



Excel 2

Module 2 – Formulas & Functions

Module Overview

This module is part of the Excel 2 course which is for advancing your knowledge of Excel. During this lesson we will expand on your existing knowledge of formulas and functions.

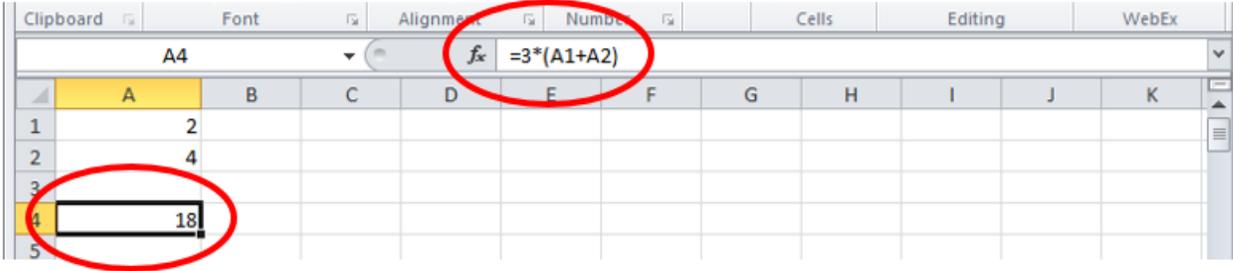
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- 2. Complex Functions - Vlookup6**

1. Formulas and Functions Review

All functions and formulas begin with an “=” sign. Formulas typically use mathematical operators, listed in the table to the right. By default, functions and formulas will show the answers in the worksheet. To see the function or formula you must select the cell and use the formula bar to evaluate the formula or function.

Excel Operators	
Plus +	Addition
Minus -	Subtraction
Asterisk *	Multiplication
Slash /	Division
Caret ^	Exponentiation
Parentheses ()	Precedence



Follow Me	Open Weekly Totals	<p>The screenshot shows a spreadsheet with a formula bar containing $=B5+C5+D5+E5+F5$. The spreadsheet table is as follows:</p> <table border="1"> <thead> <tr> <th></th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td>Monday</td> <td>Tuesday</td> <td>Wednesday</td> <td>Thursday</td> <td>Friday</td> <td>Total</td> </tr> <tr> <td>2</td> <td>Week 1</td> <td>2</td> <td>2</td> <td>7</td> <td>9</td> <td>1</td> <td>21</td> </tr> <tr> <td>3</td> <td>Week 2</td> <td>1</td> <td>4</td> <td>6</td> <td>3</td> <td>10</td> <td>24</td> </tr> <tr> <td>4</td> <td>Week 3</td> <td>5</td> <td>5</td> <td>3</td> <td>5</td> <td>1</td> <td>19</td> </tr> <tr> <td>5</td> <td>Week 4</td> <td>8</td> <td>3</td> <td>9</td> <td>5</td> <td>3</td> <td>28</td> </tr> <tr> <td>6</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		A	B	C	D	E	F	G	1		Monday	Tuesday	Wednesday	Thursday	Friday	Total	2	Week 1	2	2	7	9	1	21	3	Week 2	1	4	6	3	10	24	4	Week 3	5	5	3	5	1	19	5	Week 4	8	3	9	5	3	28	6							
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5	Week 4	8	3	9	5	3	28																																																			
6																																																										
	<ol style="list-style-type: none"> 1. Open Weekly Totals.xlsx – <i>This is the workbook created during Excel 2 – Module 1.</i> 2. Select the Total Chart and using the delete key, remove the chart. 																																																									

In the Weekly Totals workbook, the formulas under Total (column G) add each of the week’s days (Week 1 Monday, Tuesday, Wednesday, Thursday, and Friday) by adding each day’s cell reference. Remember, cell references allow us to change the value of a particular day without needing to update all the formulas and functions using that day (so you only need to update one cell).

