

1999

FORVAL for Windows: A computer program for FORest VALuation and investment analysis

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FORVAL

for Windows

Version 1.1.0

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Choose One

FORVAL for Windows:

*A Computer Program for FOREst VALuation
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For more information about this program, contact Dr. Bullard at (662) 325-2781; email, sbullard@cfr.msstate.edu. This Forest and Wildlife Research Center research bulletin was published by the Office of Agricultural Communications, a unit of the Division of Agriculture, Forestry, and Veterinary Medicine at Mississippi State University. It was edited and designed by Robert A. Hearn, publications editor.

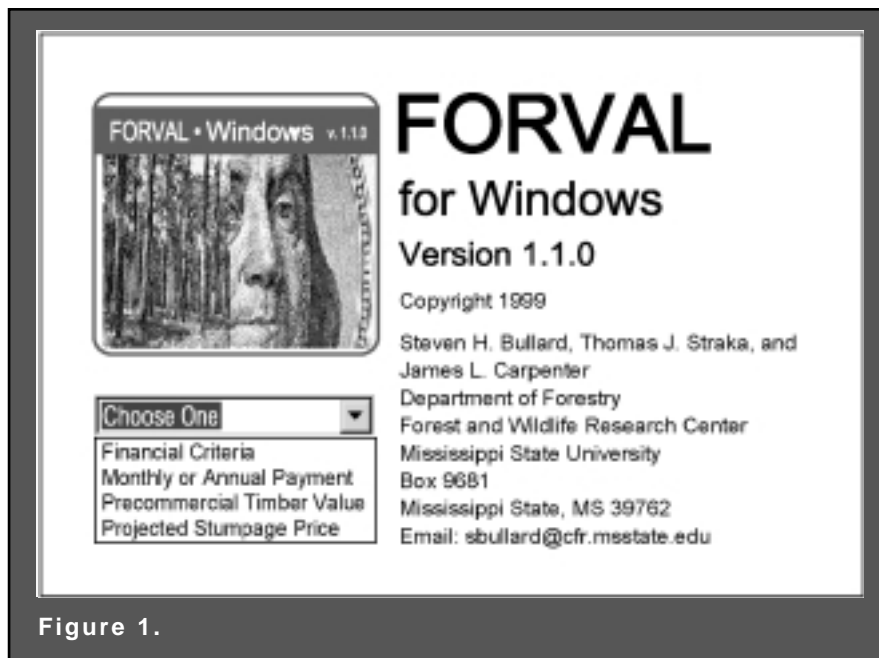


Figure 1.

Getting Started with FORVAL

FORVAL (FORest VALuation) for Windows is a computer program for cash flow analysis of forestry investments. FORVAL was written in Visual Basic and is available from the Forest and Wildlife Research Center at Mississippi State University. We designed FORVAL to be used without a manual. It is user-friendly and includes a Windows Help file. Users enter the data requested for each box on the form and then press an appropriate button to perform the desired action.

FORVAL for Windows requires these hardware and software specifications:

- Windows 95 or later, or Windows NT 3.51 or later.
- A 3.5" disk drive.
- A mouse or other pointing device.
- 486 or higher microprocessor.
- VGA or higher resolution monitor.
- 8 MB of RAM.
- 2.1 MB of hard disk space.

Installation and Use

To install the program, insert Disk 1 into your computer. Go to the *Start* menu and select the *Run* option. To begin the setup process included with FORVAL, type `a:\FORVAL1.exe`. This will start the self-extracting file that is on the disk. The files will be copied to the temp directory on your computer. When all files have been extracted, insert Disk 2 and type `a:\FORVAL2.exe` to finish file extraction. After all files have been extracted from Disk 2, the FORVAL setup program will install FORVAL on your computer. Follow the on-screen directions to complete installation and setup. After setup is complete, select the FORVAL option from the FORVAL folder on the *Programs* section of the *Start* menu.

On the title page (Figure 1), the user must choose

one of four forms to begin calculations. The choices are the financial criteria form, the annual/monthly payment form, the pre-commercial timber value form, and the projected stumpage value form. The **financial criteria form** is used to make various financial analyses, such as net present value, future value, rate of return, and other measures of financial performance. The **payment form** is used to calculate the monthly or annual payments needed to repay a loan or accumulate a future sum in a specific time period. The **pre-commercial timber value form** calculates a value estimate of an immature stand of timber. The **projected stumpage price form** calculates the future value of a specific stumpage price, given the number of years projected and the average annual rate of price increase.

Financial Criteria

From the title page, choose **Financial Criteria** (Figure 2). Once selected, you will see the following window (Figure 3).

You are allowed to switch from one form to another during the program by going to the **File** menu and selecting the desired form (Figure 3). When you switch to another form, the current form will be reset, and all information will be erased.

Your first choice is the type of financial calculation(s) to make. The program presents the following financial criteria:

- The **Net Present Value (NPV)** option calculates the present value of all revenues minus the present value of all costs.
- The **Rate of Return (ROR)** determines the interest rate that makes the net present value equal to zero. This is the rate of interest actually earned on the investment. In FORVAL for Windows, an iterative process is used to estimate the rate of return to the nearest 0.01%. This program will not calculate an ROR greater than 200%.
- The **Equivalent Annual Income (EAI)** is the annual sum of money that is equivalent to a projected stream of costs and revenues. EAI is often used to compare or rank investments that are not equal in duration.
- The **Benefit/Cost Ratio (B/C Ratio)** indicates a project's return per dollar of investment. B/C Ratio is the present value of all revenues divided by the present value of all costs.
- The **All of the Above** option calculates the Net Present Value, Rate of Return, Equivalent Annual Income, and Benefit/Cost Ratio.
- The **Land Expectation Value (LEV)** is the value of land for perpetual forest production (Straka and Bullard 1996). It is the net present value of all revenues and costs associated with growing timber on the land. LEV is often called "bare land value" or "soil expectation value."

