

HP 12c Financial Calculator - Internal Rate of Return

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Cash flow and IRR calculations

Cash flow analysis is an extension of the basic TVM concepts applied to compound interest problems when payments occur in regular periods and do not have the same value. Any financial investment can be represented as an initial investment of money and a series of later cash flows that occur in regular periods of time. Each flow of money can be positive (received) or negative (paid out) and considered as a cash flow. Common cash flow problems usually involve the calculation of the Internal Rate of Return (IRR) or the Net Present Value (NPV).

The NPV expresses the amount of money resulting from the summation of the initial investment (CF_0) and the present value of each anticipated cash flow (CF_j) calculated to the time of the initial investment. The IRR is the discounted rate applied to all future cash flows that cause $NPV = 0$.

The expression that calculates the Internal Rate of Return is:

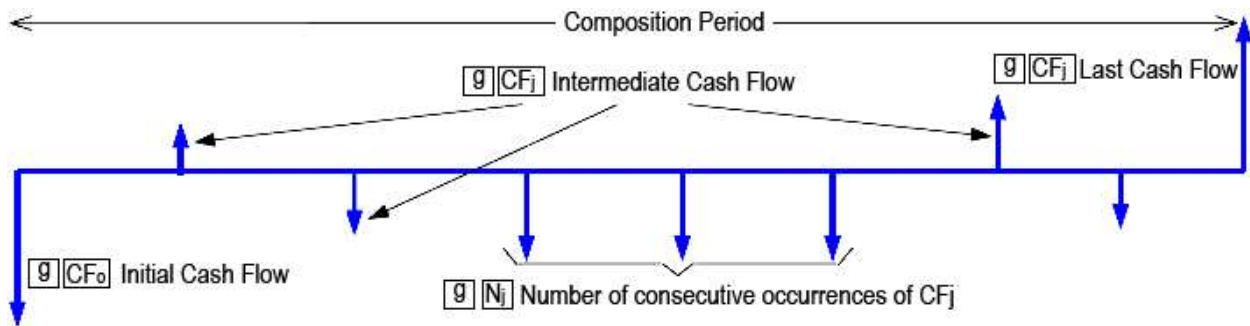
Figure : Expression calculating Internal Rate of Return

$$0 = CF_0 + \sum_{j=1}^k CF_j \times \left[\frac{1 - (1 + IRR)^{-nj}}{IRR} \right] \times (1 + IRR)^{-nj}$$

Cash flow diagrams

The cash flow diagram in Figure 1 illustrates one of the many possible situations that can be handled by the HP 12c.

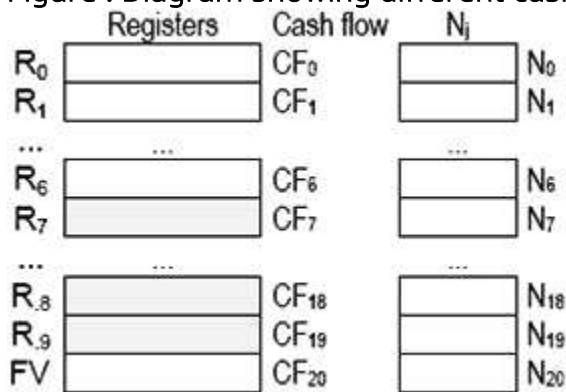
Figure : Cash flow diagram



The HP 12c cash flow approach

In the HP 12c each cash flow amount is stored in its corresponding register in memory. For each cash flow amount there is a related register to store the number of consecutive occurrences of this amount. This approach is shown below:

Figure : Diagram showing different cash flow amounts can be stored



The HP 12c memory organization allows up to 20 different cash flow amounts plus the initial investment to be stored and handled according to the diagram in Figure 2. If any cash flow amount repeats consecutively, then it can be stored as a grouped cash flow CF_j and its corresponding N_j holds the number of occurrences, up to 99. TVM register 'n' is used as an index to control CF operations.


The keys to enter cash flow data are:


Keystroke	Description
g CF_0	Stores the number in the display in R_0 and sets 'n' to zero.

Keystroke	Description
$\boxed{g} \boxed{CFj}$	Adds 1 unit to current 'n' contents (j) and then stores the number in the display in R_j .
$\boxed{g} \boxed{Nj}$	Stores the number in the display in N_j ; 'n' contents (j) are not changed.

