FSKNUM014

Calculate with whole numbers and familiar fractions, decimals and percentages for work

Learner Guide

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Unit of Competency

Application

This unit describes the skills and knowledge to interpret and calculate with whole numbers, routine fractions, decimals and percentages for workplace activities and tasks. It includes interpreting and selecting embedded mathematical information, undertaking routine arithmetical problem solving processes, and communicating results to complete workplace activities.

An individual performing these tasks works independently and uses their own familiar support resources.

This unit applies to individuals who use, or are preparing to use, numeracy skills to complete workplace activities. This includes existing workers and individuals preparing for employment through vocational education and training. This unit should be integrated and contextualised with vocational training to support achievement of vocational competency.

This unit is aligned to, but does not fully address, the Australian Core Skills Framework (ACSF) numeracy core skill indicators .09, .10 and .11 at level 3 in the workplace and employment domain of communication.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Unit Mapping Information

FSKNUM014 Calculate with whole numbers and familiar fractions, decimals and percentages for work supersedes and is equivalent to FSKNUM14 Calculate with whole numbers and familiar fractions, decimals and percentages for work.

Pre-requisite Unit

None stated

Unit Sector

Numeracy

Performance Criteria

Element *Elements describe the essential outcomes.*	**Performance Criteria** *Performance criteria describe the performance needed to demonstrate achievement of the element.*
1. Select and interpret routine mathematical information	**1.1** Identify whole numbers and routine fractions, decimals, percentages and common rates embedded in workplace tasks and texts **1.2** Interpret whole numbers and routine fractions, decimals, percentages and common rates embedded in workplace tasks and texts
2. Perform mathematical calculations to complete workplace task	**2.1** Select arithmetical problem solving process for completing the workplace task **2.2** Estimate outcome of calculations with the four arithmetical operations related to whole numbers, routine fractions, decimals and percentages **2.3** Calculate outcome of calculations with the four arithmetical operations related to whole numbers, routine fractions, decimals and percentages **2.4** Check and reflect on mathematical problem solving processes and outcomes in relation to initial estimates and the workplace context
3. Communicate workplace mathematical information	**3.1** Use informal and formal written mathematical representation to document and report on workplace calculation processes and results **3.2** Use informal and formal mathematical language to present and discuss workplace problem solving process and results.

Foundation Skills

This section describes language, literacy, numeracy and employment skills that are essential to performance but not explicit in the performance criteria.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Assessment Requirements

Performance Evidence

The candidate must demonstrate the ability to complete the tasks outlined in the elements, performance criteria and foundation skills of this unit, including evidence of the ability to:

- Select and interpret one of each of the following embedded in routine workplace tasks and texts:
    - whole numbers
    - routine common fractions
    - routine decimals
    - routine common percentages
    - common rates
- Perform routine mathematical problem solving processes to complete a workplace task, including:
    - using and applying the order of arithmetical operations to solve multi-step calculations with whole numbers
    - performing calculations with common fractions, decimals and percentages
    - using and applying rates in familiar or routine situations
    - making initial estimations and checking reasonableness of process and results.

In the course of the above the candidate must demonstrate use of relevant technology, such as calculators or spreadsheets.

Knowledge Evidence

The candidate must be able to demonstrate knowledge to complete the tasks outlined in the elements, performance criteria and foundation skills of this unit, including knowledge of:

- Purpose of workplace calculations relevant to completing workplace task
- Place value and use of zero
- Relationship and equivalence between familiar and routine fractions, decimals and percentages
- Relationship between the four operations (addition, subtraction, multiplication and division) and the use and application of the order of operations
- The meaning and purpose of familiar rates such as km/hr, $/kg and $/m
- Purpose and use of relevant technology such as calculators, spreadsheets or other relevant software
- Methods for using estimation and assessment skills to check and reflect on an outcome and its appropriateness to the workplace task
- Informal and formal mathematical written and oral language and symbolism of numbers and calculations.

Assessment Conditions

Competency is to be assessed in the workplace, a workplace simulated environment or a vocational training context.

Assistive technologies can be utilised to assist with oral and written communication.

Skills must be demonstrated using routine texts and tasks that reflect those typically found in a workplace.

The following resources are to be made available:

- A calculator
- Familiar support resources.

Assessors must:

- Satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards, and
- Have sound knowledge of the ACSF and performance features of the ACSF level being assessed, and
- Have demonstrable expertise, knowledge and skills in the vocational contextualisation and assessment of the core skill, numeracy, and
- Have completed the following or equivalent:
    - TAESS00009 Address Foundation Skills in Vocational Practice Skill Set; or
    - a higher level education qualification, such as:
        - TAE80113 Graduate Diploma of Adult Language, Literacy and Numeracy Practice (and its equivalent TAE70111); or
        - Bachelor of Education, Graduate Certificate or Graduate Diploma of Education, or higher. This may include qualifications relating to TESOL, adult education or vocational education.

Links

Companion Volume Implementation Guide is found on VETNet - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=f572fe10-a855-4986-9295-3852c771f178

1. Select and interpret routine mathematical information

1.1. Identify whole numbers and routine fractions, decimals, percentages and common rates embedded in workplace tasks and texts

1.2. Interpret whole numbers and routine fractions, decimals, percentages and common rates embedded in workplace tasks and texts

1.1 – Identify whole numbers and routine fractions, decimals, percentages and common rates embedded in workplace tasks and texts

By the end of this chapter, the learner should be able to:

- Identify how whole numbers, routine fractions, decimals, percentages and common rates are written.

Identifying mathematical information

In the workplace, numeracy is used in many everyday situations. For example, you may need to make calculations to measure materials, or to estimate out how long a task may take to complete. Therefore, an understanding of the basic types of numbers and calculations that are used will help you to do this.

Calculations will need to be made so you can identify specific numerical information that will enable you to do your work role.

For example, some professions will rely heavily on having a good knowledge of numeracy, such as the construction industry, where you will need to be able to interpret measurements from plans and calculate the quantities of different types of materials that are needed for a build. This may involve complex calculations with several steps, or a combination of different types of numbers. Alternatively, you may only need to have a general understanding of numeracy for tasks, such as stock-taking, resource-allocation, or weighing out recipe-ingredients. These types of roles will use basic numeracy, such as adding, subtracting, multiplying and dividing.

Types of numbers that are used in workplace tasks and texts include:

- Whole numbers – these are your complete numbers, such as one, two, three, etc., that you use every day; for example, you may be asked to print 50 copies of a complete document that needs to be circulated in the workplace. This is a whole number

- Fractions – these are numbers that show a part of a whole and are written as two numbers (one on top of another number with a straight line in between to separate them, or one followed by a backwards slash and then another number). For example, you may have to mix a solution of one part water to 1/10 concentrated solution; this means that for your chosen measure of water (the whole number), you will then need to calculate 1/10 of this measure to identify the smaller or fraction amount of concentrated solution that needs to be added into the water

- Decimals – these are whole and part numbers. A decimal point is placed in between the digits of the number to show the fraction amount. The number on the left of the decimal point is the whole number, and the number on the right is the part number. For example, if reading a recipe, you may have to add three and a half (or 3 1/2) teaspoons of sugar to a mixture; as a decimal, this would be 3.5

- Percentages – these are numbers that show a specified amount of a whole (similar to fractions and decimals). However, the whole of the percentage number is made up of 100 parts. A percentage number will be followed by the symbol '%' or may have the word 'percent' or the abbreviation 'pct' or 'pc' written after it. For example, you may have 100 pens in stock, which is the full amount needed; this means that you have 100% of your required stock

- Common rates – these are the numbers that you specify for a particular measure, such as time. A simple example would be how much you may charge in dollars per hour to do a job. A rate will be worked out and will be applied to give a consistent measure. Another example is how much you may charge for a kilogram (or kg) of rice. Rates are identified through the word 'per' or the symbol '/'; for example, $4 per kilogram or $4/kg.

Selecting mathematical information

The mathematical information that you need to select is likely to depend on the nature of your workplace tasks. You should be aware of the types of numbers and mathematical information that will be found in your workplace. Let's consider a further example.

You might have been asked to collate, analyse, and present statistics, e.g., the results of a customer survey. Here you would be particularly interested in percentages to show consumer trends or patterns of thinking, etc. Percentages may be the easiest way to present the information to your employer, showing the results clearly and accurately. If you weren't provided with the statistics in percentages, then you would need to convert them yourself.

This is something you will learn during this unit. In order to carry out the calculation, you would first need to select certain information, which may include the following: How many people took the survey? How many people answered yes to each question? How many people answered no? etc. You will, therefore, need to collate certain statistics before you can carry out a percentage calculation.

What should you do if you come across mathematical information you don't understand?

- Always ask your trainer, workplace supervisor or instructor

- Ask a colleague, if appropriate

- Consult workplace manuals/materials

- Improve your knowledge through further training and education

- Conduct an internet search or reference a maths textbook/dictionary.

1.2 – Interpret whole numbers and routine fractions, decimals, percentages and common rates embedded in workplace tasks and texts

By the end of this chapter, the learner should be able to:

- Determine what mathematical numbers represent in whole numbers, fractions, decimals and percentages
- Identify what common rates are and what they mean.

Interpreting mathematical information

Along with identifying mathematical information, you will need to understand what this means and how calculations are made. Interpreting this will require you to learn mathematical language and symbols.

If you came across this information in the workplace, would you know what it meant?

1/4

It is a fraction. It is also used to show one-quarter.

What about this sign, do you know what it means?

%

It is a percentage sign. It means that the number before it is a percentage of the whole. For example, 25% is 25 of the whole (always think of the whole as 100). 25% can also be used to show one-quarter.

If you came across this, what would it mean?

0.25

It is a decimal. Again, it means a quarter of the whole.

So, you can see that there are many numerous ways of presenting and interpreting the information.

What if you saw this:

45

It is simply 45, a whole number.

Finally, would you know what this was?

Yen per A$

This is the number of yen that you will get for each Australian dollar (currency exchange rate).

Fractions

What is the definition of a fraction? A numerical quantity that is not a whole number, e.g., 1/2 or 0.5.

There are three types of fractions – proper, improper, and mixed.

All fractions are a combination of two numbers, e.g., 1/4.

The top number (1) is the numerator – the number of parts you have.

The bottom number (4) is the denominator – the number of parts the whole is divided into.

So, referring back to the example of 1/4, there is one part. Each part is a quarter of a whole.

The three types of fractions:

- A proper fraction – the top number is smaller than the bottom number, i.e., the numerator is less than the denominator, e.g., 1/3, 1/8
- An improper fraction – the numerator is greater than or equal to the denominator, e.g., 4/3, 7/7
- A mixed fraction – a whole number and a proper fraction together, e.g., 1 1/3, 2 1/4.

Decimals

What is the definition of a decimal? A value relating to a system of numbers and arithmetic based on the number 10, tenth parts, and powers of 10.

First, we need to think about how we write numbers to show value – what units, tens, hundreds, etc. do we use? Let's consider an example:

1,274 – Let's look more closely at what each number means:

1	2	7	4
Thousands (1000s) Here, there is 1 thousand, meaning '1000'	Hundreds (100s) Here, there are 2 hundreds, meaning '200'	Tens (10s) Here, there are 7 tens, meaning '70'	Units (1s) Here, there are 4 units, meaning '4 ones'

Therefore, we can see how the number is broken down so that when we read it, we know its value is 'one thousand two hundred and seventy-four'.

So what does this have to do with the decimal system?

Look at the table again, if you look at it from right to left can you see how each position increases by 10? So, if a unit is one, tens are 10 units, hundreds are 100 units, thousands are 1000 units, etc.

Now, look at the table from left to right. The same applies but the other way around; each position decreases by ten. So, what happens if we go beyond the final position (the unit)? What is 10 times smaller than one unit? The answer is one-tenth or 1/10. And, we can keep moving right as shown in the example below. However, you should remember that you must place a decimal point to the right of the unit, so that we can locate the unit and therefore understand the value of the figures. Consider the following example.

E.g., 14.729:

1	4.	7	2	9
Tens	Units Note the position of the decimal point	Tenth (1/10) – here there are 7 tenths or 7/10	Hundredth (1/100) – here there are 2 hundredths or 2/100	Thousandths (1/1000) – here there are 9 thousandths or 9/1000

So, the decimal system allows us to write numbers as large or small as we need to. The decimal point is important as it shows us which numbers denote a value greater than one (those to the left) and which denote a value less than one (those to the right of the point).

If there was no decimal point, what would come before 1? The answer is zero or 0, which would come before negative numbers, e.g., -1, -2, -2.5, etc. It is important to remember that zero has no value.

Percentages

What is the definition of a percentage? A rate, number or, amount ‘in each hundred’, i.e., any proportion or share in relation to a whole.

So, consider these examples:

- 75% – this means 75 of 100 – also referred to as three-quarters
- 50% – this means 50 of 100 – also referred to as half
- 25% – this means 25 of 100 – also referred to as one-quarter
- 20% – this means 20 of 100.

So what is 100%? – this means whole/all.

So, how do you work out a percentage? Always refer back to the definition – a percentage is the number in each one hundred. So your first step is always to divide by 100. Let’s see how this works:

What is:

- 50% of 80 – first think 100% would be 80 – if 50% is half then it would be 40
- 75% of 80 – Think of 100% as 80 first – then, split 80 into 4 (20) this gives you a quarter or 25% – next, multiply this by 3 to give you 3 quarters/75% – the answer is 60. Therefore, 75% of 80 is 60.

What have you noticed about fractions, decimals and percentages?

All of them can be used to express the same value.

Consider the following examples:

- 1/4 is the same as 0.25 and the same as 25% – they all represent a quarter
- 1/2 is the same as 0.5 and the same as 50% – they all represent half.

Whole numbers

Finally, you need to know what a whole number is. Look at the three things we have considered so far – fractions, decimals, and percentages. All of them denote some part of the whole – they all show a value. So what is a whole number? It is simply one that has no fraction, decimal point, etc. Examples of whole numbers may include – 1,274, 597, 22, 2, 1, etc.

Common rates

Rates are established in many types of businesses; they provide a clear measure for others to use or follow. As mentioned in section 1.1 of this unit, there will be two different values that relate to each other. This provides you with important information on their relationship with each other and how they impact.

Some common rates are mentioned below:

- Kilometres per hour (km/hr) – this is a unit of speed and represents the number of kilometres travelled in one hour. An example of this is on speed restrictions when travelling by road; the amount you are able to travel per hour in a specific travel zone, such as 40km/hr or 40km/h
- Australian dollars per M (A$/M) – the 'M' represents '1,000' (1,000 units); when writing quotes, if you quote in large values this makes writing values more straightforward to do, for example, A$250/M means A$250 per 1,000 units
- Rate of pay/hr – how much you are paid for every hour of work that you do, for example, $22.50/hr
- Scoops/litre – if mixing up a solution, you may see a rate similar to this on the product instructions, for example, 3 scoops/litre (for every litre of fluid, add three scoops of the product)
- The rate that someone can complete work, such as how many items can be manufactured each hour. If making 40 items each hour, this would be expressed as 40/hr
- B/m – heart rate, i.e., how many heartbeats per minute (bpm). Medical and fitness workers will need to use this to measure if a person's heart rate is healthy.

2. Perform mathematical calculations to complete workplace task

2.1. Select arithmetical problem solving process for completing the workplace task

2.2. Estimate outcome of calculations with the four arithmetical operations related to whole numbers, routine fractions, decimals and percentages

2.3. Calculate outcome of calculations with the four arithmetical operations related to whole numbers, routine fractions, decimals and percentages

2.4. Check and reflect on mathematical problem solving processes and outcomes in relation to initial estimates and the workplace context

2.1 – Select arithmetical problem solving process for completing the workplace task

By the end of this chapter, the learner should be able to:

- Use a problem-solving process to make calculations
- Apply basic numeracy in calculations
- Work through calculations in the correct order.

Problem-solving

Problem-solving is all about learning the skills required to solve mathematical calculations and then applying those skills to find the answer.

It is also recognising what needs to be done in the first place, i.e., what type of calculation or process should you use to find out what it is you need to know.

Problem-solving will be required for:

- Identifying and interpreting mathematical information, language, and symbols
- Converting mathematical information
- Making estimations
- Applying steps, methods, and rules when calculating
- Assessing mathematical results and correcting calculations (as necessary).

It is through learning and using numerical calculations that you will be able to build on your ability to problem-solve.

Basic numeracy

The four main methods to calculate in numeracy are addition, subtraction, multiplication and division.

These are:

- Adding numbers together; this is indicated by the plus or '+' sign, for example, 14 + 18 = 32
- Subtracting numbers or taking one number away from another; this is indicated by the minus or '–' sign, for example, 14 – 6 = 8
- Multiplying numbers together; this is indicated by the cross or 'x' sign, for example, 5 x 12 = 60
- Dividing numbers; this is indicated by either of the following two signs, '÷' or '/', for example, 50 ÷ 4 = 12.5 (as you can see, this result includes a whole and a part number, and is written as a decimal).

A problem-solving process

To solve a mathematical problem, you must first understand what the problem is. For example, you may need to produce a quote for services. To do this, you will need to identify what the services are, how long these are required for, and how much these will cost. Having an understanding of what it is you need to achieve will help you to apply the correct actions in response. For more complex mathematical problems, it may be necessary to read through information several times or seek further understanding from a senior or more experienced colleague. Understanding the problem is key to resolving it.

