2

Time-Value-of-Money and Amortization Worksheets

The Time-Value-of-Money and Amortization worksheets are useful in applications where the cash flows are equal, evenly spaced, and either all inflows or all outflows. They help you solve problems involving annuities, loans, mortgages, leases, and savings. You can also generate an amortization schedule.

Press [↓] and [↑] to move through each set of variables.

[xP/Y]	[P/Y]	[Amort]	[BGN]	[CLR TVM]
[N]	[I/Y]	[PV]	[PMT]	[FV]

TVM and Amortization Worksheet Labels

Keys	Label	Meaning	Type of Variable
[N]	**N**	Number of periods	Enter/compute
[I/Y]	**I/Y**	Interest rate per year	Enter/compute
[PV]	**PV**	Present value	Enter/compute
[PMT]	**PMT**	Payment	Enter/compute
[FV]	**FV**	Future value	Enter/compute
[2nd] [P/Y]	**P/Y**	Number of payments per year	Enter-only
[↓]	**C/Y**	Number of compounding periods per year	Enter-only
[2nd] [BGN]	**END**	End-of-period payments	Setting
[2nd] [SET]	**BGN**	Beginning-of-period payments	Setting
[2nd] [Amort]	**P1**	Starting payment	Enter-only
[↓]	**P2**	Ending payment	Enter-only
[↓]	**BAL**	Balance	Auto-compute
[↓]	**PRN**	Principal paid	Auto-compute
[↓]	**INT**	Interest paid	Auto-compute

Notes about the TVM and Amortization Worksheets

- [2nd] [Reset] [ENTER] sets **N=0**, **I/Y=0**, **PV=0**, **PMT=0**, **FV=0**; **P/Y=12**, **C/Y=12**; **END** (not **BGN**); **P1=1**, **P2=1**; **BAL=0**, **PRN=0**, **INT=0**.
- [2nd] [CLR TVM] sets **N**, **I/Y**, **PV**, **PMT**, and **FV** to zero; does not affect **P/Y**, **C/Y**, or the **BGN/END** setting.
- [2nd] [P/Y] [2nd] [CLR Work] sets **P/Y=12** and **C/Y=12**.
- [2nd] [BGN] [2nd] [CLR Work] sets **END** (not **BGN**).
- [2nd] [Amort] [2nd] [CLR Work] sets **P1=1**, **P2=1**, **BAL=0**, **PRN=0**, and **INT=0**.
- When solving a problem using only four of the five TVM variables, make sure the unused variable is zero.

Notes about TVM and Amortization Worksheets (cont.)

- Enter values for **PV**, **PMT**, and **FV** as negative if they are outflows (cash paid out) or as positive if they are inflows (cash received). To enter a negative value, press [+/−] after entering the number.
- Enter **I/Y** as the nominal interest rate. The TVM worksheet automatically converts **I/Y** to a "per period" rate based on the values for **P/Y** and **C/Y**.
- When you enter a value for **P/Y**, the same value is automatically entered for **C/Y**. (You can change **C/Y**.)
- The **END**/**BGN** setting lets you specify whether the transaction is an ordinary annuity or an annuity due.
  - In ordinary annuities, the payments occur at the end of each payment period. Most loans are in this category. For ordinary annuities, select **END**.
  - In annuities due, payments occur at the beginning of each payment period. Most leases are in this category. For annuities due, select **BGN**.
- Pressing [CPT] when **P1** or **P2** is displayed updates **P1** and **P2** to represent the next range of payments.
- A computed value for **BAL** after a specified number of payments may be slightly different than a computed value for **FV** after the same number of payments.
  - When solving for **BAL**, **PRN**, and **INT**, the calculator uses the **PMT** value rounded to the number of decimal places specified by the decimal format.
  - When solving for **FV**, the calculator uses the unrounded value for **PMT**.

Entering, Recalling, and Computing TVM Values

You enter a TVM value by keying in a value and pressing the appropriate TVM key ([N], [I/Y], [PV], [PMT], or [FV]). The value is stored in the TVM variable (**N**, **I/Y**, **PV**, **PMT**, or **FV**).

You recall a TVM value to the display by pressing [RCL] and the TVM key.

