

## CHAPTER 2

### Using the Time-Value-of-Money and Amortization Worksheets

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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.

#### The TVM and Amortization Keys

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

#### TVM and Amortization Worksheet Keys and Labels

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

## Notes about the TVM and Amortization Worksheets

$\boxed{2\text{nd}}$   $\boxed{\text{CLR TVM}}$  sets **N**, **I/Y**, **PV**, **PMT**, and **FV** to zero; does not affect **P/Y**, **C/Y**, or the **BGN/END** setting.

$\boxed{2\text{nd}}$   $\boxed{\text{P/Y}}$   $\boxed{2\text{nd}}$   $\boxed{\text{CLR Work}}$  sets **P/Y** and **C/Y** to 12.

$\boxed{2\text{nd}}$   $\boxed{\text{BGN}}$   $\boxed{2\text{nd}}$   $\boxed{\text{CLR Work}}$  sets **END** (not **BGN**).

$\boxed{2\text{nd}}$   $\boxed{\text{Amort}}$   $\boxed{2\text{nd}}$   $\boxed{\text{CLR Work}}$  sets **P1** and **P2** to 1, and **BAL**, **PRN**, and **INT** to zero.

$\boxed{2\text{nd}}$   $\boxed{\text{Reset}}$   $\boxed{\text{ENTER}}$  sets **N**, **I/Y**, **PV**, **PMT**, and **FV** to zero; **P/Y** and **C/Y** to 12; **END** (not **BGN**); **P1** and **P2** to 1; and **BAL**, **PRN**, and **INT** to zero.

When solving a problem using only four of the five TVM variables, make sure the unused variable is zero.

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). Use  $\boxed{+/-}$  to enter a negative value.

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  $\boxed{\text{CPT}}$  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**).

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 the standard-calculator mode or a prompted-worksheet mode. The display responds differently according to the mode you are in.

- In the standard-calculator mode (accessed by pressing **2nd** [QUIT]), the variable label, the = sign, and the value you entered or recalled are displayed.
- In the prompted-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 the standard-calculator mode. Press **2nd** [QUIT] to return to the standard-calculator mode.

### Entering a Value for N using **2nd** [xP/Y]

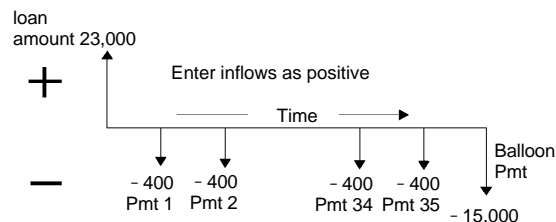
You can use the **2nd** [xP/Y] key sequence to enter a value for **N**. Pressing **2nd** [xP/Y] automatically multiplies a displayed number by the value stored in the **P/Y** variable (number of payments per year).

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

## 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.



## Steps in a TVM Calculation

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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 calculate a TVM problem.

### Procedure: Using the TVM Worksheet

1. Press  $\boxed{2nd}$  [QUIT]  $\boxed{2nd}$  [CLR TVM] to clear the worksheet.
2. Press  $\boxed{2nd}$  [P/Y] to enter payments per year and/or compounding periods per year.

The **P/Y** label and current value are displayed. (The default value is 12.) If necessary, key in the number of payments per year and press  $\boxed{ENTER}$ .

3. Press  $\boxed{\downarrow}$ . The **C/Y** label and current value are displayed. (The default value is 12.) When you entered a value for **P/Y**, the same value was automatically entered for **C/Y**.

If necessary, key in a new value for the number of compounding periods per year and press  $\boxed{ENTER}$ .

4. Press  $\boxed{2nd}$  [BGN] to select beginning-of-period payments or end-of-period payments. (**END** is the default setting.)
  - To select end-of-period payments, press  $\boxed{2nd}$  [SET] repeatedly until **END** is displayed.
  - To select beginning-of-period payments, press  $\boxed{2nd}$  [SET] repeatedly until **BGN** is displayed.

If you select beginning-of-period payments, the **BGN** indicator is displayed. If you select end-of-period payments, the **BGN** indicator is not displayed.

5. Press  $\boxed{2nd}$  [QUIT] to return to the standard-calculator mode.
6. Enter values for at least three variables. For example, enter values for **PV**, **I/Y**, and **N**.

To enter a value for a variable, key the value into the display and press the appropriate key. For example, to enter \$60,000 as the present value, key in a value of 60,000 and press  $\boxed{PV}$ . **PV = 60,000.00** is displayed.