You should next decide how you will approach solving your problem, i.e., deciding the most appropriate or reliable way to make your calculations. This will include choosing the method of calculation and any equipment that will help you to do this, such as a calculator or spreadsheet software.

Then it is using the method and means to make your calculations. Once done, this should be checked to confirm that the correct process has been followed. It also allows you to revisit the calculation method in case the result is not as expected, or you determine a more efficient method instead.

To recap, problem-solving in numeracy will involve:

- Understanding the problem
- Deciding the best approach to resolve the problem
- Making your calculation
- Checking your calculation.

Alternatively, the following process can also be used to help solve mathematical problems:

- Read and interpret the information you have
- Determine if further information is needed, if so, obtain this
- Decide the method of calculation, seeking further knowledge or learning on how to do this, if needed
- Perform the calculation using any tools or equipment that will make this easier and more reliable
- Check the result; this may be applying the calculation again, using an alternative method, or simply working this out in your head.

An example

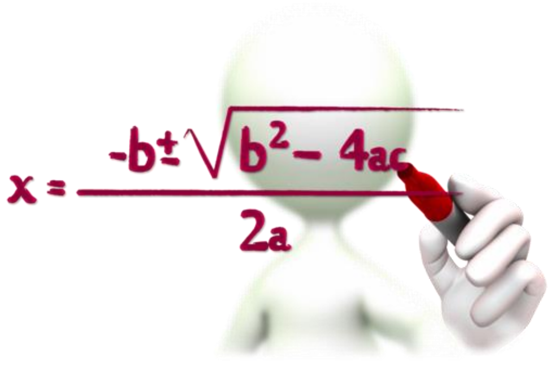
Take the calculation (4/5 x 5/10) x 17 + 11 – 3

To solve this, you should decide your approach; for example:

- Before you begin, you may wish to make a quick estimation, e.g., to then check your result against it for more accuracy
- Identify and interpret relevant information, e.g., the numbers within the brackets are fractions, so you need to know how to multiply fractions (which is different to multiplying whole numbers)
- Because there are several steps to the calculation, you need to know and apply the order of operations.

Your calculation may look something like this:

- (4/5 x 5/10): 4 x 5 = 20 and 5 x 10 = 50, so that = 20/50 which could be simplified to 2/5
- Then, multiplications and divisions – so 2/5 x 17 = 6.8 we know this because we know 2/5 is another way of saying 2 divided by 5 which is 0.4 and 0.4 x 17 = 6.8
- Then, additions and subtractions – so 6.8 + 11 = 17.8 – 3 = 14.8
- What if you wanted to work out a percentage of your answer, say 50%? You would think of 14.8 as the whole (as percentage means per 100). Half of 14.8 is 7.4, so the answer would be 7.4%
- Finally, what if you wanted to convert this to a decimal? You would need to know the correct method, which is to divide by 100 and remove the % sign. So, 7.4% / 100 = 0.074.



2.2 – Estimate outcome of calculations with the four arithmetical operations related to whole numbers, routine fractions, decimals and percentages

By the end of this chapter, the learner should be able to:

- Determine how to make estimations
- Make estimations to gain a better understanding of a mathematical outcome
- Improve estimation skills through practice.

Estimations

Although estimates of calculations can be used to gain a general idea of a numerical outcome, these will eventually need to be verified by making the correct or final calculation.

However, an estimate can help you to plan ahead on resource acquisition and when needing to gain an initial understanding of quantities or values that you may require for a project or task. They are rough calculations or judgements on what the outcome may be, without carrying out a proper calculation.

Estimating is an important skill because you are faced with calculations on a regular basis in the workplace. For example, you might need to give a customer a rough estimate of their total bill, you might need to quickly estimate how much material you need for a job, you may need to estimate a price which may be subject to certain outcomes, etc.

Why wouldn't you just carry out a calculation? Consider the list below:

- You may not have the necessary tools to complete a calculation, e.g., a computer, a calculator, measuring equipment, etc.
- Estimations can save us time and money, e.g., what if we have to place an urgent order for materials. You can quickly work out a rough estimate of how much material you need and, the overall cost
- Estimations can ensure our calculations are accurate, e.g., say you have a calculator, but you input the wrong numbers – you will end up with the wrong answer without even realising. It is easy to rely on technology too much. You need to remember that technology can fail, either with human errors or, by itself, e.g., power failure, system errors, etc.
- The more estimates we carry out, the more accurate we will become at making them
- Carrying out accurate estimations is an important skill. It enables you to think for yourself, improve your problem-solving skills, and gain a better understanding of the task at hand. It is easy to lose these skills when we rely on technology for every task.

So, how can you improve your estimation skills? The answer is by practising. You should make estimations whenever you are faced with a mathematical task, however simple or complicated. As you continue to do so, your estimations will become much more accurate, and you will gain a much better understanding of the task you have been given.

How do you make estimations?

There are different methods of making estimations, depending on the nature of the task. For example, if you were asked to make an estimation of quantity or a measurement, you might carry out a visual estimation. As this unit focuses on calculations with whole numbers, percentages, fractions, and decimals, it is important for you to be able to estimate by rounding numbers up/down to the nearest whole number.

First let's consider some general examples of estimating, to develop your skills:

E.g., 5764 + 3824: One way to approach this could be to simply round up both numbers to the highest thousand – 6000 + 4000 = 10,000. But, we know that this estimate would be too high because we have rounded up so, we would reduce our estimate by around 400 – 9,600.

Or, we could round the numbers up to the nearest 100, giving us a more accurate estimation – 5,800 + 3,800. This might be easier to calculate in your head if you first add the 5,000 and 3,000 (8,000) and then the 800 and 800 (1,600), giving a total of 9,600. This is the same as your first estimate, showing that there is no right or wrong way, it is whatever works best for you and is most accurate.

E.g., 140 + 135 + 145 + 144 + 136 + 141: look at these numbers, what do you notice? They are all close to 140. Therefore, a good way of estimating the total value of numbers with a similar value is to use an average. Here, there are some numbers slightly above and some slightly below 140. Therefore, you could use 140 as the average and simply multiply 140 by 6 – giving you a total estimate of 840.

E.g., 500 – 12 – 18: once again, looking at the numbers to be subtracted from 500, we can see that 12 is close to 10 and 18 is close to 20 and can be rounded up or down for an estimation (also by taking the 2 from 12 and adding this to 18, we get 20). The simplest way to estimate is to add the numbers that need to be subtracted together (30) and then minus this number from 500; this will be 470. Our example uses simple whole numbers, but you may have a range of values, or you may need to apply this to fractions and decimals.

Let's now consider a few examples involving percentages, decimals and/or fractions:

E.g., estimate 50% of $18.00: Remember earlier, we compared percentages to decimals and said that 50% is the same as 0.5. Both mean half. So we know that the answer is around $9.00 because half of 10 is five and half of 8 is 4 – add these together, and you get $9.00.

But what if the question was to estimate 20% of $18.00? Again, we know that 20% is the same as 0.2 or two-tenths. To get one-tenth of $18.00, we would just move the decimal point to the left. The answer is, therefore, that a tenth is $1.80. Therefore, two-tenths would be $3.60 (simply double $1.80).

E.g., 6/7 + 4/5: Both of these fractions are close to 1 or, a whole unit. Therefore, if we add them together, we know the answer is likely to be close to 2. Therefore, we can estimate 2.

E.g., 4/10 x 14: We know that 4/10 is almost half, so we can times 0.5 by 14. Our estimate is, therefore 'around 7'.

If an estimate seems noticeably greater or less than you expect, you will need to assess the method that you have taken to make the estimation. It may be that you missed a number out or interpreted this incorrectly. In mathematical calculations and estimations, it is necessary to work through in a logical and methodical order. You may need to make a new estimation to check the validity of this.

2.3 – Calculate outcome of calculations with the four arithmetical operations related to whole numbers, routine fractions, decimals and percentages

By the end of this chapter, the learner should be able to:

- Identify how to successfully complete calculations, including whole numbers, fractions, decimals, and percentages.

Performing calculations

When you calculate something, you are determining the amount of or number of something.

Calculations can become complex and may require you to follow a number of steps to work the answer out correctly. To do this, you will need to identify the correct sequence to take; this ensures that calculations are accurate.

Working through a number of steps

Let's look at different steps in more detail. What if you were asked to find the difference or the average of figures?

E.g., one employee makes 42 sales; another makes 16.

What is the difference between these figures? Difference simply means to subtract one value from another; so, 42 – 16 = 26. So employee one made 26 more sales than employee two.

The average is the value half-way between the two figures. The formula for average is (first value + second value) divided by 2. So here it is 42 + 16 (58) divided by 2 = 29.

The difference was 26.

The average was 29.

These steps will often be necessary before you can use statistics to convert figures to percentages, fractions, etc.

If, for example, you were then asked to convert this percentage to a decimal or a fraction, what would you do? You would follow a number of steps. The steps combined are known as the 'method' used to convert the figures. We will look at conversions later in this unit. However, it is worth emphasising that they are a good example of where you may need to follow several steps to perform a calculation.

Calculations will include using the four arithmetical operations:

- Addition
- Subtraction
- Division
- Multiplication.

Calculating with whole numbers

As you know, whole numbers are numbers without a fraction, decimal, percentage, etc. they are just numbers alone – whole. You will come across these all the time in workplace information. You may need whole numbers to work out a percentage or fraction.

Whole numbers are easy to work with; however, you may need to consider that some calculations with whole numbers may result in a whole and part number.

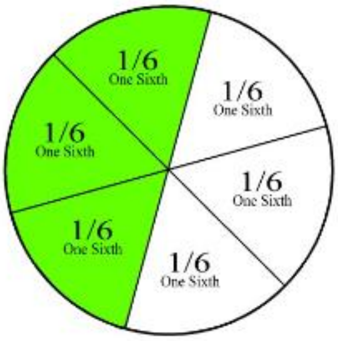
Calculation examples:

- 150 + 3,000 = 3,150
- 3,000 – 150 = 2,850
- 150 – 3,000 = -2,850 (subtracting a higher number from a lower number will give you a minus figure)
- 150 x 3,000 = 450,000
- 3,000 / 150 = 20
- 150 / 3,000 = 0.05 (dividing a higher amount into a lower amount will result in a part number).

Calculating with fractions

You may need to know the following rules:

- Multiplying fractions: multiply the top numbers with the bottom numbers to obtain the answer, e.g., what is 2/4 x 3/8? 2 x 3 = 6 and 4 x 8 = 32, so the answer is 6/32
- Dividing fractions: with the second fraction, turn the numbers so that they are the opposite way around and then multiply the two fractions to get the answer, e.g., what is 1/2 / 2/10? First, swap the second fraction to 1/2 x 10/2 then 1 x 10 = 10 and 2 x 2 = 4 so the answer is 10/4
- Basic adding of fractions: to begin with, you should ensure that the bottom numbers (denominators) are the same. You would then add the two top numbers and place the calculated figure over the top of the denominator. So if you were adding 1/6 to 2/6, then you would end up with 3/6. Such fractions should be simplified where possible. In this instance, you would simplify the fraction to 1/2. (n.d. image retrieved from http://www.printable-math-worksheets.com/fraction-concepts.html on 10/02/2020)



- More complex adding of fractions – there are likely to be instances when the denominators of two fractions aren't the same. As an example, you may be expected to add 1/3 to 3/6. It will be necessary to find the least common multiple between the denominators (3 and 6)

If you multiply 3 X 2, then you will end up with 6, so 2 is the least common multiple. You should multiply both numbers within the fraction by 2 to end up with a figure of 2/6. You would then add 2/6 to 3/6 giving you a total of 5/6

- Subtracting fractions: the same rules apply when subtracting or adding fractions – the bottom numbers must be the same, then you can simply subtract the top numbers.

Calculating with percentages

Let's consider a common workplace task. For example, you may be asked to reduce or increase an item/bill, etc. Let's say your workplace has a 25% discount on a $150 item. What should you charge the customer?

First, work out 25% of $150 using the following method: 25 / 100 x $150 = $37.50.

Second, reduce the item by 25% ($37.50): $150 – $37.50 = $112.50 is what you should charge.

What if you weren't reducing but increasing the item by 25%? You would simply follow the same procedure but add 25% ($37.50) to the original price instead of subtracting it. The answer would be $187.50.

Calculating with decimals

The following methods may help:

- When adding decimals, it is easiest to line them up and add the numbers together, e.g., 4.72 + 2.293

  You would write this as follows:

  4.72

  2.253

  Add the numbers in each row from right to left so:

  3 (there is nothing to add to the 3), 2 + 5 (7), 7 + 2 = (9), 4 + 2 = (6)

  So the answer is 6.973

- When subtracting, use exactly the same method but subtract instead of add

- When multiplying, multiply the decimals without the decimal point then add the decimal point back in according to how many points were in the original numbers.

  E.g., 0.22 x 7.4

  There are two decimal point spaces in 0.22 and one in 7.4, so remember to add 3 at the end.

  22 x 74 = 1628

  Add three decimal point places = 1.628

Dividing decimals works in the same way, in that the number you are dividing by (the divisor) is made a whole number by moving the decimal point over and adding it back in afterwards.

What is the order of operations?

The order of operations is a mathematical concept. It is simple, but important if you wish to obtain the correct answer when carrying out a calculation which has several steps.

What does it mean? It means that you have to perform certain operations in a certain order to get the right answer.

Let's look at an example:

E.g., 12 + (14 / 4) x 20 – (2 / 2)

If you simply type that into your calculator in the order given, you may end up with an incorrect answer (depending on the calculator you use). This may give you the incorrect answer of **64**.

<u>What order do you need to follow?</u>

Instead, you should apply the order of operations as follows:

- Parenthesis (part of calculation in brackets) (e.g., 8 + (7-2) x 5)
- Exponents (a quantity representing the power to wish a given number or expression is to be raised - the raised symbol(s) beside the number(s)) (e.g., cm3 = cm x cm x cm)
- Multiplication (x) and division (/) – move from left to right
- Addition (+) and subtraction (–) – move from left to right.

<u>Back to the example</u>

So, let's apply this order to our calculation:

- 14 / 4 = 3.5
- 2 / 2 = 1
- 3.5 x 20 = 70
- 12 + 70 – 1 = **81**.

We can see that this answer is very different from when we simply input the calculation into the calculator in the order it was given. That is why it is important to always follow the order of operations.

Converting number types

<u>Converting from decimals to percentages</u>

Method: move the decimal point 2 places to the right.

E.g., 0.25 becomes 25.

Therefore, 0.25 = 25%.

Or, multiply the decimal by 100 and add the % sign.

0.25 x 100 = 25.

Therefore, 0.25 = 25%.

Converting from percentages to decimals

Remember, percent means 'for every 100', so 25% means 25 of 100.

If you divide 25 by 100, you get 0.25 (a decimal number).

Therefore, it is the opposite of the previous conversion.

Method: divide percentage by 100 and remove % sign.

Or, move the decimal point 2 places to the left.

E.g., 25% becomes 25. becomes 2.5 which becomes .25 = 0.25.

Converting from fractions to decimals

Method: divide the top number by the bottom number.

E.g., convert 3/4 to a decimal.

3 divided by 4 = 0.75.

Converting from decimals to fractions

E.g., convert 0.75 to a fraction.

Method: Step 1: write the decimal over the number 1 – i.e., 0.75/1.

Step 2: multiply the top and bottom number by 10 for every number after the decimal point, e.g., 10 for one number, 100 for two numbers, etc. – i.e., 0.75 x 100/1 x 100 = 75/100.

This makes the correctly formed fraction.

Step 3: simplify the fraction – i.e., 3/4.

Converting from fractions to percentages

Method: divide the top number by the bottom number, then multiply by 100 and add the % sign.

E.g., 2/4 to a percentage.

2 divided by 4 = 0.5.

0.5 x 100 = 50%.

Converting from percentage to fractions

Method: Step 1: convert to a decimal by dividing by 100.

E.g., convert 80% to a fraction.

80 divided by 100 = 0.8.

Then, use the method for converting decimals to fractions (explained above).

Method: Step 2: write the decimal over the number 1 – i.e., 0.8/1.

Step 3: multiply the top and bottom number by 10 for every number after the decimal point, e.g., 10 for one number, 100 for two numbers, etc. – i.e., 0.8 x 10/1 x 10 = 8/10.

This makes the correctly formed fraction.

Step 3: put the fraction into its simplest form – i.e., 4/5.

Note: simplifying fractions is reducing large numbers down to a lower and simpler form; this is done by dividing the top and bottom numbers in the fraction by the highest number that will divide into both. For example, taking 8/10, you will divide both numbers by 2; 8 ÷ 2 = 4 and 10 ÷ 2 = 5, making this 4/5.

2.4 – Check and reflect on mathematical problem solving processes and outcomes in relation to initial estimates and the workplace context

By the end of this chapter, the learner should be able to:

- Use different methods to check and reflect on mathematical problem-solving processes and outcomes
- Use appropriate skills to assess outcomes against initial estimates.