When you enter or recall a value for any of the five TVM variables (**N**, **I/Y**, **PV**, **PMT**, or **FV**), you can be in either standard calculator mode or a worksheet mode. The display responds differently according to the mode you are in.

- In standard calculator mode (accessed by pressing [2nd] [QUIT]), the variable label, the = sign, and the value you entered or recalled are displayed.
- In worksheet mode, only the value you entered or recalled is displayed. Any label previously in the display remains.

To compute a TVM value, press [CPT] and the appropriate TVM key. When you compute a TVM value, you must be in standard calculator mode. Press [2nd] [QUIT] to return to standard calculator mode.

Entering a Value for N Using [xP/Y]

You can use [2nd] [xP/Y] to enter a value for **N**. Pressing [2nd] [xP/Y] automatically multiplies a displayed number by the value stored in the **P/Y** variable (number of payments per year).

By entering the number of years (for example, 30) and pressing [2nd] [xP/Y], you can compute the number of payments required to pay off an annuity. Press [N] to enter that value as the number of payments in a TVM calculation.

Compound Interest

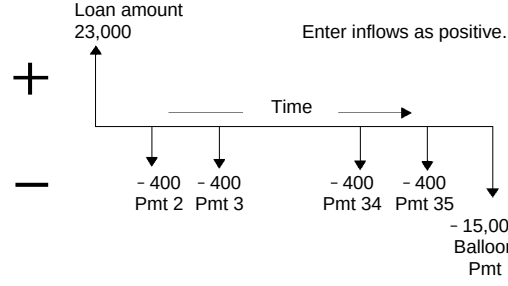
Many lending institutions add the interest you earn to the principal. The interest you earn from the previous compounding period becomes part of the principal for the next compounding period. Compound interest enables you to earn a greater amount of interest on your initial investment.

In order to earn compound interest, the interest must remain with the principal. For example, if you invest $100 at an annual interest rate of 10% compounded annually, you earn $10 interest after one year. At the end of the second year, the interest is calculated on $110 ($100 principal plus $10 accumulated interest), so you earn $11 in the second year. As additional interest accumulates, your interest earnings increase each year.

Time-Line Diagrams

A time-line diagram can help you visualize cash flows by showing the amounts paid or received (cash outflows or cash inflows) at various points in time.

- Cash flows received are shown with arrows pointing up, as with the loan amount at the left.
- Cash flows invested have arrows pointing down, as with the 35 regular payments and the balloon payment at the right.



Entering Inflows and Outflows

The calculator follows the established convention of treating inflows of cash (cash received) as positive and outflows of cash (cash paid out) as negative.

- You must enter inflows as positive values and outflows as negative values.
- The calculator displays computed inflows as positive values and computed outflows as negative values.

Procedure: Using the TVM Worksheet

The worksheet stores the values and settings you enter until you clear the worksheet or change the values or settings. Therefore, you may not need to do all the steps in the procedure every time you work a TVM problem.

❶ Press [2nd] [Reset] [ENTER] to reset all variables to their defaults (**N=0**, **I/Y=0**, **PV=0**, **PMT=0**, **FV=0**; **P/Y=12**, **C/Y=12**; **END**; **P1=1**, **P2=1**; **BAL=0**, **PRN=0**, **INT=0**).

❷ If **P/Y** (payments per year) should not be 12, press [2nd] [P/Y], key in the number of payments per year, and press [ENTER].

❸ Press [↓]. **C/Y=** (compounding periods per year) and its current value are displayed. When you enter a value for **P/Y**, the same value is automatically entered for **C/Y**. If the compounding periods per year is different than the payments per year, key in the value and press [ENTER].

❹ If you want beginning-of-period payments (**END** is the default setting), press [2nd] [BGN] [2nd] [SET].

If beginning-of-period payments are selected, the **BGN** indicator is displayed; no indicator is displayed for end-of-period payments.

❺ Press [2nd] [QUIT] to return to standard calculator mode.

❻ Enter values for the four known variables. Key in each value and press the appropriate key ([N], [I/Y], [PV], [PMT], or [FV]). The value of the unknown variable is 0.

❼ Press [CPT] and the key for the unknown variable to compute its value.

