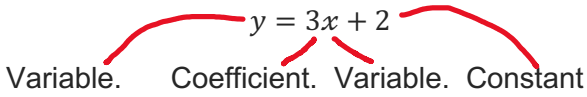
Mathematics

Term 1 Year 11 2019

Assumed Knowledge



Adding and subtracting like terms:

Find the like terms or the terms that have exactly the same pronumerals

e.g. $5a + 4b - 3a + 2b - 4 =$

equals= $2a + 6b - 4$

Chapter 3 – Formulas and Equations

3a Substitution into expressions and formulas

Substitution involves replacing the pronumeral in an algebraic expression or formula with one or more numbers. A formula is like an equation. It has two or more variables and contains an equal's sign. The subject of the formula is the single variable, usually on the left-hand side of the formula.

Example:

If A= 5, B= 3

Example $2a - c = 2 \times 5 - 3$

3b solving linear equations

An equation contains two algebraic expressions. When solving an equation, took to perform the opposite equation.

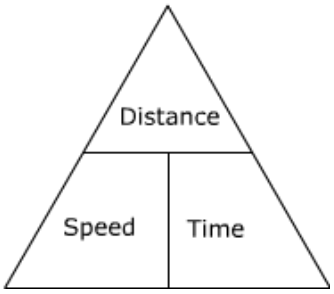
+	-
-	+
X	÷
÷	X
x^2	$\sqrt{x}$
$\sqrt{x}$	x^2

$$3(3y+5)+5=10(y+2)-y \qquad \textit{Distribute.}$$
$$9y+15+5=10y+20-y \qquad \textit{Combine same-side like terms.}$$
$$9y+20=9y+20 \qquad \textit{Combine opposite-side like terms.}$$
$$9y+20-9y=9y+20-9y$$
$$20=20 \ \checkmark \qquad \textit{True}$$

3c & 3d – Same as 3b

3e – Travel Calculation

$$Average\ speed = \frac{distance\ travelled}{Time\ taken}$$



The distance a car travels in the time it takes to stop is

$$Total\ stopping\ distance = reactiontime + braking\ distance$$

Example:

A car travels 232km in 4 hours and 17 minutes calculate the speed

17 mins -> hours = 17÷60 = 0.28

$$average\ speed = \frac{232km\ (distance\ travelled)}{4.28\ (Time\ taken)}$$

= 54.16 Km/h

Convert 65km/h to m/s (meters a second)

$$65kmh = \frac{65 \times 1000}{60 \times 60}$$

= 18.1m/s

Km -> meters x 1000 hours -> seconds x60

Calculate the reaction-time distance for a car travelling at 60kmh. Assume a reaction time of 2.5 seconds.

$$= \frac{60 \times 1000}{60\ \times\ 60} \times 2.5$$

= 42

Calculate the braking distance for a car travelling in dry conditions at 60km/h

$$braking\ distance = 0.01 \times 60^2$$

=36m

Find the total stopping distance for a car travelling 70kmh with a reaction time of 2.5 seconds

$$TSD = \frac{70 \times 1000}{60 \times 60} \times 2.5 + 0.01\ \times 70^2$$

=98m

3f blood alcohol content

BAC is a measure of the concentration of alcohol in a person's blood. It is expressed as a percentage mass per unit of volume.

For example, a person with a BAC of 0.02% has $\frac{0.02}{100}$g of alcohol in every milliliter of their blood. The number of standard drinks in a container can be calculated using the formula

$n = 0.789 \times V \times A$ where N= number of standard drinks, V= Volume of the container in Liters, A= percentage of Alcohol (% alc/vol) in the drink.

Note: 0.789 is the specific gravity of ethyl alcohol, the type used in beverages.

Male:

$$Blood\ alcohol\ content = \frac{10 \times number\ of\ drinks - 7.5 \times hours\ spend\ drinking}{6.8 \times persons\ mass}$$

Female:

$$Blood\ alcohol\ content = \frac{10\ \times\ number\ of\ drinks - 7.5\ \times hours\ spend\ drinking}{5.5\ \times persons\ mass}$$

3G Medical Calculations

There are three different formula's that can be used to calculate dosages for children, depending on the age of the child.

