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HP 12C Net Present Value (NPV)

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What NPV Means

(Before continuing here, be sure to read the information on Time Value of Money Basics and on Discounted Cash Flow Analysis Basics.)

- Which would you rather have: a dollar today or 2 dollars next year? Most would choose to wait a year to collect double the money. Why?
- How would you prefer to pay your taxes—in advance or at the end of the tax year? Why?
- If you were to win a jackpot offering a choice, would you rather receive half the amount as a lump sum now, or the entire amount distributed in 20 equal annual installments? Why?

The answers to all these questions involve two things: time and money. ***The passage of time actually changes the value of the money***. This has nothing to do with inflation. Even in an absolutely stable world of prices and values, receiving a dollar today is worth more to you than receiving that dollar tomorrow, *because that dollar could work—it could earn—for you today.* How much could it earn? That depends on where and how you put it to work. Its earning power—expressed as a rate of growth (an interest rate)—is affected by factors such as the risk and liquidity of the situation where you invest it. But almost certainly, the dollar could earn something.

So how do you equate a future expectation with a present dollar? You must adjust for the expected value of today's dollar's earnings between now and then.

For example, if you expect money invested today to earn 10% per year, then receiving $1.00 today is *equivalent to* the expectation of receiving $1.10 this time next year. Or, to compute in the other direction, any future expectation of income (or expense) must be discounted by 10% per year in order to measure it directly against income (or expense) today. *You use the expected growth rate (an interest rate) of money to discount expected future value back to the present.*

This is what NPV (Net Present Value) does: It takes each cash flow on a given timeline, discounts it back to the present according to the interest (discount) rate you specify, and sums the result. Thus, an entire complex stream of future cash flow expectations can be reduced to a single value today—the ***Net Present Value***.

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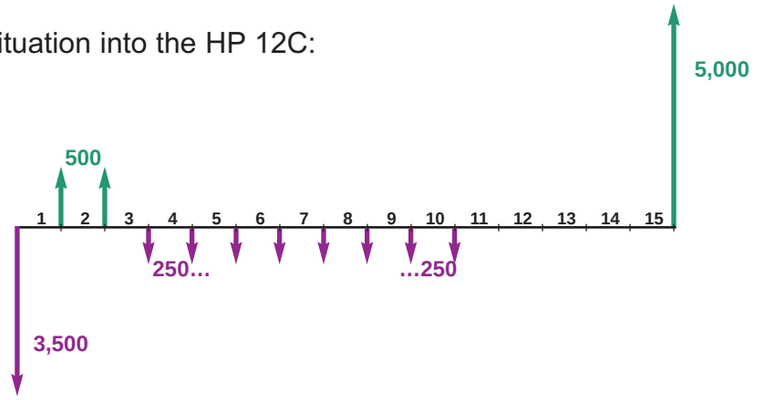
Look at a simple example. Below is an expected set of cash flows:

And here is how you'd key this situation into the HP 12C:

3500 CHS g CFo
500 g CFj
2 g Nj
250 CHS g CFj
8 g Nj
0 g CFj
4 g Nj
5000 g CFj



Now, what is the Net Present Value of this situation? If someone were to offer you the right to receive (and the obligation to pay) those cash flows in the future, what would you pay for that contract? *What's it worth to you today?*

That depends, of course, on your expectation of the earning power of your money. What discount rate should you use to adjust future amounts back to the present?

Suppose you estimate that 8% per year is a reasonable expectation. OK, tell the HP 12C: 8 g 12÷. (Yes, the NPV calculation uses the value store in the i register as its discount rate—and yes, that rate must be expressed per period, not per year. In this case, the period between each cash flow is one month, so you have to use a monthly rate—hence the dividing by 12 via g 12÷.)

Now just solve for Net Present Value: Press f NPV.... **100.10**. (Note here, too, that every NPV result is placed into the PV register as well as into the display.)

So you got 100.10. What does this number mean? It means that, *assuming* that your money today can earn 8% per year (compounded monthly), then signing a contract today for the above future cash flows (both income and expenses) is the same value to you as simply receiving $100.10 in cash today.

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Want to try a different assumption—a different discount rate?