Procedure: Generating an Amortization Schedule

The worksheet for amortization calculations uses the values you entered and computed in the TVM worksheet to compute amortization data. The procedures on these pages give you two ways to generate an amortization schedule.

❶ Press [2nd] [Reset] [ENTER] to reset all variables to their defaults (**N=0**, **I/Y=0**, **PV=0**, **PMT=0**, **FV=0**; **P/Y=12**, **C/Y=12**; **END**; **P1=1**, **P2=1**; **BAL=0**, **PRN=0**, **INT=0**).

❷ Press [2nd] [Amort].

P1= and its current value are displayed.

❸ Specify the range of payments.

- To enter a value for **P1** (the first payment in the range), key in a value and press [ENTER].
- To enter a value for **P2** (the last payment in the range), press [↓], enter a value, and press [ENTER].

❹ Press [↓] repeatedly to display the automatically computed values:

- **BAL** — the remaining balance after payment **P2**
- **PRN** — the principal
- **INT** — the interest paid over the specified range

❺ Press [2nd] [Amort] or, if **INT** is displayed, press [↓] to display **P1** again.

❻ Repeat steps 2 and 3 for each range of payments to generate an amortization schedule.

Procedure: Automatically Generating a Schedule

After you enter the initial values for **P1** and **P2**, as described above, you can automatically compute an amortization schedule.

❶ Press [2nd] [Amort] or, if **INT** is displayed, press [↓] to display **P1=** and its current value.

❷ Press [CPT]. This automatically updates both **P1** and **P2** to represent the next range of payments.

The calculator computes the next range of payments using the same number of periods as in the previous range of payments. For example, if the previous range was 1 through 12 (12 payments), pressing [CPT] updates the range to 13 through 24 (12 payments).

❸ Press [↓] to display **P2**.

- If you pressed [CPT] when **P1** was displayed, a new value for **P2** is automatically displayed. (You can still enter a new value for **P2**, if necessary.)
- If you did not press [CPT] when **P1** was displayed, you can press [CPT] when **P2** is displayed to enter values for both **P1** and **P2** for the next range of payments.

❹ Press [↓] as needed to display the automatically computed values for **BAL**, **PRN**, and **INT** for the next range of payments.

❺ Repeat steps 1 through 4 until the schedule is complete.

Example: Interest Rate

You have a 30-year mortgage for $75,000 and make payments each month of $576.69. What is the interest rate of your mortgage?

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Enter number of payments using payment multiplier.	30 2nd [xP/Y] N	N=	360.00◁
Enter loan amount.	75000 PV	PV=	75,000.00◁
Enter payment amount.	576.69 +/– PMT	PMT=	-576.69◁
Compute interest rate.	CPT I/Y	I/Y=	8.50*

The interest rate is 8.5% per year.

Basic Loan Calculations—Payments

Example: Monthly Payment

You are considering a 30-year mortgage at 8.5% for $75,000.

How much would the monthly payment be?

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Enter number of payments using payment multiplier.	**30** 2nd [xP/Y] N	**N=**	**360.00**◃
Enter interest rate.	**8.5** I/Y	**I/Y=**	**8.50**◃
Enter loan amount.	**75000** PV	**PV=**	**75,000.00**◃
Compute payment.	CPT PMT	**PMT=**	**-576.69**∗

The monthly payment would be $576.69.

Example: Quarterly Payment

(continued from previous example)

Your mortgage company also offers an option for a quarterly mortgage with quarterly compounding.

How much would your quarterly payment be? (You do not need to enter the loan amount or the interest rate. The compounding periods is automatically reset to equal the payments periods.)

Procedure	Keystrokes		Display
Set payments per year to 4.	2nd [P/Y] **4** ENTER	**P/Y=**	**4.00**◃
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments using payment multiplier.	**30** 2nd [xP/Y] N	**N=**	**120.00**◃
Compute payment.	CPT PMT	**PMT=**	**-1,732.71**∗

The quarterly payment would be $1,732.71.

Future Value of Savings

Example: Future Value of Savings

You have opened a savings account with $5,000. The bank pays 5%, compounded at the end of each year. What is the future value of the account after 20 years?

