United States
Department of
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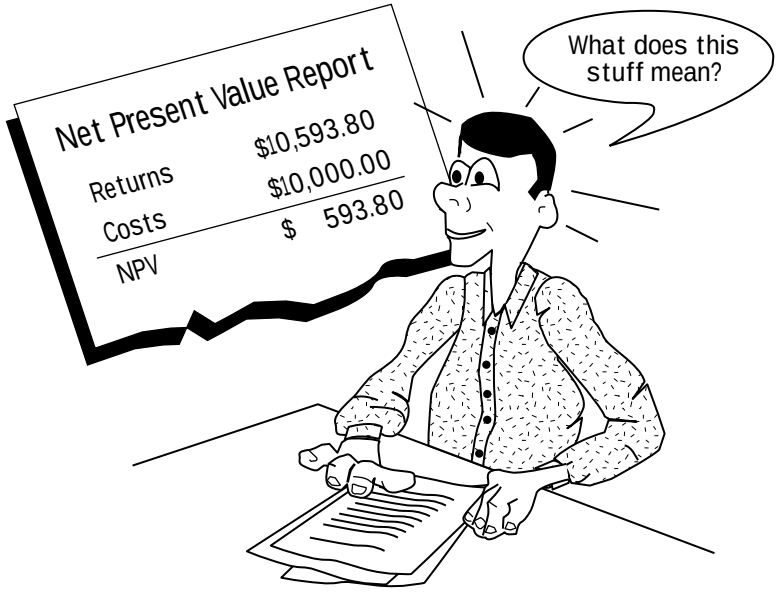
**Grazing Lands
Technology
Institute**

***Grazing Land Economics—
Made Simple***

# Understanding Internal Rate of Return and Net Present Value

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**Key Points**

- Present value is simply the value of today's dollar.
- Net present value (NPV) is merely the difference between today's value of the added returns and today's value of the added costs.
- An improvement practice is an economically viable option if it, at least, breaks even (NPV equals or is greater than zero).
- The break-even point hinges around the landowner/manager's acceptable rate of return (the discount rate).
- If the NPV is equal to or greater than zero, then the internal rate of return (IRR) will be equal to or greater than the land manager's acceptable rate of return (the discount rate).

**In conclusion, remember —**

An understanding of Net Present Value and Internal Rate of Return helps the landowner or manager to be better equipped to make informed decisions regarding application of ecologically sound conservation practices. With these tools, the landowner or manager can also be assured that economically sound practices are being selected and applied.

NPV and IRR are decision aid tools. Economics alone does not generally dictate which improvement practice, if any, the landowner or manager will apply. There are many other social, political, institutional, and personal preference reasons why the landowner or manager might choose an option which may not break even and may not be the best place to spend the money.

# Understanding Internal Rate of Return and Net Present Value

by Larry D. Butler [1]

Owners and managers of grazing lands need economic information to help make decisions as to which improvement practices to implement. Two of the values grazing land managers need to interpret are Net Present Value (NPV) and Internal Rate of Return (IRR). Let's take a few minutes and interpret these terms and **let's make grazing land economics simple.**

The Natural Resources Conservation Service (NRCS) uses Grazing Lands Application (GLA) software. The economics module of GLA, as well as other economic software, calculates the Internal Rate of Return (IRR) and the Net Present Value (NPV) for a selected improvement practice based on the inputs provided.

- Most of the inputs are not economic terms; they are **physical inputs** such as numbers of animal units, calving percentages, calf weights, and other items relative to forage production and animal numbers and how they are predicted to change because of the improvement practice.

- The **economic inputs** are items like variable costs, cost of the improvement practice, prices received for products, and a discount rate. (A discussion of discount rates will follow later.)

When all the physical and economic inputs are properly made, the software programs take all the added costs incurred from the improvement practice and all the added returns due to the improvement practice and calculate the NPV and IRR.

