Introduction to Excel

Computing Basics

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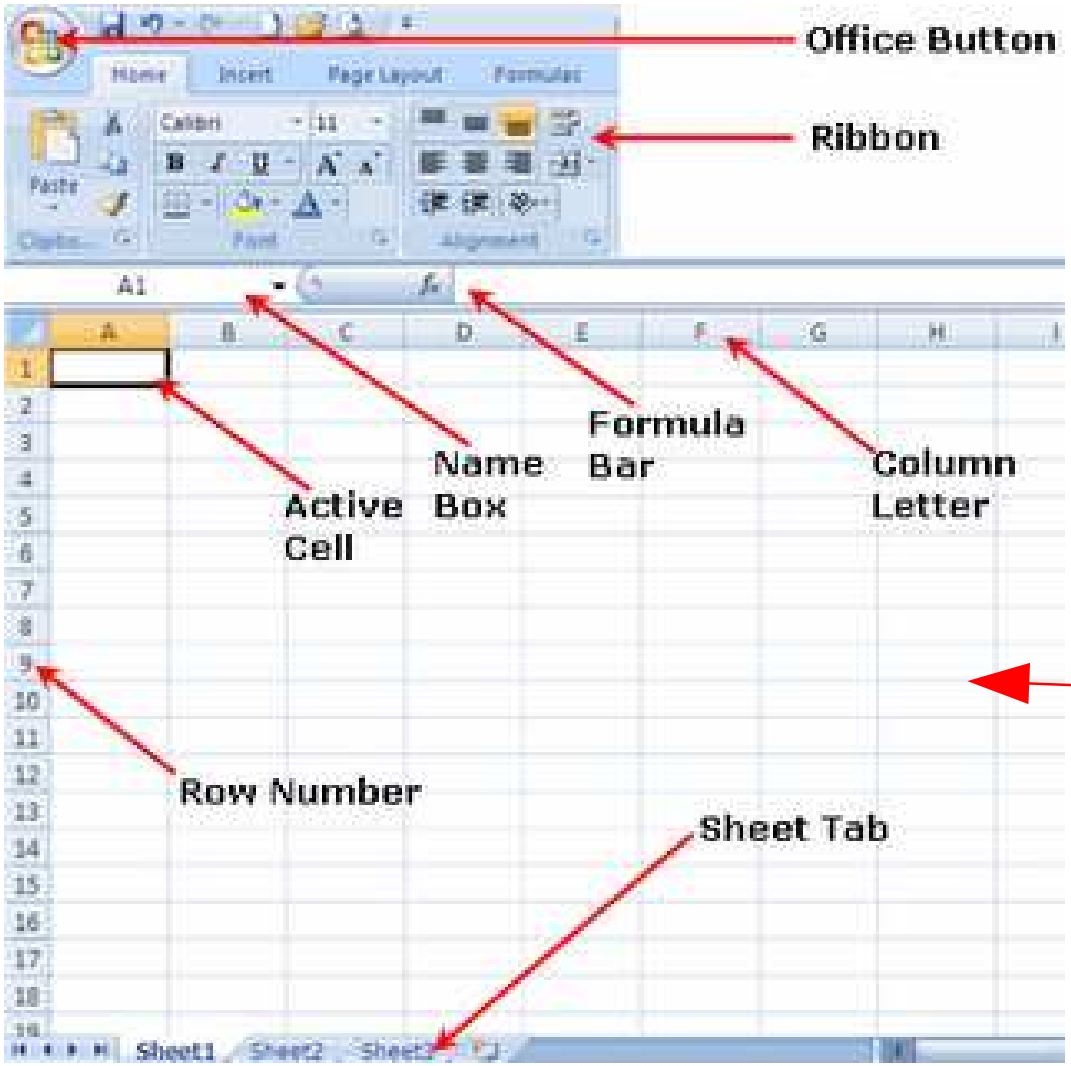
Introduction

- Excel is a spreadsheet.
  - Excel is a program for manipulating data, both numeric and alphanumeric, arranged in tabular form.
  - A workbook is a spreadsheet file. By default, each workbook in Excel contains three pages or worksheets.
  - You can enter numbers and mathematical formulas into pages.
  - Formulas allow you to perform mathematical calculations with the data stored in the page.
  - Excel provides a number of pre-defined formulas
  - Users can define their own (user-defined) formulas.
- Applications in engineering
  - To perform basic calculations
  - To convert data in graphics
  - To manage data in tables (sorting, filtering ...)
  - Statistical analysis
  - Matrix calculation
  - Calculation with complex numbers
  - Data count, dynamic tables
  - Open to other uses that the user can create (Visual Basic)

Parts of Excel



Cells

1. Cell's location in the spreadsheet is referred to as its **cell reference** or **cell name**.
   - Column letter
   - Row Number
   - (If data is in another sheet) Name of the sheet, finished in " !"
   - Examples: A1, Sheet2!B2
2. **Content** of the cell
   - Number (3, 10.32, 20%) (Individual case: date)
   - Text Strings ("Europe", "Excel")
   - Formula (operations with the content of other cells)
   - Pressing F2, you can edit the contents of the selected cell
3. **Format** of the content
   - What you actually see depends on the content and the format of the cell.
   - Excel ability to format numbers and dates in a variety of ways.
   - Numerical (general, decimal places, percentage, financial, . . .)
   - Date/Time (short, long)
   - Example: 0.2 as a decimal number is displayed as it is, as a percentage is displayed as 20%