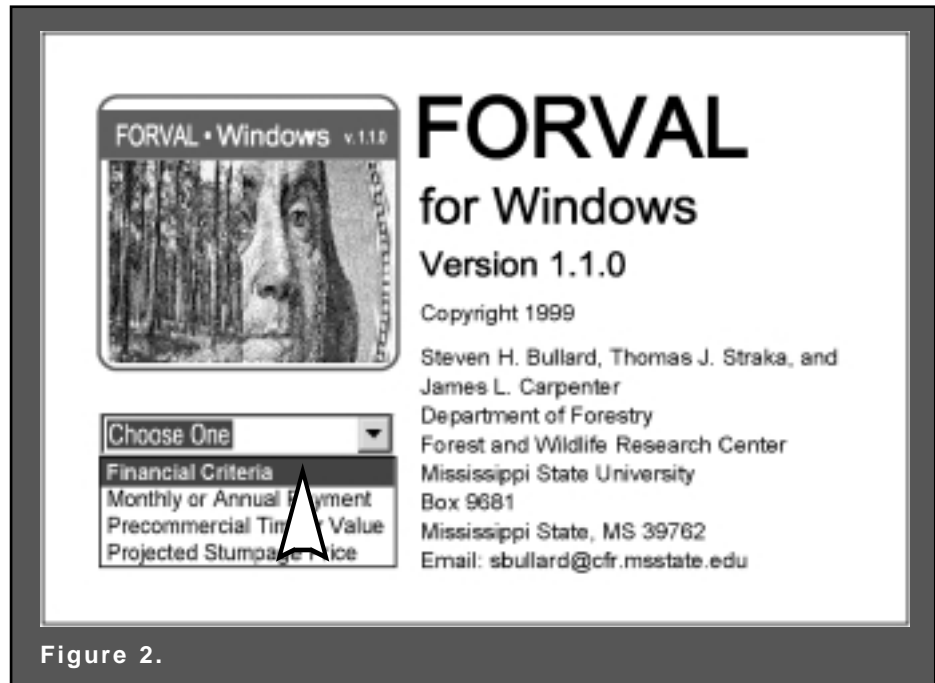


Figure 2.

- The **Future Value** option calculates the value of a single cash flow at a future date.

Net Present Value (NPV), one of the most common criteria, is also called Net Present Worth, Present Net Value, and Present Net Worth. NPV is the discounted value of an investment's cash flows. Net implies the discounted value of all costs is subtracted from the discounted value of all revenues. Since all cash flows are discounted, an interest rate must be specified.

Before illustrating the use of FORVAL, it is instructive to solve a small financial problem on paper. Consider the example of a landowner asking you to

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

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

Table 2. Calculation of Net Present Value (i = 4%).

Item	Year Incurred	Amount (\$)	Formula	Discounted Value (\$)
Establishment Cost	0	\$160.00	—	-160.00
Annual Management & Taxes	1-27	-2.50	$\frac{(1.04)^{27} - 1}{(.04)(1.04)^{27}}$	-40.82
Thinning Revenue	16	97.50	$1/(1.04)^{16}$	52.05
Thinning Revenue	22	156.00	$1/(1.04)^{22}$	65.83
Harvest Revenue	27	1,287.00	$1/(1.04)^{27}$	<u>446.35</u>
Net Present Value				363.41

determine the NPV of regenerating 40 acres of land. His alternative rate of return is 4% (net of inflation and taxes). The investment is outlined in Table 1.

The NPV of this investment is the cumulative value of all the cash flows, each discounted at 4%. FORVAL does all of this for you. The actual steps are in Table 2.

If the NPV equaled zero, the investment would earn exactly the interest rate used in the calculation. An investment is acceptable if the NPV is equal to or greater than zero. In this case, the investment earned a 4% rate of return plus \$363.41. This means you have earned at least the interest rate you used in the calculation.

Rate of Return (ROR) is the interest rate earned by the investment. ROR is the average rate of capital appreciation during the life of an investment. It is also called the Internal Rate of Return (IRR) and the Return on Investment (ROI). To solve for ROR directly, you would have to solve and resolve the NPV problem with various interest rates until the NPV effectively equaled zero. This is time-consuming but not difficult. Knowledge of compound interest tells us that the interest rate used in Table 2 must be higher than 4% to reduce NPV. An educated guess says 8% ought to be close to the interest rate that

reduces NPV to zero. Recalculating Table 2 with an 8% interest rate results in an NPV of \$30.93. Thus, the ROR must be higher than 8%. When 9% is used to recalculate Table 2, NPV becomes -\$11.46. There is no formula to calculate ROR directly; you must recalculate the problem until NPV becomes zero. In our exam-



Figure 3.

ple, this happens at 8.71%. At an 8.71% interest rate, NPV is -\$0.23 (close enough to zero for our calculation as we only need ROR to two decimal places).

Equivalent Annual Income (EAI) is the annual income equivalent to a specified NPV at a specific interest rate. It is also called Annual Equivalent, Equal Annual Equivalent, Annual Income Equivalent, and Net Annual Equivalent. 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:

$$\begin{aligned} \text{EAI} &= \text{NPV} \left[\frac{0.04 (1.04)^{27}}{(1.04)^{27} - 1} \right] \\ &= 363.41 \left[\frac{0.04 (1.04)^{27}}{(1.04)^{27} - 1} \right] = 22.25 \end{aligned}$$

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 ratio 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.

Land Expectation Value (LEV) is the value of bare land if put into perpetual forest production. It is also called bare land value or soil expectation value. The calculation involves compounding all costs and revenues to the end of a single rotation. This compounding includes establishment cost, but it does not include land cost (land value is what the user is calculating). 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. 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.

The **Future Value (FV)** criterion calculates the future value of a single sum of money. For example, the future value of any of the single sum amounts in Table 3 can be calculated using this criterion.

Table 3. Calculation of Land Expectation Value (i = 4%).

Item	Year incurred	Amount (\$)	Formula	Compounded value (\$)
Establishment Cost	0	-160.00	$(1.04)^{27}$	-461.34
Annual Management & Tax Cost	1-27	- 2.50	$\frac{(1.04)^{27} - 1}{.04}$	-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	—	<u>1,287.00</u>
			Net Future Value	\$1,047.85
$\text{LEV} = \frac{1,047.85}{(1.04)^{27} - 1} = \556.37				

Inputs for Financial Criteria

Begin by choosing the type of calculation. The choices consist of the criteria discussed above. Select the type of cost or revenue to be entered. Enter the interest rate, the dollar amount of the cost or revenue, and the year it occurs. For terminating annual entries, enter the beginning and ending years. To use 6% as the interest rate, enter 6 or 0.06. For all calculations except future value, enter the year the cost/revenue occurs from the beginning of the rotation, not the number of years until the end of the rotation.

Note that you can save inputs for financial criteria to a file. If you saved the inputs to a file, you can then reload the information in FORVAL. We recommend this step for any analysis with multiple costs and revenues. To save the input value, select **Save** from the **File** menu. To reload values saved to file, select **Open** from the **File** menu.

There are four choices for individual costs and revenues. The choices are single sum, terminating annual, perpetual annual, and perpetual periodic. All costs and revenues can be entered as one of these choices.

