Lecture Note #3: Excel Basics

BUSI 201: Business Data Analysis

Fall 2023

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
^	Powers	=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 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`.

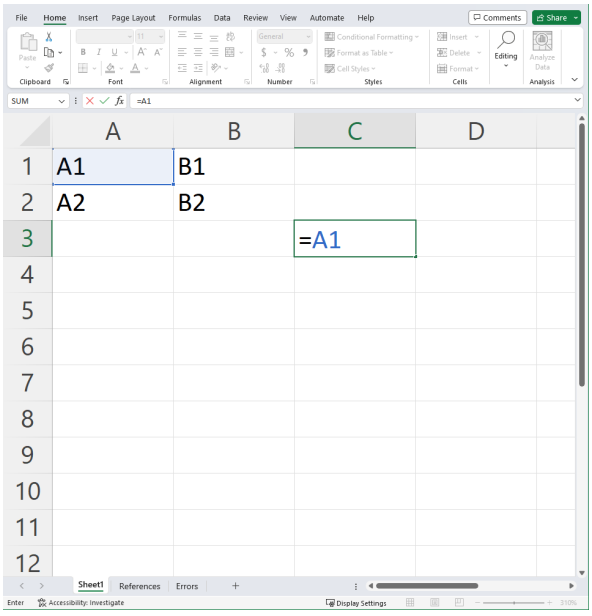


Figure 1: Formula of Relative References

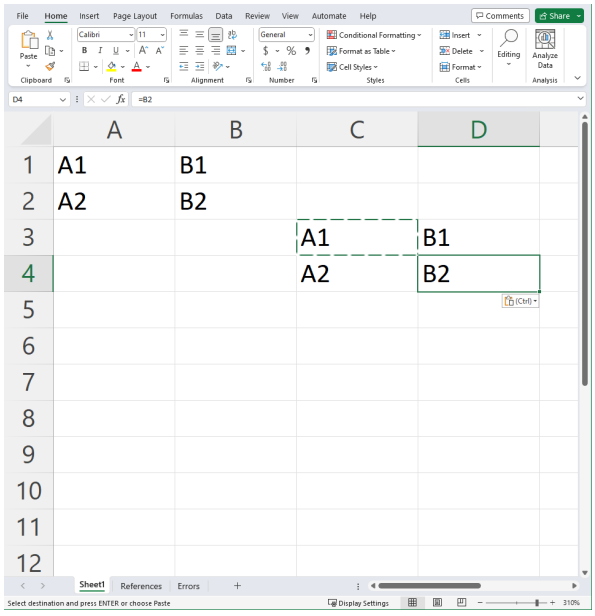


Figure 2: Result of Relative References

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.