OK, assume a more conservative rate, just 6%: 6 g 12÷. Then re-compute: f NPV… **195.81**
Under the assumption that your money earns only 6% per year, this contract is worth $195.81 to you today; that's what you would be willing to pay for it right now. In other words, *assuming* that your money today can earn 6% per year (compounded monthly), then signing a contract today for the above future cash flows (both income and expenses) is the same value to you as simply receiving $195.81 in cash today.

Why is this more than at an 8% discount rate? That's really a consequence of where in the timeline the various positive and negative cash flows occur. In this particular situation, that big positive $5,000 cash flow at the end of the time line is probably what's most influential here. It is a large amount, and it is most affected by the discount rate. (Since it has the longest time to be discounted back to the present, it is reduced the most.) So a smaller discount rate decreases the amount it is discounted; more of its future value is preserved today.

Try a more aggressive discount rate—say, 12%: 12 g 12÷ f NPV… **-83.28**

Under the assumption that your money earns 12% per year, this contract is worth -$83.28 to you today. The negative sign on this value means that someone would actually have to pay *you* that much today in order for you to be willing to commit to that contract. Anything less, and it simply wouldn't be worth it to you—you have better things to do with your money.

One note about NPV: The other financial calculation tools on the HP 12C (TVM, IRR, etc.) assume that the cash flow "picture" you are drawing for the calculator is a complete investment. So they require at least one cash flow going in each direction (negative and positive—investment and return). This is not true for NPV. It will allow all cash flows to be in the same direction, if you wish—an *incomplete* investment transaction.

Why? Because, as you saw above, the whole point of NPV is to decide what to pay (or demand) today for the right to future cash flows. That is, you are using NPV to compute the amount of the one cash flow needed to "complete the picture"—the initial cash flow.

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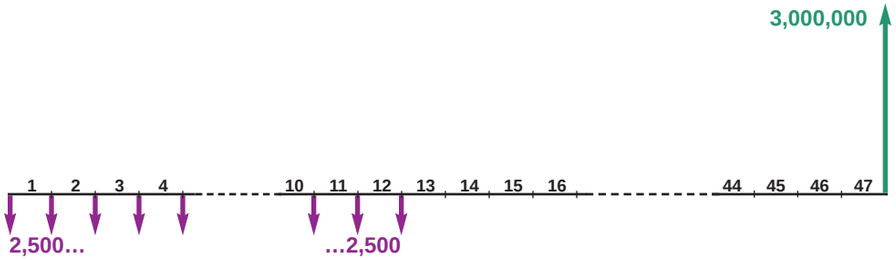
Practice with NPV Situations

Practice some more with various NPV investment scenarios here.

Problem: Find the NPV of this annual cash flow scenario, with an annual discount rate of 11%:

Solution:

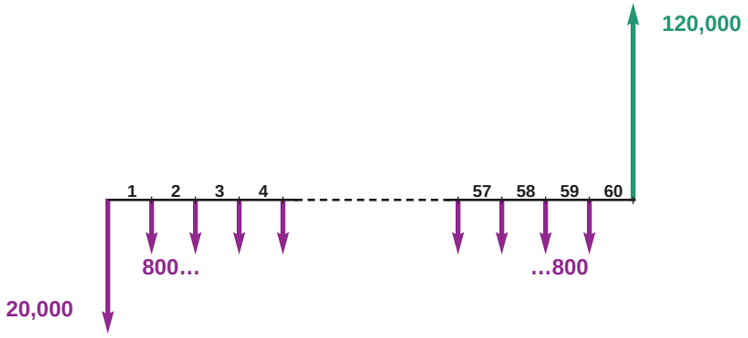
2500 CHS g CFo
2500 CHS g CFj
12 g Nj
0 g CFj
34 g Nj
3000000 g CFj
11 i
f NPV… **3,499.20**



Problem: Find the NPV of this monthly cash flow scenario, with an annual discount rate of 7.5%:

Solution:

20000 CHS g CFo
800 CHS g CFj
59 g Nj
120000 g CFj
7.5 g 12÷
f NPV… **23,197.25**



Now that you're comfortable with the concept of Net Present Value, you're ready to do calculations for Internal Rate of Return (IRR).