



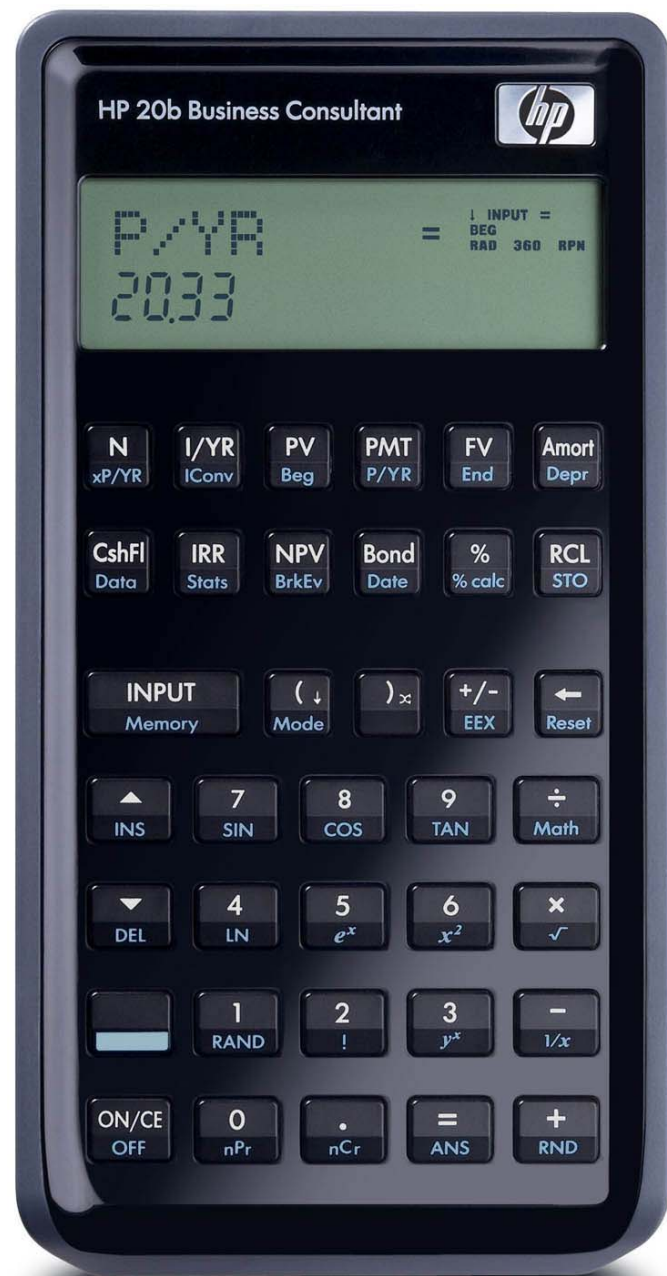
hp calculators

HP 20b Internal Rate of Return

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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 20b 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 20b 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.

On the HP 20b, IRR problems are set up by entering the problem's cash flows into the Cash Flow environment using the C key. When pressed, the keys shown in the table below allow you to enter, edit and view cash flows. In the HP20b, 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  to open the cash flow menu. For each cash flow item, enter the cash flow followed by ; then enter the number of times the cash flow occurs followed by . If a cash flow occurs once, you do not need to type  ; you can simply press , as 1 is the default. So, to quickly enter cash flows that occur one time, press   between them.

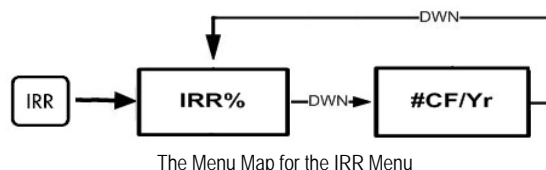
Cash Flow Keys

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) menu.

Once the cash flows have been entered, press to display the internal rate of return. Pressing  opens a short IRR menu containing two menu items: The IRR% and a second item $\#CF/Yr$, the number of cash flows per year. Usually, it will be sufficient to simply view the computed IRR%, since the default for the value for the number of cash flows per year

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is one, 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 **INPUT**. 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>#CF/Yr</i>	The number of cash flows per year. The default is 1. Enter a value and press INPUT to change.

