

Excel Workshop 1

SUM

Taking a sum just means adding. The formula for sum is:

```
=SUM()
```

where inside of the parentheses is what you want to sum.

This can be numbers, for example:

```
=SUM(2,4,6,8)
```

which evaluates to 20.

This can be cell references, for example:

```
=SUM(A1,A4,A7)
```

You can even mix numbers and cell references.

```
=SUM(A1,A4,12)
```

This would add the contents of cells A1 and A4, and add 12 to that.

Range

A range is a group of cells that fit inside a rectangle (even if that rectangle is only one row high or one column wide).

	A	B	C	D
1				
2				
3				
4				
5				

To specify a range, use the top left cell, then a colon, then the bottom right cell.

Using the example table, here are some ranges:

 A1 : B3

 A5 : D5

 D1 : D5

It's ok if the top and bottom cells are in the same row (as in the second example) or the left and right cells are in the same column (as in the third example).

Using ranges in formulas

Using ranges in formulas saves you time.

We've already seen that if you wanted to sum the green area in the example table above, you could write:

```
=SUM(A1,B1,A2,B2,A3,B3)
```

But there's an easier way, using ranges. Here's another formula that means the same thing:

```
=SUM(A1:B3)
```

And using a formula of the same length, you could sum hundreds of thousands of cells:

```
=SUM(A1:C60000)
```

Copying and pasting formulas

We learned that copying and pasting formulas usually results in Excel trying to be helpful and updating the formula.

	A	B	C
1	8	14	
2	10	22	
3	7	31	
4			
5			

Given the example table, if I wanted to find the SUM of cells A1, A2, and A3, I would type:

=SUM(A1:A3)

Let's say I put that formula in A5. It will evaluate to 25. Now I want to know the sum of the numbers in B1, B2 and B3. I can copy and paste the formula in A5 into cell B5.

	A	B	C
1	8	14	
2	10	22	
3	7	31	
4			
5	=SUM(A1:A3)		

The formula I copied and pasted into B5 will evaluate to 67. Why? If you put your cursor in the cell, you'll see it's changed to:

=SUM(B1:B3)

When you copy a formula from one cell and paste it into another, Excel measures how far apart the two cells are and what direction they're in, and adjusts the formula accordingly. In this case, you moved one column over, from A to B. So Excel moved all the references in the formula over one column.

This can be tricky for two reasons: One, you may not want that cell reference to move. We'll see an example of that later. Two, if you make a mistake in your initial formula, you'll copy and paste your mistake, compounding it.

Here's another example. Using the same table, let's total A1 and B1. Put the cursor in C1 and type the formula:

=SUM(A1:B1)

That evaluates to 22. Now let's copy and paste into row 2 and row 3.

	A	B	C
1	8	14	=SUM(A1:B1)
2	10	22	
3	7	31	
4			
5	25	67	

The formula in cell C2 will be:

=SUM(A2:B2)

And the formula in cell C3 will be:

=SUM(A3:B3)

Difference

Finding the difference is just subtracting, and it uses the minus sign. Pretty easy. To subtract cell A1 from cell B1, just type:

=B1 - A1

Note that you need to subtract one thing from one other thing, so you don't want to use a range here.

Percentage Change

If you want to know about a relative increase or decrease, you want to know percentage change.

This is about showing the difference between an increase from \$10 to \$110 and an increase from \$100,000 to \$100,100. They're both increases of \$100, but the first one is a larger percentage change — the \$100 increase is larger relative to the initial amount.

A mnemonic for percentage change is "NOOO!" You can imagine your favorite movie character's scene yelling it. It stands for New - Old, Over Old. Written out, that looks like:

$$\frac{\text{New} - \text{Old}}{\text{Old}}$$

So you want to take the New number — the current year's total, the new budget, the new salary, whatever, and subtract the old number from it. Then you want to divide that answer by the same old number you just used. Order of operations is important here. Make sure to subtract the two numbers on top before dividing by the number on bottom.

Let's look at an example:

If the 2013 city budget was \$12 million, and the 2014 city budget is \$16 million, what's the percentage change?

The new number is \$16 million. The old number is \$12 million. Here's that written out:

$$\frac{\text{New} - \text{Old}}{\text{Old}} \quad \frac{16 - 12}{12}$$

Solving, you get 4/12, which simplifies to 1/3. Converted to a decimal, that's .333. To convert

that to a percentage, multiply it by 100. You'll get 33%.

Here's how you'd write that in an Excel formula:

	A	B
1	2013	2014
2	\$12,000,000	\$16,000,000
3		
5	% change:	=(B2-A2)/A2

That formula is:

=(B2 - A2) / A2

And make sure to include the parentheses. Otherwise Excel will divide A2 by A2 (getting 1) and subtract 1 from B2. Which would be wrong.

You can format your answers as percentages by going to the Format menu and changing the cell format to percentage. You can also choose how many decimal points you want to see.

Reporting on percentage change:

When reporting on percentage change, choose your words carefully. In the above example, you could say the budget increased by 33% or that it rose by one third.

But if the percentage is above 100%, don't use percentages, use ratios. For example, let's say the budget grew from \$12 million to \$36 million. This evaluates to a 200% change (do the math, it does), but it's more intuitive to say the new budget is three times as large as the old one.