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments.	**20** N	**N=**	**20.00**◁
Enter interest rate.	**5** I/Y	**I/Y=**	**5.00**◁
Enter beginning balance.	**5000** +/– PV	**PV=**	**-5,000.00**◁
Compute future value.	CPT FV	**FV=**	**13,266.49**∗

The future value is $13,266.49.

Present Value of Savings

Example: Future Value of Savings

You are opening a savings account that you want to be worth $10,000 in 20 years. The bank pays 5%, compounded at the end of each year. How much do you need to deposit now?

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments.	**20** N	**N=**	**20.00**◁
Enter interest rate.	**5** I/Y	**I/Y=**	**5.00**◁
Enter final balance.	**10000** FV	**FV=**	**10,000.00**◁
Compute future value.	CPT PV	**PV=**	**-3,768.89**∗

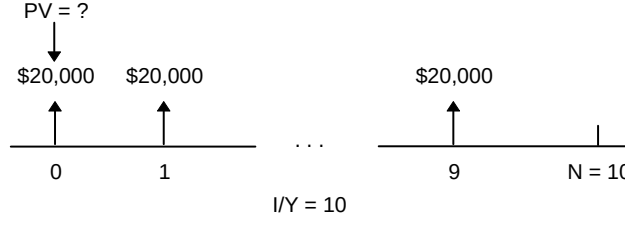
The present value is $3,768.89. This is the amount you need to deposit.

Example: Present Value of Cost Savings

The Furros Company purchased a machine that provides annual savings of $20,000 per year for the next 10 years. Using an annual discount rate of 10%, compute the present value of the savings using an ordinary annuity and an annuity due.

- For a present value ordinary annuity:

- For a present value annuity due for a leasing agreement:



Example: Present Value of Cost Savings (cont.)

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments.	**10** N	**N=**	**10.00**◁
Enter interest rate per payment period.	**10** I/Y	**I/Y=**	**10.00**◁
Enter payment.	**20000** +/– PMT	**PMT=**	**-20,000.00**◁
Compute PV for an ordinary annuity.	CPT PV	**PV=**	**122,891.34**✻
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	**BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Compute PV for annuity due.	CPT PV	**PV=**	**135,180.48**✻

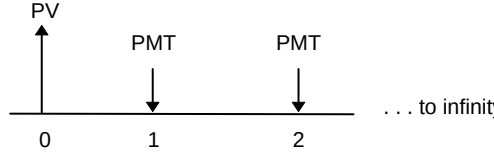
The present value is $122,891.34 with an ordinary annuity and $135,180.48 with an annuity due.

Perpetual Annuities

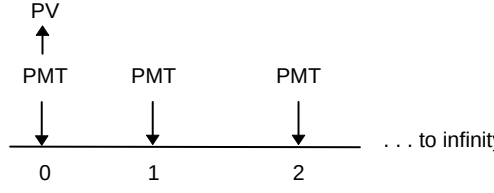
A perpetual annuity consists of equal payments that continue indefinitely. An example of a perpetual annuity is a preferred stock that yields a constant dollar dividend.

These time-line diagrams represent a perpetual annuity as an ordinary annuity and as an annuity due.

- For a perpetual ordinary annuity:



- For a perpetual annuity due:



Because the term $(1 + I/Y / 100)^{-N}$ in the present value annuity equations approaches zero as N becomes larger, you can use the following equations to solve for the present value of a perpetual annuity.

- For a perpetual ordinary annuity:

$$PV = \frac{PMT}{(I/Y / 100)}$$

- For a perpetual annuity due:

$$PV = PMT + \frac{PMT}{(I/Y / 100)}$$

Example: Present Value of Perpetual Annuities

The Land of OZ has issued perpetual bonds for replacing bricks in their highway system. The bonds pay $110 per $1000 bond. You plan to purchase the bonds if you can earn 15% annually. What price should you pay for the bonds?

Procedure	Keystrokes	Display
Clear.	2nd [QUIT] CE/C CE/C	**0.00**
Calculate PV for a perpetual ordinary annuity.	**110** ÷ **15** % =	**733.33**
Calculate PV for a perpetual annuity due.	+ **110** =	**843.33**

You should pay $733.33 for a perpetual ordinary annuity and $843.33 for a perpetual annuity due.