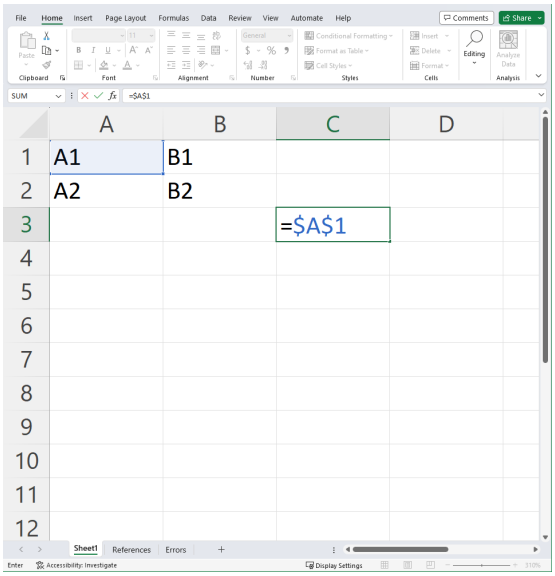


Figure 3: Formula of Absolute References

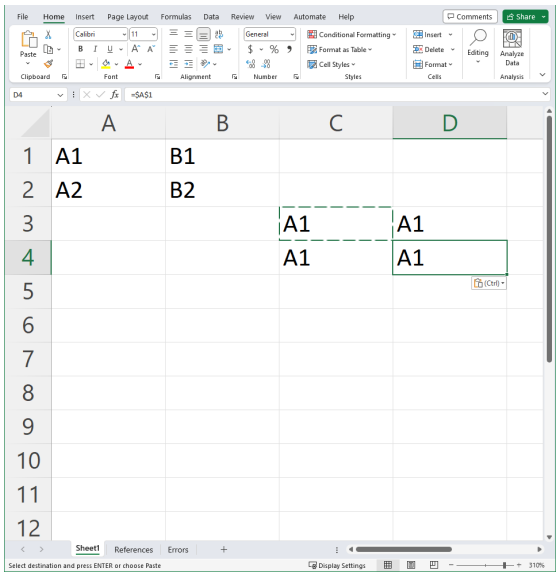


Figure 4: Result of Absolute References

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.

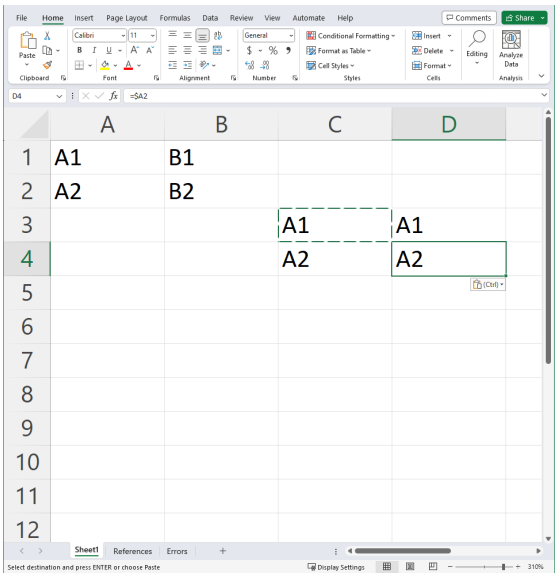


Figure 5: Mixed References: Fixed Columns

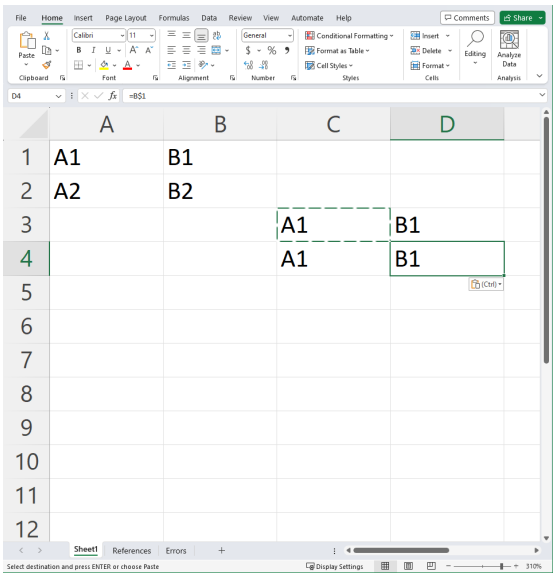
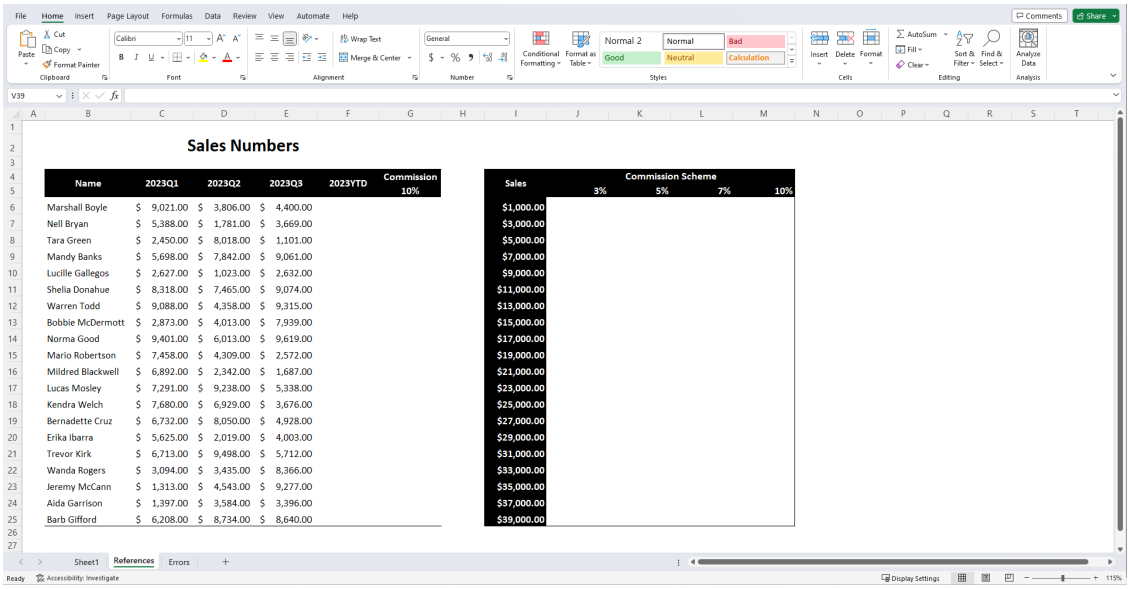