- A **Single Sum** cost or revenue occurs only once during the life of an investment. For example, if the investment consists of a timber rotation, establishment costs occur only once and, thus, are a single sum. Note that Table 1 identifies the single sums in the prior example.
- A **Terminating Annual** cost or revenue occurs annually for a set length of time during the investment. In the prior example, management and tax costs occurred annually until the end of the rotation.
- A **Perpetual Annual** cost or revenue occurs annually for an infinite period. (Perpetual annual costs or revenues cannot be used to calculate a future value.) Many calculations in forestry involve perpetual series. Land expectation value is a good example. This

option might be used for the value of annual property taxes in perpetuity.

- A **Perpetual Periodic** cost or revenue occurs periodically for an infinite period. (Perpetual periodic costs and revenues cannot be used to calculate a future value.) This calculation is standard for forestry. Many activities in forestry occur on a regular, perpetual basis. Perhaps a timber harvest occurs every five years from part of an uneven-aged forest. The value of any regular, non-annual uniform series can be calculated via this option.

The first entry is the first row of information in Table 1 (Establishment Cost). Choose the type of cost, enter the amount of the cost and the year the cost occurs, and then select **Add Cost**. When this step is complete, you should see a summary of the entry in the text box at the bottom of the window on the left-hand side (Figure 4).

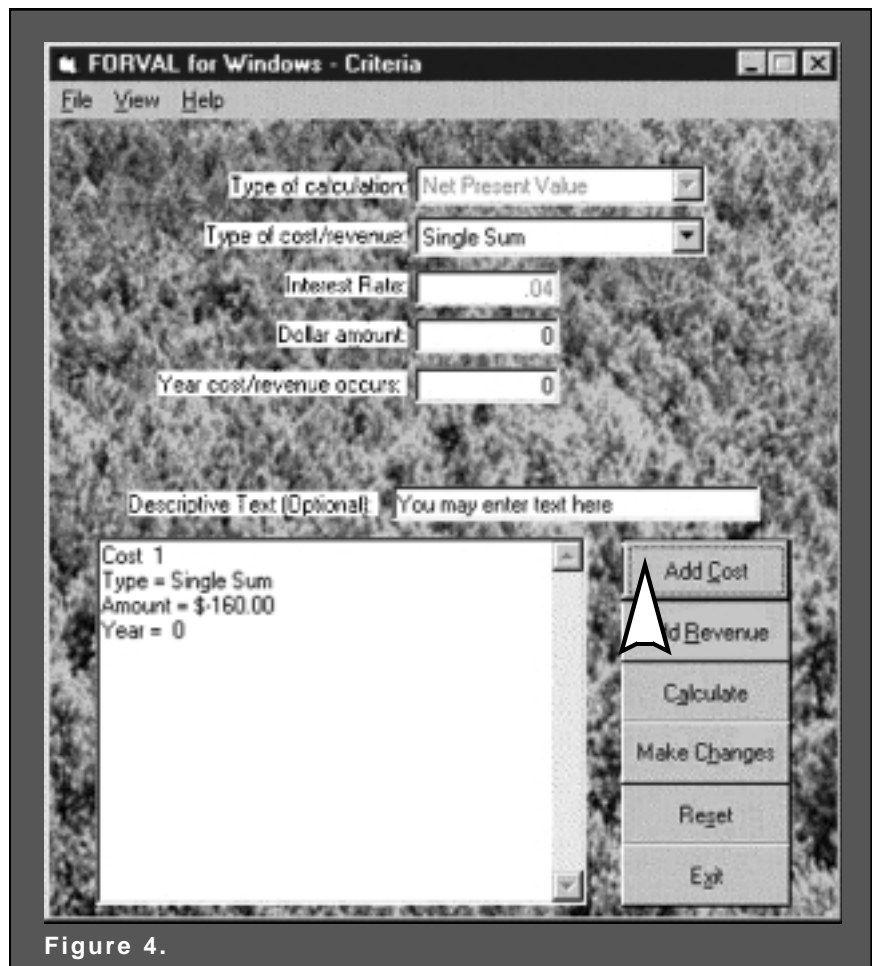


Figure 4.

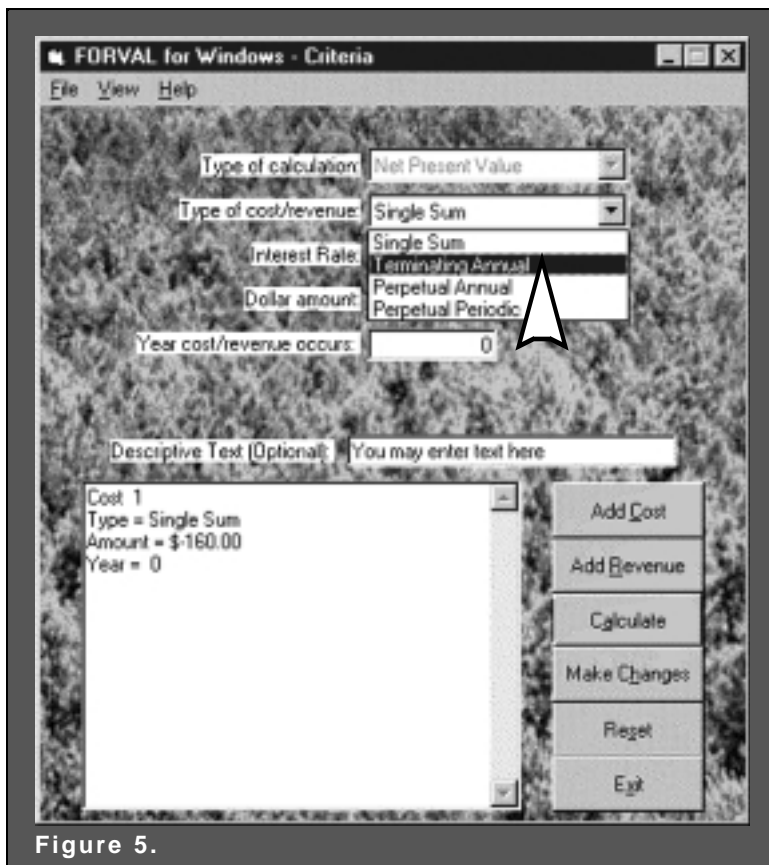


Figure 5.

- The next step involves selecting the **Terminating Annual** option from the **Type of cost/revenue** (Figure 5).

- The second entry is the second row of Table 1 (Annual Management and Tax Cost). Once the entry is made, select **Add Cost**. When this step is complete, you should see a summary of the entry in the text box at the bottom of the window on the left-hand side (Figure 6). The next step involves selecting the **Single Sum** option from the **Type of cost/revenue** (Figure 7).