Percentage of the whole

Another type of percentage we use frequently is the percentage of the whole. Saying that the police pension is 25% of the budget or that 40% of a district's students tested below proficient is using percentage of the whole.

When calculating the percentage of the whole, you just take the part divided by the whole and multiply by 100.

	A	B	C
1	Department	Budget	Percent of whole
2	Police	150	
3	Fire	100	
4	EMS	100	
5			

Using the above example, we'll figure out percent of the whole for each of the three emergency services departments.

First we can calculate the whole budget.

	A	B	C
1	Department	Budget	Percent of whole
2	Police	150	
3	Fire	100	
4	EMS	100	
5	TOTAL	=SUM(B2:B4)	

In cell B5, type **=SUM(B2:B4)** which will evaluate to 350.

Now we start to calculate the percentages.

	A	B	C
1	Department	Budget	Percent of whole
2	Police	150	=B2/B5
3	Fire	100	
4	EMS	100	
5	TOTAL	350	

Typing **=B2/B5** will evaluate to the correct percentage: .42857

We won't multiply this by 100, because if you format the cell to show percentage, Excel does that for you, showing 43%. (If you multiply by 100 and format as percentage, you'll get a wrong answer).

But there's a problem here. If you copy and paste this into cell C3, you'll get a divide-by-zero error.

This is because, as we learned in Copying and Pasting Formulas, Excel tries to be helpful in assuming that if you're moving a formula, you also want to move the cells the formula references.

In this case, since you moved one row down from C2 to C3, Excel also moved the cell references down, so the formula is **=B3/B6**. The B3 is ok, but there's no number in B6. We'll learn how to fix that error in the next section.

Absolute formula references

The way to fix the problem of formulas changing cell references when copying and pasting is by using absolute formula references.

An absolute formula reference will tell Excel: "Even if I copy and paste this formula elsewhere, don't change this reference."

Going back to our previous example, here's how they work:

	A	B	C
1	Department	Budget	Percent of whole
2	Police	150	=B2/B\$5
3	Fire	100	
4	EMS	100	
5	TOTAL	350	

Typing **=B2/B\$5** tells Excel to make the row reference in B5 to be absolute. That means that no matter which row you paste the formula into, it will always refer to row 5.

So if I copy and paste C2 into C3 in the above example, Excel will change the first part, B2, into B3. It will look at the second part and realize there's a dollar sign in front of the row reference, and not change it at all. And so you'll wind up with **=B3/B\$5**.

Note that if you were to copy the formula into a different column, Excel will still adjust the column. This is because there isn't a dollar sign in front of the column.

You can put a dollar sign in front of the column (**\$B5**), the row (**B\$5**), or both (**\$B\$5**).

Putting one in front of both the column and the row makes it certain that the formula will always reference that exact cell. Sometimes that's what you want. But consider the case:

	A	B	C	D
1	2012	Pct 1	2013	Pct2
2	150	=A2/A\$5	200	
3	100		150	
4	100		150	
5	350		500	

If you only restrict the row, not the column, you can paste the formula in B2 into B3, B4, D2, D3 and D4. The formula in D2 will be **=D2/D\$5** because Excel can adjust the column.

If you had instead put **=A2/\$A\$5** in the B2 cell, copying to D2 would give you **=D2/\$A\$5**, which would give you an incorrect percentage — it would divide 2013's part by 2012's whole.

Average (mean and median)

The hardest part about using averages in Excel is making sure you pick the right one. After that, it's simple.

Mean

Mean average is what most people think of when they think of average. You add up all the numbers and divide by how many numbers there are. If there are 5 reporters who wrote 2, 3, 5, 7 and 8 stories one week, that means the reporters wrote an average of $(2 + 3 + 5 + 7 + 8) / 5$ stories each. That evaluates to 5 stories on average.

The Excel formula for the mean average is simple to remember. Here it is:

=Average()

That's it. You put the cells you want to average inside the parentheses, and you'll get the mean average.

Median

Median average is also pretty easy to understand. You can find the median average by sorting all the values from smallest to largest, then finding the one in the middle. If there's an even number of values, there won't be one in the middle. In that case, you take the mean average of just the two values in the middle.

Let's say we have five homes with values of:

\$90,000; \$120,000; \$140,000; \$200,000; \$1,500,000

The median is the one in the middle, \$140,000.

If there were six homes, and let's say the sixth is \$80,000, we'd look at the two values in the middle (in this case it would be \$120,000 and \$140,000) and take the mean average of them. So the median in that case would be \$130,000.

The formula for median is also pretty easy:

=Median()

The median is the point where half the numbers lie above that point and half the numbers lie below it.

Which one to use?

Mean is what most people understand, so if it's not misleading, that's what you should go with. On the other hand, mean is very sensitive to outliers, while median is not.

Using our home price example with five homes:

\$90k \$120k \$140k \$200k \$1.5M

The median, as we saw, is the value in the middle: \$140k

The mean is \$410,000.

Which number is a better descriptor of the entire market? I'd suggest the median value of \$140,000 better describes the market as a whole. You could even report the median value as well as any significant outliers: "The median home value is \$140,000, but one home was valued at \$1.5 million."