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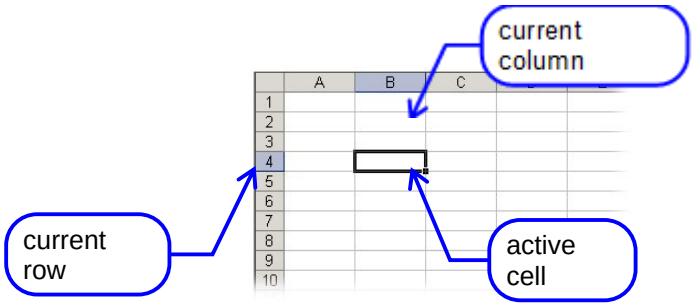
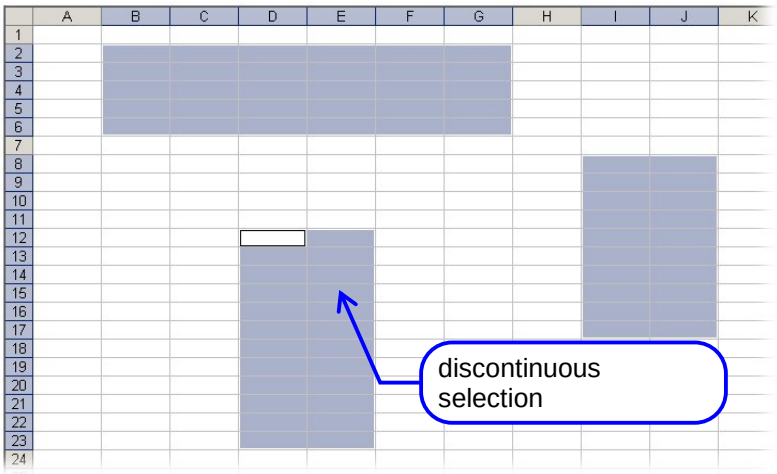
MS Excel is an example of a spreadsheet, a branch of software meant for performing different kinds of calculations, numeric data analysis and presentation, statistical operations and forecasts. The main part of a spreadsheet application is a grid consisting of equally (at least in a default view and configuration) distributed cells forming rows and columns. The rows are denoted by numbers (from 1 up to 65536, i.e. 2^{16}) and the columns by letters (from A to Z, then AA, AB up to IV, which makes a total number of columns equal to 256. i.e. 2^8). The cells are called by column and row identifiers, e.g. A3, G45, etc.



Active cell selection can be performed by means of mouse (simple clicking or keyboard arrows). The same refers to making a range selection (**Ctrl** and **Shift** keys are useful, especially in case of a discontinuous selections):

Note: *Please open excel file "EXCEL2010.xlsx" and save it as "lab_excel-studentname.xlsx" on the PC . DO EXERCICES IN THE SPREADSHEETS ALREADY CREATED IN THE FILE. THEY HAVE EXPLICIT NAMES RELATED WITH THE NUMBER OF THE EXERCICES (E.G. SPREADSHEET Exercise3-7 FOR EXERCISES 3 TO 7 DEFINED BELOW) AND MAY CONTAIN DATA TO SAVE TIME.*



Exercise 1

Open spreadsheet *Exercise1* and check different selection techniques. Try to make a selection as in the picture above. Check possibilities to select the whole tow/column by clicking on its header. Select multiple rows/columns, also discontinuously as in the picture below. Finally, select the whole worksheet by clicking on the upper-left corner (where row and column headers overlap, equivalent to **Ctrl+A** key combination).

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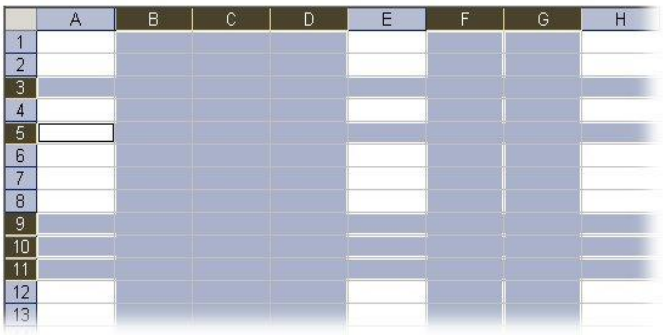
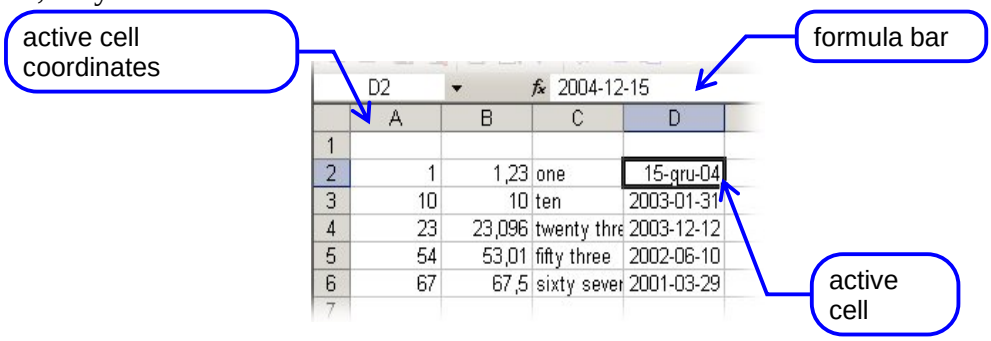


The most common way to enter data into a worksheet is just typing it. Accepting the cell value is done by:

- pressing **Enter** key (this moves the active cell one row down, useful when entering some column-sorted data),
- pressing **Tab** key (this moves the active cell one column right, useful when entering some row-sorted data),
- pressing any keyboard **arrow**,
- clicking somewhere outside the active cell.

In order to delete the cell content, make it active and just press **Delete** key or **Backspace** key (this removes cell data and starts its edition).

