# Excel Introduction

UBCO Master of Data Science – DATA 530

# Why Spreadsheets and Microsoft Excel?

***Spreadsheets*** are the most common, general-purpose software for data analysis and reporting.

Microsoft Excel is the most popular spreadsheet program with hundreds of millions of installations.

- The spreadsheet concepts translate to other products.

Excel and spreadsheets are not always the best tool for data analysis, but they are great for quick analysis, reporting, and sharing.

# Spreadsheet Overview

A ***spreadsheet*** organizes information into a two-dimensional array of cells (a *table*).

A ***cell*** has two components:

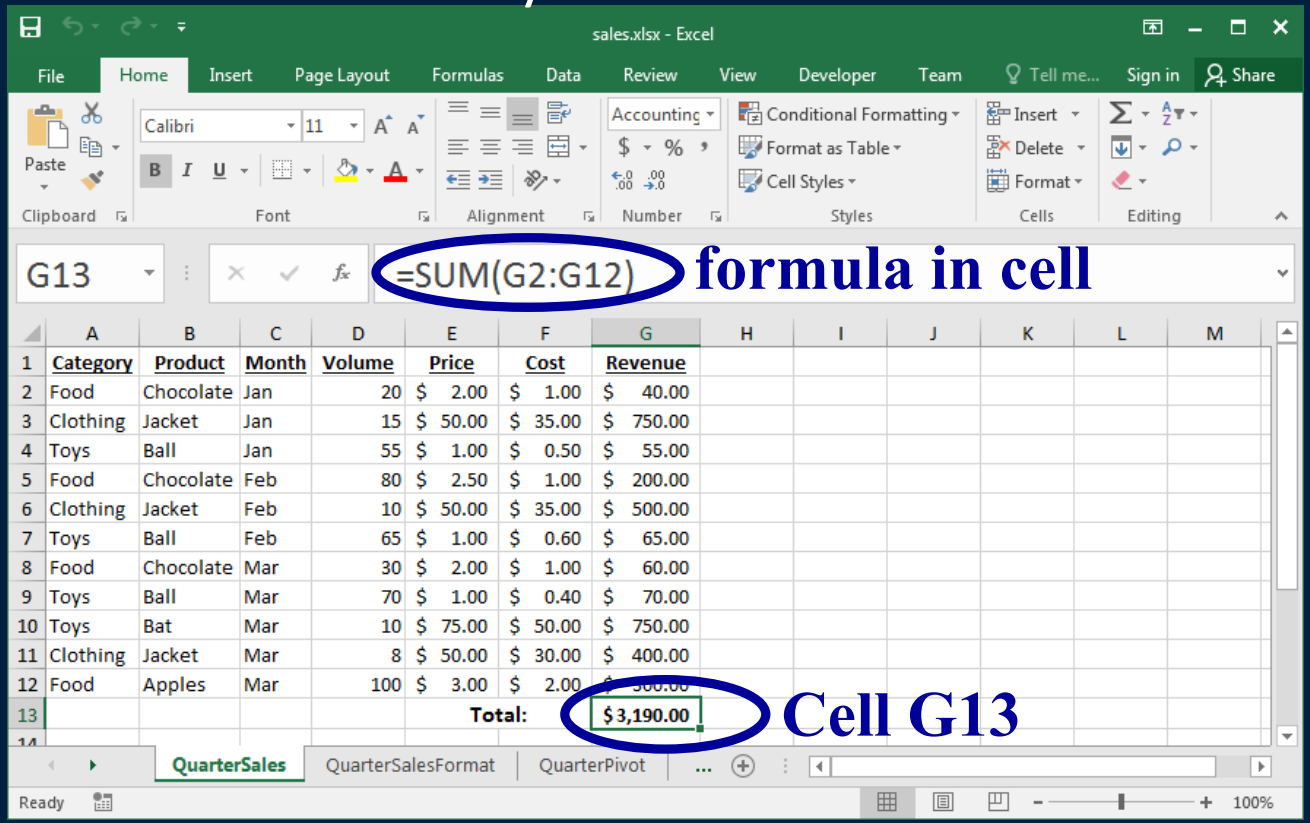
- an address - specified given a column letter and row number
- a location - that can store a number, text, or formula

The power of a spreadsheet is that we can write simple formulas (commands) to perform calculations and immediately see the results of those calculations.

Spreadsheets are very common in business and reporting applications.

# Spreadsheet Addressing

A ***cell*** is identified by a column letter and row number.




| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Category | Product | Month | Volume | Price | Cost | Revenue |
| 2 | Food | Chocolate | Jan | 20 | $ 2.00 | $ 1.00 | $ 40.00 |
| 3 | Clothing | Jacket | Jan | 15 | $ 50.00 | $ 35.00 | $ 750.00 |
| 4 | Toys | Ball | Jan | 55 | $ 1.00 | $ 0.50 | $ 55.00 |
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| 11 | Clothing | Jacket | Mar | 8 | $ 50.00 | $ 30.00 | $ 400.00 |
| 12 | Food | Apples | Mar | 100 | $ 3.00 | $ 2.00 | $ 300.00 |
| 13 | | | | | Total: | | $ 3,190.00 |

# Spreadsheet Addressing

The rows in a spreadsheet are numbered starting from 1.

The columns are represented by letters.

- A is column 1, B is column 2, …, Z is column 26, AA is column 27, …

A cell is identified by putting the column letter first then the row number.

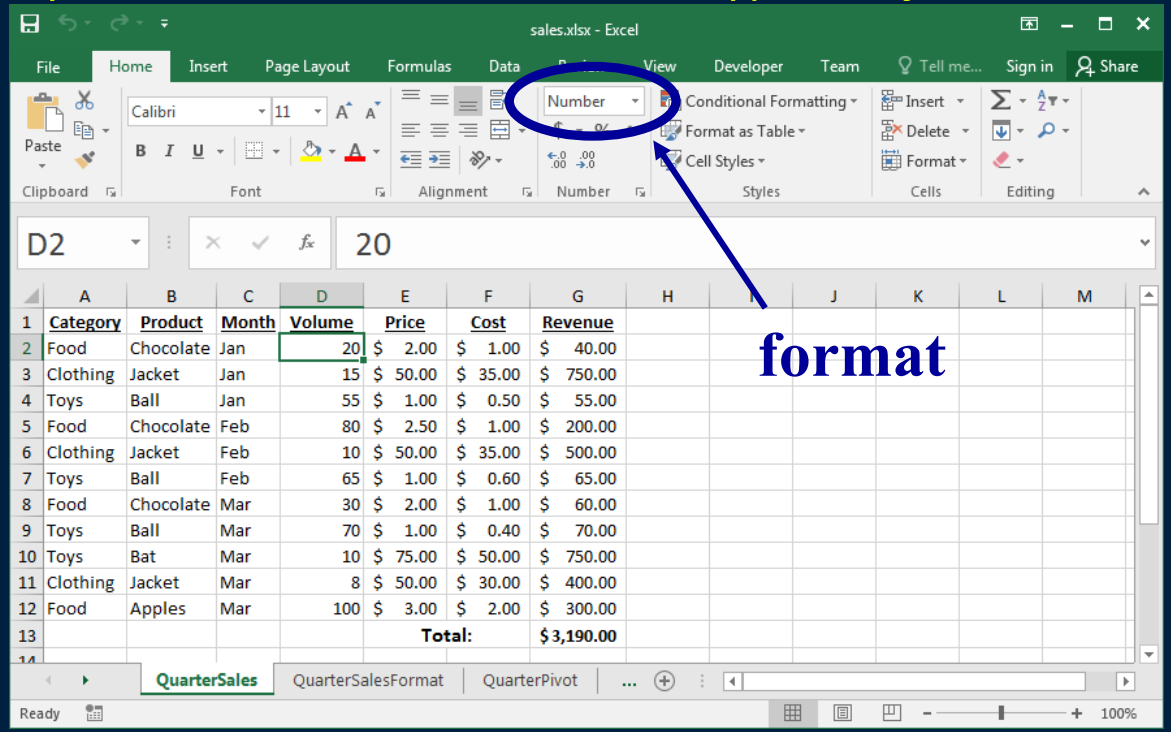
- e.g. B3 is the 2nd column and the 3rd row.

Question: What column number is AD?  How about BAD?

# Spreadsheet Data Entry

An entry is added to a cell by clicking on it and typing in the data.

- The data may be a number, text, date, etc. Type and *format* are auto-detected.

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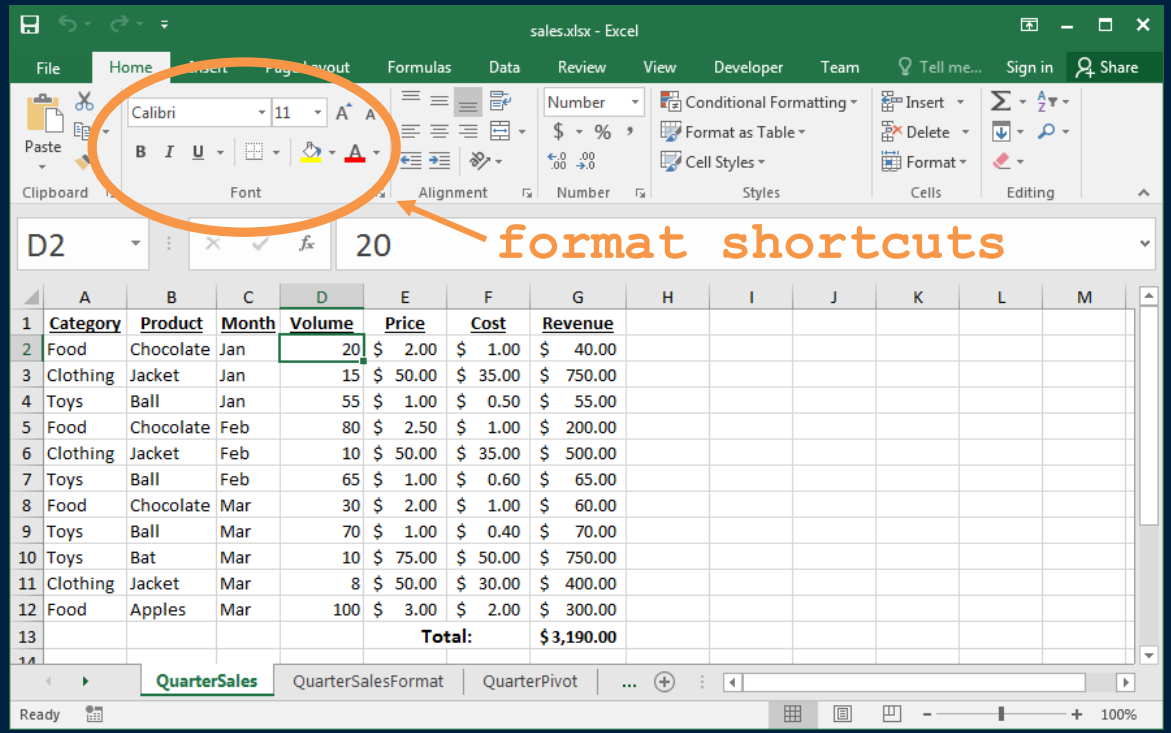
# Spreadsheet Formatting

Formatting: bold, italics, underline, fonts, colors

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# Spreadsheet Selecting Cells

Multiple ways of selecting cells:

1) With the mouse, (left) click and drag mouse to select a rectangle region of cells.