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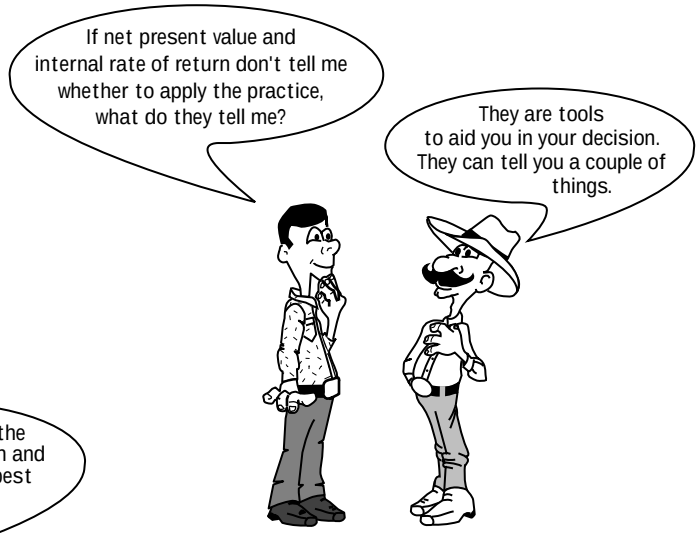
A common misconception is that the NPV and the IRR will provide the answer to the grazing land manager as to whether or not to apply the improvement practice. **This is incorrect.**





**What Net Present Value and Internal Rate of Return tell the landowner or manager**

➥ Whether or not the potential returns are acceptable; will the practice, at least, break even?

➥ Whether or not the practice is the best place to spend the money?

**What does *break even* mean?**

An improvement practice *breaks even* when added returns equal added costs at an acceptable rate of return. In other words, the improvement practice will *pay for itself*.

**How can this be determined by looking at the NPV and IRR values?**

The NPV is the difference between returns and costs when compared in today's dollars; therefore, **if the NPV is zero then the practice will exactly break**



**What do these IRRs and NPVs mean?**

Practice A IRR = 9.3% and NPV = $750
- Does better than break even. (IRR is greater than the borrowing rate of 8%.)
- Exceeds manager's acceptable rate of return. (NPV is greater than zero.)
- Is the best place to spend the money, all things being equal, among the five options.

Practice B IRR = 8.0% and NPV = $0
- Exactly breaks even. (IRR is equal to the borrowing rate of 8%.)
- Exactly equals the manager's acceptable rate of return. (NPV is equal to zero.)

Practice C IRR = 5.3% and NPV = -$600
- Does not break even. (IRR is less than the borrowing rate of 8%.)
- Does not meet the manager's acceptable rate of return. (NPV is less than zero.)

Practice D IRR = 0% and NPV = -$750
- Does not break even. (IRR equals zero, which is less than the cost of borrowing.)
- Does not meet the manager's acceptable rate of return. (NPV is less than zero.)

Practice E IRR = -2.4% and NPV = -$1286
- Does not break even. (IRR is less than the cost of borrowing, in fact, it's negative.)
- Does not meet the manager's acceptable rate of return. (NPV is less than zero)

When landowners or managers set the discount rate in the NPV calculations, they are setting their minimum acceptable rate of return. Therefore, any NPV which equals or exceeds zero is acceptable.

**How does one determine the best place to spend the money?**

In an economic sense, the best place to spend the money is where the largest return will be received. In other words, where you get the biggest bang for the buck? Generally speaking, and all things being equal, this is where the NPV or the IRR, or both, is the greatest. Example 2 illustrates five improvement practice options and their associated net present values and internal rates of return.

**Example 2. An economic software package, such as GLA, returns IRR and NPV for the following five improvement practice options. In this example, the land manager will borrow money at a rate of 8%.**

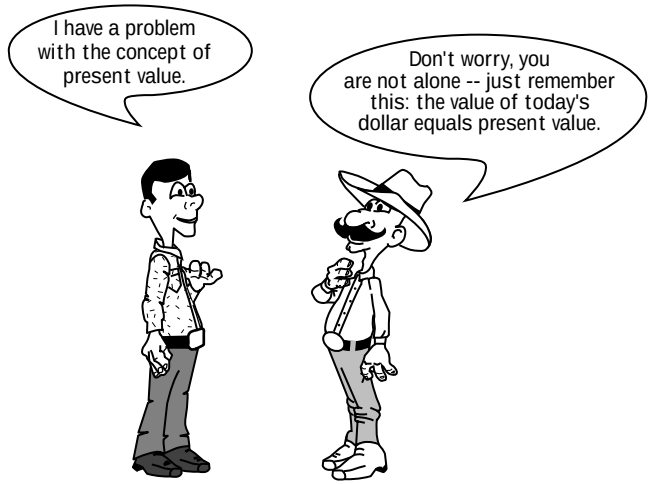
| Improvement practice | Internal Rate of Return | Net Present Value |
|---|---|---|
| A | 9.3% | $750 |
| B | 8.0% | $0 |
| C | 5.3% | -$600 |
| D | 0.0% | -$750 |
| E | -2.4% | -$1,286 |



**even**. If NPV is positive, then the practice will have a positive return to the investment in the practice.

Range conservationists and other grazing land specialists and managers have no trouble communicating with acronyms like AUMs (animal unit months) because they understand the concept and use it daily. However, the NPV (net present value) concept is sort of *fuzzy* because they haven't really grasped the concept of the time value of money. Let's see if a little short discussion and a few examples will clear this up.

