

A close-up photograph of a wooden pencil with a sharpened lead tip, resting diagonally across a document. The document features a line graph with a vertical axis labeled '100' and '50', and a horizontal axis with years '93' and '98'. The background is softly blurred, showing more of the document and the pencil's body.

MS Excel Formulas

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Topics

- Overview of Formulas
- Calculating Sum, Min, Max, Average
- Cell References

Overview of Formulas

A formula in Excel is a mathematical expression which performs certain calculations or actions on the data present in the worksheet.

- A formula can be written on any cell and always starts with an equal (=) sign followed by an expression. After the formula is typed, the **Enter** key is pressed on the keyboard.
- A formula can contain a mathematical operator (+, -, /, *) or an Excel defined function (Sum, Average, Min, Max etc.).
- If functions are used in a formula, they are always enclosed within a pair of parentheses ().
- A formula in a cell can be used as an autofill to compute formula for all the rows and columns.
- To execute/finalize a formula, press Enter on the keyboard. To exit from the formula cell. press ESC key on the keyboard.
- A formula can contain a cell address, range of cells (vertical or horizontal), function, mathematical operator or a constant. For e.g., the following formula

`=SUM(C3:C14) * 2`

uses Sum function to add the values contained in the cell range C3 through C14 and finally multiplies it by a constant 2. A constant is a number or text values entered directly into a formula. These values do not change.

- When a Formula is typed, it appears in the formula Bar on the top of the sheet. To see a formula, select a cell containing the formula and it is displayed in the formula bar.



Formulas- Exercise

Exercise: Use the enclosed IntrotoFormula.xlsx (Original Sheet) to perform this exercise.

The workbook contains the payroll data of the employees. It has employee's Last name, First name, Hourly Wage, Hours worked. It has a blank column for Pay as of June 9th. Create calculations as below:.

- Calculate the Pay for June 9th .
- Calculate Totals, Max, Min and Average.

Steps to perform calculations:

1. Open IntrotoFormula.xlsx. Review the data.

2. Calculate Pay for June 9th.

- Click on cell **F3**, type = and then click on cell C3 (Hourly Wage of the first employee),
- Type * and then click on cell D3 (Hours worked for the first employee) and press enter.

This will calculate the Pay of the first employee with a formula

=C3*D3

- Using the mouse, Autofill (click on the cell and from the edge drag it down) the rest of the cells to perform the calculation for rest of the rows.

3. Calculate Total Hourly Wage.

- Navigate to cell B15 and type the Text Total. On cell C15, type = and then type the function Sum.
- Since it is a function, it will be enclosed in a parenthesis, so type (. We can also press Tab on the keyboard.
- Using the mouse, select the range on Column C (Hourly Wage).
- Close the parenthesis and press enter.

Hourly Wage	
\$	45.90
\$	32.50
\$	20.00
\$	25.70
\$	30.60
\$	50.00
\$	10.50
\$	16.75
\$	18.30
\$	27.60
\$	14.70
=Sum(C3:C13)	

Formulas- Exercise Contd.

4. Calculate Maximum Hourly Wage.

-Navigate to cell B16 and type the Text Max. On cell C16, type = and then type the function Max. Since it is a function, it will be enclosed in parenthesis, so type (.

-Using the mouse, select the range on Column C (Hourly Wage).

-Close the parenthesis and press enter. The function should look like the following:

```
=MAX(C3:C13)
```

5. Calculate Minimum Hourly Wage.

-Navigate to cell B17 and type the Text Min. On cell C17, type = and then type the function Min. Since it is a function, it will be enclosed in a parenthesis, so type (

- Using the mouse, select the range on Column C (Hourly Wage).

- Close the parenthesis and press enter. The function should look like the following:

```
=Min(C3:C13)
```

6. Calculate Average Hourly Wage.

- Navigate to cell B18 and type the Text Average. On cell C18, type = and then type the function Average. Since it is a function, it will be enclosed in a parenthesis, type (

- Using the mouse, select the range on Column C (Hourly Wage).