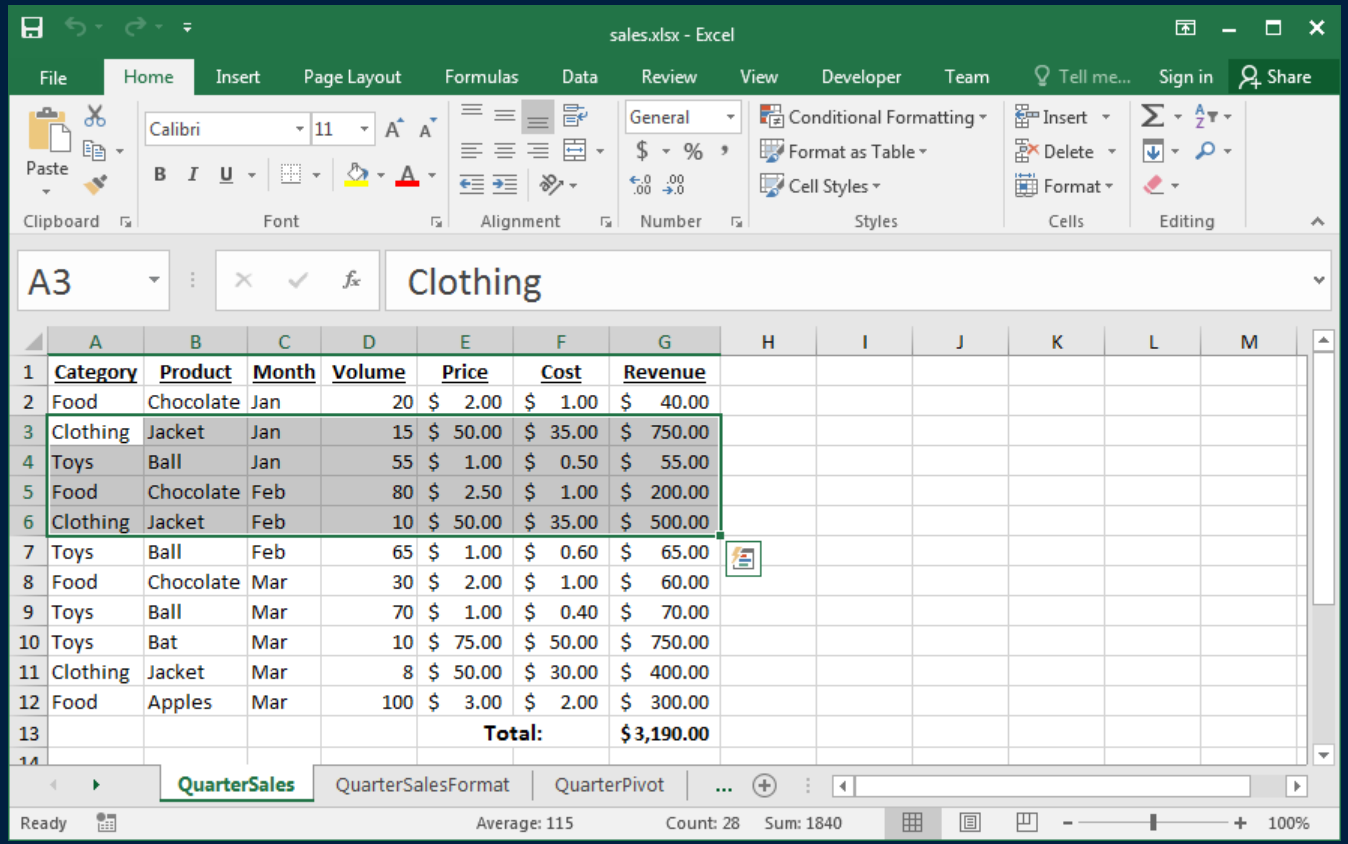
2) With keyboard, hold `SHIFT` key and use arrow keys to select a rectangle region of cells.

3) With mouse and keyboard, while holding `CTRL` key, (left) click on individual cells to select non-contiguous cells.

4) Click on a row number to select a whole row.

5) Click on a column header to select a whole column.

# Range Selecting Cells Example

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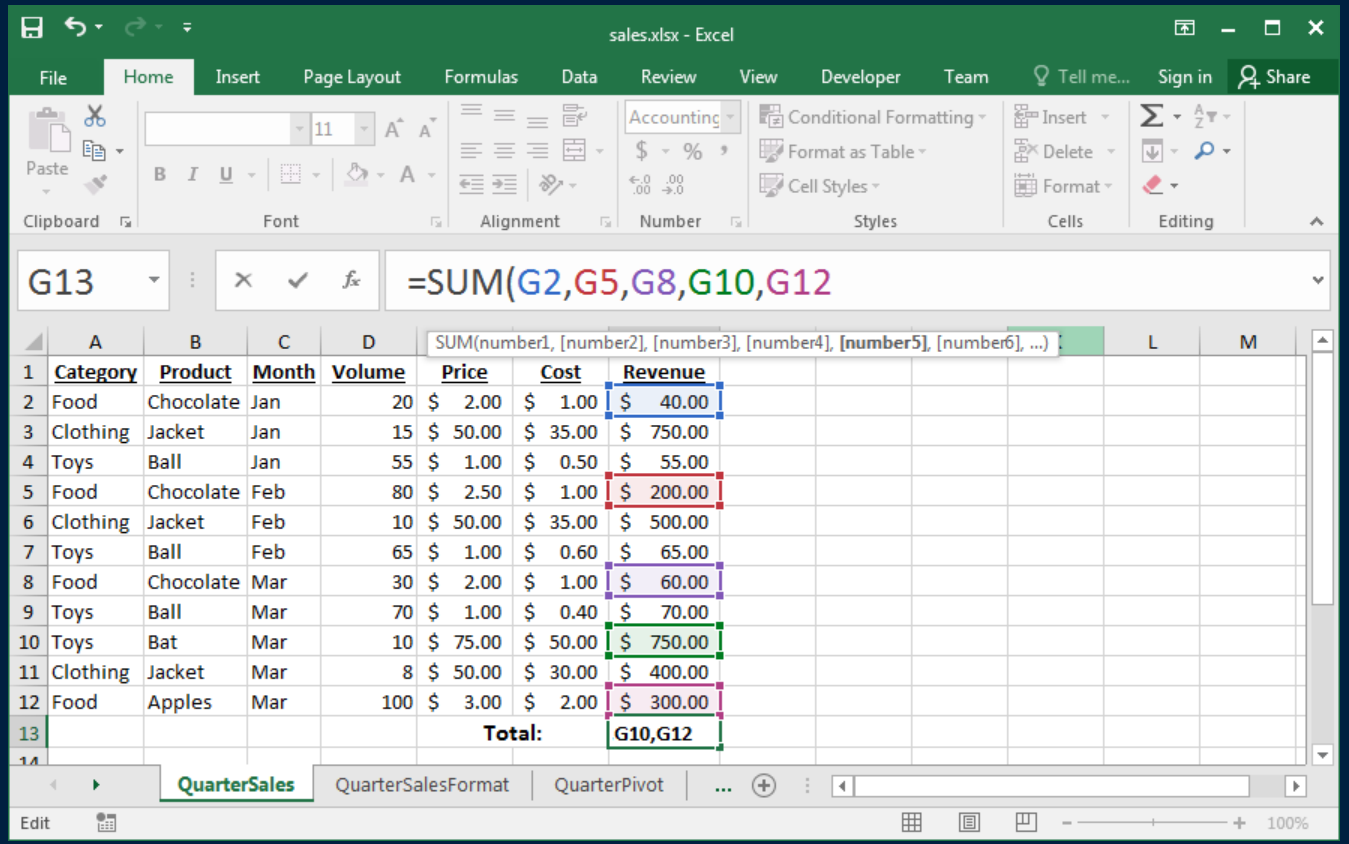
# Selecting Individual Cells Example

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| 13 | | | | | Total: | | G10,G12 |

# Manipulating Cells

Once you have selected one or more cells, there are several common actions you can perform:

1) DELETE

- delete the contents of all cells by pressing delete key
- delete the contents and the cell locations (then shift remaining) by selecting `Edit` menu, `Delete...` or `Delete…` from pop-up menu (brought up by right click).

2) Cut, Copy, Paste

- cut - copies selected cells to clipboard and removes from document
- copy - copies selected cells to clipboard
- paste - copies cells in clipboard to sheet starting at currently selected cell

3) Add selected cells to a formula (requires that you were previously constructing a formula before selecting the cells).