NOTE:

The number in the display must be a positive integer from 1 to 99,

otherwise $\boxed{g} \boxed{Nj}$ returns  to the display and no operation is performed.

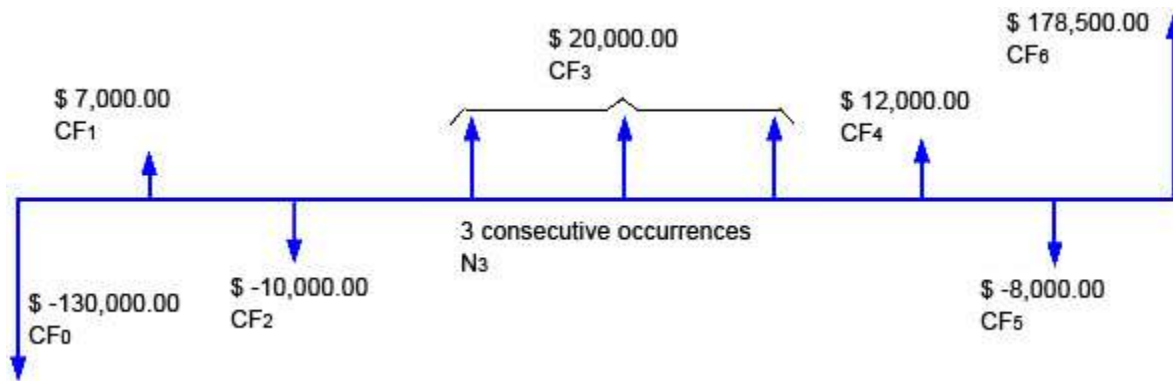
If the last available register has already been used, $\boxed{g} \boxed{CFj}$ adds 1 unit to current 'n' contents and stores the number in the display in TVM register FV. Any attempt to add a cash flow amount with $\boxed{g} \boxed{CFj}$ after FV has already been used or when 'n' contents refer to a register that is not available causes  to be shown in the display and no operation is performed.

Practice solving IRR problems

Example 1


The cash flow diagram below represents a possible investment and you were chosen to determine if it is feasible. The success of this investment dictates your future in the company, so the analysis must be precise and error free. What is the correct keystroke sequence to fill the HP 12c registers with all data?

Figure : Values entered in the cash flow diagram




Solution

Clearing all registers is not necessary to start cash flow analysis because only the registers updated with cash flow data are used.

Keystroke	Display
1 3 0 0 0 0 CHS g CF ₀ 7 0 0 0 g CF ₁ 1 0 0 0 0 CHS g CF ₁	Figure : Entering the first set of values 

The next cash flow amount occurs three times in a sequence, so it can be entered as a grouped cash flow.

Keystroke	Display
2 0 0 0 0 g CF ₁ 3 g N _i	Figure : Entering the next set of values 

The remaining data is entered with the following keystroke sequence:

Keystroke	Display
<div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 2px;"> 12000gCFI </div> <div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 2px;"> 8000CHSgCFI </div> <div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 2px;"> 178500gCFI </div>	<p>Figure : Entering the remaining set of values</p> <div style="border: 1px solid black; padding: 5px; text-align: center; background-color: #f0f0f0;"> <p>178,500.00</p> </div>

Answer

The keystrokes presented above indicate the correct entries.

Example 2

The cash flow diagram had all of its information used to compose the cash flow data in the HP 12c memory. Show how to check that they were entered correctly.

Solution

Now that all data is entered, checking for its correctness is possible in two ways. The most common way is the sequential check and the keystroke sequence for this checking is as follows:

Keystroke	Display
<div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 2px;"> RCLn </div>	<p>Figure : Displaying the number of the last register</p> <div style="border: 1px solid black; padding: 5px; text-align: center; background-color: #f0f0f0;"> <p>6.00</p> </div>

This is the number of the last register used to store the cash flow data. It will be needed later.

Keystroke	Display
RCL 9 CFj	Figure : Displaying the amount of CF ₆ 178,500.00

This is the amount of CF₆. The sequential checking works backwards, and each time RCL 9 CFj is pressed, 'n' is decreased by one unit. Now check CF₅, CF₄ and when checking CF₃ verify N₃ as well.