Variable Cash Flows

In annuities, all payments are equal. In variable cash flows, however, the payments are unequal. You can solve for the present value of variable cash flows by treating the cash flows as a series of compound interest payments.

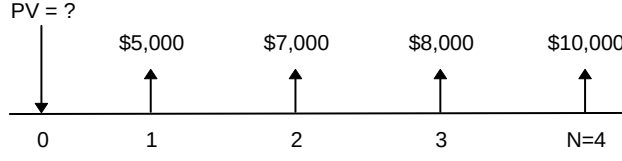
The present value of variable cash flows is the value of cash flows occurring at the end of each payment period discounted back to the beginning of the first cash flow period (time zero).

Example: Present Value of Annual Savings

The ABC Company is purchasing a machine that will save the following end-of-year amounts.

Year	1	2	3	4
Amount	$5000	$7000	$8000	$10000

Assuming a discount rate of 10%, does the present value of the cash flows exceed the original cost of $23,000?



Example: Present Value of Annual Savings

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Set payments per year to 1.	2nd [P/Y] 1 ENTER	P/Y=	1.00◁
Return to calculator mode.	2nd [QUIT]		0.00
Enter interest rate per cash flow period.	10 I/Y	I/Y=	10.00◁
Enter 1st cash flow.	5000 +/– FV	FV=	-5,000.00◁
Enter period number of 1st cash flow.	1 N	N=	1.00◁
Compute present value of 1st cash flow.	CPT PV	PV=	4,545.45*
Store in **M1**.	STO 1		
Enter 2nd cash flow.	7000 +/– FV	FV=	-7,000.00◁
Enter period number.	2 N	N=	2.00◁
Compute present value of 2nd cash flow.	CPT PV	PV=	5,785.12*
Sum to memory.	STO + 1		
Enter 3rd cash flow.	8000 +/– FV	FV=	-8,000.00◁
Enter period number.	3 N	N=	3.00◁
Compute present value of 3rd cash flow.	CPT PV	PV=	6,010.52*
Sum to memory.	STO + 1		
Enter 4th cash flow.	10000 +/– FV	FV=	-10,000.00◁
Enter period number.	4 N	N=	4.00◁
Compute present value of 4th cash flow.	CPT PV	PV=	6,830.13*
Sum to memory.	STO + 1		
Recall total present value.	RCL 1		23,171.23
Subtract original cost.	– 23000 =		171.23

The present value of the cash flows is $23,171.23, which exceeds the machine's cost by $171.23. This is a profitable investment for the company.

Lease-or-Buy Decision

Your business is considering getting a new computer server. If you lease, you would pay $36,000 per year for five years at the first of each year. You could buy it for $125,000. The server is expected to save the company $46,000 per year. It will have no resale value at the end of the five years. The company can borrow at 15% annual interest. You require a 20% annual return on projects and investments of this kind. Ignoring tax effects, should you acquire it, and if so, should you lease or purchase it?

Example: Present Value of Cost Savings

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of periods.	**5** N	**N=**	**5.00**◁
Enter required annual return rate.	**20** I/Y	**I/Y=**	**20.00**◁
Enter annual savings.	**46000** +/– PMT	**PMT=**	**-46,000.00**◁
Compute present value of savings.	CPT PV	**PV=**	**137,568.16**✻

The present value of the annual savings exceeds the purchase price (i.e., the investment will exceed your annual required return rate). Acquiring the server is a good financial move. Should you lease or buy it?

Example: Present Value of Lease Payments

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	**BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of periods.	**5** N	**N=**	**5.00**◁
Enter periodic interest rate at which your firm can borrow.	**15** I/Y	**I/Y=**	**15.00**◁
Enter annual lease payment.	**36000** +/– PMT	**PMT=**	**-36,000.00**◁
Compute present value of lease payments.	CPT PV	**PV=**	**138,779.22***

The present value of the lease payments is greater than the purchase price of $125,000, so it would be best to buy the server outright.

Present Value of Lease with Residual Value

The Peach Bright Company wants to purchase a machine that it is currently leasing from your company. You offer to sell it for the present value of the lease discounted at an annual interest rate of 22% compounded monthly. The machine has a residual value of $6500, and 46 monthly payments of $1200 remain on the lease. If the payments are due at the beginning of each month, how much should you charge for the machine?