Fried's Formula- For children 1 to 2 years old:

$$Dosage = \frac{age\ (in\ months) \times adult\ dosage}{150}$$

Young's Formula- For children 1 to 12 years old is:

$$Dosage = \frac{Age\ of\ Child\ (in\ years) \times Adult\ dosage}{Age\ of\ Child\ (in\ years) + 12}$$

Clark's Formula- For children of any age:

$$Dosage = \frac{Child's\ weight\ (in\ Kg's) \times\ Adult\ Dosage}{70}$$

Flow Rate:

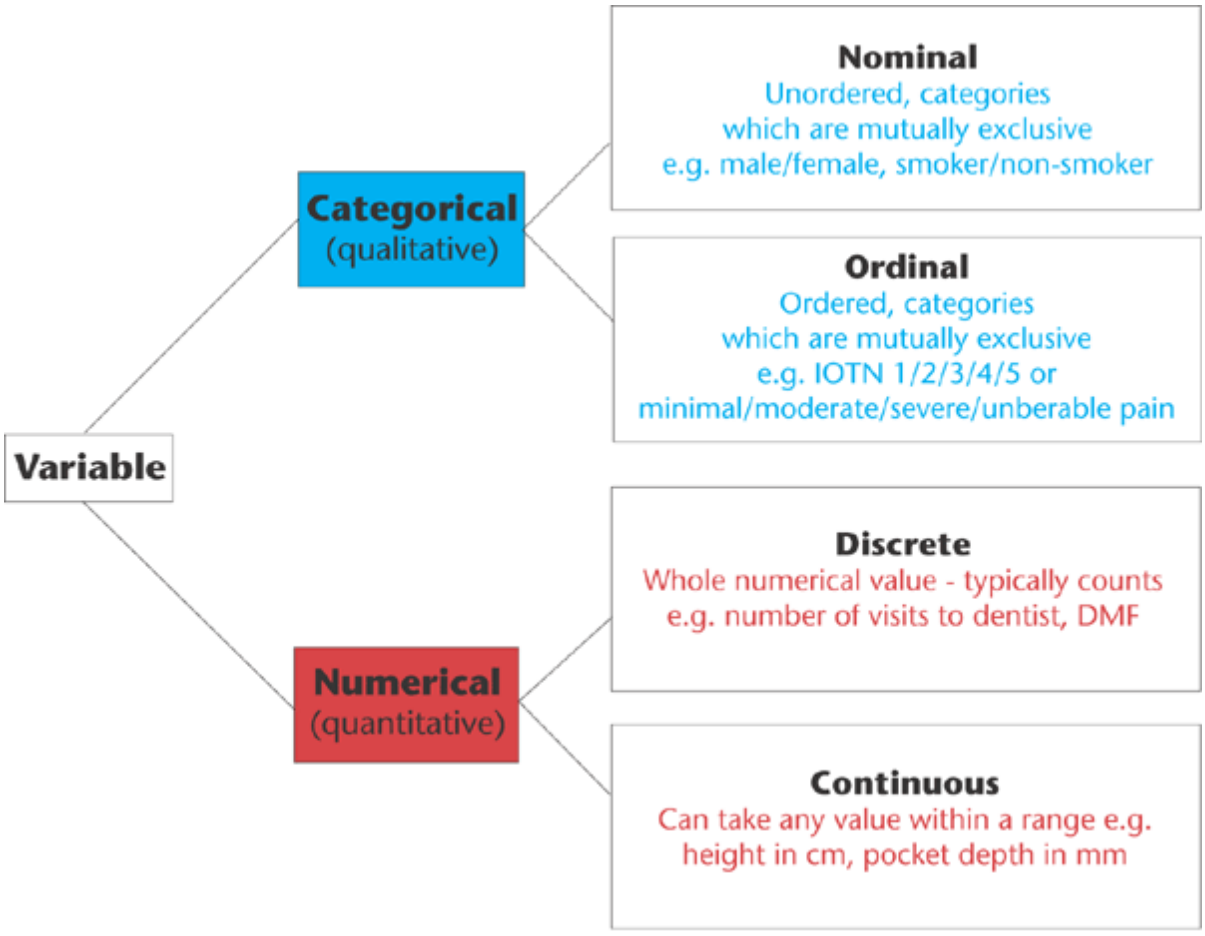
$$Flow\ Rate = \frac{Volume\ (ML)}{Time\ (H)}$$

Chapter 4: Classifying and collecting data

4a Collecting and classifying data

Statistics is the study of collecting, organizing, analyzing and interpreting data. Data is facts or pieces of information collected. The process of statistical inquiry includes the following steps:

1. Identifying a problem and posing a statistical question.
2. Collecting or obtaining data
3. Representing and analyzing data
4. Communicating and interpreting the findings.



