

# Engineering Report

An engineering report is structured in much the same way as any other. It has an introduction, the body of the report, conclusion and/or recommendations and may also have appendices. Hence it is not the structure of the engineering report that makes it different. Rather, it is the content that separates this from other reports.

The task of an engineer is to draw conclusions and/or make recommendations. Both these require some research. That means collecting information, facts and data. This all needs to be sorted, understood, analysed and in some cases, used to predict future events.

# Data

**Data** is the name given to information or facts collected through experience, observation or experiment. Data can also be thought of as the values of measurements used to describe a variable. They may consist of numbers, words, or images; particularly as measurements or observations of a set of variables.

# Population & sample

## *Populations and samples*

The term population means the entire group items that are the subject of a study or investigation. For example, if you are trying to determine the number and cause of failures in distribution transformers in a particular geographic area, the population is the total number of distribution transformers in that area. The population excludes other types of transformers and those in other geographic areas.

# Data collection error

## *Data collection errors*

Data collection can be prone to errors. This is true regardless of whether the data is collected manually or through an electronic process.

A common error is to collect insufficient data. Even if working under time constraints it is important to collect enough data to make the subsequent analysis meaningful. Too much data will make analysis time consuming but is not likely to affect the result. Too little data can save time but can have a significant effect on the result.



# 5W2H Questions

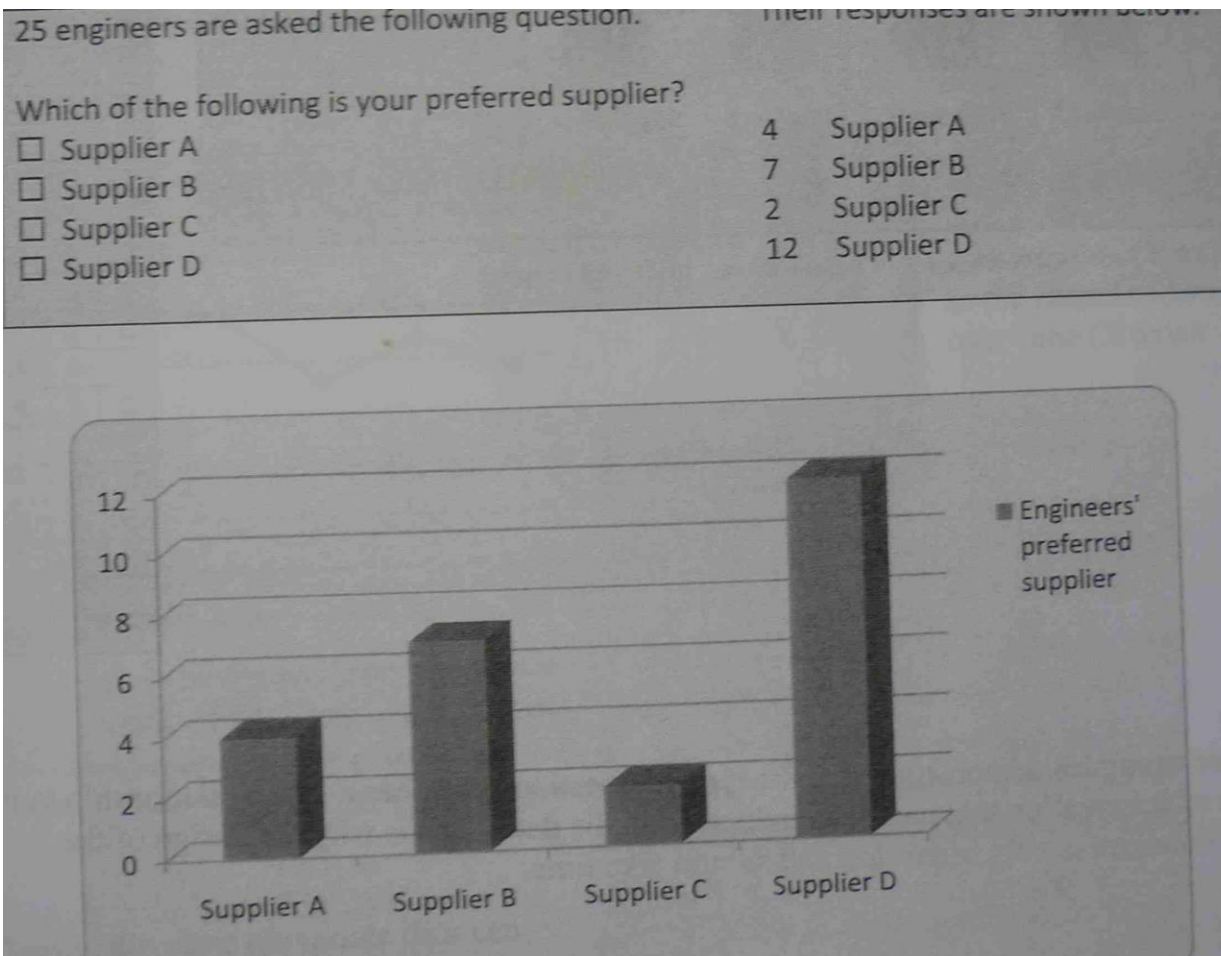
The following are typical words or phrases that may be used to describe 'problems'. In fact, each of these is a symptom. The cause needs to be investigated.