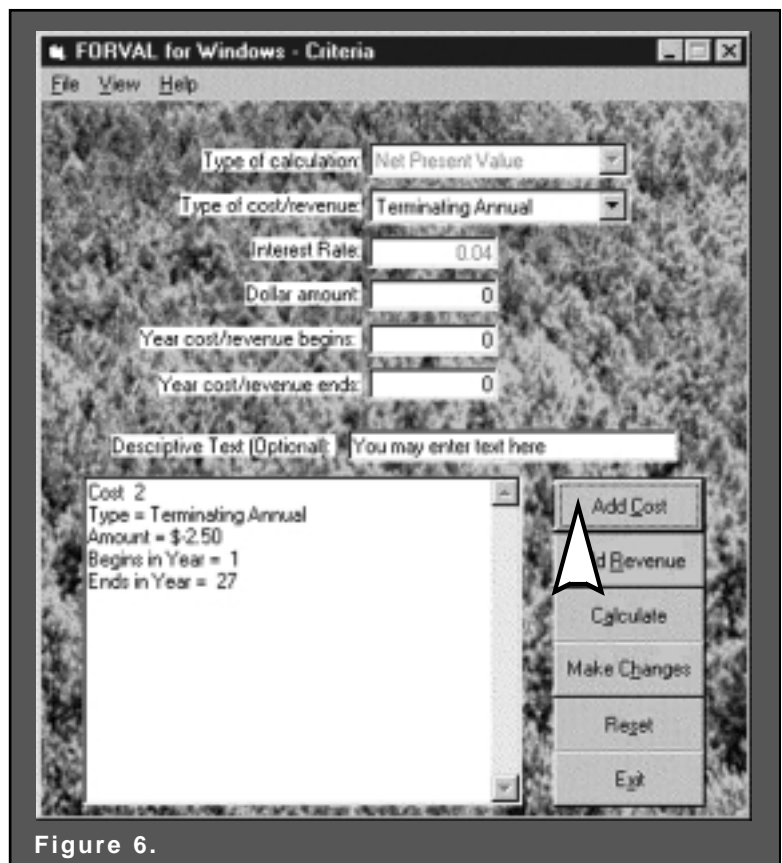


Figure 6.

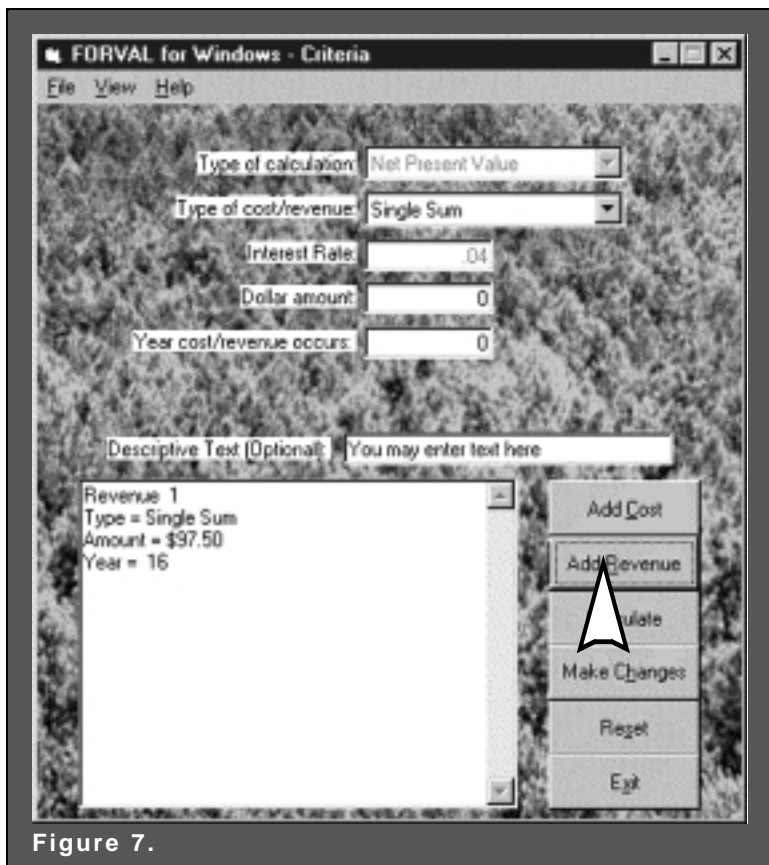


Figure 7.

- The third entry comes from the third row of Table 1 (Thinning Revenue). Once the entry is made, select **Add Revenue**. When this step is complete, you should see a summary of the entry in the text box at the bottom of the window on the left-hand side (Figure 7).

- The fourth entry comes from the fourth row of Table 1 (Thinning Revenue). Once the entry is made, select **Add Revenue**. When this step is complete, you should see a summary of the entry in the text box at the bottom of the window on the left-hand side (Figure 8).

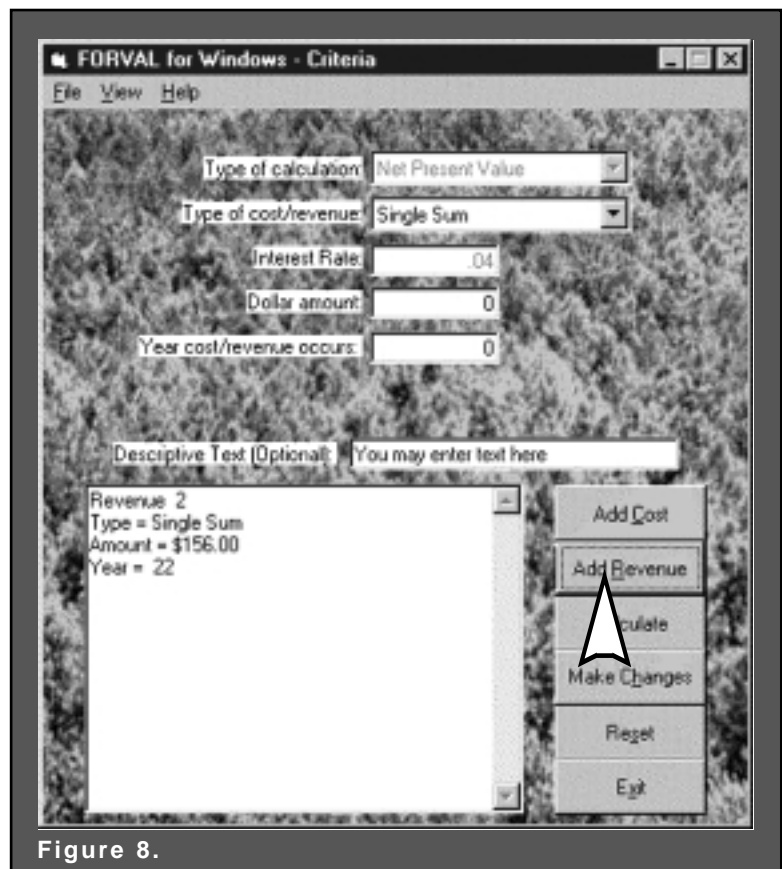


Figure 8.