Figure 6: Mixed References: Fixed Rows

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		
Tara Green	$ 2,450.00	$ 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				
$3,000.00				
$5,000.00				
$7,000.00				
$9,000.00				
$11,000.00				
$13,000.00				
$15,000.00				
$17,000.00				
$19,000.00				
$21,000.00				
$23,000.00				
$25,000.00				
$27,000.00				
$29,000.00				
$31,000.00				
$33,000.00				
$35,000.00				
$37,000.00				
$39,000.00				

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. Errors

Before we begin discussing functions, let's take some time to understand some of the common errors you may encounter. We'll start by addressing some of the more straightforward error messages. *The first two are not actually "errors."*

Error Message	Cause	Solution
##########	Column width insufficient to display numerical data.	Adjust column width.
1E+11	Numerical value too large to express directly. (Exceeds 10^11)	Adjust format of cell.
#NAME?	Function name (or function's domain) is incorrect.	Double check the function's name or domain.
#N/A	Reference function could not locate items.	Double check the function and range.
#VALUE!	Items in the function's domain is incompatible.	Double check the function's domain.
#REF!	The function is referencing cells that have been removed.	Adjust function's domain.
#DIV/0	Dividing a number by 0 or an empty cell.	Adjust function's domain.

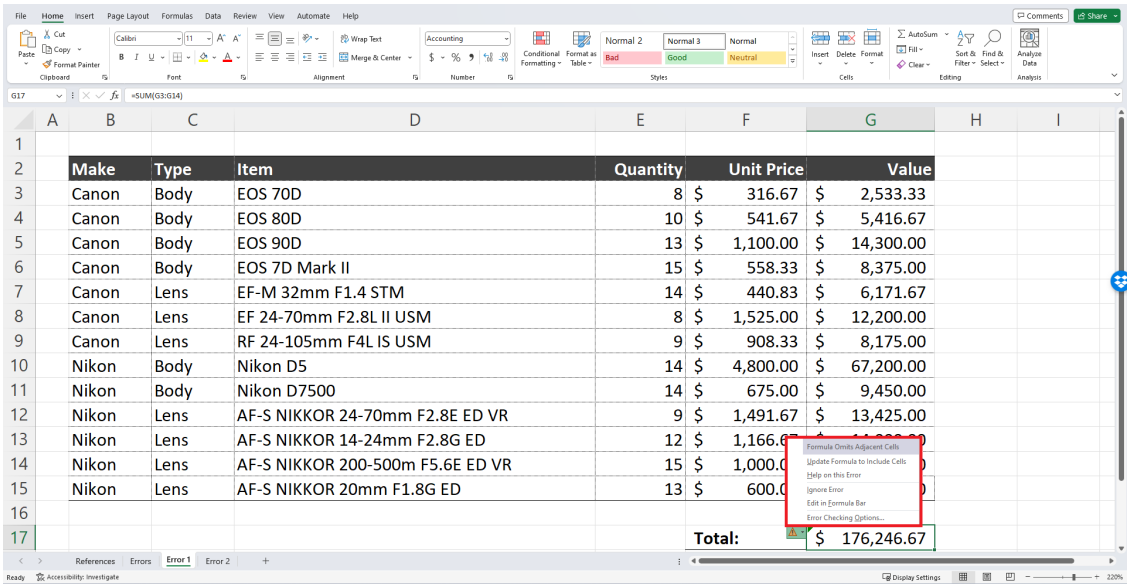
"Covert" Errors: Green Triangles

It's relatively easy to notice when an error has been detected in your worksheet due to the presence of an error message. However, there are instances where Excel will display a green triangle in the top-left corner of a cell. This triangle indicates that Excel "suspects" you may have made an error. The four cases listed below are the most common cases you will encounter.