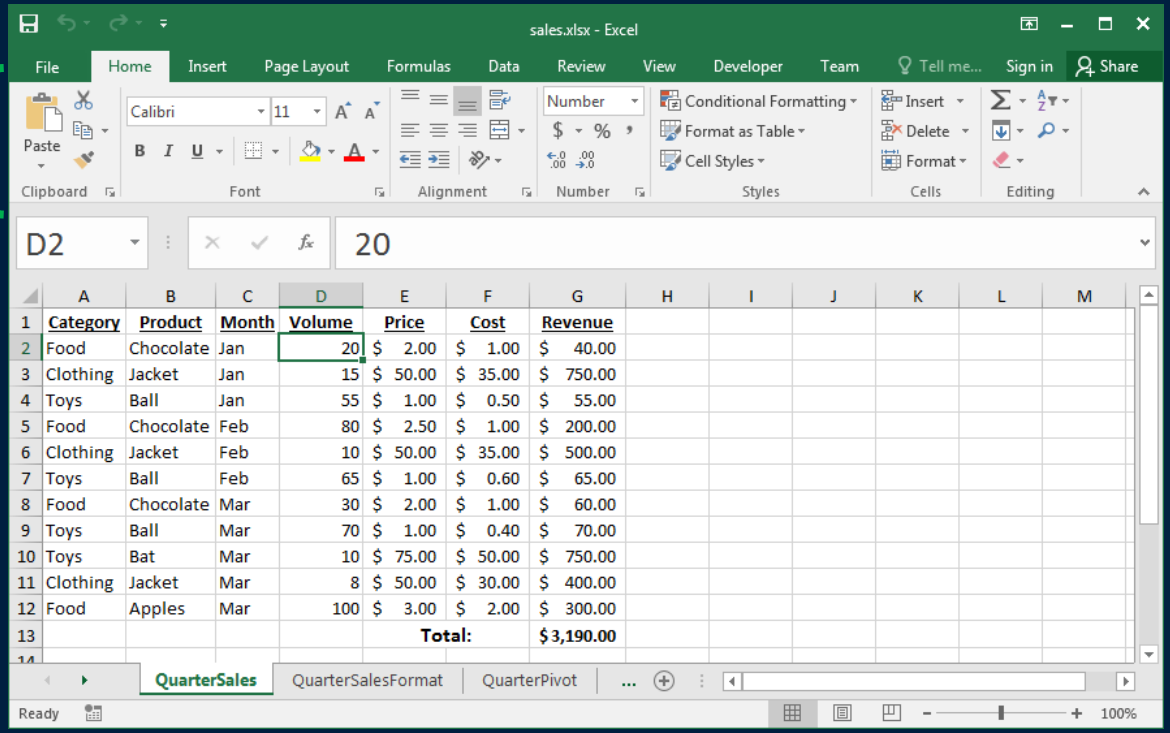
# Manipulating Cells - Filling

***Filling*** combines copy and paste.

There is a small box or tab beyond the cell's lower right corner (fill handle).  Grab it with the cursor and pull to other cells.

# Cut, Copy, Paste

cut,
copy,
paste

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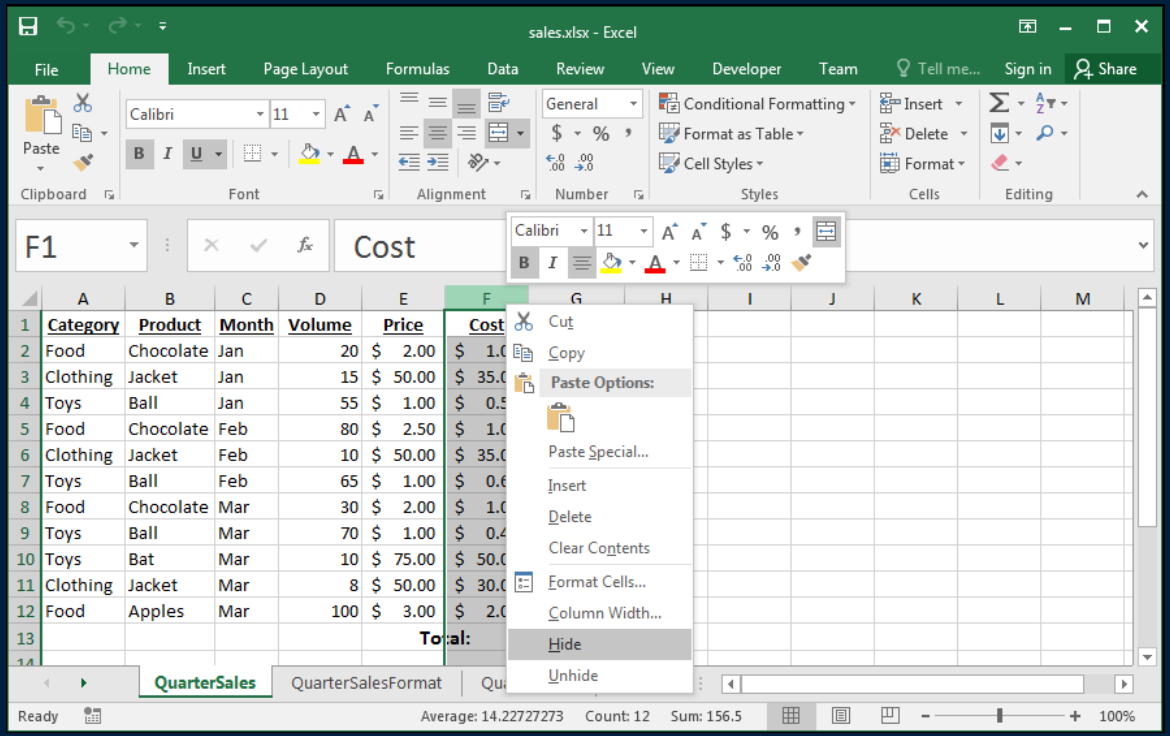
# Hiding Columns and Rows

Right-clicking on the column or row header and selecting **Hide**.

- The column/row still exists but will not be displayed or printed unless unhidden.



# Selecting Cells Question

***Question:*** Which method allows you to select non-contiguous cells in a spreadsheet?

**A)** hold `SHIFT` key and use arrow keys

**B)** With the mouse left click on a cell and drag mouse

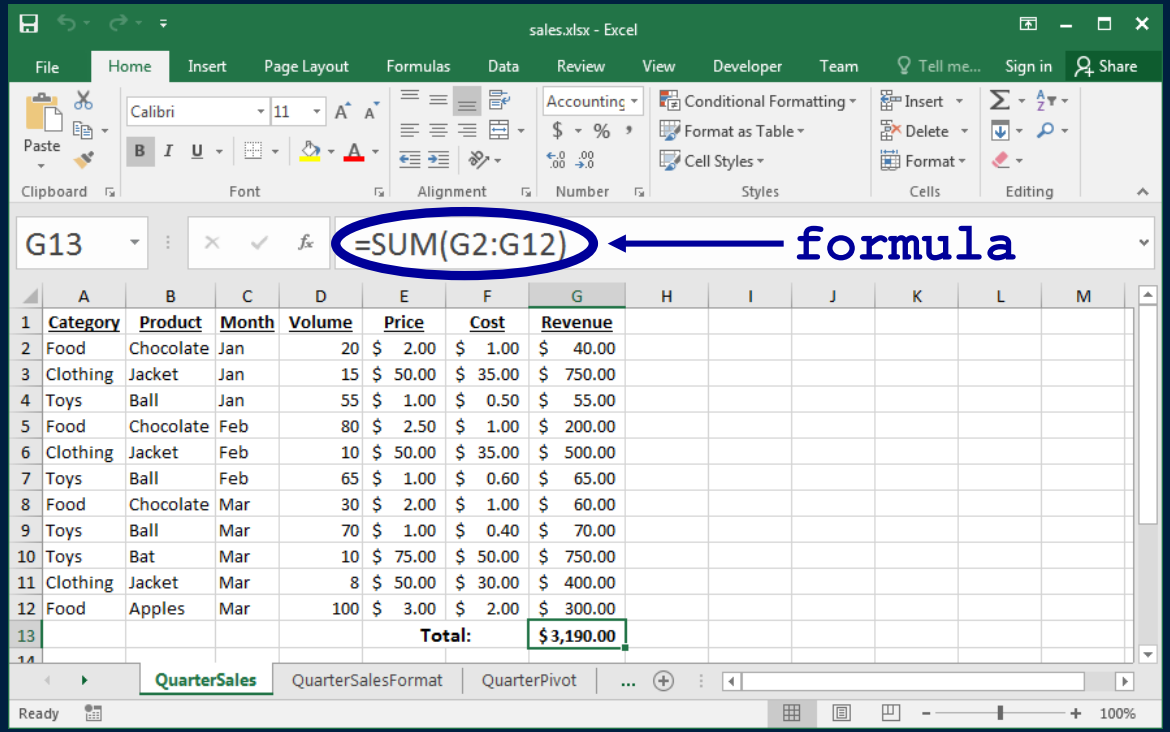
**C)** hold `CTRL` key and use arrow keys

**D)** hold `CTRL` key and left click on cells

# Entering Formulas

A ***formula*** is any expression that begins with an equal sign ("=").

- The equal sign means that a calculation must be done to compute the cell value.



# Formula Expressions

A ***formula*** expression can consist of literals (numbers, text strings), operators, functions, and cell references.

Simple mathematical expressions:

- `= 1 + 5`
- `= 1.5 * 3.14 + 42`

Common functions:

- `= ROUND(PI(),2)` // Result is 3.14
- `= CONCATENATE("Hello", " World")` // Hello World
- Other common functions for trigonometry, dates, and financial.

# Formula Expressions

The power of formulas comes from using cell references (similar to variable names in programming).

Cell reference examples:

- `= A1 + A2`
- `= B1 + A3 - A4`

# Formulas Question

***Question:*** A cell contains the following: **=2+4*3** What is the value of the cell?

**A)** 14

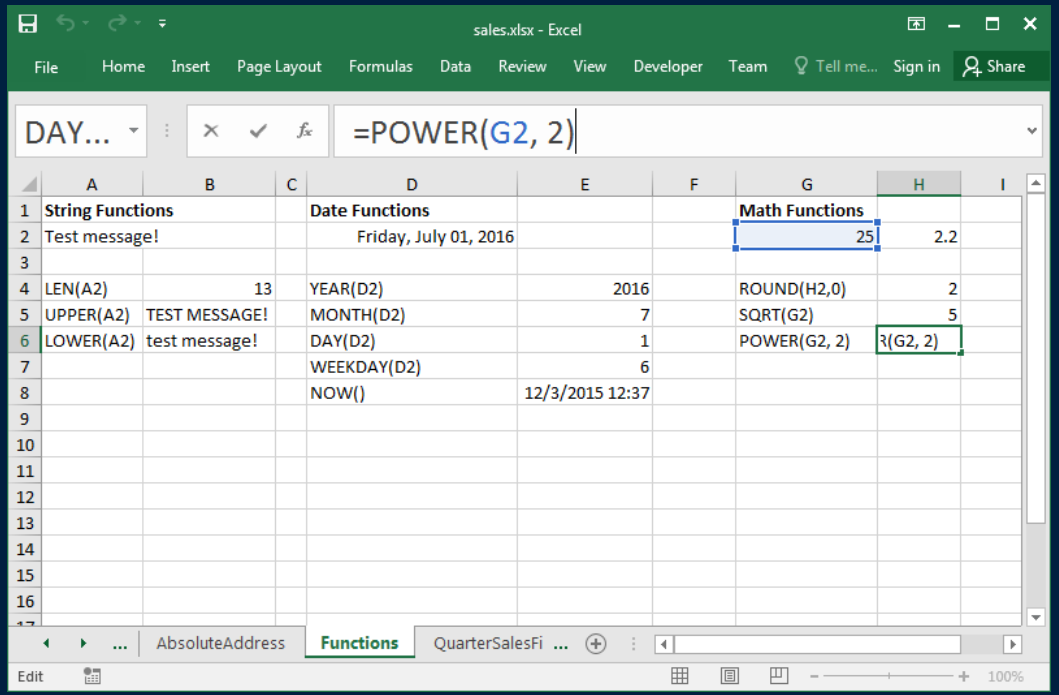
**B)** 18

**C)** =2+4*3

# Using Excel Functions

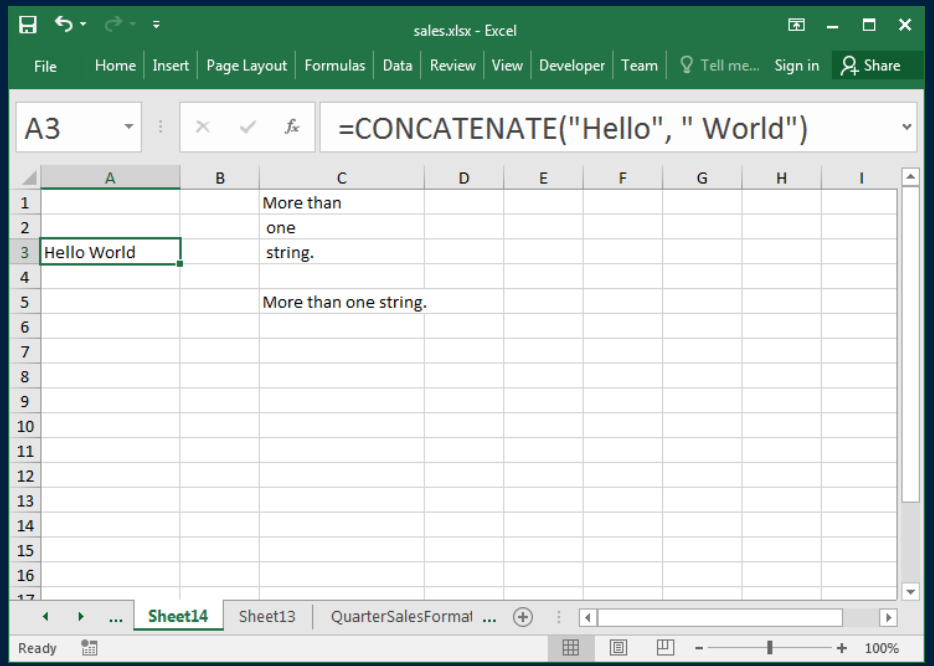
Excel has a large number of built-in functions to use.

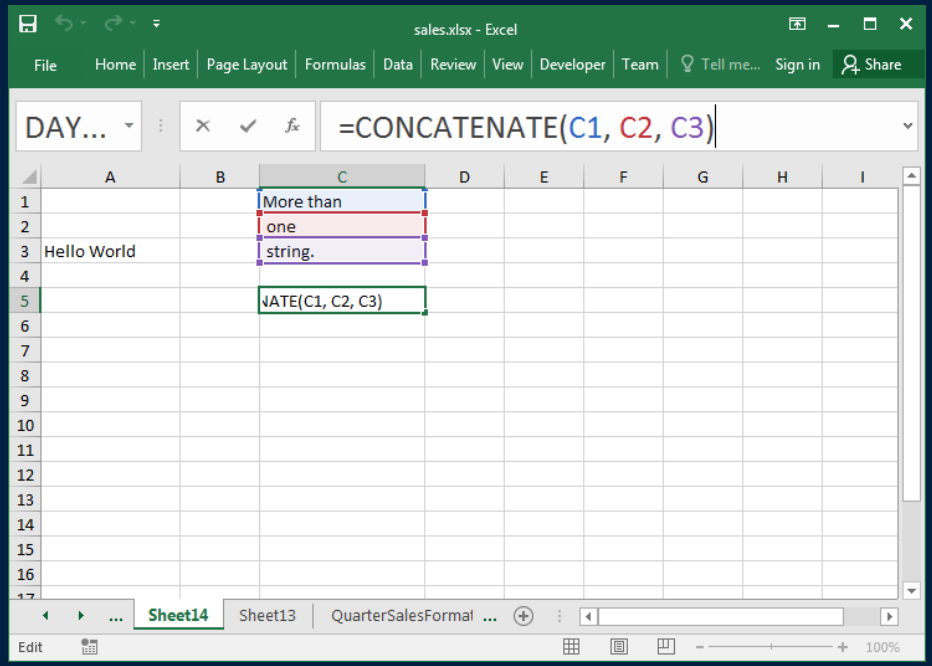
A ***function*** takes arguments as input and produces an output.



# Concatenation

***String concatenation*** is when two or more strings are combined by appending them in order. Function in Excel is `CONCATENATE()` or `&`.

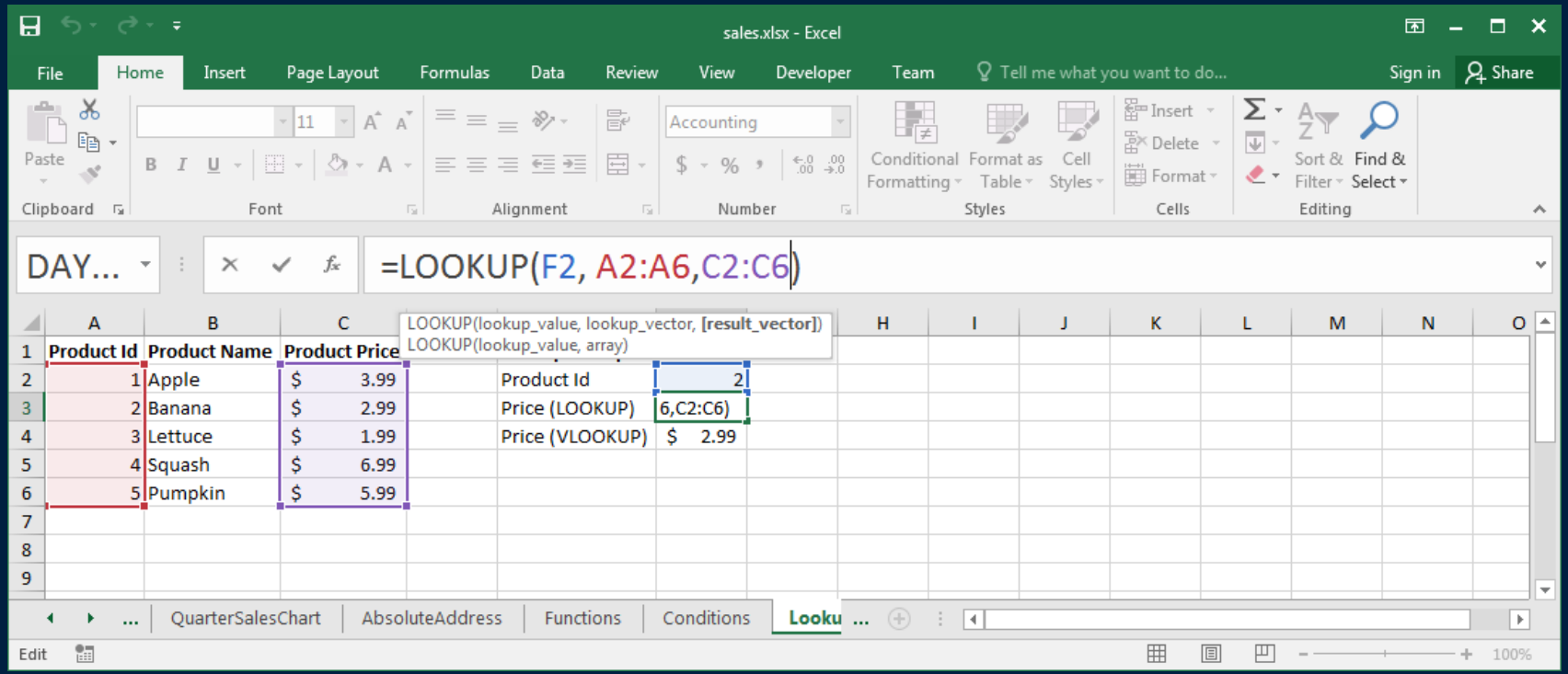


# LOOKUP Function

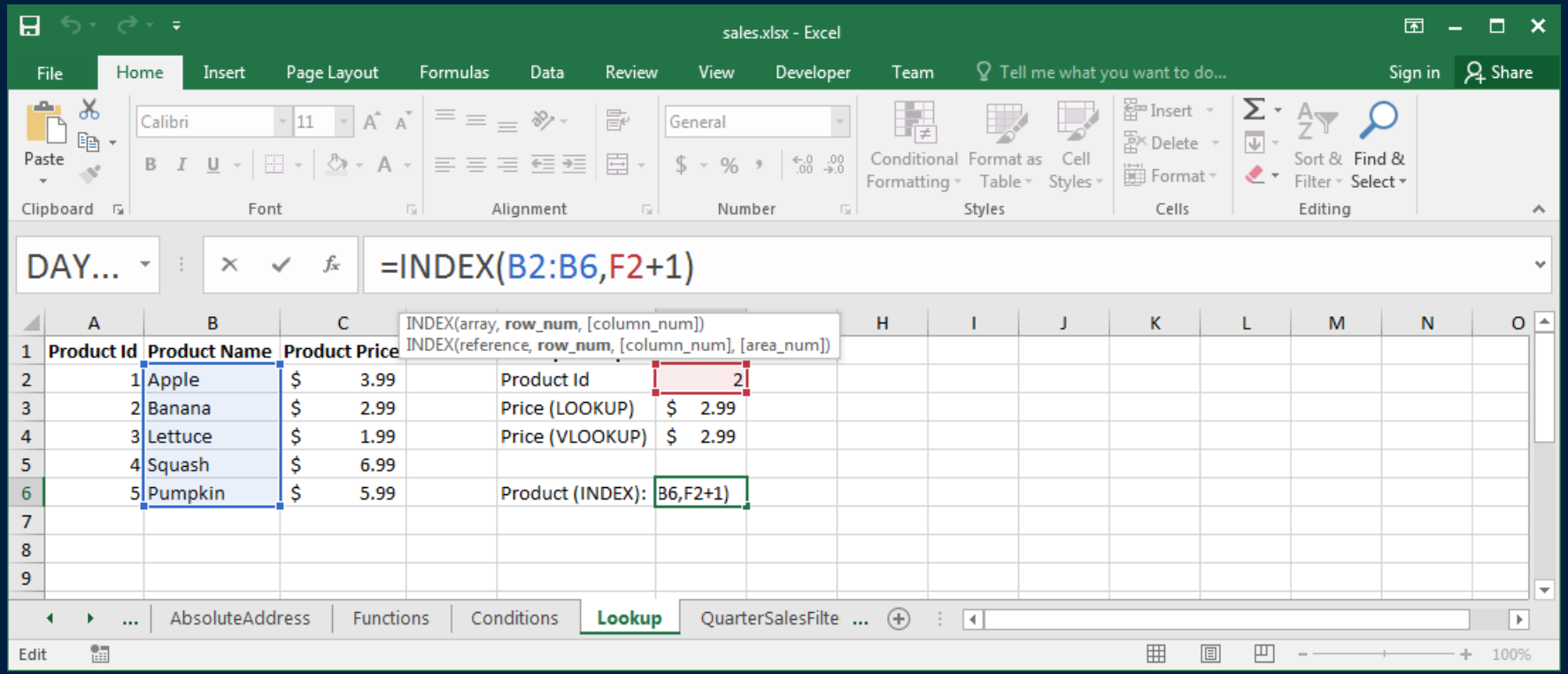
The LOOKUP function searches for a value in a column.