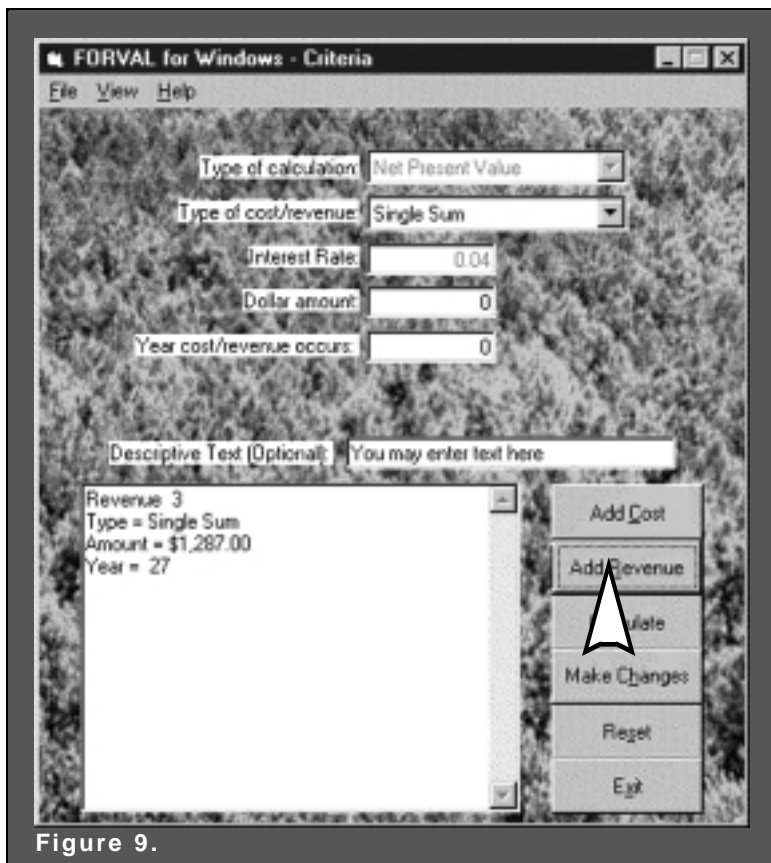


Figure 9.

- The fifth entry comes from the fifth row on Table 1 (Harvest Revenue). Once the entry is made, select **Add Revenue**. When this step is complete, you should see a summary of the entry in the text box at the bottom of the window on the left-hand side (Figure 9).

- Now choose **Calculate**. When the **Calculate** button is pressed, the answer and all information that has been entered are displayed in the large text box at the bottom of the form. The information in this text box can be printed by selecting **Print** from the **File** menu (Figure 10).

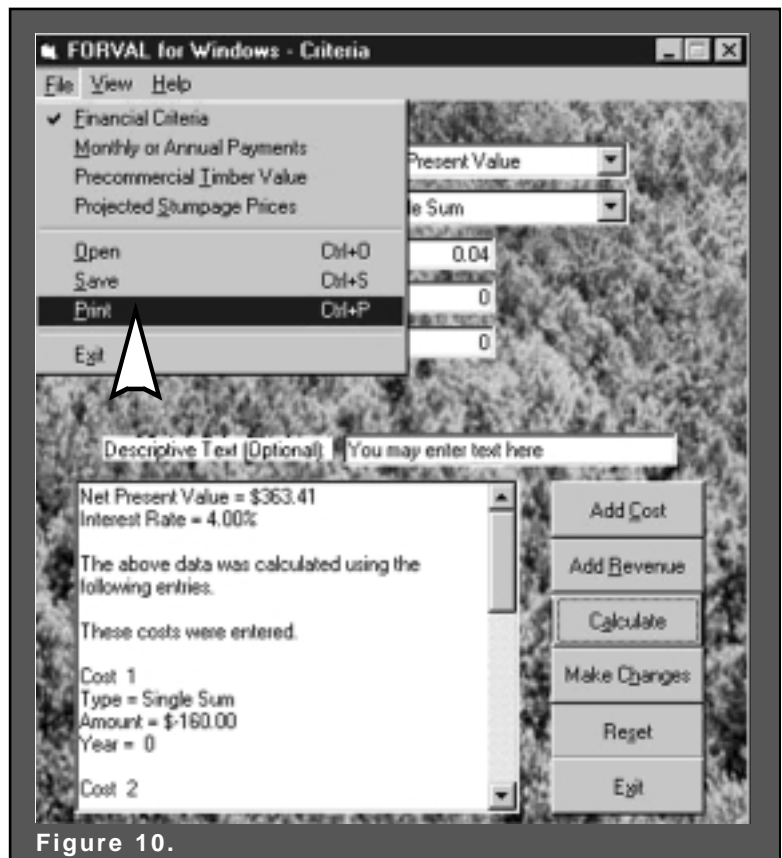


Figure 10.

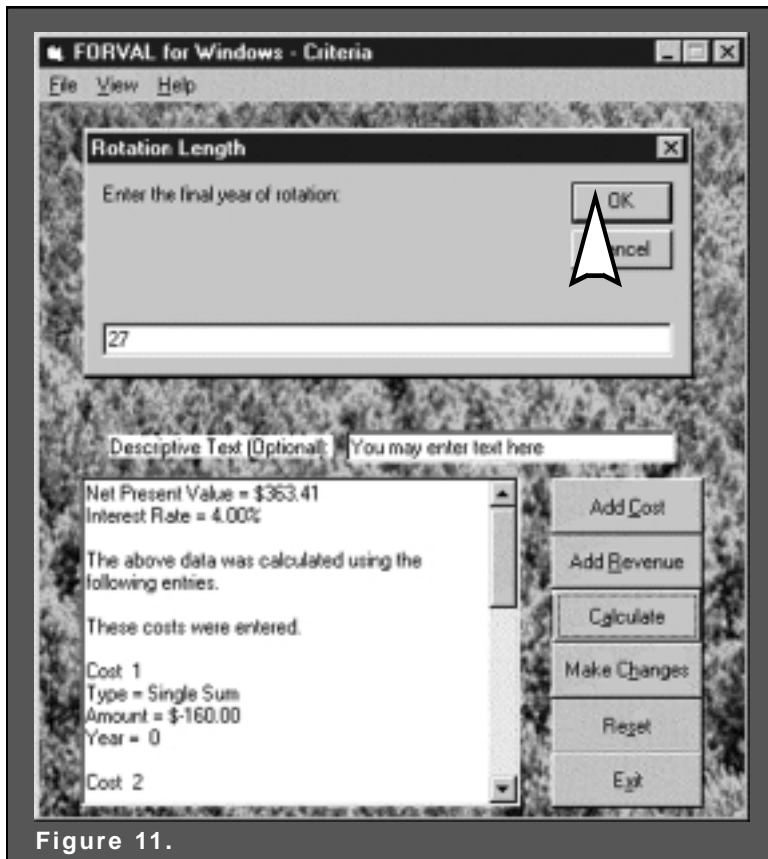


Figure 11.

