Introduction to the TVM Solver

- To access the TVM Solver hit APPS
- Choose 1: Finance
- Choose 1: TVM Solver..
Key to the TVM Solver

**N**: Total number of compounding over the entire time

- This is NOT n in the finite compound interest formula.
- This is nt in the exponent of the finite compound interest formula.
- For instance, if an investment is compounded monthly over 30 years, N=360 (30*12).
- If an investment is compounded quarterly over 20 years, then N=80 (4*20).
Key to TVM Solver

I: This the interest rate.
- Unlike substitution in the formulas, where a decimal value for the % was used, in the TVM solver I is entered in its percent form.
- For instance, if the interest rate is 6%, then in the TVM solver enter 6—not .06.
- If the interest rate is 8.75%, in the TVM solver enter 8.75.
Key to TVM Solver

**PV: Present Value**
- This is Principle in the formulas
- So, if Jonna invested $500 at 6%, her PV is $500.

**PMT: Payment**
- This would represent a regular payment to be made either on a loan or to be put in an investment.
- So, if Nick opens an account and makes a monthly installment of $150, then PMT is $150.
Key to TVM Solver

FV: Future Value

- This is the amount of money in the account or the amount remaining on a loan at a specified time.
- Suppose, Roberta invests $5,000 compounded monthly for 20 years. FV is the amount she will have at the end of the 20 years.
- Or, suppose that Mandy borrowed $20,000 for five years. At the end of 5 years, her FV is zero.
- NOTE: Generally, in the TVM solver PV and FV have opposite signs.
Key to TVM Solver

**P/Y: Payments per year**
- This is the number of payments made per year.
- Generally, set this before the C/Y.
- Generally, P/Y and C/Y will be the same.

**C/Y: Compounding periods per year.**
- Set this after P/Y.
- If interest is compounded quarterly, C/Y = 4.
- If interest is compounded monthly, C/Y = 12
One-time Investment

Frank invests $1,200 compounded quarterly at 6.25%. How much money will be in the account after 10 years?

N=40 \quad (4\times10)
I\%=6.25
PV=1200
PMT=0
FV This is what we want to find
P/Y=4
C/Y=4

Enter all values and arrow back to FV. Hit “Alpha” and “Enter.” The FV will appear. It is $2231.09, which means there is $2,231.09 in his account after 10 years.

How much of this was interest? \quad 2231.09-1200.00=1031.09
Now let’s turn to annuities

As opposed to a one-time investment like the previous example, an annuity involves regular payments into an investment account.

Example: Julia puts $150 per month into a future retirement account.

Inversely, annuities can involve a person taking regular withdrawals from an account.

Example: At 66 Julia takes the money that she has saved and begins to take regular withdrawals of $1,200.00 from her account.

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Annuity

Marcus puts $150 per month in an annuity that pays 5.75% interest compounded monthly. How much money will he have in the account in 30 years?

\[ N=360 \]
\[ I\%=5.75 \]
\[ PV=0 \]
\[ PMT=150 \]
\[ FV \text{ This is what we want to find} \]
\[ P/Y=12 \]
\[ C/Y=12 \]

Answer: FV is $-143,669.64$ or $143,669.64$

How much did Marcus put into the account? \[ 150 \times 360 = 54,000 \]

How much interest did Marcus make? \[ 143,669.64 - 54,000 = 89,669.64 \]
Combo Investment

Kim is 22 years old. She has $2,000 that she can put into an investment for retirement. She also wants to put $250 per month into the account until she retires at 66. If the investment pays 7.25% compounded monthly, how much will she have when she retires?

\begin{align*}
N &= 528 \quad (12 \times 44) \\
I\% &= 7.25 \\
PV &= 2000 \\
PMT &= 250 \\
FV \quad &\text{This is what we want to find} \\
P/Y &= 12 \\
C/Y &= 12 \\
\end{align*}

Answer: $1,002,171.89 She will be a millionaire!

How much of her million dollars is from interest?
Who has the better plan?

Jenny starts saving for retirement when she is 22 years old. She puts aside $175/month. Her friend Heather decides to wait until she is established financially to save for retirement. She plans to start setting aside $350/month beginning at age 35. If both choose investments that pay 7.75% compounded monthly and both retire at 65, who made the better choice?

\[ N=516 \quad 360 \]
\[ I\%=7.75 \quad 7.75 \]
\[ PV=0 \quad 0 \]
\[ PMT=175 \quad 350 \]
\[ FV = \text{This is what we are to find.} \]
\[ P/Y=12 \]
\[ C/Y=12 \]

Answer: Jenny: $723,748.50    Heather: $495,898.83

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How long will it last?