- VLOOKUP searches a column in a table ; HLOOKUP searches a row in a table.



# INDEX Function

`INDEX()` returns the value in the array of cells at the given index.



# Formulas Question

***Question:*** A cell contains the following: **'ABC'+'DEF'**. What is the value of the cell?

**A)** error

**B)** ABCDEF

**C)** 'ABC'+'DEF'

# Formulas Question

***Question:*** How many of the following statements are **TRUE**?

1) `CONCATENATE` function can take 3 arguments.

2) There is an Excel function that has 0 arguments.

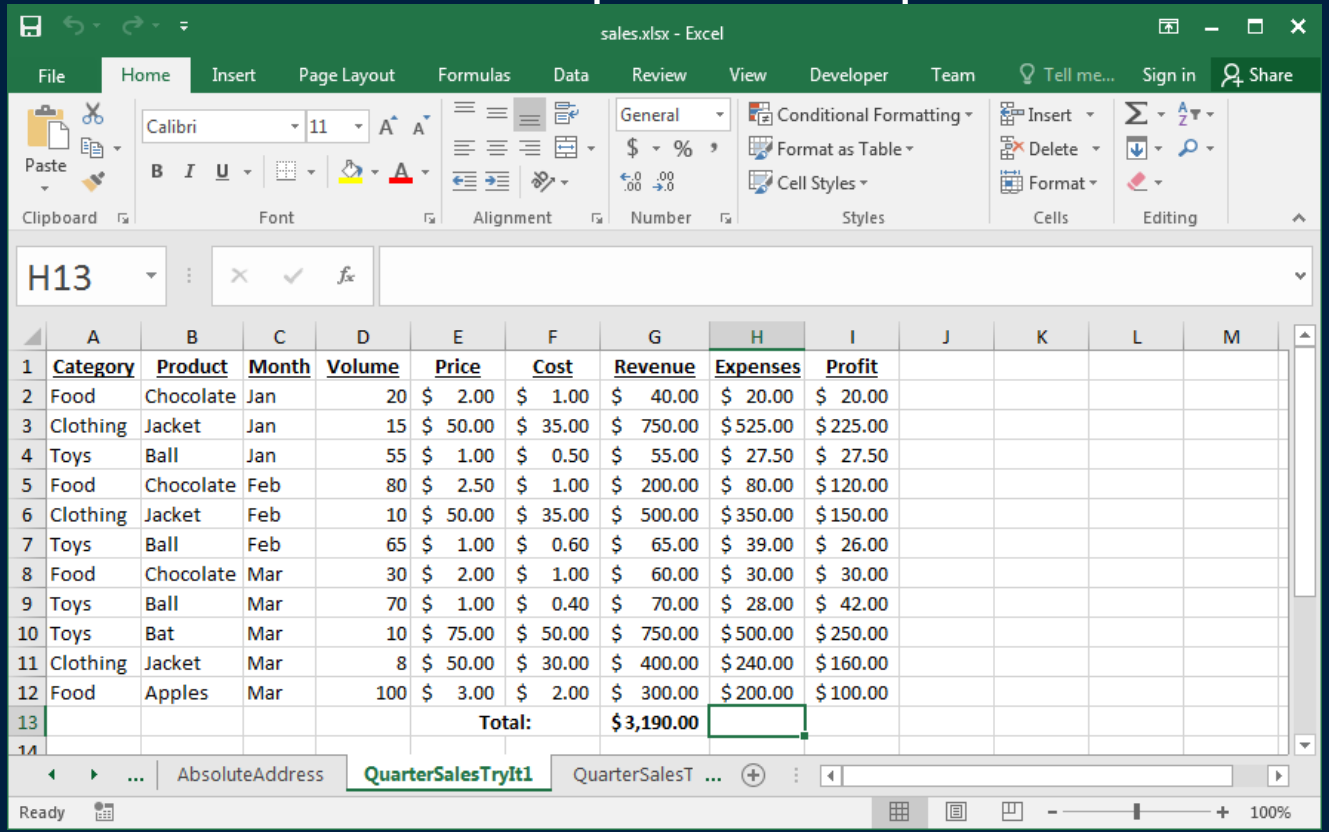
3) `=INDEX({1,3,5},2)` returns `5`.

4) `=LOOKUP(5,{1,3,5},{"a","b","c"})` returns `"c"`.

**A)** 0 **B)** 1 **C)** 2 **D)** 3 **E)** 4

# Try it: Entering Formulas

***Question:*** Add a column for expenses and profit as below:

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| 3 | Clothing | Jacket | Jan | 15 | $ 50.00 | $ 35.00 | $ 750.00 | $ 525.00 | $ 225.00 | | | | |
| 4 | Toys | Ball | Jan | 55 | $ 1.00 | $ 0.50 | $ 55.00 | $ 27.50 | $ 27.50 | | | | |
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| 9 | Toys | Ball | Mar | 70 | $ 1.00 | $ 0.40 | $ 70.00 | $ 28.00 | $ 42.00 | | | | |
| 10 | Toys | Bat | Mar | 10 | $ 75.00 | $ 50.00 | $ 750.00 | $ 500.00 | $ 250.00 | | | | |
| 11 | Clothing | Jacket | Mar | 8 | $ 50.00 | $ 30.00 | $ 400.00 | $ 240.00 | $ 160.00 | | | | |
| 12 | Food | Apples | Mar | 100 | $ 3.00 | $ 2.00 | $ 300.00 | $ 200.00 | $ 100.00 | | | | |
| 13 | | | | | Total: | | $ 3,190.00 | | | | | | |

# Advanced Spreadsheet Addressing

The dollar sign "**$**" is a symbol that indicates an ***absolute address***.

- By default, addresses are "relative" in the sense that if they are in a formula that is copied to another cell, they will be changed relative to where they were copied from their origin.

Example:

- Cell `A1` has the formula `=A2+B1`
- Copy contents of cell `A1` to cell `C4`.
- Formula changes to `=C5+D4` because moved down three rows and over two columns.
- If cell `A1` had the formula `=$A$2+$B$1`, then the same formula would be in cell `C4`.
- Question: What if formula was `=$A2+B$1`?

# Formulas and References Question

***Question:*** Cell **A1** contains the following: **=$B2+D$4**. What is the formula if the cell is copied to cell **D3**?

**A)** error

**B)** =$B2+D$4

**C)** =$B4+F$4

**D)** =$B4+G$4

# Aggregate Functions

An ***aggregate function*** computes a summary function over a range of cells. The values can either be data values or cell locations.

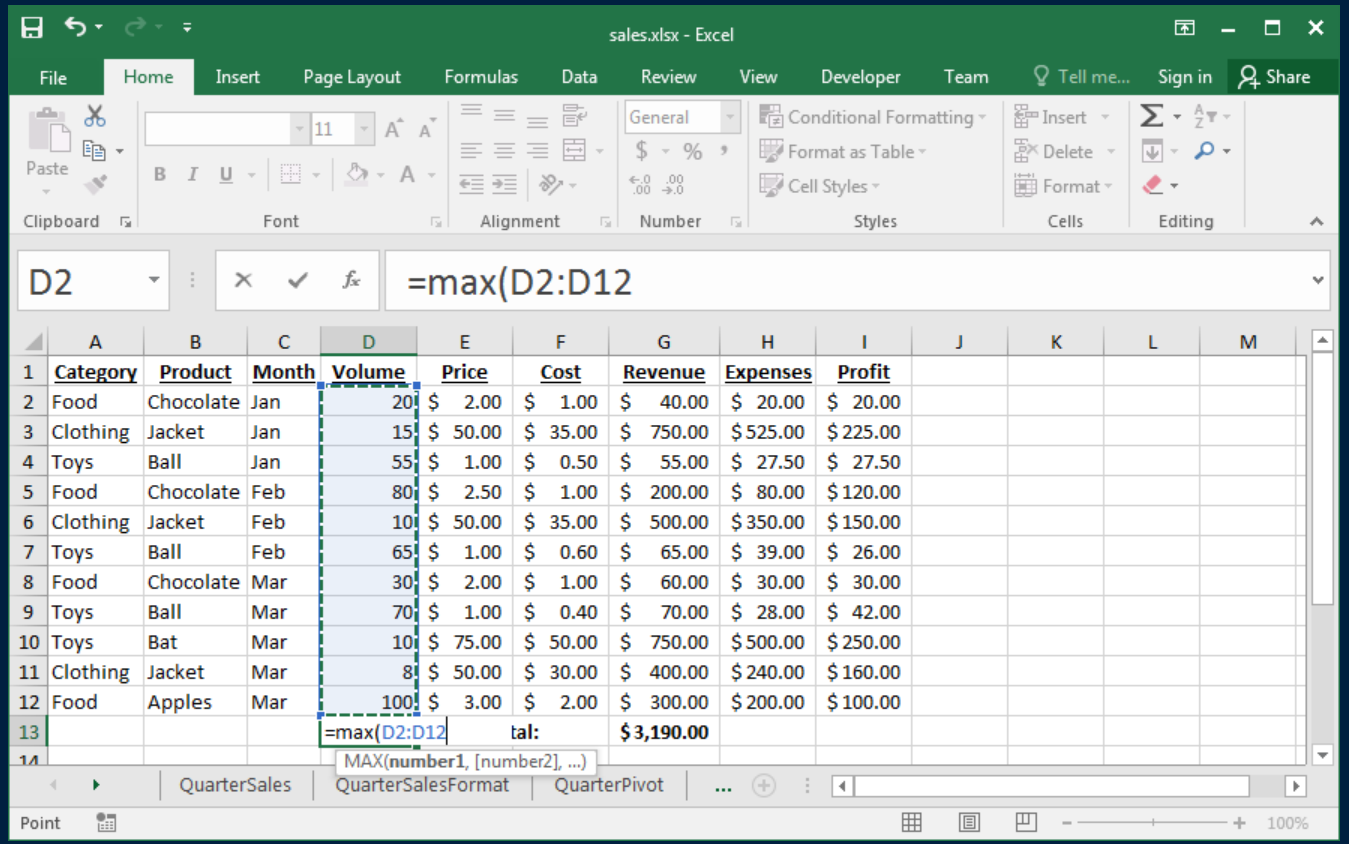
Common functions are:

- `MIN(<value list>)` - returns minimum value in list
- `MAX(<value list>)` - returns maximum value in list
- `SUM(<value list>)` - returns sum of all values in list
- `AVERAGE(<value list>)` - returns average of values in list
- `COUNT(<value list>)` - returns count of values in list
- `MEDIAN(<value list>)` - returns median value of list

If specifying a cell rectangle, give the upper left and lower right corners, separated by a colon.