- Function returns an error.
- Some cells (that Excel thinks should be included) are left out.
- Numerical values are stored as text.
- Formulae are not consistent with adjacent cells.

Resolving Green Triangle Errors

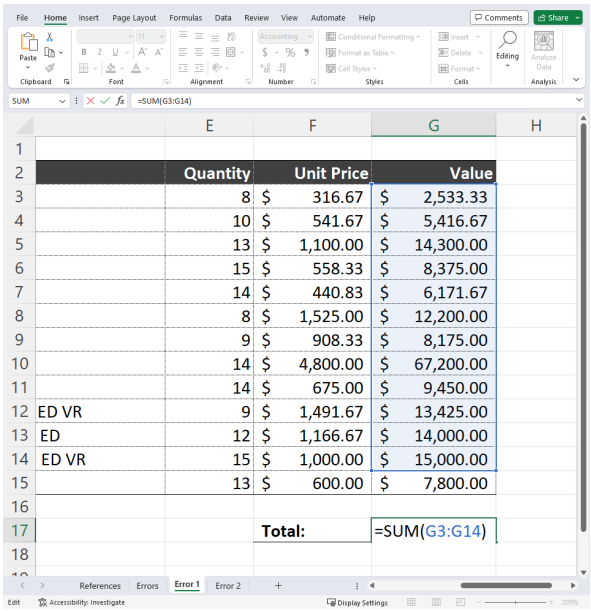
Let's walk through an example of how these green triangle errors are reported and can be resolved. Please open sheet `Error 1` in `BUSI201-LEC03-Workbook.xlsx`. The table is designed to track photo equipment within a hypothetical company. As depicted in figure 8, there is a green triangle present in cell `G17`, which is intended to display the total value of all items stored.



Make	Type	Item	Quantity	Unit Price	Value
Canon	Body	EOS 70D	8	$ 316.67	$ 2,533.33
Canon	Body	EOS 80D	10	$ 541.67	$ 5,416.67
Canon	Body	EOS 90D	13	$ 1,100.00	$ 14,300.00
Canon	Body	EOS 7D Mark II	15	$ 558.33	$ 8,375.00
Canon	Lens	EF-M 32mm F1.4 STM	14	$ 440.83	$ 6,171.67
Canon	Lens	EF 24-70mm F2.8L II USM	8	$ 1,525.00	$ 12,200.00
Canon	Lens	RF 24-105mm F4L IS USM	9	$ 908.33	$ 8,175.00
Nikon	Body	Nikon D5	14	$ 4,800.00	$ 67,200.00
Nikon	Body	Nikon D7500	14	$ 675.00	$ 9,450.00
Nikon	Lens	AF-S NIKKOR 24-70mm F2.8E ED VR	9	$ 1,491.67	$ 13,425.00
Nikon	Lens	AF-S NIKKOR 14-24mm F2.8G ED	12	$ 1,166.67	
Nikon	Lens	AF-S NIKKOR 200-500m F5.6E ED VR	15	$ 1,000.00	
Nikon	Lens	AF-S NIKKOR 20mm F1.8G ED	13	$ 600.00	
				Total:	$ 176,246.67

Figure 8: Green Triangle

If you hover the mouse cursor over the box with an exclamation mark in it, an error message "The formula in this cell refers to a range that has additional numbers adjacent to it." is revealed. This means that there is at least one number that has been left out in calculating the sum.