Exercises

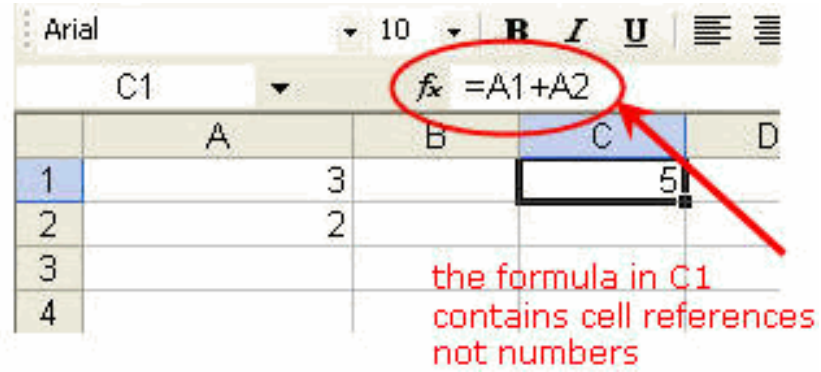
1. Download Examples.zip and open file Example1
2. Take a look at the content of each cell (move the cursor and look at the formula bar).
3. Cells in column B contain numbers, displayed with different formats.
   - Date and time are also internally numbers.
     - Write 1, 2, 3 in F1, F2 and F3, respectively. Format these cells as dates. What happens?
   - Percentages are alse numbers.
     - Write 10 in F4 and 0.1 in F5. Format these cells as percentages. What happens?
     - Format B5 as a number. What happens?
4. Move to column D. Try to guess what each formula does.
5. Change the content of B3. Do the results of the formulas change?.
6. Try to obtain "Greater" in D6.
7. Changing the format doesn't change the value stored in the cell. Only the way it is shown. Write 0.999 in G1, 0.001 in G2. Format both with 2 decimal places. Write the formula "$=G1+G2$" in G3. What happens?

How to select cells

- Only one
  - Clicking with the mouse, or move with the arrows of the keyboard
- Adjacent range (rectangle)
  - Click and drag
  - Click a cell, Shift+Click in the other corner
  - Moving with Shift+arrows of the keyboard.
- Scattered Cells
  - Ctrl+click.
- An entire row/column/all
  - Click on the header of the row/column, upper-left corner of the grid.
- By some criterion
  - Ctrl+i “Special”

Formulas

- Formulas must begin with an equal sign (=).
- Operate with the content of another cell or constant numbers.
- The cell name or cell reference represents the value in that cell.



- Exercises
  - Open an empty sheet in Example1 and write A1 $\rightarrow 5+3$ and A2 $\rightarrow = 5+3$
  - Can you see the difference?
  - Now, write B1 $\rightarrow 1$, B2 $\rightarrow 2$ and B3 $\rightarrow = B1 + B2$.
  - Can you see the difference now?
- Try with different operators as $+$, $-$, $*$, $/$ and $\hat{}$(power).
- Try using brackets to modify the precedence.
- Compare "$= 3 + 4 * 2$" with "$= (3 + 4) * 2$"

Relative cell reference

- By default, a cell reference is **relative**. This means that if a formula is copied and pasted to other cell, the cell references in the formula **change** to reflect the formula's new location.
- Check what happens
  - In a new sheet (Sheet3), try the following
    - Fill in cells A1, B1, C1 and D1 with the numbers 1, 2, 3 and 4
    - In A2, write the formula "=A1+B1". What do you get?
    - Use "Copy" and "Paste" to copy the formula from A2 to B2
    - Do you get the same? Check (formula bar) the formula in B2.
    - Use "Paste" again to replicate again the formula in A3.
    - What do you get now? Check the formula "pasted".
  - This behavior is usually what you want.

Absolute cell references

- What if we want a formula refers to a specific cell, regardless of the cell where the formula is executed?
- You can put a dollar sign ($) in front of anything you want to remain a static reference if you copy the formula to other cells.
  - Ex: A1, A$1, $A1
- Try:
  - Starting from the example in the previous slide.
  - Write in A2 the formula =A1 + B1.
  - Copy and paste the formula on B2 and A3.
  - Try to understand the functioning of $ in the reference
    - Try to predict what you obtain if you write in A2 = $A1+ $B1 and copies/pastes the formula on B2 and A3.
    - Similar with A2 = A$1+B$1

About copy/paste

- The format (colors, fonts, etc) is also copied.
  - It is possible to copy only the format, or only the content, or other options (drop-down menu under "Paste").
- When you copy and paste a formula, this is rewritten (relative references).
  - On the other hand, if you move it (cut & paste) this does not happen.
  - It is possible to paste only the result of the formula.
- If you move a cell (cut and paste) referenced from others, the other cells will automatically update their references.
  - If you copy a cell(copy and paste) this does not happen.

Cells and named ranges

- You can give a name to a cell or range
- Example:
  1. On Example1, Sheet2, select the range A1:D1 (1,2,3,4).
  2. Click the right mouse button, choose "Name a Range".
  3. Name it "Data"
- This allows to use the name in formulas
- Example: In an empty cell put the formula $= SUM(Data)$
- Note that the range name is an absolute reference.