In case of cell edition, also select it as active. By double-clicking (equivalent to pressing **F2** key), you start editing the data within the cell. If you want to overwrite current cell data, just start typing on it. However, very often it becomes more convenient to edit the cell data in a **formula bar**:



Excel makes maximum effort to recognize data type (e.g. text, numeric, currency, date), which feature is **usually** ;) very useful and convenient. In case of each data type it applies appropriate alignment and some predefined display formats. **Be careful about the data types recognized by the software while entering data, as sometimes it is very difficult to change them.**

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Exercise 2

Enter the data below in spreadsheet *Exercise2*. Format the data so that they look as a table (change fonts, borders, shading, override default alignments, etc). Add some dummy header. Try also formatting the table using ***Format as Table*** button from the ***Styles*** group (try two of the four styles shown below).

code	date	notes	price
1,000	15 December 2004	one	1,23 zł
10,000	31 January 2003	ten	10,00 zł
0,000	31 October 2004	zero	0,00 zł
23,000	12 December 2003	twenty three	23,10 zł
54,000	10 June 2002	fifty three	53,01 zł
67,000	29 March 2001	sixty seven	67,50 zł

code	date	notes	price
1,000	15 December 2004	one	1,23 zł
10,000	31 January 2003	ten	10,00 zł
0,000	31 October 2004	zero	0,00 zł
23,000	12 December 2003	twenty three	23,10 zł
54,000	10 June 2002	fifty three	53,01 zł
67,000	29 March 2001	sixty seven	67,50 zł

code	date	notes	price
1,000	15 December 2004	one	1,23 zł
10,000	31 January 2003	ten	10,00 zł
0,000	31 October 2004	zero	0,00 zł
23,000	12 December 2003	twenty three	23,10 zł
54,000	10 June 2002	fifty three	53,01 zł
67,000	29 March 2001	sixty seven	67,50 zł

code	date	notes	price
1,000	**15 December 2004**	*one*	1,23 zł
10,000	**31 January 2003**	*ten*	10,00 zł
0,000	**31 October 2004**	*zero*	0,00 zł
23,000	**12 December 2003**	*twenty three*	23,10 zł
54,000	**10 June 2002**	*fifty three*	53,01 zł
67,000	**29 March 2001**	*sixty seven*	67,50 zł

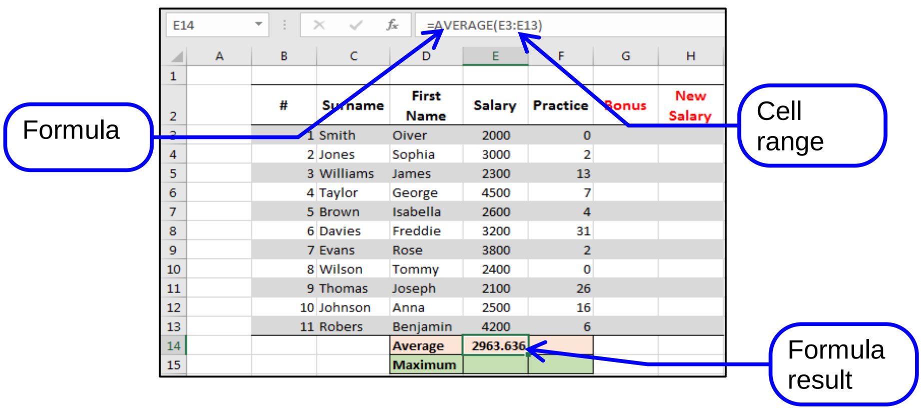
WARNING: REMEMBER TO OFTEN SAVE YOU WORK. WE NEVER KNOW WHAT CAN HAPPEN DURING THE LAB.

Exercise 3

Use the table already created in spreadsheet Exercise3-7 (see below):

	A	B	C	D	E	F	G	H
1								
2		#	Surname	First Name	Salary	Practice	Bonus	New Salary
3		1	Smith	Oiver	2000	0		
4		2	Jones	Sophia	3000	2		
5		3	Williams	James	2300	13		
6		4	Taylor	George	4500	7		
7		5	Brown	Isabella	2600	4		
8		6	Davies	Freddie	3200	31		
9		7	Evans	Rose	3800	2		
10		8	Wilson	Tommy	2400	0		
11		9	Thomas	Joseph	2100	26		
12		10	Johnson	Anna	2500	16		
13		11	Robers	Benjamin	4200	6		

Then enter the appropriate formula in the cell corresponding to **average salary** value:



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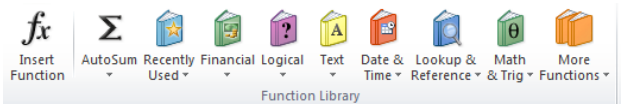
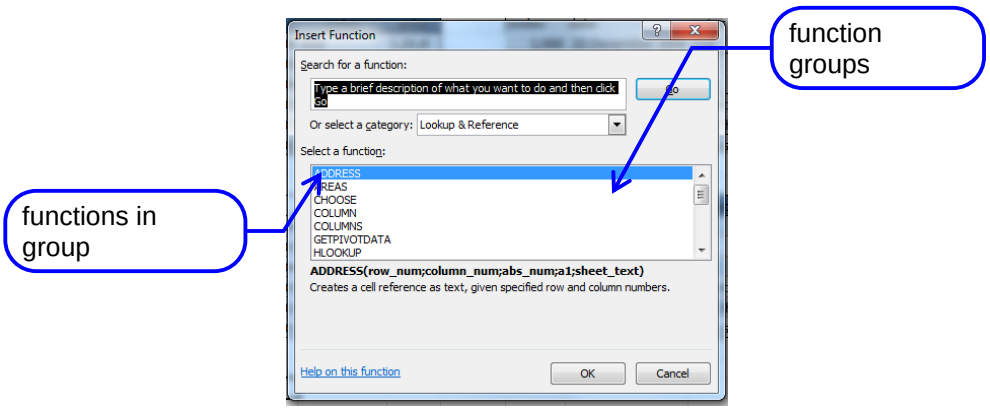
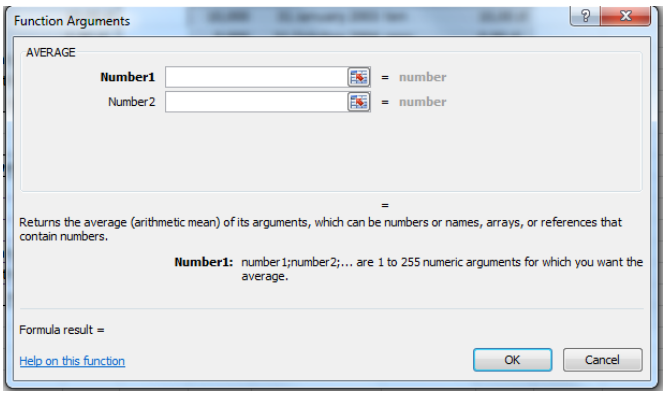
Hints:

1. Select a cell where the formula is to be entered.
2. If you already know the formula syntax (and the function name) you can directly type it in the formula bar (always prefix the formula with an equality sign '=').
3. Otherwise, choose the your formula from the large list of built-in functions available from the ***Formulas*** tab.



You can select your function from the different categories or press on the function button  . The dialog containing function group appears:





4. Choose appropriate group (Statistical in case of **AVERAGE** function) and the function itself. The another dialog shows, where you can enter the function arguments (e.g. cell range):
5. Click the range button and select the cell range (MS Excel will attempt to suggest the right range):

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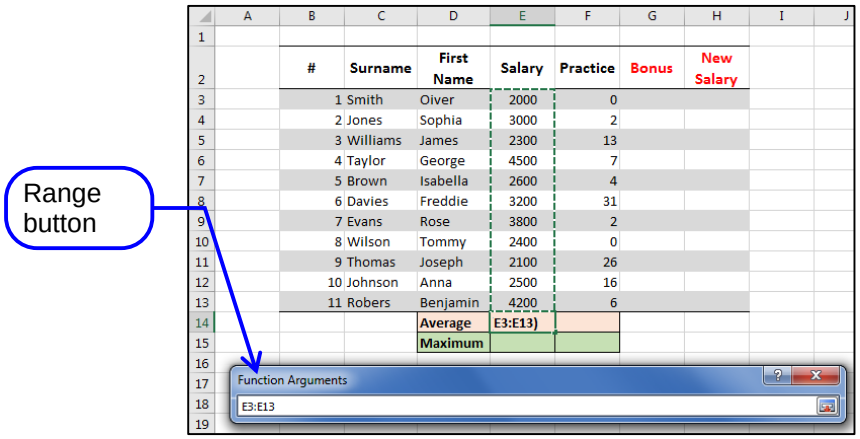

	#	Surname	First Name	Salary	Practice	Bonus	New Salary
3	1	Smith	Oiver	2000	0		
4	2	Jones	Sophia	3000	2		
5	3	Williams	James	2300	13		
6	4	Taylor	George	4500	7		
7	5	Brown	Isabella	2600	4		
8	6	Davies	Freddie	3200	31		
9	7	Evans	Rose	3800	2		
10	8	Wilson	Tommy	2400	0		
11	9	Thomas	Joseph	2100	26		
12	10	Johnson	Anna	2500	16		
13	11	Robers	Benjamin	4200	6		
14			Average	E3:E13)			
15			Maximum				

6. Accept the range and the formula.

Format the cell to 2 decimal places:

#	Surname	First Name	Salary	Practice	Bonus	New Salary
1	Smith	Oiver	2000	0		
2	Jones	Sophia	3000	2		
3	Williams	James	2300	13		
4	Taylor	George	4500	7		
5	Brown	Isabella	2600	4		
6	Davies	Freddie	3200	31		
7	Evans	Rose	3800	2		
8	Wilson	Tommy	2400	0		
9	Thomas	Joseph	2100	26		
10	Johnson	Anna	2500	16		
11	Robers	Benjamin	4200	6		
		Average	2963.64			
		Maximum				

Copy the formula to the adjacent cell corresponding to the average **practice**. Notice, that the cell range in the formula bar is also shifted (as the cells are):

#	Surname	First Name	Salary	Practice	Bonus	New Salary
1	Smith	Oiver	2000	0		
2	Jones	Sophia	3000	2		
3	Williams	James	2300	13		
4	Taylor	George	4500	7		
5	Brown	Isabella	2600	4		
6	Davies	Freddie	3200	31		
7	Evans	Rose	3800	2		
8	Wilson	Tommy	2400	0		
9	Thomas	Joseph	2100	26		
10	Johnson	Anna	2500	16		
11	Robers	Benjamin	4200	6		
		Average	2963.64	9.73		
		Maximum				

Calculate the maximum *salary* and *practice* using **MAX** function. Finally, apply the best fit to all the columns. **Keep the table for the next exercises (4-7)**.

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#	Surname	First Name	Salary	Practice	Bonus	New Salary
1	Smith	Oiver	2000	0		
2	Jones	Sophia	3000	2		
3	Williams	James	2300	13		
4	Taylor	George	4500	7		
5	Brown	Isabella	2600	4		
6	Davies	Freddie	3200	31		
7	Evans	Rose	3800	2		
8	Wilson	Tommy	2400	0		
9	Thomas	Joseph	2100	26		
10	Johnson	Anna	2500	16		
11	Robers	Benjamin	4200	6		
		Average	2963.64	9.73		
		Maximum	4500	31		

Exercise 4

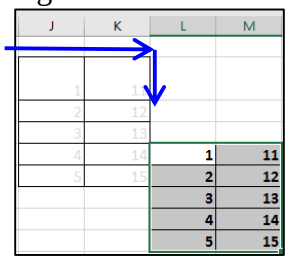
Enter the following data set (in column J):

J
1
2
3
4
5

In the right column (K) enter the formula increasing cell value by 10 (e.g. **=J2 + 10**). Remember, that it is enough to enter the formula in one cell, then drag it over other cells. The result is presented below.

