hp calculators

HP 17bII+ Net Present Value and
Internal Rate of Return

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CASH FLOW ZERO:

Two important calculations to make that are associated with discounted cash flow analysis are net present value, which is usually but not always different from present value, and the internal rate of return. To calculate each of these we need to give the calculator an initial cash flow, what the calculator has been asking us for when we see "FLOW(0)=?."

This "zero-year" cash flow is what is paid for the asset, it is the cash flow that buys the asset and initiates ownership of the cash flows for the purchaser. As such, it is thought of as flowing in the opposite direction from the positive cash flows the asset is going to produce for the owner. We'll show it as a negative in our cash flows.

A SERIES OF CASH FLOWS:

Estimated cash flow at the end of periods 1 through 4: $3000./period
period 5: $4000.

Discount rate: 12%
Purchase price for this asset: $10,000.

Go to the cash flow menu from the main menu by pressing 'FIN' and 'CFLO.' Then clear with 'SK' (shift key), 'CLR DATA,' and 'YES.'

Then, put in the purchase price with these keystrokes:

10000
+/-
INPUT

Why are we making the $10,000. negative? Recall that this is the purchase price and that money is flowing away from the purchaser. We show it as a negative to indicate that direction of cash flow.

Keystrokes for the cash flows:

3000
INPUT
4
INPUT
4000
INPUT

Now calculate with these keystrokes:

EXIT
CALC
12
I%
NPV   Answer: 1,381.76

WHAT NET PRESENT VALUE IS:

What does this mean that the net present value is $1,382. (rounded)? Does that mean the asset that is projected to produce the cash flows we entered is worth this amount?

No, actually it is worth more than that.   The net present value is a differential, it is a number you get when you subtract what someone pays for an asset from what the asset is worth. It is:

> Present value
> -Purchase price
> Net present value

It is a measure of whether someone has overpaid or underpaid for an asset. If the net present value is positive, the purchaser has underpaid. If the net present value is negative, the purchaser paid too much for the asset when compared to what it is worth. If the net present value is zero, the purchaser bought the asset for just what it is worth.

PRESENT VALUE AND NET PRESENT VALUE:

Look at our problem we just keyed into the calculator:

> Present value
> -10,000
> 1,382.

Can you see how we compute the actual present value? Sure. We do the reverse of the subtraction and add the net present value and the purchase price. The present value is $11,382.

How, you may ask, if you read our section on discounted cash flow analysis, did the calculator get the present value earlier without having to add this net present value and purchase price? Well, we did not include the purchase price in the cash flows. We left it as "0" in the "FLOW(0)." If you do that - leave off the purchase price - then the so-called net present value you are computing is actually the same as the present value. Zero subtracted from a number is still that number.

Look above, where we subtracted the $10,000. purchase price from the present value. If we made the purchase price "zero," we are subtracting zero from the present value:

> Present value
> -0
> Net present value

We are forcing the present value and the net present value to be the same by setting the purchase price at zero. Or, another way to look at it is we have taken the one time when present value and net present value are the same, namely when nothing is paid for the asset. That way we can use the net present value function of the calculator to calculate present value.

GETTING THE PRESENT VALUE:

Exit to the cash flow menu. Clear it with 'SK' and 'CLR DATA.' Press 'YES,' you want to clear the list. We are ready and are looking at "FLOW(0)=?" in the display. Hit '0' and 'INPUT,' telling the calculator that cash flow 0, where the purchase price goes, is "0." You are now at the first cash flow. Put in the rest of the cash flows. From the time you cleared your cash flows your keystrokes have been this:

> 0
> INPUT
> 3000
> INPUT
> 4
> INPUT
> 4000
> INPUT

Now you are ready to calculate. Press in:

> EXIT
> CALC
> 12
> I%
> NPV   Answer: 11,381.76

You have calculated the present value by calculating the net present value under a special circumstance: when no purchase price is included in the cash flows.

> $11,382. present value
> -   0   purchase price
> $11,382. net present value

So, when you want to calculate present value, leave off the purchase price by putting '0' into "FLOW(0)." When you want to calculate net present value, put the purchase price in "FLOW(0)" as a negative.