Checking mathematical calculations

Once calculations are made, it will be necessary to check these against any initial estimates that have been made. There may be additional factors that have changed your expected calculation, for example, another value or a change of rate (such as an hourly rate for a contractor). Your work records must contain the accurate amounts and values that have been determined.

Equally, comparing calculations against estimates allows you to assess whether amounts or values are as expected and whether your estimating skills are effective.

To check calculations:

- Review your calculation process and/or method (and check your working out)
- Try an alternative method of calculation (if this applies)
- Perform an inverse calculation (work in the opposite direction to undo the calculation); for example, you may have the calculation 508 x 4 = 2,032. To check this with an inverse operation, you can then divide 2,032 by 4 to check that the answer does result in 508 (i.e., all three numbers are the same in the equation); 2,032 ÷ 4 = 508
- Use technology to perform a calculation (if working straight onto paper)
- Use your estimate to gauge if the outcome of a calculation is within the expected amount.

Skills to assess calculation outcomes

Assessing calculations and estimates will include having patience and a methodical approach to work through calculation processes. You will need to develop a system to review your work, so that each part of the calculation is looked at in turn. Reviewing numerical information may require you to write out calculations in different ways so you can assess these more clearly. You may need to break down complex calculations into separate parts to look at these in isolation. Equally, you may need to convert numbers to another type to make these the same, or easier to work with. If one part is wrong, it can have a big impact on the overall result.

Skills to assess calculations include:

- Numeracy skills – without a basic understanding, it will be difficult to understand the information in front of you
- Critical and analytical thinking – to be able to look at the information and discern what is and is not right
- Logic and reasoning – to be able to break down information and work through calculations
- Information ordering – to be able to recognise numbers, calculation sequences and patterns in numerical information.

Using technology

Technology in numeracy will include calculators and software that facilitate making calculations. Along with this is the software to interpret calculations into an easily understandable visible form; for example, graphs and graphical illustrations.

Calculators vary in type, depending on the calculations that need to be made; these include:

- Basic calculators (includes the four operations of adding, subtracting, dividing and multiplying, and also percentages and memory function)
- Financial calculators (with functions, such as profit and loss, cash flow analysis and trigonometric calculations)
- Scientific calculators (for more mathematical calculating, such as trigonometry, powers and statistics)
- Graphing calculators (these are advanced display calculators which allow you to interpret calculations into graphs)
- Printing calculators (to print out calculations)
- Online calculators (for a range of different purposes, such as conversion calculators or health-related calculators (e.g., a calorie calculator)).

Using a calculator will rely on inputting figures and commands correctly, and in the right order; care must be taken to check this is the case. Errors can easily occur when inputting figures quickly or if interrupted during a calculation. It may be necessary to repeat a calculation to check this has been inputted correctly, if the answer does not seem to fit or you are unsure if this has been carried out correctly. It will be necessary to understand the functionality of the calculator and how to perform calculations specific to the device.

Software can be used in a similar sense, depending on its purpose and functionality. Financial and planning software will have specific calculation functions, along with professions that require bespoke software calculating programs. One of the simplest programs to use for calculating is a spreadsheet program, such as Microsoft Excel, Google Sheets or Apple Numbers.

Spreadsheets can be constructed to perform a range of calculations. These are applied as formulas to designated cells; different spreadsheet programs will have slight differences, such as appearance, menu options and compatibilities with other software.

Essentially spreadsheets will be similar in:

- The use of columns and rows to set input data (typically letters to indicate columns, and numbers to indicate rows)
- The use of individual cells for data values
- The application of formula (and functions in some spreadsheet programs) to selected cells.

Software can also transform numerical data into graphs and charts; data will need to be selected and plotted using simple software commands (or function buttons). Graphs can then be adjusted, such as use of colour, size of text and orientation.

3. Communicate workplace mathematical information

3.1. Use informal and formal written mathematical representation to document and report on workplace calculation processes and results

3.2. Use informal and formal mathematical language to present and discuss workplace problem solving process and results

3.1 – Use informal and formal written mathematical representation to document and report on workplace calculation processes and results

3.2 – Use informal and formal mathematical language to present and discuss workplace problem solving process and results

By the end of this chapter, the learner should be able to:

- Use appropriate mathematical language and level of formality for documentation and communications
- Follow organisational reporting requirements for workplace calculation processes and results
- Prepare for presentation and discussion of problem-solving processes and results.

Mathematical representation

What is the 'result' of a task? It is the outcome of your calculation – this could either be the answer to an exact calculation, an estimate or, a conversion, etc. Think about how you need to document and report this, so that you and others can understand exactly what the outcome represents.

How will you communicate your result?

- You will need to show how you have reached the result, e.g., your calculation. This is so that you and others can understand the figures. Figures alone are often meaningless without the prior calculation, e.g., 2,000 people took a survey, and 1,500 answered 'yes'. Your result may be written as 75%, 3/4 or 0.75. However, you may need the statistics in future, to work out different results or, to show your workplace supervisor how you reached the result, etc.
- Look at the above example again – note that the result could have been written in three ways, as a percentage, decimal, or fraction. The use of a certain symbol/language may have been specified when you were given the task. Alternatively, a certain type may be used routinely in your workplace. If not, it could be which you find most appropriate. Using the same example, percentages for all results allow consistency and make the data easier to understand
- Also, when you make an estimate or a conversion you need to ensure that you show that this is an estimate or conversion by writing down how you came to that result and labelling it with 'estimate' or 'conversion' to make any data as clear as possible to whoever might read it.

Language and symbols

Any calculations and results should be shown using the correct mathematical language and/or symbols, such as:

- x/multiply/times, //÷/divide, +/add, –/subtract, =/equals
- %/percent, ./decimal point, 3/4/fraction
- Measurements, e.g., m, cm, mm
- Currency, e.g., $, ¥, £
- Whole numbers, e.g., 9, 74, 104.

The appropriate language and or/symbols will depend on what language and symbols your workplace routinely uses and what your task is. For example, employees may all work to the same form of measurement or currency, etc. to ensure consistency within the workplace. If you don't know what symbols you should be using, or what they mean, you should ask your manager (or the relevant person) to clarify this before you undertake the task.

Formality of language and symbols

Depending on your role and organisation, you may need to alter the formality of your language and numerical information.

When communicating results, think carefully about your audience and select language and symbols according to that context. For example, when relaying information to managers, supervisors, key external people, you should adopt more formal and professional language.

Examples of formal language and symbol names:

- 'Multiply' (instead of times)
- 'Subtract' (instead of take away)
- 'Add' (instead of plus)
- Full sentences with correct grammar
- Concise language choices.

If you are communicating with colleagues or in a more relaxed setting, then you may wish to use more conversational language. This means using the forms and symbol names you are more familiar with and referring to your own handwritten notes.

Communicating results

Using formal and informal mathematical language, it will be necessary to present calculations and results in a clear manner. You may need to write out calculations, highlight results or depict information in a graphical format. Information should be selected for its relevancy and means to communicate what needs to be shared.

Discussing calculations and results will mean that you need to have a good grasp of mathematical language (as relevant to the calculation) and an understanding of how results were reached. It will be necessary to explain this and to answer any questions that others may raise in response. You should prepare for discussions in advance and include any supporting information and evidence that may be of help to you.

Communicating may require:

- Spoken explanations of problem-solving processes and why these were used
- Written evidence of calculations and results
- Visual and graphical interpretations of calculations and results.

You may need to report results directly or indirectly to other persons; these may be subject to certain reporting timelines. When needing to report calculation results or problem-solving processes, always ensure you are aware of what you are required to do, who you need to report these to and when these must be reported by.

Summative Assessments

At the end of your Learner Workbook, you will find the Summative Assessments.

This includes:

- Skills Activity
- Knowledge Activity
- Performance Activity.

This holistically assesses your understanding and application of the skills, knowledge and performance requirements for this unit. Once this is completed, you will have finished this unit and be ready to move onto the next one – well done!

References

These suggested references are for further reading and do not necessarily represent the contents of this unit.

<u>Websites</u>

'Fraction Concepts' from Printable Maths Worksheets: http://www.printable-math-worksheets.com/fraction-concepts.html

All references accessed on and correct as of 10/02/2020*, unless otherwise stated.*

FSKNUM015

Estimate, measure and calculate with routine metric measurements for work

Learner Guide

Table of Contents

Unit of Competency

Application

This unit describes the skills and knowledge required to undertake routine workplace metric estimations, measurements and calculations to complete workplace tasks. It includes interpreting and selecting workplace measurement information, completing workplace measurement tasks, and communicating workplace measurement information.

An individual performing these tasks works independently and uses their own familiar support resources.

This unit applies to individuals who use, or are preparing to use, numeracy skills to complete workplace activities. This includes existing workers and individuals preparing for employment through vocational education and training. This unit should be integrated and contextualised with vocational training to support achievement of vocational competency.

This unit is aligned to, but does not fully address, the Australian Core Skills Framework (ACSF) numeracy core skill indicators .09, .10 and .11 at level 3 in the workplace and employment domain of communication.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Unit Mapping Information

FSKNUM015 Estimate, measure and calculate with routine metric measurements for work (Release 1) supersedes and is equivalent to FSKNUM15 Estimate, measure and calculate with routine metric measurements for work.

Pre-requisite Unit

None stated

Unit Sector

Numeracy

Performance Criteria

Element *Elements describe the essential outcomes.*	**Performance Criteria** *Performance criteria describe the performance needed to demonstrate achievement of the element.*
1. Select and interpret familiar and routine workplace measurement information	**1.1** Identify and select familiar and routine measurement information embedded in workplace tasks and texts in order to complete workplace measurement task **1.2** Interpret familiar and routine measurement information embedded in workplace tasks and texts in order to complete workplace measurement task
2. Complete workplace measurement task	**2.1** Select mathematical problem solving process for completing the measurement task **2.2** Estimate measurements required to complete workplace tasks **2.3** Select and use measurement equipment to take workplace measurements **2.4** Calculate with measurements to complete workplace tasks **2.5** Check and reflect on estimation, measurement and calculation outcomes and appropriateness of outcome to workplace task
3. Communicate workplace measurement information	**3.1** Use informal and formal written mathematical representation to document and report on workplace measurement and problem solving process and results **3.2** Use informal and formal mathematical language to present and discuss workplace measurement and problem solving process and results

Foundation Skills

This section describes language, literacy, numeracy and employment skills that are essential to performance but not explicit in the performance criteria.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Assessment Requirements

Performance Evidence

The candidate must demonstrate the ability to complete the tasks outlined in the elements, performance criteria and foundation skills of this unit, including evidence of the ability to:

- Identify routine and familiar metric measurement information and units of measurement in workplace texts and perform routine measurements, calculations, and conversions using at least three of the following measurements:
  - length or perimeter
  - mass
  - volume or capacity
  - temperature
  - area of a rectangle or square.

In the course of the above the candidate must demonstrate use of relevant technology, such as calculators or spreadsheets.

Knowledge Evidence

The candidate must be able to demonstrate knowledge to complete the tasks outlined in the elements, performance criteria and foundation skills of this unit, including knowledge of:

- Purpose of workplace measurement relevant to meeting workplace objectives
- Purpose and meaning of metric unit prefixes
- Purpose, function, selection, set up and safe use of routine measurement tools and equipment
- Methods to estimate, measure and calculate measurements
- Methods for using estimation and assessment skills to check and reflect on outcome and its appropriateness to the workplace task
- Informal and some formal mathematical written and oral language and symbolism of measurement
- Relevant technology such as calculators or spreadsheets.

Assessment Conditions

Competency is to be assessed in the workplace, a workplace simulated environment or a vocational training context.

Assistive technologies can be utilised to assist with oral and written communication.

Skills must be demonstrated using routine texts and tasks that reflect those typically found in a workplace.

The following resources are to be made available:

- A calculator
- Measurement equipment relevant to the workplace
- Own familiar support resources.

Assessors must:

- Satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards, and
- Have sound knowledge of the ACSF and performance features of the ACSF level being assessed, and
- Have demonstrable expertise, knowledge and skills in the vocational contextualisation and assessment of the core skill, numeracy, and
- Have completed the following or equivalent:
  - TAESS00009 Address Foundation Skills in Vocational Practice Skill Set; or
  - a higher level education qualification, such as:
    - TAE80113 Graduate Diploma of Adult Language, Literacy and Numeracy Practice (and its equivalent TAE70111); or
    - Bachelor of Education, Graduate Certificate or Graduate Diploma of Education, or higher. This may include qualifications relating to TESOL, adult education or vocational education.

Links

Companion Volume Implementation Guide is found on VETNet - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=f572fe10-a855-4986-9295-3852c771f178

1. Select and interpret familiar and routine workplace measurement information

1.1. Identify and select familiar and routine measurement information embedded in workplace tasks and texts in order to complete workplace measurement task

1.2. Interpret familiar and routine measurement information embedded in workplace tasks and texts in order to complete workplace measurement task

1.1 – Identify and select familiar and routine measurement information embedded in workplace tasks and texts in order to complete workplace measurement task

By the end of this chapter, the learner should be able to:

- Understand measurement information such as metric units, symbols and language
- Interpret workplace information in tasks and texts
- Select and use information to perform measurements.

Measurement and calculations for the workplace

A measurement could be the length, temperature, weight, volume, etc. of an object, liquid, etc.

Over time in your work role, you will become familiar with the types of measurements and calculations that you will need to make. This learning unit will provide you with some standard information on routine metric measurements to give you the right starting point.

It is important that measurements and calculations are made so that the correct application of materials and substances is carried out in routine work tasks. This prevents errors from occurring, such as measuring too little or too much of an ingredient, a length of material that is too short or too long, and not having enough space to store a consignment of raw materials for manufacturing. Making efficient and reliable measurements and calculations will mean that you complete tasks more easily and are able to meet your workplace objectives.

Note: when taking temperatures, such as checking the temperature of cooked or stored food, it can also prevent you from making errors in food hygiene, causing harmful bacteria to grow and the potential for food poisoning.

Systems of measurement

There are different systems of measurement; the most widely used is the metric system. This learning unit will focus on the metric system of measurement; however, it may be necessary for you to know about others that are relevant to your workplace or business industry.

Systems of measurement include:

- The imperial system for measuring (a system used before the metric system, still in use in the United Kingdom and the United States of America (USA)) – this may be the second system that you need to know and use in order to convert measures to metric values
- Measuring temperature:
    - Celsius (or Centigrade) – used in most parts of the world and is designed around using measures in tens (based on the international metric system)
    - Fahrenheit – an older temperature scale that is most used in the USA

- Kelvin – a scientific scale and easily converted with the Celsius scale (it has the same increments; you just add or take away 273)

- Measuring time in seconds, minutes and hours

- Measuring electric currents in ampere (based on the international metric system).

Source 'Systems of Measurement | Weights and Measures' at Skills You Need, retrieved from: https://www.skillsyouneed.com/num/measurement-systems.html

The metric system

Metric is a standard system of measurement, within which measurements are given in metric form. This is the international decimal system of weights and measures, and provides a consistent method by which to measure. Measures are simple to work with as they work in multiples of ten; this means that measures in metric can be converted to another for consistency and ease. For example, you may have a measure given to you as 4 kilograms; this can be easily converted to grams by moving the decimal point to the corresponding position (1 kilogram is equivalent to 1000 grams), i.e., 4000 grams.

The metric system is a group of units used to make any kind of measurement – length, area, mass, power, temperature, pressure, velocity, volume, energy, etc. This unit is about the metric measurements you might come across during your work. Most countries use the metric system but, for example, the USA is a major exception.

You might encounter different types of measurements in routine workplace information, but it is likely that they will all follow a standardised way of measuring – to ensure consistency within the workplace. You need to know what type of information you might come across at work and, what it means. You will need to recognise which measures are stated in metric and which are not. There are several basic units of measurement within the metric system, for each type of measurement.

The following are examples of commonly used types of measures along with their base metric units:

- **Length** – metre (m)
- **Area:**
  - square metre (square m or m2); are – 100 square metres (a)
- **Weight:**
  - gram (g); metric ton – 1,000,000 grams (t)
- **Volume (liquid) or capacity –** litre (l)
- **Volume (solids):**
  - cubic metre (cubic m or m3); stere – 1 cubic metre (s)
- **Temperature** – degrees Celsius (°C).

Source 'Metric system' at Encyclopaedia Britannica, retrieved from:
https://www.britannica.com/science/metric-system-measurement

Note: Mass and weight are sometimes used to mean the same thing; it should be remembered that mass is constant, whereas weight is affected by gravitation. In the workplace, this will not be relevant to objects within the Earth's gravitational field; this will relate to measures made in more scientific fields, such as astrophysics.

How are measurements displayed?

A measure will be recognised by a number and a following unit of measure word or symbol afterwards.

For example:

- Metre = **m**
- Centimetre = **cm**
- Millimetre = **mm**
- Kilometre = **km**
- Gram = **g**
- Milligram = **mg**
- Kilogram = **kg**
- Litre = **l**.

What do you notice about each example in the above list? They have the same prefixes – e.g., 'milli', 'kilo', 'centi', etc.

Look at the following scale:

- Kilo – 1000 (thousand)
- Hecto – 100 (hundred)
- Deca – 10 (ten)
- **[1 one]**
- Deci – 0.1 (tenth)
- Centi – 0.01 (hundredth)
- Milli – 0.001 (thousandth).