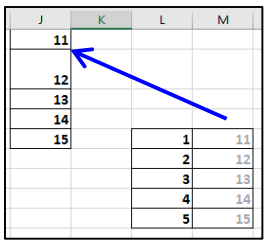
J	K
1	11
2	12
3	13
4	14
5	15

Select the whole data set (J**2:K6**) and drag it so that it starts in cell **L5**.



As shown in the above picture, each cell was shifted 2 columns right and 3 rows down. The values in the formula column do not change – this means that the formula were correctly translated, so that they refer to the appropriate cells. The first cell formula (formerly referring to the cell **J2**) now refers to the cell **L5**, i.e. **=L5 + 10**.

Select only the column with formulae. Move it for example as in the picture below. Notice, that none of the formulae changes, as the cells they refer to remain in the same location:



And now for something completely different :-) Move only the reference cell. See, that all the formulae adjust to the new cells' positions:

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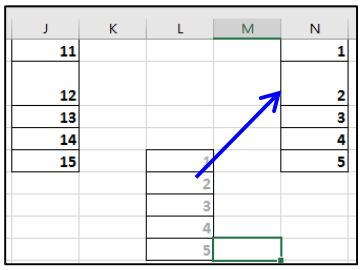


In the above exercises, the functions used as their arguments cell ranges, e.g. in **MAX(E3:E9)** the cell range is **E3:E9**. The range is denoted as the top-left corner cell, colon, the bottom-right corner cell. In the case of single column ranges, only row numbers change in a range limit. Similarly, for single row ranges only the column letter changes.

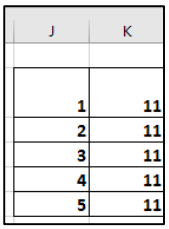
Notice, that in either formula there appeared **relative cell references**. This means, that when copying the formula, or moving the cell with the formula, the cell references are shifted (translated) in the same manner as the cell corresponding to its base location.

The **absolute cell references** refer always to a stated cell (sometimes only a row or a column). They are denoted with **$** preceding a column and/or row, e.g. **A3**, **$B5**, **G$29**.

`

Exercise 5

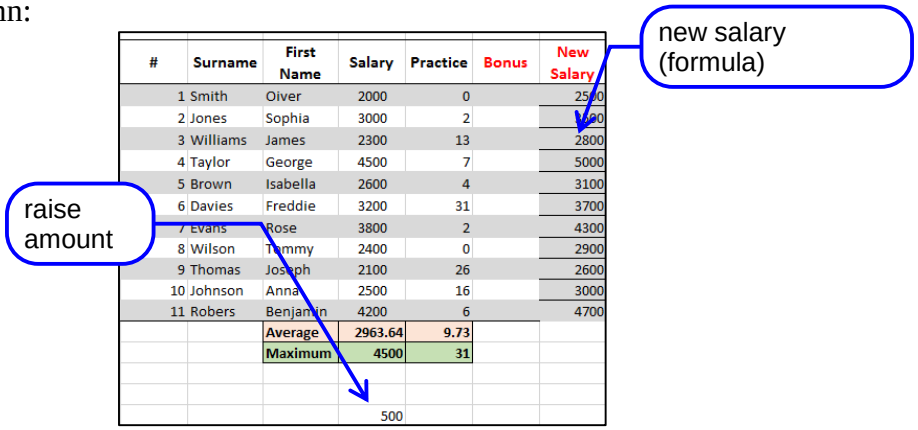
Having the data set and the formulae from previous exercise (move it again to columns A and B), modify the formula in the first row in the following way **=J2 + 10**. Propagate the formula over other cells containing the formula:



Check the copied formulae. In each there is the reference **J2**. It remains constant during the copying process. Try data range manipulations as in the previous exercises and compare their results.

Exercise 6

Use the table from exercise 3. Create an additional cell containing a value equal to 500. Using a formula with an absolute reference, give each employee 500 raise. Of course, the new salary must be placed in a new column:



The following steps will format the sheet in a way enabling us to hide from the users unwanted data. At first, move the data range with the previous salary somewhere outside the table. Do the same with the raise cell (place it in the same column as the previous salary). Formulae will by automatically

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updated:

#	Surname	First Name	Salary	Practice	Bonus	New Salary	
1	Smith	Oiver		0		2500	2000
2	Jones	Sophia		2		3500	3000
3	Williams	James		13		2800	2300
4	Taylor	George		7		5000	4500
5	Brown	Isabella		4		3100	2600
6	Davies	Freddie		31		3700	3200
7	Evans	Rose		2		4300	3800
8	Wilson	Tommy		0		2900	2400
9	Thomas	Joseph		26		2600	2100
10	Johnson	Anna		16		3000	2500
11	Robers	Benjamin		6		4700	4200
		Average	2963.64	9.73			
		Maximum	4500	31			500

Now fix the new salary in the table and apply the formatting:

#	Surname	First Name	Salary	Practice	Bonus	New Salary	
1	Smith	Oiver	2500	0			2000
2	Jones	Sophia	3500	2			3000
3	Williams	James	2800	13			2300
4	Taylor	George	5000	7			4500
5	Brown	Isabella	3100	4			2600
6	Davies	Freddie	3700	31			3200
7	Evans	Rose	4300	2			3800
8	Wilson	Tommy	2900	0			2400
9	Thomas	Joseph	2600	26			2100
10	Johnson	Anna	3000	16			2500
11	Robers	Benjamin	4700	6			4200
		Average	3463.64	9.73			
		Maximum	5000	31			500

Check the formula for the average and maximum salaries. Which cell do they refer to? If the reference was translated and still binds the previous salary, correct the formulae.

