Lecture Note #4: Basic Functions

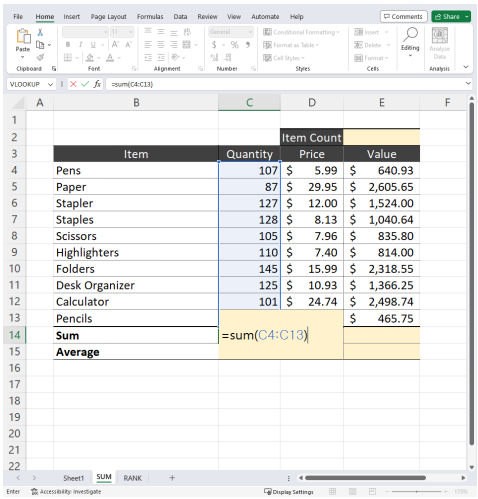
BUSI 201: Business Data Analysis

Topic 1. The `SUM` Function

The sum function returns the sum of all cells included in the argument. So essentially, it is the `+` operator made simple. The syntax of the `SUM` function would be:

```
= SUM(ADDRESS OF CELLS CONTAINING THE VALUES YOU WOULD LIKE TO ADD)
```

Let us go through an example to make it clear. The cells `C14` and `E14` from this worksheet is supposed to track the sum of the quantity of goods, and the sum of the value of the goods in storage, so we may apply the `SUM` function.



	Item	Quantity	Price	Value
			Item Count	
4	Pens	107	$ 5.99	$ 640.93
5	Paper	87	$ 29.95	$ 2,605.65
6	Stapler	127	$ 12.00	$ 1,524.00
7	Staples	128	$ 8.13	$ 1,040.64
8	Scissors	105	$ 7.96	$ 835.80
9	Highlighters	110	$ 7.40	$ 814.00
10	Folders	145	$ 15.99	$ 2,318.55
11	Desk Organizer	125	$ 10.93	$ 1,366.25
12	Calculator	101	$ 24.74	$ 2,498.74
13	Pencils			$ 465.75
14	**Sum**	=sum(C4:C13)		
15	**Average**			

Figure 1: `SUM`

The correct formula to find the total number of individual items in storage, which is the intended content of cell `C14` is:

```
= SUM(C4:C13)
```

You could get the same result by manually adding all cells using the operator `+` as well:

```
= C4 + C5 + C6 + C7 + C8 + C9 + C10 + C11 + C12 + C13
```

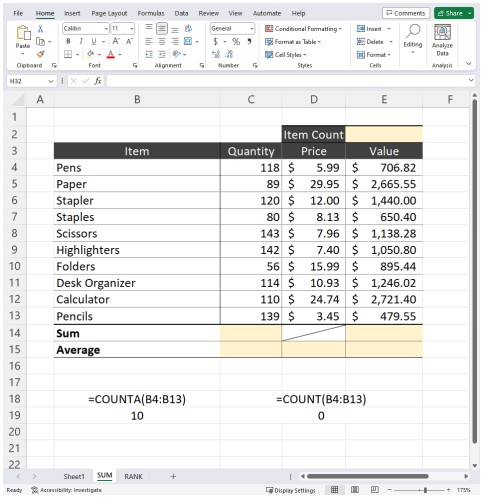
Hopefully we can all agree that using the `SUM` function, even when there are only 10 entries, is by far the superior way to perform addition.

As the function performs an addition, only numerical information is allowed. Any values that are not numerical (including empty cells) will be ignored in calculating the sum. While this is probably not a limiting factor for most, the maximum number of arguments that you can input in the `SUM` function is 255. Please use the `SUM` function to fill out cell `E14` to display the sum of the value of all office supplies in storage.

Topic 2. The COUNTA and COUNT Functions

The COUNTA Function

The COUNTA function will count the number of non-empty cells in the given range dictated by the arguments of the function. The syntax of the COUNTA function is identical to the SUM function.



	Item	Quantity	Price	Value
			Item Count	
4	Pens	118	$ 5.99	$ 706.82
5	Paper	89	$ 29.95	$ 2,665.55
6	Stapler	120	$ 12.00	$ 1,440.00
7	Staples	80	$ 8.13	$ 650.40
8	Scissors	143	$ 7.96	$ 1,138.28
9	Highlighters	142	$ 7.40	$ 1,050.80
10	Folders	56	$ 15.99	$ 895.44
11	Desk Organizer	114	$ 10.93	$ 1,246.02
12	Calculator	110	$ 24.74	$ 2,721.40
13	Pencils	139	$ 3.45	$ 479.55
14	**Sum**			
15	**Average**			
18	=COUNTA(B4:B13)		=COUNT(B4:B13)	
19	10		0	