makes unusual noise, won't work, no power, machine down, broken tool, head froze up, contaminated, rough surface, porosity, shortage of parts, rattles, quality problem, worn out, line stopped, not to specification, labour problem, management problem, too much variation

Determining the cause can be as simple as applying the 5W2H questions.

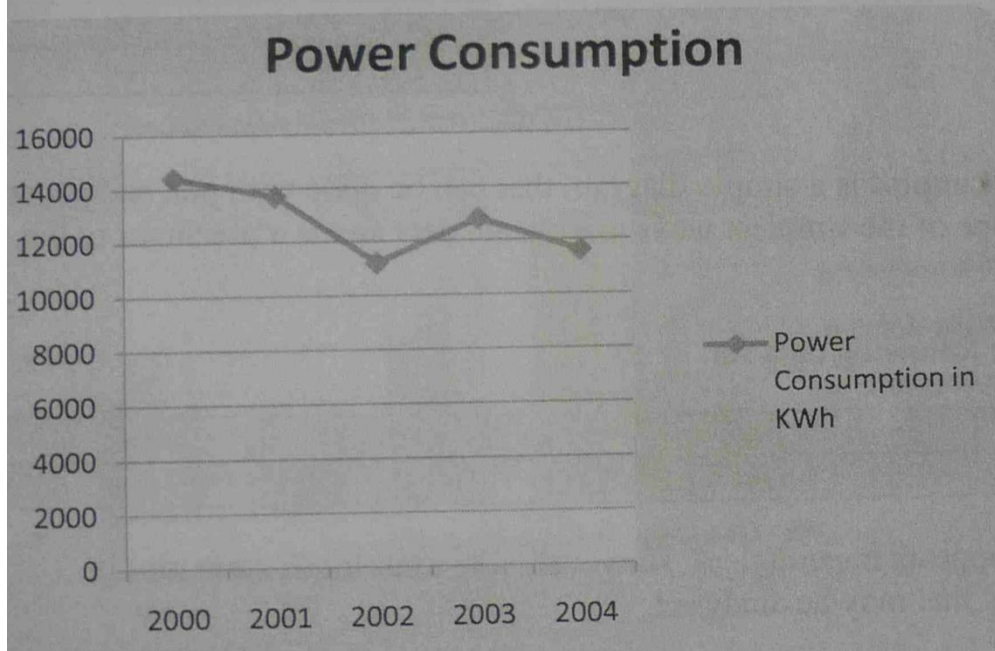
Who?	...brought the problem to your attention
What?	...is happening or not happening
When?	...did the problem start
Where?	...is it occurring?
Why?	...is it happening – this is about the context of the problem
How?	...is it happening - in what mode or situation did the problem occur
How Many?	...times or errors or similar measures of the problem

# Bar chart question



# Graph

Year	2000	2001	2002	2003	2004
Power consumption in KWh	14400	14500	11200	9600	6300



The graph at left shows how power consumption (Y axis) in the household varied over time (X axis).

# Frequency Distribution

Data can be displayed in a wide variety of graphical forms. The following diagrams types can all be created by hand or using the “insert chart” function in Microsoft Word<sup>®</sup> or Excel<sup>®</sup>.

## *Frequency distribution*

In very simple terms, a **frequency distribution** is simply a count of data. This count is displayed in a way that makes sense to the observer. For example, a maintenance team may count the number of call outs each month of the year and record it in a frequency distribution such as the one at right.

<b>Month</b>	<b>No. of call outs</b>
January	175
February	209
March	186
April	155
May	102
June	134
July	178
August	172
September	118
October	130
November	156
December	169

Stemplot



# Stem & leaf plot

A **stem and leaf plot** or **stemplot** is a simple diagram that can be done with pen and paper with no other tools. It is one of the simplest ways to indicate data and is a precursor to the histogram.