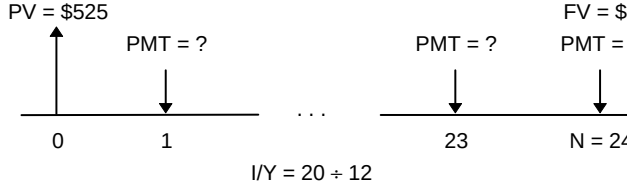
The total value of the machine is the present value of the residual value plus the present value of the lease payments.

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Set payments per year to 1.	2nd [P/Y] 1 ENTER	P/Y=	1.00◁
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	BGN	
Return to calculator mode.	2nd [QUIT]		0.00
Enter number of payments.	46 N	N=	46.00◁
Calculate and enter periodic interest rate.	22 ÷ 12 = I/Y	I/Y=	1.83◁
Enter residual value of asset.	6500 +/– FV	FV=	-6,500.00◁
Compute present value of residual.	CPT PV	PV=	2,818.22*
Enter amount of lease payment.	1200 +/– PMT	PMT=	-1,200.00◁
Compute present value of lease payments.	CPT PV	PV=	40,573.18*

Peach Bright should pay your company $40,573.18 for the machine.

Monthly Payments

You are planning to purchase a new small desk and chair set that is sale priced at $525. You can finance your purchase at 20% APR, compounded monthly, for two years. How much is the monthly payment?



Example: Monthly Payments

Procedure	Keystrokes		Display
Set all variables to defaults.	[2nd] [Reset] [ENTER]	**RST**	**0.00**
Enter number of payments using payment multiplier.	**2** [2nd] [xP/Y] [N]	**N=**	**24.00**◃
Enter interest rate.	**20** [I/Y]	**I/Y=**	**20.00**◃
Enter loan amount.	**525** [+/–] [PV]	**PV=**	**-525.00**◃
Compute payment.	[CPT] [PMT]	**PMT=**	**26.72***

Your monthly payment is $26.72.

Yield to Maturity on Bond Purchased on Interest Date

A 9% $1,000 semiannual commercial bond has 13 remaining coupon payments. You can purchase the bond for $852.50 (ignoring commissions). At this price, what is your yield to maturity and the annual effective rate?

Example: Yield to Maturity

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Set payments per year to 2.	2nd [P/Y] 2 ENTER	P/Y=	2.00◁
Return to calculator mode.	2nd [QUIT]		0.00
Enter number of remaining coupon payments.	13 N	N=	13.00◁
Enter bond price.	852.5 +/– PV	PV=	-852.50◁
Calculate the coupon payment.	9 % ÷ 2 × 1000 = PMT	PMT=	45.00◁
Enter bond redemption value.	1000 FV	FV=	1,000.00◁
Compute annual yield.	CPT I/Y	I/Y=	12.37*
Store in memory.	STO 1		

Example: Effective Annual Interest

(continued from previous example)

Use the Interest Conversion worksheet (Chapter 7) to calculate the effective annual interest rate.

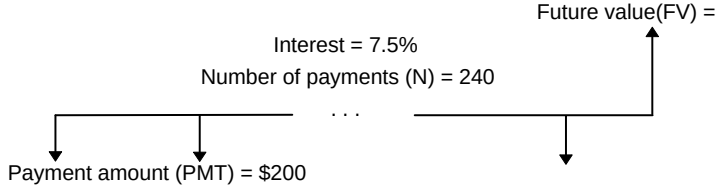
Procedure	Keystrokes		Display
Select and clear Interest Conversion worksheet.	2nd [I Conv] 2nd [CLR Work]	NOM=	0.00
Recall rate from memory.	RCL 1 ENTER	NOM=	12.37◁
Enter compounding periods.	↓ ↓ 2 ENTER	C/Y=	2.00◁
Compute annual effective rate.	↑ CPT	EFF=	12.75*

The annual yield to maturity is 12.37% with semiannual compounding. The equivalent annual effective rate is 12.75%.