Figure 2: COUNTA

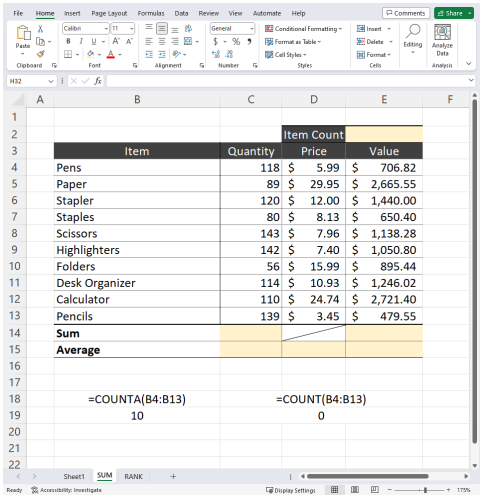
To report the number of unique items stored in storage for this firm, we can use the COUNTA function in cell E2. One possible forumla may be:

$$= \texttt{COUNTA(B4:B13)}$$

Note that it is stated that it is one possible formula. In fact, we can use any of the columns ranging from B to E to get the same answer in this specific case. This is possible as the other columns also have a value assigned to each row, matching that of the item description in column B. There is no one correct rule to use in real life, and the argument that you choose should depend on each specific case.

The COUNT Function

One commonly made mistake is using the COUNT function when you mean to use the COUNTA function. The COUNT function is a similar function, but only counts the number of cells in the range that contains numerical values.



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14	**Sum**			
15	**Average**			
18	=COUNTA(B4:B13)		=COUNT(B4:B13)	
19	10		0	

Figure 3: COUNT vs COUNTA

Recall the status bar trick, where there were two separate types of "count" options. One was a "Numerical Count," and the other was simply "Count." In functions, for some reason, Excel decided to let COUNT correspond to the "Numerical Count," and COUNTA correspond to "Count."

The results depicted below the main table in figure 3 illustrates the difference in results when applying COUNT and COUNTA functions on cells with text data. Please try out applying the COUNT and COUNTA functions on the cell range C4:C13 to verify that they will return the same result, as column C consists of numerical data.

Topic 3. The AVERAGE Function

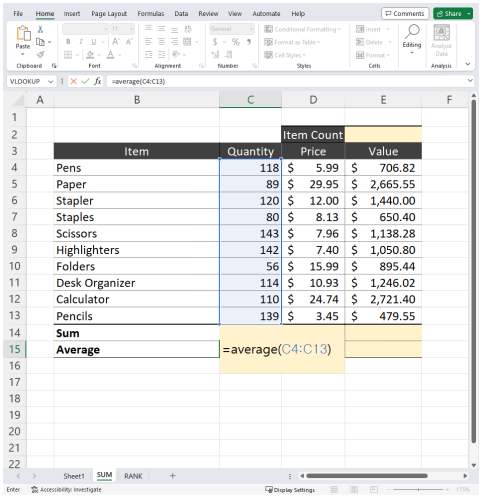


Figure 4: AVERAGE

The cells C15, D15, and E15 each aim to find the average value of the respective columns. The syntax is identical to the SUM, COUNTA, and COUNT functions. That is:

$$= \texttt{AVERAGE(C4:C13)}$$

Similar to the SUM function, all values related to this function must be numerical in nature. Any values that are not numerical (or empty) will be ignored in calculating the average value.

Please fill out the cells D15 and E15 and find the average unit price of each type of good in storage, and the average of each items' total worth, respectively.

Since the AVERAGE function returns the arithmetic mean of the selected values, the output from the AVERAGE function is identical to the result of taking the ratio of the SUM and COUNTA functions:

$$\texttt{AVERAGE(C4:C13)} = \frac{\texttt{SUM(C4:C13)}}{\texttt{COUNTA(C4:C13)}}$$

Topic 4. Other Statistical Functions

The MEDIAN and MODE functions share the same syntax with the AVERAGE function, and return the sample median and mode respectively. The sample median is the middle value of the sample data, while the mode is the value that most often appears in the set of data. You should learn more about these statistics in BUSI 205.