For example, consider the following data set.

22	45	28	36	34	29	24	37	31	49
52	58	38	26	54	34	39	39	28	41

In its raw form, this data appears meaningless. However, when put into a stem plot it begins to assume a 'shape' that may be analysed.

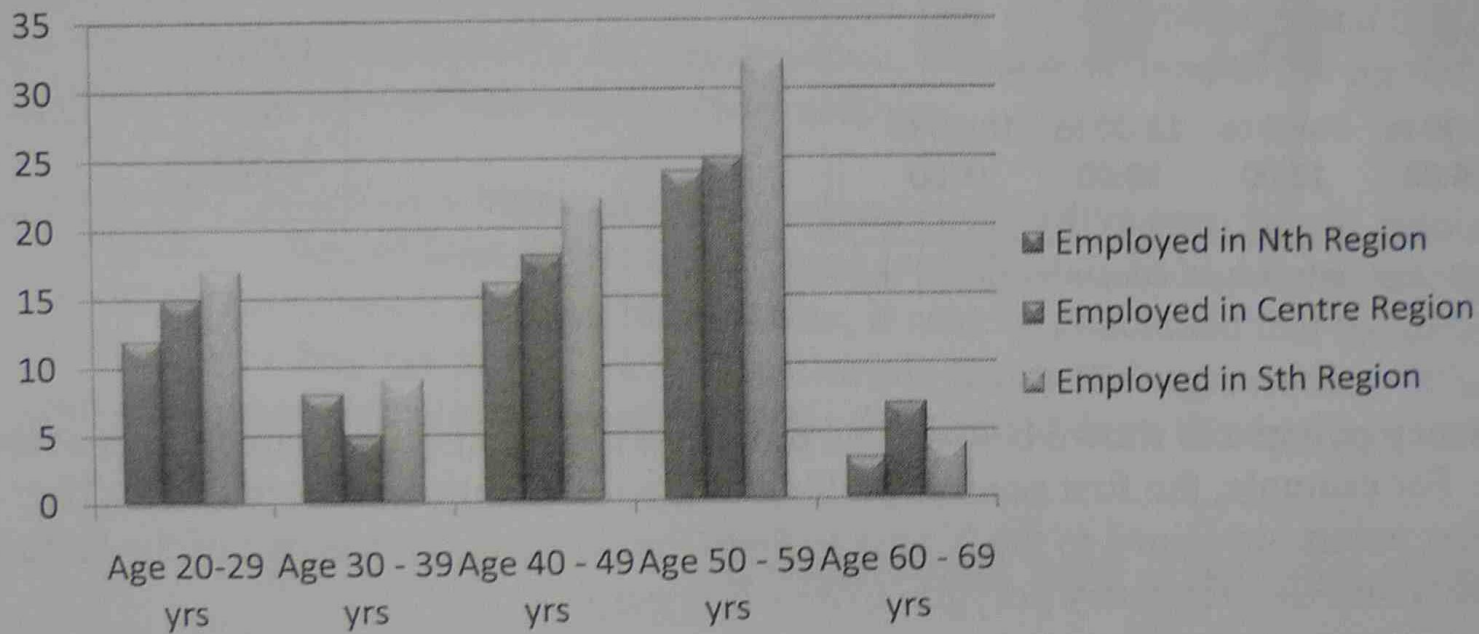
To create the stemplot the 1<sup>st</sup> number (ie most significant digit) is used as the stem and the 2<sup>nd</sup> number as the leaf as shown below.

2		2 4 6 8 8 9
3		1 3 4 4 6 7 9 9
4		1 5 9
5		2 4 8

From this very simple diagram we can immediately see that there are four sub-groups of data, there are more items in the 30-39 sub-group than any other and the majority of the data is in the lower two sub-groups (20-29 and 30-39).

# Histogram

**Histograms** are similar to bar charts except each 'bin' (bar) represents a 'class' (subgroup) of data. For example, the histogram below shows the number of employees in age ranges (sub-groupings of ages) employed in different regions.



# Pareto chart

## *Pareto charts*

A bar chart or histogram arranged from highest to lowest value is called a **Pareto chart**.