We can see from this scale that each prefix is defined by a value (10, 100, 1000, and so on). For example, 'milli' is one thousandth, 'centi' one hundredth and 'kilo' denotes multiplication by one thousand. Let's consider an example, using the prefix 'kilo' – 1 kilogram = 1000 grams, 1 kilometre = 1000 metres, etc. So you can see that if you put 'kilo' before the unit of measurement, it simply means 1000 of.

This is why the metric system is often considered to be very simple. The units used to measure increase or decrease by multiples of ten; for example, 1 cm = 10 mm, 1 m = 100 cm, etc.

Metric units

Consider the following chart. The following basic units, all based around the metre, may be commonly used for length and, therefore, commonly found in workplace information.

Metric units for length, including 'prefix'	Definition
Metre	The fundamental unit of length in the metric system. Equal to 100 centimetres
Millimetre	A metric unit of measurement. Equal to one-thousandth of a metre
Centimetre	A metric unit of measurement. Equal to one-hundredth of a metre
Kilometre	A metric unit of measurement. Equal to 1,000 metres

Looking at the above chart in relation to measuring length, you can see exactly how the metric system works. The same principles apply to all different types of measurements in the metric system.

Using measurements

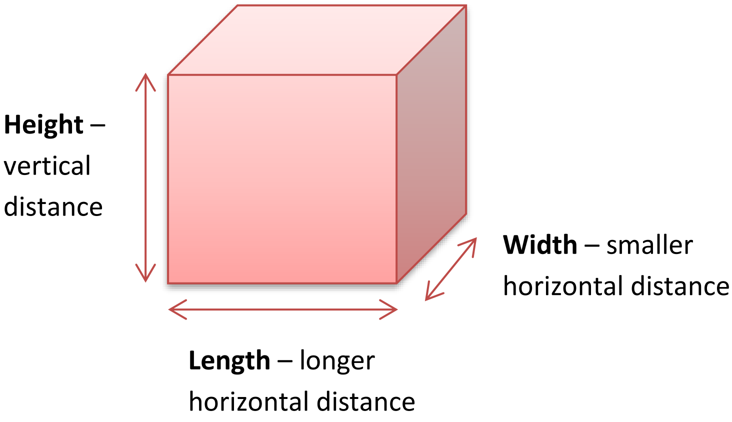
Now that you understand the basic principles of the metric system, you need to establish how exactly you can use or establish information relating to measurements. Before you begin looking at information relating to measurements, you need to understand what you are actually looking for.

Let's consider three common types of measurements.

Volume is the amount of space a substance or object takes up, or that is enclosed within a container – it can include the volume of liquid, regular or irregular shaped objects.

Mass is the amount of matter in an object.

Length is the distance from 'A' to 'B' or, from one specified point to another. However, it can also be used to mean the longest horizontal distance across an object, as shown below.



1.2 – Interpret familiar and routine measurement information embedded in workplace tasks and texts in order to complete workplace measurement task

By the end of this chapter, the learner should be able to:

- Identify information specific to length, volume, mass, temperature and area
- Determine how to apply knowledge of length, volume, mass, temperature and area in workplace tasks.

Types of measurements

We have established that there are several types of measurements you may encounter or need to obtain on a regular basis in the workplace.

Some of the most common may relate to:

- Length
- Volume
- Mass.

You need to establish exactly what you need to measure, for example, if length, is it simply from one point to another? Or, is it one part of an object, e.g., the length, width or height? If volume, is it liquid or a solid object, etc.

<u>Length or perimeter</u>

This can be the length of a given shape or path, or it can relate to the distance around a shape. For example, you may need to measure how long one side of a rectangle is in a diagram, or you may need to measure each side of the rectangle to identify the entire boundary (or perimeter).

Length or perimeter is typically measured in metric units of:

- Metres (m)
- Kilometres (km)
- Centimetres (cm)
- Millimetres (mm).

<u>Volume or capacity</u>

Volume is how much space a solid object takes up, while capacity is how much liquid or gas is contained in a given vessel. Another way of looking at this is that volume is a three-dimensional object and has a length, width and height. Capacity is a measure of how much fluid/gas is needed to fill a specific vessel.

Solid volume is typically measured in metric units of:

- Cubic metre (m3)
- Cubic centimetre (cm3)

➢ Cubic millimetre (mm3).

Liquid volume or capacity is typically measured in metric units of:

➢ Litres (l)

➢ Millilitres (ml).

Mass

This is how much matter is in an object, i.e., how heavy or light the mass of an object is. It is a fixed amount, whereas weight is affected by changes in gravity. Mass is typically measured in kilograms or grams; weight is measured in newtons and is the measure of the force that is placed upon it.

Mass is typically measured in metric units of:

➢ Kilogram (kg)

➢ Gram (g)

➢ Centigram (cg)

➢ Milligram (mg).

Temperature

As mentioned in section 1.1 of this unit, temperature can be measured in Celsius, Fahrenheit or Kelvin scales. They allow you to determine what temperature is actually experienced, be it cold warm or hot. Temperature is measured by either direct contact with the intended substance (or person), or it can be measured by placing a thermometer in the area where the reading needs to be taken, although this must be away from any external influences that may alter the reading, such as direct sunlight.

Area of a rectangle or square

This is how much space there is inside a shape or surface. This is a two-dimensional measure, as indicated by the metric unit m2. An example of when you may need this is in construction, such as calculating the area of a space or room.

Area is typically measured in metric units of:

➢ Square metres (m2)

➢ Square kilometres (km2)

➢ Square centimetres (cm2)

➢ Square millimetres (mm2).

Once you are aware of what your measures relate to, you can apply these in your workplace tasks.

This will include:

➢ Measuring and calculating

➢ Converting measures to the same or another system of measurement.

2. Complete workplace measurement task

2.1. Select mathematical problem solving process for completing the measurement task

2.2. Estimate measurements required to complete workplace tasks

2.3. Select and use measurement equipment to take workplace measurements

2.4. Calculate with measurements to complete workplace tasks

2.5. Check and reflect on estimation, measurement and calculation outcomes and appropriateness of outcome to workplace task

2.1 – Select mathematical problem solving process for completing the measurement task

By the end of this chapter, the learner should be able to:

- Identify and assess information in mathematical problem-solving
- Choose appropriate mathematical problem-solving processes to resolve measurement tasks.

Problem-solving processes

You will need to undertake mathematical problem-solving processes when you are given a task that presents a problem. This is about assessing the information that you have in front of you, and then working out the best way to solve the mathematical problem.

As you learn and apply measurements and calculations, you will develop the skills to process problems and identify the appropriate techniques and methods to resolve them. Volume is an excellent example to consider when thinking of problem-solving processes, because the shape of the object and, therefore, its volume, is not always straightforward.

You may need to establish the volume of:

- Liquid
- A solid object (this could be the shape of a cube, or it could be shaped so that it is difficult to measure).

What are the differences? Will the same method work for each? How will you solve each problem? Measuring the volume of liquid can be done by using a piece of equipment called a graduated cylinder – a cylinder marked with the measurements. You would place the liquid into the cylinder and record the measurement.

What if there was already a volume of liquid within the cylinder?

- Measure the volume of the starting liquid (e.g., 12 ml)
- Add the liquid
- Note the measurement of the ending liquid (e.g., 20 ml)
- **Volume = ending amount – starting amount** (e.g., 20 ml – 12 ml = **8 ml**).

Next, think about how you would measure the volume of an object shaped like a cube. The following method applies.

Measure length (L), width (W) and height (H)

L x W x H = volume

E.g., cube: (L) 3 m x (W) 3 m x (H) 3 m = 27 m3 (volume in cubic metres)

What if the object wasn't shaped like a cube, so you couldn't follow the same method to work out the volume in the same way?

- Fill a graduated cylinder with water and note the starting volume (e.g., 20 ml)
- Place the irregular shaped object into the cylinder
- Note the ending volume (e.g., 28 ml)
- **Ending volume – starting volume = volume** (e.g., 28 ml – 20 ml = 8 ml = **8 cm3**).

Note: as the volume is a solid object, the final metric measure can be changed to cm; in the metric system, 1 ml is the same as 1 cm.

Other problem-solving processes include:

- Looking for the patterns that help you to solve the problem – in numeracy, there are often patterns in numbers and calculations, such as repeated number sequences and number scales
- Drawing or writing down the problem can help you to visualise it in a different way
- Using logic and reasoning to determine what is possible and whether results are feasible
- Looking back at previous measurements and calculations to understand how they were resolved.

Conversions

Let us consider conversions between routinely used metric units in length. This can help you in mathematical problems when you need to convert measurements to the same metric unit.

Remember, these include the following units:

- km – 1,000 m
- m – 100 cm
- cm – one-hundredth of a metre
- mm – one-thousandth of a metre.

So, with that in mind, convert the following measurements to metres:

- 1000 mm – this is one metre
- 100 cm – this is one metre
- 500 cm – this is five metres.

Remember, these units are based on the decimal system. To convert, all we need to do is move the decimal point either left or right.

Therefore, any other areas of units, e.g., volume, the same rules apply.

So, we can convert the following measurements to litres in the same way:

- 1750 ml – this is 1.75 l
- 1750 cl – this is 17.5 l.

What about converting cl to ml?

- 1750 cl – this is 17,500 ml.

You can see from the examples how easy it is to convert metric units due to the simplicity of the metric system being based on multiples of ten.

What about conversions between the metric system and another, such as the imperial system used in the USA. For example, you may commonly hear people in your workplace refer to measurements in inches, feet, yards, miles, etc. This will help you when you need to ensure all measurements are in the same system of measurement. There are conversion charts available in books and online to help you convert measurement units to another type.

First, you need to establish what the correct conversion is, e.g., what it is equivalent to.

E.g., 1 foot is equivalent to 0.3048 metres.

Therefore, to convert feet (ft) to metres, you need to multiply the measurement by 0.3048.

E.g., you are given a measurement of 5 ft. What is the conversion to metres?

5 x 0.3048 = 1.524 m

Let's take another example.

E.g., 1 inch is equivalent 2.54 cm

Therefore, to convert inches to cm, you need to multiply the measurement by 2.54.

E.g., you are given a measurement of 10 inches. What is the conversion to cm?

10 x 2.54 = 25.4 cm

Let's apply this to what we just looked at previously, converting metric measurements to different units. What if we want to establish how many mm this is?

We know that there are 10 mm in a cm.

10 x 25.4 = 254 mm, we simply moved the decimal point.

2.2 – Estimate measurements required to complete workplace tasks

By the end of this chapter, the learner should be able to:

- Determine suitable units of measure to make estimations
- Use different methods to estimate mathematical workplace tasks.

Estimating in the workplace

Estimating is a good way to develop your skills and to obtain an initial understanding of what the outcome should be. This can be done quickly when you are planning work, or when you need to gain a clearer idea of what needs to be done.

When estimating, you will need to have an understanding of the metric system, so you know which unit will be most suitable for your estimate. Or, put another way, when estimating length, the type of unit will need to be appropriate and relevant to the length that needs to be measured.

For example:

- If the length is very long – e.g., the distance from one village to another – you may wish to estimate/measure the distance in **km**
- If it is something medium in length – e.g., the length of a vehicle – you may wish to estimate/measure the length in **m**
- If it is something small – e.g., the length of a book – you may wish to estimate/measure it in **cm**
- If it is something tiny – e.g., the length of a paper clip – you may wish to estimate/measure it in **mm**.

This will also apply when choosing units for volume and mass. Once you understand the measurements in relation to one another, it is easier to start estimating.

Estimating measurements

In the above example, as you have already established what each common prefix means, the prefixes give you a better idea of length to estimate with.

For example, you might compare your foot stride to a metre (or just over/under). You might compare your thumb to so many centimetres. You can use such methods to estimate length. You might see how long it takes you to drive from one town to another and base your estimate on that. As you begin to estimate more often and compare those estimations to actual results, you become more accustomed to guessing lengths. In the workplace, guessing can be useful; for example, to understand which method might be best in that situation. However, you should always follow up estimations with accurate measurement reading and recording.

The more often you estimate and check measurements, the more your brain will adapt to guessing measurements more accurately.

So, if we revert back to our knowledge of common prefixes, we can apply it to other estimations of units. For example:

We would measure weight in grams, but something very large, e.g., that weighs 2000 grams, we may measure in kilograms (remember 1 kg = 1000 grams), so instead of estimating 2000 grams which is much harder to try to guess, we would estimate 2 kilograms.

Methods to estimate include:

- Making a visual assessment to guess the size or mass
- Comparing the length, area or mass with a similar object
- Using previous knowledge or experience to make an estimate
- Rounding up and down numbers to the nearest whole number or unit measure.

For example, consider the following chart:

Item	Equipment used	Estimation	Measurement and unit
Length of pencil			
Volume of liquid in a can of juice			
Width of desk			

Each category of the chart should be completed to estimate and calculate using routine measurements.

First, let us consider our estimation.

Let’s take the first item, the length of a pencil. What unit of measurement do you need to use? You may be told to use a specific unit by your workplace, for example, if they all work to the same unit. If not, because the object is quite small, you may want to use cm or mm.

When you come to actually measure the item, you need to establish the equipment that will be most appropriate to measure this. Here, a small ruler may be appropriate, or a tape measure.

Once you have chosen an appropriate unit of measurement, you can estimate the length of the pencil. Your estimation may even govern what equipment is suitable for the task.

It may help to compare it to other objects that you know the length of. For example, most pencils will be around the same size as a small ruler, which is usually around 15 cm in length so we can estimate that the pencil might be a similar length. Remember, this is only an estimate. If we have chosen the unit mm, for example, we know that there are 10 mm in a cm and, therefore, we can estimate that there the pencil length is approximately 150 mm.

Other measurements we might use to make a comparison include our own height, the length of our stride, etc. Or, for example, other things we know the measurements of, e.g., a litre of milk.

We might use this knowledge to guess the volume liquid in the can by comparing the size or weight with a similar item where the volume is known. The desk could be visually estimated, or you could use the span of your outstretched arms to make a guess at the width.

2.3 – Select and use measurement equipment to take workplace measurements

By the end of this chapter, the learner should be able to:

- Identify measuring equipment relevant to their workplace measurement tasks
- Choose measuring equipment that is most appropriate for the task
- Check and ensure that measuring equipment is ready to use.

Routine measuring equipment

When you are ready to take your measurements, you need to identify and select the appropriate routine measuring equipment to complete the task. Different devices and tools will be available to take measurements, and will be specific in their operation and unit of measure. They allow you take accurate and consistent measures.

The following are examples of measuring equipment found in the workplace:

- A tape measure
- A short or long ruler
- Weights and weighing scales
- An angle gauge
- Callipers
- A micrometre
- A thermometer
- A graduated cylinder.

There are many more types of measuring equipment, and what is 'routine' will depend on your type of workplace. For example, say you are a trainee chef. Routine measuring equipment might include measuring spoons, weighing scales, and a graduated cylinder.

What measuring equipment would you use for each type of measurement?

For example, say you are asked to measure a piece of wood. What measuring equipment would you use?

A standard tool for measuring items in many workplaces is a tape measure. The tape measure features metric measurements and also has the benefit of being adjustable so that you can measure shorter or longer items with ease. If you were asked to measure a short item, you could always use a metric ruler and save your tape measure for longer items.

Things to think about when using a tape measure:

- Are you measuring in mm, cm or m, etc.?
- What exactly are you measuring – from one specified point to another? Or the length, width and/or height of an object?
- Would a simple ruler be more suitable for the task? E.g., is it a very small measurement?
- Is a standard tape measure long enough for the task?
- Do you have a pen and paper to make a note of the measurement(s)?
- Are you starting from 0 on the tape?

Let us consider more examples – measuring volume and mass. What equipment would you use to measure volume?

A graduated cylinder or measuring cylinder can be used to measure the volume of liquid. It is a cylinder marked very much like a ruler; so that once you have placed the liquid into the cylinder, you can simply take the reading from the markings on the cylinder. Ensure that you take the reading at eye level so that it is as accurate as possible.

When measuring mass, it is common to use a triple beam balance, which can measure masses very precisely. Before you start, you need to ensure that the pan is empty and that the sliders are positioned so that the balance reads zero.

You can use a thermometer to measure the temperature of food, for example. Before using a thermometer, you will need to make sure it is clean and dry before placing the probe into the food and waiting until the temperature reading has stabilised before reading it. You should also measure different parts of the food as the temperature may not be the same, depending on how it was stored. After use, it is important to clean and sanitise the thermometer to avoid cross-contamination.

Modified from source, 'Thermometers and using them with potential hazardous food' at Food Standards, retrieved from: https://www.foodstandards.gov.au/consumer/safety/faqsafety/documents/Technical_Fact_Sheet_Thermometers_Feb_2008.pdf (accessed on 28/03/2017)

Before you use any measuring equipment, you need to learn how to use the equipment correctly – in order to get the most accurate result. For example, if you were measuring weight using weighing scales, you would need to ensure that you set them to zero before weighing the object. If it was an electric weighing scale, you would need to ensure you set it to the correct unit of measurement, etc. If equipment is not used as intended or not set-up correctly, your measuring could well be wrong.

