

Lecture Note #3: Introduction to Functions

BUSI 201: Business Data Analysis

Spring 2024

Topic 1. Basic Operations in Excel

Excel can handle basic calculations through simple operators, effectively acting as an impromptu calculator. Some of the fundamental operations include the following:

Symbol	Operation	Example	Result
+	Addition	= 2 + 10	12
-	Subtraction	= 2 - 10	-8
*	Multiplication	= 2 * 10	20
/	Division	= 2/10	0.2
^	Exponents	= 2^10	1,024

Aside from the operations listed above, Excel can also run some basic logic tests:

Symbol	Operation	Example	Result
=	Equal to	=2=10	FALSE
>	Greater than	=2>10	FALSE
<	Less than	=2<10	TRUE
>=	Greater than or equal to	=2>=10	FALSE
<=	Less than or equal to	=2<=10	TRUE
<>	Not equal to	=2<>10	TRUE

Finally, the following operators are introduced here as a primer for functions:

Symbol	Operation	Example	Result
:	Choose Cell Range	A1:C3	Rectangle with upper LHS corner at A1 and lower RHS corner C3
,	Choose Multiple Cells / Cell Ranges	A1:C3, D5	Choose Range A1:C3 and Cell D5
“Space”	Choose Cells that Overlap	A1:C3 B2:D4	Choose B2:C3

Topic 2. Referencing

One concept that will be useful when using functions is the three different ways we can “reference” certain cells. This becomes incredibly important when attempting to autofill a large number of cells based on certain formulas, or when copying and pasting functions to calculate the value of multiple cells. Let’s explore the three types of references with an example. Imagine you have some information in cell A1. The three types of references are:

- Relative References: A1
- Absolute References: \$A\$1
- Mixed References: \$A1 or A\$1

Relative references are... well... relative. For example, let’s say you are copying the information from cell A1 by typing =A1 into cell C3. This way, the content from cell A1 will be displayed in cell C3. Now, if you copy and paste cell C3 to cell C4, the formula shown in cell C4 will be =A2, as the reference is *relative* to the positions of the cells. Similarly, if you copy cell C3 to cell D3, the formula displayed in cell D3 will be =B1.

A screenshot of Microsoft Excel showing a spreadsheet with four columns (A, B, C, D) and 12 rows. Cell A1 contains the value "A1". Cell B1 contains the value "B1". Cell C3 contains the formula "=A1". The formula bar at the top shows the formula =A1. The status bar at the bottom indicates "Enter" and "Display Settings".

	A	B	C	D
1	A1	B1		
2	A2	B2		
3			=A1	
4				
5				
6				
7				
8				
9				
10				
11				
12				

Figure 1: Formula of Relative References

A screenshot of Microsoft Excel showing the result of copying the formula from cell C3. Cell C3 now contains "B1". Cell C4 contains "A2". Cell D3 contains "B1" and cell D4 contains "A2". The formula bar at the top shows the formula =B2. The status bar at the bottom indicates "Select destination and press ENTER or choose Paste" and "Display Settings".

	A	B	C	D
1	A1	B1		
2	A2	B2		
3			A1	B1
4			A2	B2
5				
6				
7				
8				
9				
10				
11				
12				

Figure 2: Result of Relative References

Absolute references, on the other hand, will always refer to the selected cell even after copying, pasting, or autofilling. For instance, if we reference cell A1 in cell C3 by typing =\$A\$1, and then copy cell C3 to cells D3 and C4, all of them will display the content of cell A1. You can compare the results of relative and absolute references by examining figures 1 to 4.

A screenshot of Microsoft Excel showing a 3x4 grid of cells. Cells A1 and B1 contain "A1" and "B1" respectively. Cell C3 contains the formula " $=A\$1$ ". The formula bar at the top also shows " $=A\$1$ ". The ribbon menu is visible at the top.

Figure 3: Formula of Absolute References

A screenshot of Microsoft Excel showing the result of copying the formula from Figure 3. Cells A1, A2, and A3 now contain "A1". The formula bar at the top shows " $=A\$1$ ". The ribbon menu is visible at the top.

Figure 4: Result of Absolute References

Mixed references are precisely what they sound like – a combination of absolute and relative references. When the \$ sign precedes the column indicator (alphabet) but not the row indicator (number), only the column information will be “absolute,” while the row information remains “relative.” For instance, if we reference cell A1 in cell C3 using $=\$A1$, and then copy cell C3 to cells D3, C4, and D4, these cells will display the contents of cells A1, A2, and A2, respectively.

A screenshot of Microsoft Excel showing mixed references. Cell C3 contains the formula " $=\$A1$ ". Cells D3 and C4 also contain "A1". The formula bar at the top shows " $=\$A1$ ". The ribbon menu is visible at the top.

Figure 5: Mixed References: Fixed Columns

A screenshot of Microsoft Excel showing mixed references. Cells C3, D3, and C4 contain "B1". The formula bar at the top shows " $=\$B1$ ". The ribbon menu is visible at the top.

