

CHAPTER-05**FORMULAS AND FUNCTIONS**

Introduction

One of the most powerful features in Excel is the ability to **calculate** numerical information using **formulas**. Just like a calculator, Excel can add, subtract, multiply, and divide. In this lesson, we'll show you how to use **cell references** to create simple formulas.

Mathematical operators

Excel uses standard operators for formulas, such as a **plus sign** for addition (+), a **minus sign** for subtraction (-), an **asterisk** for multiplication (*), a **forward slash** for division (/), and a **caret** (^) for exponents.

Addition	+
Subtraction	-
Multiplication	*
Division	/
Exponents	^

All formulas in Excel must begin with an **equals sign** (=). This is because the cell contains, or is equal to, the formula and the value it calculates.

Understanding cell references

While you can create simple formulas in Excel using numbers (for example, =2+2 or =5*5), most of the time you will use **cell addresses** to create a formula. This is known as making a **cell reference**. Using cell references will ensure that your formulas are always accurate because you can change the value of referenced cells without having to rewrite the formula.

In the formula below, cell A3 adds the values of cells A1 and A2 by making cell references:

	A	B
1	5	
2	2	
3	=A1+A2	
4		

When you press Enter, the formula calculates and displays the answer in cell A3:

	A	B
1	5	
2	2	
3	7	
4		

If the values in the referenced cells change, the formula automatically recalculates:

	A	B
1	6	
2	2	
3	8	
4		

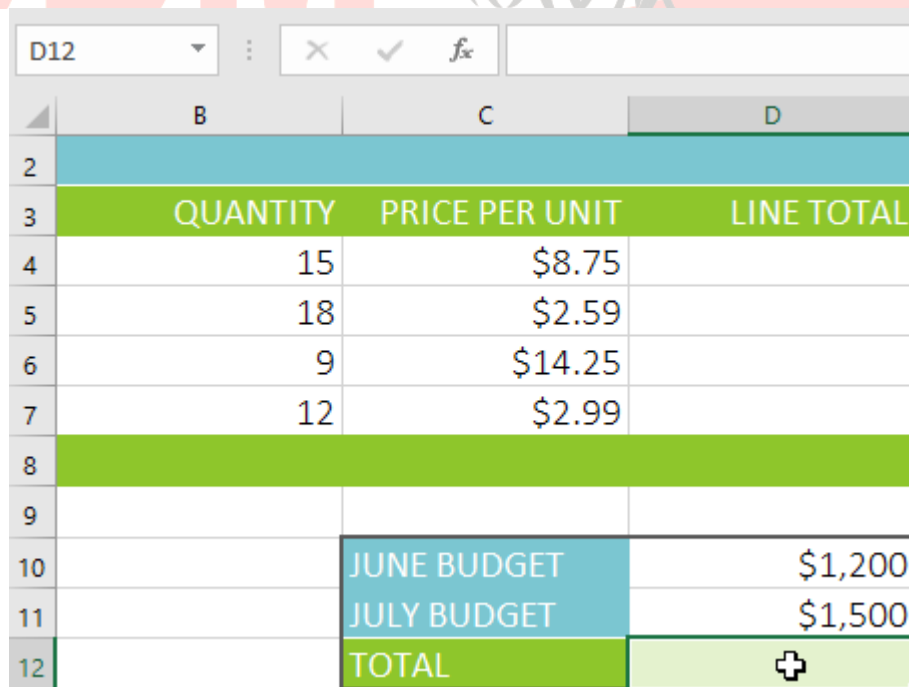
By combining a mathematical operator with cell references, you can create a variety of simple formulas in Excel. Formulas can also include a combination of cell references and numbers, as in the examples below:

=A1+A2	Adds cells A1 and A2
=C4-3	Subtracts 3 from cell C4
=E7/J4	Divides cell E7 by J4
=N10*1.05	Multiplies cell N10 by 1.05
=R5^2	Finds the square of cell R5

To create a formula:

In our example below, we'll use a simple formula and cell references to calculate a budget.