- e.g. `=AVERAGE(A3:E6)` - rectangle of 4 rows and 5 columns

# Aggregate Functions Example

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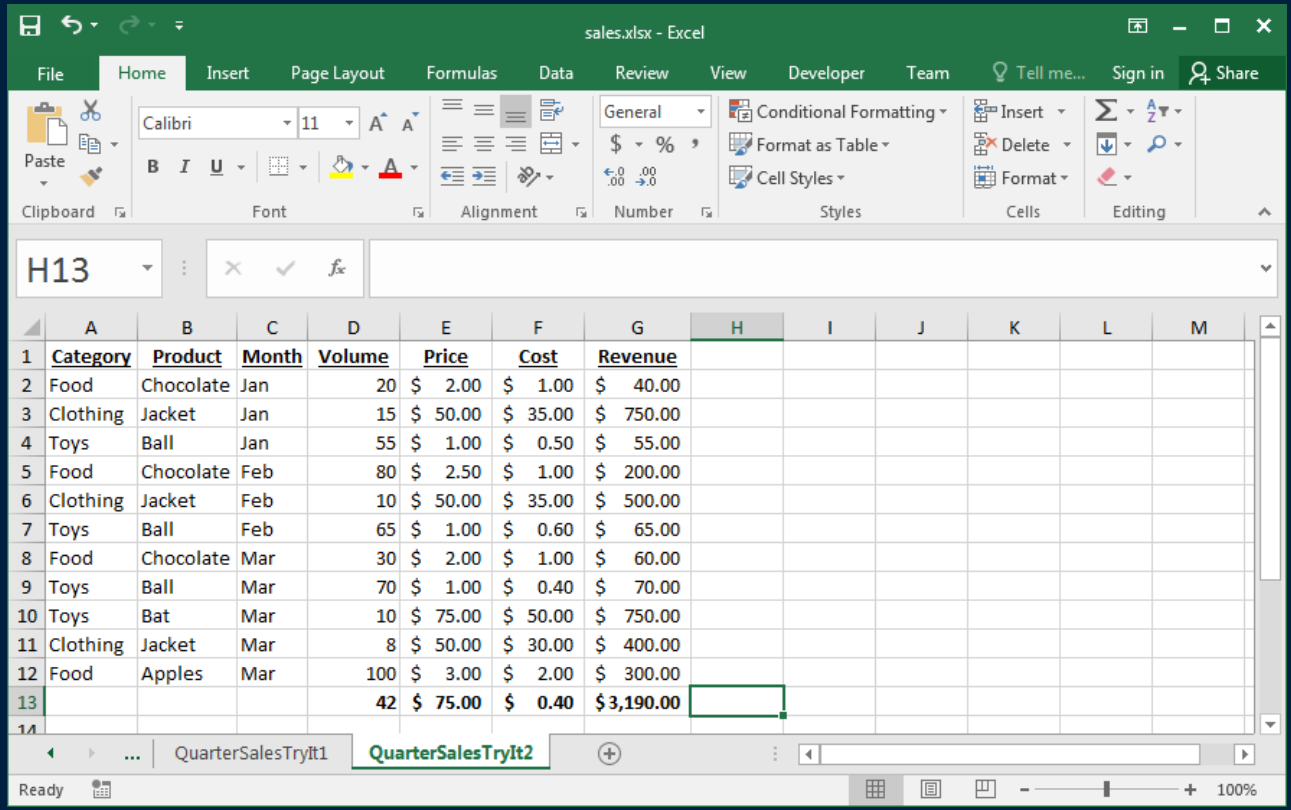
| 13 | | | | =max(D2:D12 | | tal: | $ 3,190.00 | | |
| 14 | | | | | | | | | |

# Try it: Aggregate Functions

***Question:*** Create aggregate functions to match below:

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| 5 | Food | Chocolate | Feb | 80 | $ 2.50 | $ 1.00 | $ 200.00 | | | | | | |
| 6 | Clothing | Jacket | Feb | 10 | $ 50.00 | $ 35.00 | $ 500.00 | | | | | | |
| 7 | Toys | Ball | Feb | 65 | $ 1.00 | $ 0.60 | $ 65.00 | | | | | | |
| 8 | Food | Chocolate | Mar | 30 | $ 2.00 | $ 1.00 | $ 60.00 | | | | | | |
| 9 | Toys | Ball | Mar | 70 | $ 1.00 | $ 0.40 | $ 70.00 | | | | | | |
| 10 | Toys | Bat | Mar | 10 | $ 75.00 | $ 50.00 | $ 750.00 | | | | | | |
| 11 | Clothing | Jacket | Mar | 8 | $ 50.00 | $ 30.00 | $ 400.00 | | | | | | |
| 12 | Food | Apples | Mar | 100 | $ 3.00 | $ 2.00 | $ 300.00 | | | | | | |
| 13 | | | | **42** | **$ 75.00** | **$ 0.40** | **$ 3,190.00** | | | | | | |
| 14 | | | | | | | | | | | | | |

# Aggregate Functions Question

***Question:*** Assume the cells in the range `A1:C4` each contain a number that is equal to their row number (e.g. `B3` contains `3`). How many of the following statements are **TRUE**?

1) The number of cells in the range is `12`.
2) The value of `SUM(A1:C4)` is `20`.
3) The value of `COUNTIF(A1:B4,">2")` is `4`.
4) `AVERAGE(A1:C4) > MAX(C2:C3)`

**A)** 0 **B)** 1 **C)** 2 **D)** 3 **E)** 4

# Aggregate Functions Question

***Question:*** Assume the three cells in the range `A1:C1` contain numbers. Which of these formula output results is **ALWAYS** the largest?

**A)** `MAX(A1:C1)`

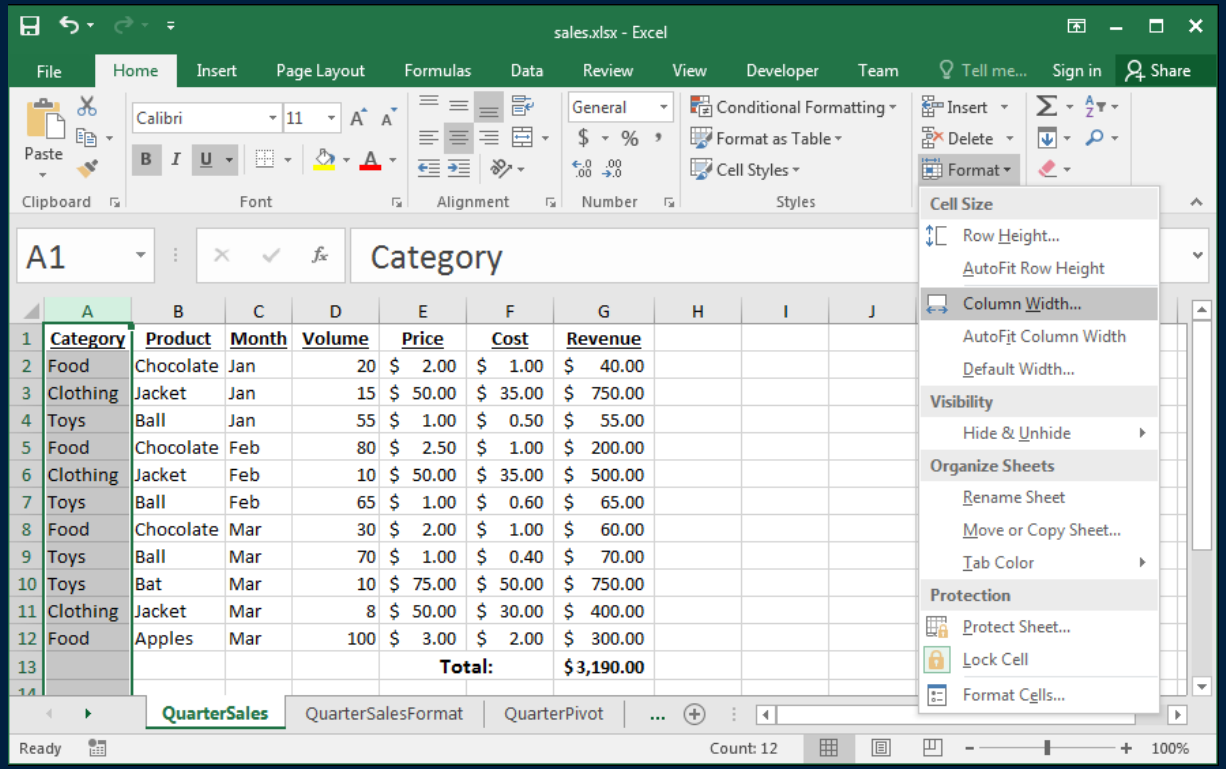
**B)** `MIN(A1:C1)`

**C)** `COUNT(A1:C1)`

**D)** `SUM(A1:C1)`

**E)** none of the above are always guaranteed to be the largest

# Other Formatting: Column Width




| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Category | Product | Month | Volume | Price | Cost | Revenue |
| 2 | Food | Chocolate | Jan | 20 | $ 2.00 | $ 1.00 | $ 40.00 |
| 3 | Clothing | Jacket | Jan | 15 | $ 50.00 | $ 35.00 | $ 750.00 |
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| 12 | Food | Apples | Mar | 100 | $ 3.00 | $ 2.00 | $ 300.00 |
| 13 | | | | | Total: | | $ 3,190.00 |

Resizing columns/rows:

Auto-resize by double clicking on border between columns or using the `Format` option.

Drag row/column border for manual resize.

# Conditions and Decisions

A ***condition*** is an expression that is either `TRUE` or `FALSE`.

Conditions are used to make decisions and perform different actions depending on the condition value.