**Note:** Make sure the unused variable (in this case, **FV**) is zero. Pressing  $\boxed{0}$   $\boxed{FV}$  stores zero to **FV**.

7. Compute a value for the unknown variable. To compute a value, press  $\boxed{CPT}$  and the appropriate key.

**Example:** To compute and display a value for payment (**PMT**), press  $\boxed{CPT}$   $\boxed{PMT}$ . **PMT =** and the computed value for the payment amount are displayed.

## ***Steps in an Amortization Calculation***

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The prompted 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.

### **Procedure: Generating an Amortization Schedule**

1. Press **[2nd]** **[Amort]**.  
**P1** is displayed, along with the previous value.
2. 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 **[↓]**. Then key in a value and press **[ENTER]**.
3. Press **[↓]** repeatedly to view the automatically computed values for **BAL**, **PRN**, and **INT**.  
The remaining balance (**BAL**) after payment **P2**, and the principal (**PRN**) and interest (**INT**) paid over the specified range are displayed.
4. Press **[2nd]** **[Amort]** or, if **INT** is displayed, press **[↓]** to display **P1** again.  
Repeat steps 2 and 3 for each range of payments to generate an amortization schedule.

### **Procedure: Automatically Generating an Amortization Schedule**

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

1. Press **[2nd]** **[Amort]** or, if **INT** is displayed, press **[↓]** to display **P1** and the value you entered previously for **P1**.
2. 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).

**Procedure: Automatically Generating an Amortization Schedule** (Continued)

3. Press  $\downarrow$  to display **P2**.
  - If you pressed  $\boxed{\text{CPT}}$  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  $\boxed{\text{CPT}}$  when **P1** was displayed, you can press  $\boxed{\text{CPT}}$  when **P2** is displayed to enter values for both **P1** and **P2** for the next range of payments.
4. Press  $\downarrow$  as needed to view the automatically computed values for **BAL**, **PRN**, and **INT** for the next range of payments.
5. Repeat steps 1 through 4 until the schedule is complete.

**Example: TVM/Amortization Application**

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: Part 1**

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
Clear TVM worksheet.	$\boxed{2\text{nd}} \boxed{\text{QUIT}}$ $\boxed{2\text{nd}} \boxed{\text{CLR TVM}}$	0.00
If necessary, set payments per year to 12.	$\boxed{2\text{nd}} \boxed{\text{P/Y}}$ 12 $\boxed{\text{ENTER}}$	<b>P/Y =</b> 12.00<
If necessary, select end-of-period payments.	$\boxed{2\text{nd}} \boxed{\text{BGN}}$ $\boxed{2\text{nd}} \boxed{\text{SET}}$	<b>END</b>
Return to standard-calculator mode.	$\boxed{2\text{nd}} \boxed{\text{QUIT}}$	0.00
Enter loan amount.	120000 $\boxed{\text{PV}}$	<b>PV =</b> 120,000.00<
Enter interest rate.	9.125 $\boxed{\text{I/Y}}$	<b>I/Y =</b> 9.13<
Enter number of payments.	30 $\boxed{2\text{nd}} \boxed{\text{xP/Y}}$ $\boxed{\text{N}}$	<b>N =</b> 360.00<
Compute payment.	$\boxed{\text{CPT}} \boxed{\text{PMT}}$	<b>PMT =</b> -976.36*

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

## Example: Part 2

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 Amortization worksheet.	<b>2nd</b> [Amort]	<b>P1</b> (old contents)
Clear worksheet.	<b>2nd</b> [CLR Work]	<b>P1</b> = 1.00
Set ending period to 9.	↓ 9 <b>ENTER</b>	<b>P2</b> = 9.00<
View first year amortization data.	↓ ↓ ↓	<b>BAL</b> = 119,407.46* <b>PRN</b> = -592.54* <b>INT</b> = -8,194.70*
Change beginning period to 10.	↓ 10 <b>ENTER</b>	<b>P1</b> = 10.00<
Change ending period to 21	↓ 21 <b>ENTER</b>	<b>P2</b> = 21.00<
View second year amortization data.	↓ ↓ ↓	<b>BAL</b> = 118,551.85* <b>PRN</b> = -855.61* <b>INT</b> = -10,860.71*
Move to <b>P1</b> and press <b>CPT</b> to enter next range of payments	↓ <b>CPT</b>	<b>P1</b> = 22.00<
View <b>P2</b> .	↓	<b>P2</b> = 33.00<
View third year amortization data.	↓ ↓ ↓	<b>BAL</b> = 117,614.86* <b>PRN</b> = -936.99* <b>INT</b> = -10,779.33*

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

