Mathematical writing and combining fractions

Key topics

Basic principles of writing Mathematics

Order of operations

Use of symbols

Writing clear equations

Combining fractions

Using MS Equation Editor

Writing multiplication

We often don't include the 'times by' symbol x when multiplying constants (can be confused with x)

12b=3a instead of 12xb=3xa

When we do use it we use a 'straight x' (see also 'cross product' in later lectures)

$$12 \times x = 12x$$

We do sometimes use the asterisk symbol * to mean multiply, usually when we have two numbers or two letters to multiply

12*3=36 instead of 123=36

BODMAS and the order of operations

Sometimes this does matter, sometimes used to confuse people

$8 \div 2(2+2) = ?$

- Brackets
- Orders (powers and square roots)
- Division/Multiplication
- Addition/Subtraction

Which is correct?

8 ÷ 2(2+2) = ?

8÷2(4)=

4(4)=

16

8 ÷ 2(2+2) = ?

8÷2(4)=

8÷ 8=

1

Is the 8 being divided by everything else or just the 2?

https://trendingpress.com/why-mathematicians-hate-that-viral-equation/

Clear equations

$8 \div 2(2+2) = ?$

Is the 8 being divided by the 2 or by everything?

$8 \div \mathbf{2}(2+2) = ?$ $8 \div \mathbf{2(2+2)} = ?$

If it was being divided by everything, we should write it with an extra set of brackets:

$8 \div (2(2+2)) = ?$

To make the correct version clearer, we could write:

$(8 \div 2)(2+2) = ?$

Writing division

I hardly ever see a division sign (÷) at University, instead we usually write:

$$\frac{8}{2}(2+2)$$

Now it is clear that the (2+2) isn't below the dividing line and we are not tempted to include it when dividing the 8

Use of Brackets

When there are not brackets to separate out the different sections, we need to think carefully:

3+5*2=?

Multiplication & division come before addition & subtraction so…

3+5*2=13 3+5*2≠16

Equality and inequality symbols

$a=b$	a is equal to b
$a\neq b$	a is not equal to b
$a>b$	a is greater than b
$a<b$	a is less than b
$a\geq b$	a is greater than or equal to b
$a\leq b$	a is less than or equal to b
$a\gg b$	a is much greater than b
$a\ll b$	a is much less than b
$a\approx b$	a is approximately b
$a\equiv b$	a is exactly b

Fractions

$$\frac{\boldsymbol{Numerator}}{Denominator}$$

If the denominator is greater then the **numerator**, it is a proper fraction, if the **numerator** is greater than the denominator it is an improper fraction:

$$\frac{\mathbf{2}}{3} = 0.6\dot{6}$$

Is a proper fraction (the dot over the 6 means recurring, so $0.6\dot{6} = 0.66666666\ldots$)

$$\frac{\mathbf{3}}{2} = 1.5$$

Is an improper fraction

Problems with fractions

Fractions are very exact, using them gives you a more precise answer but they can be hard to interpret.

e.g. Which is greater, $\frac{9}{17}$ or $\frac{49}{97}$?

$\frac{9}{17} \approx 0.529$

$\frac{49}{97} \approx 0.505$

When to use fractions

Generally, if you want to be sure it is exact (e.g. you are doing algebra) you should keep things as fractions. If you are happy to approximate (e.g. you are doing Statistics) then resolving the fraction to decimals is best.

When you write out workings, perhaps for coursework, it is a good idea to write them out again as decimals, just to make sure that it all makes sense to you!

Combining fractions: addition

$$\frac{a}{b}+\frac{c}{d}=\frac{ad+bc}{bd}$$

$$\frac{2}{3}+\frac{4}{5}=\frac{2*5+3*4}{3*5}=\frac{10+12}{15}=\frac{22}{15}\approx 1.47$$

Sense check!

You are combining two positive things, so the result should be larger than either of them alone it is.

Combining fractions: subtraction

$$\frac{a}{b} + \frac{c}{d} = \frac{ad - bc}{bd}$$

$$\frac{2}{3} - \frac{4}{5} = \frac{2*5-3*4}{3*5} = \frac{10-12}{15} = \frac{-2}{15} \approx \text{-0.13}$$

Sense check!

You are taking away something bigger (0.8) than you start with (0.67) so it should turn negative and it does.

Combining fractions: multiplication

$$\frac{a}{b} * \frac{c}{d} = \frac{ac}{bd}$$

$$\frac{2}{3} * \frac{4}{5} = \frac{2*4}{3*5} = \frac{8}{15} \approx 0.53$$

Sense check!

You are multiplying two things that are less than one so the answer should be smaller than either of them and it is.

Combining fractions: division

$$\frac{a}{b} \div \frac{c}{d} = \frac{ad}{bc}$$

$$\frac{2}{3} \div \frac{4}{5} = \frac{2*5}{3*4} = \frac{10}{12} \approx 0.83$$

Sense check!