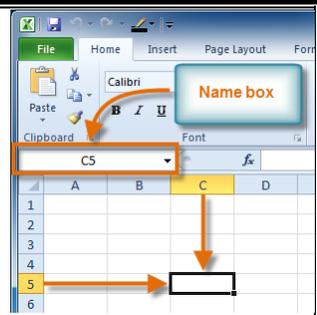
Vocabulary	Cell Reference	<p>The screenshot shows an Excel spreadsheet with the Name box displaying C5. Arrows point from the Name box to cell C5 in the spreadsheet grid.</p>
	<p><i>Noun</i></p> <p>Cell Reference is the intersection of a row and column, used to describe the location of a cell within a spreadsheet.</p>	

Functions in Excel can be used to make working in Excel simpler. Let’s begin with a simple example of a function.

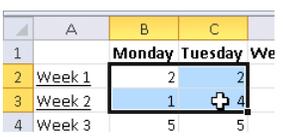
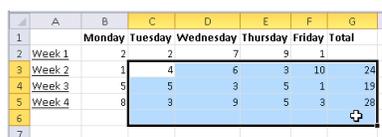
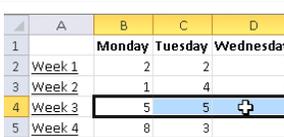
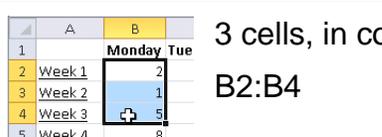
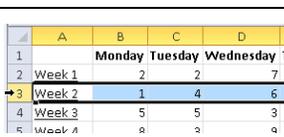
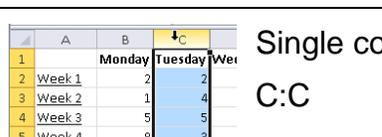
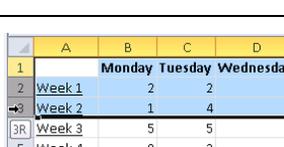
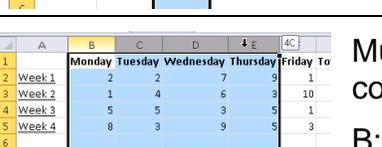
Follow Me	<p>Change formulas into functions</p> <ol style="list-style-type: none"> In G2, replace =B2+C2+D2+E2+F2 with the SUM function. Type =SUM(B2,C2,D2,E2,F2) – remember to hit enter after entering data into a cell.
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1.1. Cell Ranges

When using functions Excel allows cell ranges to be used. These allow the user to enter in many cells for a calculation rather than selecting individual cells.

Vocabulary	Cell Range	
	<p><i>Noun</i></p> <p>Cell Range or just Range refers to a selection of cells. It is noted as the first cell reference and last cell reference of a selection with a “:” between.</p> <p>For example A2:A10 or B4:D9</p>	

Ranges are always ordered from the left or top most to the bottom or right most. Ranges can also be used for full columns or rows.

Example Ranges	
 <p>4 cells, square B2:C3</p>	 <p>20 cells, rectangle C3:G6</p>
 <p>3 cells, in row B4:D4</p>	 <p>3 cells, in column B2:B4</p>
 <p>Single row 3:3</p>	 <p>Single column C:C</p>
 <p>Multiple(3) rows 1:3</p>	 <p>Multiple(4) columns B:E</p>

Follow Me	Replace cell references for range																																																															
	<ol style="list-style-type: none"> In G2, replace =SUM(B2+C2+D2+E2+F2) with the same function using a range. Type =SUM(B2:F2) – you can use your mouse to click and select the range or type it. Using the auto fill, change all of the formulas under Total to the new function 																																																															
	<table border="1"> <thead> <tr> <th></th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> <th>H</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td>Monday</td> <td>Tuesday</td> <td>Wednesday</td> <td>Thursday</td> <td>Friday</td> <td>Total</td> <td></td> </tr> <tr> <td>2</td> <td>Week 1</td> <td>2</td> <td>2</td> <td>7</td> <td>9</td> <td>1</td> <td>=SUM(B2:F2)</td> <td></td> </tr> <tr> <td>3</td> <td>Week 2</td> <td>1</td> <td>4</td> <td>6</td> <td>3</td> <td>10</td> <td>24</td> <td></td> </tr> <tr> <td>4</td> <td>Week 3</td> <td>5</td> <td>5</td> <td>3</td> <td>5</td> <td>1</td> <td>19</td> <td></td> </tr> <tr> <td>5</td> <td>Week 4</td> <td>8</td> <td>3</td> <td>9</td> <td>5</td> <td>3</td> <td>28</td> <td></td> </tr> <tr> <td>6</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			A	B	C	D	E	F	G	H	1		Monday	Tuesday	Wednesday	Thursday	Friday	Total		2	Week 1	2	2	7	9	1	=SUM(B2:F2)		3	Week 2	1	4	6	3	10	24		4	Week 3	5	5	3	5	1	19		5	Week 4	8	3	9	5	3	28		6							
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1.2. Absolute Reference