Saving for the Future by Making Monthly Deposits

Accounts with payments made at the beginning of the period are referred to as "annuity due" accounts. Interest on annuity due accounts starts accumulating earlier and produces slightly higher yields.

An individual has decided to invest $200 at the beginning of each month in a retirement plan. What will the account balance be at the end of 20 years if the fund earns an annual interest of 7.5 % compounded monthly, assuming beginning-of-period payments?



Example: Regular Deposits (Annuity Due)

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	**BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments using payment multiplier.	**20** 2nd [xP/Y] N	**N=**	**240.00**◃
Enter interest rate.	**7.5** I/Y	**I/Y=**	**7.50**◃
Enter amount of payment.	**200** +/– PMT	**PMT=**	**-200.00**◃
Compute future value.	CPT FV	**FV=**	**111,438.31**∗

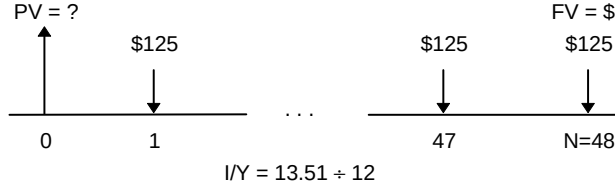
Depositing $200 at the beginning of each month for 20 years results in a future amount of $111,438.31.

Amount to Borrow and Down Payment

You want to buy a car that sells for $5,100. The finance company charges 13.51% APR, compounded monthly, on a 48-month loan. If you can afford a monthly payment of $125, how much can you borrow? How much do you need for the down payment?

Example: Loan Amount and Down Payment

Calculate the loan amount. Then subtract it from the cost of the car to find the down payment.



Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Enter number of payments using payment multiplier.	**4** 2nd [xP/Y] N	**N=**	**48.00**◁
Enter monthly interest rate.	**13.51** I/Y	**I/Y=**	**13.51**◁
Enter payment.	**125** +/– PMT	**PMT=**	**-125.00**◁
Compute loan amount.	CPT PV	**PV=**	**4,615.73**∗
Calculate down payment.	+ **5100** +/– =		**-484.27**

To buy the car, you can borrow $4,615.73 and make a down payment of $484.27.

Regular Deposits for a Specified Future Amount

You plan to open a savings account and deposit the same amount of money at the beginning of each month. In 10 years, you want to have $25,000 in the account. How much should you deposit if the annual interest rate is 7% with quarterly compounding?

C/Y (compounding periods per year) is automatically set to equal **P/Y** (payments per year), so you need to set **C/Y**.

Example: Monthly Deposits Compounded Quarterly

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set compounding periods to 4.	2nd [P/Y] ↓ **4** ENTER	**P/Y=** **C/Y=**	**12.00** **4.00**◁
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	 **BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of deposits using payment multiplier.	**10** 2nd [xP/Y] N	**N=**	**120.00**◁
Enter interest rate.	**7** I/Y	**I/Y=**	**7.00**◁
Enter future value.	**25000** FV	**FV=**	**25,000.00**◁
Compute deposit amount.	CPT PMT	**PMT=**	**-143.92***

You need to make monthly deposits of $143.92.

Time Value of Money/Amortization Schedule

This two-part example shows you how to use the TVM and Amortization worksheets to compute the monthly payment on a 30-year loan and then generate an amortization schedule for the first three years of the loan.

Example: Mortgage Payment

Using the TVM worksheet, determine the monthly payment on a 30-year mortgage with a loan amount of $120,000 and an annual percentage rate of 9.125%.

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Enter number of payments using payment multiplier.	**30** 2nd [xP/Y] N	**N=**	**360.00**◁
Enter interest rate.	**9.125** I/Y	**I/Y=**	**9.13**◁
Enter loan amount.	**120000** PV	**PV=**	**120,000.00**◁
Compute payment.	CPT PMT	**PMT=**	**-976.36**∗

Notice that the interest rate displays as 9.13, even though you entered 9.125. The calculator uses 9.125 for **I/Y** to make the calculation. To see the stored value of **I/Y** displayed with three digits, press 2nd [Format] **3** ENTER 2nd [QUIT] RCL **I/Y**.

The computed monthly payment is $976.36. Because **PMT** is money paid out, it is displayed as a negative number.

