Learning Enhancement Team

Steps into Numeracy

University of East Anglia

STUDENT SUPPORT SERVICE

Adding & Subtracting Fractions

This guide helps you understand how to add and subtract fractions. It also introduces the important idea of a common denominator.

Introduction

If you have six apples and seven oranges, when you add them together you still have six apples and seven oranges but this gives you a total number of thirteen *pieces of fruit*. Only when you identify apples and oranges as fruit (i.e. **what they have in common**) can you add them together. This idea of only being able to meaningfully add and/or subtract things which are the same (or have been expressed in terms of something they share) is extremely common in science and mathematics and is crucial to understanding how to add and/or subtract fractions.

The **denominator** of a fraction identifies the **type** of fraction you have whilst the **numerator** gives the **number** of that type of fraction (see study guide: *Types of Fractions*). **When you are adding and/or subtracting fractions the denominators need to be the same** fractions only add or subtract meaningfully when this is the case. The fractions you need to add and/or subtract may not have identical denominators, if this is the case you will have to change your denominators using **equivalent fractions**.

Common denominators

If you are given the sum $\frac{1}{2}+\frac{1}{3}$, you may be tempted to add the denominators and numerators together to get $\frac{1+1}{2+3}=\frac{2}{5}$. This is a very common mistake. As one half and one third have **different denominators**, they are **different types of fractions**. You need to find a **common denominator** before adding them. Expressing the fractions as equivalent fractions with the same denominator allows you to do the sum.

A suitable common denominator is **any** number which has the denominators of the fractions in question as **factors**. In every calculation there are many potential common denominators that you can choose. The easiest way to find a common denominator is to multiply together the denominators of the fractions; the resulting number is **always** a suitable common denominator. Another way is to find the **lowest common multiple** (LCM) of the denominators, see study guide: *Lowest Common Multiple*. The advantage of finding the LCM is that it is the smallest common denominator making conversion to equivalent fractions easier. Also you may not have to cancel down your answer.

Let's return to the problem of $\frac{1}{2}+\frac{1}{3}$. Multiplying the denominators gives $2\times 3=6$ which in this case is also the LCM of 2 and 3. You now have to express $\frac{1}{2}$ and $\frac{1}{3}$ as equivalent fractions with a denominator of 6. Start with $\frac{1}{2}$. **When finding equivalent fractions, you must multiply the denominator and numerator by the same number**. In order to change the denominator from 2 (in the half) to 6 you must multiply by 3, so you must also multiply the numerator by 3. The numerator in a half is 1, so multiplying by 3 gives $1\times 3=3$ so:

$$\frac{1}{2}\overset{\times 3}{=}\frac{3}{6}$$

As you can see one half can be expressed as the equivalent fraction three sixths. You now need to do the same for the third. In order to change the denominator of 3 (in the third) into 6 you multiply by 2; the numerator in a third must also be multiplied by 2 to give $1\times 2=2$. So:

$$\frac{1}{3}\overset{\times 2}{=}\frac{2}{6}$$

one third has an equivalent fraction of two sixths. By expressing the fractions as equivalent fractions with a common denominator of 6 you can now add them together.

So:

$$\frac{1}{2}+\frac{1}{3}=\frac{3}{6}+\frac{2}{6}=\frac{3+2}{6}=\frac{5}{6}$$

Or, in words, three sixths plus two sixths is five sixths. The type of fraction (sixths) remains the same in the answer and you add the numerators to find out how many you have. The method for subtracting fractions is similar.

Adding and/or Subtracting fractions

1. Find a common denominator.
2. Express all the fractions involved as equivalent fractions with this common denominator.
3. Add or subtract the numerators as required but keep your common denominator.

Example: Calculate $\frac{2}{5}-\frac{1}{4}$.

A common denominator is $5\times 4=20$, which is also the LCM. Expressing as equivalent fractions with the denominator of 20 gives:

$$\frac{2}{5}=\frac{8}{20} \quad (\times 4 \text{ top and bottom})$$

$$\frac{1}{4}=\frac{5}{20} \quad (\times 5 \text{ top and bottom})$$

So the subtraction becomes:

$$\frac{2}{5}-\frac{1}{4}=\frac{8}{20}-\frac{5}{20}=\frac{8-5}{20}=\frac{3}{20}$$

Or, in words, two fifths take away one quarter is three twentieths.

Example: Calculate $\frac{3}{10}+\frac{2}{5}-\frac{1}{2}$.

Here if you multiply the denominators together you get $10\times5\times2=100$. The required equivalent fractions can be found by multiplying the numerators and denominators by 10, 20 and 50 respectively. So the calculation can be performed as follows:

$$\frac{3}{10}+\frac{2}{5}-\frac{1}{2}=\frac{30}{100}+\frac{40}{100}-\frac{50}{100}=\frac{30+40-50}{100}=\frac{20}{100}=\frac{1}{5}$$

with the final result being achieved by cancelling down.

You may also notice that 10 is the LCM of 2, 5 and 10. Using 10 as the denominator simplifies the calculation:

$$\frac{3}{10}+\frac{2}{5}-\frac{1}{2}=\frac{3}{10}+\frac{4}{10}-\frac{5}{10}=\frac{3+4-5}{10}=\frac{2}{10}=\frac{1}{5}$$

but still gives the same result after cancelling down.

Want to know more?

If you have any further questions about this topic you can make an appointment to see a **Learning Enhancement Tutor** in the **Student Support Service**, as well as speaking to your lecturer or adviser.

Call: 01603 592761
Ask: ask.let@uea.ac.uk
Click: https://portal.uea.ac.uk/student-support-service/learning-enhancement

There are many other resources to help you with your studies on our website.
For this topic, these include questions to practise, model solutions and a webcast.

Your comments or suggestions about our resources are very welcome.

	Scan the QR-code with a smartphone app for a webcast of this study guide.	