revenues (a single cost or revenue that occurs just once during the life of an investment; e.g., the costs of preparing a site for tree planting), three types of payment series or annuities may be specified by the user: (i) **terminating annual series** where costs or revenues occur annually for a set period of time (an example is a payment of $3.00 per hectare annual property tax for 30 years); (ii) **perpetual annual series** where a cost or revenue occurs annually for an infinite period of time (an example is a payment of $3.00 per hectare annual property tax forever); and (iii) **perpetual periodic series** where a cost or revenue occurs periodically for an infinite time period (an example is timber harvest revenue every 30 years forever). Bullard et al. (1987) outline the use of these option is in more detail.

Table 1: Cash flow from a typical forestry investment (per hectare).

Item	Year Incurred	Type of Cost/Revenue	Amount (Dollars)
Establishment cost	0	Single sum	-160.00
Annual management & tax cost	1-27	Terminating annual	-2.50
Thinning revenue	16	Single sum	97.50
Thinning revenue	22	Single sum	156.00
Harvest revenue	27	Single sum	1,287.00

The financial criteria will be illustrated with examples from Bullard et al. (1998). A landowner asks you to determine the net present value of regenerating 40 hectares. His alternative rate of return is 4% (net of inflation, as are costs and revenues in the examples). The landowner desires to know how much the investment in one 27-year rotation will pay. The investment is outlined in Table 1.

[1] Thomas J. Straka is Professor of Forest Management at Clemson University, Clemson, SC, USA

[2] Steven H. Bullard is Interim Head of the Department of Forest Products and Director of the Institute of Furniture Manufacturing and Management, Forest and Wildlife Research Center, Mississippi State University, Mississippi State, MS, USA.

The user specifies the **net present value** option. The program allows costs and revenues to be entered and then performs the calculations when prompted. The first item is for establishment cost. The user inputs Year 0, single sum, and $160.00. Year 0 implies we replant today. If we planned to take a year for site preparation and planting, for example, we would allocate this cost to Year 1. The second item is for annual management and taxes. The user inputs terminating annual series that begins in Year 1 and ends in Year 27 for an amount of $2.50. Many costs and revenues in forestry are *annual* or occur every year. Property taxes are due each year. An annual management fee is common. Hunting lease revenue often accrues on an annual basis. The next three items are revenues in Years 16, 22, and 27 for $97.50, $156.00, and $1,287.00, respectively. The first two revenues are for thinnings and a final harvest occurs at Year 27. Each item is entered in turn with computer prompts for necessary data. Figure 1 illustrates the interactive web page used for calculations by FORVAL-online.

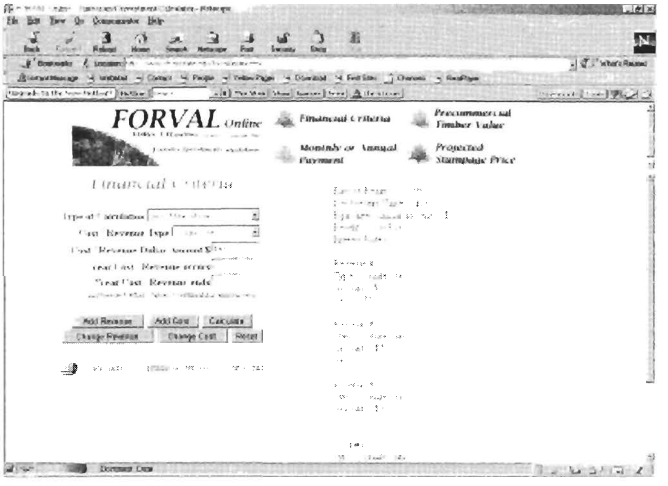
The present value option will provide the following numerical values. The net present value of this investment is $363.41 per hectare. This means the investment would earn a 4% rate of return, plus $363.41 in today's dollars. The rate of return is calculated at 8.7%. If we recalculated this example at an 8.7% interest rate, we'd expect a net present value of zero.