4B Sample or Census and self-selected

A census involves collecting data about every individual in the whole population. The individuals may be people or objects. A Census is detailed and accurate but is expensive, time consuming and often impractical.

A sample involves collecting data about a portion of the population. It is cheaper and quicker than a census but is not as detailed or as accurate. Conclusions drawn from samples always involve some sort of degree or error.

A biased sample is one in which the data hasn't been fairly influenced by the collection process and is not truly representative of the whole population.

Example:

Census- The cause of car accidents in NSW

Sample- The length of time a light globe will last

Bias- Doing a survey on people that catch a train in not including other forms of transport.

4C Random Sampling

In a random sample, each member of the population has an equal chance of being selected. There are a number of ways in which a random sample may be taken

For example, suppose we wanted to choose a random sample of 10 students out of 30 we could

- Write the students names on a piece of paper, put the names in a hat, mix then draw out 10 names.
- Write the students names on cards then deal 10 cards
- Assign the class numbers then draw numbers out.

If the population is large, we can use number generators by tables, calculators or computers.

Summary:

Random- drawing out of a hat, assigning numbers and using tables.

4D Stratified Sample

Where the population is divided into subgroups based on different characteristics. At stratified sample is a sample taken from subgroups of the population, proportional to the relative size of each subgroup. Characteristics include

- Age
- Gender
- Income
- Year Group
- Address

Summary:

Stratified- Splitting into groups and randomly selecting people from each group. MUST BE PROPORTIONAL.

4E Systematic Sample

A systematic sample is a sample chosen in a methodical way. Each person or item is given a number, the first number is chosen at random, and then we select a number at regular intervals.

For example: a factory produces 240 batteries per day, we want to find the interval size when selecting a systematic sample of 20 items. $240 \div 20 = 12$, check every 12 batteries.

Summary:

Systematic- a sample chosen in a methodical way when members of the population are put in order, the first number is chosen at random and then every χth number is chosen for the sample.

4F Sustainability of sample types

A good sample is one that almost has exactly the same characteristics as the total population. We say that a good sample is representative of the population.

Random: each member of the population has an equal chance of being picked for the sample.

Stratified: The population is divided into sub-groups and then a random sample, proportion to the relative size of each subgroup.

Systematic: People chosen in intervals

Self-selected: The participants choose to be a part of the survey.

Chapter 7: Representing Data

7A Frequency distribution tables

We are looking at recording and displaying data.

Class (Rs.)	Tally Marks	Frequency Students
20 - 30	𝍸	5
30 - 40	𝍸 |||	8
40 - 50	𝍸 ||||	9
50 - 60	𝍸 𝍸	10
60 - 70	𝍸 |	6
70 - 80	||	2
Total		**40**

Grouping Data:

Sometimes if we are dealing with a huge range of numbers, we can condense the data by grouping it into classes or class intervals instead.

7B Cumulative and Relative frequency

Cumulative frequency is found by adding the frequencies of all scores.

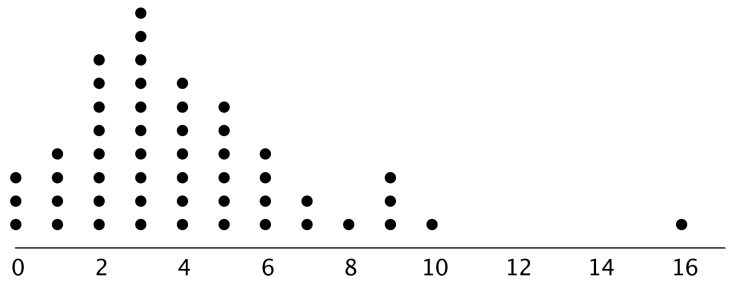
Relative frequency is its frequency as a fraction.