Excel condition and decision functions:

- `FALSE()` – returns `FALSE`
- `TRUE()` – returns `TRUE`
- `AND(cond1, cond2)` – returns `TRUE` if both `cond1` and `cond2` are true
- `OR(cond1, cond2)` – returns `TRUE` if either or both of `cond1` and `cond2` are true
- `NOT(cond)` – returns `TRUE` if `cond` is `FALSE`

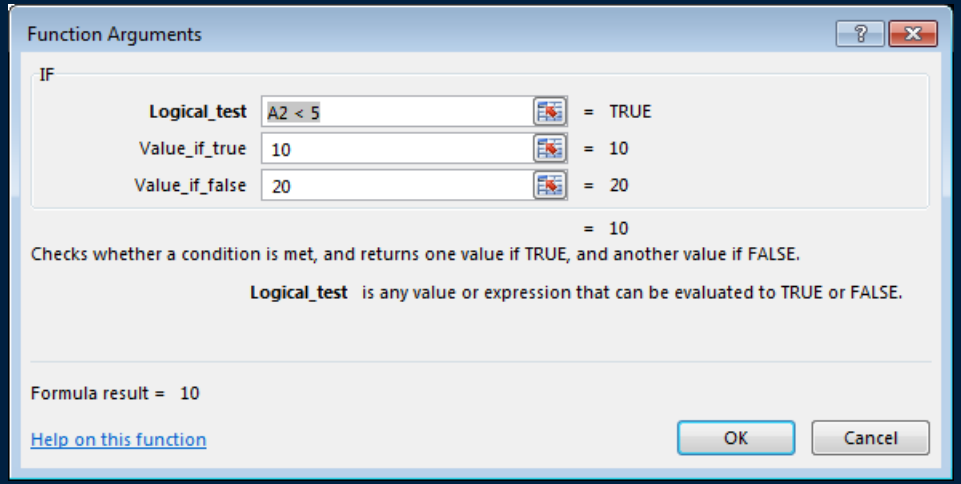
# Decisions using `IF()`

The `IF()` function is used to make a decision based on a condition.

- `IF(condition, value_if_true, value_if_false)`

Example: If cell A2 is less than 5, return 10 otherwise return 20.

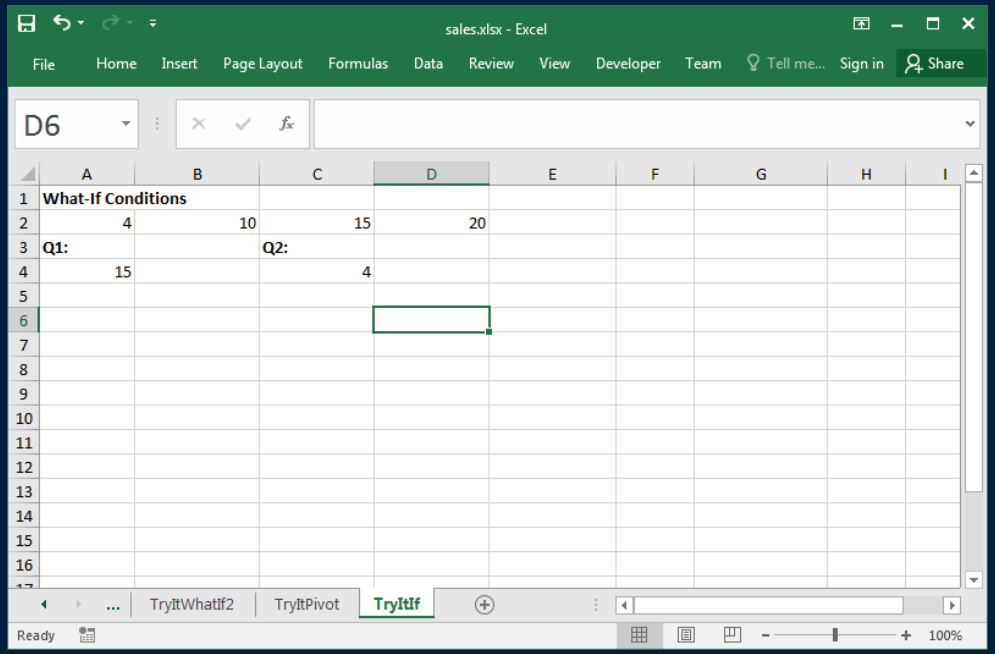
```
= IF(A2 < 5, 10, 20)
```



# Try it: Conditions and `IF()`

***Question:*** Create two conditions:

- 1) If cell B2 >= 10, then show C2, otherwise D2.
- 2) If cell B2 < 15 and C2 > 20, return B2*C2, otherwise if D2 < 10, return 1, else 4.



# Decisions using `IF()` Question

***Question:*** How many of these statements are **TRUE**? **`A1=40,A2=10`**

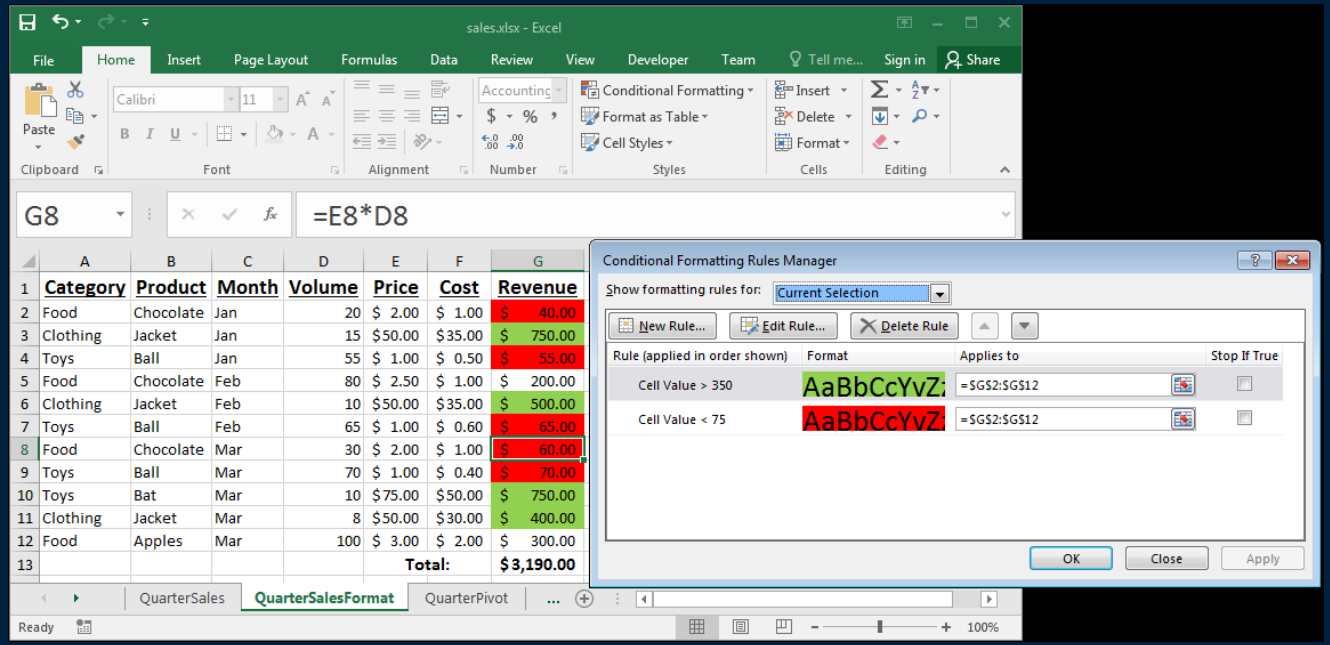
1) `=AND(FALSE(), TRUE())`
2) `=OR(FALSE(), NOT(TRUE()))`
3) `=IF(A1=40, 5, 10)` returns `10`.
4) `=IF(OR(A1=40,A2>10),1, 2)` returns `2`.
5) `=IF(A2=10,IF(A1=40,FALSE()),TRUE())`

**A)** 0 **B)** 1 **C)** 2 **D)** 3 **E)** 4

# Conditional Formatting

***Conditional formatting*** allows you to change the cell format based on data values. This is accessible under **`Styles`**.

- Other options: data bars, color scales




| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Category | Product | Month | Volume | Price | Cost | Revenue |
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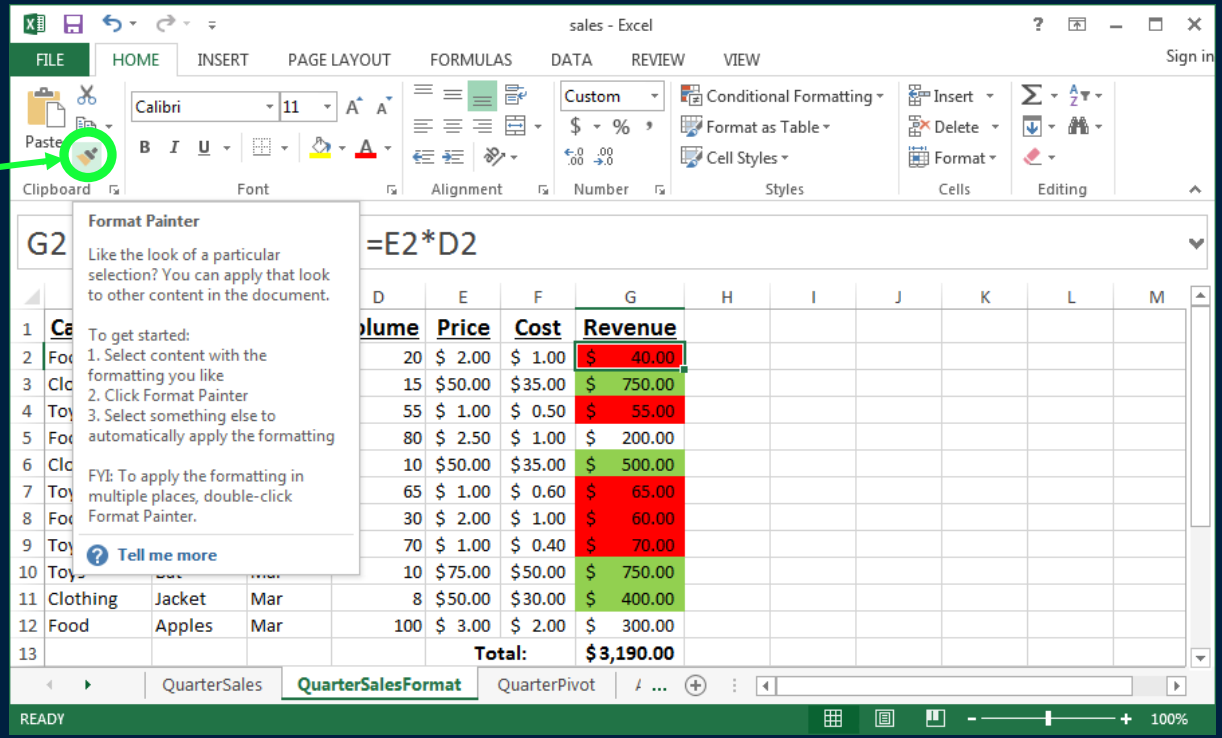
| 12 | Food | Apples | Mar | 100 | $ 3.00 | $ 2.00 | $ 300.00 |
| 13 | | | | | | Total: | $3,190.00 |

