



hp calculators

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Discounted cash flow analysis

There are times when a financial problem has either irregular or unequal payments. Since the time value of money application is not designed for these situations, the HP 30b contains functions that solve these types of problems, commonly referred to as discounted cash flow (DCF) analysis.

As usually presented, DCF problems have an initial negative cash flow followed by several positive cash flows. This might occur when a company is evaluating the purchase of a new machine. There would be an initial cash outlay to pay for the machine and then (hopefully) several periods of positive cash inflow as the result of the acquisition. Cash outflows are considered negative while inflows are considered positive.

DCF problems routinely occur within financial applications such as capital budgeting, but the functionality built into the HP 30b calculator is more flexible, allowing for the more general analysis of uneven and irregular payment situations.

Internal Rate of Return

The Internal Rate of Return (IRR) is defined as the interest rate that makes the present value of all future cash flows equal to the initial cash flow. By definition, this will be where the Net Present Value (NPV) is equal to zero. The IRR is computed so that it can be compared to a target or hurdle return. This rate to which it is compared is usually either the company's cost of funds or a required rate of return.

Modified Internal Rate of Return

Modified Internal Rate of Return (MIRR) addresses several problem areas that arise when using the IRR. First, IRR assumes that interim cash flows are reinvested into an investment that provides a rate of return equal to the IRR. This is often very difficult to accomplish. Second, when there are cash flows with alternating signs (positive cash flows followed by negative cash flows followed by positive cash flows, for example), the IRR can generate multiple rates of return that will make the NPV equal to zero. This is unhelpful when trying to evaluate alternatives. The MIRR modifies the approach taken by the IRR by evaluating the n th root of the future value of all positive cash flows at the investment rate expressed as a negative number divided by the present value of all negative cash flows at a safe rate minus 1, where the n th root is the number of cash flows present in the problem after the original cash flow, if any. This is shown by the formula below.

$$MIRR = \sqrt[n]{\frac{-FV(\text{positive cash flows, investment rate})}{PV(\text{negative cash flows, safe rate})}} - 1$$

IRR and MIRR on the HP 30b

On the HP 30b, IRR and MIRR problems are set up by entering the problem's cash flows into the Cash Flow environment using the **CshF1** key. When pressed, the keys shown in the table below allow you to enter, edit and view cash flows. In the HP30b, a cash flow list is a set of numbered pairs, $CF(n)$ and $\#CF(n)$, where n refers to the position in the cash flow list, beginning with cash flow 0. $CF(n)$ represents the monetary value of the cash flow; $\#CF(n)$ is the number of consecutive occurrences of that cash flow. By default, $\#CF(n)$ is equal to 1, as most cash flows occur only once. However, in cases where a cash flow is repeated multiple times, using $\#CF(n)$ instead of entering the cash flow value multiple times saves calculation time and memory space in the calculator as well as keystrokes.

To enter a cash flow list, press **CshF1** to open the cash flow menu. For each cash flow item, enter the cash flow followed by **INPUT**; then enter the number of times the cash flow occurs followed by **INPUT**. If a cash flow occurs once, you do not need to type **1** **INPUT**; you can simply press **INPUT**, as 1 is the default. So, to quickly enter cash flows that occur one time, press **INPUT** **INPUT** between them.

Cash Flow Keys

| Key | Description |
|-----|---|
| | Opens the cash flow list. |
| | Inputs (saves) entered values to variables in the cash flow list. |
| | Scrolls up and down. |
| | Inserts cash flows into a cash flow list. |
| | Removes the displayed cash flow from a cash flow list. |
| | Opens internal rate of return (IRR) and modified internal rate of return (MIRR) menu. |

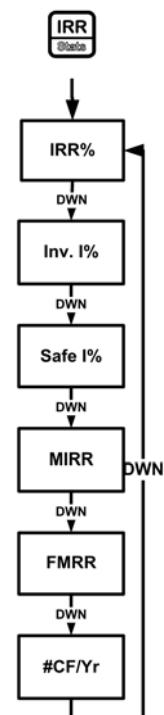
Once the cash flows have been entered, press to display the internal rate of return. Pressing opens the IRR menu containing the items shown in the table and menu maps below. Note that it is possible to specify the number of cash flows per year. Usually, it will be sufficient to leave this at the default for the value of one for the number of cash flows per year, implying annual cash flows. However, in some circumstances, a problem might be encountered that requires cash flows with a different frequency, such as monthly, quarterly, etc. In these circumstances, pressing will display the menu item #CF/Yr. Key in the new value, 12 for monthly for example, and press . Then press to return to the IRR% menu item to see the automatically updated new IRR%. The menu map for the IRR menu is shown below along with a table describing each of the menu items.