1. Select the **cell** that will contain the formula. In our example, we'll select cell **D12**.



	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	
5	18	\$2.59	
6	9	\$14.25	
7	12	\$2.99	
8			
9			
10		JUNE BUDGET	\$1,200
11		JULY BUDGET	\$1,500
12		TOTAL	+

2. Type the **equals sign (=)**. Notice how it appears in both the **cell** and the **formula bar**.

	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	
5	18	\$2.59	
6	9	\$14.25	
7	12	\$2.99	
8			
9			
10		JUNE BUDGET	\$1,200
11		JULY BUDGET	\$1,500
12		TOTAL	=

3. Type the **cell address** of the cell you want to reference first in the formula: cell **D10** in our example. A **blue border** will appear around the referenced cell.

	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	
5	18	\$2.59	
6	9	\$14.25	
7	12	\$2.99	
8			
9			
10		JUNE BUDGET	\$1,200
11		JULY BUDGET	\$1,500
12		TOTAL	=D10

4. Type the **mathematical operator** you want to use. In our example, we'll type the **addition sign (+)**.

5. Type the **cell address** of the cell you want to reference second in the formula: cell **D11** in our example. A **red border** will appear around the referenced cell.

SUM			
=D10+D11			
	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	
5	18	\$2.59	
6	9	\$14.25	
7	12	\$2.99	
8			
9			
10	JUNE BUDGET		\$1,200
11	JULY BUDGET		\$1,500
12	TOTAL		=D10+D11

6. Press **Enter** on your keyboard. The formula will be **calculated**, and the **value** will be displayed in the cell. If you select the cell again, notice that the cell displays the result, while the formula bar displays the formula.

D12			
=D10+D11			
	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	
5	18	\$2.59	
6	9	\$14.25	
7	12	\$2.99	
8			
9			
10	JUNE BUDGET		\$1,200
11	JULY BUDGET		\$1,500
12	TOTAL		\$2,700

If the result of a formula is too large to be displayed in a cell, it may appear as **pound signs (#####)** instead of a value. This means the column is not wide enough to display the cell content. Simply **increase the column width** to show the cell content.

Modifying values with cell references

The true advantage of cell references is that they allow you to **update data** in your worksheet without having to rewrite formulas. In the example below, we've modified the value of cell D10 from \$1,200 to \$1,800. The formula in D12 will automatically recalculate and display the new value in cell D12.

	C	D
10	JUNE BUDGET	\$1,800
11	JULY BUDGET	\$1,500
12	TOTAL	\$3,300

Excel **will not always tell you** if your formula contains an error, so it's up to you to check all of your formulas. To learn how to do this, you can read the [Double-Check Your Formulas](#) lesson from our [Excel Formulas](#) tutorial.

To create a formula using the point-and-click method:

Instead of typing cell addresses manually, you can **point and click** the cells you want to include in your formula. This method can save a lot of time and effort when creating formulas. In our example below, we'll create a formula to calculate the cost of ordering several boxes of plastic silverware.

1. Select the **cell** that will contain the formula. In our example, we'll select cell **D4**.

D4

	A	B	C	D
1		Budget & Paper Supplies		
		Sabrosa Empanadas & More		
		1202 Biscayne Bay Drive		
		Orlando, FL 32804		
2	PAPER SUPPLY ORDERS			
3	ITEM	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	Plastic Silverware (box of 100)	15	\$8.75	+
5	Napkins (box of 250)	18	\$2.59	
6	Plates (box of 50)	9	\$14.25	
7	Plastic Cups (box of 100)	12	\$2.99	
8				

2. Type the **equals sign (=)**.

3. Select the **cell** you want to reference first in the formula: cell **B4** in our example. The **cell address** will appear in the formula.

B4

	A	B	C	D
1		Budget & Paper Supplies		
		Sabrosa Empanadas & More		
		1202 Biscayne Bay Drive		
		Orlando, FL 32804		
2	PAPER SUPPLY ORDERS			
3	ITEM	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	Plastic Silverware (box of 100)	15	\$8.75	=B4
5	Napkins (box of 250)	18	\$2.59	
6	Plates (box of 50)	9	\$14.25	
7	Plastic Cups (box of 100)	12	\$2.99	
8				

4. Type the **mathematical operator** you want to use. In our example, we'll type the **multiplication sign (*)**.
5. Select the **cell** you want to reference second in the formula: cell **C4** in our example. The **cell address** will appear in the formula.