Equivalent Annual Income (EAI) is the annual income equivalent to a specified NPV at a specific interest rate and is calculated as $22.25 per hectare. This criterion is often used to compare or rank investments that are not equal in duration. It is popular in forestry investment analysis for comparing timberland investments with annual income from other land uses such as pasture rent or agricultural crops. Table 2 represents a typical forestry investment over a 27-year rotation. Foresters are often asked, "How does that compare to my option of renting the land as pasture at $20 per acre per year?" At 4% interest, we can calculate an equivalent annual income that will equal the NPV of Table 2. The calculation is:

$$EAI = NPV \left[\frac{0.04(1.04)^{27}}{(1.04)^{27} - 1} \right]$$

$$EAI = \$363.41 \left[\frac{0.04(1.04)^{27}}{(1.04)^{27} - 1} \right] = \$22.25$$

Figure 1: Example of an interactive web page used for calculations by FORVAL-online.



At 4% interest, a landowner should be indifferent between $363.41 today and $22.25 per year for 27 years. The values are equivalent.

The **Benefit/Cost Ratio** (B/C) of an investment is the total present value of revenues divided by the total present value of costs. An acceptable investment will have a B/C ration equal to or greater than 1. In this case, the present value of revenues at least equals the present value of costs. Public agencies most commonly use B/C ratios. In Table 2, if the sum of the three discounted revenues is divided by the sum of the two discounted costs, we obtain a B/C ratio of 2.8.

The future value option is included to allow the user to quickly calculate the future value of single sums. The only inputs are amount, interest rate, and number of compounding periods.

Land expectation value (LEV) is the value of bare land if put into perpetual forest production. It is often also called bare land value or soil expectation value. The user inputs all costs and revenues associated with a rotation of the forest, including establishment costs. This option performs a fundamental calculation used in forest valuation: the value of bare land in permanent forest production. This is actually a standard NPV calculation, but with several critical assumptions:

1 The values of all costs and revenues are identical for all rotations. All costs and revenues are compounded to the end of the rotation to get the future value of one rotation. This value will be the amount received every *n* years.

Table 2: Calculation of net present value (interest rate 4%).

Item	Year Incurred	Amount ($)	Formula	Discounted Value ($)
Establishment cost	0	-160.00	-	-160
Annual management & taxes	1-27	-2.50	$\frac{(1.04)^{27}-1}{(.04)(1.04)^{27}}$	-40.82
Thinning revenue	16	+97.50	$1/(1.04)^{16}$	+54.05
Thinning revenue	22	+156.00	$1/(1.04)^{22}$	+65.83
Harvest revenue	27	+1,287.00	$1/(1.04)^{27}$	+446.35
Net Present Value				**363.41**

Table 3: Calculation of land expectation value (interest rate = 4%).

Item	Year Incurred	Amount ($)	Formula	Compounded Value ($)
Establishment cost	0	- 160.00	$(1.04)^{27}$	-461.34
Annual management $ taxes	1-27	-2.50	$(1.04)^{27}-1$ .04	-117.71
Thinning revenue	16	+97.50	$(1.04)^{11}$	+150.10
Thinning revenue	22	+156.00	$(1.04)^{5}$	+189.80
Harvest revenue	27	+1,287.00	-	+1,287.00
Net Future Value				**1,047.85**

$$LEV = \frac{\$1,047.85}{(1.04)^{27}-1} = \$556.37$$

2 The land will be forested in perpetuity.
3 The land requires regeneration costs at the beginning of the rotation.
4 Land value does not enter into the calculation. Land value is what you are calculating.

The LEV calculation involves compounding all costs and revenues to the end of a single rotation. This net future value is assumed to occur at the end of every rotation length to form a perpetual series. The value of bare land in perpetual forest production is a fundamental forest valuation calculation. The data in Table 2 can be used to illustrate the calculation because land cost was not included in the problem and the 4% interest rate is a real interest rate (net of inflation). Table 3 shows the LEV calculation.

Land expectation value is $556.37 per hectare. This represents the maximum amount that could be paid for the land for forestry uses – if the required interest rate of 4% must be earned and if the timber values assumed are those actually expected for the property.