For more information on histograms go to <http://www.netmba.com/statistics/histogram/> (accessed in June 2009)

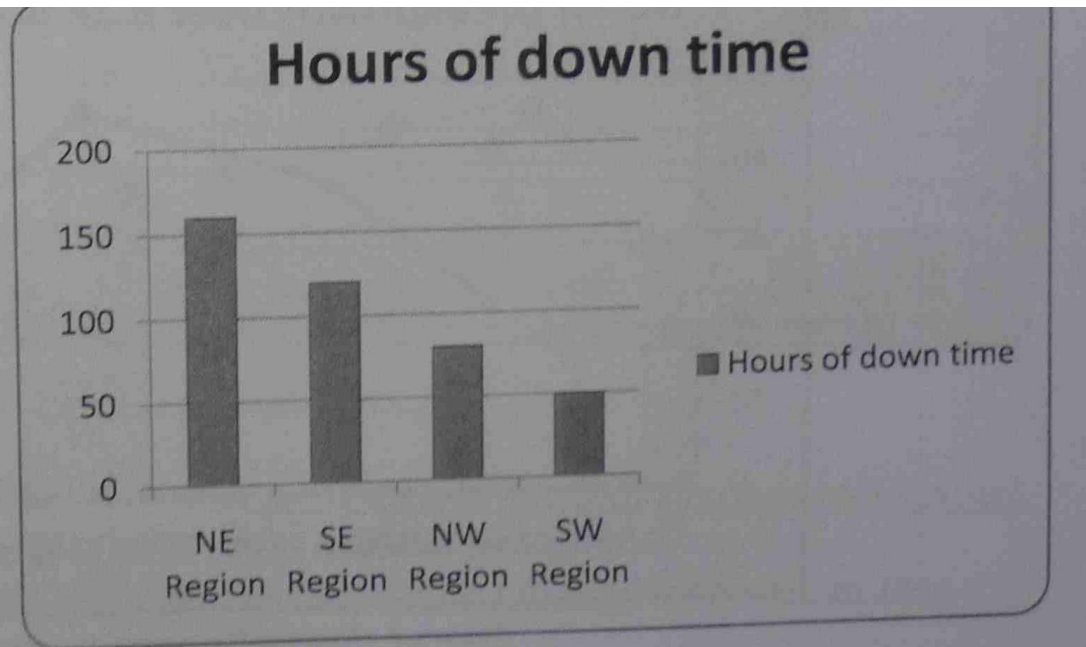
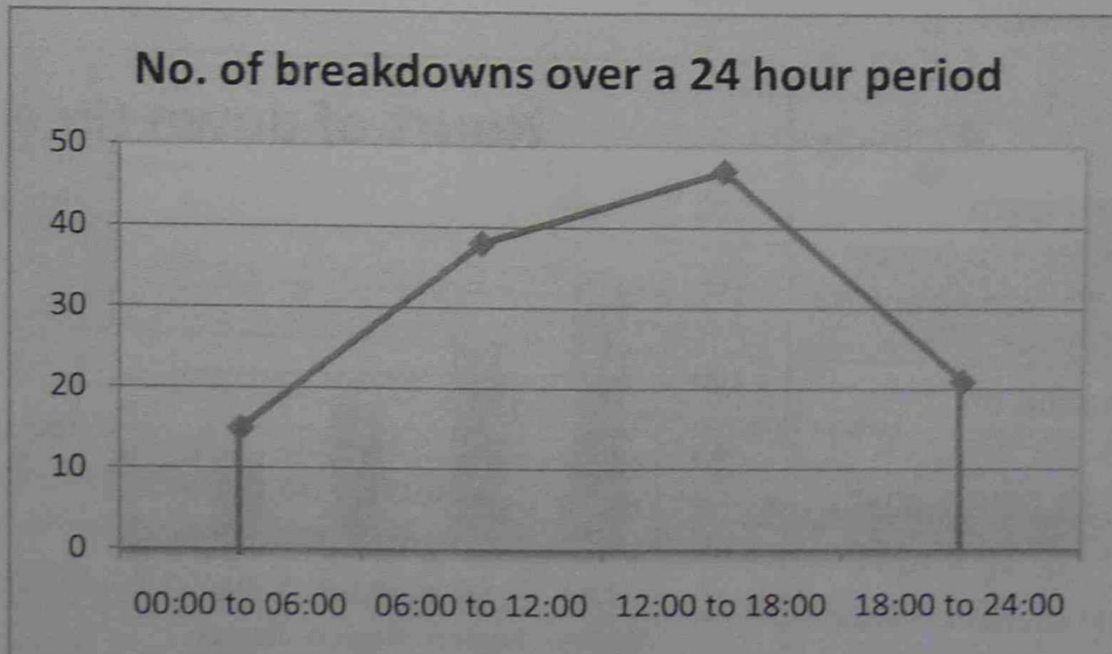