ITEM	QUANTITY	PRICE PER UNIT	LINE TOTAL
Plastic Silverware (box of 100)	15	\$8.75	=B4*C4
Napkins (box of 250)	18	\$2.59	
Plates (box of 50)	9	\$14.25	
Plastic Cups (box of 100)	12	\$2.99	

6. Press **Enter** on your keyboard. The formula will be **calculated**, and the **value** will be displayed in the cell.

ITEM	QUANTITY	PRICE PER UNIT	LINE TOTAL
Plastic Silverware (box of 100)	15	\$8.75	\$131.25
Napkins (box of 250)	18	\$2.59	
Plates (box of 50)	9	\$14.25	
Plastic Cups (box of 100)	12	\$2.99	

Copying formulas with the fill handle

Formulas can also be **copied** to adjacent cells with the **fill handle**, which can save a lot of time and effort if you need to perform the **same calculation** multiple times in a worksheet. The **fill handle** is the small square at the bottom-right corner of the selected cell(s).

1. Select the cell containing the formula you want to copy. Click and drag the **fill handle** over the cells you want to fill.

	B	C	D	E
2				
3	QUANTITY	PRICE PER UNIT	LINE TOTAL	
4	15	\$8.75	\$131.25	
5	18	\$2.59		
6	9	\$14.25		
7	12	\$2.99		
8				
9				

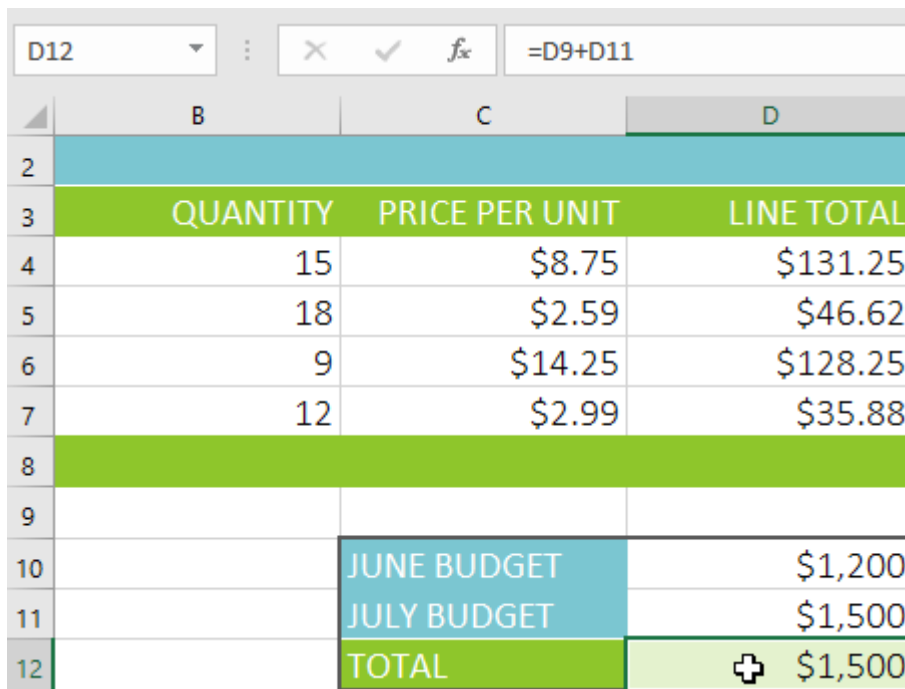
2. After you release the mouse, the formula will be copied to the selected cells.

	B	C	D	E
2				
3	QUANTITY	PRICE PER UNIT	LINE TOTAL	
4	15	\$8.75	\$131.25	
5	18	\$2.59	\$46.62	
6	9	\$14.25	\$128.25	
7	12	\$2.99	\$35.88	
8				
9				

To edit a formula:

Sometimes you may want to modify an existing formula. In the example below, we've entered an incorrect cell address in our formula, so we'll need to correct it.