Excel functions

- A formula can contain a call to a function.
- If a function takes some input data, this is written in parentheses. An argument can be a reference to another cell.
  - Examples: SQRT(2), SQRT(C7), SIN(A10)
- Let's assume that the value of a leg is in cell C1, and the other in cell C2. Calculate the value of the hypotenuse in C3, knowing that

$$h = \sqrt{c_1^2 + c_2^2}$$

- Some functions take more than one data as input
  - Enumeration of cells (cell, cell, cell)
  - Ranges of cells (first: last)
  - Examples: SUM(A1,B1,C1,D1) SUM(A1:D1)

Excel functions

- EXCEL offers hundreds of functions for:
  - Databases (information retrieval, statistics)
  - Date and time (counting days, weekdays, etc.)
  - Engineering (complex numbers, matrices, change of base, metric)
  - Financial (interest, depreciation, etc.)
  - Search (find cells that meet criteria)
  - Mathematics (root, absolute value, modulus, logarithms, trigonometric sums, etc.).
  - Statistics (mean, standard deviation, variance, probability distributions, etc.).
  - Text (text data conversion, change to upper case, etc.).
  - Information (obtained if a number is odd or even, if a cell is empty, etc.).
  - Logic (to assess conditions)
- Later we will review some of them.

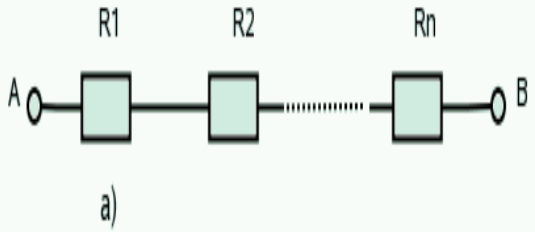
Reference to basic functions (I). Calculus

From now on, r represents a range (or a set of data separated by semicolon or the first and the last separated by colon), while n represents a numeric data.

Elementary	SUM(r), PRODUCT(r), QUOTIENT(numerator,denominator), MOD(numerator,denominator), ABS(n), SIGN(n)
Exponential	LOG10(n), LN(n), EXP(n), SQRT(n), POWER(number,power)
Trigonometric	SIN(n), COS(n), TAN(n) (the angle must be in radians), ASIN(n), ACOS(n), ATAN(n)
Round	INT(n), TRUNC(n), ROUND(n;digits)
Change of base	HEX2DEC(n), DEC2HEX(n), BIN2DEC(n), DEC2BIN(n), etc.

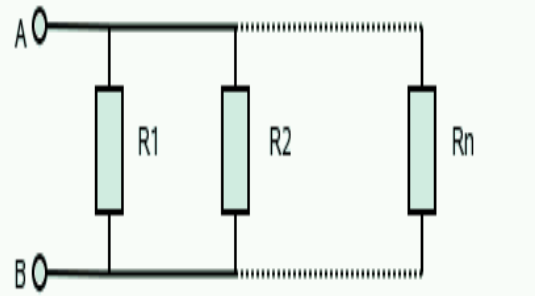
Calculate electrical resistance

- A set of resistors in series behaves as a single resistor and the total resistance can be found as the sum of their resistances.
- A set of resistors in parallel behaves as a single resistor and the total resistance can be found as the inverse of the sum of the inverse of the values of the resistances.



a)

