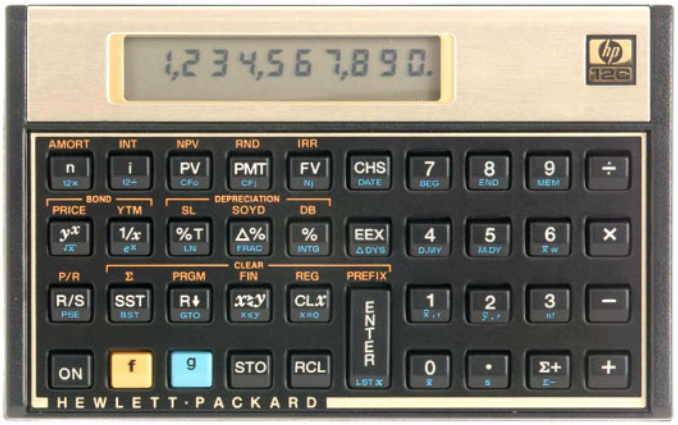
hp calculators



HP 12C 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:

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

Figure 1

Cash flow diagrams

The cash flow diagram in Figure 1 illustrates one of the many possible situations that can be handled by the HP12C.

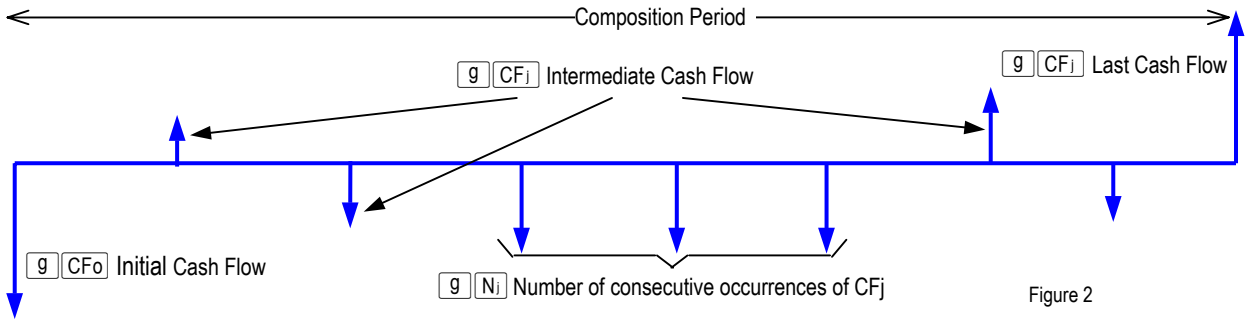

Figure 2

The HP12C cash flow approach

In the HP12C 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:

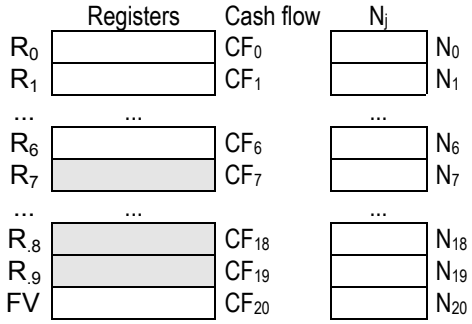

Figure 3

The HP12C 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:

[g] [CFo] - stores the number in the display in R_0 and sets n to zero
[g] [CFj] - adds 1 unit to current n contents (j) and then stores the number in the display in R_j
[g] [Nj] - stores the number in the display(*) in N_j; n contents (j) are not changed

(*) The number in the display must be a positive integer from 1 to 99, otherwise [g] [Nj] returns Error 6 to the display and no operation is performed.

If the last available register has already been used, [g] [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 [g] [CFj] after FV has already been used or when n contents refer to a register that is not available causes Error 6 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 HP12C registers with all data?

