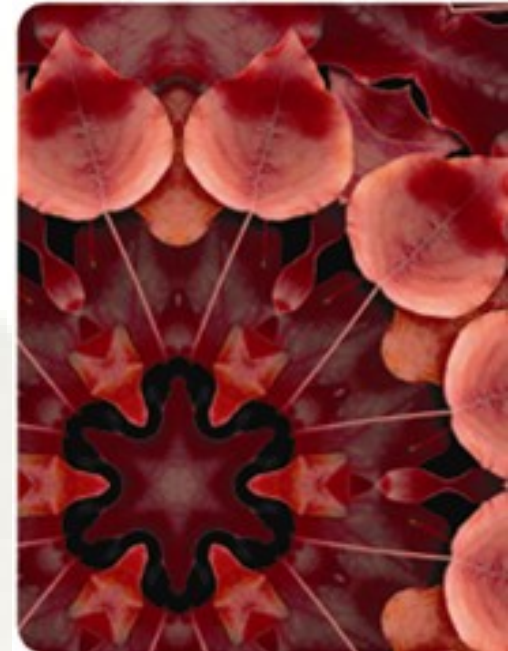


Excel Tutorial 3

Working with Formulas and Functions



Objectives

- Copy formulas
- Build formulas containing relative, absolute, and mixed references
- Review function syntax
- Insert a function with the Insert Function dialog box
- Search for a function
- Type a function directly in a cell



Objectives

- Use AutoFill to fill in a formula and complete a series
- Enter the IF logical function
- Insert the date with the TODAY function
- Calculate monthly mortgage payments with the PMT financial function



Using Relative References

Figure 3-2 Formula using a relative reference

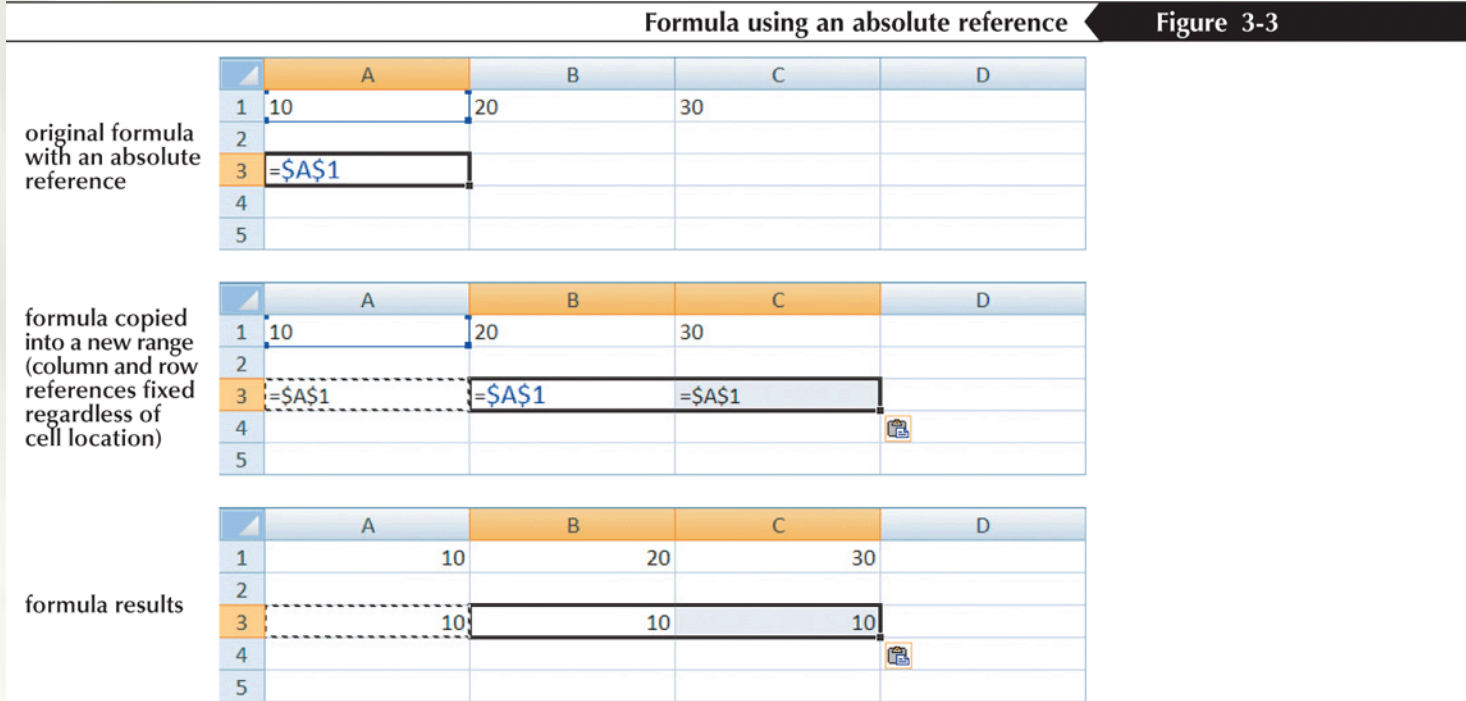
The figure illustrates the concept of relative references in Excel through three sequential screenshots of a spreadsheet. Each spreadsheet has columns A, B, C, and D, and rows 1 through 5.