$$R_{AB} = R_1 + R_2 + \ldots + R_n$$

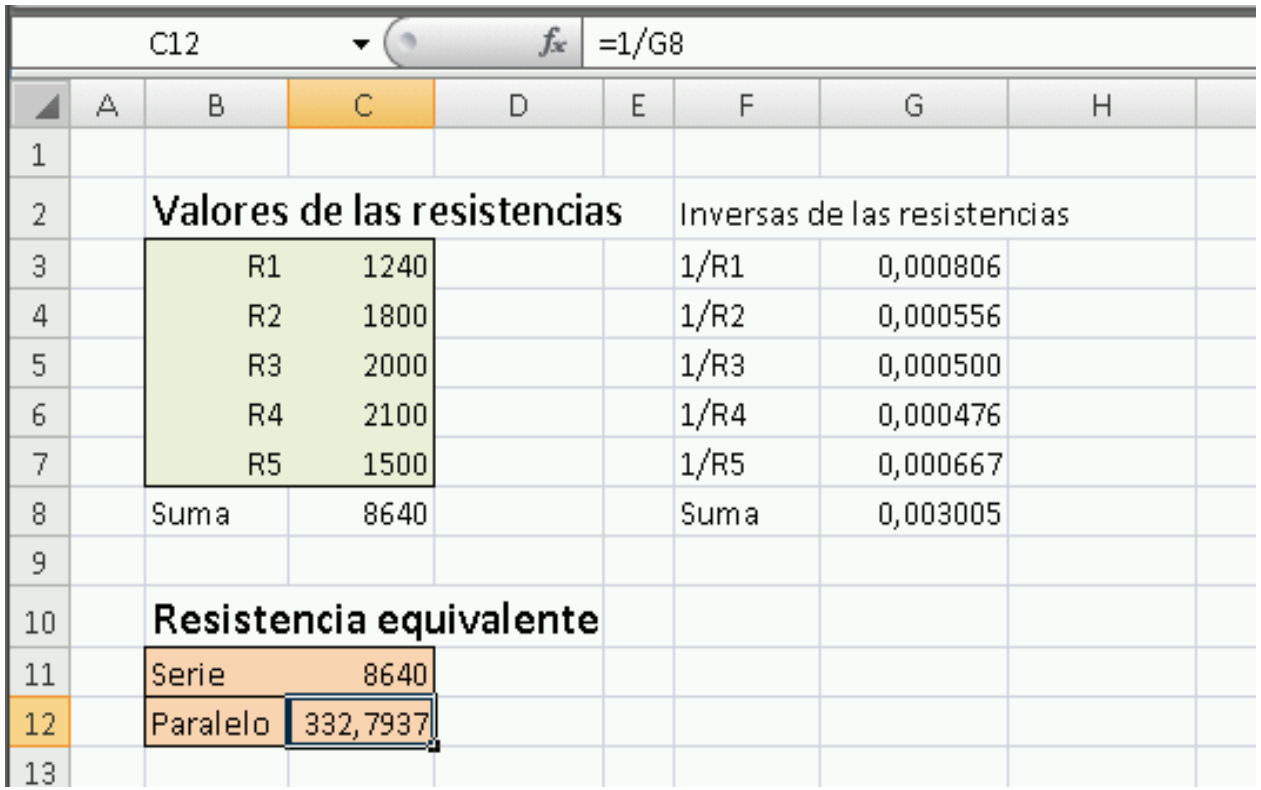


b)

$$\frac{1}{R_{AB}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$$

Calculate electrical resistance

- Create a new Excel workbook. Write the values of five resistors as follows and calculate the equivalent series and parallel resistance. Save it as "resistances.xlsx".
- Example:



	A	B	C	D	E	F	G	H
1								
2		**Valores de las resistencias**				Inversas de las resistencias		
3		R1	1240			1/R1	0,000806	
4		R2	1800			1/R2	0,000556	
5		R3	2000			1/R3	0,000500	
6		R4	2100			1/R4	0,000476	
7		R5	1500			1/R5	0,000667	
8		Suma	8640			Suma	0,003005	
9								
10		**Resistencia equivalente**						
11		Serie	8640					
12		Paralelo	332,7937					
13								

Reference to basic functions (I). Logical

- Comparison operators are: =, >, <, >=, <= and <>.
- When comparing two values the result is a logical value TRUE or FALSE.
- Logical functions produce a result or the other according to a condition.

AND(condition1, condition2, ...) If all the conditions are true, it returns true. Otherwise, false.

OR(condition1, condition2, ...) If all the conditions are false, it returns false. Otherwise, true.

NOT(condition) If the condition is true, it returns false. Otherwise, true.

IF(condition, result1, result2) The condition is usually a comparison of equality or inequality between cells and data. If the condition is true, it returns result1. Otherwise, result2. Examples: IF(A1>5,"Pass","Fail"), IF(AND(A1>0,B1>0,C1>0),"All positive", "No")

Now, open Example2.xls and try to fill in the table.

Reference to basic functions (II). Logical

Create an new Excel workbook to solve a second degree equation.

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Taking into account the following:

1. If $b^2 - 4ac < 0$ the formula can't be applied.
2. If $b^2 - 4ac = 0$ both roots are in the same number.
3. If $b^2 - 4ac > 0$ there are two possible (and different) roots.

Using IF, solve the equation when possible.

Reference to basic functions. Information

These functions provide information about the type of content in other cells. They are normally used as part of the condition to evaluate in a logical function.

ISBLANK(value) Returns TRUE if the value is blank

ISNUMBER(value) Returns TRUE if the value is a number

ISTEXT(value) Returns TRUE if the value is text

Try to guess the result of the following functions

1. Fill in the first row with the following values: $A1 \to 1$, $B1 \to Hello$, $C1 \to var_1$
2. In A2 write the formula $= isblank(A1)$ and copy to B2 . . . D2
3. Repeat the process in the third row with “isnumber” and in the fourth with “istext”

Reference to basic functions. Information (II)

The following can be found under "Statistical", but they can be considered as information functions too.

COUNT(value1, value2, ...) Counts how many numbers are in the list of arguments

COUNTBLANK(range) Counts the number of blank cells within a range

COUNTA(value1, value2, ...) Counts how many values are in the list of arguments

COUNTIF(range, criteria) Counts the number of nonblank cells within a range that meet the given criteria

Reference to basic functions. Information (III)

