FINANCIAL CALCULATIONS WITH THE TI-83 PLUS CALCULATOR

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This is a tutorial on financial calculations with the Texas Instruments TI-83 Plus calculator, using the TVM Solver. In addition to this tutorial, it is recommended that you read the manual for your calculator. After reading this tutorial, you will know how to do the following:

(1) Compute present and future values of investments.
(2) Compute present and future values of annuities.
(3) Compute mortgage payments.
(4) Compute the payments for sinking funds.
(5) Compute effective rates of interest.

1. Time value of money

The value of a dollar depends on when it is received. Given the choice, we all prefer to receive cash now than to receive the same amount later. Conversely, we all prefer to make payments later instead of now, if the amounts are equal. This observation is the basis of compound interest and the time value of money (TVM).

TVM calculations are based on an interest rate r. If an amount PV (the **present value**) is invested at the interest rate r, for n years, then the **future value** FV of the investment after n years will be given by the formula $FV = PV(1 + r)^n$. Solving this equation for PV gives $PV = FV(1 + r)^{-n}$. When the interest rate is expressed as a percentage, remember to divide the percentage by 100. For example $6\% = .06$.

When using the TVM Solver, it is important to distinguish between inflows and outflows of cash. An inflow of cash occurs when you receive, withdraw, or borrow money. An outflow of cash occurs when you spend money, invest money, or make a payment. Inflows of cash should be entered as positive numbers, and outflows of cash as negative numbers.

2. Orientation to the TVM Solver

Before using the calculator, it is a good idea to completely clear all settings. To do this, press 2nd MEM 7 ENTER, then select Reset from the menu. Press APPS ENTER ENTER to start the TVM Solver. The screen should look like this.

```
N=█
I%=0
PV=0
PMT=0
FV=0
P/Y=1
C/Y=1
PMT:END BEGIN
```

The seven TVM variables are as follows.

N The number of payments, or (if there are no payments) the number of years.
I% The interest rate, as a percentage. It should not be divided by 100.
PV Present value
PMT Periodic payment
FV Future value
P/Y Payments per year
C/Y Times per year that interest is compounded

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The last line asks whether payments should be made at the end or the beginning of each period. The default is for payments to be made at the end. I don't recommend changing this option, because it is easy to forget to change it back.

To use the TVM Solver, enter the known values of the TVM variables. Then move the cursor to the variable that you wish to compute, and press ALPHA SOLVE.

3. Investments and loans without periodic payments

Exercise 1. *Mary invests \$10,000 in an account earning 6% interest, compounded annually. How much money will be in her account after five years?*

Solution. Enter the following values in the TVM Solver. Note that PV is negative because it is an investment, which is an outflow of cash.

```
N=5
I%=6
PV=-10000
PMT=0
FV=█
P/Y=1
C/Y=1
PMT:END BEGIN
```

Move the cursor to FV, then press ALPHA SOLVE. The answer is $PV = \$13{,}382.26$.

Exercise 2. *Steve borrows \$8,000 at 6.5% interest, compounded quarterly. If he makes no loan payments, how much will he owe in two years?*

Solution. Enter the following values, then compute FV. Note that PV is positive, while FV is negative.

$$\begin{array}{llll} N=2 & I\%=6.5 & PV=8000 & \\ PMT=0 & P/Y=1 & C/Y=4 & \qquad FV=-9101.11 \end{array}$$

Exercise 3. *How much money must be invested in an account earning 5% interest, compounded annually, if it is to grow to \$5,000 in 20 months?*

Solution. Enter the following values, then compute PV. Notice that when you enter $P/Y = 12$, the calculator will automatically set $C/Y = 12$, so you need to change it back to $C/Y = 1$.

$$\begin{array}{llll} N=20 & I\%=5 & PMT=0 & \\ FV=5000 & P/Y=12 & C/Y=1 & \qquad PV=-4609.51 \end{array}$$

An alternative method is to set $N = 20/12$ and $P/Y = 1$.