You start with 2/3 which is about 67%. You are dividing by something less than one, so it should become larger and it does.

Reduce and simplify

It is good practice to reduce fractions to their smallest convenient form:

$$\frac{100}{80} = \frac{50}{40} = \frac{5}{4}$$

$$\frac{90}{30} = \frac{9}{3} = \frac{3}{1}$$

There is no formula or golden rule for doing this, over time you just get used to it.

Short cuts

You can use the lowest common multiples to solve some problems without even using the equations we looked at.

e.g. what is $\frac{1}{2} + \frac{3}{4}$?

Using the formula: $\frac{1}{2} + \frac{3}{4} = \frac{1*4+3*2}{2*4} = \frac{4+6}{8} = \frac{10}{8} = 1.25$

But, we can write $\frac{1}{2} as \frac{2}{4}$, it is still a half. Then we have $\frac{2}{4} + \frac{3}{4} = \frac{5}{4} = 1.25$

Significant figures and decimal places

Generally, reporting decimal values can mean truncating the real value.

0.123456789 can be written as 0.12, this is truncating to 2 decimal places.

We often work with significant figures, which means the first non-zero digits.

0.123456789

Significant figures	result
1s.f	0.1
2s.f.	0.12
3s.f.	0.123
4s.f.	0.1234

Recurring values

Fractions often give recurring values, e.g. 1/3 = 0.333333333333333…

When a decimal has a recurring last figure we denote it with a dot above:

$$1/3 = 0.3\dot{3} \approx 0.33$$

Writing Mathematics electronically

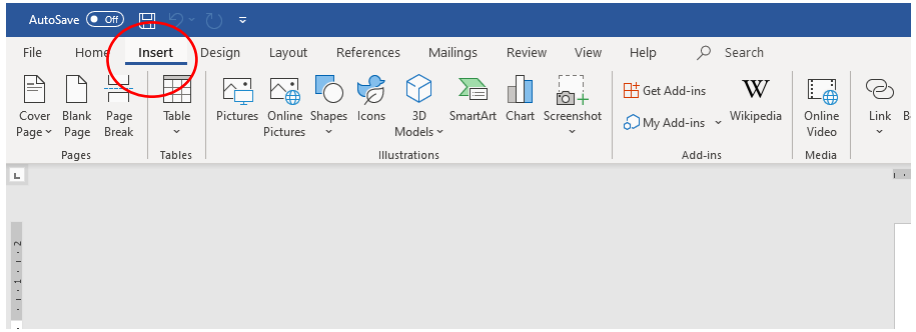
There are some specialist Mathematical writing packages (like LaTex), which you will study if you progress to a Maths course, but most of the world uses MS Office.

MS equation editor is a learned skill, until you get used to it, it can take a long time to make equations.

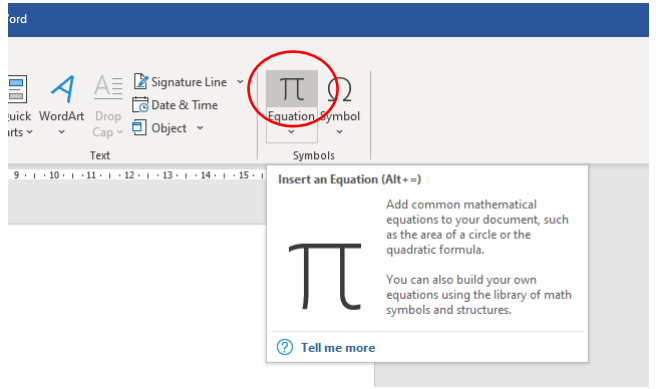
MS equation editor is available in Word, Excel and PowerPoint