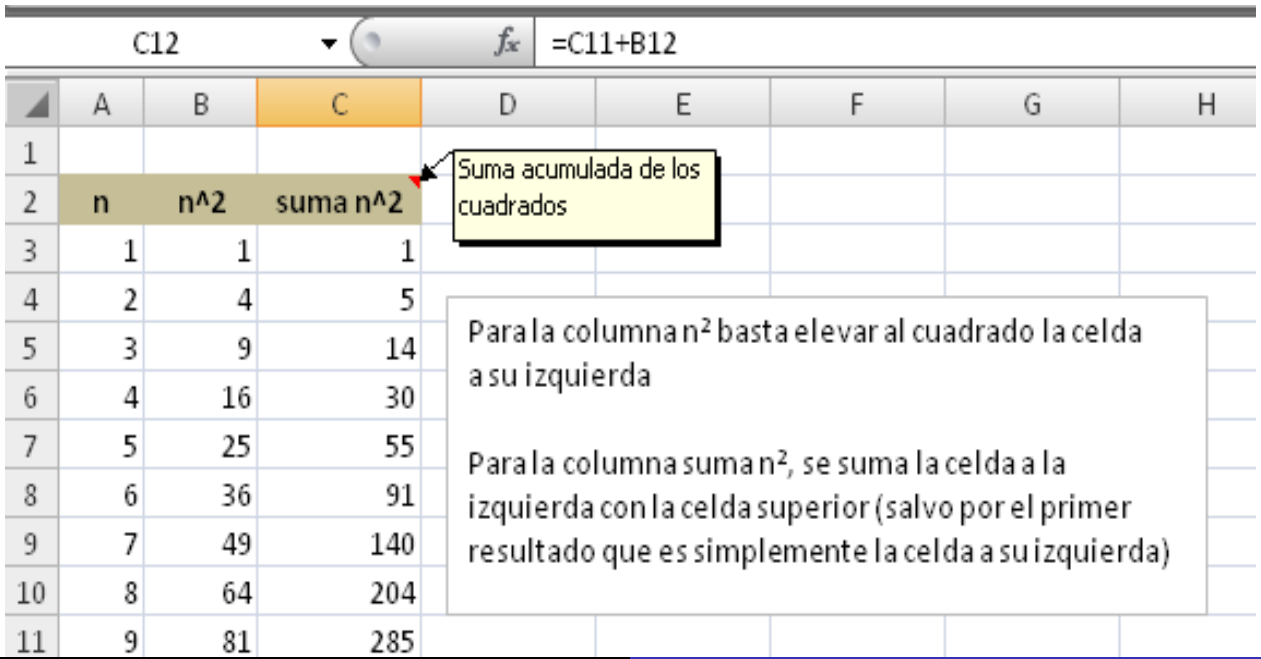
Try the following

1. In D1 write the formula $= count(A1, B1, C1)$ and in E1 $= count(A1 : C1)$.
2. Select the range A1 through C4 and give then the name $MyRange$. Insert in F1 the formula $= countblanck(MyRange)$.
3. Insert in G1 the formula $= counta(A1, B1)$ in G2 $= counta(A1, B1, C1)$ and in G3 $= counta(MyRange)$.
4. Finally, in H1 insert the formula $= countif(MyRange, " = 1")$.

Documenting the worksheet

Comments should be included to clarify the meaning of a formula or cell, or what is the spreadsheet for. This can be done in different ways:

- Inserting a text box with the explanation (place the mouse anywhere and select *Insert* in the ribbon and then, *Text Box*.).
- Including a comment in the cell (click the cell with the right button).



	A	B	C	D	E	F	G	H
1								
2	n	n^2	suma n^2					
3	1	1	1					
4	2	4	5					
5	3	9	14					
6	4	16	30					
7	5	25	55					
8	6	36	91					
9	7	49	140					
10	8	64	204					
11	9	81	285					

Practise

Try to create a worksheet as the one shown in the previous slide.
Reach up to n=20. Save it as Example3.xls
Trick: Auto-fill cells

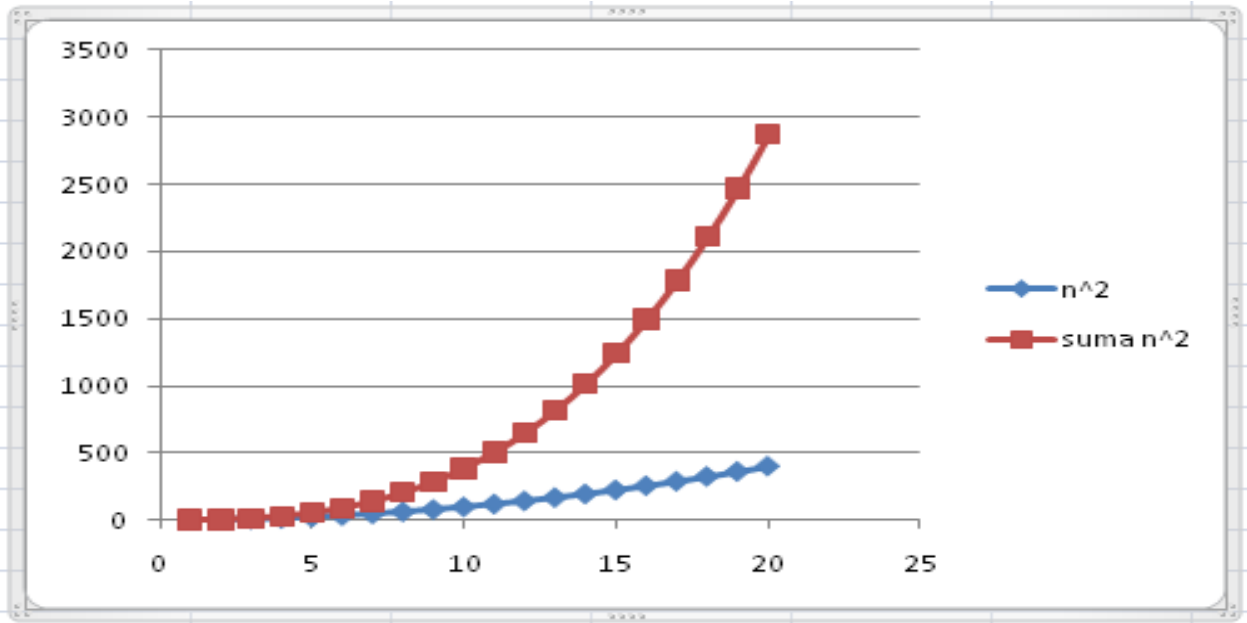
- For the column named "n"
  - Write the first two numbers (1 and 2).
  - Select these two values.
  - Stretch toward the bottom of the lower right corner of the selection
  - Excel will automatically fill the cells with correlative values
- For the column named "n^2"
  - Write the formula in the first cell.
  - Stretch toward the bottom of the lower right corner of the selection
  - Excel will automatically copy the formula to all the cells
- Repeat the procedure in the column named "$sumn^2$"