Figure 6: Mixed References: Fixed Rows

Meanwhile, if we repeat the exercise above using the formula $=A\$1$, the row is now anchored so that all references will be “fixed” at row 1, while the columns are allowed to vary. As a result, cells C3, C4, D3, and D4 will display content from cells A1, A1, B1, and B1, respectively. This distinction between relative, absolute, and mixed references will prove to be important as we delve into working with functions later on.

Sales Numbers

Name	2023Q1	2023Q2	2023Q3	2023YTD	Commission 10%
Marshall Boyle	\$ 9,021.00	\$ 3,806.00	\$ 4,400.00		
Nell Bryan	\$ 5,388.00	\$ 1,781.00	\$ 3,669.00		
Tari Green	\$ 2,458.00	\$ 8,018.00	\$ 1,101.00		
Mandy Banks	\$ 5,698.00	\$ 7,842.00	\$ 9,061.00		
Lucille Gallegos	\$ 2,627.00	\$ 1,023.00	\$ 2,632.00		
Shelia Donahue	\$ 8,318.00	\$ 7,465.00	\$ 9,074.00		
Warren Todd	\$ 9,088.00	\$ 4,358.00	\$ 9,315.00		
Bobbie McDermott	\$ 2,873.00	\$ 4,013.00	\$ 7,939.00		
Norma Good	\$ 9,401.00	\$ 6,013.00	\$ 9,619.00		
Mario Robertson	\$ 7,458.00	\$ 4,309.00	\$ 2,572.00		
Mildred Blackwell	\$ 6,892.00	\$ 2,342.00	\$ 1,687.00		
Lucas Mosley	\$ 7,291.00	\$ 9,238.00	\$ 5,338.00		
Kendra Welch	\$ 7,680.00	\$ 6,929.00	\$ 3,676.00		
Bernadette Cruz	\$ 6,732.00	\$ 8,050.00	\$ 4,928.00		
Erika Ibarra	\$ 5,625.00	\$ 2,019.00	\$ 4,003.00		
Trevor Kirk	\$ 6,713.00	\$ 9,498.00	\$ 5,712.00		
Wanda Rogers	\$ 3,094.00	\$ 3,435.00	\$ 8,366.00		
Jeremy McCann	\$ 1,313.00	\$ 4,543.00	\$ 9,277.00		
Aida Garrison	\$ 1,397.00	\$ 3,584.00	\$ 3,396.00		
Barb Gifford	\$ 6,208.00	\$ 8,734.00	\$ 8,640.00		

Sales	Commission Scheme	3%	5%	7%	10%
\$1,000.00		\$30.00	\$5.00	\$1.50	\$1.00
\$5,000.00		\$150.00	\$25.00	\$7.50	\$5.00
\$7,000.00		\$210.00	\$35.00	\$10.50	\$7.00
\$9,000.00		\$270.00	\$45.00	\$13.50	\$9.00
\$11,000.00		\$330.00	\$55.00	\$16.50	\$11.00
\$13,000.00		\$390.00	\$65.00	\$19.50	\$13.00
\$15,000.00		\$450.00	\$75.00	\$22.50	\$15.00
\$17,000.00		\$510.00	\$85.00	\$25.50	\$17.00
\$19,000.00		\$570.00	\$95.00	\$28.50	\$19.00
\$21,000.00		\$630.00	\$105.00	\$31.50	\$21.00
\$23,000.00		\$690.00	\$115.00	\$34.50	\$23.00
\$25,000.00		\$750.00	\$125.00	\$37.50	\$25.00
\$27,000.00		\$810.00	\$135.00	\$40.50	\$27.00
\$29,000.00		\$870.00	\$145.00	\$43.50	\$29.00
\$31,000.00		\$930.00	\$155.00	\$46.50	\$31.00
\$33,000.00		\$990.00	\$165.00	\$49.50	\$33.00
\$35,000.00		\$1,050.00	\$175.00	\$52.50	\$35.00
\$37,000.00		\$1,110.00	\$185.00	\$55.50	\$37.00
\$39,000.00		\$1,170.00	\$195.00	\$58.50	\$39.00

Figure 7: Sales Data

Consider the worksheet References of BUSI201-LEC03-Workbook.xlsx. Please fill out the table to the left of figure 7 using the rules listed below:

- 2023YTD: Sum of sales over 2023Q1, 2023Q2, and 2023Q3.
- Commission: 10% of year-to-date sales 2023YTD.

The table to the right should provide information about the expected commission for an individual employee under two scenarios: (1) when the commission rate varies between 3% and 10%, and (2) when their year-to-date sales range from \$1,000 to \$39,000.

Suggested Solution

You can utilize relative references and basic operators for the 2023YTD column. For example, cell F6 can be populated using relative references and addition operators: =C6+D6+E6. Afterward, copying and pasting cell F6 to other cells in the 2023YTD column will provide the year-to-date sales information for all employees in the table.

Moving to the second column, we can begin by filling cell G6 using absolute references and multiplication: =F6*\$G\$5. Copying and pasting cell G6 to the remaining cells in the Commission column will suffice. It's important to note that by employing \$G\$5 instead of a relative reference, we ensure that the year-to-date sales information for each individual is consistently multiplied by the 10% commission rate.