Other Options

Monthly or Annual Payments. FORVAL is also capable of calculating the amount of a monthly or annual payment necessary to repay an installment loan (capital recovery) or to accumulate a future sum of money (sinking fund). Two simple examples will illustrate these options. First, assume you need to replace a $250,000 skidder in 6 years. How much must you deposit annually into an account that pays 6% interest? The answer is $35,840.65 per year. Or, if type of payment is changed to monthly, we see the monthly payment would be $2,893.22.
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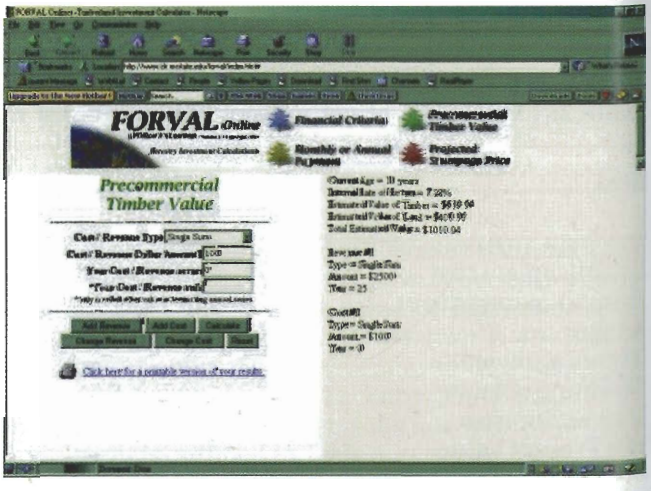
Second, the opposite problem would be to borrow $250,000 at a 6% annual interest rate today. What is the annual payment? Six payments of $50,840.65 would be needed to repay the loan. Or, 72 monthly payments of $4,143.22 would repay the same loan.

Precommercial Timber Value. This option calculates the value of a stand of immature timber at the stands current age. The calculation discounts the future stand value using the rate of return earned by the timber rotation as the discount rate. Land opportunity is included in the calculation (annual land rent). The valuation method is fully described in Straka (1991) and Bullard and Straka (1998). Inputs are costs and revenues for one rotation, beginning and ending land value, and the stand's current age.

Consider a simple example. You need to calculate the value of a 10-year-old pine plantation. Originally, the land was worth $400 per acre. To keep the calculation simple, we will assume no land appreciation. Therefore, at the end of the 25-year rotation, land will still be worth $400 per acre. Regeneration at Year 0 costs $100 per acre, and timber revenue at Year 25 will be $2,500 per acre.

The program calculates a 7.28% rate of return and an estimated value of timber of $610.04. Because we used a simple example, the calculation can be easily illustrated. First, both costs occurred at Year 0 (land cost of $400 and regeneration cost of $100). This equates to a single cost of $500 per acre at Year 0. Second, both revenues occur at Year 25 (land sale of $400 and timber sale of $2,500). This equates to a single revenue of $2,900 per acre at Year 25. We can solve for the rate of return by calculating $[(2,900/500)^{1/25}-1]$. This rate of return is 7.285%. This is, a single rotation using these costs and

Figure 2: Precommercial timber value.



revenues earns a 7.285% rate of return.

Since $400 of capital is tied up in growing the trees (the land), an annual opportunity cost must be calculated. Using the rate of return as the interest rate, this opportunity cost is 0.07285 x $400 = $29.14 per hectare per year.

First, we need to obtain the value of $100 spent 10 years ago using a 7.285% interest rate. This is $202.02, which is obtained by calculating the future value of a single sum: $100(1.07285)^{10}$. Second, we need to calculate the value of $29.14 per year for 10 years (future value of a terminating annual series). This is $408.07. Adding the two compounded costs yields $610.09. The small difference is due to rounding.

The value of the compounded costs, $610.09, is the value of the pre-commercial timber. Using the same interest rate, all future costs and revenues could be discounted to Year 10. This would again produce a value of $610.09. Thus, this method produces a consistent value using the standard concepts of both seller's and buyer's value. Figure 2 illustrates the web page for this calculation.

Projected Stumpage Value. The projected stumpage price form calculates the future value of a specific stumpage price. The calculation is performed using the present price, the number of years projected, and the compound annual rate of price increase. The underlying formula is the future value of a single sum.

The option requires only three inputs: current stumpage price, annual rate of increase, and number of years. For example, a $1,000 current price projected to increase annually at 5.75% for 15 years would be projected to be $2,313.15.

FORVAL performs all the basic valuation calculations used in forestry. It was originally designed for instructional purposes and purposely stressed ease-of-use. The current model is for general forestry valuation use, but its popularity is still centered on its ease of use. Foresters will find it to be a useful tool.

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