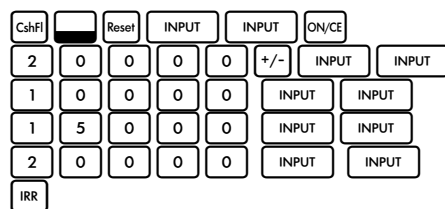
To reset a cash flow list to its default values, with any cash flow displayed, press **Reset**. The number of cash flows in the list is displayed on the bottom line, along with *Cash Flow=*. At this prompt, press **INPUT**. You will be asked to confirm your choice. Either press **INPUT** to confirm and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

Note that if you press **IRR** before you have entered any cash flows, the HP 20b will automatically open up the **CshFl** cash flow menu so that you can enter them for a problem.

Practice solving Internal Rate of Return 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:



IRR% = RPN
47.15

Figure 1

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

Example 2: 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,

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\$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:

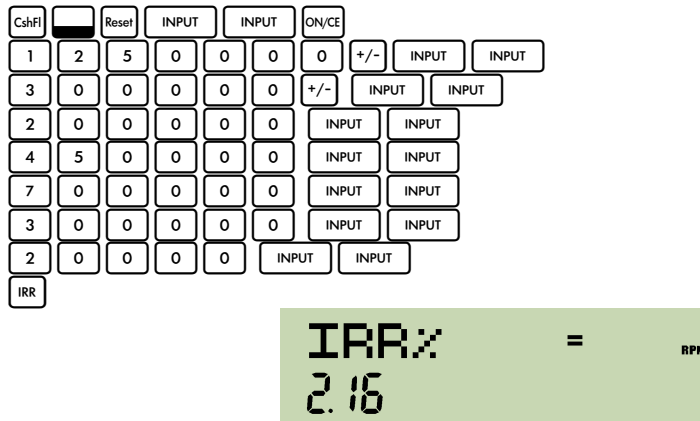


Figure 2

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 3: A company is considering expanding a product line, which will require an investment today of \$800,000. Future cash inflows are estimated to be \$190,000 a year for 6 years followed by \$90,000 a year for the 4 years thereafter. If the company's cost of funds is 15%, compute the IRR and compare it to the cost of funds. Should the product line be expanded? As a check, enter the IRR as the cost of funds and compute the NPV. Verify that it is equal to zero. Store the IRR in memory 9 as a temporary holding place when switching over to the NPV calculation and then recall memory 9 as the investment rate for the NPV calculation.

Solution:

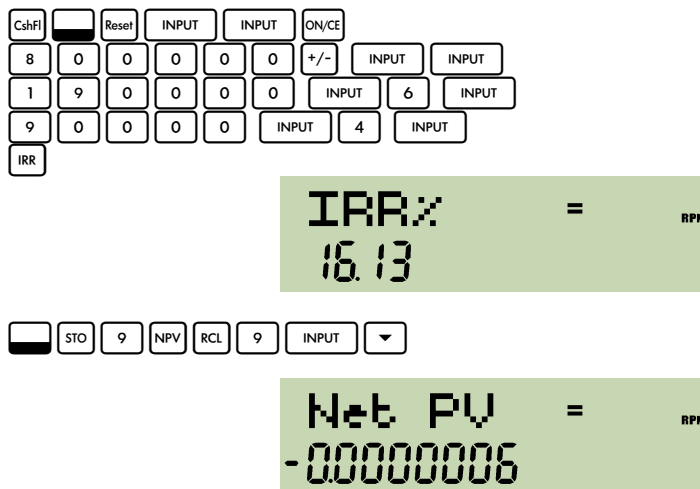


Figure 3

[STO] [9] [NPV] [RCL] [9] [INPUT] [v]



Figure 4

Answer: 16.13%. Since this is larger than the company's cost of funds, the product line should be expanded. Also note that when the NPV is evaluated using the IRR as the cost of funds, the NPV is equal to zero (or very, very close to zero).