Figure 7 - Sample Pareto chart



# Frequency polygon

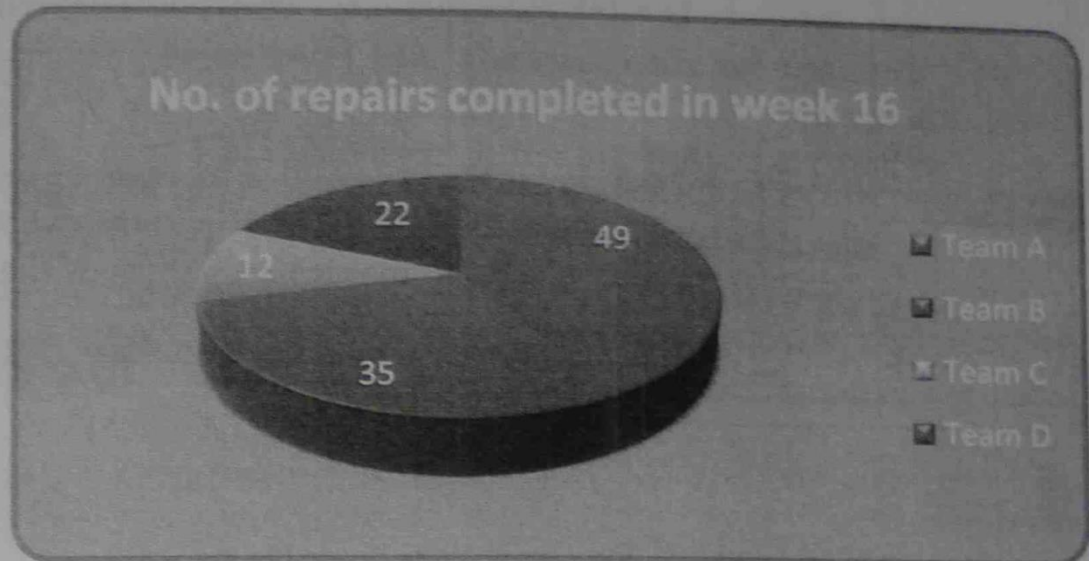
The frequency polygon is shown below. The points on the X axis are the midpoints of the subgroup. For example, the first point is at 03:00 – the midpoint of 00:00 to 06:00. The first and last points are joined to the X axis to form the polygon. This is one of the features that differentiates the frequency polygon from a line graph.



# Pie chart

**Pie charts** are very useful for showing relative values. In the example below, the total number of repairs completed in week 16 has been represented in terms of the proportion completed by each of four teams.

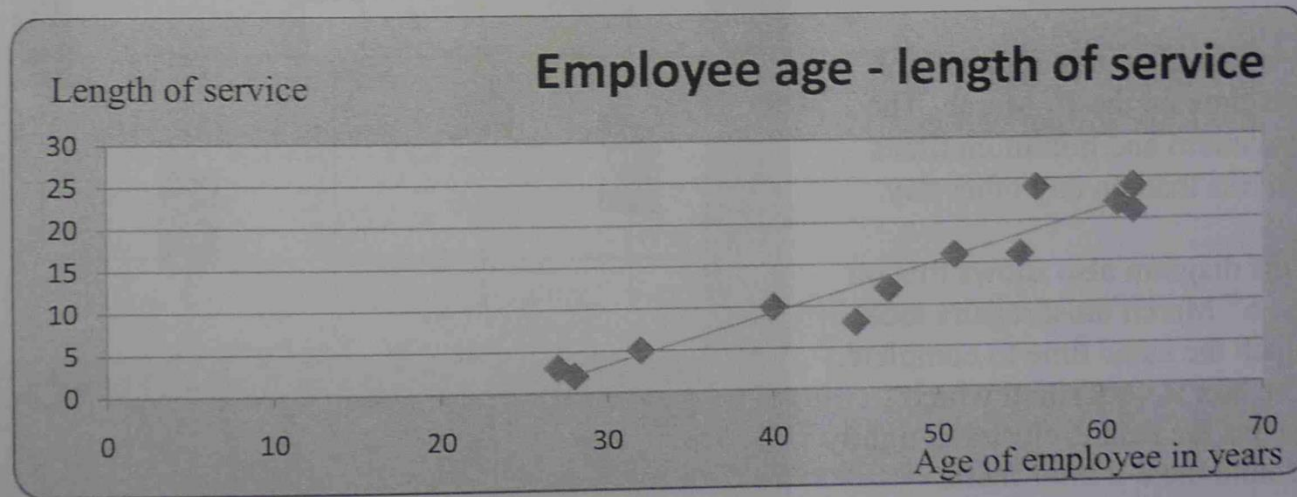
It is important to note that the 'pie' must always represent 100% of the data values.