Keystroke	Display
RCL 9 CFj RCL 9 CFj RCL 9 Nj	Figure : Checking the cash flow data entered 3.00



This is the N₃ value. Whenever N_j needs to be checked, it must be recalled first. Now check the CF₃ value:

Keystroke	Display
RCL 9 CFj	Figure : Checking the CF ₃ value 20,000.00

Continue checking CF₂, CF₁ and stop when CF₀ is shown in the display.

Keystroke	Display
RCL 9 CFj RCL 9 CFj RCL 9 CFj	Figure : Displaying the value of CF ₀ - 130,000.00

Recall 'n' contents to the display:

Keystroke	Display
	Figure : Recalling the contents 

Answer

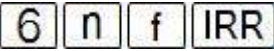


The entries are correct.

Example 3

The investment is considered attractive if it shows at least 8% of internal rate of return. Calculate the IRR.

Solution

To perform either IRR or NPV calculations, 'n' must have its contents restored to the correct value:

Keystroke	Display
	(flashing)  Figure : Calculating the Internal Rate of Return 

Answer

Yes, the investment is attractive based on its 9.37% internal rate of return.

[How to modify cash flow entries](#)

If it happens that a cash flow entry was wrongly entered, modifying its amount is not difficult and there is no need to enter all data again. In fact there are two ways for doing this.

Example 4

Update the amount of CF_2 for \$-9,500.00 and compute the new IRR after this change.

Solution 1

Type in the correct amount and store it in R_2 :

Keystroke	Display
<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 9 5 0 0 CHS STO 2 f IRR </div>	<p>Figure : Updating the amount of CF_2</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; background-color: #f0f0f0;"> 9.42 </div>

Solution 2

Set 'n' register to (j-1), type in the correct amount, press g CFj, then restore 'n' prior to compute IRR:

Keystroke	Display
<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 1 n 9 5 0 0 CHS </div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-top: 2px;"> g CFj 6 n f IRR </div>	<p>Figure : Calculating the Internal Rate of Return</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; background-color: #f0f0f0;"> 9.42 </div>

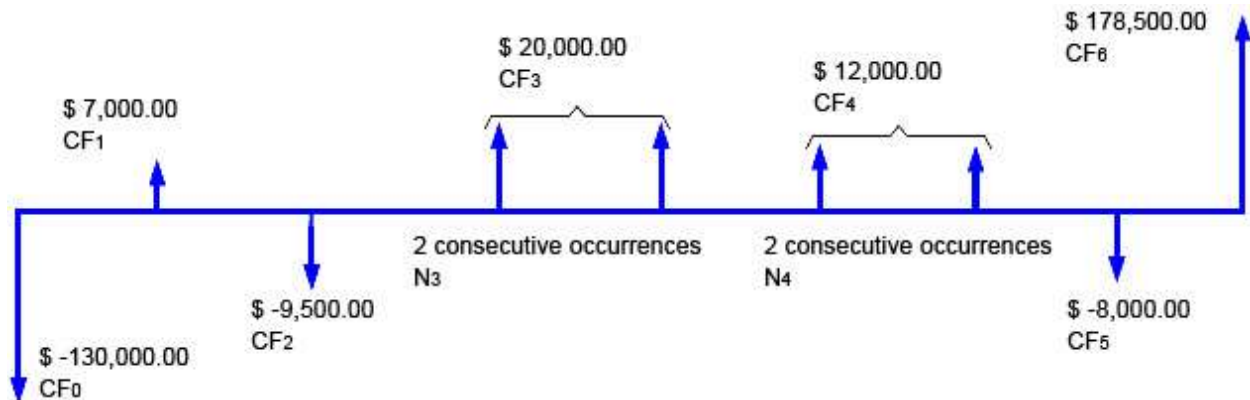
Answer

The investment is still attractive based on revised IRR of 9.42%.

To modify a wrongly entered N_j , it is necessary to change the value stored in the register 'n'.

Example 5

Now change both N_3 and N_4 to 2 and calculate the IRR again. The cash flow diagram now looks like this:



Solution

For each correction, set 'n' to match 'j,' type in the correct N_j and press **g** **N_j** . After all corrections, set 'n' to its original value and press **f** **IRR**.

Keystroke	Display
3 n 2 g N_j	Figure : Calculating the new Internal Rate of Return 8.77
4 n 2 g N_j	
6 n f IRR	

Answer

The newly computed IRR is 8.77%.