#	Surname	First Name	Salary	Practice	Bonus	New Salary	
1	Smith	Oiver	2500	0			2000
2	Jones	Sophia	3500	2			3000
3	Williams	James	2800	13			2300
4	Taylor	George	5000	7			4500
5	Brown	Isabella	3100	4			2600
6	Davies	Freddie	3700	31			3200
7	Evans	Rose	4300	2			3800
8	Wilson	Tommy	2900	0			2400
9	Thomas	Joseph	2600	26			2100
10	Johnson	Anna	3000	16			2500
11	Robers	Benjamin	4700	6			4200
		Average	3463.64	9.73			
		Maximum	5000	31			500

At the end, click on the column with the previous salary and the raise. Try deleting the values of cells involved in the formulae. Since a numeric value of an empty cell in MS Excel is 0 (zero), the formulae results are recalculated:

#	Surname	First Name	Salary	Practice	Bonus	New Salary
1	Smith	Oiver	0	0		
2	Jones	Sophia	0	2		
3	Williams	James	0	13		
4	Taylor	George	0	7		
5	Brown	Isabella	0	4		
6	Davies	Freddie	0	31		
7	Evans	Rose	0	2		
8	Wilson	Tommy	0	0		
9	Thomas	Joseph	0	26		
10	Johnson	Anna	0	16		
11	Robers	Benjamin	0	6		
		Average	0.00	9.73		
		Maximum	0	31		

updated formulae's results

On the other hand, if you delete the cells (the whole column or only the range), an error of invalid address is returned from the formulae:

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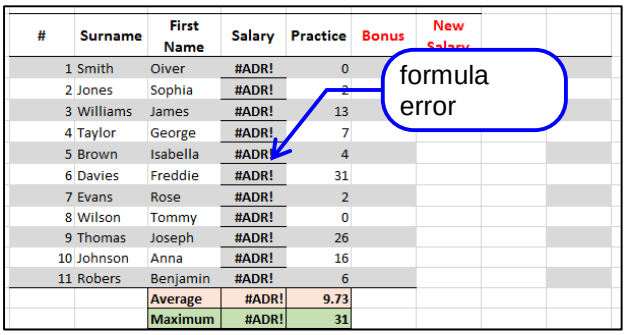
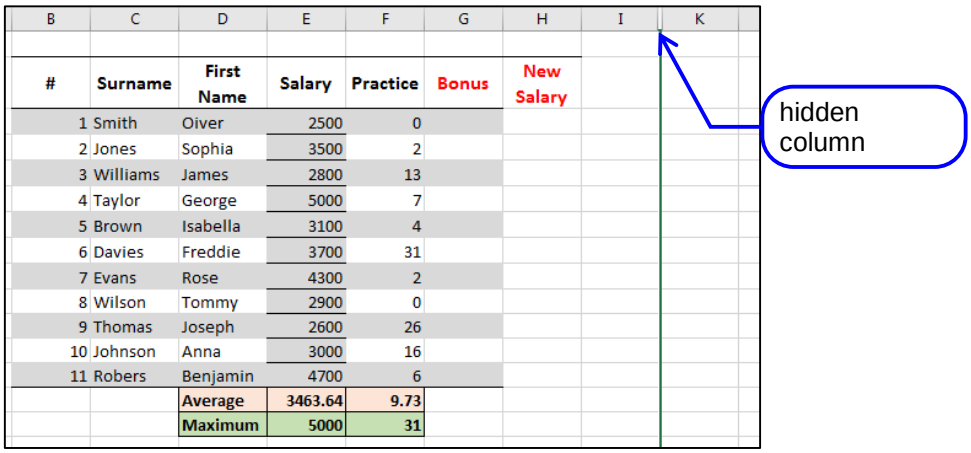


#	Surname	First Name	Salary	Practice	Bonus	New Salary
1	Smith	Oiver	#ADR!	0		
2	Jones	Sophia	#ADR!	2		
3	Williams	James	#ADR!	13		
4	Taylor	George	#ADR!	7		
5	Brown	Isabella	#ADR!	4		
6	Davies	Freddie	#ADR!	31		
7	Evans	Rose	#ADR!	2		
8	Wilson	Tommy	#ADR!	0		
9	Thomas	Joseph	#ADR!	26		
10	Johnson	Anna	#ADR!	16		
11	Robers	Benjamin	#ADR!	6		
		Average	#ADR!	9.73		
		Maximum	#ADR!	31		

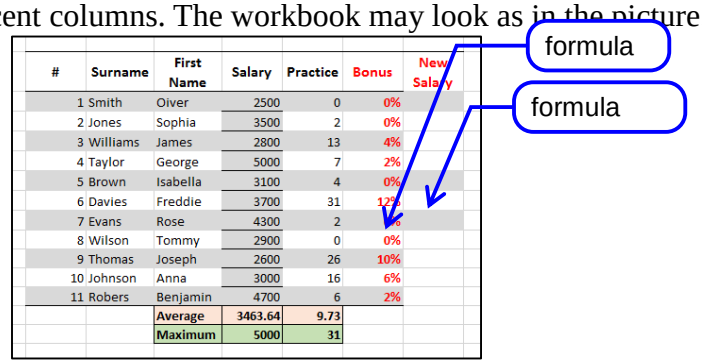
Since the values from the cells referred to in formulae must exits in the worksheet, you may not delete them. However, in most cases it is enough to hide a column or a row with "spare" data. Do it by selecting the column and choosing **Hide** from the context menu. Try also to unhide the hidden column:



B	C	D	E	F	G	H	I	K
#	Surname	First Name	Salary	Practice	Bonus	New Salary		
1	Smith	Oiver	2500	0				
2	Jones	Sophia	3500	2				
3	Williams	James	2800	13				
4	Taylor	George	5000	7				
5	Brown	Isabella	3100	4				
6	Davies	Freddie	3700	31				
7	Evans	Rose	4300	2				
8	Wilson	Tommy	2900	0				
9	Thomas	Joseph	2600	26				
10	Johnson	Anna	3000	16				
11	Robers	Benjamin	4700	6				
		Average	3463.64	9.73				
		Maximum	5000	31				

