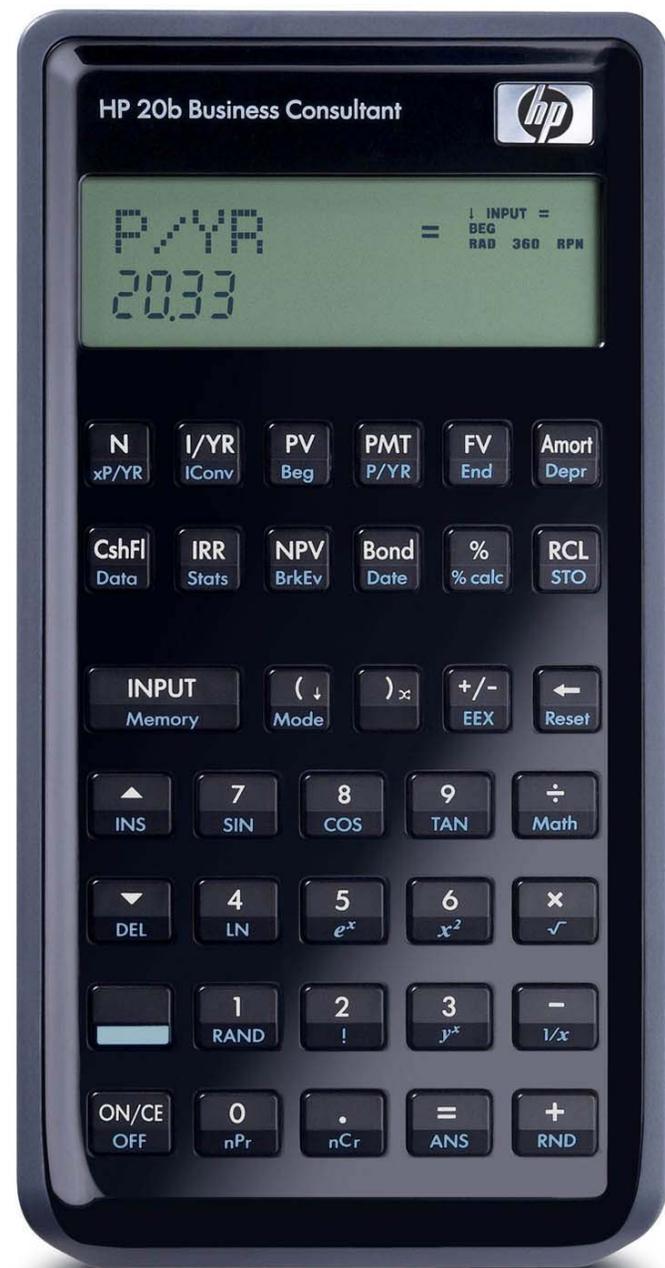# hp calculators

HP 20b Net Present Value and other
Discounted Cash Flow Measures

Discounted cash flow analysis

Net present value, net future value, and payback

Practice solving discounted cash flow problems

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.

Net present value, net future value, and payback

The Net Present Value (NPV) is defined as the present value of future cash inflows net of the initial cash outflow. If this result is positive, then this is the amount in today's dollars by which the inflows exceed the outflows – it will be the amount of incremental benefit for entering into the transaction. If this result is negative, then this is the amount by which the outflows exceed the inflows – it will be the amount of incremental cost for entering into the transaction. The present value is found using an interest rate representing the cost of funds involved.

The Net Future Value (NFV) is the same as the net present value but with the focal point being the end of the cash flow time frame, rather than today. In other words, this is the amount by which the inflows exceed the outflows at the end of the cash flow timeframe, whether positive or negative.

The Net Uniform Series (NUS) computes an annual cash flow for the cash flow timeframe involved whose present value is equal to the NPV, somewhat like an NPV per year.

Payback refers to the length of time it takes to recover the initial investment in a project, without considering the time value of money. Since this is a fairly significant weakness of the payback method, an alternative measure, called discounted payback, is provided that takes the time value of money into account.