1. Select the **cell** containing the formula you want to edit. In our example, we'll select cell **D12**.



	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	\$131.25
5	18	\$2.59	\$46.62
6	9	\$14.25	\$128.25
7	12	\$2.99	\$35.88
8			
9			
10		JUNE BUDGET	\$1,200
11		JULY BUDGET	\$1,500
12		TOTAL	+ \$1,500

2. Click the **formula bar** to edit the formula. You can also **double-click** the cell to view and edit the formula directly within the cell.

	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	\$131.25
5	18	\$2.59	\$46.62
6	9	\$14.25	\$128.25
7	12	\$2.99	\$35.88
8			
9			
10		JUNE BUDGET	\$1,200
11		JULY BUDGET	\$1,500
12		TOTAL	\$1,500

3. A **border** will appear around any referenced cells. In our example, we'll change the first part of the formula to reference cell **D10** instead of cell **D9**.

	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	\$131.25
5	18	\$2.59	\$46.62
6	9	\$14.25	\$128.25
7	12	\$2.99	\$35.88
8			
9			
10		JUNE BUDGET	\$1,200
11		JULY BUDGET	\$1,500
12		TOTAL	=D9+D11

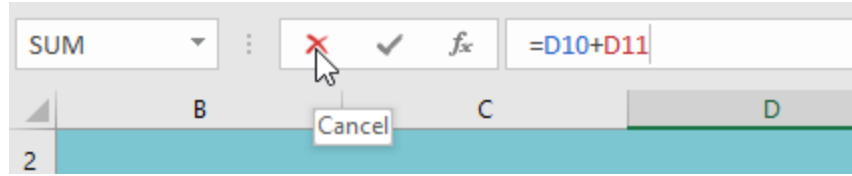
4. When you're finished, press **Enter** on your keyboard or select the **Enter** command in the formula bar.

	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	\$131.25
5	18	\$2.59	\$46.62
6	9	\$14.25	\$128.25
7	12	\$2.99	\$35.88
8			
9			
10		JUNE BUDGET	\$1,200
11		JULY BUDGET	\$1,500
12		TOTAL	=D10+D11

5. The formula will be **updated**, and the **new value** will be displayed in the cell.

	B	C	D
2			
3	QUANTITY	PRICE PER UNIT	LINE TOTAL
4	15	\$8.75	\$131.25
5	18	\$2.59	\$46.62
6	9	\$14.25	\$128.25
7	12	\$2.99	\$35.88
8			
9			
10		JUNE BUDGET	\$1,200
11		JULY BUDGET	\$1,500
12		TOTAL	\$2,700

If you change your mind, you can press the **Esc** key on your keyboard or click the **Cancel** command in the formula bar to avoid accidentally making changes to your formula.



To show all of the formulas in a spreadsheet, you can hold the **Ctrl** key and press ` (grave accent). The grave accent key is usually located in the top-left corner of the keyboard. You can press **Ctrl+`** again to switch back to the normal view.

Challenge!

1. Open our [practice workbook](#).
2. Click the **Challenge** tab in the bottom-left of the workbook.
3. Create a formula in cell **D4** that multiplies the quantity in **B4** by the price per unit in cell **C4**.
4. Use the **fill handle** to copy the formula in cell **D4** to cells **D5:D7**.
5. Change the price per unit for the fried plantains in cell **C6** to \$2.25. Notice that the line total automatically changes as well.
6. Edit the formula for the total in cell **D8** so it also adds cell **D7**.
7. When you're finished, your workbook should look like this:

ITEM	QUANTITY	PRICE PER UNIT	LINE TOTAL
Empanadas: Braised Short Rib	15	\$3.75	\$56.25
Empanadas: Nutella and Banana	18	\$2.59	\$46.62
Sides: Fried Plantains	15	\$2.25	\$33.75
Sides: Rice and Black Beans	12	\$2.15	\$25.80
TOTAL			\$162.42

Relative references

By default, all cell references are **relative references**. When copied across multiple cells, they change based on the relative position of rows and columns. For example, if you copy the formula **=A1+B1** from row 1 to row 2, the formula will become **=A2+B2**. Relative references are especially convenient whenever you need to repeat the same calculation across multiple rows or columns.

To create and copy a formula using relative references:

In the following example, we want to create a formula that will multiply each item's **price** by the **quantity**. Instead of creating a new formula for each row, we can create a single formula in cell **D4** and then copy it to the other rows. We'll use relative references so the formula calculates the total for each item correctly.