original formula with a relative reference: Cell A1 contains the value 10, B1 contains 20, and C1 contains 30. Cell A3 contains the formula `=A1`.

formula copied to a new range (column and row references shift based on cell location): The formula from A3 is copied to B3 and C3. Dashed lines show the shift: from A1 to B1 and from A1 to C1. Cell B3 now contains `=B1` and cell C3 contains `=C1`.

formula results: The spreadsheet now shows the calculated results: 10 in A3, 20 in B3, and 30 in C3.

Using Absolute References



Using Mixed References

Formulas using mixed references

Figure 3-5

	A	B	C	D
original formula with a mixed reference	1	10	20	30
	2			
	3	=A\$1		
	4			
	5			
formula copied to a new range (row reference fixed on row 1, column reference shifts based on the cell location)	A	B	C	D
	1	10	20	30
	2			
	3	=A\$1	=B\$1	=C\$1
	4	=A\$1	=B\$1	=C\$1
5	=A\$1	=B\$1	=C\$1	
formula results	A	B	C	D
	1	10	20	30
	2			
	3	10	20	30
	4	10	20	30
5	10	20	30	

Entering Relative, Absolute, and Mixed References

- To enter a relative reference, type the cell reference as it appears in the worksheet. For example, enter B2 for cell B2
- To enter an absolute reference, type \$ (a dollar sign) before both the row and column references. For example, enter \$B\$2
- To enter a mixed reference, type \$ before either the row or column reference. For example, enter \$B2 or B\$2

or

- Select the cell reference you want to change
- Press the F4 key to cycle the reference from relative to absolute to mixed and then back to relative

Understanding Function Syntax

- Every function has to follow a set of rules, or **syntax**, which specifies how the function should be written
 - **Arguments**

Figure 3-6

Categories of Excel functions

Category	Contains functions that
Cube	Retrieve data from multidimensional databases involving online analytical processing or OLAP
Database	Retrieve and analyze data stored in databases
Date & Time	Analyze or create date and time values and time intervals
Engineering	Analyze engineering problems
Financial	Have financial applications
Information	Return information about the format, location, or contents of worksheet cells
Logical	Return logical (true-false) values
Lookup & Reference	Look up and return data matching a set of specified conditions from a range
Math & Trig	Have math and trigonometry applications
Statistical	Provide statistical analyses of a set of data
Text	Return text values or evaluate text