For instance, for a sequence of numbers $\{1, 2, 3, 5, 5\}$:

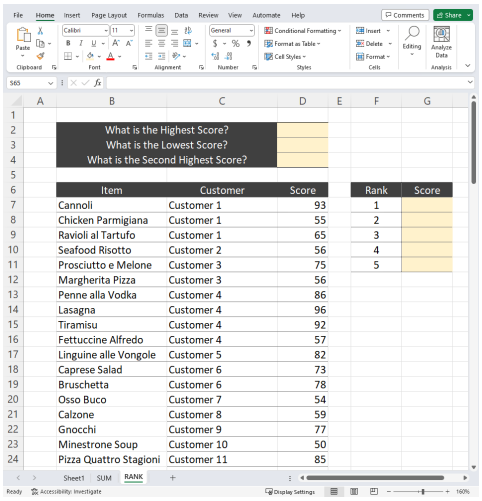
- AVERAGE = 3.2
- MEDIAN = 3
- MODE = 5

It is interesting to note that while the AVERAGE function "calculates" the value for us, the MEDIAN and MODE functions "locate" a certain value out of an array of numbers. Next we will be examining some more functions that "locate" certain values for the user.

Topic 5. Ordering Numbers: The MAX, MIN, LARGE, and SMALL Functions

The MAX and MIN Functions

Recall the other two variables that was readily available for the user in the status bar of Excel; the maximum and minimum values of an array of numbers. These are also available in the functions MAX and MIN, respectively. The syntax is identical to all previous examples, where the only argument(s) is the address of the cells that contain the numerical data you wish to evaluate. Please navigate to the ORDER sheet of the workbook BUSI201-LEC04-Workbook.xlsx.



What is the Highest Score?	
What is the Lowest Score?	
What is the Second Highest Score?	

Item	Customer	Score	Rank	Score
Cannoli	Customer 1	93	1	
Chicken Parmigiana	Customer 1	55	2	
Ravioli al Tartufo	Customer 1	65	3	
Seafood Risotto	Customer 2	56	4	
Prosciutto e Melone	Customer 3	75	5	
Margherita Pizza	Customer 3	56		
Penne alla Vodka	Customer 4	86		
Lasagna	Customer 4	96		
Tiramisu	Customer 4	92		
Fettuccine Alfredo	Customer 4	57		
Linguine alle Vongole	Customer 5	82		
Caprese Salad	Customer 6	73		
Bruschetta	Customer 6	78		
Osso Buco	Customer 7	54		
Calzone	Customer 8	59		
Gnocchi	Customer 9	77		
Minestrone Soup	Customer 10	50		
Pizza Quattro Stagioni	Customer 11	85		

Figure 5: Restaurant Menu Ratings

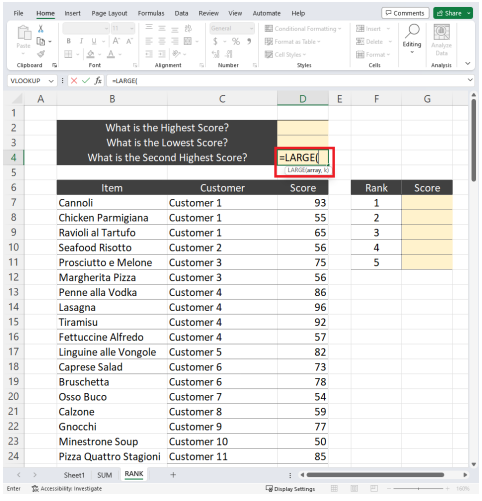
The worksheet consists of feedback from customers from an imaginary Italian restaurant. Suppose that we are primarily interested in what is the absolutely highest and lowest score any dish received. Those are the items to fill out in cells D2 and D3, repsectively. Each value can be found by using the MAX and MIN functions:

$$= \texttt{MAX(D7:D106)}$$
$$= \texttt{MIN(D7:D106)}$$

Similar to the functions we covered up to this point, the MAX and MIN functions ignore any cell that include non-numerical inputs and empty inputs.

The LARGE and SMALL Functions

Even with the MAX and MIN functions, we run into a problem with the next empty cell of D4. How do we find the second highest score in the list? Here is where the LARGE function comes into play.



What is the Highest Score?	
What is the Lowest Score?	
What is the Second Highest Score?	=LARGE(

Item	Customer	Score	Rank	Score
Cannoli	Customer 1	93	1	
Chicken Parmigiana	Customer 1	55	2	
Ravioli al Tartufo	Customer 1	65	3	
Seafood Risotto	Customer 2	56	4	
Prosciutto e Melone	Customer 3	75	5	
Margherita Pizza	Customer 3	56		
Penne alla Vodka	Customer 4	86		
Lasagna	Customer 4	96		
Tiramisu	Customer 4	92		
Fettuccine Alfredo	Customer 4	57		
Linguine alle Vongole	Customer 5	82		
Caprese Salad	Customer 6	73		
Bruschetta	Customer 6	78		
Osso Buco	Customer 7	54		
Calzone	Customer 8	59		
Gnocchi	Customer 9	77		
Minestrone Soup	Customer 10	50		
Pizza Quattro Stagioni	Customer 11	85		