1. Select the **cell** that will contain the formula. In our example, we'll select cell **D4**.

	A	B	C	D	E
3	MENU ITEM	UNIT PRICE	QUANTITY	LINE TOTAL	
4	Empanadas: Beef Picadillo	\$2.99	15	+	
5	Empanadas: Chipotle Shrimp	\$3.99	10		
6	Tamales: Chicken Tinga	\$2.29	20		
7	Tamales: Vegetable	\$2.29	30		
8	Arepas: Carnitas	\$2.89	10		
9	Arepas: Queso Blanco	\$2.49	20		
10	Empanadas: Apple Cinnamon	\$3.19	40		
11	Beverages: Horchata	\$1.89	25		
12	Beverages: Lemonade	\$1.89	35		
13	Beverages: Tamarindo	\$1.89	10		
14	TOTAL			\$0.00	
15					

2. Enter the **formula** to calculate the desired value. In our example, we'll type **=B4*C4**.

	A	B	C	D
3	MENU ITEM	UNIT PRICE	QUANTITY	LINE TOTAL
4	Empanadas: Beef Picadillo	\$2.99	15	=B4*C4
5	Empanadas: Chipotle Shrimp	\$3.99	10	
6	Tamales: Chicken Tinga	\$2.29	20	
7	Tamales: Vegetable	\$2.29	30	
8	Arepas: Carnitas	\$2.89	10	
9	Arepas: Queso Blanco	\$2.49	20	
10	Empanadas: Apple Cinnamon	\$3.19	40	
11	Beverages: Horchata	\$1.89	25	
12	Beverages: Lemonade	\$1.89	35	
13	Beverages: Tamarindo	\$1.89	10	
14	TOTAL			\$0.00
15				

3. Press **Enter** on your keyboard. The formula will be calculated, and the result will be displayed in the cell.

Locate the **fill handle** in the bottom-right corner of the desired cell. In our example, we'll locate the fill handle for cell **D4**.

Absolute references

There may be times when you do not want a cell reference to change when filling cells. Unlike relative references, **absolute references** do not change when copied or filled. You can use an absolute reference to keep a row and/or column **constant**.

An absolute reference is designated in a formula by the addition of a **dollar sign (\$)** before the column and row. If it precedes the column or row (but not both), it's known as a **mixed reference**.

\$A\$2	The column and the row do not change when copied
A\$2	The row does not change when copied
\$A2	The column does not change when copied

You will use the relative (**A2**) and absolute (**\$A\$2**) formats in most formulas. Mixed references are used less frequently.

When writing a formula in Microsoft Excel, you can press the F4 key on your keyboard to switch between relative, absolute, and mixed cell references, as shown in the video below. This is an easy way to quickly insert an absolute reference. Using cell references with multiple worksheets

Excel allows you to refer to any cell on any **worksheet**, which can be especially helpful if you want to reference a specific value from one worksheet to another. To do this, you'll simply need to begin the cell reference with the **worksheet name** followed by an **exclamation point (!)**. For example, if you wanted to reference cell **A1** on **Sheet1**, its cell reference would be **Sheet1!A1**.

Note that if a worksheet name contains a **space**, you'll need to include **single quotation marks (')** around the name. For example, if you wanted to reference cell **A1** on a worksheet named **July Budget**, its cell reference would be **'July Budget'!A1**.

To reference cells across worksheets:

In our example below, we'll refer to a cell with a calculated value between two worksheets. This will allow us to use the **exact same value** on two different worksheets without rewriting the formula or copying data.

1. Locate the cell you want to reference, and note its worksheet. In our example, we want to reference cell **E14** on the **Menu Order** worksheet.