- Close the parenthesis and press enter. The function should look like the following:

```
=Average(C3:C13)
```

7. Calculate Total, Max, Min and Average for the Pay column.

- Copy the calculation performed previously for Total, Max, Min and Average i.e., columns C15, C16, C17, and C18

- Paste on F15. It will automatically fill F15, F16, F17, and F18 with appropriate values from the F column.

Cell Reference

When a formula or calculation is created in Excel, it refers to the data in a cell/address or range of cells.

A reference can be made to the cells in any part of the same worksheet, different worksheets in the same workbook or in other workbooks.

As seen in the previous exercise, the range of cells is denoted by a colon i.e., C3:C13 means the range of cells from C3 through C13.

In a formula, a reference to a cell is made in five ways –

- Relative cell reference
- Absolute cell reference
- Mixed cell reference

Relative Cell reference

- Relative cell reference is based on the relative position of the cell containing the formula and the cell/data it refers to.
- If the position of the cell containing the formula changes, its reference is also changed.
- If the formula is copied in rows or columns, the reference automatically changes.
- By default, all formulas use relative reference.

Refer to previous exercise . Pay was calculated using the formula =C3*D3 in cell F3.

When the formula is auto filled in the remaining columns, Excel automatically changed the reference to the respective cells.

```
=C3*D3  
=C4*D4  
=C5*D5  
=C6*D6  
=C7*D7  
=C8*D8  
=C9*D9  
=C10*D10  
=C11*D11  
=C12*D12  
=C13*D13
```

Absolute Cell Reference

Absolute Cell reference

Absolute cell reference always refers to a specific cell address.

If the position of the cell containing the formula changes, the absolute reference remains the same. Unlike relative reference, if a formula containing absolute reference is copied or auto filled, it does not change.

Absolute references are made by using a \$ sign before the respective Column and Row.

For e.g., to make an absolute reference to cell G1, the syntax will be \$G\$1.

Exercise. Use the enclosed IntroductiontoFormula.xlsx (Absolute Reference Sheet) to perform this exercise.

- Calculate Nightly incentive.

If the Shift (Column E) is 'Night', multiply the Hourly wage with the % value provided in cell G1 for the Shift Incentive.

- Calculate Total Pay by adding the values of the Nightly incentive column to Pay (Column F).

Since this exercise involves using a condition, we will first understand the IF Function.

IF Function

An IF function evaluates a logical expression and displays a value if it is true and another value if it is false.

Syntax: =IF (logical_test, value_if_True, value_if_false)

Absolute Cell Reference – Exercise Contd.

5. Calculate Total Pay.

- In the column next to Nightly Incentive (Column H) add text for the header as '9-Jun Total Pay'.
- Add the calculation to add the values in Column F and Column G.
=F4+G4

Autofill all the cells in column H.

- 6. Copy the totals under Column F i.e., from F16 through F19 and paste it on Column H16. The values will automatically adjust accordingly.

				Shift Incentive	15%		
				Pay			
Last Name	First Name	Hourly Wage	Hours Worked	Shift	9-Jun	Nightly Incentive	9-Jun Total Pay
Smith	Adam	\$ 45.90	41	Day	\$ 1,881.90	0	\$ 1,881.90
Shin	Mark	\$ 32.50	42	Day	\$ 1,365.00	0	\$ 1,365.00
Keller	Shawn	\$ 20.00	49	Night	\$ 980.00	3	\$ 983.00
Hay	Kayal	\$ 25.70	41	Day	\$ 1,053.70	0	\$ 1,053.70
Sharma	Rekha	\$ 30.60	39	Day	\$ 1,193.40	0	\$ 1,193.40
Costanza	David	\$ 50.00	44	Day	\$ 2,200.00	0	\$ 2,200.00
Schultz	Patrick	\$ 10.50	55	Night	\$ 577.50	1.575	\$ 579.08
Jonas	Nick	\$ 16.75	33	Night	\$ 552.75	2.5125	\$ 555.26
Gill	Suraj	\$ 18.30	29	Night	\$ 530.70	2.745	\$ 533.45
Reynolds	Mike	\$ 27.60	40	Day	\$ 1,104.00	0	\$ 1,104.00
Lenge	John	\$ 14.70	30	Night	\$ 441.00	2.205	\$ 443.21
Total		\$ 292.55			\$ 11,879.95		\$ 11,891.99
Max		\$ 50.00			\$ 2,200.00		\$ 2,200.00
Min		\$ 10.50			\$ 441.00		\$ 443.21
Average		\$ 26.60			\$ 1,080.00		\$ 1,081.09