On the HP 20b, NPV 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 [CshFl] 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
CshFl	Opens the cash flow list.
INPUT	Inputs (saves) entered values to variables in the cash flow list.
▲ ▼	Scrolls up and down.
▭ INS	Inserts cash flows into a cash flow list.
▭ DEL	Removes the displayed cash flow from a cash flow list.
NPV	Opens the net present value (NPV) menu.

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.

Once the cash flows have been entered, pressing NPV opens the NPV menu containing several menu items, as shown in the table below. The menu map for the NPV menu is also shown.
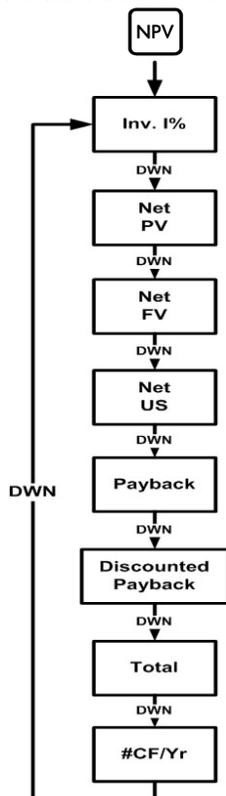
NPV Menu Items

Item	Description
Inv. I%	Investment or discount rate. Enter the investment rate or discount rate for the cash flows followed by INPUT. Input only.
Net PV	Net present value. Shows the value of the cash flows at the time of the initial cash flow, discounting the future cash flows by the value set for *Inv. I%*. Output only.
Net FV	Net future value. Shows the accumulated future value of the cash flows at the time of the last cash flow, using the value set for *Inv. I%*. Output only.
Net US	Net uniform series. Shows the per-period cash flow of equivalent present value to the cash flow list. Output only.
Payback	Payback. Shows the number of periods for the investment to recover the initial cost. Output only.
Discounted Payback	Discounted Payback. Shows the number of periods required for the investment to recover the initial cost if the cash flows are discounted using the value set in *Inv. I%*. Output only.
Total	The sum of all cash flows, equal to NPV if Inv. I% is *0*. Output only.
#CF/Yr	The number of cash flows per year. The default is *1*. Input only.

The last item in the list, #CF/Yr, specifies the number of cash flows per year. Usually, the default value of 1 will be what you need, 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 .

Note that if you press NPV 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 discounted cash flow 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%, what is the Net Present Value? Should the machine be replaced? What is the Net Future Value? What is the Net Uniform Series amount? What is the payback? What is the discounted payback? What is the total of the cash flows?
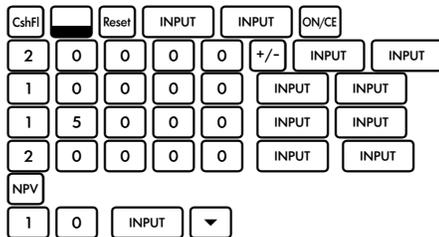
Solution:

CshFl		Reset	INPUT	INPUT	ON/CE
2	0	0	0	0	+/-	INPUT	INPUT
1	0	0	0	0	INPUT	INPUT
1	5	0	0	0	INPUT	INPUT
2	0	0	0	0	INPUT	INPUT
NPV
1	0	INPUT	▼

```
Net PV    =        RPN
 16,513.90
```
Figure 1

▼

```
Net FV    =        RPN
 21,980.00
```
Figure 2

▼

```
Net US    =        RPN
 6,640.48
```
Figure 3

▼

```
Payback   =        RPN
 1.67
```
Figure 4

▼

```
Discounte =        RPN
 1.88
```
Figure 5

▼

```
Total     =        RPN
 25,000.00
```
Figure 6

Answer: The NPV is $16,513.90. If the company replaces the machine, they will be better off by $16,513.90, so they should replace the machine. The NFV is $21,980, the NUS is $6640.48 and the total of the cash flows is $25,000. The payback of 1.67 indicates that the cost is recovered 2/3 of the way through the second year of the project. The discounted payback, however, indicates that taking the time value of money into account, recovery of the initial funds used for the project does not occur until 1.88 years into the project.