Now, try the following

1. Insert a comment in a cell (sum_n2). For example: *This column is the sum of the squared.*

Charts

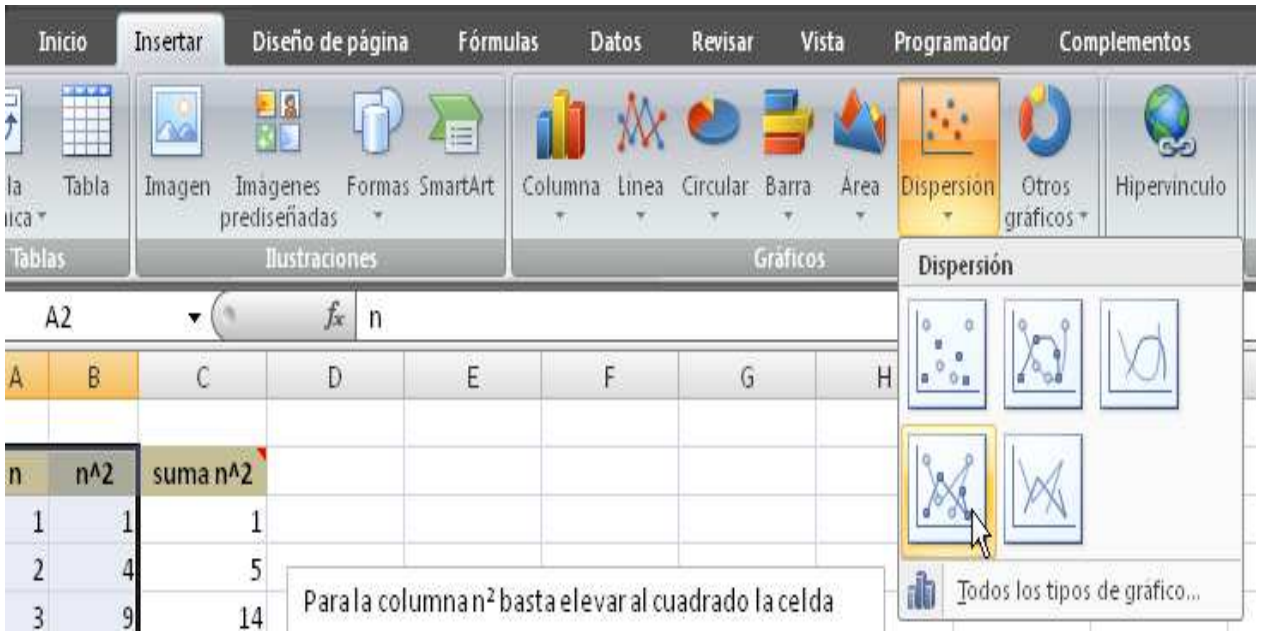
Excel can create different type of charts from the values stored in the cells. But it is usually needed modify the result *by hand*.



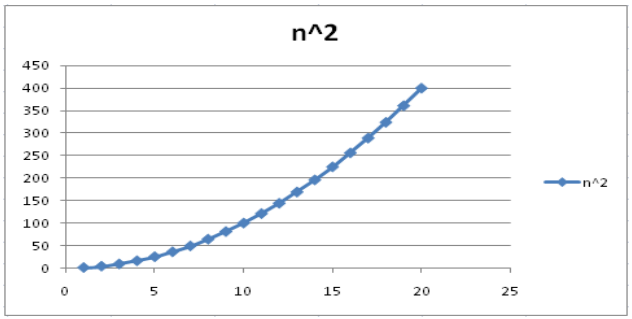
You can take a look to http://www.gcflearnfree.org/excel2010/17.2

Example

- Open Example3.
- Select all the cells of the columns n and n^2 (including the cells with the names of the columns).
- In the ribbon, select Insert → Chart → Scatter, and choose the forth option.