No. of Siblings *X*	Frequency *f*	Cumulative Frequency *cf*	Relative Frequency *rf*	Cumulative Relative Frequency *crf*
0	3	3	0.11	0.11
1	7	10	0.25	0.36
2	10	20	0.36	0.71
3	3	23	0.11	0.82
4	4	27	0.14	0.96
5	0	27	0.00	0.96
6	1	28	0.04	1.00
Total	28			

7C Dot plots and stem-and-leaf plots

A dot plot displays data as columns or rows of dots. The number of dots is the frequency of the variable.

Stem and leaf plots are used to group and rank data to show the range and distribution. The leaf is the first digit of a number, the preceding digits from the stem.



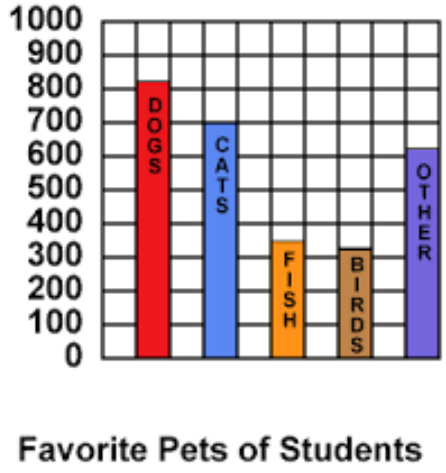
weight in kilograms

stem	leaf
0	1, 1, 2, 2, 3, 4, 4, 4, 4, 5, 8
1	0, 0, 0, 1, 1, 3, 7, 9
2	5, 5, 7, 7, 8, 8, 9, 9
3	0, 1, 1, 1, 2, 2, 2, 4, 5
4	0, 4, 8, 9
5	2, 6, 7, 7, 8
6	3, 6

Key: 6|3 = 63 years old

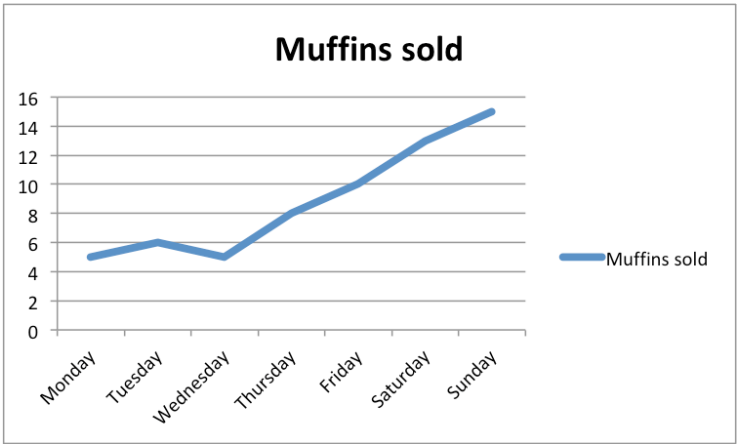
7D Column and Bar Graphs

- Good for showing categorical and numerical
- Time consuming



7E Line Graphs

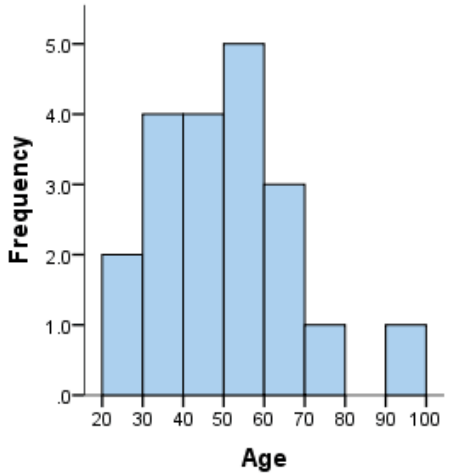
Line graphs are useful for showing upward and downward trends in data.