Understanding Function Syntax

Figure 3-7

Math, Trig, and Statistical functions

Function	Category	Description
AVERAGE(<i>number1</i> [, <i>number2</i> , <i>number3</i> , ...])	Statistical	Calculates the average of a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references. Only <i>number1</i> is required. For more than one cell reference or to enter numbers directly into the function, use the optional arguments <i>number2</i> , <i>number3</i> , and so forth.
COUNT(<i>value1</i> [, <i>value2</i> , <i>value3</i> , ...])	Statistical	Counts how many cells in a range contain numbers, where <i>value1</i> , <i>value2</i> , and so forth are text, numbers, or cell references. Only <i>value1</i> is required. For more than one cell reference or to enter numbers directly into the function, use the optional arguments <i>value2</i> , <i>value3</i> , and so forth.
COUNTA(<i>value1</i> , [, <i>value2</i> , <i>value3</i> , ...])	Statistical	Counts how many cells are not empty in ranges <i>value1</i> , <i>value2</i> , and so forth, or how many numbers are listed within <i>value1</i> , <i>value2</i> , and so forth.
INT(<i>number</i>)	Math & Trig	Displays the integer portion of a number, <i>number</i> .
MAX(<i>number1</i> [, <i>number2</i> , <i>number3</i> , ...])	Statistical	Calculates the maximum value of a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references.
MEDIAN(<i>number1</i> [, <i>number2</i> , <i>number3</i> , ...])	Statistical	Calculates the median, or middle, value of a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references.
MIN(<i>number1</i> [, <i>number2</i> , <i>number3</i> , ...])	Statistical	Calculates the minimum value of a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references.
RAND()	Math & Trig	Returns a random number between 0 and 1.
ROUND(<i>number</i> , <i>num_digits</i>)	Math & Trig	Rounds a number to a specified number of digits, where <i>number</i> is the number you want to round and <i>num_digits</i> specifies how many digits to which you want to round the number.
SUM(<i>number1</i> [, <i>number2</i> , <i>number3</i> , ...])	Math & Trig	Adds a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references.

Inserting a Function

- Click the Formulas tab on the Ribbon
- To insert a function from a specific category, click the appropriate category button in the Function Library group. To search for a function, click the Insert Function button in the Function Library group, enter a description of the function, and then click the Go button
- Select the appropriate function from the list of functions
- Enter the argument values in the Function Arguments dialog box, and then click the OK button



Inserting a Function

Figure 3-8 Function Arguments dialog box

Tip
You can click the Collapse Dialog Box button to shrink the Function Arguments dialog box to see more of the worksheet, select the range, and then click the Expand Dialog Box button to restore the dialog box.

The screenshot shows the 'Function Arguments' dialog box for the SUM function. The dialog box is titled 'Function Arguments' and contains the following elements:

- Function Name:** SUM
- Number1 (required argument):** D21:O21. A callout points to this field with the label 'required argument'. A 'Collapse Dialog Box' button is located to the right of this field.
- Number2 (optional argument):** (empty). A callout points to this field with the label 'optional argument'.
- Argument List:** A list of values in the range: {2950,2950,2950,2950,2950,3800,3...}. A callout points to this list with the label 'list of values in the range'.
- Preview:** = 37950. A callout points to this value with the label 'preview of the value returned by the function with the current argument values'.
- Description:** Adds all the numbers in a range of cells. A callout points to this text with the label 'description of the function'.
- Number1 Description:** Number1: number1,number2,... are 1 to 255 numbers to sum. Logical values and text are ignored in cells, included if typed as arguments. A callout points to this text with the label 'description of the Number1 argument'.
- Formula Result:** Formula result = 37,950. A callout points to this text with the label 'text that will be displayed in the worksheet'.
- Buttons:** OK and Cancel buttons are at the bottom right.
- Help:** A link 'Help on this function' is at the bottom left.