Equation editor

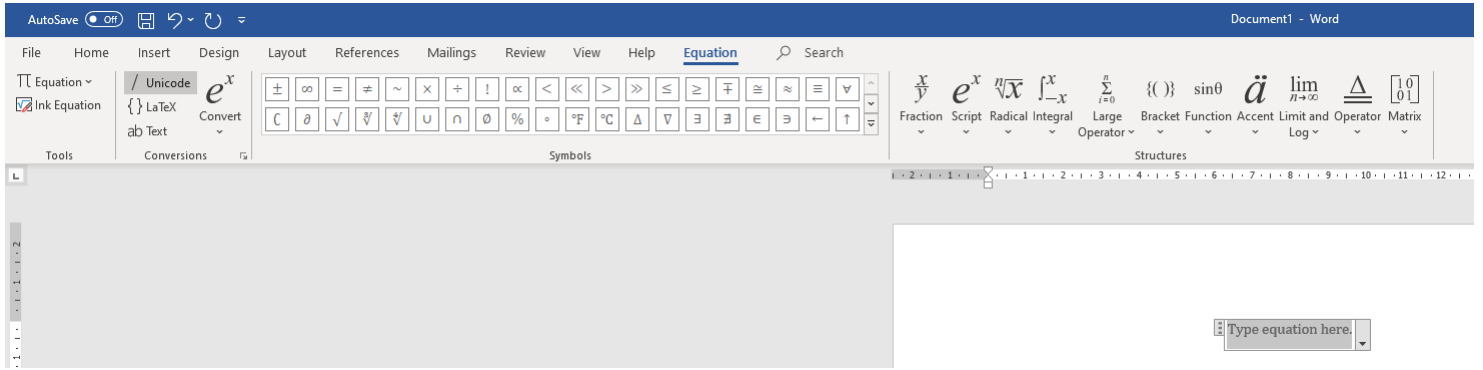
Found under the ‘insert’ menu option



On the far right of the top bar



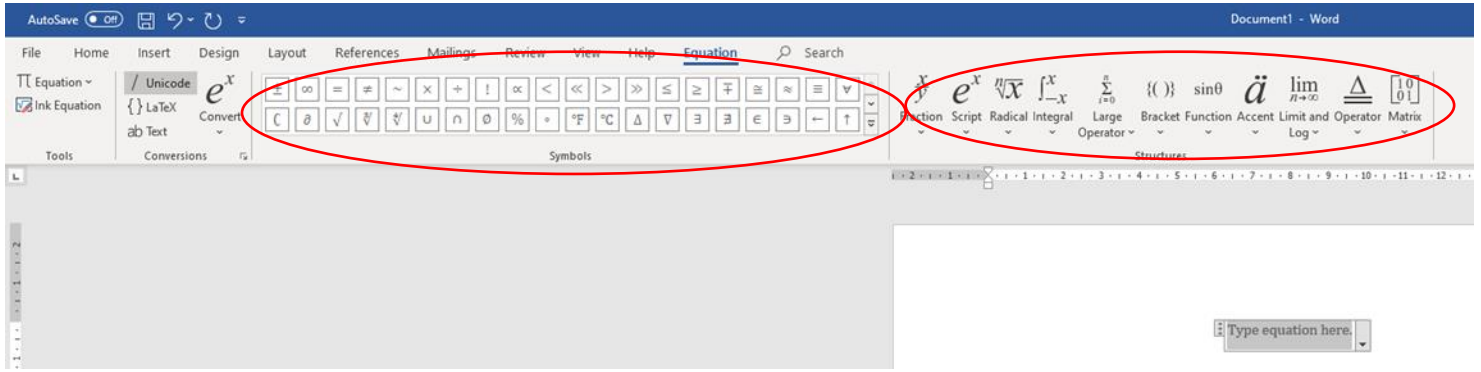
It opens a whole new menu



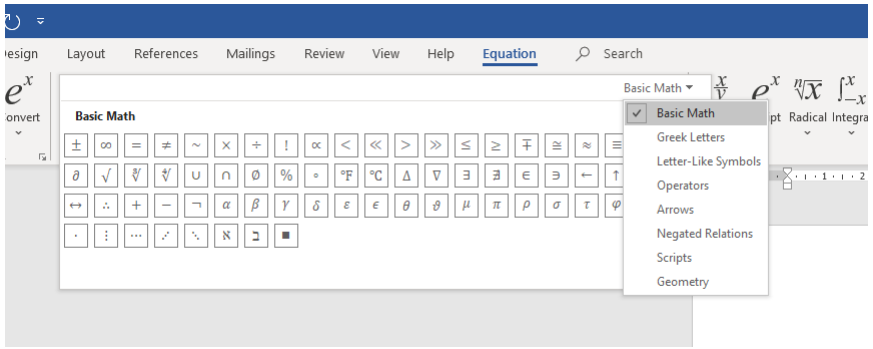
Equations and symbols

Symbols on the left

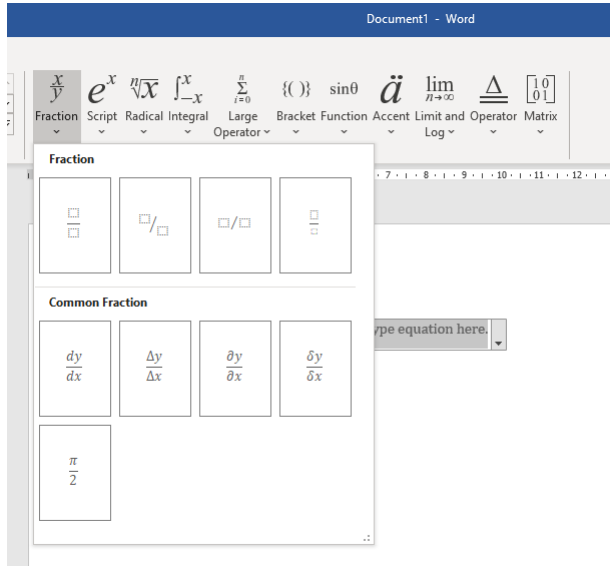
Equation options on the right



The symbols expand to show basic Maths options and other options like Greek letters



Each of the Equation options opens a different menu. The ‘Fractions’ menu is what I used in these slides.

