1 Numeracy

In this section we will learn the basic techniques required to be successful at business analytics. The section will include topics such as order of operations, fractions, percentages and ratios.

1.1 Basic Operations and Order of Operations

We will begin by investigating the importance of the order in which we do calculations. To perform calculations we use one of the following four operations +, −, × and ÷.

1.1.1 Addition

When we are dealing with the sum of two or more numbers, i.e. $2 + 3 = 5$ the order in which we write the numbers down is irrelevant. We can see that $2 + 3 = 5$ is equivalent to $3 + 2 = 5$. As the order in which we add numbers together does not matter we say addition is **commutative**. We will not use words such as this throughout this text as I want to try and keep the mathematical language to a minimum. I only mention it so that if you see the word used in other texts or in a lecture you know what it means.

1.1.2 Subtraction

When we are dealing with subtraction we are finding the difference between two numbers. For example if we write $13 - 8$ we are finding the difference between 13 and 8 which is 5. It is important to note in subtraction that the order in which we write the numbers down is vital, i.e. $13 - 8 = 5$ is not the same as $8 - 13 = -5$. It should also be noted that when we subtract a negative number it is equivalent to adding a positive number, i.e. $8 - (-5) = 8 + 5 = 13$.

1.1.3 Multiplication

Multiplication is typically denoted with ×, i.e. $9 \times 3 = 27$. You may also see it written with a ·, i.e. $4 \cdot 3 = 12$ or even with no sign and only with brackets, i.e. $(5)(8) = 40$. Similarly to addition, the order in which we multiply two or more numbers does not matter, i.e. $7 \times 8 = 8 \times 7 = 56$. Care is required when multiplying positive and negative numbers, you should remember the following rules when multiplying numbers:

positive × positive = positive

positive × negative = negative

negative × positive = negative

negative × negative = positive

Example 1.1.1

Calculate the value of (−4) × 6.

In this example we are multiplying a negative with a positive which we know from above will give us a negative answer. We are therefore required to calculate 4 × 6 = 24 and hence we find (−4) × 6 = −24.

Calculate the value of (−7)(−6).

In this example we are multiplying a negative with a negative which if we follow the rules will give us a positive answer. We are therefore required to calculate 7 × 6 = 42 and hence we find (−7) × (−6) = 42.

1.1.4 Division

Similarly to multiplication, there are several different ways of writing a division. For example, we can write 16 ÷ 4 to mean 16 divided by 4. We could also write this division using 16/4 or as a fraction $\frac{16}{4}$. When we write the division as a fraction, i.e. $\frac{16}{4}$ we call the number on the top the **numerator** and the number on the bottom is the **denominator**. It should also be noted that the order in which we write the numbers down is important, i.e. 16 ÷ 4 = 4 whereas 4 ÷ 16 = 0.25. Similarly with multiplication it is important that we take care when dividing positive and negative numbers and you should remember the following rules:

positive ÷ positive = positive

positive ÷ negative = negative

negative ÷ positive = negative

negative ÷ negative = positive

Example 1.1.2

Calculate the value of −16 ÷ 8

To calculate −16 ÷ 8 we should first note that we are dividing a negative with a positive, which if we follow the rules from above will give us a negative answer. We are therefore required to calculate 16 ÷ 8 = 2 and we find −16 ÷ 8 = −2.

Calculate the value of −16 ÷ (−4)

To calculate the value of −16 ÷ −4 we should note that we are dividing a negative by another negative and hence we should have a positive answer. Upon calculating 16 ÷ 4 = 4 we can conclude that −16 ÷ (−4) = 4.

1.1.5 Order of Operations

Now that we are familiar with the four main operations we can perform on numbers, we should also be aware that the order in which we do the operations is vitally important. For example, if we wrote down:

$$(4 + 12) \div 3 - 2 \times 5$$

we need a set of rules to follow to ensure that we get an answer that we all can agree upon. To help us recall the order in which we perform calculations we use the acronym **BIDMAS**. You may also know the alternate acronym **BODMAS**. BIDMAS tells us the order in which we should perform the operations within an expression or equation.

B Brackets → Anything within brackets should be calculated first.

I Indices → Any indices, e.g. 3^3 must be calculated next (you may know them as powers).

D Division → Perform all divisions as you move from left to right.

M Multiplication → Perform all multiplications as you move from left to right.

A Addition → Perform all additions as you move from left to right.

S Subtraction → Perform all subtractions as you move from left to right.

Example 1.1.3

Calculate the value of $3 + 8 \times (5 - 2)$.

To evaluate the expression, following the order described by BIDMAS, we should first calculate the value of the term within the brackets, i.e. $(5 - 2) = 3$ to find:

$$3 + 8 \times (5 - 2) = 3 + 8 \times 3$$

Notice that there are no powers or divisions to calculate so we should move on to the multiplication, i.e. $8 \times 3 = 24$ to find:

$$3 + 8 \times 3 = 3 + 24$$

The final step is to perform the addition to find:

$$3 + 24 = 27$$

Example 1.1.4

Calculate the value of $9 - 25 \div (10 - 5)^2 \times 3 + 7$.

To evaluate the expression we should follow BIDMAS and calculate any values in brackets. The only bracket here is $(10 - 5) = 5$, hence we find:

$$9 - 25 \div (10 - 5)^2 \times 3 + 7 = 9 - 25 \div 5^2 \times 3 + 7$$

The next step is to calculate any powers, which in this example is $5^2 = 5 \times 5 = 25$. We can therefore simplify the expression to find:

$$9 - 25 \div 5^2 \times 3 + 7 = 9 - 25 \div 25 \times 3 + 7$$

The next part of BIDMAS is to perform divisions; in this example there is one, i.e. $25 \div 25 = 1$ to find:

$$9 - 25 \div 25 \times 3 + 7 = 9 - 1 \times 3 + 7.$$