

# 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?*

$$N=40 \quad (4*10)$$

$$I\%=6.25$$

$$PV=1200$$

$$PMT=0$$

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?  $2231.09 - 1200.00 = 1031.09$



# 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.



# 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 This is what we want to find

$$P/Y=12$$

$$C/Y=12$$

Answer: FV is  $-143669.64$  or  $\$143,669.64$

How much did Marcus put into the account?  $150 * 360 = 54,000$

How much interest did Marcus make?  $143,669.64 - 54,000 = 89669.64$

# 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 in to the account until she retires at 66. If the investment pays 7.25% compounded monthly, how much will she have when she retires?*

$$N=528 \quad (12*44)$$

$$I\%=7.25$$

$$PV=2000$$

$$PMT=250$$

FV This is what we want to find

$$P/Y=12$$

$$C/Y=12$$

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=516 360

I <sub>0</sub> =7.75	7.75
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PV=0 0

PMT=175 350

FV = This is what we are to find.

P/Y=12

$$C/Y=12$$

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

# 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?*

$$N=240 \quad (12*20)$$

$$I\%=6.5$$

$$PV=450000$$

PMT This what we are to find.

$$FV = 0$$

$$P/Y=12$$

$$C/Y=12$$

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?*

$$N=240 \quad (12*20)$$

$$I\%=6.5$$

$$PV=450000$$

PMT This what we are to find.

$$FV = -100000 \quad (\text{Notice the opposite sign of PV})$$

$$P/Y=12$$

$$C/Y=12$$

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 .

$$.20 \times 120,000 = 24,000$$

# 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 ( $.02 * 96000$ ).



# 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?*

$$N=180 \quad (12*15)$$

$$I\%=4.125$$

$$PV= -175000 \quad (\text{Notice the negative})$$

$$PMT=\text{This what we want to find}$$

$$FV=0$$

$$P/Y=12$$

$$C/Y=12$$

$$\text{Answer: } \$1,305.44$$

# 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 ( $\text{Points} = .02 * 160,000 = 3,200$ ). 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.

N=360	180
I%=4.25	4
PV=120000	120000
PMT=	This is what we are finding
FV = 0	0
P/Y=12	12
C/Y=12	12

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:

$$\text{Total Interest} = \text{Total Cost} - \text{Selling Price}$$

Or

$$\text{Total Interest} = \text{Total Payments} - \text{Mortgage} + \text{Points}$$