In some cases there may be parts of the formula that you will not want to change when copying or auto filling formulas. To do this you need to tell Excel which part of the cell reference should not change (the row or the column) when the formula is copied to a different location in the worksheet. To do this, put a \$ in front of the part you do not want to change.

Allow changes	A1
Do not change the Row	A\$1
Do not change the Column	\$A1
Do not change either (always the same cell)	\$A\$1

In our example, Weekly Totals, let's calculate the average of the week Totals and compare each week to that average.

Follow Me	Compare Totals to Average																																																																																																																																																																																																																																																																																	
	<ol style="list-style-type: none"> In A7 type Average Select B7, click the function button. Search for Average by typing average into the top box and clicking go. Select Average if needed and click OK. 																																																																																																																																																																																																																																																																																	
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Using the Function Arguments dialog box is one of the easiest ways to ensure your function works correctly. The box will guide you through the function parameters and the bottom of the box shows the Formula result.

Follow Me

Compare Totals to Average Cont.

We would like to average the weekly totals.

- 5. Select the range of weekly Totals for Number1, **G2:G5**
- 6. Click OK once you have selected or typed in the range.

The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		Monday	Tuesday	Wednesday	Thursday	Friday	Total						
2	Week 1	2	2	7	9	1	21						
3	Week 2	1	4	6	3	10	24						
4	Week 3	5	5	3	5	1	19						
5	Week 4	8	3	9	5	3	28						
6													
7	Average	G2:G5											

The 'Function Arguments' dialog box is open, showing the AVERAGE function with the following details:

- Function:** AVERAGE
- Number1:** G2:G5 (Range: {21;24;19;28})
- Number2:** (Empty)
- Formula result:** = 23

Now that the average has been calculated we can compare each weekly Total to the Average, being careful to use absolute cell reference to ensure the cell reference representing the average does not change as the function is copied.

Follow Me

Compare Totals to Average Cont.

- 7. In H1 type **Difference**
- 8. In cell H2 enter the following formula, **=G2-\$B\$7**
- 9. Using the auto fill, add the formula to the other weeks (through H5)

The screenshot shows the same Excel spreadsheet as before, but with the 'Difference' column added in column H. The formula bar shows '=G2-\$B\$7'.

	A	B	C	D	E	F	G	H	
1		Monday	Tuesday	Wednesday	Thursday	Friday	Total	Difference	
2	Week 1	2	2	7	9	1	21	-2	
3	Week 2	1	4	6	3	10	24	1	
4	Week 3	5	5	3	5	1	19	-4	
5	Week 4	8	3	9	5	3	28	5	
6									
7	Average	23							

2. Complex Functions - Vlookup

Entering in more complex functions can be easy using the Function Arguments dialog box. Let's work through another example.

Vlookups can be used to pull information into a table from another table. One variable in the table should be unique, such as name, social security number, or ID number. That variable must be included in both tables you are working with.

In our example, we will use Vlookup to add birthdates to our list of students. The first table will be a teacher's class roster. The second table will be a master list of school birthdays.

<p>Follow Me</p> <p>Open Ms Roberts Birthdays</p> <ol style="list-style-type: none"> 1. Open Ms Roberts Birthdays.xlsx 2. Add Birthdays to D2. <p><i>Ms Roberts has 19 students. There are 218 student birthdays in the Birthdays tab, they are currently sorted by day.</i></p> <p><i>Adding each birthday to the list will take time, a fast way is to use a vlookup.</i></p>	Open Ms Roberts Birthdays				
	1	Ms Roberts - 1st Hour			
	2	Student ID	Last Name	First Name	Birthdays
	3	20160109	Ahtisaari	Martti	
	4	20160135	Annan	Kofi	
	5	20160147	Carter	Jimmy	
	6	20160172	Dae-jung	Kim	
	7	20160187	Ebadi	Shirin	
	8	20160207	ElBaradei	Mohamed	
	9	20160212	Gbowee	Leymah	
	10	20160216	Gore	Albert	
	11	20160220	Hume	John	
	12	20160231	Karman	Tawakkol	
	13	20160233	Maathai	Wangari	
	14	20160242	Obama	Barack	
	15	20160244	Santos	Juan	
	16	20160249	Satyarthi	Kailash	
	17	20160259	Sirleaf	Ellen	
	18	20160287	Trimble	David	
	19	20160288	Xiaobo	Liu	
	20	20160295	Yousafzai	Malala	
	21	20160302	Yunus	Muhammad	
22					