2.4 – Calculate with measurements to complete workplace tasks

By the end of this chapter, the learner should be able to:

- Calculate length, perimeter, volume and area
- Use measuring devices to calculate mass and temperature.

Calculating with measurements

It will be necessary to perform mathematical measuring and any required calculations. This ensures that you verify initial estimations and obtain the actual outcomes to mathematical measuring and calculating tasks. The right equipment and method will need to be used.

To make measurements, you will need to:

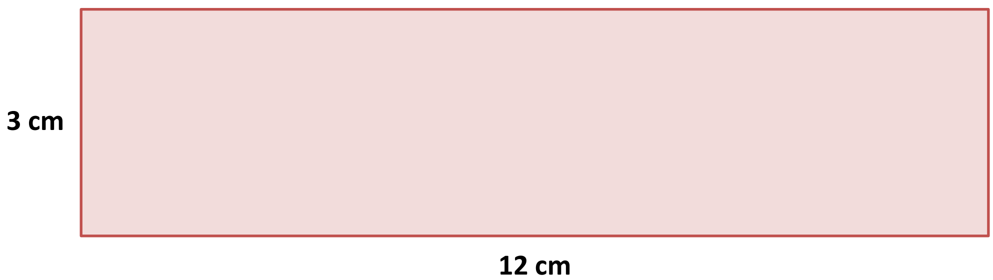
- Identify and use the correct measuring equipment and/or device
- Make any necessary preparations, such as re-setting or calibrating measuring equipment
- Perform the measurement, using the equipment or device correctly, and making sure you use the right unit of measure
- Write down or document your measurement clearly and fully.

When carrying out further calculations with measurements, you will need to work through a calculation method. This may include using one or more of the four basic arithmetical operations; these are addition, subtraction, multiplication and division.

Length or perimeter

To measure the length of an object is simple, that is if it has a flat, straight surface. All you need to do is measure from the designated start point to the identified endpoint. You must make sure you start at zero or a predetermined measure, and that your equipment does not move or alter to give you a false reading. The end-reading can then be written down, taking into account if you started at 1 or another higher value. If measuring a non-straight or uneven surface, you will need to determine the exact path that you need to measure and then choose the appropriate measuring tool that can measure this accurately. To measure the perimeter, you need to add together the edges of the two-dimensional shape.

See the following example, to find the perimeter of a rectangle:

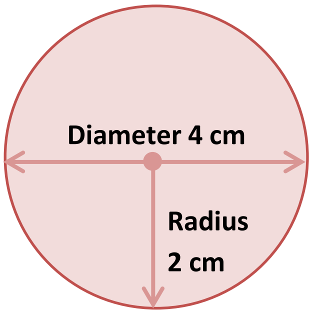


Add each side together: 3 cm + 12 cm + 3cm + 12 cm = 30 cm.

Alternatively, if your shape is a square, you can simply multiply the measure by 4, as each side is the same; e.g., if your square was 3 cm each side, you would multiply 3 by 4, which is 3 cm x 4 = 12 cm.

To calculate the perimeter (or circumference) of a circle, you need to identify either the diameter or the radius measure of the circle and calculate with Pi.

For example:



The circumference/perimeter can be found by calculating the following:

Pi x diameter, in this example: 3.14 x 4 cm = 12.56 cm

Or Pi x (2 x radius), in this example: 3.14 x (2 x 2 cm) = 12.56 cm

(Note, the value of Pi (or π) is approximately 3.14, or if taking to three decimal places, 3.142).

Mass

As mentioned in section 2.3 of this unit, a triple beam balance will measure mass very precisely. Each of the three beams has a weight that slides across to the right, so you can obtain a clear and accurate reading in grams/kilograms of an object placed upon it.

However, mass can also be calculated if you know the specific values that are needed; one formula for measuring mass is 'mass = volume x density'. Each material will have a density value in grams or kilograms, for example, different types of metals. Next, the volume of the object needs to be established. Volume will then be multiplied by density and the final result given as a gram or kilogram measure.

Volume or capacity

To recap from section 2.1 of this unit, for regular shapes, calculating the volume will follow this formula – length x width x height.

For example, if you need to determine the volume of a box which is 50 cm long, 20 cm wide and 32 cm high, you would calculate:

50 x 20 x 32 = 32,000 cm3

(Remembering that this requires the unit of measurement to be squared to show the three-dimensional value '3')

As mentioned in section 2.1, irregular shapes can be measured in a container of measured water. For capacity, it is simply using a measure at eye-level to take a reading of the liquid inside or filling a sized-vessel to its capacity marker.

Temperature

A measure of scale is usually depicted along the edge or side of a thermometer; this can then be applied to take a temperature. Some thermometers are electronic, meaning that a reading will show on a display screen once a temperature has been registered.

Celsius is the standard metric measure for temperature; however, some thermometers may have both Celsius and Fahrenheit scales. Care will need to be taken to ensure the correct scale for your task is selected and used. Thermometers can be submerged or placed into contact with the material/item being measured, or they may be placed within the environment to take a reading of the ambient/room temperature. A short amount of time should be allowed when making contact with a material or item; this is to ensure the thermometer obtains a clear and accurate reading.

Area of a rectangle or square

Area is calculated in square units of measure; to calculate the area of a rectangle, you need to multiply the height by the width, using a unit of measure such as cm2. In the example of the rectangle given previously, the area would be 12 cm x 3 cm = 36 cm2. Similarly, with the square shape, you just need to multiply one side by another (knowing that this will be the same value for each side), i.e., 3 cm x 3 cm = 9 cm2.

Note: the area of a circle is Pi x radius x radius (πr2). Using the above circle example, this would be 3.142 x 2 x 2 = 12.56 cm2. Although this is the same as the circumference value, the area value is squared.

Using technology

You may need to know and use specific technology for your workplace tasks. This may include measuring devices, such as laser measures, odometers or air pressure gauges. Technology will make measuring and calculating easier to do, but this equipment will need to be used correctly and maintained according to manufacturer instructions.

Technology will include using calculators and computer software that facilitate making calculations. Software may be needed to interpret or convert readings to other devices.

You may also need to use software to interpret calculations into different formats, for example, converting data readings into graphs and creating graphical illustrations.

Calculators

Using a calculator will rely on inputting figures and commands correctly, and in the right order; care must be taken to check this is the case. Errors can easily occur when inputting figures quickly or if interrupted during a calculation. It may be necessary to repeat a calculation if the answer does not seem to fit, or you are unsure if this has been carried out correctly. It will be necessary to understand the functionality of the calculator and how to perform calculations specific to the device.

Calculators vary in type, depending on the calculations that need to be made; these include:

- Basic calculators (includes the four operations of adding, subtracting, dividing and multiplying, and also percentages and memory function)
- Financial calculators (with functions, such as profit and loss, cash flow analysis and trigonometric calculations)
- Scientific calculators (for more mathematical calculating, such as trigonometry, powers and statistics)
- Graphing calculators (these are advanced display calculators which allow you to interpret calculations into graphs)
- Printing calculators (to print out calculations)
- Online calculators (for a range of different purposes, such as conversion calculators or health-related calculators (e.g., a calorie calculator)).

Spreadsheet software

Software can be used in a similar sense, depending on its purpose and functionality. Financial and planning software will have specific calculation functions, along with professions that require bespoke software calculating programs. One of the simplest programs to use for calculating is a spreadsheet program, such as Microsoft Excel, Google Sheets or Apple Numbers.

Spreadsheets can be constructed to perform a range of calculations. These are applied as formulas to designated cells; different spreadsheet programs will have slight differences, such as appearance, menu options and compatibilities with other software.

Essentially spreadsheets will be similar in:

- The use of columns and rows to set input data (typically letters to indicate columns, and numbers to indicate rows)
- The use of individual cells for data values

- The application of formula (and functions in some spreadsheet programs) to selected cells.

Software can also transform numerical data into graphs and charts; data will need to be selected and plotted using simple software commands (or function buttons). Graphs can then be adjusted, such as the use of colour, size of text and orientation.

2.5 – Check and reflect on estimation, measurement and calculation outcomes and appropriateness of outcome to workplace task

By the end of this chapter, the learner should be able to:

- Determine how to check and reflect on estimation, measurement and calculation outcomes and their appropriateness to the task
- Use effective skills to check and reflect on mathematical tasks and outcomes.

Check your calculations

All estimations, measurements and calculations should be checked at the necessary points during workplace tasks. It may be relevant to revisit estimations at a later time to refer to your initial thinking; you may need to check that outcomes have been reached correctly, or you may need to be sure that your measurements or figures have not changed.

Checking will involve making sure that the correct values and amounts have been measured and worked with in calculations. For example, a missing or incorrect decimal point placing can alter your calculation outcomes and give you a drastically different result. Equally, an incorrect or missing unit of measurement can be a cause of future confusion.

To check calculations:

- Review your calculation process and/or method (and check your working out)
- Try an alternative method of calculation (if this applies)
- Perform an inverse calculation (work in the opposite direction to undo the calculation); for example, you may have the calculation 508 x 4 = 2,032. To check this with an inverse operation, you can then divide 2,032 by 4 to check that the answer does result in 508 (i.e., all three numbers are the same in the equation); 2,032 ÷ 4 = 508
- Use technology to perform a calculation (if working straight onto paper)
- Use your estimate to gauge if the outcome of a calculation is within the expected amount.

<u>Skills to assess calculation outcomes</u>

Assessing measurements and calculations will include having patience and a methodical approach to work through processes. You will need to develop a system to review your work, so that each part is looked at in turn. Reviewing numerical information may require you to write out calculations in different ways so you can assess these more clearly. You may need to break down complex calculations into separate parts to look at these in isolation.

Skills to assess calculations include:

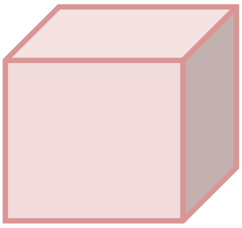
- Numeracy skills – without a basic understanding, it will be difficult to understand the information in front of you
- Critical and analytical thinking – to be able to look at the information and discern what is and is not right
- Logic and reasoning – to be able to break down information and work through calculations
- Information ordering – to be able to recognise numbers, calculation sequences and patterns in numerical information.

Check the problem-solving process

How can we use estimations to check our problem-solving process and the outcome?

Consider the following example:

Measure the volume of the following object which is 3 cm long, 3 cm wide and 3 cm high



We have already established that the correct problem-solving method is:

Length x width x height = volume (cubic centimetre)

First, decide what measuring equipment you need to use. A simple ruler would be appropriate here. What unit of measurement would be appropriate? Considering the sizes of the cube have been provided, cm3 might be appropriate here.

First, you should make an estimation. Look at the length, width and height. What do you estimate they will measure – an estimation might be, say, length 2 cm, width 2 cm, height 2 cm. What would the volume be – 2 cm x 2 cm x 2 cm = 8 cm3 volume.

Now, use the actual measurements. Follow the process – what is the outcome? 3 cm x 3 cm x 3 cm = 27 cm3 volume

Ask yourself:

- Was the measuring equipment selected appropriate for the task?
- Was the strategy appropriate for the measurement required?
- Was the outcome close to your estimate?

3. Communicate workplace measurement information

3.1. Use informal and formal written mathematical representation to document and report on workplace measurement and problem solving process and results

3.2. Use informal and formal mathematical language to present and discuss workplace measurement and problem solving process and results

3.1 – Use informal and formal written mathematical representation to document and report on workplace measurement and problem solving process and results

3.2 – Use informal and formal mathematical language to present and discuss workplace measurement and problem solving process and results

By the end of this chapter, the learner should be able to:

- Document mathematical information using the appropriate representation of language and symbols
- Document and report on mathematical outcomes according to audience needs
- Select informal and formal mathematical language to communicate with others.

Record information

When documenting and communicating mathematical information, you will need to be aware of the correct formal and informal mathematical language and symbols to use. It is important to communicate this correctly and clearly to ensure that everyone knows the outcomes and can use these in their own work tasks.

Mathematical language is writing or relaying your mathematical processes and values clearly and in a way that is commonly known and understood by others. It may be necessary to explain this in more simple or fuller terms if your audience is not well-versed in the terminology. However, with those who have the same mathematical understanding, you can use language and symbols succinctly to convey information. We have used some mathematical language and symbols throughout this learning unit; some examples of these are also given below.

Some common language/symbols for metric units:

Unit	Measurement	Meaning
M	Length	Metre
M2	Area	Square metre
Kg	Mass	Kilogram
°C	Temperature	Degrees Celsius/Centigrade
S	Time	Second
m/s	Velocity	Metre per second
M3	Volume (solids)	Cubic metre
L	Volume (liquids)	Litre

A recap of some common prefixes (relevant to units of measure):

- **'Kilo'** – thousand
- **'Centi'** – hundredth
- **'Milli'** – thousandth.

What about language used in other systems, e.g., imperial?

For example, the imperial units for length are:

- **Ft** – foot
- **In** – inch
- **Yd** – yard
- **Mile** – mile.

Other symbols to remember:

- The ten digits, i.e.: 0-9
- Symbols for operations, i.e.: + [add]; – [subtract]; x [multiply]; / or ÷ [divide]
- Symbols to show types of values, e.g., % (percent), . (decimal point), 3/4 (fraction)
- Other symbols, e.g.: = [equals]; < [less than]; > [more than]
- Letters to stand in for other digits or symbols, e.g., 'a + b = c' or 'ab – cd = v'.

Why it is important to use the correct symbols/prefixes etc.

- So that all members of the workplace are working to the same units. Then, information will be the same across the board, i.e., consistent, and everyone is using the same method of measurement
- It is easier for the person you are discussing or communicating with, to understand the mathematical information
- It is clear and concise. Instead of wordy explanations, only simple mathematical language is required.

Formality of language and symbols

When communicating results, think carefully about your audience and select language and symbols according to that context. For example, when relaying information to managers, supervisors, key external people, you should adopt more formal and professional language.

Examples of formal language and symbol names:

- 'Multiply' (instead of times)
- 'Subtract' (instead of take away)
- 'Add' (instead of plus)

- Full sentences with correct grammar
- Concise language choices.

If you are communicating with colleagues or in a more relaxed setting, then you may wish to use more conversational language. This means using the forms and symbol names you are more familiar with and referring to your own handwritten notes.

Summative Assessments

At the end of your Learner Workbook, you will find the Summative Assessments.

This includes:

- Skills Activity
- Knowledge Activity
- Performance Activity.

This holistically assesses your understanding and application of the skills, knowledge and performance requirements for this unit. Once this is completed, you will have finished this unit and be ready to move onto the next one – well done!

References

These suggested references are for further reading and do not necessarily represent the contents of this unit.

Websites

'Systems of Measurement | Weights and Measures' from Skills You Need: https://www.skillsyouneed.com/num/measurement-systems.html

'Metric system' from Encyclopaedia Britannica: https://www.britannica.com/science/metric-system-measurement

'Thermometers and using them with potential hazardous food' from Food Standards: https://www.foodstandards.gov.au/consumer/safety/faqsafety/documents/Technical_Fact_Sheet_Thermometers_Feb_2008.pdf (accessed on 28/03/2017)

All references accessed on and correct as of 13/02/2020, unless otherwise stated.

FSKNUM018

Collect data and construct routine tables and graphs for work

Learner Guide

Table of Contents

Unit of Competency

Application

This unit describes the skills and knowledge required to collect, collate and organise familiar and routine data and construct tables, column and bar graphs for work. It includes interpreting data from workplace tables and graphs and communicating mathematical information.

An individual performing these tasks works independently and uses familiar support resources.

This unit applies to individuals who use, or are preparing to use, numeracy skills to complete workplace activities. This includes existing workers and individuals preparing for employment through vocational education and training. This unit should be integrated and contextualised with vocational training to support achievement of vocational competency.

This unit is aligned to, but does not fully address, the Australian Core Skills Framework (ACSF) numeracy core skill indicators .09, .10 and .11 at level 3 in the workplace and employment domain of communication.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Unit Mapping Information

Supersedes and is equivalent to FSKNUM18 Collect data and construct routine tables and graphs for work.

Pre-requisite Unit

None stated

Unit Sector

Numeracy

Performance Criteria

Element *Elements describe the essential outcomes.*	**Performance Criteria** *Performance criteria describe the performance needed to demonstrate achievement of the element.*
1. Identify relevant and familiar workplace data	**1.1** Identify basis and specifications of data collection requirements for workplace task including being aware of audience of data and purpose of collection **1.2** Identify source(s) of familiar and routine data in the workplace and possible methods of collection
2. Collect data and develop routine tables and graphs for workplace task	**2.1** Select mathematical problem solving process for completing workplace task **2.2** Describe an expected result of the data collection and results **2.3** Select method to collect routine workplace data and collect relevant data sample **2.4** Collect, order and collate data into a table or spreadsheet **2.5** Determine scale and axes and construct routine graph or chart using appropriate tools **2.6** Check and reflect on expected result, data collection and outcomes and appropriateness of outcome to workplace task
3. Communicate results	**3.1** Use informal and formal written mathematical representation to document and report on workplace data and problem solving process and results **3.2** Use informal and formal mathematical language to present and discuss workplace information and problem solving process and results.