Figure 6: LARGE

The LARGE function searches the array of numbers it is given, and looks for the kth largest value. Naturally, the LARGE function has two mandatory arguments; the address for the array of numbers, and the position of interest k. The function can be used in cell D4 as follows:

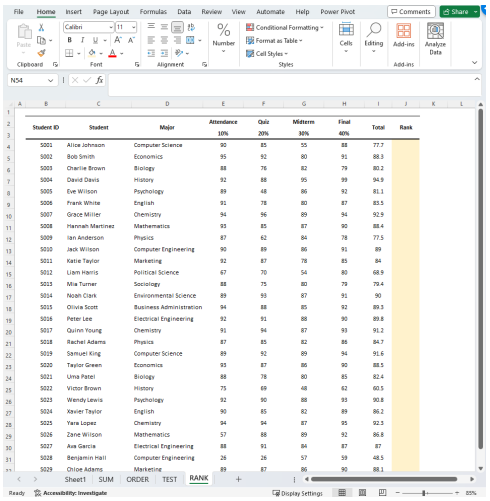
$$= \texttt{LARGE(D7:D106,k)}$$

In words, this means "Find the kth largest numerical value in cells D7:D106." Meanwhile, the SMALL function does the exact opposite, and returns the kth smallest numerical value in the given array of numbers. Note that:

$$\texttt{LARGE(ARRAY,1)} = \texttt{MAX(ARRAY)}$$

Topic 6. The `RANK` Function

We now know how to find the top or bottom ranked item in a list. But what if we wanted to know the ranking of all elements in a list? This is where the `RANK` function can be helpful. Navigate to the `RANK` worksheet which is a mock gradebook for a college level course.



Student ID	Student	Major	Attendance 10%	Quiz 20%	Midterm 30%	Final 40%	Total	Rank
S001	Alice Johnson	Computer Science	90	85	55	88	77.7	
S002	Bob Smith	Economics	95	92	80	91	88.3	
S003	Charlie Brown	Biology	88	76	82	79	80.2	
S004	David Davis	History	92	88	95	99	94.9	
S005	Eve Wilson	Psychology	89	48	86	92	81.1	
S006	Frank White	English	91	78	80	87	83.5	
S007	Grace Miller	Chemistry	94	96	89	94	92.9	
S008	Hannah Martinez	Mathematics	93	85	87	90	88.4	
S009	Ian Anderson	Physics	87	62	84	78	77.5	
S010	Jack Wilson	Computer Engineering	90	89	86	91	89	
S011	Katie Taylor	Marketing	92	87	78	85	84	
S012	Liam Harris	Political Science	67	70	54	80	68.9	
S013	Mia Turner	Sociology	88	75	80	79	79.4	
S014	Noah Clark	Environmental Science	89	93	87	91	90	
S015	Olivia Scott	Business Administration	94	88	85	92	89.3	
S016	Peter Lee	Electrical Engineering	92	91	88	90	89.8	
S017	Quinn Young	Chemistry	91	94	87	93	91.2	
S018	Rachel Adams	Physics	87	85	82	86	84.7	
S019	Samuel King	Computer Science	89	92	89	94	91.6	
S020	Taylor Green	Economics	93	87	86	90	88.5	
S021	Uma Patel	Biology	88	78	80	85	82.4	
S022	Victor Brown	History	75	69	48	63	60.5	
S023	Wendy Lewis	Psychology	92	90	88	93	90.8	
S024	Xavier Taylor	English	90	85	82	89	86.2	
S025	Yara Lopez	Chemistry	94	94	87	95	92.5	
S026	Zane Wilson	Mathematics	57	88	89	92	86.8	
S027	Ava Garcia	Electrical Engineering	88	91	84	87	87	
S028	Benjamin Hall	Computer Engineering	26	26	57	59	48.5	
S029	Chloe Adams	Marketing	89	87	86	90	88.1	

Figure 7: `RANK`

The `RANK` function finds the relative rank of some number in a range of references. The syntax will be:

$$= \texttt{RANK}(\texttt{number}, \texttt{ref}, [\texttt{order}])$$

You can read this function as "Find the rank of `number` out of a list of numbers in `ref`." Here, you can see that the last argument of the function `[order]` is in brackets. This means that this item is optional when writing up a function. If you want the greatest number to be ranked 1, the `order` should be 0. So, in our example, cell `J4` should read:

$$= \texttt{RANK}(\texttt{I4}, \texttt{\$I\$4:\$I\$33}, 0)$$