

# HP 12c Calculator - Analyzing Financial Problems

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## Introduction

The HP 12c Financial calculator provides functions for the two most commonly used methods of discounted cash flow analysis: **f** **NPV** (net present value) and **f** **IRR** (internal rate of return). These functions enable analyzing financial problems involving cash flows, that is, money paid out or received, occurring at regular intervals.

NPV is calculated by adding the initial investment, represented as a negative cash flow, to the present value of the anticipated future cash flows. The interest rate,  $i$ , will be referred to NPV and IRR as the rate of return. The value of NPV indicates the result of the investment:

- If NPV is positive, the financial value of the investor's assets would be increased — the investment is financially attractive.
- If NPV is zero, the financial value of the investor's assets would not change — the investor is indifferent to the investment.
- If NPV is negative, the financial value of the investor's assets would be decreased — the investment is not financially attractive.

The greater the NPV, the more the financial value of the investor's assets increases.

IRR is the rate of return at which the discounted future cash flows equal the initial cash outlay — IRR is the discount rate at which NPV is zero. The value of IRR relative to the present value discount rate also indicates the result of the investment:

- If IRR is greater than the desired rate of return, the investment is financially attractive.
- If IRR is equal to the desired rate of return, the investor is indifferent to the investment.
- If IRR is less than the desired rate of return, the investment is not financially attractive.

## Calculating the net present value (NPV) for ungrouped cash flows

The amount of the initial investment ( $CF_0$ ) is entered into the calculator using the **g** **CF<sub>0</sub>** keys. Pressing **g** **CF<sub>0</sub>** stores  $CF_0$  in storage register  $R_0$  and also stores the number 0 in the n register.

The amounts of the subsequent cash flows are stored in the order they occur in the remaining storage registers:  $CF_1$  through  $CF_9$  in  $R_1$  through  $R_9$ , and  $CF_{10}$  through  $CF_{19}$  in  $R_{10}$  through  $R_{19}$ , respectively. If there is a  $CF_{20}$ , that amount is stored in the FV register.

Each cash flow ( $CF_1$ ,  $CF_2$ , etc.) is designated  $CF_j$ , where j takes on values from 1 up to the number of the final cash flow. The amount of a cash flow is entered using the **g** **CF<sub>j</sub>** keys. Each time **g** **CF<sub>j</sub>** is pressed, the amount in the display is stored in the next available storage register, and the number in the n register is increased by 1. This register therefore counts how many cash flow amounts, in addition to the initial investment,  $CF_0$ , have been entered.

### NOTE:

When entering cash flow amounts, including the initial investment  $CF_0$ , enter a negative cash flow by pressing **CHS** after keying in the number.

To enter the cash flow amounts:

1. Press **f** **CLEAR** **REG** to clear the financial and storage registers.
2. Key in the amount of the initial investment, press **CHS** if that cash flow is negative, then press **g** **CF<sub>0</sub>**.

3. Key in the amount of the next cash flow, press **CHS** if the cash flow is negative, then press **g** **CFj**. If a cash flow amount is zero, press **0** **g** **CFj**.
4. Repeat step 3 for each cash flow until all have been entered.

With the amounts of the cash flows stored in the calculator's registers, calculate NPV as follows:

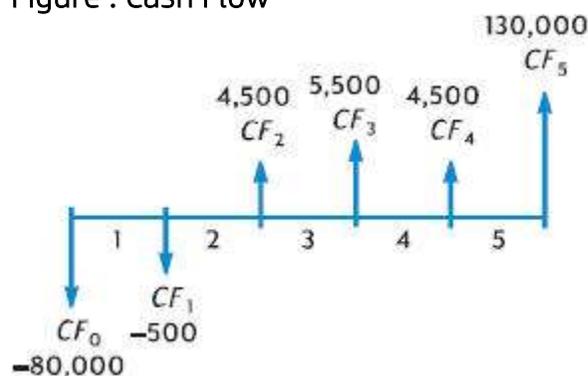
1. Enter the interest rate, using **i** or **g** **12** **÷**.
2. Press **f** **NPV**.

The calculated value of NPV appears in the display and is automatically stored in the PV register.

## Example for calculating the net present value (NPV) for ungrouped cash flows

An investor has an opportunity to buy a duplex for \$80,000 and would like a return of at least 13%. The investor expects to keep the duplex five years and then sell it for \$130,000 and anticipates the cash flows shown in the diagram below. Calculate NPV to determine whether the investment would result in a return or a loss.

Figure : Cash Flow



### NOTE:

The cash flow amount of \$4,500 occurs twice; these cash flows are not consecutive.