Let's take a look at the vlookup function.

VLOOKUP(lookup_value, table_array, col_index_num, range_lookup)

Looks for a value in the leftmost column of a table, and then returns a value in the same row from a column you specify. By default, the table must be sorted in an ascending order.

Lookup Value – what you are looking for in the other table (In our example, we will look for the matching student ID number).

Table Array – the table or range from which the data will be retrieved, the lookup value needs to match the leftmost column of the table array and the data to be retrieved

should also be in the table. (In our example, we will use the entire table in the Birthdays sheet).

Column Index Number (Col_index num) – this is how many columns over in the table the data you want is located (In our example, the birthday is the second column of the table).

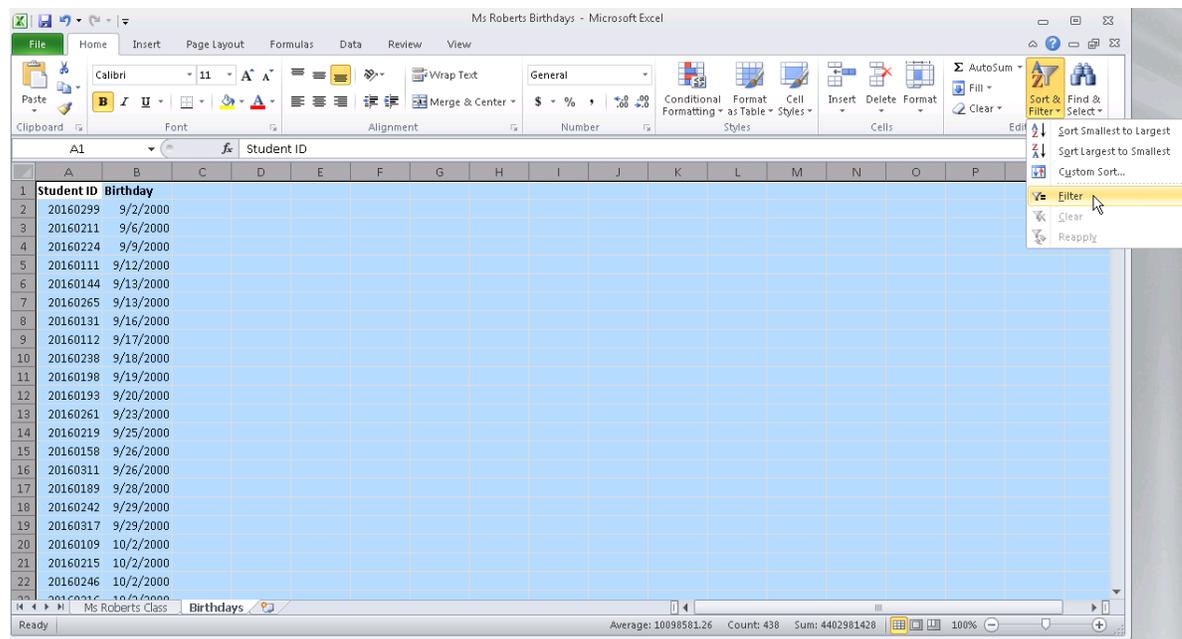
Range lookup – this value (either TRUE or FALSE) is used to tell Excel if you want an exact match or approximate. In many cases, including our example, you will want an exact match. Use FALSE to find an exact match.

Note: the table must be sorted in ascending order. This means the further down the table, the larger the number.