AND NOW FOR THE INTERNAL RATE OF RETURN:

One time you must put the purchase price into flow '0' is when you want to calculate the internal rate of return (IRR). And that is because the IRR is a rate of return of cash flows when measured against the purchase price. It is a return on the purchase price that the cash flows are earning.

Let's calculate it for the last cash flows. We would start out putting in the keystrokes above when the purchase price was included. These were:

> 10000
> +/-
> INPUT
> 3000
> INPUT
> 4
> INPUT
> 4000
> INPUT
> EXIT
> CALC

At this point, in the calculator menu, you can immediately ask the calculator for the IRR. You don't need a discount rate or to calculate the net present value. You may put in a rate and calculate a net present value, but it isn't necessary. It will not affect your IRR calculation. But, let's put in our discount rate of 12% and also calculate the net present value. So:

> 12
> I%
> NPV   Answer: 1,381.76

Then:

> IRR%   Answer: 17.23

This internal rate of return of 17.23% means that paying $10,000. for this asset and earning $3,000. per period for four periods and then $4,000. the next period represents an average periodic rate of return on the $10,000. of 17.23%.

And remember what the net present value means. It is a measure of whether you have overpaid or underpaid for an asset when compared to what it is worth. The positive $1,382. (rounded) means you have paid below value by this amount. You got a bargain!

RELATING NPV TO IRR:

Do you see the net present value's relationship with the internal rate of return? You can draw certain conclusions from one about the other.

<u>Positive Net Present Value</u>

A positive net present value, again, means you paid less for the property than it is worth. Well, if you did that and still got the returns that were projected, your money is working harder for you than represented by the discount rate.

Look at our cash flows here. When they were discounted at 12%, we got a value of $11,382. That's what the cash flows are worth. If you paid $11,382. for an asset and got these returns, you would be earning 12% per period on your $11,382.

But we plugged in a purchase price of $10,000. and put in the same cash flows for the returns. So, what we are saying is that our $10,000., a smaller amount of money than the $11,382., can earn the same returns. The rate of return on the $10,000. is going to be higher than the 12% discount rate we used to value the asset at $11,382.

Our $10,000. is getting a better rate of return. It is doing a better job because, although less than the $11,382., it is earning the same dollars. Hence, its rate of return is higher.

Do you see what we are getting at? A net present value that is positive means the internal rate of return will exceed the discount rate.

<u>Negative Net Present Value</u>

On the other hand, if we overpaid for the property, the net present value is going to be negative. With a purchase price of, let's say, $12,000., the net present value is:

$$\begin{array}{ll} \$11,382. & \text{present value} \\ \underline{-\ 12,000.} & \text{purchase price} \\ -\quad 618. & \text{net present value} \end{array}$$

What is the internal rate of return going to be in comparison to the discount rate? It is going to be less than the discount rate, isn't it? When we overpay, we are paying more money for the asset than we should, more than it is worth.

Discounting the returns at 12% yields a value of $11,382. That says that paying $11,382. for the asset and getting those cash flows is a 12% return on our purchase price. Well, if we pay more than $11,382. (a negative net present value!) and still get the same returns, our money is not working so well for us, it is earning less than 12%.

Get back to the cash flow menu from the calculation menu by pressing 'EXIT.' After you have cleared it, put in:

<div align="center">
12000
+/-
INPUT
</div>

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Key in the remainder of the cash flows as we did above:

<div align="center">

3000
INPUT
4
INPUT
4000
INPUT
EXIT
CALC
12
I%
NPV   Answer: -618.24

</div>

Note the negative sign on the $618. (rounded). The purchase price is more than this asset is worth by a margin of $618.

Now key in:

<div align="center">

IRR%   Answer: 9.98

</div>

If the net present value is negative, the internal rate of return will be less than the discount rate.

<div align="center">

Net Present Value of Zero

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Of course, finally, if we pay exactly what the asset is worth, $11,382., the net present value is zero:

<div align="center">

$11,382. present value
- 11,382.   purchase price
0   net present value

</div>

And, the internal rate of return will be the same as the discount rate. After all, that is how we got the value of $11,382. We discounted those cash flows at 12%.

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Summary Chart

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	Net present value	Internal rate of return
Purchase price less than value	Positive	Exceeds discount rate
Purchase price exceeds value	Negative	Less than discount rate
Purchase price equals value	Zero	Equals discount rate