Keystroke	Display	Description
<b>f</b> CLEAR <b>REG</b>	0.00	Clears financial and storage registers.
<b>8</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>CHS</b> <b>g</b> <b>CF<sub>0</sub></b>	-80,000.00	Stores CF <sub>0</sub> (with minus sign for a negative cash flow).
<b>5</b> <b>0</b> <b>0</b> <b>CHS</b> <b>g</b> <b>CF<sub>1</sub></b>	-500.00	Stores CF <sub>1</sub> (with minus sign for a negative cash flow).
<b>4</b> <b>5</b> <b>0</b> <b>0</b> <b>g</b> <b>CF<sub>1</sub></b>	4,500.00	Stores CF <sub>2</sub> .
<b>5</b> <b>5</b> <b>0</b> <b>0</b> <b>g</b> <b>CF<sub>1</sub></b>	5,500.00	Stores CF <sub>3</sub> .
<b>4</b> <b>5</b> <b>0</b> <b>0</b> <b>g</b> <b>CF<sub>1</sub></b>	4,500.00	Stores CF <sub>4</sub> .
<b>1</b> <b>3</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>g</b> <b>CF<sub>1</sub></b>	130,000.00	Stores CF <sub>5</sub> .
<b>RCL</b> <b>n</b>	5.00	Checks number of cash flow amounts entered (in addition to CF <sub>0</sub> ).
<b>1</b> <b>3</b> <b>i</b>	13.00	Stores i.

Keystroke	Display	Description
<b>f</b> <b>NPV</b>	212.18	NPV.

Since NPV is positive, the investment would increase the financial value of the investor's assets.

## Calculating the net present value (NPV) for grouped cash flows

The HP 12c Financial calculator stores a maximum of 20 cash flow amounts (in addition to the initial investment  $CF_0$ ). However, the calculator can handle problems involving more than 20 cash flows if there are equal, consecutive cash flows occurring among the other cash flows. For such problems, enter the amount(s) of the cash flows, and the number of times up to 99 each amount occurs consecutively. The number of times a cash flow occurs is designated by  $N_i$ , **g**  **$N_i$** , and it corresponds to the cash flow amount,  $CF_i$ . Each value for  $N_i$  is stored in a special register inside the calculator.

The grouping of equal, consecutive cash flows is provided to minimize the number of storage registers required.

### NOTE:

When entering cash flow amounts, including the initial investment  $CF_0$ , enter a negative cash flow by pressing **CHS** after keying in the number.

Follow these steps to enter the amounts of the cash flows and the number of times they occur consecutively:

1. Press **f** **CLEAR** **REG** to clear the financial and storage registers.
2. Key in the amount of the initial investment, press **CHS** if that cash flow is negative, then press **g**  **$CF_0$** .
3. If the initial investment consists of more than one cash flow of the amount entered in step 2, key in the number of times those cash flows occur, and then press **g**  **$N_i$** . If **g**  **$N_i$**  is not pressed, the calculator assumes that  $N_0$  is 1.

4. Key in the amount of the next cash flow. Press **CHS** if that cash flow is negative, and then press **g** **CFj**. If the cash flow amount is zero in the next period, press **0** **g** **CFj**.
5. If the amount entered in step 4 occurs more than once consecutively, key in the number of times that cash flow amount occurs, then press **g** **Nj**. If **g** **Nj** is not pressed, the calculator assumes that  $N_j$  is 1 for the  $CF_j$  just entered.
6. Repeat steps 4 and 5 for each  $CF_j$  and  $N_j$  until all cash flows have been entered.

With the amounts of the cash flows and the number of times they occur consecutively stored in the calculator, NPV can be calculated by entering the interest rate and pressing **f** **NPV**.

## Example for calculating the net present value (NPV) for grouped cash flows

An investor has an opportunity to purchase a piece of property for \$79,000, and he would like a 13½% return. He expects to be able to sell it after 10 years for \$100,000 and anticipates the yearly cash flows shown in the table below:

Year	Cash Flow	Year	Cash Flow
1	\$14,000	6	\$9,100
2	\$11,000	7	\$9,000
3	\$10,000	8	\$9,000
4	\$10,000	9	\$4,500
5	\$10,000	10	\$100,000

Since two cash flow amounts (\$10,000 and \$9,000) are repeated consecutively, the number of storage registers required can be minimized by using this method:

Keystroke	Display	Description
<b>f</b> CLEAR <b>REG</b>	0.00	Clears financial and storage registers.
<b>7</b> <b>9</b> <b>0</b> <b>0</b> <b>0</b> <b>CHS</b> <b>g</b> <b>CFo</b>	-79,000.00	Initial investment (with minus sign for a negative cash flow).
<b>1</b> <b>4</b> <b>0</b> <b>0</b> <b>0</b> <b>g</b> <b>CFj</b>	14,000.00	First cash flow amount.
<b>1</b> <b>1</b> <b>0</b> <b>0</b> <b>0</b> <b>g</b> <b>CFj</b>	11,000.00	Next cash flow amount.
<b>1</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>g</b> <b>CFj</b>	10,000.00	Next cash flow amount.
<b>3</b> <b>g</b> <b>Ni</b>	3.00	Number of times this cash flow amount occurs consecutively.
<b>9</b> <b>1</b> <b>0</b> <b>0</b> <b>g</b> <b>CFj</b>	9,100.00	Next cash flow amount.
<b>9</b> <b>0</b> <b>0</b> <b>0</b> <b>g</b> <b>CFj</b>	9,000.00	Next cash flow amount.