- In FORVAL, LEV is calculated much the same way as NPV with one exception. You need to select Land Expectation Value in the **Type of Calculation** box. The previous entries are also made with the calculation of LEV. However, once you choose **Calculate**, the program will prompt the **Rotation length** window, which states “Enter the final year of rotation” (Figure 11).

- In the present example, the final year of rotation is 27. The answer and all information that has been entered are displayed in the large text box at the bottom of the form (Figure 12). Print the information in this text box by selecting **Print** from the **File** menu (Figure 10).

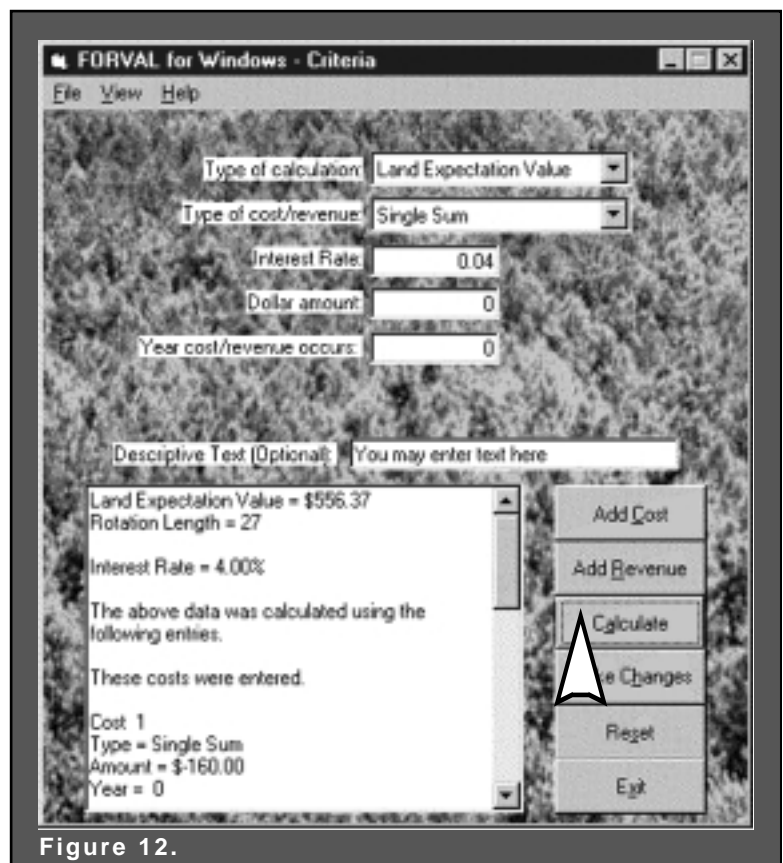


Figure 12.

After calculating the answer, you may change the interest rate or the type of calculation to perform. You may also enter additional costs or revenues. Before beginning a new problem, you must press the **Reset** button. After pressing the **Reset** button, you will be asked to confirm this decision.

At any point while FORVAL is running, you may view all costs or revenues entered or make changes. To view all costs or revenues that have been entered, go to the menu bar and select the **View** option. Then select **View Costs** or **View Revenues**. When you make this choice, all costs or revenues that have been entered can

be viewed in the large text box at the bottom of the form.

To make changes to a cost or revenue, begin by clicking the **Make Changes** button on the form. Another form will appear asking if you would like to change a cost or revenue. Click the desired option and enter the number of the cost or revenue you would like to change. After you click the **OK** button, all the information about the cost or revenue will appear on the form in the appropriate boxes. Make the desired changes and click the **Save Changes** button. This will save the changes you made. If an error occurs, you must restart the process by clicking the **Make Changes** button.

Monthly or Annual Payments

The monthly or annual payments form is used to calculate the amount of each payment either to repay a loan or to accumulate a future sum. This calculation is performed using the amount to be borrowed or accumulated, the interest rate, and the number of years to repay the loan or accumulate the sum.

Begin by choosing to accumulate a future sum or to repay a loan. Then select the frequency of payments as annual or monthly. After making these selections, enter the dollar amount to be saved or the amount of the loan, the number of years of payments, and the annual interest rate. To use 6% as the interest rate, enter 6 or 0.06. Then press the **Calculate** button. Print the information in this text box by selecting **Print** from the **File** menu.

The option to **Accumulate a Future Sum** determines the amount of each payment necessary to accumulate a future sum in the stated time. This is an account where you make payments to yourself. Interest on the account is compounded. This calculation uses the Sinking Fund formula

The option to **Repay a Loan** determines the amount of each payment necessary to repay a loan in the stated time. This calculation uses the Capital Recovery formula. The details of both formulas are well described in Section 3.3 of Bullard and Straka (1998).

Sinking Fund Formula

$$a = V_n \left[\frac{i}{(1+i)^n - 1} \right]$$

Capital Recovery Formula

$$a = V_o \left[\frac{i(1+i)^n}{(1+i)^n - 1} \right]$$

For Both Formulas

- a** = annual payment
- i** = interest rate expressed as a decimal
- V_n** = amount to be accumulated
- V_o** = amount to be paid back
- n** = number of compounding periods (years)

Example of a Sinking Fund Problem

How much money would you need to set aside each year to accumulate enough money to replace a \$40,000 truck in seven years? Your “sinking fund” account will earn 5.25% annually.

The information needed to complete the screen is:

Payments to:	Accumulate a future sum
Type of payments:	Annual
Dollar amount:	40,000
Number of years:	7
Annual interest rate:	5.25

Each payment will be \$4,875.55 (Figure 13).

What if the payments were monthly? Simply change type of payment to Monthly. Monthly payments would be \$395.07 over 84 months.