The table on the right is slightly more intricate, involving two types of mixed references. Cell J6 can be computed as =\$I6*\$J\$5. This arrangement guarantees that sales remain constant as we move across the row, while the commission rate remains constant as we descend the columns.

Referencing Across Worksheets

You may also find some situations where you want to reference contents of a cell that is in the worksheet that is not currently active. The easiest way to reference a cell across worksheets would be to navigate to the cell you wish to display information, and start an “equation” by typing =. Then, click on the tab of the worksheet that contains the information you wish to import, and click on the cell(s) to reference. If you wish to do this manually, you can type:

= SHEETNAME ! CELL_ADDRESS

That is, if you wish to reference cell H2 in sheet BUSINESS, the syntax should be: =BUSINESS ! H2. The same rules on relative, mixed, and absolute references hold, where the \$ is placed in front of the column indicator (alphabet) if the column is to be fixed when copying and pasting, while the \$ in front of the row indicator (number) will hold the row fixed upon copying and pasting.

Topic 3. The Basic Structure of Excel Functions

Excel allows its users to automate complex calculations and tasks using various functions. Each function serves a unique purpose and has its own syntax, which we must learn to fully utilize Excel as a tool. However, the basic structure remains consistent across different types of functions:

= FUNCTION (ARGUMENT #1, ARGUMENT #2, [ARGUMENT #3], ..., ARGUMENT #N)

Functions always begin with an = sign, followed by the function name and the arguments in parentheses. Some arguments are strictly required, while others are optional. Optional arguments are typically enclosed in square brackets. As shown in Figure 8, this matches the syntax Excel uses to report which arguments are required, and which are optional.

The screenshot shows a Microsoft Excel spreadsheet. The formula bar at the top has the text '=sum(' entered. A tooltip below the formula bar displays the syntax 'SUM(number1, [number2], ...)'. The main area of the spreadsheet shows a grid from A1 to E6. Cell B3 contains the formula '=sum('. The cells in the first two columns (A1-A6) are empty, while the cells in the third column (C1-C6) are empty. The cells in the fourth and fifth columns (D1-D6, E1-E6) are also empty.

Figure 8: Function Inputs

Topic 4. Built-in Help

If you already have some working knowledge of the function you intend to use, you can navigate to the cell of choice and simply start typing in the function and arguments. If the cell you chose is empty, you may start by typing the = key. However, if the cell you chose is already populated with another function (so, if you are editing a pre-existing function), you may navigate to the cell, and press **F2** to start editing the formula. To reference certain cells to use as arguments for the function, you may either type in the address of the cells (e.g. A1 : C5), or use your mouse to select cells directly.

If you are not sure which function you wish to use, or you would like some more help from Excel, you may rely on the “Insert Function” feature located next to the formula bar. For windows users, you may also use the hotkey **shift+F3** to access the insert function feature.

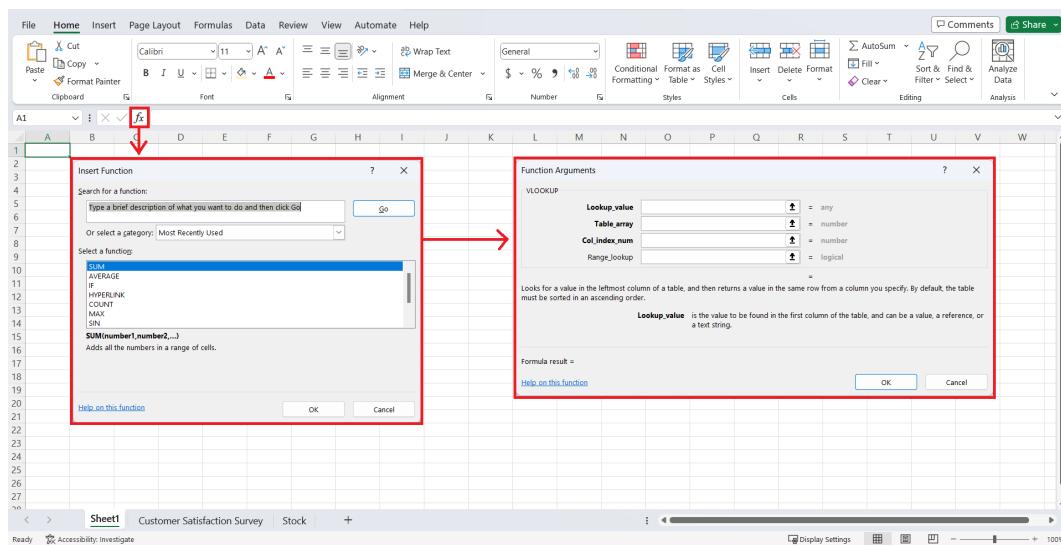


Figure 9: Insert Function Feature

As you can see in Figure 9, once you open the insert function window, you may search for a specific function, and call up a more detailed guide on the arguments of said function.