Inserting a Function

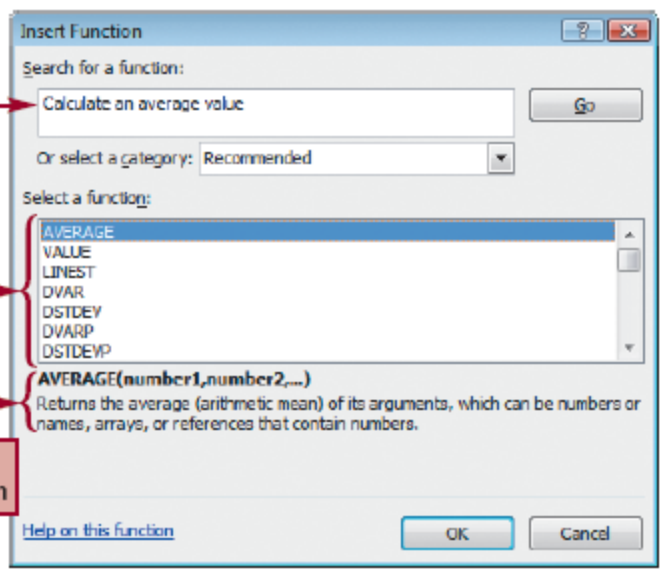
Figure 3-10 Insert Function dialog box

Tip
You can also open the Insert Function dialog box by clicking the Insert Function button on the formula bar.

description of function

list of functions that match the search description

syntax and description of the selected function



Typing a Function

- As you begin to type a function name within a formula, a list of functions that begin with the letters you typed appears

Figure 3-12 Typing a function

The screenshot shows an Excel spreadsheet with a 'Year-End Summary' table. The table has columns for various metrics and their values. A dropdown menu is open for the 'Monthly Minimum' cell, showing a list of functions starting with 'MI'. A red box points to the dropdown menu with the text 'list shows functions starting with MI'. Another red box points to the 'MID' function in the list with the text 'ScreenTip describes the selected function'. The ScreenTip for 'MID' is visible, stating 'Returns the characters from the middle of a text string, given a starting position and length'. The spreadsheet data is as follows:

Year-End Summary		Total Take-Home Pay	37,950
		Monthly Average	3,163
		Monthly Minimum	=MI
		Monthly Maximum	
		Total Expenses	
		Monthly Average	
		Monthly Minimum	
		Monthly Maximum	

Take-Home Pay & Expenses		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pay	Diane	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	
	Glenn	950	950	950	950	950	1,800	1,800	1,800	