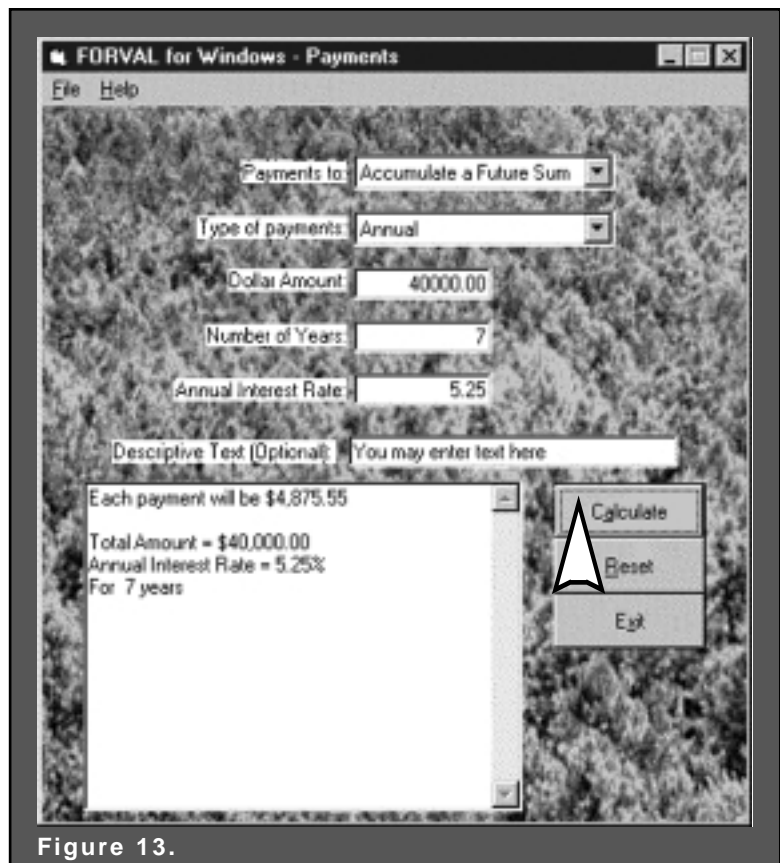


Figure 13.

Example of a Capital Recovery Problem

You purchase a new truck for \$40,000 and take out a loan for the full amount. You agree to 84 monthly payments at 5.25% interest. What is your monthly payment?

The information needed to complete the screen is:

Payments to:	Repay a loan
Type of payments:	Monthly
Dollar amount:	40,000
Number of years:	7
Annual interest rate:	5.25

Each payment will be \$570.07 (Figure 14).

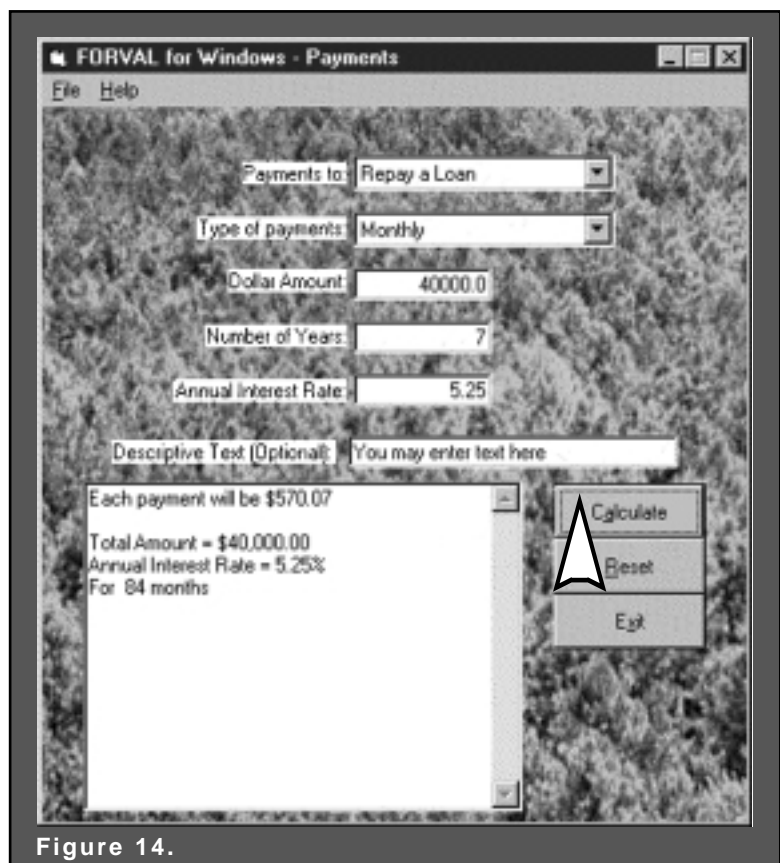


Figure 14.

Pre-Commercial Timber Value

The pre-commercial timber value form calculates the value of a tract of immature timber at the stand's current age. The calculation is done by first finding the projected rate of return, which must be less than 200%. The inflation rate of the tract of land is calculated, and finally the annual land rent is calculated. The valuation method is fully presented in Bullard and Straka (1998) and Bullard and Monaghan (1999).

For this calculation, enter the beginning and ending land cost, current age, and rotation length of the timber. Then enter the costs and revenues by choosing the type of cost or revenue, the amount, and the year the cost or revenue occurs (for terminating annual entries, you must also enter the ending year). After entering this information, press either the **Add Cost** or **Add Revenue** button. When all costs and revenues have been entered, press the **Calculate** button. The estimated value, rate of return, and information on all costs and revenues are displayed in the text box at the bottom of the form. Print the information in this text box by selecting **Print** from the **File** menu.

At any point while FORVAL is running, you may view all costs or revenues entered or make changes. To view all costs or revenues that have been entered, go to the menu bar and select the **View** option. Then select **View Costs** or **View Revenues**. When this choice is made, you can view all previously entered costs or revenues in the large text box at the bottom of the form.

To make changes to a cost or revenue, begin by clicking the **Make Changes** button on the form. Another form will appear asking if you would like to change a cost or revenue. Click the desired option, and enter the number of the cost or revenue you would like to change. After you click the **OK** button, all the information about the cost or revenue will appear on the form in the appropriate boxes. Make the desired changes, and click the **Save Changes** button. This will save the

changes you made. If an error occurs, you must restart the process by clicking the **Make Changes** button.

The valuation technique considers all costs and revenues, explicitly including land cost. You must invest in land to grow timber; thus, you should consider this opportunity cost when valuing a pre-commercial timber stand. Once all costs and revenues are entered, click on **Calculate**. The internal rate of return for a single rotation of the stand is calculated. This interest rate is used to compound all costs to the year of valuation.