Foundation Skills

This section describes language, literacy, numeracy and employment skills that are essential to performance but not explicit in the performance criteria.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Assessment Requirements

Performance Evidence

The candidate must demonstrate the ability to complete the tasks outlined in the elements, performance criteria and foundation skills of this unit, including evidence of the ability to:

- Identify and collect a set of workplace data on at least one occasion for a workplace purpose and order and collate into an appropriate format, such as a graph or chart
- Perform a workplace task using routine tables and graphs, including:
  - identifying features and uses of tables and graphs
  - constructing a table and appropriate graph for a workplace purpose
  - interpreting data represented and identifying key features.

In the course of the above the candidate must demonstrate use of relevant technology, such as graphing calculators or spreadsheets.

Knowledge Evidence

The candidate must be able to demonstrate knowledge to complete the tasks outlined in the elements, performance criteria and foundation skills of this unit, including knowledge of:

- Routine data collection and collation methods relevant to workplace
- Common features of routine graphs and tables
- Methods to perform calculations with data and information, including frequencies and percentage frequencies
- Use of routine tools to draw and construct tables and graphs
- Appropriate use of different kinds of graphs
- Routine scales and axes
- Methods to perform reasonableness check of processes and outcomes in relation to the workplace context
- Informal and some formal mathematical written and oral language and symbolism
- Relevant technology such as graphing calculators or spreadsheets.

Assessment Conditions

Competency is to be assessed in the workplace, a workplace simulated environment or a vocational training context.

Assistive technologies can be utilised to assist with oral and written communication.

Skills must be demonstrated using routine texts and tasks that reflect those typically found in a workplace.

The following resources are to be made available:

- A calculator
- Tools to draw routine tables and graphs in the performance evidence, this may include handheld tools and electronic spreadsheet software
- Own familiar support resources.

Assessors must:

- Satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards, and
- Have sound knowledge of the ACSF and performance features of the ACSF level being assessed, and
- Have demonstrable expertise, knowledge and skills in the vocational contextualisation and assessment of the core skill, numeracy, and
- Have completed the following or equivalent:
    - TAESS00009 Address Foundation Skills in Vocational Practice Skill Set; or
    - a higher level education qualification, such as:
        - TAE80113 Graduate Diploma of Adult Language, Literacy and Numeracy Practice (and its equivalent TAE70111); or
        - Bachelor of Education, Graduate Certificate or Graduate Diploma of Education, or higher. This may include qualifications relating to TESOL, adult education or vocational education.

Links

Companion Volume Implementation Guide is found on VETNet - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=f572fe10-a855-4986-9295-3852c771f178

1. Identify relevant and familiar workplace data

1.1. Identify basis and specifications of data collection requirements for workplace task including being aware of audience of data and purpose of collection

1.2. Identify source(s) of familiar and routine data in the workplace and possible methods of collection

1.1 – Identify basis and specifications of data collection requirements for workplace task including being aware of audience of data and purpose of collection

By the end of this chapter, the learner should be able to:

- Determine what they need to know before beginning data collection for workplace tasks
- Have an awareness of the audience's needs in relation to data tasks.

Data collection and calculation tasks

Data handling in the workplace will require you to have good numeracy skills. You will need to be able to perform your organisation's standard numerical operations, as relevant to your job role. Data tasks may include collating sales figures, calculating financial performance statistics, project planning and organisational procurement.

You will also need to be able to communicate numerical information in a format that is easy for you and others to read. Therefore, you will also need to have good data visualisation skills. Data presentation should conform to some standard rules. This will include using a logical format to display data and calculation results, and making sure that information is visually easy to interpret.

Data collection requirements

To start with, you will need to be clear on the requirements for data collection. You may be responsible for your own tasks, or you may be instructed to complete data tasks, either way, you will need to be certain about what the data relates to and how this needs to be worked with.

You will need to know:

- Where you can obtain the data from, such as raw data files, pdf files, spreadsheet-compatible software programs and written information on paper
- What the data is, for example:
    - data time periods
    - data values
    - data history

- Data specifications, for example:
    - how data should be written, such as decimal values to two decimal places
    - required data fields, such as names or other identifying information
    - specific data sets, i.e., the group or batch of data that must be worked with

- How the data needs to be handled, including:
    - data confidentiality
    - data sorting and cleaning
    - data calculations
    - data visualisation
- The purpose of data collection and what needs to be achieved from this, for example:
    - to inform others of workplace performance
    - to keep data collection records
    - to perform statistical analysis
- Who will see the data and what they will want to know.

It will also be necessary to determine the practical considerations to undertaking data handling tasks, such as when the task needs to be completed by, where information should be saved or stored, and how this should be saved or stored.

At the start of your tasks, it will be necessary to be clear on the requirements and specifications for data collection and handling. Once this is known, your job to work with the data will be a more straightforward process.

Audience needs

Your audience may be your work colleagues, or they may be managers; they may also be other persons who do not work at your organisation. Each type of audience will have different expectations and needs; these can vary, and attention should be made to your audience and what they should and should not see. You should make sure you know what is right and relevant, and how you can customise and adapt information to suit your particular audience.

Data confidentiality and privacy is one aspect that must be maintained when handling data. It may relate to the sensitivity of information, such as your organisation's performance statistics or future work plans, or it may include the personal details of your employees or customers, such as their names and contact details.

Equally, you must make sure that information is tailored to suit the audience's level of understanding, and that data is given in the right measure; for example, while your manager may want to see statistics on workplace performance, this may have little relevance for other work departments who have their own or different performance goals.

1.2 – Identify source(s) of familiar and routine data in the workplace and possible methods of collection

By the end of this chapter, the learner should be able to:

- Determine where to find reliable and trusted sources of routine workplace data
- Follow workplace procedures to collect routine workplace data.

Data sources

Different data sources may exist, depending on the task. As briefly mentioned in section 1.1 of this unit, this may include a variety of data source files and handwritten information. It may also include information that needs to be obtained from other persons, such as financial figures from a sales team or recent website analytics that show how your customers are using your organisation's website.

If you are not informed on where to find this, you must search your workplace systems, or speak with those persons who can supply this to you, or help you to identify where this can be obtained from. You should follow workplace procedures to collect data; this will include the way in which you ask or request information, the mechanics to search or locate information, and the actions you take to handle and store collected information.

Routine workplace data may include:

- Orders of raw materials
- Stock held by suppliers on organisational supply contracts
- Budget information and/or spending
- Seasonal trends in production and/or sales
- Employee work hours and work output records.

Some data may be collated by other work personnel, and you may need to request this directly from them. Other sources may be easily retrieved through your own means; for example, you may be able to retrieve data from a designated work folder or by running an automatic data collection function in a software program. When accessing data, you must make sure you collect data that is the most current (or from the required period) and is from a trusted information source. The versions that you access must be the final copies, which are known to be valid and accurate.

It may be possible to access data in the format that you require this to be in. However, in some instances, you may need to reformat or retype information from an incompatible source into a format you can use. It should be noted that additional time or assistance may be needed to do this.

<u>Sourcing information</u>

You should have established workplace methods and technologies to access data at your workplace. Therefore, you will need to follow the appropriate collection and collation methods that are readily available to you.

Routine data collection and collation methods include:

- Collection:
  - retrieving information from electronic files and information systems
  - requesting information from work personnel or external information sources, in-person, or by electronic communications
  - sourcing information from written work records and paper files
- Collation:
  - filtering and sorting data in electronic files
  - data capturing from software programs
  - manually inputting information into data files.

2. Collect data and develop routine tables and graphs for workplace task

2.1. Select mathematical problem solving process for completing workplace task

2.2. Describe an expected result of the data collection and results

2.3. Select method to collect routine workplace data and collect relevant data sample

2.4. Collect, order and collate data into a table or spreadsheet

2.5. Determine scale and axes and construct routine graph or chart using appropriate tools

2.6. Check and reflect on expected result, data collection and outcomes and appropriateness of outcome to workplace task

2.1 – Select mathematical problem solving process for completing workplace task

By the end of this chapter, the learner should be able to:

- Assess numerical information and task requirements for mathematical problem-solving processes
- Follow a problem-solving process to work with data
- Identify and perform mathematical calculations.

Mathematical problem-solving

Once you have obtained the correct data, if required, you will then need to assess the most appropriate mathematical problem-solving process for the data task.

This will depend on factors, such as:

- The type of data you have, for example, financial, statistical or analytical, and the type of calculations you need to make
- The purpose of the data task, for example, do you need to report figures or show performance data?
- The audience's needs, i.e., what does your audience expect to receive information about, and how can you ensure this is understood by them?
- How data and data results need to be used, for example, will this be used in a presentation, or is this part of your organisation's recordkeeping?

You will need to determine which mathematical process needs to be applied and how you can do this in the most efficient way. Software programs designed to handle and manipulate numerical data make this easier to do, and will have specific numerical functions for such needs. You may also want to use a calculator, such as a graphing calculator, which can be used to plot and visualise data in a simple graph format.

Mathematical problem-solving processes may include:

- Converting different number types into the same format, e.g., fractions into decimals
- Converting units of measurement into the same type for making calculations
- Determining the order to complete calculation steps
- Identifying the most direct or straightforward route to reach a mathematical outcome.

You will need to develop your skills to understand what the need is, what you need to do to resolve this, and how you can go about doing this.

A problem-solving process will include:

- Reading the information you have to understand the problem or what needs to be done
- Assessing the tools, techniques, methods and technologies at your disposal
- Deciding which tools, techniques, methods and technologies will be the most appropriate and efficient for the task
- Using the knowledge, equipment and mathematical processes to complete numerical tasks
- Checking the outcomes and results of your task to ensure information is correct.

Performing calculations

There are different types of calculations that you may be required to make with data. This will depend on your job role and your organisation's business. Some example calculations are mentioned below.

Mean

This includes both population and sample means. Population refers to all data in the data set, whereas sample is just a selection or section of this data. The mean is the average value in your data set or selected data.

To calculate the mean or average of your values, you must add all your data values together and then divide this by the total number of values.

Median

This is your middle value in your population or sample data. To find the middle value, order your data from smallest to largest in value. If you have an odd number of values, then the middle value will be found in the middle of your data. If you have an even number of values, there will be no middle value, and you will need to locate the two values that are in the middle. Once found, calculate the average of these two values to find your median (i.e., add these together and divide by two).

Standard deviation

This refers to the amount of variability in your data (either population or sample) or average variation from your identified mean. To obtain the standard deviation, you need to calculate the average of your data values, once this is known, subtract the average number from each individual value and square this. Next, calculate the mean of the squared numbers and take the square root.

As this is a more complex process, an example is given below:

You have the following six values – 10, 4, 8, 12, 16, 22

Add these together and divide by six to obtain the average – 10 + 4 + 8 + 12 + 16 + 22 = 72

72 ÷ 6 = 12

Next you subtract the average from each number and square this (noting that negative numbers when squared (multiplying by the same value) become positive):

(10 – 12)2 = (-2)2 = 4

(4 – 12)2 = (-8)2 = 64

(8 – 12)2 = (-4)2 = 16

(12 – 12)2 = (0)2 = 0

(16 – 12)2 = (4)2 = 16

(22 – 12)2 = (10)2 = 100

Next, add the resulting values together:

4 + 64 + 16 + 0 + 16 + 100 = 200

Then apply the following (1 ÷ 6) x 200 = 33.33 (this is dividing your number of data values by 1 and multiplying by your added values in the previous step). This is your variance value.

Finally, you take the square root of this value – √(33.33) = 5.77

This process is slightly different for a sample standard deviation; when using a sample set of data from the entire population, you must divide the total number of added together squared values by the total number of selected values' minus one'. At this point, subtracting one from your sample number of total values and then dividing, provides you with a sample variance value. Then you calculate the square root of this number for your final result.

Source 'Standard Deviation Formulas' at Math is Fun, retrieved from https://www.mathsisfun.com/data/standard-deviation-formulas.html

Frequencies

Frequencies are the number of times that an event repeats in a specified unit of time; this relates to physics, such as calculating the frequency of sound waves. It also relates to statistical analysis, where frequencies are the number of times that a specific value in variable data appears.

With the focus on statistical interpretation, this includes absolute frequency (the number of times the value occurs), and relative frequency (the number of times the value occurs in relation to the total number of values for that variable data set).

Absolute frequency is simply given as the number of times the value appears in a set of data; however, relative frequency is calculated by dividing the absolute frequency by the total number of values in the variable data set.

For example – you have a data set with 40 variable values, and the same value appears eight times. This means that your absolute frequency in the data set is eight. The relative frequency for this is 8 ÷ 40 = 0.2, to make this a percentage multiply this number by 100 to obtain 20%.

Frequencies can be expressed as:

- Ratios (the comparison of one frequency value for a variable with another frequency value for the variable) – this is written as the first value followed by a colon and then the second value, e.g., 2:4 (so the first value appears twice, and the second value appears four times in the set of data)
- Rates (a measurement of one value for a variable against another measured quantity); using the above example and the first frequency value, if your data set contained 15 values, the frequency rate is two from 15
- Proportions (the share of one value from the whole); to calculate this from the variable data set, you need to divide the number of times the frequency value appears by the total number of values in the data set, e.g., two divided by 15 is 0.13
- Percentages (the value for a variable as a fraction of one hundred from the whole); see below for calculating this.

<u>Percentage frequencies</u>

To work out the percentage of a frequency, you will need to ensure the dataset is equivalent to 100 so that the whole can be expressed as 100%. A percentage is calculated by dividing the number of times a particular value for a variable data set appears by the total number of overall values in the data set, and multiplying this by 100.

For example:

The value appears twice, and the data set has 15 values in total.

2 ÷ 15 x 100 = 13%

(Rounding down to the nearest whole, 13.3 to 13)

Source 'Describing Frequencies' at the Australian Bureau of Statistics, retrieved from https://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-+describing+frequencies

2.2 – Describe an expected result of the data collection and results

By the end of this chapter, the learner should be able to:

- Identify data requirements in tasks which need to be explained
- Assess data collection and results for reporting and communicating with others.

Reporting on numerical data tasks

When completing data tasks, you will need to provide information to explain the process and the results of your data analysis. You must be clear on what you have done so that you and others can refer back to it at any time and understand what this is. It may be necessary to generate work reports for specific data handling activities and for communicating data results.

For example, reports may include:

- Weekly and monthly activity reports
- Statistical analysis reports
- Spend and budget reports
- Work health and safety performance reports
- Customer purchasing reports
- Business analysis trend reports.

Data handling tasks should be clearly identified in work records or documentation. Applying different analysis and calculation processes will alter and change the meaning of your data, and this should be documented accordingly.

For example:

Imagine that you have been asked to generate a report to identify the income gained from sales in the previous year. You would need to obtain data on the total number of sales for the period, along with the corresponding information on income from sales and the associated costs to provide products and services. From this, you would identify the total sales revenue. This may be lower than expected, it may be as projected, or it may exceed expectations. Your report would communicate what you find.

However, if you were asked to report if sales were better or worse than the year prior to this. You would then have to go back one year further and obtain the relevant sales data for data comparison analysis. This report would specifically look at how the two years compared. This report may not show the previous year's data in the same way as the first report. The context of the report will need to be described.

Using technology

Data handling will require you to have technology skills. You will need to be able to collate, calculate and transform data into appropriate forms for organisational business use. This will require the use of electronic hardware and software.

Technology relevant to data handling includes:

- Calculators, including graphing calculators that allow you to visualise data and interpret calculations in simple graph formats
- Data management software to store and access data from
- Spreadsheet software, such as Microsoft Excel and Google Sheets
- Graphic software (if not creating in spreadsheet software), such as Adobe Illustrator, Gnuplot and Microsoft PowerPoint.

<u>Spreadsheets</u>

One of the most commonly used data handling software will be a spreadsheet program. Spreadsheets can be used to import data from compatible text files, or they can be used to type data into individual cells that allow you to order and isolate information quickly. They can be used to perform a range of mathematical calculations that can be applied to specific cells, to enable you to incorporate new information into calculations as new information is inputted.

Different spreadsheet programs will have slight differences, such as appearance, menu options and compatibilities with other software.

Essentially spreadsheets will be similar in:

- The use of columns and rows to format data (typically letters to indicate columns, and numbers to indicate rows)
- The use of individual cells for data values
- The application of formula (and functions in some spreadsheet programs) to selected cells.

Software can also transform numerical data into graphs and charts; data will need to be selected and plotted using simple software commands (or function buttons). Graphs can then be adjusted, such as the use of colour, size of text and graph orientation.

Data from spreadsheets can also be used to create graphs in other graph plotting software, depending on your organisation's choice of software programs and the standards in place to visualise and present information. The data may be imported or copied into such software for graphic styling.

2.3 – Select method to collect routine workplace data and collect relevant data sample

2.4 – Collect, order and collate data into a table or spreadsheet

By the end of this chapter, the learner should be able to:

- Follow workplace requirements to obtain data
- Access data from source files
- Sort information and data into tables and spreadsheets.