Example: Loan Amortization

(continued from previous example)

Use the Amortization worksheet to generate an amortization schedule for the first three years of the loan. Assume that the first payment is in April; therefore, the first year has 9 payment periods. There are 12 payment periods per year thereafter.

Procedure	Keystrokes		Display
Select the Amortization worksheet.	2nd [Amort]	**P1=**	**1.00**
Set ending period to 9.	↓ **9** ENTER	**P2=**	**9.00**◁
Display first year amortization data.	↓ ↓ ↓	**BAL=** **PRN=** **INT=**	**119,407.46*** **-592.54*** **-8,194.70***
Change beginning period to 10.	↓ **10** ENTER	**P1=**	**10.00**◁
Change ending period to 21.	↓ **21** ENTER	**P2=**	**21.00**◁
Display second year amortization data.	↓ ↓ ↓	**BAL=** **PRN=** **INT=**	**118,551.85*** **-855.61*** **-10,860.71***
Move to **P1** and press CPT to enter next range of payments.	↓ CPT	**P1=**	**22.00**◁
Display **P2**.	↓	**P2=**	**33.00**◁
Display third year amortization data.	↓ ↓ ↓	**BAL=** **PRN=** **INT=**	**117,614.86*** **-936.99*** **-10,779.33***

Note that the principal and interest are displayed as negative because they are outflows.

Interest and Loan Balance after Specified Payment

To evaluate the financial advisability of financing all or some of the sale price of a property, a seller must know the amount of interest that will be received and the remaining balance at the end of the term (balloon payment).

A seller is asked to finance $82,000 at 10% annual interest, amortized over a 30-year term but with a balloon payment due after five years.

The seller wants to know:
- The amount of the monthly payment.
- The amount of interest he will receive.
- The amount of the balloon payment.

Example: Compute Monthly Payment

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Enter number of payments using payment multiplier.	**30** 2nd [xP/Y] N	**N=**	**360.00**◃
Enter interest rate.	**10** I/Y	**I/Y=**	**10.00**◃
Enter loan amount.	**82000** PV	**PV=**	**82,000.00**◃
Compute payment.	CPT PMT	**PMT=**	**-719.61***

Example: Compute Amortization Schedule

(continued from previous example)

Procedure	Keystrokes		Display
Select Amortization worksheet.	2nd [Amort]	**P1=**	**1.00**
Enter end period after five years.	↓ **5** 2nd [xP/Y] ENTER	**P2=**	**60.00**◃
View computed balance due after five years.	↓	**BAL=**	**79,190.83***
View computed interest paid after five years.	↓ ↓	**INT=**	**-40,367.43***

If the seller financed the sale, he would receive:
- $719.61 each month for five years.
- $40,367.43 in interest over the five-year term.
- $79,190.83 as the balloon payment.

Canadian Mortgages

Canadian mortgages typically require the borrower to make monthly payments, although interest is compounded semiannually. Additionally, mortgages are usually refinanced at the end of a fixed period of time, such as five years.

A home buyer borrows $60,000 for 20 years at an annual interest rate of 13 % compounded semiannually. How much are the monthly payments and the amount necessary to pay off the mortgage after five years?

Example: Payment

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Leave payments per year at 12.	2nd [P/Y]	**P/Y=**	**12.00**◃
Set compounding periods per year to 2.	↓ **2** ENTER	**C/Y=**	**2.00**◃
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments using payment multiplier.	**20** 2nd [xP/Y] N	**N=**	**240.00**◃
Enter interest rate per year.	**13** I/Y	**I/Y=**	**13.00**◃
Enter present value.	**60000** PV	**PV=**	**60,000.00**◃
Compute payment.	CPT PMT	**PMT=**	**-688.52**∗

Example: Amortization Schedule

(continued from previous example)

Procedure	Keystrokes		Display
Select Amortization worksheet.	2nd [Amort]	**P1=**	**1.00**
Enter number of payments as **P2** using payment multiplier.	↓ **5** 2nd [xP/Y] ENTER	**P2=**	**60.00**◃
View balance after five years.	↓	**BAL=**	**55,389.85**∗

The monthly payment is $688.52, and $55,389.85 is required to pay off the mortgage after five years.