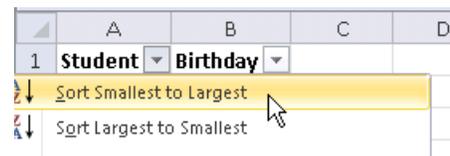
Follow Me

Sort Birthdays

1. Select Birthday tab
2. Highlight the entire table, can use a shortcut to select all (ctrl + A)
3. Select **Filter** from the Sort & Filter drop down on the ribbon Home tab (Editing group)



4. Using the drop down arrow on Student ID, sort smallest to largest (ascending).



Now that the birthdays have been sorted, we can begin adding the vlookup to add in birthdays to Ms Roberts Class.

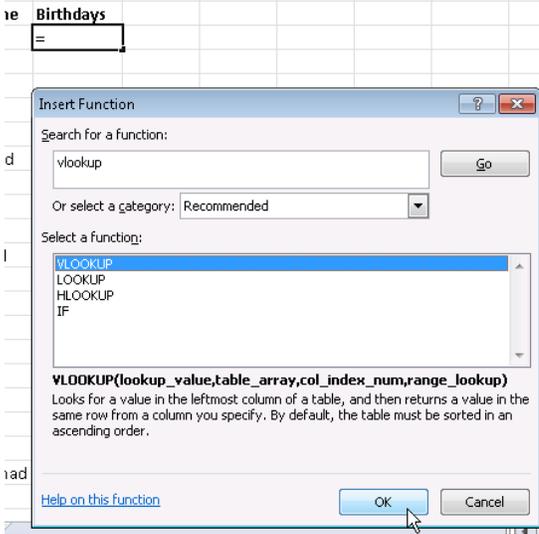
Follow Me

Add Vlookup

- 1. Return to the Ms Roberts Class tab.
- 2. Select D3
- 3. Click the function button
- 4. Search for **Vlookup**
- 5. Select VLOOKUP from the list and click OK

Add Function Arguments

- 6. In the **Lookup_value** we will begin by adding the student ID of the student we are looking for, type or click **A3**. *You should now see the student ID appear next to your selection, 20160109.*
- 7. In **Table_array** we will add the birthday table, to ensure the entire table is always selected we will choose this by column. You can type or click but choose the Birthdays tab columns A and B or **Birthdays!A:B**



Clipboard Font Alignment Number Styles

VLOOKUP =VLOOKUP(A3,Birthdays!A:B)

	A	B	C	D	E	F	G	H	I	J	K	L
1	Student	Birthday										
2	20160299	9/2/2000										
3	20160211	9/6/2000										
4	20160224	9/9/2000										
5	20160111	9/12/2000										
6	20160144	9/13/2000										
7	20160265	9/13/2000										
8	20160131	9/16/2000										
9	20160112	9/17/2000										
10	20160238	9/18/2000										
11	20160198	9/19/2000										
12	20160193	9/20/2000										
13	20160261	9/23/2000										
14	20160219	9/25/2000										
15	20160158	9/26/2000										
16	20160311	9/26/2000										
17	20160189	9/28/2000										
18	20160242	9/29/2000										
19	20160317	9/29/2000										
20	20160109	10/2/2000										
21	20160215	10/2/2000										
22	20160246	10/2/2000										

Function Arguments

VLOOKUP

Lookup_value: A3 = 20160109

Table_array: Birthdays!A:B = {...}

Col_index_num: = number

Range_lookup: = logical

=

Looks for a value in the leftmost column of a table, and then returns a value in the same row from a column you specify. By default, the table must be sorted in an ascending order.

Lookup_value is the value to be found in the first column of the table, and can be a value, a reference, or a text string.

Formula result =

Help on this function

OK Cancel

We recognize the cell range A:B but have not covered referencing cells or ranges in other sheets. This is done by typing the name exactly as it appears (capitals included) with an ! after. In our examples the two sheet references are **Ms Roberts Class!** and **Birthdays!**