Working with AutoFill

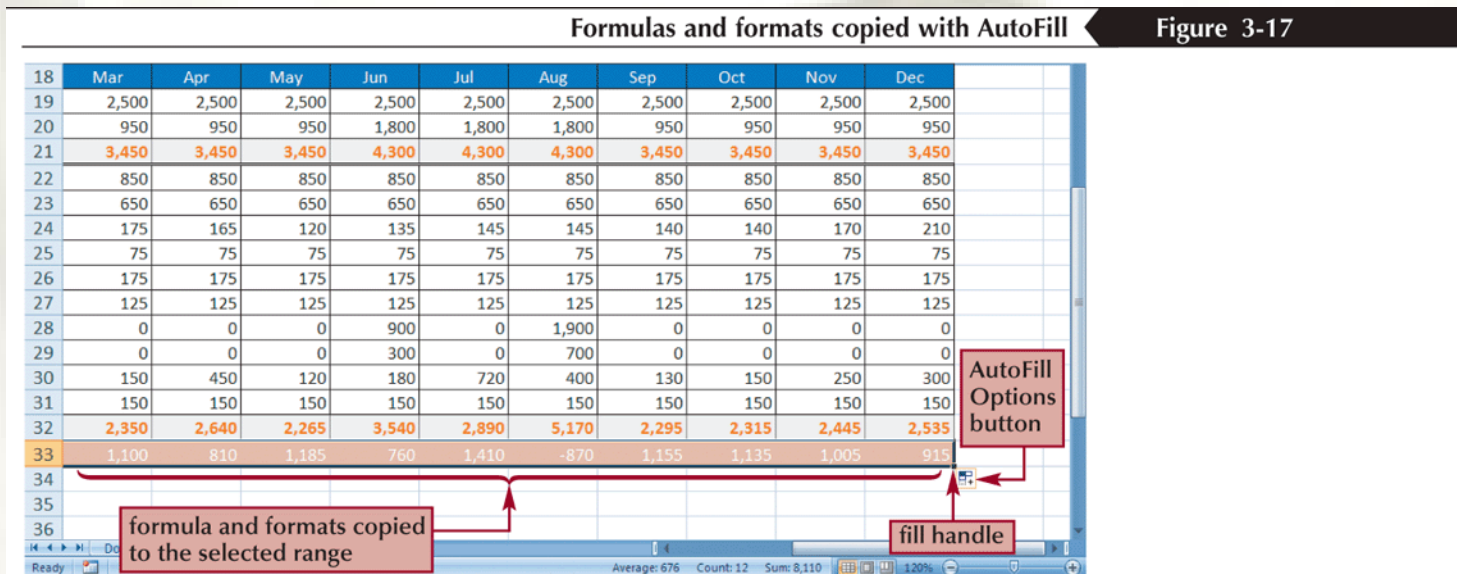
- **AutoFill** copies content and formats from a cell or range into an adjacent cell or range
- Select the cell or range that contains the formula or formulas you want to copy
- Drag the fill handle in the direction you want to copy the formula(s) and then release the mouse button
- To copy only the formats or only the formulas, click the AutoFill Options button and select the appropriate option

or

- Select the cell or range that contains the formula or formulas you want to copy
- In the Editing group on the Home tab, click the Fill button
- Select the appropriate fill direction and fill type (or click Series, enter the desired fill series options, and then click the OK button)

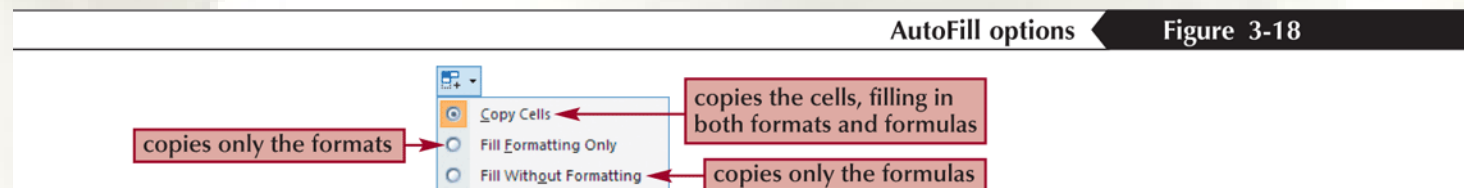


Working with AutoFill



Using the AutoFill Options Button

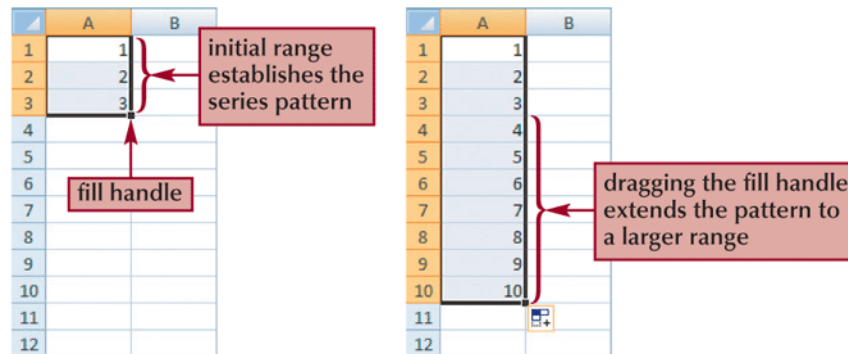
- By default, AutoFill copies both the formulas and the formats of the original range to the selected range
- You can specify what is copied by using the AutoFill Options button that appears after you release the mouse button