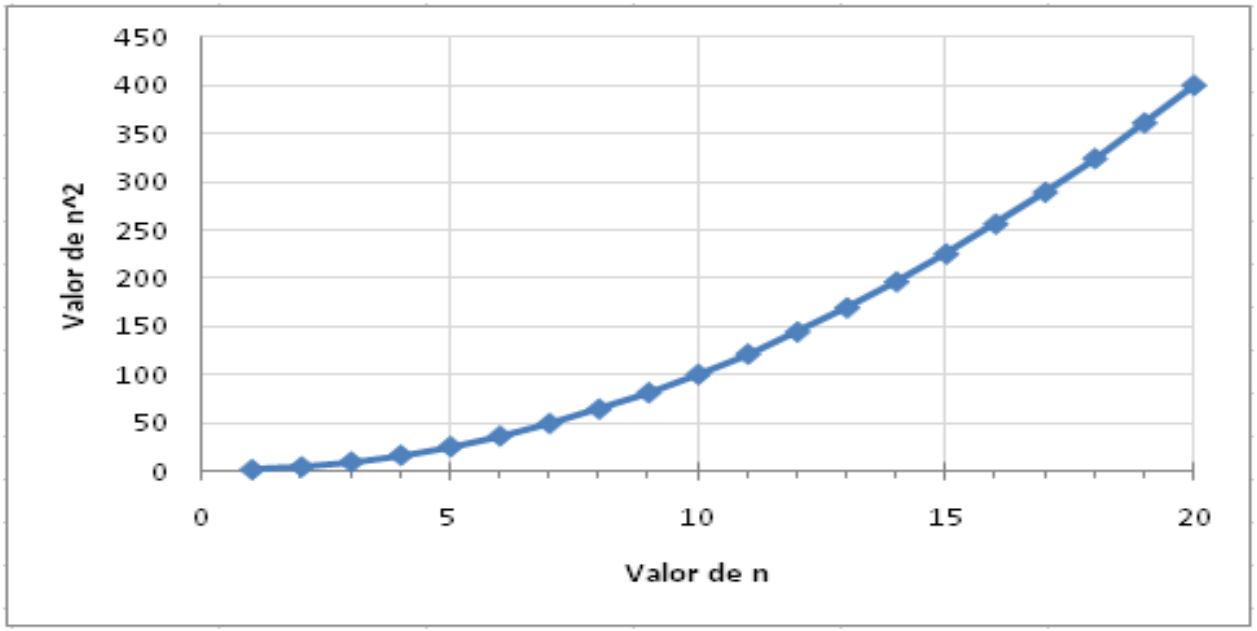
Example: Poor Result



The graph generated automatically has several problems.

1. The axes do not inform about what they represent.
2. The legend on the right is unnecessary (only one line).
3. The title is inappropriate.
4. The X axis reaches to 25, but the data end in 20.
5. The horizontal grid lines are too dark.
6. No vertical gridlines.

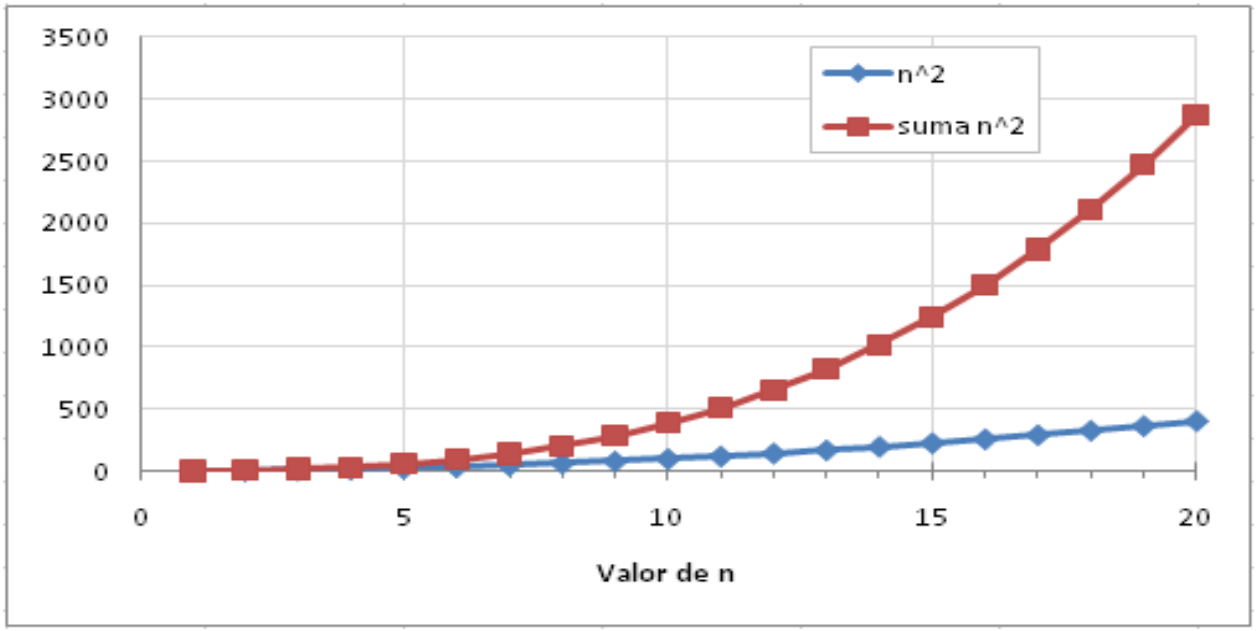
Final Result



Practise

1. Make the graph "$sumn^2$" against "n".
   - With the mouse, select the cells in column "n".
   - While pressing CTRL, select the cells in column "$sumn^2$" too.
   - Make a new scattered chart.
   - Repeat the previous process to solve representation problems.
2. Make a joint graph of "n^2" and "$sumn^2$" against "n"
   - With the mouse, select all data (the three columns and their titles).
   - Make a new graphic.
   - Improve it.