Exercise 7

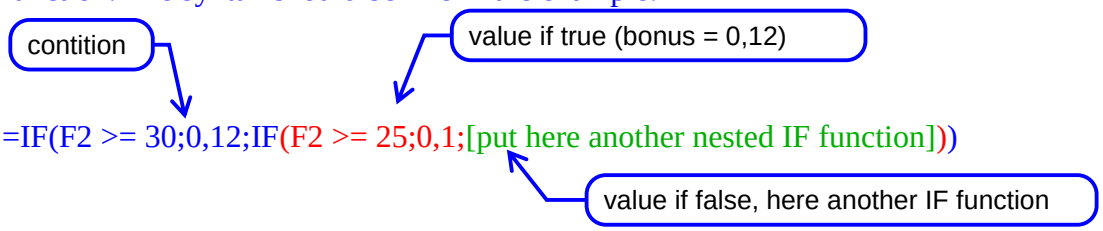
Use the same table, but now look at the 2 empty columns *bonus* and *new salary*. Write 2 formulae enabling to determine employee's practice bonus (e.g. 2 % for each 5 years, with maximum 12 %) and the total salary in the adjacent columns. The workbook may look as in the picture:



#	Surname	First Name	Salary	Practice	Bonus	New Salary
1	Smith	Oiver	2500	0	0%	
2	Jones	Sophia	3500	2	0%	
3	Williams	James	2800	13	4%	
4	Taylor	George	5000	7	2%	
5	Brown	Isabella	3100	4	0%	
6	Davies	Freddie	3700	31	12%	
7	Evans	Rose	4300	2	0%	
8	Wilson	Tommy	2900	0	0%	
9	Thomas	Joseph	2600	26	10%	
10	Johnson	Anna	3000	16	6%	
11	Robers	Benjamin	4700	6	2%	
		Average	3463.64	9.73		
		Maximum	5000	31		

Hints:

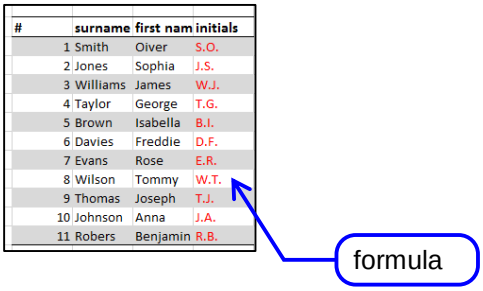
1. Use **nested** IF function: IF(condition;[if true];[else]), where [else] clause is another IF function. The syntax should be like in the example:



2. References to another worksheet cells are denoted as **[worksheet name]![cell address]**, e.g. **Sheet1!F32**. The expressions should look like this:
=(1+Sheet2!D2)*Sheet1!C2
You can type the references or click on the appropriate cell in another worksheet while entering the formula.

Exercise 8

Use the table already created in spreadsheet *Exercise8*. In the third column create a formula displaying initials of the people:



#	surname	first nam	initials
1	Smith	Oiver	S.O.
2	Jones	Sophia	J.S.
3	Williams	James	W.J.
4	Taylor	George	T.G.
5	Brown	Isabella	B.I.
6	Davies	Freddie	D.F.
7	Evans	Rose	E.R.
8	Wilson	Tommy	W.T.
9	Thomas	Joseph	T.J.
10	Johnson	Anna	J.A.
11	Robers	Benjamin	R.B.

Hint:

The functions required in the formula are:
CONCATENATE(*text1;text2;...***)** - concatenation of text1, text2, ...
MID(*text,starting_character;number_of_characters***)** – substring of *text* starting at *starting_character* (the first one is 1), *number_of_characters* long, e.g.
MID("some text";2;6) retrieves "ome te".

MS Excel 2010 offers a large set of graphs and plots for data visualization. For those who are familiar with older version of Excel, the layout is completely different. The following exercises demonstrate different graphs and the set of operations to create and manipulate them.

Exercise 9

Now, move to spreadsheet Exercise9-10-12. You will notice that a column is already created with values ranging from -10 to 10 with a step of 0.5. Be aware that you should know how to create such column automatically. Ask the teacher if you need help.
Enter the function $f(x) = log^2 \mid 3x + 1 \mid$ in column B. Here, the variable *x* corresponds to cell values in column A and *f(x)* corresponds to corresponding function values in column B.
Create a line plot of the function.

Hints:

1. Select the whole data range and click ***Insert*** tab, then on the ***Scatter*** button from the ***Charts*** group. Then select ***Scatter with Smooth Lines and Markers*** from the different plot choices (If it does not work, simply select ***Marked Scatter***, then select points in chart, click right and select ***Format Data Series***):

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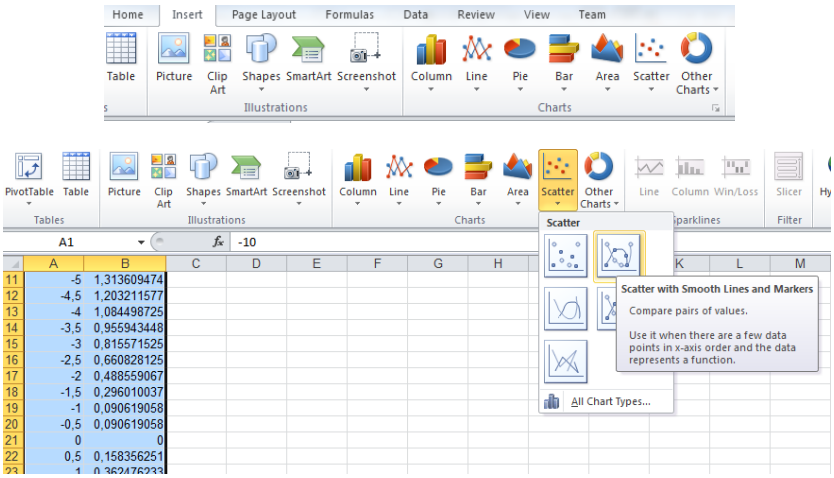
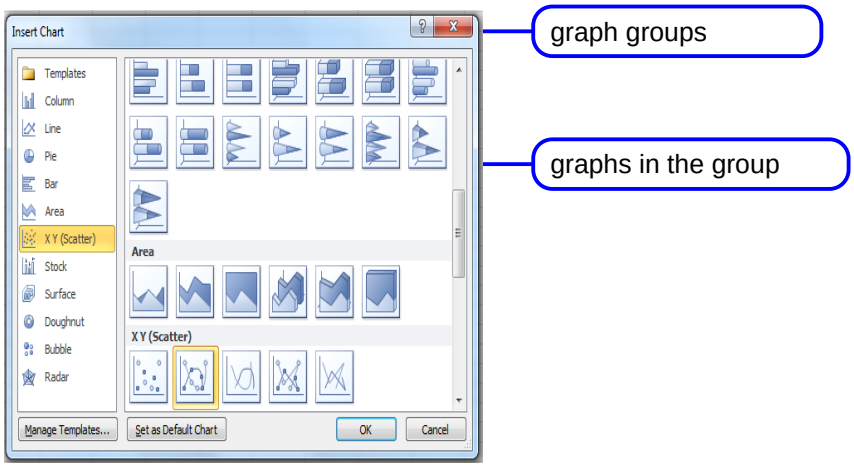
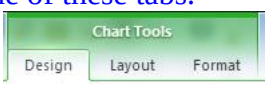