Everyone understands that *today's dollar* is worth less than a dollar 20 years ago and that today's dollar is worth more than a dollar 20 years from now. If someone asks if you would like to be given a $100 dollar bill today or wait a year and receive the same $100 dollar bill; you would rather get it today. If you get it today, you have more options as to what to do with it. You could put it in a savings account or you could purchase something with it now and not have to wait. You also have a sure thing if you receive it now rather than waiting on a good faith promise that you will get it in a year.



### The value of today's dollar = present value

With this in mind, you can see that the total returns from an improvement practice calculated in today's dollars minus the total costs due to the improvement practice calculated in today's dollars equals the net value in today's dollars which is the same thing as net present value.

Dollars you expect to receive in the future can be equal to today's dollars; if you discount them back to the present. Discounting is a process that seems to be difficult to understand, so let's take a simplistic look at it. If you are told you will have $1,070 in an account one year from now because your account will earn 7% interest and you want to know how much you have in the account now, you essentially remove the interest by the economic process of discounting and you will find that you currently have $1,000 in the account. This means the present value of $1,070 dollars 1 year from now, at a 7% discount rate, is $1,000.

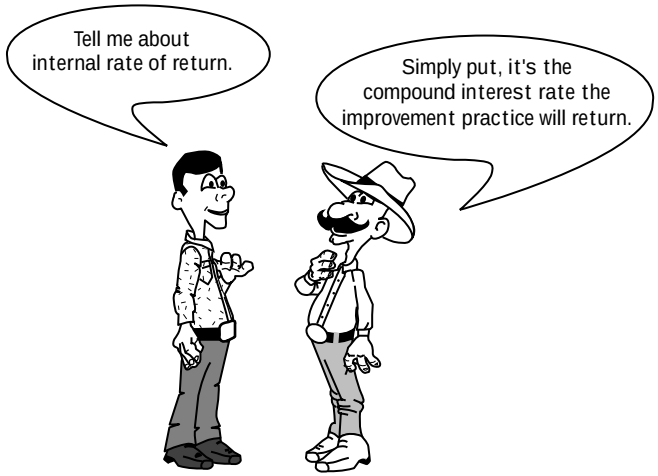
The process of discounting is nothing more than the reverse of compounding interest in a savings account that has a current balance of $1,000 that will earn 7% compound interest for 1 year and the balance will then be $1,070 (fig. 1).

**Figure 1**. "Economic Time Machine": Compounding and Discounting.

Compounding takes the value of money forward in time **from** the present and discounting brings the value of money backward in time **to** the present

| Present Value Amount in the account now | | Future Value Amount in the account in 1 year |
|---|---|---|
| $1,000 | Compounding at 7% for 1 year → | $1,070 |
| $1,000 | ← Discounting at 7% for 1 year | $1,070 |






Up to this point, we have not discussed the concept and process of Internal Rate of Return (IRR). What is it? The IRR is the compounded interest rate the practice will return based upon the inputs provided. How can we tell if the practice will break even by looking at the IRR? *If the IRR is equal to the borrowing rate, then the practice will exactly break even;* if it is higher, the practice will have a positive return.

In the above example, the IRR is greater than the borrowing rate of 7%. Hint: An easy way to tell if the IRR is greater than the borrowing rate is to look at the NPV. If the NPV is greater than zero, the IRR will be greater than the borrowing rate. The actual IRR in this example is 7.75%. The above example does better than break even because NPV is positive and IRR is greater than the borrowing rate.