# Scatter plot

A **scatter plot** or **scattergram** can be used to show the relationship between two variables. For example, the scatter plot below shows the age of 12 employees and the length of time they have been employed by the organisation. Being displayed in the scatter plot shows there is a relationship between the two variables.

The scatter plot shown below seems to indicate a 'positive correlation' between the two variables. A **line of best fit** has been drawn over the data to highlight the relationship. Based on how closely the data fits that line, it may be concluded that the older an employee is, the longer they are likely to have been employed by the organisation. Whether that is a causal or coincidental relationship can't be determined from the data provided.



# Mean

## *Definition and calculation of mean*

When most people use the word '**average**' they are usually referring to the mean (or arithmetic mean). This is simply the total sum of all the numbers in a data set, divided by the number of numbers.

The symbol  $M$  is used for the mean of a sample.

$$\text{The formula for } m \text{ is } M = \frac{\sum X}{N}$$

where  $\sum X$  is the sum of all the numbers in the sample  
and  $N$  represents how many numbers there were.

For example, the mean of the numbers  $1 + 1 + 1 + 2 + 2 + 3 + 6 + 8 = \frac{24}{8} = 3$

# Median

## *Definition and calculation of median*

The **median** is the middle data point in a data set and is not related at all to the value of that data point. The median is found by locating the data point that is equidistant from either end of the data set. If there are an equal number of data points in the set, the median is the average of the two central points.

For example, the median of the numbers **1 1 1 2 2 3 6 8** is the number **2**.

The median is the point where there are an equal number of data points above and below.



# Mode

## *Definition and calculation of mode*

The **mode** is the most common data point in a data set. This is the value that occurs with greatest frequency.

For example, the mode of the numbers **1 1 1 2 2 3 6 8** is the number **1**. It occurs three times, which is more frequently than any other number in the set.

If two data points have the highest and equal frequency, the data is termed **bimodal** – that means it has two modes. If there are more than two modes, the data set is **multi-modal**.

# Ordered data set

If a data set is sequenced from lowest to highest value it is known as an **ordered data set**.

In an ordered data set the 25% of the data points at the lower end of the range are known as the **lower quartile** (LQ). The 25% of the data points at the upper end of the range are known as the **upper quartile** (UQ).



# Inter quartile range

## *Definition and calculation of inter-quartile range*

Like the range, the inter-quartile range is an easy measure of dispersion to calculate and is **not** very sensitive to outlying data (very small or very large values in the data set). Using an ordered data set, the inter-quartile range can be calculated by finding the difference between the lower and upper quartile values.

The steps to find the IQR are as follows.

1. Order the data set
2. Take the median of the data set
3. Find the medians of the upper and lower halves of the set
4. The inter-quartile range is the difference between these two secondary medians

In mathematical terms this is written as  $IQR = UQ - LQ$

# Variance

## *Definition and calculation of variance*

If all the data points in a set are clustered around the mean, there is little variability in the data. The more widely the data are scattered the larger the variance of the data set.

Calculations of variance are sensitive to outlying data - very small or very large values in the data set.

Variance is the approximate average of the squared deviations from the mean of the data set. The formula looks challenging but in fact the calculation is quite simple if the steps are followed.

$$S^2 = \frac{\sum(\bar{x} - x^i)^2}{n-1}$$

1. Calculate the mean of the data set
2. Determine the variation of each data point from the mean
3. Square each deviation
4. Find the sum of the squares
5. Divide by the number of data points - 1 ( $n-1$ )

# Variance

Consider data set used in the previous example.