A default chart is inserted to the worksheet. Remember, the 1st column corresponds to the abscissae, the 2nd one to the ordinates. Alternatively, you can choose the chart type from the ***Insert Chart*** dialog box when you click on the little arrow at the bottom-right hand side of the ***Charts*** group.



2. You can now notice that the menu bar as changed its display, with a ***Chart tools*** banner appearing above the ***Design***, ***Layout*** and ***Format*** tabs. When a chart is activated, you can change its display by accessing one of these tabs.



3. A chart is composed of different components. All of them are displayed in a drop-down list in the ***Current Selection*** group of the ***Layout*** or ***Format*** tab. For instance, a default chart, as shown below, is composed of the plotted series, a plot area, value axes, grid lines, a chart area and a legend of the series.

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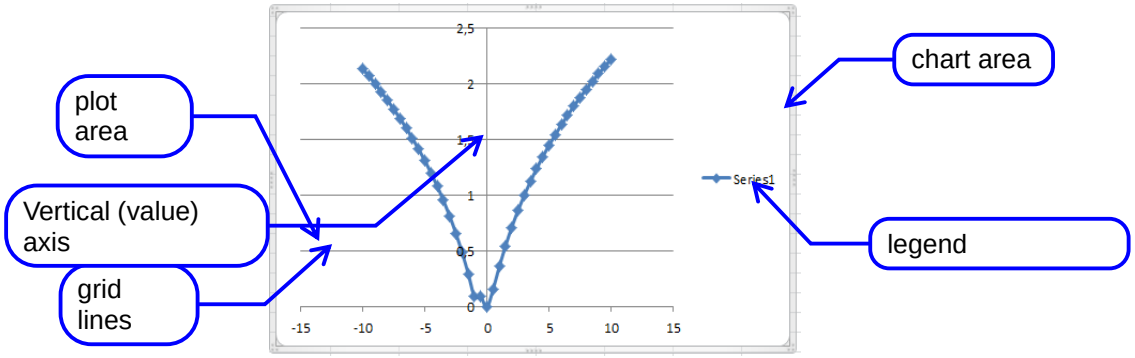
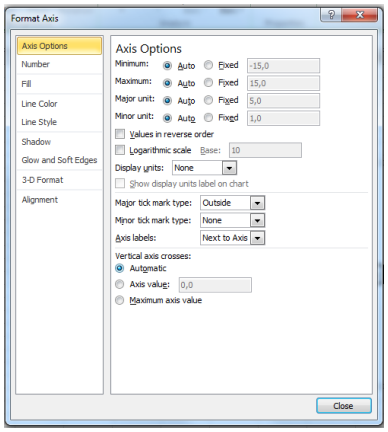
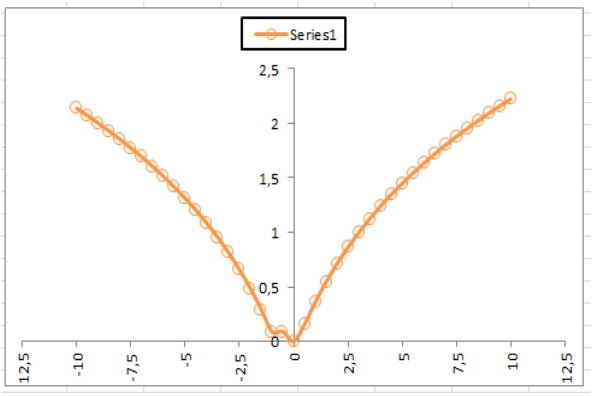


However, it can be more detailed by adding a chart title and the axis titles. Each items can be edited. They can be accessed from the drop-down list mentioned above, or simply by clicking on them. To change their properties, either choose options from the toolbar, open the ***Format "item"*** Dialog box (e.g. ***Format Axis***) by clicking on ***Format Selection*** of the ***Current Selection*** group or from the context menu.



Exercise 10

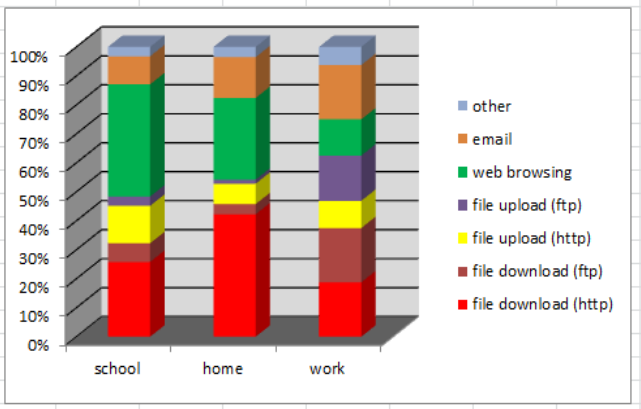
Based on the information provided above, format the plot from the previous exercise so that it looks like in the example below:



Exercise 11

Move to *Exercise11* spreadsheet and create the column chart basing on the values:

network load			
	school	home	work
file download (http)	40	60	30
file download (ftp)	10	5	30
file upload (http)	20	10	15
file upload (ftp)	5	2	25
web browsing	60	40	20
email	15	20	30
other	5	5	10