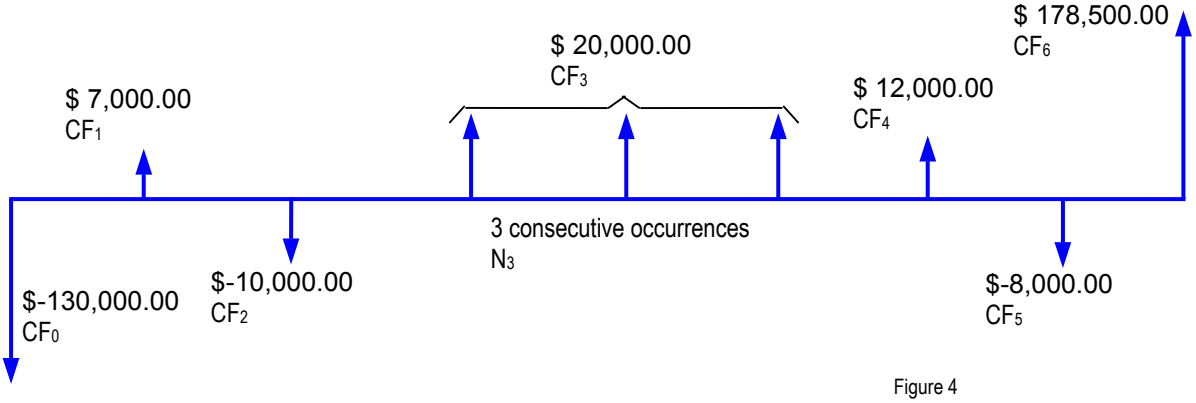

Figure 4

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

[1] [3] [0] [0] [0] [0] [CHS] [g] [CFo]
[7] [0] [0] [0] [g] [CFj]
[1] [0] [0] [0] [0] [CHS] [g] [CFj]

Figure 5

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

2 0 0 0 0 g CFj
3 g Nj

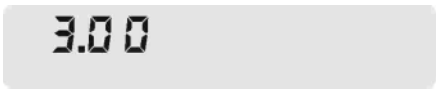

Figure 6

The remaining data is entered with the following keystroke sequence:

1 2 0 0 0 g CFj
8 0 0 0 CHS g CFj
1 7 8 5 0 0 g CFj

Figure 7

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 HP12C 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:

RCL n

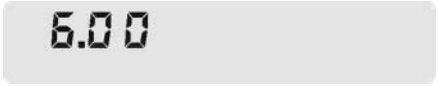

Figure 8

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

RCL g CFj

Figure 9

This is the amount of CF_6. The sequential checking works backwards, and each time RCL g CFj is pressed, n is decreased by one unit. Now check CF_5, CF_4 and when checking CF_3 verify N_3 as well.

RCL g CFj
RCL g CFj
RCL g Nj

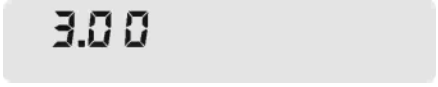

Figure 10

This is the N_3 value. Whenever N_j needs to be checked, it must be recalled first. Now check the CF_3 value:

RCL g CF_j

Figure 11

Continue checking CF_2, CF_1 and stop when CF_0 is shown in the display.

RCL g CF_j
RCL g CF_j
RCL g CF_j

Figure 12

Recall n contents to the display:

RCL n

Figure 13

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:

6 n f IRR

(flashing)

Figure 14

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:

9 5 0 0 CHS STO 2 f IRR

Figure 15

Solution 2: Set n register to (j-1), type in the correct amount, press g CFj, then restore n prior to compute IRR:

1 n 9 5 0 0 CHS g CFj 6 n f IRR

Figure 16

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

To modify a wrongly entered Nj, 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:

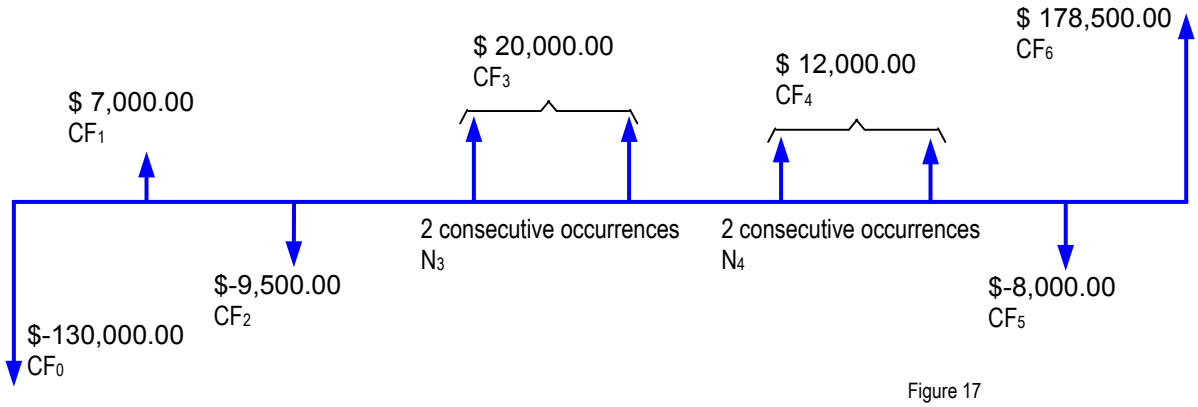

Figure 17

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

3 n 2 g Nj 4 n 2 g Nj 6 n f IRR

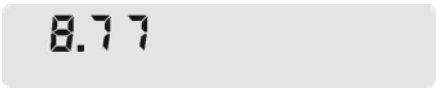

Figure 18

Answer: The newly computed IRR is 8.77%.