E14 : =SUM(E4:E13)

	A	B	C	D	E
2				TAX RATE:	7.5%
3	MENU ITEM	UNIT PRICE	QUANTITY	SALES TAX	LINE TOTAL
4	Empanadas: Beef Picadillo	\$2.99	15	\$3.36	\$48.21
5	Empanadas: Chipotle Shrimp	\$3.99	10	\$2.99	\$42.89
6	Tamales: Chicken Tinga	\$2.29	20	\$3.44	\$49.24
7	Tamales: Vegetable	\$2.29	30	\$5.15	\$73.85
8	Arepas: Carnitas	\$2.89	10	\$2.17	\$31.07
9	Arepas: Queso Blanco	\$2.49	20	\$3.74	\$53.54
10	Empanadas: Apple Cinnamon	\$3.19	40	\$9.57	\$137.17
11	Beverages: Horchata	\$1.89	25	\$3.54	\$50.79
12	Beverages: Lemonade	\$1.89	35	\$4.96	\$71.11
13	Beverages: Tamarindo	\$1.89	10	\$1.42	\$20.32
14				TOTAL	+\$578.19
15					
16					
17					
18					

Catering Invoice **Menu Order** +

- Navigate to the desired **worksheet**. In our example, we'll select the **Catering Invoice** worksheet.

	SERVICE	DESCRIPTION	LINE TOTAL
4	Menu Order	Food & beverage	
5	Paper Goods	Plates, utensils, cups	\$110.87
6	Rental Equipment	Tables, chairs, linens	\$249.95
7	Service Fee	18% of food & beverage	\$0.00
8		TOTAL	\$360.82
9			
10			
11			
12			

Catering Invoice **Menu Order** +

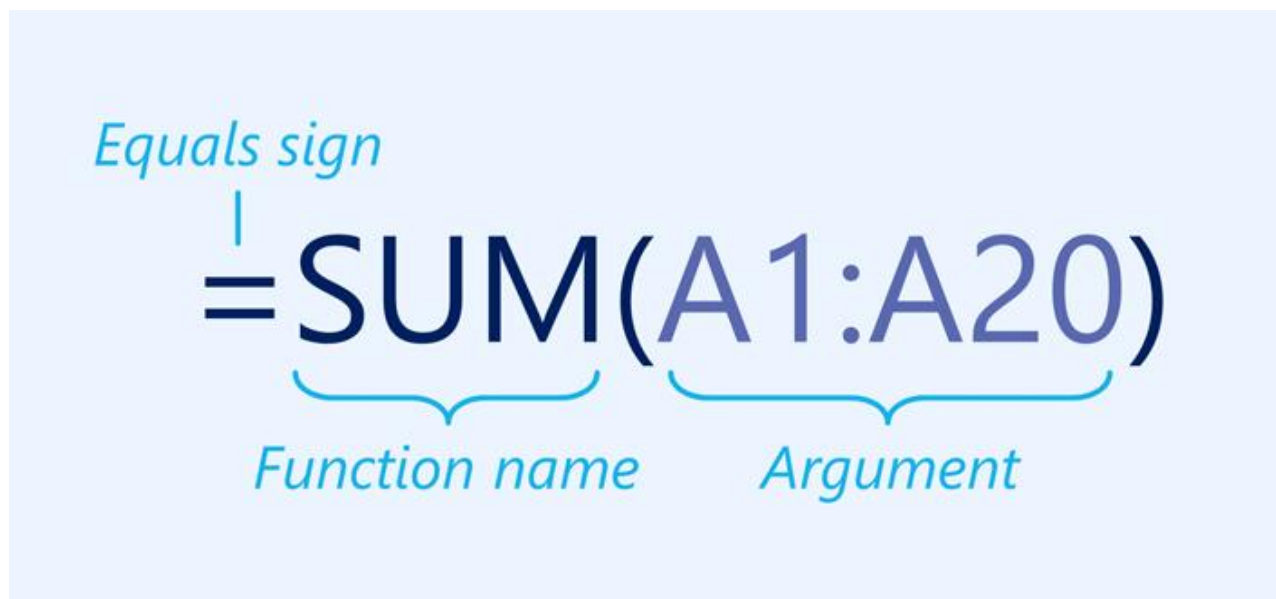
3. Locate and select the **cell** where you want the value to appear. In our example, we'll select cell **C4**.