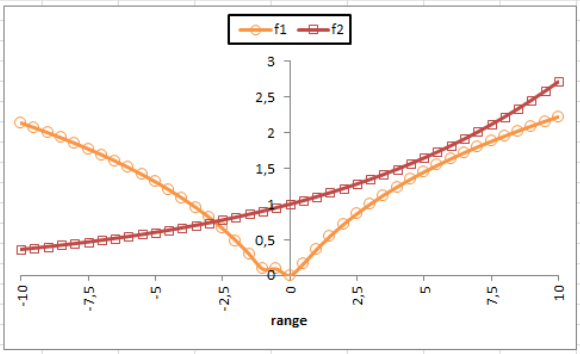
Hints:

1. Insert one of the default bar types which corresponds the best to what is needed, then you can click on the ***Switch Row/Column*** button of the ***Data*** group displayed in the ***Design*** tab to change the series.
2. In the Plot Area, the different sides of the 3D view are called ***floor***, ***side*** and ***back walls*** in the component drop-down list.
3. Select each data series and change its color.

Exercise 12

Go back to the worksheet corresponding to *Exercise9-10-12* and add to the chart a new plot corresponding to the function f(x)=exp(x/10) (function f2).The updated worksheet should look as follows:

	range	f1	f2
2	-10	2,138607904	0,367879441
3	-9,5	2,071678604	0,386741023
4	-9	2,002149575	0,40656966
5	-8,5	1,92978241	0,427414932
6	-8	1,854302699	0,449328964
7	-7,5	1,775392249	0,472366553
8	-7	1,69267905	0,496585304
9	-6,5	1,605724189	0,522045777
10	-6	1,514004548	0,548811636
11	-5,5	1,416889552	0,57694981
12	-5	1,313609474	0,60653066
13	-4,5	1,203211577	0,637628152
14	-4	1,084498725	0,670320046
15	-3,5	0,955943448	0,70468809
16	-3	0,815571525	0,740818221
17	-2,5	0,660828125	0,778800783
18	-2	0,488559067	0,818730753
19	-1,5	0,296010037	0,860707976
20	-1	0,090619058	0,904837418
21	-0,5	0,090619058	0,951229425



Hints:

1. to add a new series to the chart, click on the ***Select Data*** button 

. In the Select Data Source dialog box, click on add, then select the right series name, X and Y values. Update also the name for the column B (i.e. f2).
2. Add an Horizontal Axis Title.
3. Modify the chart/plot styles to match the example as much as you can.

Exercise 13

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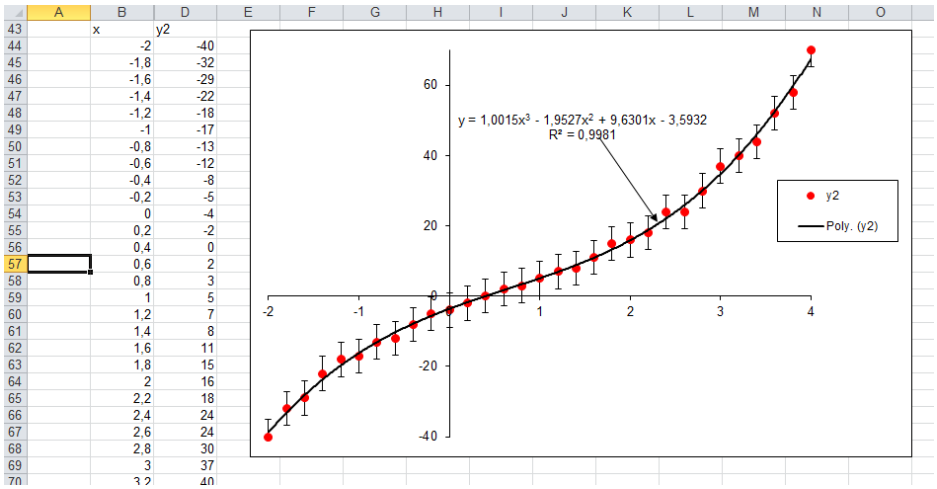
The measured data very often contains some error. Go to spreadsheet *Exercise13-14* and create the scattered plot (select column B-C). Add the trend line, assuming the most accurate approximation. Indicate also the standard error bars (or any error type you assume in the measurement):

Hints:



1. You can insert a trend line from the context menu or by clicking on the ***Trendline*** button (***Layout*** tab), then select ***More Trendline Options...***
2. Use polynomial approximation (degree: 3) for the trend curve. Display also the equation and the R^2 value on the chart
3. To embed the arrow, go to the ***Insert*** tab and click on ***Shapes***. Modify the style in consequence.
4. Verify that the arrow moves with the chart

Exercise 14

Using the embedded Solver is another way to fit a given function to a set of scattered values. If the Solver is not yet installed, proceed as follows:

- Go in the File → Options → Add-ins
- Select Solver Add-in and click on the Go button
- Check Solver Add-in and click OK
- You can find the Solver on the Data tab

In the spreadsheet *Exercise13-14*, add a new polynomial function of order 3 for the given domain interval (column B "x"), e.g. in column D. Prior to this, set the 4 polynomial constants to arbitrary values and called them in the function using absolute referencing.
In a new column, set the absolute difference between the scattered data (column C "y2") and polynomial function, e.g. in column D. Then set the sum of the column. This is the parameter you will minimized in solver, while changing the polynomial constants.
To do so, open the Solver window and do the following steps:

- Link the "Set Objective" to the cell where you calculating the sum of the absolute difference
- Select ***Min***, to have the Objective Cell as small as possible
- Set the "*Changing Variable Cells*" to the range of cells where you defined the polynomial constants
- Uncheck the "*Make Unconstrained Variables Non-Negative*" check-box

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- Select the "*GRG nonlinear*" solving methods
- Press "*solve"*

Compare the results of the optimized polynomial constants with the ones from the trend line.