	Quantity	Unit Price	Value
	8	$ 316.67	$ 2,533.33
	10	$ 541.67	$ 5,416.67
	13	$ 1,100.00	$ 14,300.00
	15	$ 558.33	$ 8,375.00
	14	$ 440.83	$ 6,171.67
	8	$ 1,525.00	$ 12,200.00
	9	$ 908.33	$ 8,175.00
	14	$ 4,800.00	$ 67,200.00
	14	$ 675.00	$ 9,450.00
ED VR	9	$ 1,491.67	$ 13,425.00
ED	12	$ 1,166.67	$ 14,000.00
ED VR	15	$ 1,000.00	$ 15,000.00
	13	$ 600.00	$ 7,800.00
		Total:	=SUM(G3:G14)

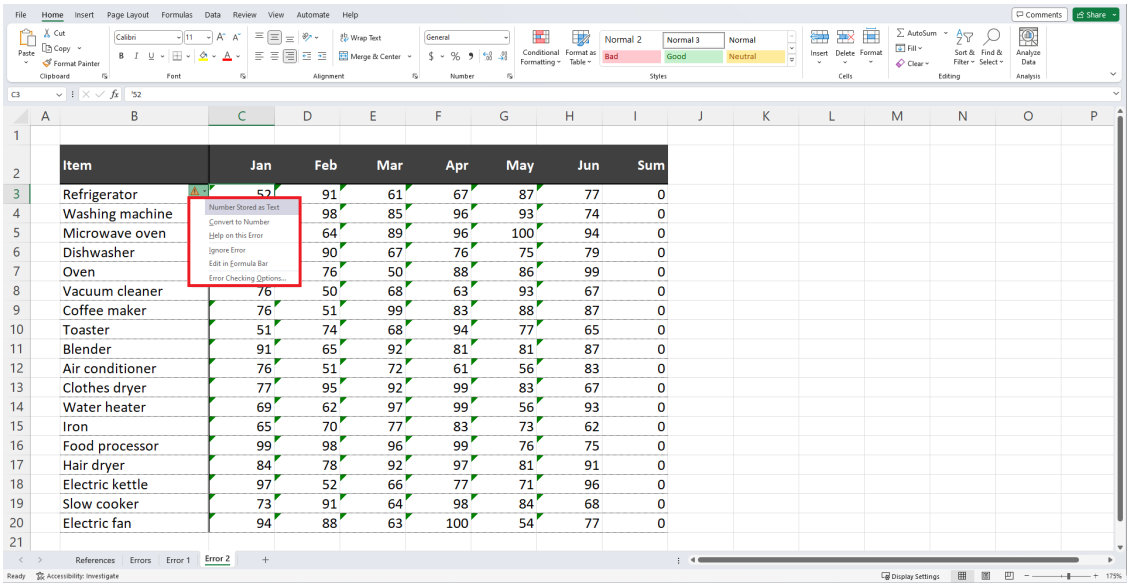
Figure 9: The SUM function

The function used in this cell is the `SUM` function, which returns the sum of all values included in the range. Notice that the range is set as `G3:G14`, which leaves out the value of the last item on the list. You can correct this error by replacing the range with `G3:G15`.

Another way to correct the error is to click the "Update Formula to Include Cells" option shown in Figure 8. You can access this menu by left-clicking on the box with the exclamation mark that appears when you select cell `G17`. I would advise you to check if the updated formula indeed reflects your intentions, as there is no guarantee that what Excel *thinks* is correct is what the user intended.