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 7.29% rate of return and

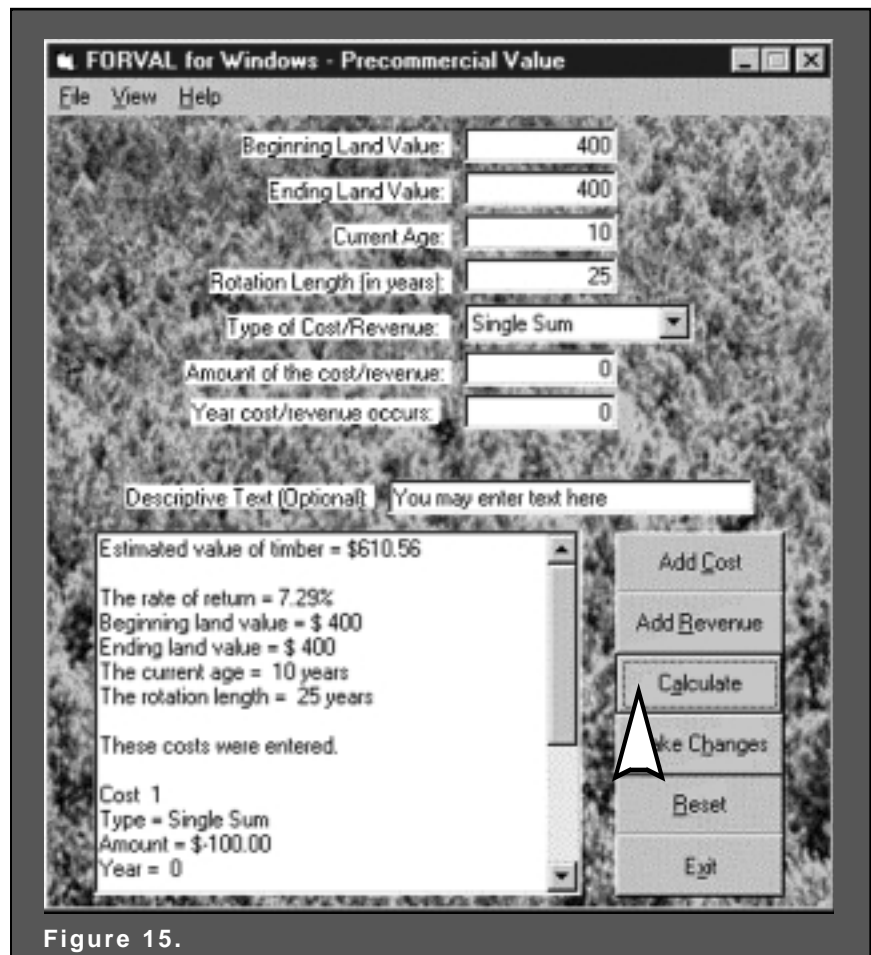


Figure 15.

an estimated value of timber of \$610.56. 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 7.29%. That is, a single rotation using these costs and revenues earns a 7.29% 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 $0.0729 \times \$400 = \29.16 per acre per year.

First, we need to obtain the value of \$100 spent 10 years ago using a 7.29% interest rate. This is \$202.11, which is obtained by calculating the future value of a

single sum: $100 (1.0729)^{10}$. Second, we need to calculate the value of \$29.16 per year for 10 years (future value of a terminating annual series). This is \$408.45. Adding the two compounded costs yields \$610.56.

The value of the compounded costs, \$610.56, is the value of the pre-commercial timber (Figure 15). Using the same interest rate, all future costs and revenues could be discounted to year 10. This would again produce a value of \$610.56. Thus, this method produces a consistent value using the standard concepts of both seller's and buyer's value (Bullard and Straka 1998).

Note that you can save inputs for pre-commercial timber valuation to a file. If you save the inputs to a file, you can reload the information in FORVAL. We recommend this step for any analysis with multiple costs and revenues. To save the input value, select **Save** from the **File** menu. To load values saved to file, select **Open** from the **File** menu.

Projected Stumpage Price

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.

Begin by entering the present price, the annual rate of price increase, and the number of years projected. To use a 5.75% annual rate of increase, enter 5.75 or 0.0575 in the text box. After entering these values, press the **Calculate** button, and all information that was entered and the final answer are displayed in the text box at the bottom of the form. Print the information in this text box by selecting **Print** from the **File** menu (Figure 16).

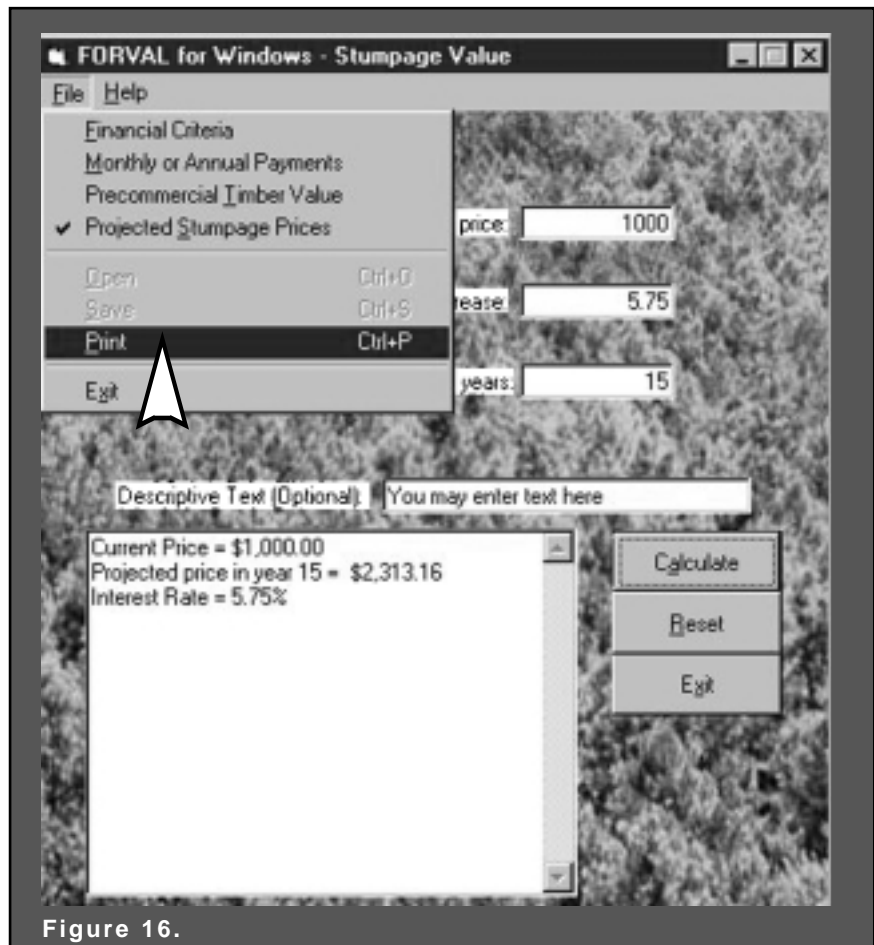


Figure 16.

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