Keystroke	Display	Description
<b>2</b> <b>g</b> <b>N<sub>i</sub></b>	2.00	Number of times this cash flow amount occurs consecutively.
<b>4</b> <b>5</b> <b>0</b> <b>0</b> <b>g</b> <b>CF<sub>j</sub></b>	4,500.00	Next cash flow amount.
<b>1</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>g</b> <b>CF<sub>j</sub></b>	100,000.00	Final cash flow amount.
<b>RCL</b> <b>n</b>	7.00	Seven different cash flow amounts have been entered.
<b>1</b> <b>3</b> <b>.</b> <b>5</b> <b>i</b>	13.50	Stores i.
<b>f</b> <b>NPV</b>	907.77	Calculates NPV.

Since NPV is positive, the investment would increase the financial value of the investor's assets by \$907.77.

## Calculating internal rate of return (IRR)

To calculate the internal rate of return:

1. Enter the cash flows using either of the methods described above under calculating net present value.
2. Press **f** **IRR**.

The calculated value of IRR appears in the display and also is automatically stored in the i register.

NOTE:

Remember that the **f IRR** function may take a significant amount of time to produce an answer, during which the calculator displays, 'running.'

## Example for calculating internal rate of return (IRR)

The NPV calculated in the preceding example was positive, indicating that the actual rate of return, that is, the IRR, was greater than the  $13\frac{1}{2}$  used in the calculation. Find the IRR. Assuming the cash flows are still stored in the calculator, press **f IRR**:

Keystroke	Display	Description
<b>f IRR</b>	13.72	IRR is 13.72%.

NOTE:

The value calculated by **f IRR** is the periodic rate of return. If the cash flow periods are other than years (for example, months or quarters), calculate the nominal annual rate of return by multiplying the periodic IRR by the number of periods per year.

## Reviewing cash flow entries

To review the cash flow entries:

- To display a single cash flow amount, press **RCL**, then key in the number of the register containing the cash flow amount to be displayed. Alternatively, store the number of that cash flow amount, that is, the value of  $j$  for the  $CF_j$  desired, in the  $n$  register, then press **RCL 9 CFj**.
- To review all the cash flow amounts, press **RCL 9 CFj** repeatedly. This displays the cash flow amounts in the reverse order — that is, beginning with the final cash flow and proceeding to  $CF_0$ .
- To display the number of times a cash flow amount occurs consecutively — that is, to display the  $N_j$  for a  $CF_j$  — store the number of that cash flow amount, that is, the value of  $j$ , in the  $n$  register, then press **RCL 9 Nj**.
- To review all the cash flow amounts together with the number of times each cash flow amount occurs consecutively, that is, to review each  $CF_j$  and  $N_j$  pair,

press **RCL** **g** **N<sub>j</sub>** **RCL** **g** **CF<sub>j</sub>** repeatedly. This displays  $N_j$  followed by  $CF_j$  beginning with the final cash flow amount and proceeding to  $N_0$  and  $CF_0$ .

**NOTE:**

Neither **f** **IRR** nor **f** **NPV** changes the number in the n register. However, each time **RCL** **g** **CF<sub>j</sub>** is pressed, the number in the n register is decreased by 1.

## Example for reviewing cash flow entries

To display the fifth cash flow amount and the number of times that amount occurs consecutively from the previous example:

Keystroke	Display	Description
<b>RCL</b> <b>5</b>	9,000.00	$CF_5$ .
<b>5</b> <b>n</b>	5.00	Stores the value of j in the n register.
<b>RCL</b> <b>g</b> <b>N<sub>j</sub></b>	2.00	$N_5$ .
<b>7</b> <b>n</b>	7.00	Resets the number in the n register to its original value.

## Changing cash flow entries

To change a cash flow amount:

1. Key the amount into the display.
2. Press **STO**.
3. Key in the number of the register containing the cash flow amount to be changed.

To change the number of times a cash flow amount occurs consecutively — that is, to change the  $N_j$  for a  $CF_j$ :

1. Store the number of that cash flow amount, that is,  $j$ , in the  $n$  register.
2. Key the number of times the cash flow amount occurs consecutively into the display.
3. Press **g** **N<sub>j</sub>**.

**NOTE:**

When changes are made to the number in the  $n$  register in order to change a value for  $N_j$ , be sure to reset the number in the  $n$  register to the total number of cash flow amounts originally entered (not including the amount of the initial investment  $CF_0$ ). If this is not done, NPV and IRR calculations will yield incorrect results.

## Example for changing cash flow entries

With the cash flows now stored in the calculator from the previous example, change  $CF_2$  from \$11,000 to \$9,000, and then calculate the new NPV for a  $13\frac{1}{2}\%$  return.

Keystroke	Display	Description
<b>9</b> <b>0</b> <b>0</b> <b>0</b> <b>STO</b> <b>2</b>	9,000.00	Stores the new $CF_2$ in $R_2$ .
<b>1</b> <b>3</b> <b>.</b> <b>5</b> <b>i</b>	13.50	Stores $i$ .
<b>f</b> <b>NPV</b>	-644.75	The new NPV.

Since this NPV is negative, the investment with this change would decrease the financial value of the investor's assets.