Mixed Cell Reference

Mixed Cell Reference combines both relative and absolute cell references. It can have either of the two flavors:

- Absolute row (for e.g., G\$1) and Relative column. If copied or auto filled, the row remains unchanged while the column changes.
- Absolute column (for e.g., \$G1) and Relative row. If copied or auto filled, the column remains unchanged and the row changes.

Exercise. Use the enclosed IntroductiontoFormula.xlsx (Mixed Reference Sheet_1) to perform this exercise.

This sheet contains Gross pay of the employees for different Weeks and their deductions.

- For each month Calculate Net Pay as Gross Pay – (Gross – Deduction)

This exercise will use Mixed reference type 1 where column is absolute, and row is relative.

Steps to perform Mixed cell reference calculation:

1. On IntrotoFormula_.xlsx (Mixed reference_1 Sheet), navigate to 9-Jun Net Pay (Column G).
2. On Cell G3, type the calculation for Net Pay as follows. Select the cells for C3 and F3 to include them in the formula.

$$=C3 - (C3*F3)$$

Autofill the rest of the cells in Column G. All the values will be calculated correctly. This can be checked by selecting each of the cells.

3. Now to get the values for the week starting 23-Jun, perform Autofill horizontally.

This will produce incorrect results.

What is the reason for the incorrect results?

On cell H3, currently, the calculation displayed is $=D3 - (D3*G3)$. Here D3 is correct but the Deduction column is shown as G3 instead of F3. Since Excel uses relative referencing by default, it changed F3 to G3 in the new column.

The **objective** is to keep the Deduction column (F) constant but change the rows (values vertically).

For resolution, the calculation on G3 needs to be modified to include the Mixed reference for Column F so that the column does not change when autofill is used.

	9-Jun	23-Jun
Net Pay	Net Pay	
\$	1,787.81	
\$	1,296.75	
\$	963.34	
\$	1,022.09	
\$	1,157.60	
\$	2,112.00	
\$	573.28	
\$	549.71	
\$	528.11	
\$	1,081.92	
\$	438.77	

Mixed Cell Reference – Exercise Contd.

4. Delete all the data in column G (for the formula) and modify the calculation in G4 as

=C3 - (C3*\$F3)

Tip: To add a \$ sign for mixed reference, first type the regular calculation and then in the formula bar add \$ before the respective column or row.

Now perform autofill vertically and horizontally for all the weeks. The correct values will be displayed. \$F3 in the formula will keep the column F constant and change the rows.

Exercise. Use the enclosed IntrotoFormula.xlsx (Mixed Reference Sheet_2) to perform this exercise.

This sheet contains the Salary of the employees and % spent on various Expenses such as Grocery, Rent and Movies.

- Calculate Actual amounts spent by employees on each of these expenses by multiplying Pay with each of the expenses % values.

This exercise will use both types of Mixed references - Row absolute/Column relative and Column absolute/Row relative.

Steps to perform Mixed cell reference, both the types of calculations:

1. Open IntrotoFormula.xlsx (Mixed reference_2 Sheet). Navigate to Grocery Amount (Cell D6).

Create a calculation by typing = and selecting the cell for Pay (C6), then type * and then select the cell for Grocery % (C2). The calculation should look like:

=C6*C2

2. Autofill the values horizontally to get values for Rent Amount and Movie Amount for the first employee Adam Smith and observe the results.