# Conditional Formatting Result

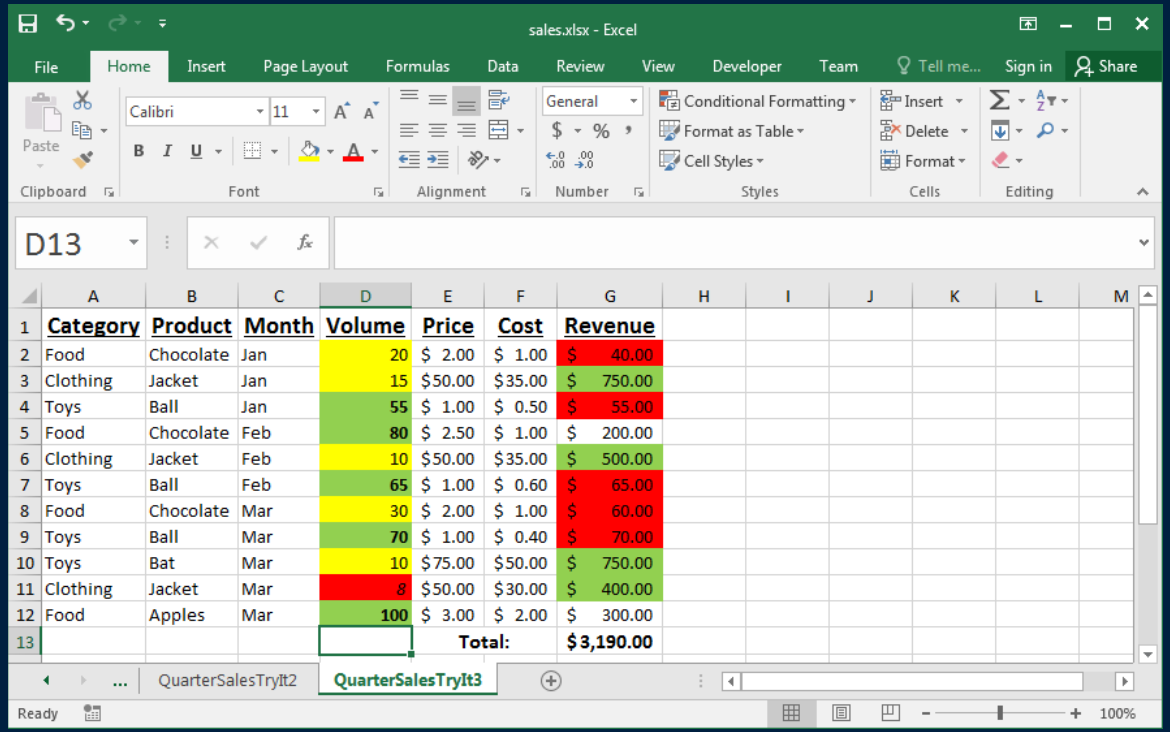
The format painter button allows you to copy formatting to many cells. Select the cell, click paint button, then highlight cells to have identical formatting.

format painter button



# Try it: Conditional Formatting

***Question:*** Format rows so: 1) bold/green if volume > 50, 2) italics/red if volume < 10, 3) yellow background otherwise as below:




| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Category | Product | Month | Volume | Price | Cost | Revenue |
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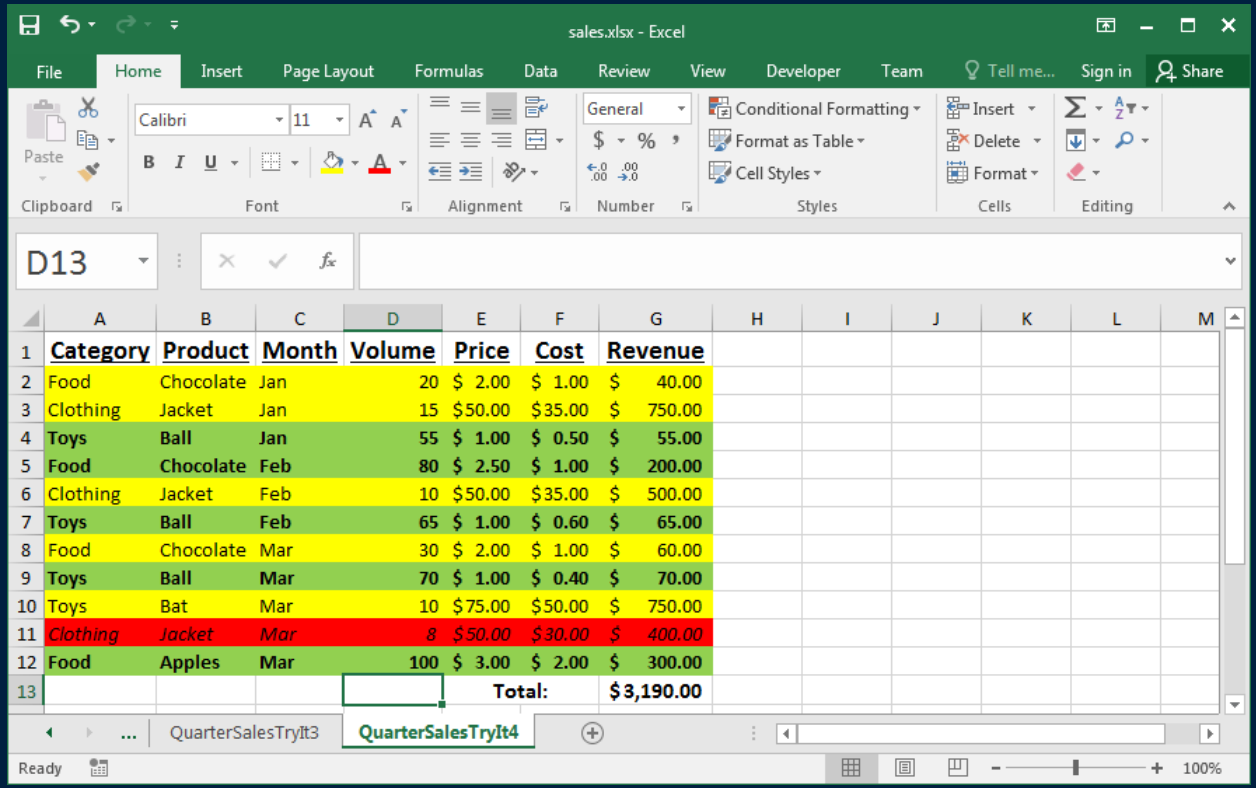
| 12 | Food | Apples | Mar | 100 | $ 3.00 | $ 2.00 | $ 300.00 |
| 13 | | | | | Total: | | $3,190.00 |

# Try it: Conditional Formatting Challenge

***Question:*** Take the previous formatting and apply it to whole row:




| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Category | Product | Month | Volume | Price | Cost | Revenue |
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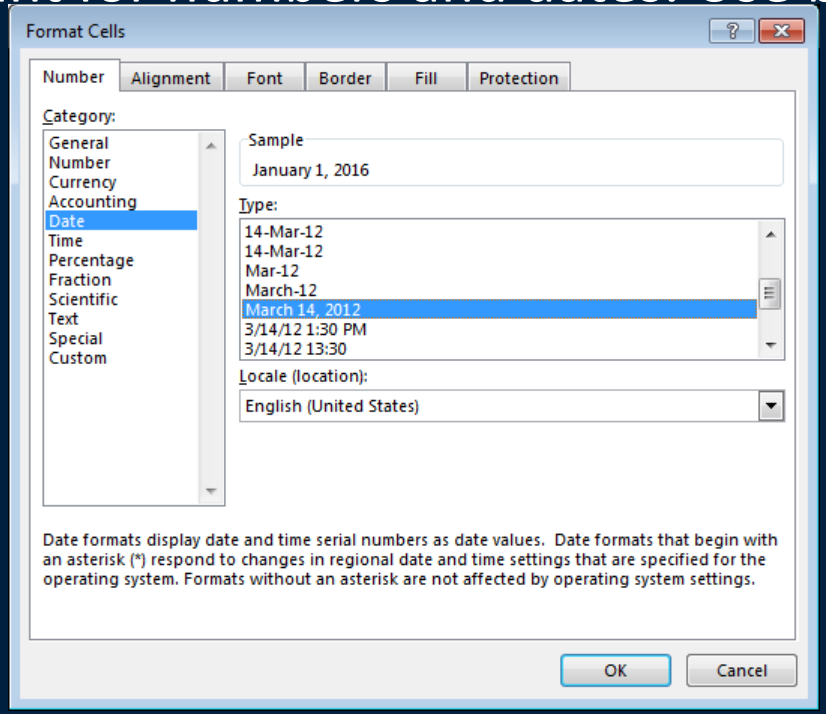
| 9 | Toys | Ball | Mar | 70 | $ 1.00 | $ 0.40 | $ 70.00 |
| 10 | Toys | Bat | Mar | 10 | $75.00 | $50.00 | $ 750.00 |
| 11 | *Clothing* | *Jacket* | *Mar* | *8* | *$50.00* | *$30.00* | *$ 400.00* |
| 12 | Food | Apples | Mar | 100 | $ 3.00 | $ 2.00 | $ 300.00 |
| 13 | | | | | Total: | | $3,190.00 |

# Date and Type Formats

Formatting data helps users read and understand data and is especially important for numbers and dates. Use built-in or custom formats.



# Conclusion

***Spreadsheets*** are general purpose tools for data analysis that consist of a table of cells which contain data and formulas.

Formulas contain data values, cell references, and functions.

- Aggregate functions summarize multiple data values into a single value.
- Functions exist for statistics, string manipulation, lookup/indexing, and decisions.
- Absolute addresses use a $ in front of column and/or row so that address does not change when copying formula.

Conditions are used for making decisions with `IF()` and for conditional formatting.

# Objectives

- Explain what a spreadsheet is.
- Explain how cells are addressed in a spreadsheet.
- List some of the ways to select cells in a spreadsheet.
- Define and explain: formula, function, argument, concatenation
- Use these functions: concatenate, lookup, index
- Explain the difference between an absolute and relative address.
- Explain how an aggregate function works.  List some examples.
- Evaluate and create conditions. Use IF() to make decisions.
- Explain how to use conditional formatting.
- Be able to apply date and type formats.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