	A	B	C
3	SERVICE	DESCRIPTION	LINE TOTAL
4	Menu Order	Food & beverage	+
5	Paper Goods	Plates, utensils, cups	\$110.87
6	Rental Equipment	Tables, chairs, linens	\$249.95
7	Service Fee	18% of food & beverage	\$0.00
8	TOTAL		\$360.82
9			

4. Type the **equals sign (=)**, the **sheet name** followed by an **exclamation**

The parts of a function

In order to work correctly, a function must be written a specific way, which is called the **syntax**. The basic syntax for a function is the **equals sign (=)**, the **function name** (SUM, for example), and one or more **arguments**. Arguments contain the information you want to calculate. The function in the example below would add the values of the cell range A1:A20.



Working with arguments

Arguments can refer to both **individual cells** and **cell ranges** and must be enclosed within **parentheses**. You can include one argument or multiple arguments, depending on the syntax required for the function.

For example, the function **=AVERAGE(B1:B9)** would calculate the **average** of the values in the cell range B1:B9. This function contains only one argument.

	A	B	C	D	E
1		1			
2		4			
3		5			
4		6			
5		8			
6		2			
7		3			
8		5			
9		6			
10		=AVERAGE(B1:B9)			
11					

Multiple arguments must be separated by a **comma**. For example, the function **=SUM(A1:A3, C1:C2, E1)** will **add** the values of all of the cells in the three arguments.

	A	B	C	D	E	F
1	4		6		20	
2	8		10			
3	12					
4						
5						
6						

Creating a function

There are a variety of functions available in Excel. Here are some of the most common functions you'll use:

- **SUM:** This function **adds** all of the values of the cells in the argument.
- **AVERAGE:** This function determines the **average** of the values included in the argument. It calculates the sum of the cells and then divides that value by the number of cells in the argument.
- **COUNT:** This function **counts** the number of cells with numerical data in the argument. This function is useful for quickly counting items in a cell range.
- **MAX:** This function determines the **highest cell value** included in the argument.
- **MIN:** This function determines the **lowest cell value** included in the argument.



To create a function using the AutoSum command:

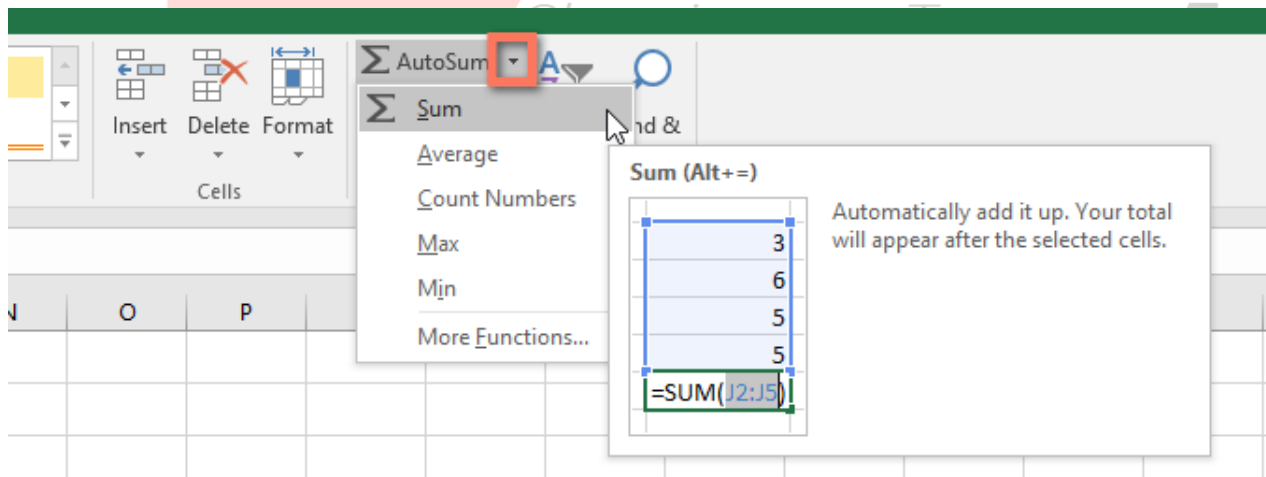
The **AutoSum** command allows you to automatically insert the most common functions into your formula, including SUM, AVERAGE, COUNT, MIN, and MAX. In the example below, we'll use the **SUM** function to calculate the **total cost** for a list of recently ordered items.