Incorrect results.

The Amount and calculation for D6 (Adam Smith Grocery) is correct but it is incorrect for Rent and Movie. Due to relative referencing, Rent calculation has changed to D6*D2 (it should be C6 * D2) and for Movie it has changed to E6* E2 (it should be C6 * E2). We have to keep the Pay (Column C) absolute and row relative.

Mixed Cell Reference – Exercise Contd.

3. Resolution.

To resolve this issue, delete the previous calculation on D6 and change it to

$=\$C6*C2$

Now do autofill horizontally to get the correct amounts for Rent and Movies. The formulas on Rent will appear like $=\$C6*D2$ and for Movie it will appear as $=\$C6*E2$.

4. Calculate remaining values.

Now to calculate the values for all the employees, select the cells D6, E6, and F6 and drag them down to autofill in all the cells for different employees. This will display incorrect results.

Incorrect results.

Notice in the above figure, first row for Adam Smith is correct but in rest of the rows, the % values are calculated incorrectly. It should consider only C2, D2 and E2 cells but due to relative referencing it has changed to C3, D3, and E3 etc. in the remaining cells.

In this case the calculation should keep the row absolute and columns relative.

5. Resolution.

To resolve this issue, delete all the previous calculations. On D6, change the calculation to

$=\$C6*C\2

Now do autofill horizontally to get the correct amounts for Rent and Movies for Adam Smith and then select all the three cells (D6, E6, and F6) and drag them down to autofill the rest of the cells.

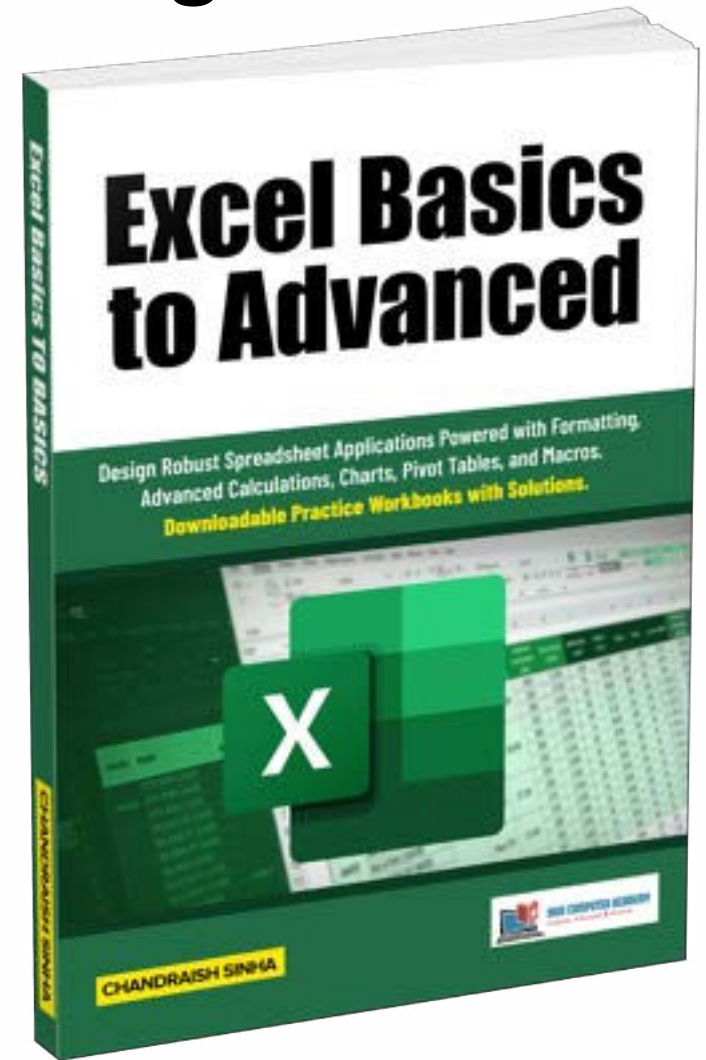
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Thank You...

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