

## WATCH THE NPV FORMULA! M.D. Squirrel & Webster

During recent professional development computer workshops conducted by the Property Studies Education Unit at RMIT a little known inconsistency in the application of the Net Present Value (NPV) function in Lotus 123 has come to light.

**Net Present Value** is defined in Business Finance by Pierson & Bird as:

*"the difference between the present value of the net cash inflows generated by a project and the initial outlay".*

This definition is consistent with many other of the standard business finance and property investment texts.

In the Lotus 123 Help Screens the **@NPV** function is stated to:

*"calculate the net present value of a series of future cash flows discounted at a fixed, periodic interest rate. 123 assumes that the cash flows occur at equal time intervals and that the first cash flow occurs at the end of the first time period and that subsequent cash flows occur at the end of subsequent periods."*

Note the inconsistency between these two definitions. The Lotus function calculates a "gross present value" in that it does not make any reference to an initial cash outlay and this outlay must be addressed separately in constructing the formula.

This issue is raised because we discovered a number of participants at workshops have not been aware of the NPV formulation in Lotus 123 and have been writing their NPV formula to include the initial outlay in the calculation range. This has the effect of moving all the cash flows out by one period and thus understating the calculated NPV.

The correct approach under these circumstances is to add the initial outlay\* to the function formula - probably by cell reference - as follows:

**@NPV(discount rate, Range [Period 1 - end]) + period 0**

\* In most cases the initial outlay will be a negative number.

The Lotus Manual makes such a reference to this in a Note at the end of the NPV section in the manual.

Consider the following example:

Discount Rate	.15
Year 0	(1000000)
1	150000
2	150000
3	150000
4	150000
5	1150000

NPV \$0.00

**Correct formula @NPV(C4,C6..C10)+C5**

**Note:** That where the discount rate for the NPV is the same as the internal rate of return there is no difference in the calculated NPV but from the following table it can be seen that the value of the NPV's differ as the discount rate diverges from the IRR.

<u>Disc Rate</u>	<u>Wrong formula</u>	<u>Right formula</u>
.10	72,308	189,539
.13	62,251	70,344
.15 <b>IRR</b>	0	0
.17	-54,689	-63,986
.20	-124,608	-149,530

This can also be shown graphically to illustrate the extent of differences between the two formulas.

Using the incorrect NPV formula should not lead to a faulty investment decision because the incorrect formula should lead to a more conservative NPV result as demonstrated above. However the correct approach is advocated in all cases.

Further, there is an inconsistency in the construction of the NPV and IRR functions. These measures are related and the difference in their construction can be confusing. The correct formula for the NPV function is written as follows:

**@NPV(discount rate, Range [Period 1 - end]) + period 0**

yet the formula for the IRR function is written as:

**@IRR(guess rate, Range [Period 0 - end])**

and it can be seen that the IRR function includes the initial outlay within the body of the function.

Other commonly used spreadsheets include EXCEL and QUATTRO. EXCEL states in both its Help Screens and Manual that an addition outside the formula needs to be made for the initial investment as for Lotus.

In QUATTRO Ver. 3.0. however the NPV function allows for a choice on whether the cash flows are at the beginning or the end of the period. This means you can choose to compute either an ordinary annuity [Type 1] (where all the periodic payments are made at the end of each period), or an annuity due [Type 0], where the payments are made at the beginning of each period. If the annuity due option is selected then the initial outlay can be included as part of the cash-flow block (of cells) within the formula. The equivalent QUATTRO function is:

**@NPV(discount rate,Range [Period 0 - end],Type{0})**

or

**@NPV(discount rate,Range [Period 1 - end],Type[1]) + period 0**

In conclusion it should be remembered that the NPV function available in Lotus 123 calculates how much an investor could afford to pay for a future series of cash flows at a given discount rate - not the Net Present Value as defined in most of the finance literature.