Example 2: Show that the NPV from example 1 is equal to the present value of the Net Future Value from example 1, using the cost of funds as the interest rate.

Solution: To show this relationship, use the time value of money keys and solve for the PV.
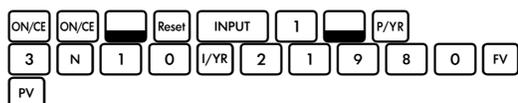

Figure 7

Answer: The PV is $-16,513.90. The negative sign is due to the time value of money sign convention. The NPV is the PV of the NFV, as it should be.

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 NPV. Should the company introduce the new product? What is the payback? What is the discounted payback? What does the discounted payback result mean?
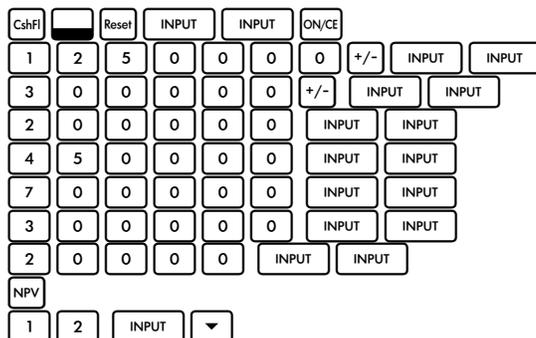
Solution:

Figure 8

Figure 9

Figure 10

Answer: -$412,893.92. No, the company should not introduce the new product, since they will be over $400,000 worse off if they do. Note that both of the first two cash flows were negative or cash outflows. Introducing a new product can often cause that situation. The payback is computed as 4.67 years, but the discounted payback calculation produces an error message that scrolls on the display saying "No payback." This error indicates that, when the time value of money is considered, the project never recovers the initial cash outlay. Since the NPV is -$412,893.92, this may not be too surprising. It does indicate how the regular payback can be a very misleading way to evaluate projects.

Example 4:   Find the present value of $200 three months from today, $400 four months from today, $200 a month from months 7 through 10, and $1000 twelve months from today. Assume interest is assessed at 8%, compounded monthly.

Solution: This example will illustrate how to use the DCF functions to solve non-annuity, irregular payment problems. The cash flows or payments for this example could be summarized as:

Month 0: $0	Month 5: $0	Month 10: $200
Month 1: $0	Month 6: $0	Month 11: $0
Month 2: $0	Month 7: $200	Month 12: $1000
Month 3: $200	Month 8: $200	
Month 4: $400	Month 9: $200	

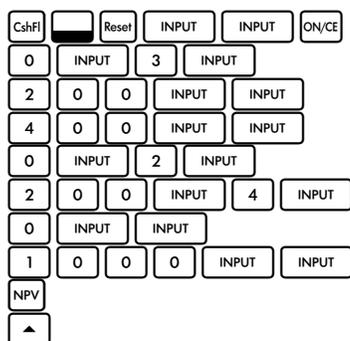Figure 11

Figure 12

Figure 13

Answer: $2,265.01. Note that it was necessary to change the #CF/Yr setting from 1 to 12, since these were monthly cash flows. Using [▲] rather than [▼] to move to the #CF/Yr menu item saved many keystrokes.

Example 5:   Find the present value of deposits of $10 a year for 19 years with a final deposit at year 20 of $100. Assume interest is 9%, compounded annually.

Solution: This is another example of how to use the DCF functions to solve non-annuity, irregular payment problems.
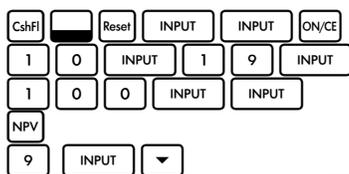

Figure 14

Answer: $117.01. Note that the #CF/Yr setting is reset to its default value of 1 when you reset the cash flow menu.