### What is an acceptable return?

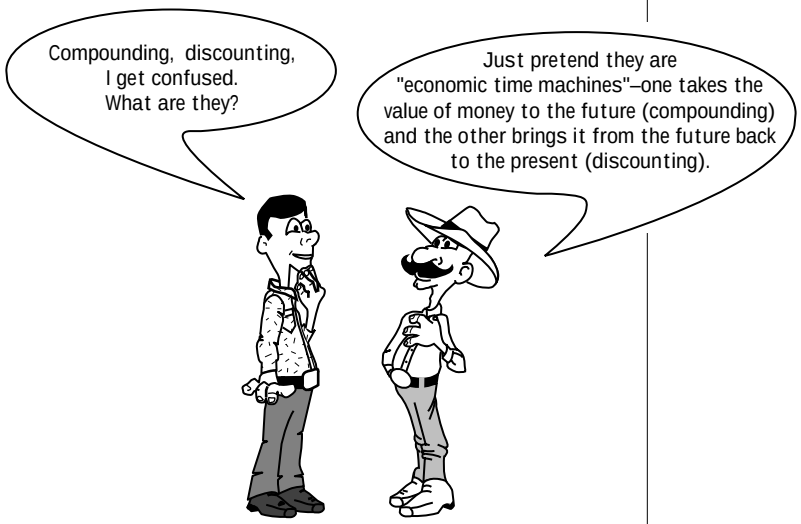
The landowner or manager must decide what is acceptable. This will differ from person to person. However, generally speaking, an acceptable return (an acceptable IRR) is one that meets or exceeds the rate at which the manager would need to borrow money to carry out the practice or a rate which at least equals the rate of return on other investment options.

**Table 1.** Discounting of returns of example improvement practice.

| Year | Expected future return | Discount rate | Present value |
|---|---|---|---|
| 1 | $1,000 | 7% | $934.60 |
| 2 | $1,000 | 7% | $873.40 |
| 3 | $1,000 | 7% | $816.30 |
| 4 | $1,000 | 7% | $762.90 |
| 5 | $1,000 | 7% | $713.00 |
| 6 | $1,000 | 7% | $666.30 |
| 7 | $1,000 | 7% | $622.70 |
| 8 | $1,000 | 7% | $582.00 |
| 9 | $1,000 | 7% | $543.90 |
| 10 | $1,000 | 7% | $508.30 |
| 11 | $1,000 | 7% | $475.10 |
| 12 | $1,000 | 7% | $444.00 |
| 13 | $1,000 | 7% | $415.00 |
| 14 | $1,000 | 7% | $387.80 |
| 15 | $1,000 | 7% | $362.40 |
| 16 | $1,000 | 7% | $338.70 |
| 17 | $1,000 | 7% | $316.60 |
| 18 | $1,000 | 7% | $295.90 |
| 19 | $1,000 | 7% | $276.50 |
| 20 | $1,000 | 7% | $258.40 |
| Total present value of returns from improvement practice | | | $10,593.80 |
| Cost of improvement practice today (already in present value) | | | -10,000.00 |
| **Net Present Value** | | | $ 593.80 |

The improvement practice in the above example has an NPV of $593.80. It does better than break even. Today's value of the added returns are $593.80 greater than the added costs. Another way of saying this is, "The practice is expected to pay for itself and is worth an additional $593.80 in today's dollars "