IRR Menu Items

| Item | Description |
|----------------|---|
| <i>IRR%</i> | Internal rate of return. This is the discount rate for the cash flow that returns a Net Present Value of 0. |
| <i>Inv. I%</i> | The investment rate for MIRR and FMRR problems. |
| <i>Safe I%</i> | The safe rate for MIRR and FMRR problems. |
| <i>MIRR</i> | Modified internal rate of return. |
| <i>FMRR</i> | Financial management rate of return (covered in a separate learning module). |
| <i>#CF/Yr</i> | The number of cash flows per year. The default is 1. Enter a value and press to change. |

To reset a cash flow list to its default values, with any cash flow displayed, press . The number of cash flows in the list is displayed on the bottom line, along with *Cash Flow=*. At this prompt, press . You will be asked to confirm your choice. Either press to confirm and to return to the cash flow list, or press to cancel. Pressing once again after you cancel the reset command also returns you to the cash flow list.

Note that if you press before you have entered any cash flows, the HP 30b will automatically open up the cash flow menu so that you can enter them for a problem.



Practice solving IRR and MIRR problems

Example 1: A company is considering replacing a machine. It will require an initial cash outlay of \$20,000 and then is expected to generate cash flows the next 3 years of \$10,000, \$15,000 and \$20,000. If the cost of funds for the company is estimated at 10%, compute the IRR and compare it to the cost of funds. Should the machine be replaced?

Solution:

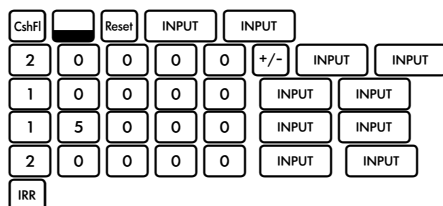


Figure 1

Answer: 47.15%. Since this is larger than the cost of funds, the IRR suggests the machine should be replaced.

Example 2: What is the MIRR for the problem in example 1? Assume an investment rate of 8% and a safe rate of 3%. Also assume that this example is worked immediately after example 1.

Solution:

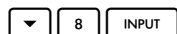


Figure 2

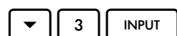


Figure 3

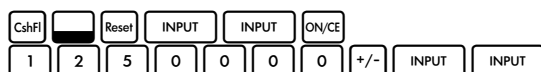


Figure 4

Answer: 33.76%. Replacing the machine still generates a 33.76% return even after assuming a lower rate of return on the reinvested cash flows.

Example 3: A company is considering introducing a new product. It will require an initial cash outlay of \$1,250,000 and the company expects to get cash flows the next 6 years of -\$300,000, \$200,000, \$450,000, \$700,000, \$300,000 and \$20,000. If the company's cost of funds is estimated at 12%, compute the IRR and compare it to the cost of funds? Should the company introduce the new product?

Solution:



HP 30b IRR and MIRR

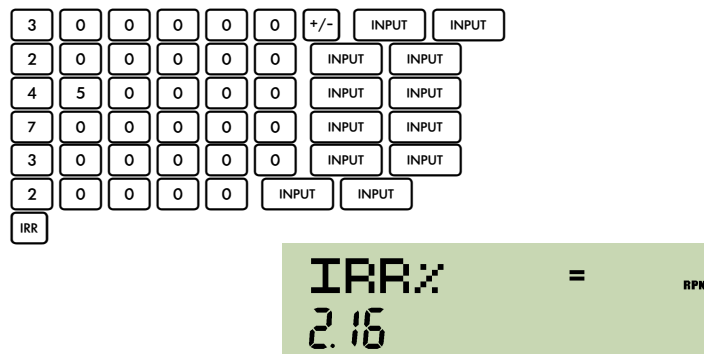


Figure 5

Answer: 2.16%. Since this is less than the cost of funds, the company should not introduce the new product. Note that both of the first two cash flows were negative or cash outflows. Introducing a new product can often cause that situation.

Example 4: Compute the MIRR for the situation given in Example 3 above. Assume a 6% investment rate and a 3% safe rate. Is it higher or lower? Why? Assume this example is performed immediately after Example 3.

Solution:



Figure 6

Answer: 3.63%, which is higher than the IRR. Remember that the IRR assumes interim cash flows are reinvested into an investment which earns the IRR, which in this case is 2.16%. The MIRR assumes that positive cash flows earn the investment rate and negative cash flows earn (most likely borrowed) at the safe rate. Both of these rates (6% and 3%) are higher than the IRR of 2.16%. Hence, the MIRR is higher in this instance. Regardless, since both of these are lower than the firm's cost of capital, this new product earn a high enough rate of return to be profitable.