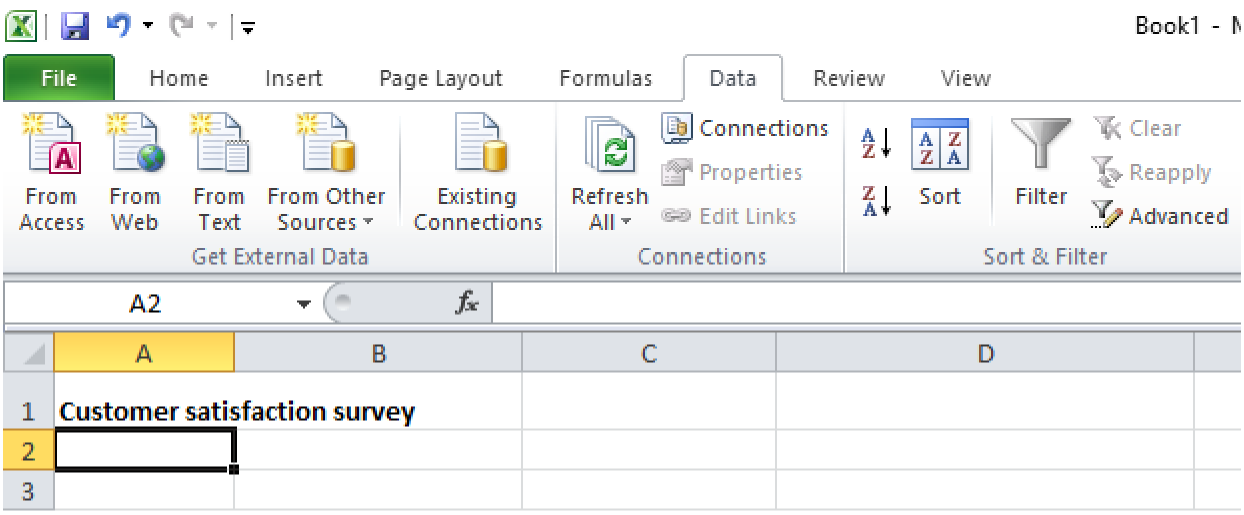
Collecting routine data

Your place of work will develop standard requirements for its data tasks. This will relate to where you source your data from, how you access or import data, and what you need to do to format and present this. Standard operating procedures and role requirements will provide you with the correct guidance to perform such tasks. You may also access guidance and assistance from your colleagues or a manager.

To work with your data, you must first locate and select what you need to use. This may be the entire data population or just a smaller data sample from your source file. It is crucial that you are clear on which data, so you do not end up with errors further along in your work. This first stage is an important one; if you capture just one additional data figure that should not be included, this can alter your calculations and final data results.

If typing in information, make sure you check that this is inputted correctly. You will need to proofread this to check that you have the correct number of figures, and that information is correctly written and labelled. Alternatively, a system may be in place where this is checked by another person or a work colleague. If importing or accessing data from an existing electronic file or database, you will need to take care to select the right information. The start and end-point should be carefully selected to prevent missing or including additional data. Taking the time to work carefully and methodically will prevent you from trying to unravel errors and issues that may be found later on.

Importing data in Microsoft Excel can be done through the menu options shown next:



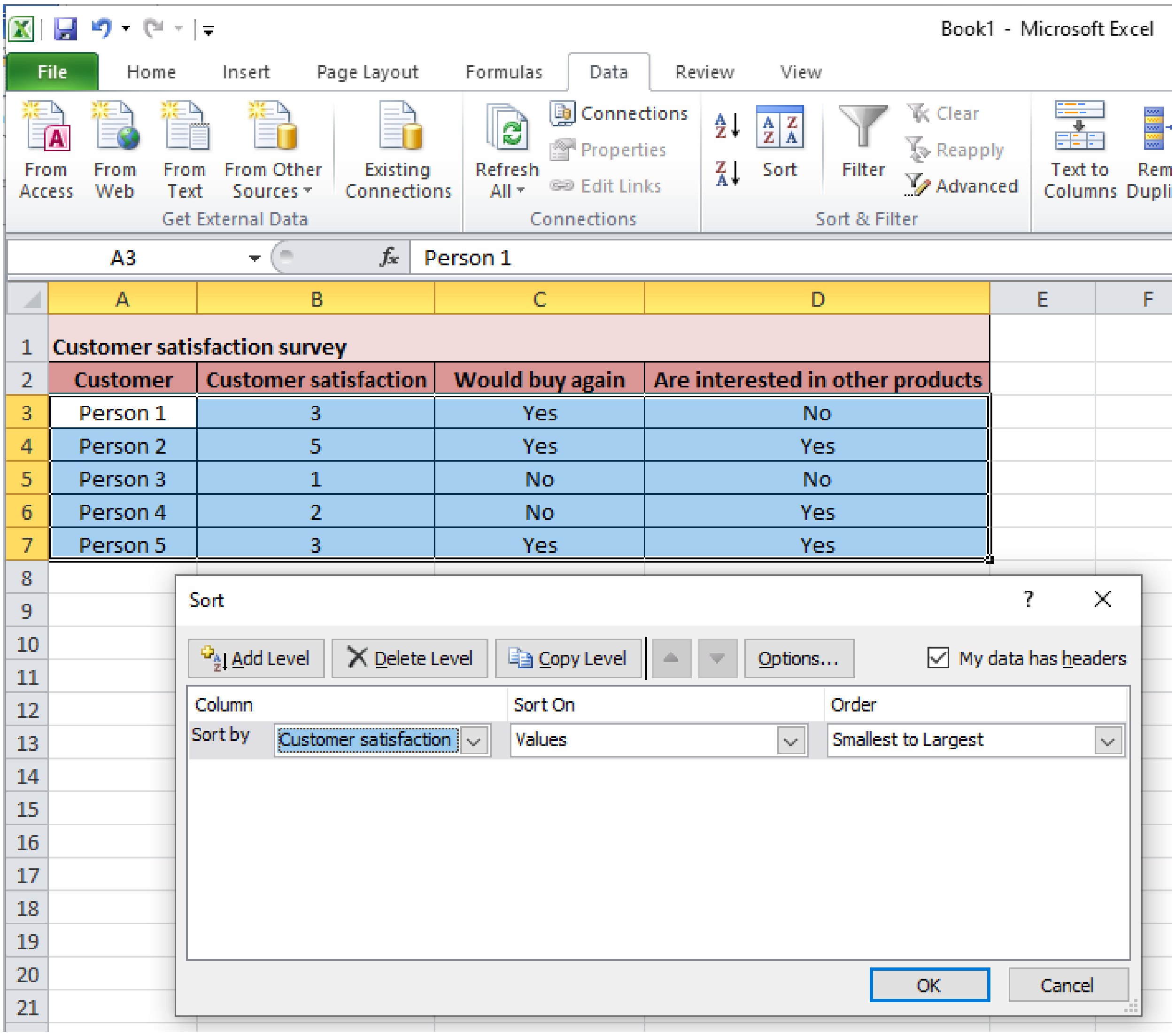
As you can see in the top right corner, options in the data menu tab allow you to import text from compatible programs and also from the web.

Working with data

Once data is selected and prepared for working with, you will need to perform any necessary calculations and ensure this information is saved and stored correctly. Your work should be saved and kept separate from your source files; this will ensure you keep a clear history of your data, and original information is not lost. If you need to revert back to a source file, this will make this easier and quicker to do.

Data should be put in the correct order in clear columns and rows. You may need to alter the layout of your data to ensure this is logical and relevant to the data task. Along with cutting/copying and pasting text into the correct position and order, you can also sort data; for example, this could be date order, alphabetical order or small to large values. A spreadsheet program that allows you to select cells, rows and columns for this purpose will be most appropriate.

This simple example in Microsoft Excel shows sorting by customer satisfaction levels:



As you can see from this example, your cells and rows can be turned into a table. This will help you to separate and order information more clearly. You can apply lines/borders and colours to selected cells. Equally, if you only need to display data without making calculations, you can import or type this into a page layout program that allows you to construct more detailed tables that are more easily edited (such as Microsoft Word, InDesign or QuarkXPress).

Using tables

Tables allow you to visually present information, so you are led to read this in a certain way. They are designed to help you and others interpret information more clearly by separating and ordering information. Graphic features, such as borders and colours, also highlight the important features.

Whether drawing a table in a spreadsheet or page layout program, the following will apply:

- Table headings to explain data/information
- Table rows and columns to separate and organise data/information
- Shading and colour to separate, connect or highlight data/information
- Table borders and lines to separate and highlight data/information.

In a page layout program, you will have more control over the shape, position and appearance of your table.

Constructing tables in page layout software

Although programs may vary in language and menu design, the same principles for drawing/constructing tables will apply. Taking Microsoft Word as the example, you can select the table icon and physically draw a table (using the pen icon to add any additional rows and columns), or you can specify the number of rows and columns for automatically created tables. Once on the page, these can be altered in size as well as adding or deleting unrequired rows or columns. A degree of flexibility will be included in page layout programs, which is not found in spreadsheets, and you can alter your table more freely. Colours can be added into individual or group-selected boxes, rows and columns, and once text is added (by copy/paste or typing), you can change the size, colour and font as required. Text can also be styled separately in their rows and columns; you can align text and apply bold and italic styling.

For example:

Customer satisfaction survey			
Customer	**Customer satisfaction**	**Would buy again**	**Are interested in other products**
Person 1	3	Yes	No
Person 2	5	Yes	Yes
Person 3	1	No	No
Person 4	2	No	Yes
Person 5	3	Yes	Yes

Additional design features will also exist in page layout programs, such as drop shadows and graduated shading in QuarkXPress, and can also be used, if appropriate to your organisation's visual presentation style.

Microsoft Word also has a SmartArt function that creates more complex visual graphics that can also be used (if appropriate). Although not strictly table formats, these options may prove useful when interpreting the results of data.

2.5 – Determine scale and axes and construct routine graph or chart using appropriate tools

By the end of this chapter, the learner should be able to:

- Identify a suitable scale for visualising data values in graphs and charts
- Apply their understanding of x- and y-axes to interpret data
- Use appropriate spreadsheet or graph plotting software to create graphs and charts.

Constructing graphs and charts

When constructing graphs and charts, specific tools and software functions will enable you to do this more effortlessly. The program that you use for graphs and charts must be known to you, and it may be necessary to seek instruction or training on the full functionality and capabilities of your organisation's software.

For this learning unit, we will refer to Microsoft Excel and Word for constructing graphs and charts. Note, the words charts and graphs are often used to mean the same thing, for example, your organisation may use the term line chart; however, this may be called a line graph by another.

You will need to know which type of graph/chart is required, some common types are:

- Line – plotting data as lines (with or without individual data points); good for showing how data changes over a period of time, and the relationships between different plotted data values
- Column – plotting data as vertical columns; good to show how unconnected data compares
- Bar – plotting data as horizontal columns/bars; as above, this is good to show data comparison in values that are unconnected
- Pie – plotting data in a circle to show values in proportion to one another, i.e., the parts of a whole; good for showing percentages
- Area – plotting data along data points (as a line graph) and showing the values by shading in the plotted data; good for comparing data
- Scatter – plotting data as data points without joining values together, so the graph/chart shows individual dots or shapes; good for showing changes in variable data.

Common features

When deciding which graph to use, you may only need to follow organisational instructions, or you may need to choose a graph/chart that will best visualise and interpret the data that you have to show.

There are some common features associated with graphs and charts that must be included in their construction.

These are:

- A set of data values to plot
- A vertical and horizontal axis on the graph (except for pie graphs/charts which show parts of a whole)
- Units/scales of measure to visualise your data values in the graph/chart
- Your text labels and legends, to explain the elements in the graph/chart, this also includes a key to state what lines or plotted data refers to
- A suitable graph/chart heading.

Vertical and horizontal axes

There are two axes in graphs/chart (not applicable to pie charts); the x-axis is the line across the bottom (horizontal axis), the y-axis is the line going up at the side (the vertical axis); typically the y-axis contains is where your values are plotted, and the x-axis is your corresponding data, such as a timeline or your named items; however, this will be reversed for a bar graph.

Some graphs/charts also have data points along both axes (see the scatter graph further on in this section). Note – Cartesian graphs also have two sets of data along both axes in order to compare two sets of data. It also important to check if your data starts at '0' or another number, as this will impact how your data will view and be positioned on the graph/chart.

Units/scales of measure

This explains what your data relates to, and shows how your data maps out within the graph/chart. Choosing the right scale can help you to visualise data more accurately; for example, when plotting data, it is good practice to establish a scale that is just above your maximum data point value, so your graph displays data more clearly. If you use a scale that includes far more values than needed, the graph data will visualise smaller or lower within the graph, making it difficult to understand what is being shown.

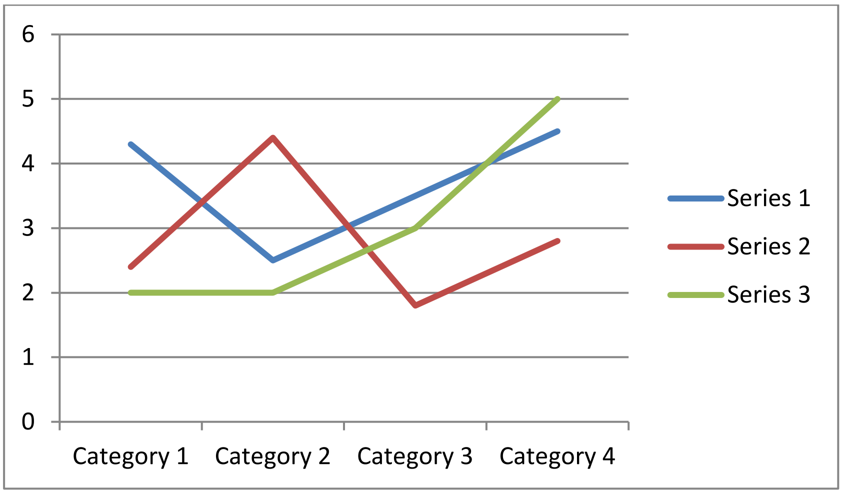
Scales should allow you to show a clear progression in values and should relate to the values that you have to plot. If data is plotted on both the x- and y-axes, you will need to understand how each set of values will interact with each other, so the visualisation is not skewed or misleading.

An example:

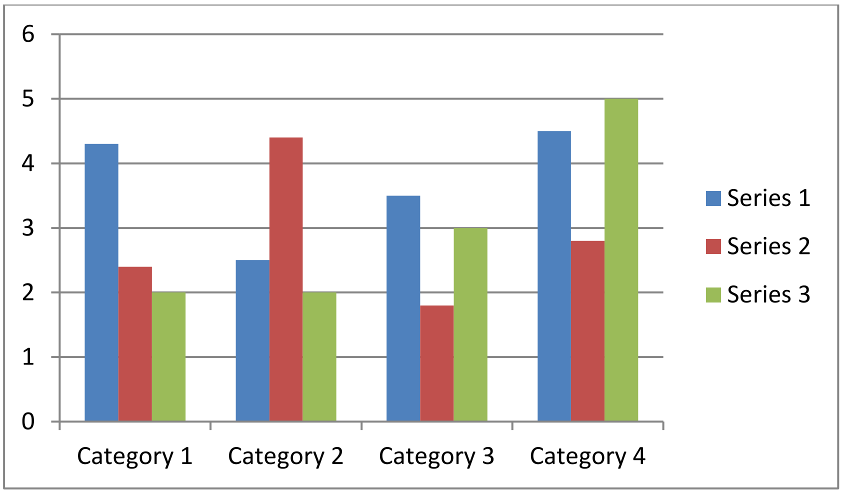
If you have data values that range from two to 18, your y-axis may be 0, 5, 10, 15 and 20. This means that your measure is shown in multiples of five, and this scale will allow you to have an immediate focus on how the values compare.