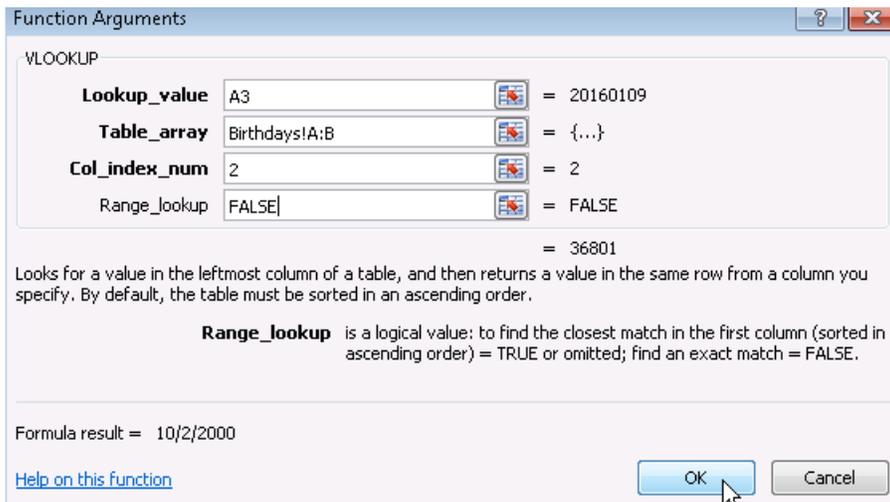
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Add Function Arguments Cont.

8. In **Col_index_num** add the column number of the table that holds the data you wish to add. In this case birthdays are held in the second column so type **2**
9. In **Range_lookup** we will add **FALSE** this will ensure that only an exact match will be returned.

The second section of the Function Arguments dialog box contains more information on the function being entered as well as what information is required for each argument (parameter).

10. Click OK once finished.



The functions button and dialogs fill in the function for you. Notice how D3 now holds the full function with all arguments completed
=VLOOKUP(A3,Birthdays!A:B,2,FALSE)

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Continue adding all Birthdays

- Using the auto fill function, continue adding each birthday.

The sheet may look funny as the vlookup does not copy formatting. Because dates are also numbers we need to format our sheet to show dates in a way we can read.

- Select D3:D21 us the drop down in the Number group of the Home tab to format the numbers into the Short Date format.

Student ID	Last Name	First Name	Birthdays
20160109	Ahtisaari	Martti	36801
20160135	Annan	Kofi	36950
20160147	Carter	Jimmy	37095
20160172	Dae-jung	Kim	37079
20160187	Ebadi	Shirin	37015
20160207	ElBaradei	Mohamed	37055
20160212	Gbowee	Leymah	36940
20160216	Gore	Albert	37133
20160220	Hume	John	36857
20160231	Karman	Tawakkol	37118
20160233	Maathai	Wangari	37084
20160242	Obama	Barack	36798
20160244	Santos	Juan	36960
20160249	Satyarthi	Kailash	36959
20160259	Sirleaf	Ellen	36828
20160287	Trimble	David	36974
20160288	Xiaobo	Liu	37107
20160295	Yousafzai	Malala	36897
20160302	Yunus	Muhammad	37017

The screenshot shows the Excel interface with the 'Home' tab selected. The 'Number' group in the ribbon is open, and the 'Short Date' option is highlighted. The spreadsheet shows the 'Birthdays' column (D3:D21) with dates formatted as 'MM/DD/YYYY'. The formula bar shows the VLOOKUP formula: `=VLOOKUP(A3,Birthdays!A:B,2,FALSE)`. The status bar at the bottom indicates 'Average: 4/1/2001', 'Count: 19', and 'Sum: 11/1/3823'.

Student ID	Last Name	First Name	Birthdays
20160109	Ahtisaari	Martti	10/2/2000
20160135	Annan	Kofi	2/28/2001
20160147	Carter	Jimmy	7/23/2001
20160172	Dae-jung	Kim	7/7/2001
20160187	Ebadi	Shirin	5/4/2001
20160207	ElBaradei	Mohamed	6/13/2001
20160212	Gbowee	Leymah	2/18/2001
20160216	Gore	Albert	8/30/2001
20160220	Hume	John	11/27/2000
20160231	Karman	Tawakkol	8/15/2001
20160233	Maathai	Wangari	7/12/2001
20160242	Obama	Barack	9/29/2000
20160244	Santos	Juan	3/10/2001
20160249	Satyarthi	Kailash	3/9/2001
20160259	Sirleaf	Ellen	10/29/2000
20160287	Trimble	David	3/24/2001
20160288	Xiaobo	Liu	8/4/2001
20160295	Yousafzai	Malala	1/6/2001
20160302	Yunus	Muhammad	5/6/2001