Solving for unknown [CFj] using the HP-12C [NPV]

Tony Hutchins, #1049

A 3-step method is used, the essentials of which are:

1. Input the complete transaction time-line including known CF_j, and with the unknown CF_j set to zero. Then [f][NPV][PMT].

2. Set the unknown CF_j=100 (pro rata if necessary). Then [f][NPV].

3. Run the following program: [RCL][PMT] [RCL][PV] [−] [RCL][PMT] [%T] [g][GTO]00.

The unknown CF_j is then displayed. Five different types of usage follow:

1. Construction Loan (multiple advance transaction)

$20,000 is advanced on the 15th of April, June and September. This $60,000 is to be repaid by 240 monthly instalments, the first due on 15th December. Find the monthly repayment rate assuming 10.25% interest.

[f]CLEAR[REG] 10.25 [g][12÷] 20000[g][CFo]

0[g][CFj]	[RCL]0[g][CFj]	0[g][CFj] 2[g][Nj]	[RCL]0[g][CFj]
0[g][CFj] 2[g][Nj]	0[g][CFj] 80[g][Nj]	0[g][CFj] 80[g][Nj]	0[g][CFj] 80[g][Nj]
[f][NPV][PMT]	100[STO]6[STO]7[STO]8	[f][NPV][R/S]	see: -612.93

2. Increasing Annuity (arithmetic progression)

A new business with growth prospects borrows $30,000 repayable over 5 years at 15%, and negotiates a scheme of 5 annual repayments increasing by $3,000 a year. What is the amount of the first year's repayment?

[f]CLEAR[REG] 15[i] 30000[CHS][g][CFo]

0[g][CFj]	3000[ENTER][ENTER][ENTER][g][CFj]	[+][g][CFj]	[+][g][CFj]
[+][g][CFj]	[f][NPV][PMT]	100[STO]1[STO][+]2	[STO][+]3
[STO][+]4	[RCL]5[+][STO]5	[f][NPV][R/S]	see: 3781.02

3. Photocopier Lease (Advance Payments with Residual)

Taken from page 176 of the *HP-12C Owner's handbook*. 4 lease payments made at the outset, then 44. Term is 48 months with 30% residual. Based on $22,000 value the residual is $6,600. Find the monthly payment assuming 15% interest. The book uses a 27 line program. Here (and in example 4) the 100 is also applied pro rata.

[f]CLEAR[REG] 15 [g][12÷] 22000[CHS][g][CFo]

0[g][CFj] 44[g][Nj]	0[g][CFj] 3[g][Nj]	6600[g][CFj]	[f][NPV][PMT]
400[STO][+]0	100[STO]1	[f][NPV][R/S]	see: 487.29

4. Graduated Payment Mortgage (geometric progression)

Taken from page 35 of the *HP-12C Solutions Handbook*. $50,000 repayable monthly with 5% increases in first 6 years and constant thereafter. 30 year term. 12.5% interest. Find payments for years 1-6 and balances at the end of years 1-5. Book has a 77 line program. The rounding below (in f 2) just emulates the book.

f CLEAR REG 12.5 g 12÷ 50000 CHS g CFo PMT

0 g CFj 12 g Nj	0 g CFj 12 g Nj	0 g CFj 12 g Nj	0 g CFj 12 g Nj
0 g CFj 12 g Nj	0 g CFj 96 g Nj	0 g CFj 96 g Nj	0 g CFj 96 g Nj
0 g CFj 12 g Nj	(no need for NPV)	1.05 ENTER ENTER ENTER	100 STO 1
X STO 2 X STO 3	X STO 4 X STO 5	X STO 6 STO 7	STO 8 STO 9
f NPV R/S	see: 448.88, STO 1	RCL 2 %	see: 471.33, STO 2
CLx RCL 3 %	see: 494.89, STO 3	CLx RCL 4 %	see: 519.64, STO 4
CLx RCL 5 %	see: 545.62, STO 5	CLx RCL 6 %	see: 572.90

Then: 0 PMT, RCL 1 f RND STO 1, RCL 2 f RND STO 2, RCL 3 f RND STO 3, RCL 4 f RND STO 4, and RCL 5 f RND STO 5 sets up data for the balances:

1 n f NPV 12 n FV	see: 50,914.67	2 n f NPV 24 n FV	see: 51,665.07
3 n f NPV 36 n FV	see: 52,215.34	4 n f NPV 48 n FV	see: 52,523.85
5 n f NPV 60 n FV	see: 52,542.97		

5. Bulldozer Purchase (skipped payments)

Taken from page 39 of the *HP-12C Solutions Handbook*. $100,000 repayable over 5 years at 14%. Find monthly repayment. Jan-Mar skipped. Loan drawn in Sept. Book has a complex 10 step keystroke solution, ingenious but challenging to *understand*, and without the usual practical explanation, which is understandable as the formula used is condensed. This at least sets out a clear time-line:

f CLEAR REG 14 g 12÷ 100000 CHS g CFo PMT

0 g CFj 3 g Nj	0 g CFj 3 g Nj	0 g CFj 9 g Nj	0 g CFj 3 g Nj
0 g CFj 9 g Nj	0 g CFj 3 g Nj	0 g CFj 9 g Nj	0 g CFj 3 g Nj
0 g CFj 9 g Nj	0 g CFj 3 g Nj	0 g CFj 6 g Nj	(no need for NPV)
100 STO 1 STO 3	STO 5 STO 7 STO 9	STO .1 f NPV R/S	see: 3119.89

Notes

The tables above are intended to be read/actioned across and down, and the first cells up to f NPV PMT or "(no need for PV)" always *correspond* to sequential storage register content, like so:

Register 1	Register 2	Register 3	Register 4
Register 5	Register 6	...	

100 is used as a basis for the unknown cashflows as it causes sufficient perturbation in the NPV to ensure a solution of adequate accuracy. Note that this technique leaves the known cashflows intact, unless an unknown cashflow has simultaneous incidence (see 2 & 3), thus facilitating further variations to be investigated without too much effort. In 4 & 5 PMT=CF_0 as only CF_0 is known.