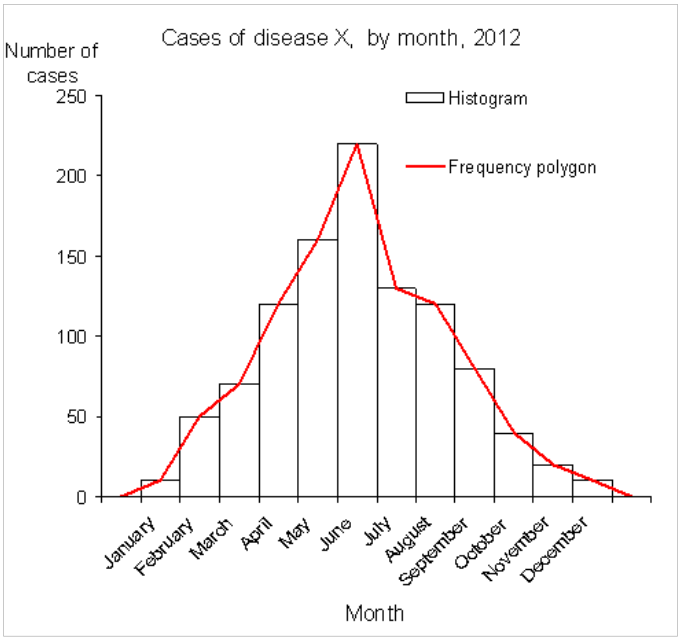
7F frequency histograms and polygons

A Histogram is a column or bar graph in which the values of the variable are placed in the horizontal axis and the frequency on the vertical, there are no gaps between the columns

A frequency polygon is a line graph made by joining the midpoints of the top of the columns of a frequency histogram, with the first and last points joined to the horizontal axis to form a polygon are located on the horizontal axis at half the column width before the first column and at half the column width after the last column in the histogram.



Histogram



Polygon

7G cumulative frequency graph

A cumulative frequency histogram is a histogram with cumulative frequency on the vertical axis. Cumulative frequency polygon is a line graph formed by joining the upper right-hand corners of each column of the cumulative frequency histogram. A cumulative frequency polygon is also called an ogive.

Practicalities of Measurement

2a Significant figures

Are the number of digits in a number the indicate its accuracy?

Example:

293568 to 1 significant figure is 300000, to 2 significant figures is 29000 and to 3 figures is 294000.

2b scientific notation

A value written as a number from 1 up to 10 multiplied by a power of 10.

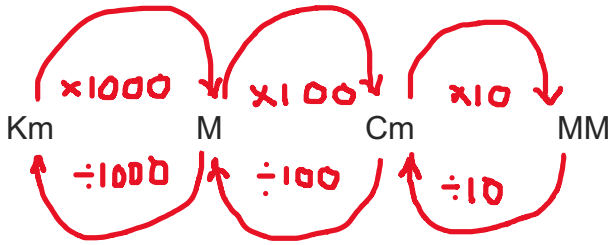
Example:

$$1.38000 = \ 1.38 \times 10^5$$

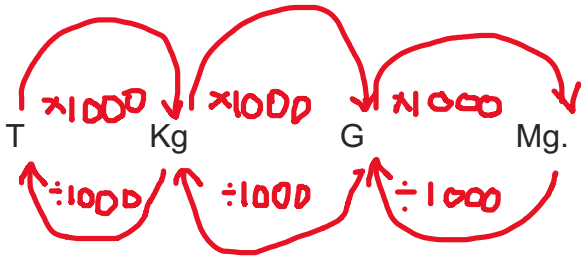
2c metric units of measurement

The metric system of measurement uses basic units for quantities such as length, mass, capacity, area and volume.

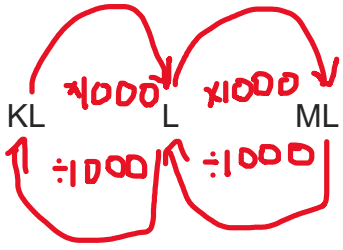
Length



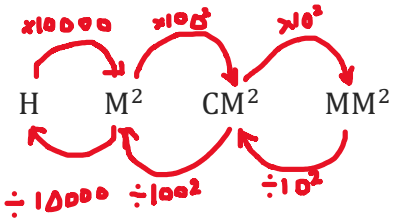
Mass



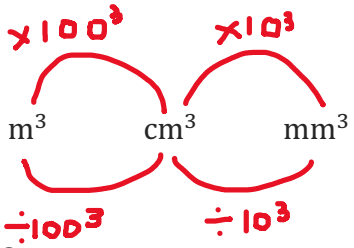
Capacity



Area



Volume



2d was skipped for relevance

2e error and accuracy in measurement

No measurement is ever exact. When we use a device to measure something, there is always some error caused by one or more of the following

- Human error
- Faulty device
- Incorrect device

You can increase the correct of a measurement by repeating it a number of times and averaging the answers.