Manuel just retired. He has $450,000 in investments that he is combining to buy an annuity, which pays 6.5% interest compounded monthly. He wants his money to last for 20 years. How much money can he withdraw per month to meet his goal?

\[
\begin{align*}
N &= 240 \quad (12 \times 20) \\
I\% &= 6.5 \\
PV &= 450000 \\
PMT &= \text{This what we are to find.} \\
FV &= 0 \\
P/Y &= 12 \\
C/Y &= 12
\end{align*}
\]

Answer: $3,355.08 per month for 20 years.
How long will it last?

On second thought, Manuel wants to have $100,000 left for his heirs. He has $450,000 in investments that he is combining to buy an annuity, which pays 6.5% interest compounded monthly. He wants his money to last for 20 years. How much money can he withdraw per month to meet his goal?

\[
\begin{align*}
N &= 240 \quad (12 \times 20) \\
I\% &= 6.5 \\
PV &= 450000 \\
PMT &\quad \text{This what we are to find.} \\
FV &= -100000 \quad \text{(Notice the opposite sign of PV)} \\
P/Y &= 12 \\
C/Y &= 12
\end{align*}
\]

Answer: $3,151.17 per month for 20 years.
Home Buying Terminology

**Selling price:** The price in the contract to buy the house.

**Closing:** The meeting at which the buyer, seller, and loan officers legally finalize the sell of the house.

**Down payment:** The amount of money the buyer must bring to closing to prepay part of the price of the house. This is usually a percentage of the selling price.

Example: A buyer pays $120,000 for a house. The down payment is 20% of the purchase price.

$$0.20 \times 120,000 = 24,000$$
Home buying terminology

**Mortgage:** The amount of money that the buyers actually borrow to pay for the house.

Example: The mortgage for a house with purchase price of $120,000 and a 20% down payment is $96,000.

\[(Mortgage = Purchase \ Price - Down \ payment)\]

**Points:** A prepayment on interest due at closing in order to lower the interest rate of the mortgage. Each point is a percentage point of the mortgage (loan amount).

Example: 2 points are paid at closing to lower the interest rate of the mortgage (loan amount) of $96,000.

The points will cost $1,920 (0.02 * 96000).
Mortgage

Mary Beth takes out a $175,000 mortgage that requires monthly payments. The interest is 4.125 compounded monthly for 15 years. What is her monthly payment?

\[
\begin{align*}
N &= 180 \quad (12 \times 15) \\
I\% &= 4.125 \\
PV &= -175000 \quad \text{(Notice the negative)} \\
PMT &= \text{This what we want to find} \\
FV &= 0 \\
P/Y &= 12 \\
C/Y &= 12 \\
\end{align*}
\]

Answer: $1,305.44
How much does the house REALLY cost?

The cost of a house is NOT really the selling price. Consider all that goes into what you pay for a house.

Total Cost = Down payment + Points + Total Monthly Payments

Example: George buys a house for $200,000. The down payment is 20% (DP = .20 * 200,000 = 40,000). He pays 2 points (Points = .02 * 160,000 = 3,200). Suppose his monthly payments end up being $763.86 for 30 years ($274,989.60). TC = 40,000 + 3,200 + 274,989.60 = $318,189.60
How much did they really pay?

Joey and Penny are buying a house. The cost of the house is $150,000 and requires a 20% down payment. They can get a 30 year mortgage for 4.25% interest, or they can get a 15 year mortgage for 4.00% interest. Find the total cost of the house for each plan.

First, remember the mortgage does not include the down payment, but the total cost will. The mortgage is 80% of $150,000 ($120,000). Now find the payment under each plan.

\[
\begin{align*}
N &= 360 &\quad 180 \\
I\% &= 4.25 &\quad 4 \\
PV &= 120000 &\quad 120000 \\
PMT &= \text{This is what we are finding} \\
FV &= 0 &\quad 0 \\
P/Y &= 12 &\quad 12 \\
C/Y &= 12 &\quad 12 \\
\end{align*}
\]

Answer: $590.33 for 30 years or $887.63
How much did they really pay?

Joey and Penny are buying a house. The cost of the house is $150,000 and requires a 20% down payment. They can get a 30 year mortgage for 4.25% interest, or they can get a 15 year mortgage for 4.00% interest. Find the total cost of the house for each plan.

Now, the total cost is the sum of the down payment and the monthly payments.

30 years  $242,518.80       15 years  $189,773.40
Total Interest

The Total Interest paid can be found in the following ways:

Total Interest = Total Cost – Selling Price

Or

Total Interest = Total Payments – Mortgage + Points