

## MANSW Conference 2006

### Financial Maths with a Graphics Calculator

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Now that students are allowed to use graphics calculators in the General Mathematics HSC examination, it's time to look at how these calculators can help with financial maths. Using the Finance Application on the TI-83/84 Plus, students can very quickly carry out calculations about compound interest, depreciation, annuities and loan repayments. More importantly, once the initial problem has been set up, it is easy to change one or more parameters to investigate different scenarios, and then display the results in a graph. This allows us to play (painlessly) a “what if ... ?” game, asking questions like: “What would happen to my home loan if the interest rate increased?” “What would happen if I increased my monthly payments?” and so on.

To begin using the Finance Application, switch on the calculator, and then press the **A** key. Finance is the first application in the list and it is already highlighted, so just press **e** to select it. Press **e** again to select the TVM solver.

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PNG decompressor  
are needed to see this picture.

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TVM stands for “time-value-of-money”

The variables here need some explanation:

**N** is the number of payment periods

**I%** is the interest rate in percent per year.

**PV** is the present value or (initial value) of the loan or investment.

**PMT** is payment amount. In the case of straightforward compound interest or depreciation, no regular payments are being made, so PMT is set to zero.

**FV** is the future value (or final value) of the loan or investment.

If you know the values of any four of these five variables, you can solve for the fifth.

**P/Y** is the number of payments made per year and **C/Y** is the number of times interest is compounded per year. Finally, you need to know whether payments are made at the beginning or end of the payment period. Generally, they are made at the end.

One final point: you must enter cash inflows (money received) as positive numbers and cash outflows (money paid out to a bank, financial institution, for example) as negative numbers.

#### Using the TVM solver for compound interest problems.

Suppose I invest \$7000 at 5.8% per annum, compounded annually. What will be the amount (the future value) at the end of 6 years?

Here  $N = 6$ ,  $I\% = 5.8$ ,  $PV = -7000$ ,  $PMT = 0$ ,  $P/Y = 1$ ,  $C/Y = 1$ , and PMT is END. Enter these in the TVM Solver, pressing **e** after each to move to the next line. Note that PV is negative, because the money is being given to the bank. It doesn't matter what you enter for FV, because this is what we want to find — but you can't leave it blank.

Enter the numbers, place the cursor on FV and press **a** and **e** (to get SOLVE).

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This shows that at the end of 6 years, the initial investment of \$7000 will have increased to \$9817.75.

Now we can vary the question. For example, ask: What would be the difference if interest is compounded monthly?

To answer this, change C/Y to 12, put the cursor on FV again and SOLVE.

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We see that in this case the Future Value would be \$9905.32.

What would be the difference if interest was compounded quarterly? daily?

[Change C/Y to 4 and then to 365 and solve for the FV.]

If interest of 5.8% is compounded monthly, how long do you need to leave the money in the account before it doubles in value?

[Change FV to \$14000, place the cursor on N and SOLVE.]

What interest rate would be needed for the sum to double in value in 10 years?

[Change N to 10, place the cursor on I5 and SOLVE.]

### Paying off a loan

Peta borrows \$28 000 from a credit union at 6% per annum compounding monthly. She will repay the money over nine years. [Scenario from 2005 General Mathematics HSC paper]

This is very similar to the compound interest problems, except that PMT is no longer 0. Here  $N = 9 \times 12$  (payments are monthly),  $I\% = 6$ ,  $PV = 28\ 000$ ,  $PMT = ?$ ,  $FV = 0$  (the loan will be completely paid off in 9 years,  $P/Y = 12$  and  $C/Y = 12$ . Place the cursor on PMT and SOLVE.

The Present Value is positive, because Peta receives the loan from the credit union, but PMT is negative – this is a cash outflow, as she is making payments to the credit union.

Again, we can vary any of the parameters of the problem – e.g., vary the interest rate or the number of years for repayment and ask what difference this makes to the repayments. Or we can say: if she can only afford to pay \$300 per month, how much longer before the loan is paid off? If she decides to pay \$168 every two weeks, how long before the loan is paid off?

### Graphing the decreasing balance of the loan

Press  $\leftarrow$  M to QUIT from the Finance App, and then press M again. Use the arrow keys to highlight PAR (in the 3<sup>rd</sup> row down) and press  $\leftarrow$  to set up parametric graphing.

Press ! to see the parametric function editor. If any functions are there, use the arrow keys to put the cursor on them and press C. If any of Plot1, Plot2 or Plot3 is highlighted (has a dark background), use the arrow keys to place the cursor on it, and press  $\leftarrow$ . The window should look like the one shown. Press  $\times$  and  $\leftarrow$ , to define  $X_{1T}$  as T. Press A  $\leftarrow$  to return to the Finance Application, then press 9 and  $\times$  ). This defines  $Y_{1T}$  as bal(T)

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Now we need to set a suitable window to view the graph.

Press @, and set the window parameters as follows:

$$T_{\min} = 0, T_{\max} = 12, T_{\text{step}} = 12,$$

$$X_{\min} = 0, X_{\max} = 120, X_{\text{scl}} = 12,$$

$$Y_{\min} = 0, Y_{\max} = 30\ 000, Y_{\text{scl}} = 5000.$$

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Press % to see a graph of the balance after T months.

By pressing \$ you can use the arrow keys to explore values of the function.