For example: $\frac{(190+189+190+192+190)}{2} = 190.2mm$

2F Absolute error and limits of accuracy

The smallest unit on a measuring instrument is called the precision of the instrument.

The absolute error when measuring a quantity (sometimes called the greatest possible error) is equal to plus or minus half the precision.

The smallest and largest values between which that actual measurement lies are called the lower and upper bounds of the true measurement. These are the limits of accuracy of measurement.

Error in measurement:

$$Absolute\ error(+,-) = smallest\ unit\ of\ measure\ \times\ 0.5$$

Relative Error:

$$\frac{Absolute\ error}{measured\ quantity}$$

Percentage error:

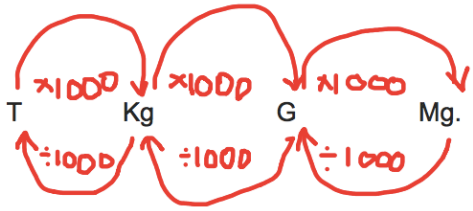
$$\frac{Absolute\ error}{measured\ quantity} \times 100\%$$

e.g.

	Precision	Absolute error	Lower bound and upper bound
16 s	1 s	+,- 0.55	Upper: 16.55 s Lower: 15.55 s

Chapter 13: Units of energy and mass

13a Units of Mass



13b Units of Energy

Energy is measured in kilojoules and calories. The international unit for energy is the Joule. The Joule is very small, so the kilojoule is often used instead.

1kJ = 1000J

1cal = 4.184 J

1 calorie is also too small to be used to describe the energy content of food. Another energy unit called the calorie or Cal is used for representing the energy contained in the food we eat. The Calorie is equivalent to 1000 calories or 1 kilocalorie.

So: 1 Cal = 1kcal = 1000 cal = 4184 J = 4.184kJ

13c Food and Nutrition: Energy Intake

The food we eat provides us with the energy we need to function. Most of that energy comes from carbohydrates, protein, fat and dietary fibre. In Australia, energy in food and drinks is measured in kilojoules.

- Protein – 17kJ/g
- Fat – 38kJ/g
- Carbohydrates – 17kJ/g
- Dietary fibre – 8 kJ/g

To calculate our total energy intake from a serving of food, we take the amount of each of these nutrients, multiply it by the energy it provides and add the subtotals.

13d energy expenditure

Energy out refers to the amount of energy the body uses to sustain its basic physiological functions (breathing, digestion, maintaining body temperature, muscle activity, etc.) and to perform these activities is influenced by a number of factors including gender, age, weight, height and level of fitness.

Another method for calculating the amount of energy used in an activity involves using the concepts of basal metabolic rate and a physical activity factor. The basal metabolic rate (BMR) of a person refers to the minimal amount of energy needed to sustain basic bodily functions for a 24-hour period. An estimated can be calculated using either the Schofield formula or the Harrison-Benedict formula.

The physical activity level (PAL) is the result of the comparison:

$$\frac{total\ energy\ needed\ for\ the\ activity}{BMR}$$

13E Energy Consumption

Electricity is a form of energy. Domestic users are usually charged for their household electricity by way of a quarterly bill. Users are charged for the cost of supplying the electricity (supply charge) and are also charged foe the amount of electricity they use. All power appliances have a power rating. This is the rate at which the appliances use electricity and is measured in watts or kilowatts.

One Kilowatt (1kW) = 1000 Watts (1000W)

The unit we use to measure the energy consumption (energy used by an appliance) is the kilowatt-hour (kWh), this is the energy used by a one-kilowatt appliance in one hour.

The energy consumption of an appliance can be calculated using:

$$Energy\ (kWh) = power\ (kW) \times\ time\ (h)$$

For example:

Calculate the cost of running a 300-watt television for 6 hours if the domestic rate is 47.77 cents/kWh

$$energy\ used = 0.3\ \times 6 = 1.8 \times 0.4777 = \$\ 0.86$$