3	3	3	3	4	5	6	6	6	6	7	7	8	8	8	8	9	9	9	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	----

The sum of the data points is 128 therefore the mean is  $128 \div 20 = 6.4$

Data point	Deviation from mean	Squared deviation
3	$6.4 - 3 = 3.4$	11.56
3	$6.4 - 3 = 3.4$	11.56
3	$6.4 - 3 = 3.4$	11.56
3	$6.4 - 3 = 3.4$	11.56
4	$6.4 - 4 = 2.4$	5.76
5	$6.4 - 5 = 1.4$	1.96
6	$6.4 - 6 = 0.4$	0.16
6	$6.4 - 6 = 0.4$	0.16
6	$6.4 - 6 = 0.4$	0.16
6	$6.4 - 6 = 0.4$	0.16

Data point	Deviation from mean	Squared deviation
7	$6.4 - 7 = -1.4$	1.96
7	$6.4 - 7 = -1.4$	1.96
8	$6.4 - 8 = -2.4$	5.76
8	$6.4 - 8 = -2.4$	5.76
8	$6.4 - 8 = -2.4$	5.76
8	$6.4 - 8 = -2.4$	5.76
9	$6.4 - 9 = -3.4$	11.56
9	$6.4 - 9 = -3.4$	11.56
9	$6.4 - 9 = -3.4$	11.56
10	$6.4 - 10 = -4.4$	19.36

The sum of the squares is 135.6

$$135.6 \div (n-1) = 135.6 \div (20 - 1) = 6.61$$

**Therefore the variance of the data set is 6.61**

# Standard deviation

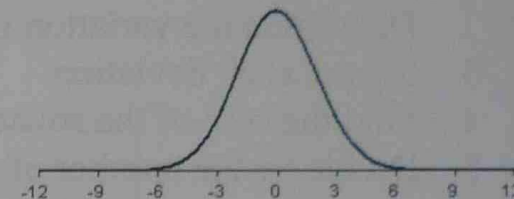
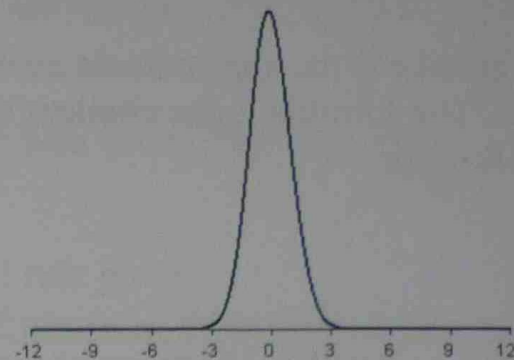
## *Definition and calculation of standard deviation*

Standard deviation is the square root of the variance. Hence it is also known as the Root Mean Squared Deviation (RMSD). The symbol often used for standard deviation is  $\sigma$  (sigma). Calculations of standard deviation are sensitive to outlying data.

One way to think about standard deviation is that it measures how spread out the points in a data set are. If our data set follows a bell curve and had a standard deviation of 1 it would look like this. →

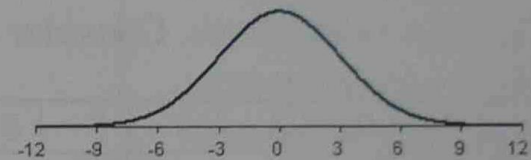
It is quite concentrated around the middle.

However, a data set with the same mean, median and range but a standard deviation of 2 it would look like this. →



# Standard deviation

Finally, a data set with the same mean, median and range but a standard deviation of 3 would look like this.



Knowing the variance of a data set is just one step short of knowing the standard deviation. Standard deviation is the square root of the variance.

$$\sigma = \sqrt{S^2} = \sqrt{\frac{\sum(x^i - \bar{x})^2}{n-1}}$$

For our previous example  $\sigma = \sqrt{6.61} = 2.57$

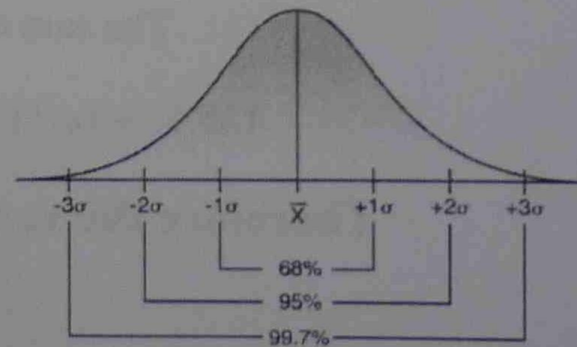


# Normal distribution curve

## *Normal distribution curve and the empirical rule*

In statistics, the normal distribution curve or bell curve represents the shape of data that clusters around the mean of the data set. In theory, any variable that is made up of a large number of independent factors is likely to be distributed in a bell curve.

For example, if the weight of all persons living in a town was graphed the result will look like this. Some of the values will be at the extreme ends of the distribution and most will be clustered around the mean.



# Normal distribution curve

The Empirical rule states that approximately...

