PVal: Tools for Project Evaluation

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Abstract

This is a small library (written in UserRPL) that complements the Finance Tools already included in the HP49G. This package can calculate the Internal Rate of Return given a Cash Flow or the Net Present Value given a Cash Flow and a discount rate. It also calculates annuities and perpetuities and gives their Present Value or Future Value.

1 Copyrights & Disclaimer

2 Introduction

I've made this library when I was studying the subject "Evaluacion de Proyectos de Inversion" at Facultad de Ciencias Economicas, Universidad Nacional de La Plata. I needed to calcute the Internal Rate of Return of an investment project, or its Net Present Value. Aditionally, some projects involve annuities or perpetuities so I needed to get the Present Value of them.

3 Installation

To install the library to port x: (where x could be 0, 1 or 2)

1. Download the library to your HP49.
2. Recall the library to the stack and purge the variable created by the download procedure.
3. Type x STO (where x is the port number you chose)
4. Press ON-C

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4 Using PVal

To use PVal, simply type PVAL and press enter. You can also acces it through the *Library* menu. Then you can choose the IRR/NPV or the Annuity/Perpetuity application.

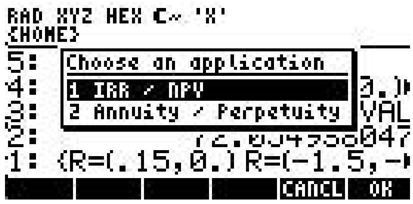

Figure 1: PVal first screen

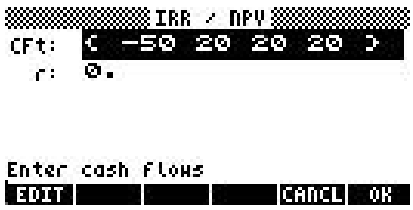

Figure 2: PVal IRR/NPV application

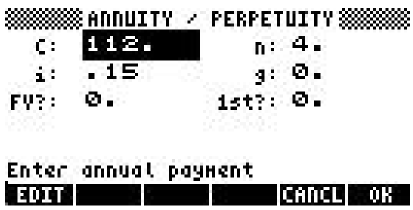

Figure 3: PVal Annuality/Perpetuity application

5 Net Present Value (NPV

The Present Value of a cash flow —also *discounted cash flow*— is the sum of each cash flow discounted by the opportunity cost of capital. Formally,

$$NPV = C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_T}{(1+r)^T} \tag{1}$$

$$NPV = \sum_{t=0}^{T} \frac{C_t}{(1+r)^t} \tag{2}$$

Once inside the IRR/NPV application you have to enter the cash flow as a list:

$$\{C_0, C_1, \ldots, C_T\}$$

for example,

$$\{-1000, 150, 150, 1150\}$$

where a negative cash flow is an outflow and a positive an inflow.

You should also enter the discount rate r in decimal format, e.g. 12% is entered as .12

The result of this short example will be,

$$NPV = 72.055 = -1000 + \frac{150}{1+.12} + \frac{150}{(1+.12)^2} + \frac{1150}{(1+.12)^3} \ .$$

6 Internal Rate of Return (IRR)

The Internal Rate of Return is defined as the rate of discount which makes the net present value of a cash flow equal to zero. Formally[1],

$$IRR = \left\{ r \Big/ \sum_{t=0}^{T} \frac{C_t}{(1+r)^t} = 0 \right\} \ . \tag{3}$$

Once inside the IRR/NPV application you have to enter the cash flow as a list and leave the rate of discount equal to zero.

Another quick example: find the IRR of the following cash flow

$$\{-1000, 150, 150, 1150\} \ .$$

$$IRR = .15 = 15\%$$

7 Annuities

An annuity is an asset that pays a fixed sum each year for a specified number of years. The Present Value of an annuity that produces a cash flow of C in each year beginning in year 1 and for n years is,

$$PV = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \cdots + \frac{C}{(1+r)^n} \ . \tag{4}$$

If it starts in $t = 0$ then,

$$PV = C + \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \cdots + \frac{C}{(1+r)^{n-1}} \ . \tag{5}$$

We can also find the Future Value of an annuity, i.e., the value of the cash flow the year after it finishes. Respectively,

$$FV_{n+1} = C(1+r)^n + C(1+r)^{n-1} + \cdots + C(1+r) \tag{6}$$

$$FV_n = C(1+r)^n + C(1+r)^{n-1} + \cdots + C(1+r) \ . \tag{7}$$

[1]Be aware that there could be a multiplicity of solutions, even negative, which should be discarded

7.1 Growing Annuities

If the payment of the annuity, C, growth at a constant rate g, and it starts in $t = 1$, then,

$$PV = C\frac{(1+g)}{(1+r)} + C\frac{(1+g)^2}{(1+r)^2} + \cdots + C\frac{(1+g)^n}{(1+r)^n} \ . \tag{8}$$

If it starts in $t = 0$ then,

$$PV = C + C\frac{(1+g)}{(1+r)} + C\frac{(1+g)^2}{(1+r)^2} + \cdots + C\frac{(1+g)^{n-1}}{(1+r)^{n-1}} \ . \tag{9}$$

To find the PV of an annuity, enter C, n, i and g. Set $g = 0$ for a constant anuity; $FV? = 1$ to find instead the Future Value; $1st? = 1$ if the first payment is in $t = 0$.

8 Perpetuities

The perpetuities are assets that offer a fixed payment for each year to perpetuity. They are like an annuity but whith $n \to \infty$. Formally,

$$PV = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \cdots \ . \tag{10}$$

If the first payment of the perpetuity is in $t = 0$, then,

$$PV = C + \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \cdots \ . \tag{11}$$

To find the PV of a perpetuity, set $n = \infty$

8.1 Growing Perpetuities

If the payment of the perpetuity, C, growth at a constant rate g,[2]

$$PV = C\frac{(1+g)}{(1+r)} + C\frac{(1+g)^2}{(1+r)^2} + \cdots \ . \tag{12}$$

If the first payment of the perpetuity is in $t = 0$, then,

$$PV = C + C\frac{(1+g)}{(1+r)} + C\frac{(1+g)^2}{(1+r)^2} + \cdots \ . \tag{13}$$

9 Examples

1. Given the following cash flows find the IRR of the project.

   Ans: $IRR \cong 10\%$

2. In the last project, how much would be its NPV if the interest rate is 7%?.

   Ans: $NPV = 81.65$

[2] To find a solution for the sum of this geometric series we should assume that $g < r$

t	C_t
0	-800
1	-27
2	251
3	300
4	300
5	300

3. You won a competition and you can chosse one of the following prizes:

   - \$100.000 now
   - \$11.400 a year forever
   - \$19.000 for each of ten years
   - \$6.500 next year and increasing thereafter by 5% a year forever

   If the interest rate is 12%, wich is the most valuable prize?.

   Ans: The Present Values of the options are respectively,

   - \$100.000
   - \$95.000
   - \$107.354
   - \$97.500

   So you should choose the 3rd. option.

10 Comments

If you have any comments, suggestions, or you want to report any bug, feel free to write me at jfbalat@hotmail.com