Correcting Multiple Green Triangle Errors

You may also encounter cases where there are multiple green triangle errors in a single worksheet. In such cases, correcting one error at a time would be an inefficient use of your time. Let's walk through one more example with a different type of error to learn how to deal with multiple errors of the same type. Please open the sheet `Error 2` in the file named `BUSI201-LEC03-Workbook.xlsx`.



Item	Jan	Feb	Mar	Apr	May	Jun	Sum
Refrigerator	52	91	61	67	87	77	0
Washing machine	3	98	85	96	93	74	0
Microwave oven	3	64	89	96	100	94	0
Dishwasher	1	90	67	76	75	79	0
Oven	5	76	50	88	86	99	0
Vacuum cleaner	0	76	50	68	63	93	67	0
Coffee maker	1	76	51	99	83	88	87	0
Toaster	51	74	68	94	77	65	0
Blender	91	65	92	81	81	87	0
Air conditioner	76	51	72	61	56	83	0
Clothes dryer	77	95	92	99	83	67	0
Water heater	69	62	97	99	56	93	0
Iron	65	70	77	83	73	62	0
Food processor	99	98	96	99	76	75	0
Hair dryer	84	78	92	97	81	91	0
Electric kettle	97	52	66	77	71	96	0
Slow cooker	73	91	64	98	84	68	0
Electric fan	94	88	63	100	54	77	0

Figure 10: Green Triangles

The error in this specific case is that some numbers are stored as text, rather than being stored as numbers. This can be achieved when you insert an apostrophe in front of a number. We can see that this is causing the `SUM` function to not work as intended in column `I`.

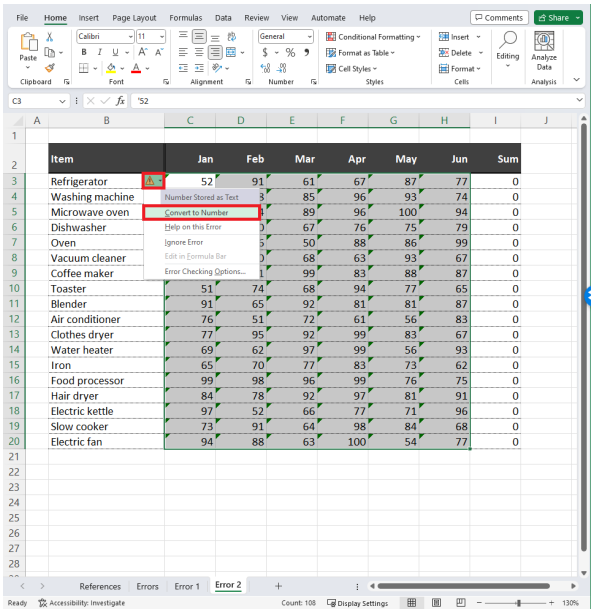


Figure 11: Numbers as Texts

To correct this error, we first select the range `C3:H20` which are the cells that share a common error. Then, click on the box with the exclamation mark, and then click "Convert to number" to correct the error.

After the error has been corrected, you can immediately notice that the `SUM` function now works as intended, displaying the total number of each appliance sold between the months of Jan~Jun. If you navigate to each cell that once displayed the green triangle error, you can see that the apostrophe has been removed.

Ignoring Green Triangles: NOT Recommended

From time to time, you may encounter cases where Excel *thinks* that something you did intentionally was, in fact, an error. For instance, you may intentionally want to leave out one row's worth of data when calculating a sum, as it includes information about expenses that are not reimbursable. In this scenario, Excel will still think you made an error by excluding one row. You may choose to leave the green triangle alone, but you do have an option to ignore these errors.