Filling a Series

- AutoFill can also be used to create a series of numbers, dates, or text based on a pattern

Figure 3-19 AutoFill extends a numeric sequence



Filling a Series

Figure 3-20 AutoFill applied to different series

Type	Initial Entry	Extended Series
Values	1, 2, 3	4, 5, 6, ...
	2, 4, 6	8, 10, 12, ...
Dates and Times	Jan	Feb, Mar, Apr, ...
	January	February, March, April, ...
	15-Jan, 15-Feb	15-Mar, 15-Apr, 15-May, ...
	12/30/2010	12/31/2010, 1/1/2011, 1/2/2011, ...
	12/31/2010, 1/31/2011	2/28/2011, 3/31/2011, 4/30/2011, ...
	Mon	Tue, Wed, Thu, ...
	Monday	Tuesday, Wednesday, Thursday, ...
	11:00AM	12:00PM, 1:00PM, 2:00PM, ...
Patterned Text	1st period	2nd period, 3rd period, 4th period, ...
	Region 1	Region 2, Region 3, Region 4, ...
	Quarter 3	Quarter 4, Quarter 1, Quarter 2, ...
	Qtr3	Qtr4, Qtr1, Qtr2, ...

Creating a Series with AutoFill

- Enter the first few values of the series into a range
- Select the range, and then drag the fill handle of the selected range over the cells you want to fill

or

- Enter the first few values of the series into a range
- Select the entire range into which you want to extend the series
- In the Editing group on the Home tab, click the Fill button, and then click Down, Right, Up, Left, Series, or Justify to set the direction you want to extend the series



Working with Logical Functions

- A **logical function** is a function that works with values that are either true or false
- The **IF function** is a logical function that returns one value if the statement is true and returns a different value if the statement is false
- $IF(\textit{logical_test}, \textit{value_if_true}, [\textit{value_if_false}])$



Working with Logical Functions

- A **comparison operator** is a symbol that indicates the relationship between two values

Comparison operators		Figure 3-27
Operator	Statement	Tests whether
=	A1 = B1	the value in cell A1 <i>is equal to</i> the value in cell B1
>	A1 > B1	the value in cell A1 <i>is greater than</i> the value in cell B1
<	A1 < B1	the value in cell A1 <i>is less than</i> the value in cell B1
>=	A1 >= B1	the value in cell A1 <i>is greater than or equal to</i> the value in cell B1
<=	A1 <= B1	the value in cell A1 <i>is less than or equal to</i> the value in cell B1
<>	A1 <> B1	the value in cell A1 <i>is not equal to</i> the value in cell B1

Working with Logical Functions

- =IF(A1="YES", "DONE", "RESTART")
- =IF(A1="MAXIMUM", MAX(B1:B10), MIN(B1:B10))
- =IF(D33>0, \$K\$10, 0)



Working with Logical Functions

Function arguments for the IF function

Figure 3-28

test condition that is either true or false

value returned if the condition is true

value returned if the condition is false

Function Arguments

IF

Logical_test: D33>0 = FALSE

Value_if_true: \$K\$10 = 800

Value_if_false: 0 = 0

Checks whether a condition is met, and returns one value if TRUE, and another value if FALSE.

Value_if_false is the value that is returned if Logical_test is FALSE. If omitted, FALSE is returned.