Practise: Possible result



Managing data organized in tables

- Excel can be useful for maintaining simple databases organized in tables.
- It allows you to order and filter data easily.
- Example: Load data stored in book named Cannes.xls
  - Convert it into a table.
  - Put the movies in alphabetical order by title.
  - Put movies in order by the year they got a prize.
  - Filter the movies in such a way that only spanish (or co-produced) films appear.
- Extra exercise: Find out the actresses prized since 2000

Statistical functions

The following are some of the functions Excel provides for basic statistical analysis.

Average AVERAGE(number1, number2, ...) or AVERAGE(range).

Median MEDIAN(number1, number2, ...) or MEDIAN(range).

Mode MODE(number1, number2, ...) or MODE(range).

Standard deviation STDEV(number1, number2, ...) or STDEV(range).

Variance VAR(number1, number2, ...) or VAR(range).

Maximum and minimum MAX or MIN(number1, number2, ...) or MAX or MIN(range).

Number of data COUNT(range)

Confidence interval CONFIDENCE(alpha,standard_dev,size)

Practise

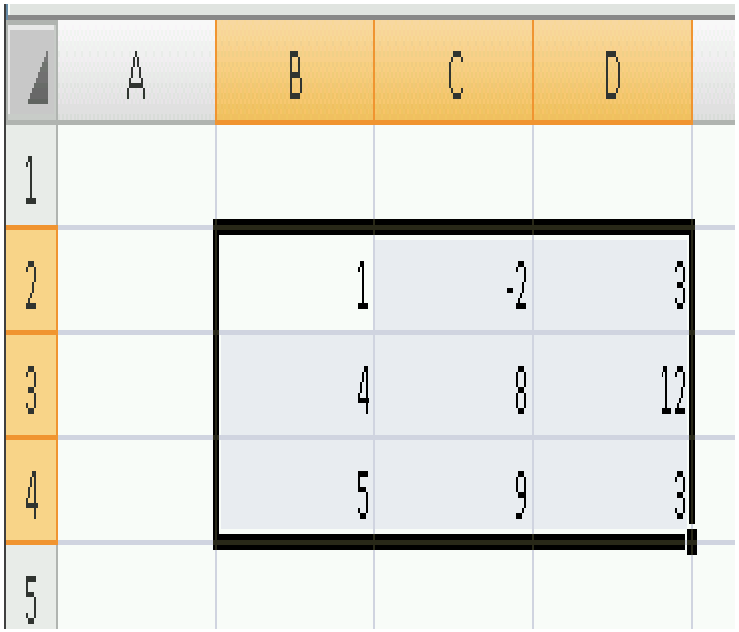
- Create a new Excel book.
- Load the page
  `http://www.itl.nist.gov/div898/strd/univ/michelso.html`
- Show the date in the browser.
- In the browser, select the data. Copy and paste them in a column in the new Excel book.
- Give a name to the range of data.
- Create a table with the previous statistical measures.

Result

	A	B	C	D	E	F	G
1		Velocidad de la luz (Mm/s)	Obtenido de http://www.itl.nist.gov/div898/strd/univ/michelso.html				
2		299,85					
3		299,74					
4		299,90		Estadísticas con fórmulas de Excel			
5		300,07					
6		299,93		Media	299,8524		
7		299,85		Error típico	0,007901055		
8		299,95		Mediana	299,85		
9		299,98		Moda	299,88		
10		299,98		Desviación estándar	0,079010548		
11		299,88		Varianza	0,006242667		
12		300,00		Rango	0,45		
13		299,98		Máximo	300,07		
14		299,93		Mínimo	299,62		
15		299,65		Suma	29985,24		
16		299,76		Cuenta	100		
17		299,81		Mayor	300,07		
18		300,00		Menor	299,62		
19		300,00		Nivel de confianza 95%	0,015485783		
20		299,96					

Operations with Matrices

- A rectangular region of the grid containing numbers, can be treated as an array



	A	B	C	D
1				
2		1	-2	3
3		4	8	12
4		5	9	3
5				

Example: B2:D4

- Excel has functions that operate on arrays
  - Example: To calculate the determinant, the function is MDETERM(B2:D4).
  - The result is -192. Check it.

Operations with Matrices

- Some operations with arrays, produce another array. For example, the inverse.
- Therefore the result does not fit on a cell. So, what is the procedure in this case?
- If the result of the formula is another array,
  - We must know in advance the size of the result.
  - We have to select a range of empty cells of the appropriate size.
  - We write the formula.
  - Press Mayus+Ctrl+Enter to finish.

Operations with Matrices

- Exercise: Calculate the inverse of the previous matrix.
  - The function is MINVERSE(array), where array is a numeric array with an equal number of rows and columns.

	A	B	C	D	E	F	G	H
1							Inversa	
2		1	-2	3		0,4375	-0,171875	0,25
3		4	8	12		-0,25	0,0625	0
4		5	9	3		0,02083333	0,0989583	-0,083333
5								

Operations with Matrices

- TRANSPOSE(array)
  - Shift the vertical and horizontal orientation of an array on a worksheet.
  - If the input range is $m \times n$, the output will be $n \times m$.
  - Be careful when you select the output range.
- MMULT(array1; array2)
  - Returns the matrix product of two arrays.
  - If array1 is $m \times n$, array2 must be $n \times k$.
  - The result is an array with the same number of rows as array1 and the same number of columns as array2.
- Try to repeat the following exercise.