1. Select the **cell** that will contain the function. In our example, we'll select cell **D13**.

Changing your Tomorrow

	A	B	C	D
2	ITEM	QUANTITY	UNIT PRICE	LINE TOTAL
3	Tomatoes (case of 12)	3	\$17.44	\$52.32
4	Black Beans (case of 10)	5	\$20.14	\$100.70
5	All Purpose Flour (50 lb.)	5	\$14.05	\$70.25
6	Corn Meal/Maza (25 lb.)	5	\$18.69	\$93.45
7	Brown Rice (25 lb.)	5	\$10.99	\$54.95
8	Lime Juice (1 gallon)	5	\$11.99	\$59.95
9	Tomato Juice (case of 10)	3	\$19.49	\$58.47
10	Hot Sauce (1 gallon)	8	\$7.35	\$58.80
11	Salsa, Medium (1 gallon)	12	\$8.47	\$101.64
12	Olive Oil (2.5 gallon)	4	\$28.69	\$114.76
13	TOTAL			+
14				

- In the **Editing** group on the **Home** tab, click the **arrow** next to the **AutoSum** command. Next, choose the **desired function** from the drop-down menu. In our example, we'll select **Sum**.



- Excel will place the **function** in the cell and automatically select a **cell range** for the argument. In our example, cells **D3:D12** were selected automatically; their values will be **added** to calculate the total cost. If

Excel selects the wrong cell range, you can manually enter the desired cells into the argument.

NETWORK... : X ✓ fx =SUM(D3:D12)				
	A	B	C	D
2	ITEM	QUANTITY	UNIT PRICE	LINE TOTAL
3	Tomatoes (case of 12)	3	\$17.44	\$52.32
4	Black Beans (case of 10)	5	\$20.14	\$100.70
5	All Purpose Flour (50 lb.)	5	\$14.05	\$70.25
6	Corn Meal/Maza (25 lb.)	5	\$18.69	\$93.45
7	Brown Rice (25 lb.)	5	\$10.99	\$54.95
8	Lime Juice (1 gallon)	5	\$11.99	\$59.95
9	Tomato Juice (case of 10)	3	\$19.49	\$58.47
10	Hot Sauce (1 gallon)	8	\$7.35	\$58.80
11	Salsa, Medium (1 gallon)	12	\$8.47	\$101.64
12	Olive Oil (2.5 gallon)	4	\$28.69	\$114.76
13				=SUM(D3:D12)
14				SUM(number1, [number2], ...)

4. Press **Enter** on your keyboard. The function will be **calculated**, and the **result** will appear in the cell. In our example, the sum of D3:D12 is **\$765.29**.

	A	B	C	D
2	ITEM	QUANTITY	UNIT PRICE	LINE TOTAL
3	Tomatoes (case of 12)	3	\$17.44	\$52.32
4	Black Beans (case of 10)	5	\$20.14	\$100.70
5	All Purpose Flour (50 lb.)	5	\$14.05	\$70.25
6	Corn Meal/Maza (25 lb.)	5	\$18.69	\$93.45
7	Brown Rice (25 lb.)	5	\$10.99	\$54.95
8	Lime Juice (1 gallon)	5	\$11.99	\$59.95
9	Tomato Juice (case of 10)	3	\$19.49	\$58.47
10	Hot Sauce (1 gallon)	8	\$7.35	\$58.80
11	Salsa, Medium (1 gallon)	12	\$8.47	\$101.64
12	Olive Oil (2.5 gallon)	4	\$28.69	\$114.76
13			TOTAL	\$765.29
14				

The **AutoSum** command can also be accessed from the **Formulas** tab on the **Ribbon**.

The screenshot shows the Microsoft Excel ribbon with the **Formulas** tab selected. The **AutoSum** button (represented by the sigma symbol Σ) is highlighted with a red box. A dropdown menu is open, showing the following options: **Sum**, **Average**, **Count Numbers**, **Max**, **Min**, and **More Functions...**. The background of the screenshot shows the same grocery list table as in the previous image, with the formula bar displaying `=SUM(D3:D12)`.

You can also use the **Alt+=** keyboard shortcut instead of the AutoSum command. To use this shortcut, hold down the **Alt** key and then press the **equals sign**.

Watch the video below to see this shortcut in action.