Formula result = 0

[Help on this function](#) OK Cancel

Working with Date Functions

Date functions

Figure 3-31

Function	Description
DATE(<i>year, month, day</i>)	Creates a date value for the date represented by the <i>year</i> , <i>month</i> , and <i>day</i> arguments
DAY(<i>date</i>)	Extracts the day of the month from the <i>date</i> value
MONTH(<i>date</i>)	Extracts the month number from the <i>date</i> value where 1=January, 2=February, and so forth
YEAR(<i>date</i>)	Extracts the year number from the <i>date</i> value
WEEKDAY(<i>date, [return_type]</i>)	Calculates the day of the week from the <i>date</i> value, where 1=Sunday, 2=Monday, and so forth; to choose a different numbering scheme, set the optional <i>return_type</i> value to "1" (1=Sunday, 2=Monday, ...), "2" (1=Monday, 2=Tuesday, ...), or "3" (0=Monday, 1=Tuesday, ...)
NOW()	Displays the current date and time
TODAY()	Displays the current date



Working with Financial Functions

Figure 3-33

Financial functions for loans and investments

Function	Description
<code>FV(rate, nper, pmt, [pv=0], [type=0])</code>	Returns the future value of an investment, where <i>rate</i> is the interest rate per period, <i>nper</i> is the total number of periods, <i>pmt</i> is the payment in each period, <i>pv</i> is the present value of the investment, and <i>type</i> indicates whether payments should be made at the end of the period (0) or the beginning of the period (1)
<code>PMT(rate, nper, pv, [fv=0], [type=0])</code>	Calculates the payments required each period on a loan or investment
<code>IPMT(rate, per, nper, pv, [fv=0], [type=0])</code>	Calculates the amount of a loan payment devoted to paying the loan interest, where <i>per</i> is the number of the payment period
<code>PPMT(rate, per, nper, pv, [fv=0], [type=0])</code>	Calculates the amount of a loan payment devoted to paying off the principal of a loan, where <i>per</i> is the number of the payment period
<code>PV(rate, nper, pmt, [fv=0], [type=0])</code>	Calculates the present value of a loan or investment based on periodic, constant payments
<code>NPER(rate, pmt, pv, [fv=0], [type=0])</code>	Calculates the number of periods required to pay off a loan or investment
<code>RATE(nper, pmt, pv, [fv=0], [type=0])</code>	Calculates the interest rate of a loan or investment based on periodic, constant payments

Using the PMT Function to Determine a Monthly Loan Payment

- For loan or investment calculations, you need to know the following information:
 - The annual interest rate
 - The payment period, or how often payments are due and interest is compounded
 - The length of the loan in terms of the number of payment periods
 - The amount being borrowed or invested
- $\text{PMT}(\text{rate}, \text{nper}, \text{pv}, [\text{fv}=0] [\text{type}=0])$



Using the PMT Function to Determine a Monthly Loan Payment

Function Arguments dialog box for the PMT function

Figure 3-35

Function Arguments

PMT

Rate	B5	=	0.005416667
Nper	B7	=	240
Pv	B8	=	160000
Fv		=	number
Type		=	number

= -1192.917017

Calculates the payment for a loan based on constant payments and a constant interest rate.

Fv is the future value, or a cash balance you want to attain after the last payment is made, 0 (zero) if omitted.

Formula result = -1192.917017

[Help on this function](#)

OK Cancel

Using the PMT Function to Determine a Monthly Loan Payment

Figure 3-36 Monthly payment for a \$160,000 loan

The screenshot shows an Excel spreadsheet titled "Drake Family Budget - Microsoft Excel". The spreadsheet contains the following data:

	A	B	E	F	G	H	I
1	Home Loan						
2							
3	Annual Interest Rate	6.50%					
4	Interest Payments per Year	12					
5	Interest Rate per Period	0.0054167					
6	Number of Years	20					
7	Number of Payments	240					
8	Loan Amount	160,000					
9	Monthly Loan Payment	\$1,192.92					
10							

Annotations in the image:

- A red box with an arrow pointing to the formula bar containing `=PMT(B5,B7,B8)` is labeled "PMT function entered in cell B9".
- A red box with an arrow pointing to the value **\$1,192.92** in cell B9 is labeled "value returned by the PMT function".