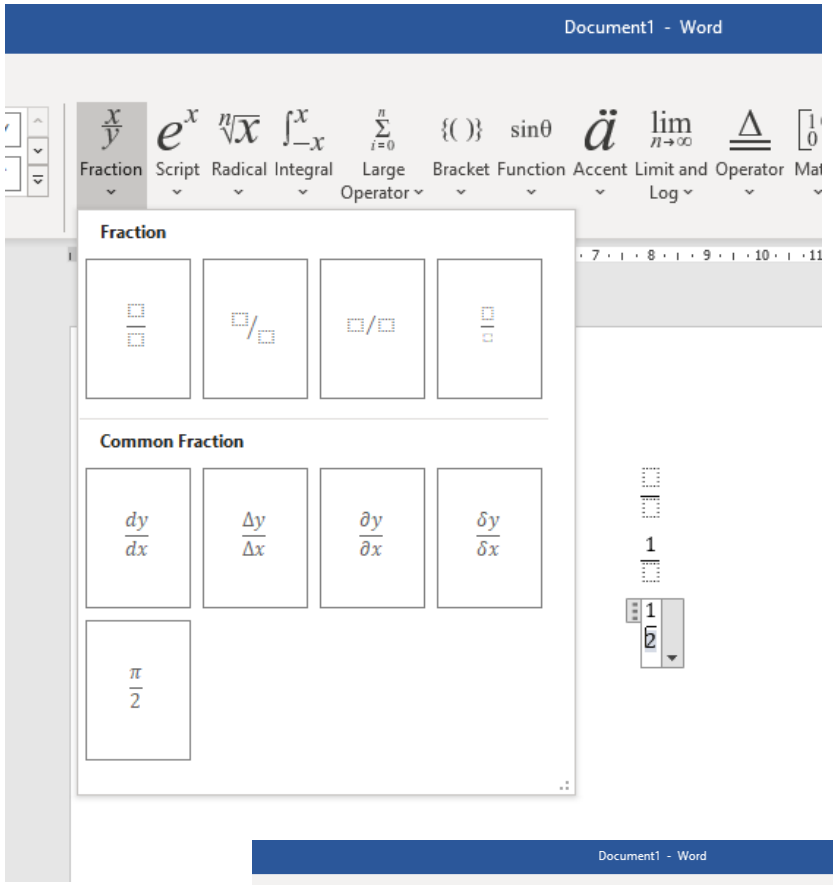


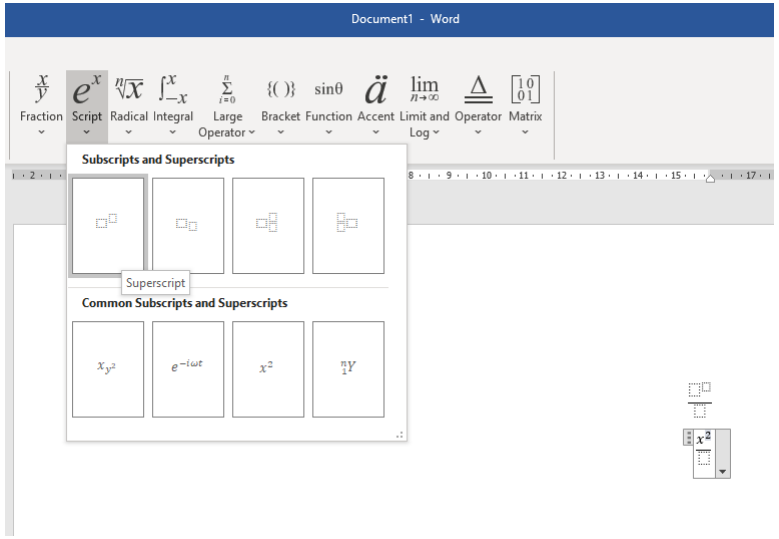
Building equations

Start with the structure of the equation. Does it have a divisor?

If so, put in in to begin, then fill in the values above and below the line.

Do you want x^2? Select ‘superscript’, then fill in the x and the 2.





Example

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

This is a picture of the Normal distribution curve equation, try to type it out in MSEE now

Tips for using MSEE

1) Be patient, it will take time to find everything quickly
2) Think about the structure first (brackets, divisions etc.) and numbers/symbols last
3) Remember that you can copy and paste!
4) Use the arrow keys to move the cursor around equations