hp calculators

HP 12C Net Present Value

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Cash Flow and NPV 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 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 Net Present Value is:

\[
NPV = CF_0 + \frac{CF_1}{(1+i)} + \frac{CF_2}{(1+i)^2} + \cdots + \frac{CF_j}{(1+i)^j}
\]

Cash flow diagrams

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

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:

\[
\begin{array}{c|c|c}
\text{Registers} & \text{Cash flow} & \text{N}_j \\
R_0 & CF_0 & N_0 \\
R_1 & CF_1 & N_1 \\
\vdots & \vdots & \vdots \\
R_6 & CF_6 & N_6 \\
R_7 & CF_7 & N_7 \\
\vdots & \vdots & \vdots \\
R_8 & \cdots & \cdots \\
R_9 & CF_{19} & N_{19} \\
FV & CF_{20} & N_{20}
\end{array}
\]
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:

- **gJ** - stores the number in the display in R0 and sets n to zero
- **gK** - adds 1 unit to current n contents (j) and then stores the number in the display in Rj
- **gN** - stores the number in the display (*) in Nj; n contents (j) are not changed

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

If the last available register has already been used, **gK** 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 **gK** 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 NPV 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 this data?

**Figure 4**

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

```
1 3 0 0 0 0 CHS g CF0
7 0 0 0 9 CF1
1 0 0 0 0 CHS g CF1

-10,000.00
```

**Figure 5**
The next cash flow amount occurs three times in a sequence, so it can be entered as a grouped cash flow.

\[
\begin{align*}
\text{20000} & \hspace{1em} \text{gK} \\
\text{30} & \hspace{1em} \text{gN}_i \\
\end{align*}
\]

![Figure 6]

The remaining data is entered with the following keystroke sequence:

\[
\begin{align*}
\text{12000} & \hspace{1em} \text{gK} \\
\text{8000} & \hspace{1em} \text{CHS} \hspace{1em} \text{gK} \\
\text{178500} & \hspace{1em} \text{gK} \\
\end{align*}
\]

![Figure 7]

**Answer:** The keystrokes presented above indicate the correct entries.

**Example 2:** The cash flow diagram has all of its information used to compose the cash flow data in the HP12C memory. How can the entries be checked to ensure they are correct?

**Solution:** Now that all data is entered, checking for its correctness is possible in two ways. The alternative way is the random check through the use of the \[\text{RCL}\] key. The procedure for this checking is as follows:

\[
\begin{align*}
\text{RCL} & \hspace{1em} \text{n} \\
\text{6.00} & \hspace{1em} \text{Figure 8} \\
\text{RCL} & \hspace{1em} \text{6} \\
\text{178,500.00} & \hspace{1em} \text{Figure 9} \\
\text{RCL} & \hspace{1em} \text{3} \\
\text{20,000.00} & \hspace{1em} \text{Figure 10} \\
\end{align*}
\]

This is the number of the last register used to store the cash flow data.

This is the amount of \(CF_6\). Now check \(CF_3\) and verify \(N_3\) as well.

This is \(CF_3\) contents. To randomly check for \(N_j\) contents, \(n\) register contents must be set to indicate which \(N_j\) will be recalled.
Now check CF₂ and CF₀.

Recall n contents to the display:

Answer: The entries are correct.

Example 3: The investment is considered attractive if the calculated net present value is positive for a given interest rate. Now that all data is stored and checked, calculate the NPV for a given interest rate of 8%.

Solution: If n had its contents changed, it must be restored prior to calculate either IRR or NPV:

Answer: Yes, the investment is attractive based on a net present value of $11,429.11 for an interest rate of 8%.

How to modify cash flow entries

If it happens that a cash flow entry was wrongly entered, modifying its amount is not difficult. There are two ways to correct entries.

Example 4: Update the amount of CF₂ to $-9,500.00 and compute the new NPV after this change.

Solution 1: Type in the correct amount and store it in R₂:
**Solution 2:** Set \( n \) register to \((j-1)\), type in the correct amount, press \( \text{g} \text{CF}_{j} \), then restore \( n \) prior to compute NPV:

\[
\begin{align*}
1 & \text{n} 9 5 0 0 \text{CHS} \text{g} \text{CF}_{6} \text{n} \text{f} \text{NPV}
\end{align*}
\]

To modify a wrongly entered \( N_{j} \), it is necessary to change the value stored in register \( n \).

**Example 5:** Now change both \( N_{3} \) and \( N_{4} \) to 2 and calculate NPV again. The cash flow diagram now looks like this:

\[
\begin{align*}
\text{CF}_{0} & = -130,000.00 \\
\text{CF}_{1} & = 7,000.00 \\
\text{CF}_{2} & = -9,500.00 \\
\text{CF}_{3} & = 20,000.00 \\
\text{CF}_{4} & = -12,000.00 \\
\text{CF}_{5} & = -8,000.00 \\
\text{CF}_{6} & = 178,500.00
\end{align*}
\]

**Solution:** For each correction, set \( n \) to match \( j \), type in the correct \( N_{j} \) and press \( \text{g} \text{N} \). After all corrections, set \( n \) to its original value and press \( \text{f} \text{NPV} \).

\[
\begin{align*}
3 & \text{n} 2 \text{g} \text{N} 4 \text{n} 2 \text{g} \text{N} 6 \text{n} \text{f} \text{NPV}
\end{align*}
\]

**Answer:** The newly computed NPV is $6,413.11.