4. Investments and loans with periodic payments

In the previous examples we have always set $PMT = 0$, but now we will solve interest problems involving fixed periodic payments. Situations of this sort include mortgages, annuities, and sinking funds.

Exercise 4. *Joseph deposits \$250 at the end of each month in an account earning 4.5% interest, compounded daily. How much will be in his account after 30 months?*

Solution. There are $N = 30$ monthly payments, and each payment is $-\$250$. There are 12 payments per year, and interest is compounded 365 times per year, so we set $P/Y = 12$ and $C/Y = 365$.

$$\begin{array}{llll} N=30 & I\%=4.5 & PV=0 & \\ PMT=-250 & P/Y=12 & C/Y=365 & \qquad FV=7923.25 \end{array}$$

Exercise 5. *Using the data from the previous problem, how long will it take for Joseph to acquire \$10,000?*

Solution. The calculator gives us $N = 37.34$, which we round up to 38 months.

$$\begin{array}{llll} I\%=4.5 & PV=0 & PMT=-250 & \\ FV=10000 & P/Y=12 & C/Y=365 & \qquad N=37.34 \end{array}$$

Exercise 6. *Bruce borrows \$236,000 at 5.75% annual interest, compounded monthly, and he makes a loan payment at the end of each month. If the term of the loan is 30 years, what is the monthly payment?*

Solution. Bruce will make $30 \times 12 = 360$ monthly payments. We calculate that the monthly payment will be \$1,377.23.

$$\begin{array}{llll} N = 360 & I\% = 5.75 & PV = 236000 & \\ FV = 0 & P/Y = 12 & C/Y = 12 & \qquad PMT = -1377.23 \end{array}$$

Exercise 7. *Tammy wants to save \$5,000 for a vacation in Italy in 18 months, by making equal deposits at the end of each month to an account earning 3.5% interest, compounded annually. How much should she deposit each month?*

Solution. She should deposit \$271.06 each month.

$$\begin{array}{llll} N = 18 & I\% = 3.5 & PV = 0 & \\ FV = 5000 & P/Y = 12 & C/Y = 12 & \qquad PMT = -271.06 \end{array}$$

Exercise 8. *Cecilia owes \$4677 in credit card debt at 18% interest, compounded monthly. If she pays \$200 at the* beginning *of each month, how many months will she need to retire her debt?*

Solution. Instead of setting payments to the beginning of each period, we will simply subtract the first payment from the total. We find $N = 27.00$, so she will be clear in 27 months.

$$\begin{array}{llll} I\% = 18 & PV = 4477 & PMT = -200 & \\ FV = 0 & P/Y = 12 & C/Y = 12 & \qquad N = 27.00 \end{array}$$

5. Nominal and effective rates of interest

The more frequently interest is compounded, the more money will be paid in interest. A nominal interest rate r_n, compounded t times per year, is equivalent to a higher effective interest rate r_e, compounded annually. The relationship between r_n and r_e is given by the following formula.

$$r_e = (1 + r_n/t)^t - 1$$

Exercise 9. *The interest rate on a credit card is 16%, compounded monthly. What is the effective annual rate?*

Solution. $r_e = (1 + .16/12)^{12} = 17.23\%$

The TI-83 Plus has two functions for computing nominal and effective rates of interest. The function *Nom*$(r\%, t)$ calculates the nominal rate, compounded t times per year, corresponding to an effective rate of $r\%$. The reverse function *Eff*$(r\%, t)$ calculates the effective annual rate, given a nominal rate of $r\%$ that is compounded t times per year. Both of these functions are in the Finance menu.

Exercise 10. *A savings account pays 3% interest, compounded quarterly. What is the effective annual rate?*

Solution. *Eff*$(3, 4) = 3.03\%$. Press the following keys.

APPS ENTER ALPHA C 3 , 4 ENTER

Exercise 11. *The effective interest rate on a credit card is 14.93%. If the interest is compounded monthly, what is the nominal interest rate?*

Solution. *Nom*$(14.93, 12) = 14\%$. Press the following keys.

APPS ENTER ALPHA B 14.93 , 12 ENTER