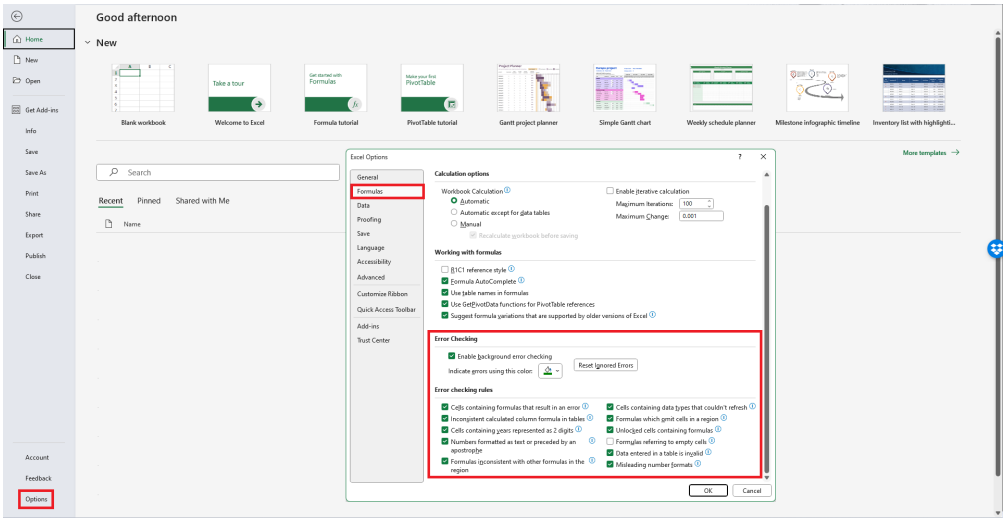


Figure 12: Ignoring Errors

Navigate to `File` > `Options` > `Formulas`. Under "Error Checking," you can disable background error checking completely by deselecting 'Enable background error checking." You may also customize the rules that Excel applies when determining if a cell contains an error. You can do this by selecting or deselecting items under "Error checking rules."

Checking for Errors Manually

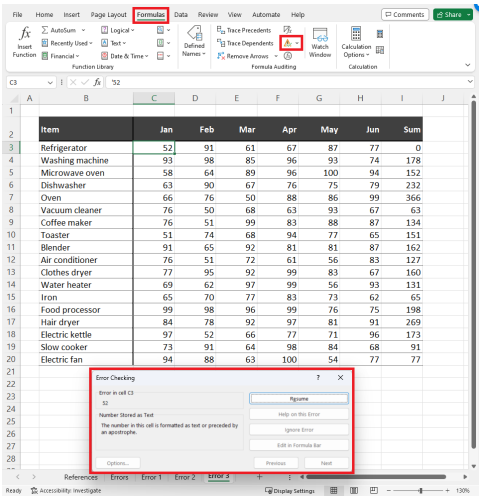


Figure 13: Numbers as Texts

If you come across a situation where you want to manually prompt Excel to check for errors, you can navigate to `Formulas` > `Error Checking`. The icon should look like a yellow triangle with an exclamation mark embedded inside.

The error checking window will show you if there are any suspected errors, the location of the error, and give you a choice to either fix the error automatically or ignore the error.

Topic 4. Hotkeys

The following is a nonexhaustive list of some hotkeys that are frequently used in Excel:

- ctrl+Arrow Keys: Move to the "End"
- shift+Arrow Keys: Start Selecting a Region
- ctrl+shift+Arrow Keys: Select to the "End"
- ctrl+Z: Undo
- ctrl+Y: Redo
- ctrl+C: Copy
- ctrl+V: Paste
- ctrl+alt+V: Paste (with Options)
- ctrl+S: Save
- ctrl+A: Select "All"
- ctrl+N: Create New Document
- shift+F11: Create New Sheet
- ctrl+pageup: Move to Previous Sheet
- ctrl+pagedown: Move to Next Sheet
- ctrl+Mouse Wheel: Zoom In / Out
- elt+enter: Line Break within Cell
- ctrl+F: Find
- ctrl+H: Find and Replace
- ctrl+D: Autofill with Content Above
- ctrl+R: Autofill with Content to the Left
- ctrl+E: Flash Fill
- ctrl++: Call "Insert" Menu
- ctrl+-: Call "Delete" Menu
- F2: Edit Selected Cell
- F4: Repeat Previous Task