Examples of graph types are shown next:

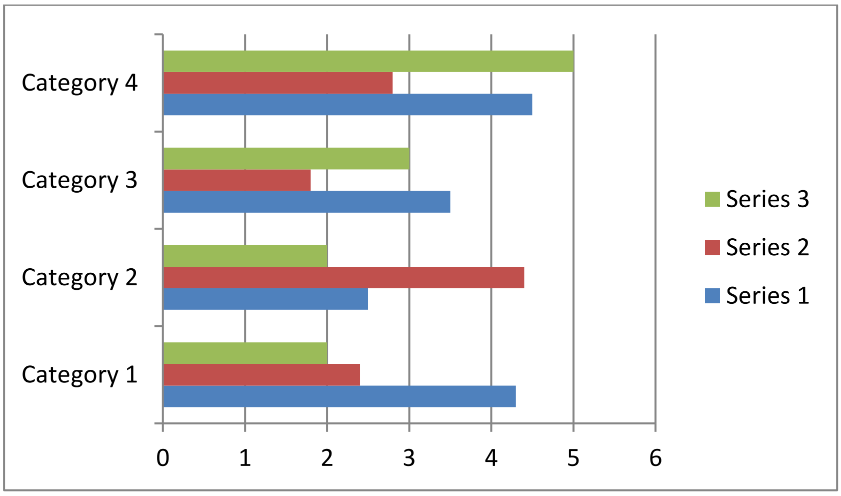
Line graph/chart



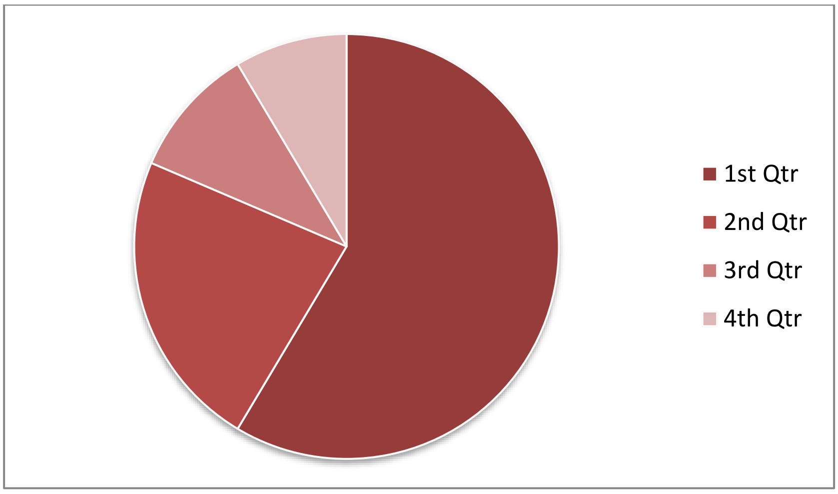
Column graph/chart



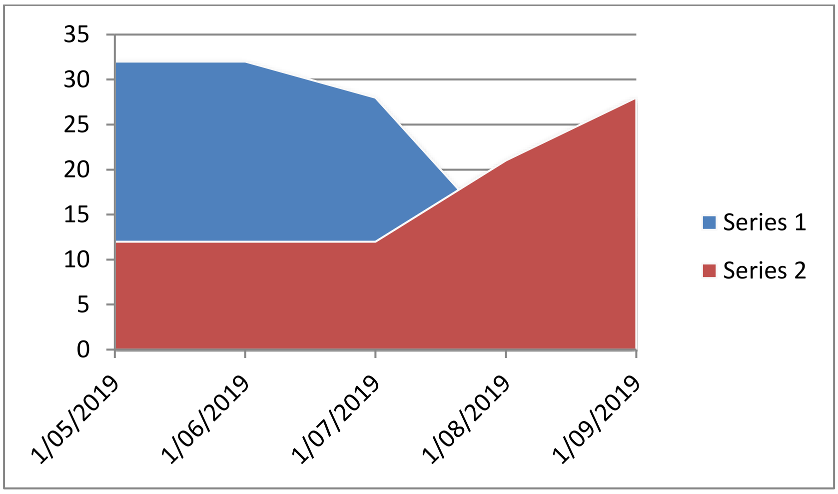
Bar graph/chart



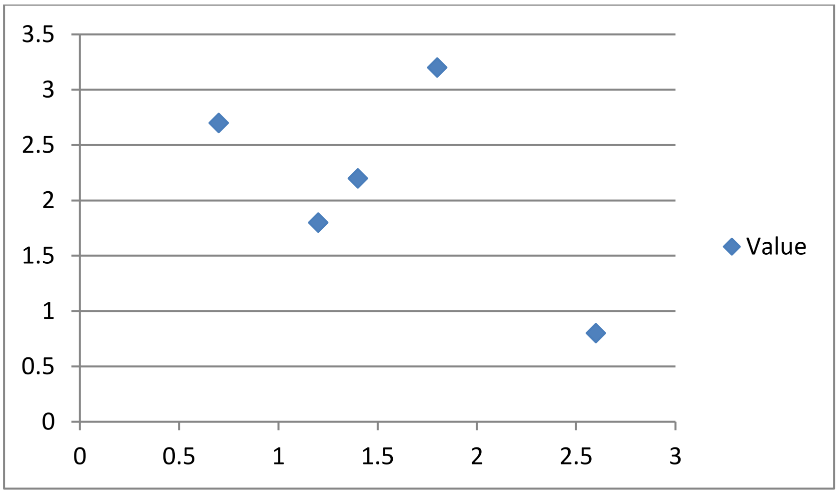
Pie graph/chart



Area graph/chart



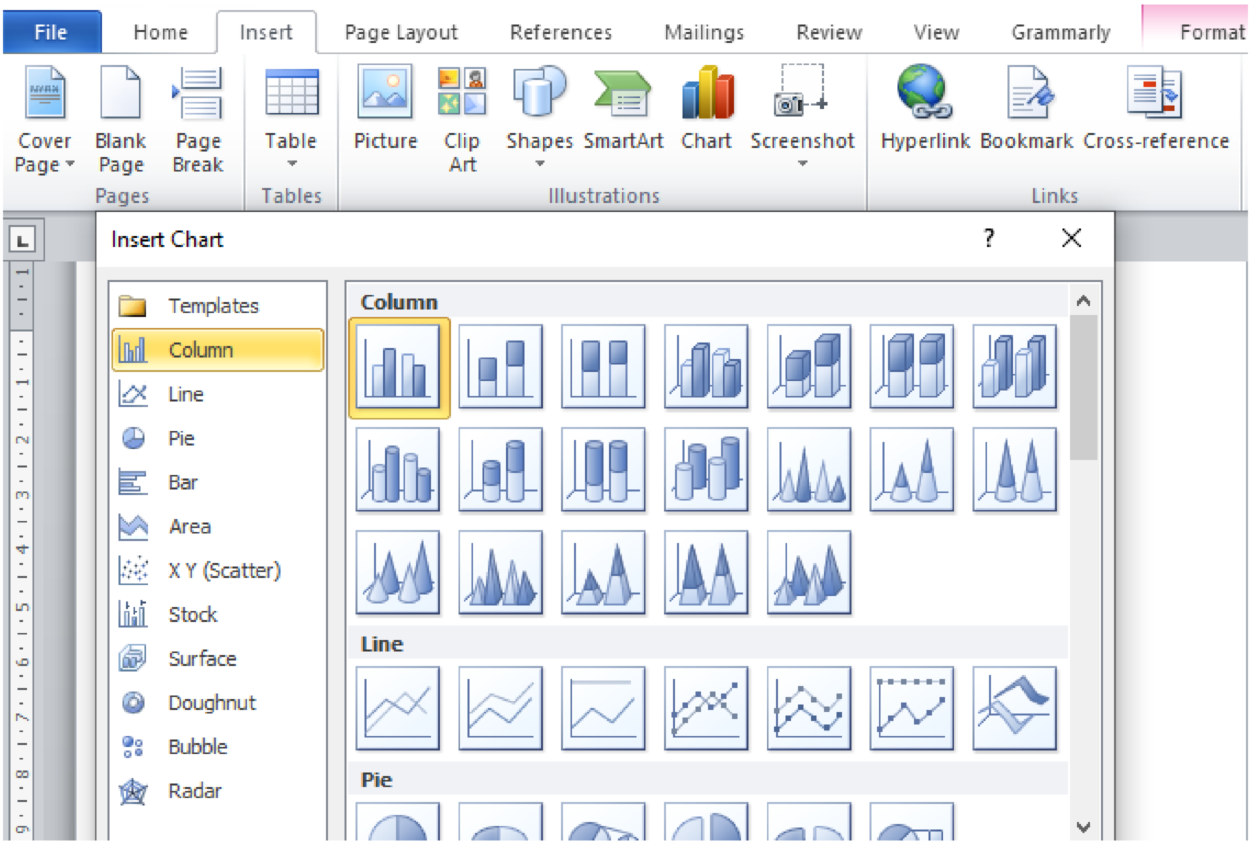
Scatter graph/chart



Using software to create graphs/charts

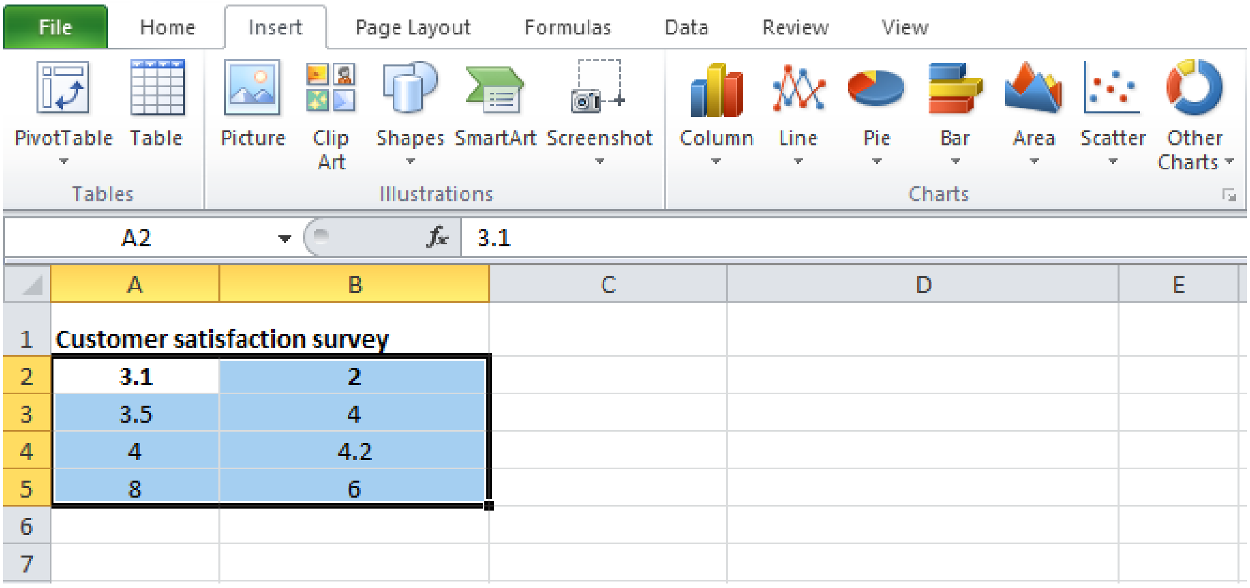
In Microsoft Word, you can create graphs by going to the 'insert' menu tab and then selecting 'chart'. This will bring up a sub-menu with different graph/chart options; you just click on the type you want to create, and a corresponding Excel sheet will appear, in which you can enter your data or import your saved data (if in a compatible format). From here, you can then apply your formatting in Word and revert back to the Excel sheet to alter your data.

'Chart' in the menu for Microsoft Word:



In Excel, a similar process is required, although you are just working in Excel. With your data values prepared, you can select the graph/chart type in the 'insert' menu tab and resize/format in the worksheet.

Selecting charts in Microsoft Excel:



Both applications are easy to use and can be edited after the graph is constructed. Other applications will have similar functionality, although menus will be different.

2.6 – Check and reflect on expected result, data collection and outcomes and appropriateness of outcome to workplace task

By the end of this chapter, the learner should be able to:

- Perform checks on finished tables and graphs
- Ensure that data collection and outcomes are accurate in appearance and appropriateness for the workplace.

Check tables and graphs

Once tables and graphs have been constructed; it will be necessary to check they are correct in values and appearance. A system to proofread your work should be followed. This will include checking that graphics and data illustrations are according to your organisation's information and style guidelines.

A system (or process) to check your work may include the following:

- Proofreading to make sure this is accurate in content and spelling
- Design checking to make sure tables and graphs are the correct size and provide the right visual interpretation of data; you will also need to check that table and graph elements have reproduced correctly and in an appropriate size and position (note, check that colour tones do not make comparison values difficult to distinguish between)
- Checking that the final document or electronic file meets organisational standards and includes any other required information
- Checking that organisational style guidelines have been met.

Each type of check should be performed separately; if you try to check for all things at once, invariably, something will get missed. It is far better to focus on one type of check to allow your eyes and brain to look through with more ease. Separate checks are thorough and may seem to take more time, but if you forget what you are checking on a one-check system, you will end up going through this more than once anyway.

Design checks may include:

- Making sure that text is aligned correctly in tables
- Tables and graphs are not split across two pages
- Text is clear and in the correct position
- Colours are correct across all elements
- Tables and graphs are positioned correctly on the page
- Graphs are the same size
- Headings belong to the correct graph.

Tools to help you check

You may want to use a checklist that identifies the elements to check; this will mean that you document your checking and are able to leave this for a brief period of time to attend to any other urgent tasks. Checklists can also be used to prompt or remind you to check for reoccurring issues or specific features.

Checking may also be helped by using the skills of your colleagues; asking a trusted colleague to check content or design can often prove effective as they will have a fresh pair of eyes. Unless you are able to take a short break in between finishing and checking, it can prove harder to spot errors in work that you have been looking at for a significant amount of time. Your eyes and brain may compensate for errors, as you have absorbed and understood information which you will automatically expect to see.

3. Communicate results

3.1. Use informal and formal written mathematical representation to document and report on workplace data and problem solving process and results

3.2. Use informal and formal mathematical language to present and discuss workplace information and problem solving process and results

3.1 – Use informal and formal written mathematical representation to document and report on workplace data and problem solving process and results

3.2 – Use informal and formal mathematical language to present and discuss workplace information and problem solving process and results

By the end of this chapter, the learner should be able to:

- Document mathematical information using the appropriate representation of language and symbols
- Document and report on mathematical outcomes according to audience needs
- Select informal and formal mathematical language to communicate with others.

Communicate your results

In your tables, graphs and charts, you will have numerical information to communicate. What may be easy to understand from one perspective may not be so clear from another. Care must be taken to use the correct mathematical representation and language in all reports and documentation. For example, you will need to be clear on units of measure, whether values are percentages or another type, which results relate to which data, and any types of calculations that were made. The language should be clear and include mathematical terminology that is easily understood by your audience.

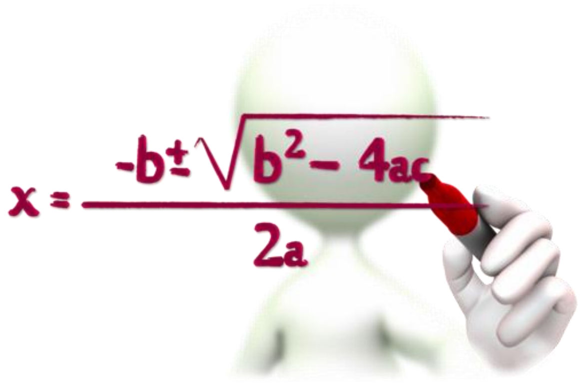
Mathematical representation will involve:

- Deciding on the best type of graph, table or another format to present data results
- Thinking about how to layout information, so it is clear, e.g., where to place values or how to order data calculations and results
- Choosing scales that visualise data results accurately in graphs
- Displaying any relevant calculations.

Reporting will need to explain how information was worked with, and any methodologies used to analyse and interpret this. You should think about how you need to communicate this, so that you and others can understand exactly what the outcome represents.

Mathematical language

Mathematical language includes the numbers, symbols and arrangement of calculations and mathematical processes. This is how you write numbers (e.g., whole numbers, fractions or decimals), your calculations (e.g., formulas, equations in brackets or data results), and how you present this on the page. This language will describe a series of actions that you follow to interpret and reach outcomes with numerical data.



Mathematical language includes:

- Mathematical symbols, such as add (+), subtract (–), multiply (x), divide (÷ or /) and equals (=)
- Values and measurement symbols, such as percent (%), decimal point (.), currency (e.g., dollar $ or yen ¥), kilometres (km) and cubic centimetres (cm3)
- The order of operations, i.e., calculating in a certain order, such as performing calculations in brackets first
- Letters to express variables in calculations, such as *d* for distance, *r* for radius, and so on
- Greek alphabet symbols, such as the letter sigma (∑), which means adding several numbers, or pi (*л*).

The appropriate language and or/symbols will depend on what language and symbols your workplace routinely uses and what your task is. If you don't know what symbols you should be using, or what they mean, you should ask the relevant person to clarify this before you undertake the task.

Why it is important to use the correct symbols/prefixes etc.

- So that all members of the workplace are working the same. Then, information will be the same across the board – consistent, everyone using the same mathematical language to communicate
- It is easier for the persons you are discussing it with to understand commonly used symbols and language
- It is clear and concise. Instead of wordy explanations, only simple mathematical language is required.

Formality of language and symbols

Depending on your role and organisation, you may need to alter the formality of your language and numerical information.

When communicating results, think carefully about your audience and select language and symbols according to that context. For example, when relaying information to managers, supervisors, key external people, you should adopt more formal and professional language.

Examples of formal language and symbol names:

- 'Multiply' (instead of times)
- 'Subtract' (instead of take away)
- 'Add' (instead of plus)
- Full sentences with correct grammar
- Concise language choices.

If you are communicating with colleagues or in a more relaxed setting, then you may wish to use more conversational language. This means using the forms and symbol names you are more familiar with and referring to your own handwritten notes.

Summative Assessments

At the end of your Learner Workbook, you will find the Summative Assessments.

This includes:

- Skills Activity
- Knowledge Activity
- Performance Activity.

This holistically assesses your understanding and application of the skills, knowledge and performance requirements for this unit. Once this is completed, you will have finished this unit and be ready to move onto the next one – well done!

References

These suggested references are for further reading and do not necessarily represent the contents of this unit.

Websites

'Standard Deviation Formulas' from Math is Fun: https://www.mathsisfun.com/data/standard-deviation-formulas.html

'Describing Frequencies' from the Australian Bureau of Statistics: https://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-+describing+frequencies

All references accessed on and correct as of 21/02/2020, unless otherwise stated.