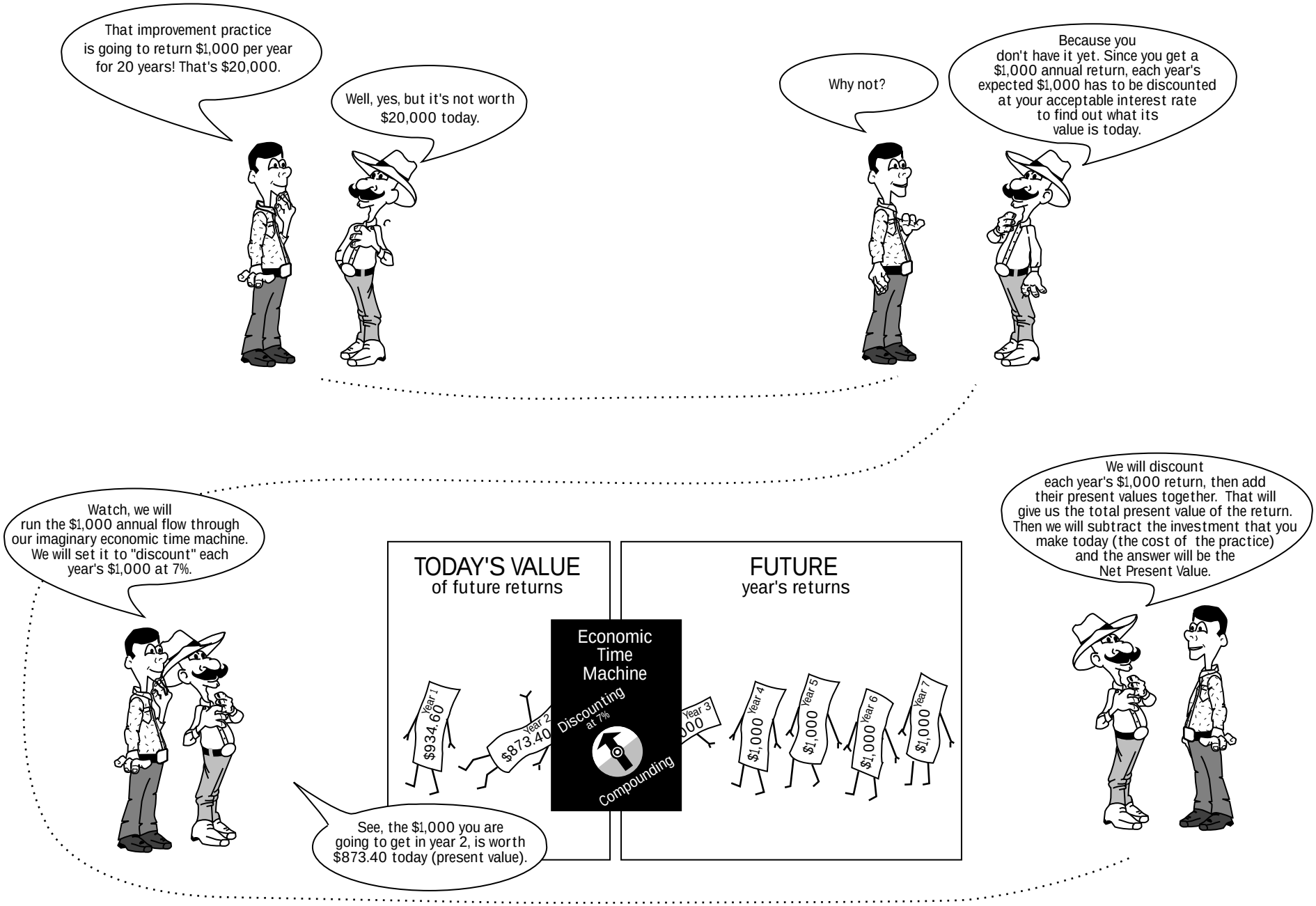





Now, let's apply this concept and proceed to a grazing land improvement practice. If an improvement practice is expected to return a given amount each year for 20 years, then each year's return must be discounted back to today's dollars so you can determine the net present value (NPV) of the practice (example 1).

**Example 1. An improvement practice that costs $10,000 to implement today is expected to return $1,000 to the grazing land operator each year for 20 years and the operator chooses a 7% discount rate because that is the rate at which money will be borrowed. (A discussion on acceptable return will follow later.)**

At first glance you might notice that a total of $20,000 will be returned to the operation. However; we know that this $20,000 is not worth $20,000 today because the $1,000 received each year is not worth the same amount of today's dollars; so we need to discount each year's $1,000 return and add them to find the total present value of the returns. Table 1 illustrates the discounting of each year's return and sums them to calculate the present value.


That improvement practice is going to return $1,000 per year for 20 years! That's $20,000.
Well, yes, but it's not worth $20,000 today.
Why not?
Because you don't have it yet. Since you get a $1,000 annual return, each year's expected $1,000 has to be discounted at your acceptable interest rate to find out what its value is today.
Watch, we will run the $1,000 annual flow through our imaginary economic time machine. We will set it to "discount" each year's $1,000 at 7%.
TODAY'S VALUE
of future returns
FUTURE
year's returns
Economic Time Machine
Discounting at 7%
Compounding
Year 1
$934.60
Year 2
$873.40
Year 3
Year 4
$1,000
Year 5
$1,000
Year 6
$1,000
Year 7
$1,000
See, the $1,000 you are going to get in year 2, is worth $873.40 today (present value).
We will discount each year's $1,000 return, then add their present values together. That will give us the total present value of the return. Then we will subtract the investment that you make today (the cost of the practice) and the answer will be the Net Present Value.