- 68% of values in a normally distributed data set will be clustered within one standard deviation of the mean  $\mu + 1\sigma$
- 95% of values in a normally distributed data set will be within two standard deviations of the mean  $\mu + 2\sigma$
- 99.7% of the values in a normally distributed data set will be within three standard deviations of the mean  $\mu + 3\sigma$

To see an example calculation proving the Empirical rule go to

[http://www.nku.edu/~statistics/212\\_Justifying\\_the\\_Empirical\\_Rule.htm](http://www.nku.edu/~statistics/212_Justifying_the_Empirical_Rule.htm) (accessed in June 2009)



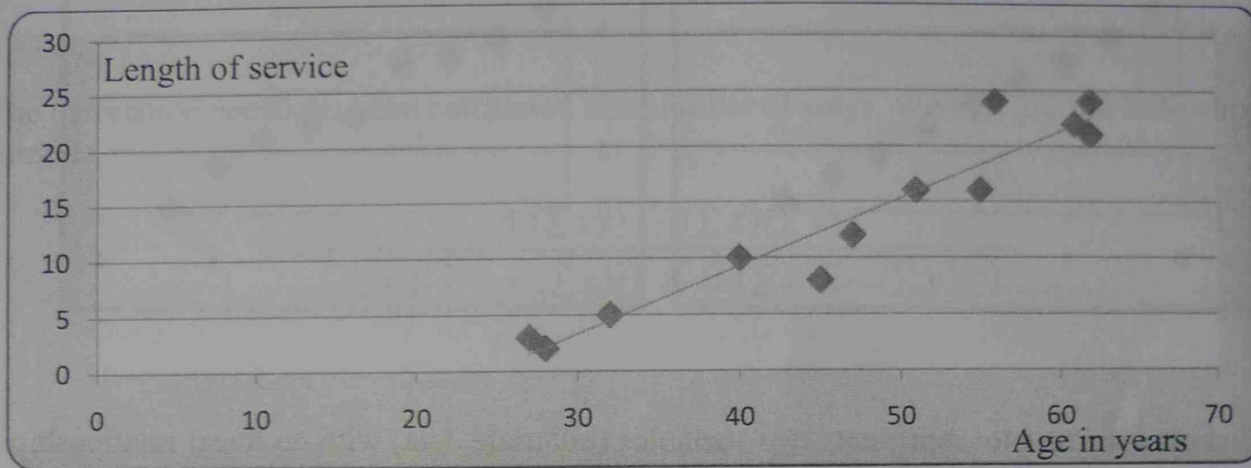
# Bi-variate data

## Analysing bivariate data

### *Linear relationships between variables*

A linear 'relationship' between variables means that both change in a pattern consistent with each other. Generally we can see a relationship by using a scatter plot.

Consider the following example. This scatter plot would indicate that there is a positive linear relationship between the age of an employee and how long they have been employed by the organisation.



# Correlation

## *Definition and calculation of correlation in bivariate data*

One of the statistical measures used to determine the existence and strength of a linear relationship between two variables is the **Pearson product-moment correlation coefficient**, also known as the **correlation coefficient**. A strong correlation coefficient gives us confidence to make predictions based on the bivariate data.

NOTE: The correlation coefficient does not indicate whether the linear relationship is causal. It merely tells us the strength of the linear relationship.

# Correlation

- A correlation coefficient will always be a value between -1.0 and +1.0
- A correlation coefficient of +1.0 indicates a perfect positive linear relationship
- A correlation coefficient of -1.0 indicates a perfect negative linear relationship
- The closer the correlation coefficient is to 1.0, the stronger the positive linear relationship is
- The closer the correlation coefficient is to -1.0, the stronger the negative linear relationship is
- The closer the correlation coefficient is to 0, the weaker the linear relationship is

The correlation coefficient can be calculated in a number of ways. We will use the following formula.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2] \times [n(\sum y^2) - (\sum y)^2]}}$$

# Regression

## *Definition and calculation of regression*

When the correlation coefficient is +1 or -1 there is a straight line that will pass through all data points when displayed on a scatter plot. However, when the correlation coefficient is strong but is not +1 or -1, we can only approximate the linear relationship with a line of best fit.

Regression analysis is the statistical determination of the line of best fit for a set of bivariate data. The line of best fit is known as the regression line.

In mathematics the formula for determining the slope of a straight line is  $y = mx + b$

In statistics, the formula for determining the regression line is calculated by  $\hat{y} = ax + b$  where  $\hat{y}$  is pronounced 'y hat'

The formulae for finding the values  $a$  and  $b$  are as follows.

$$a = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

$$b = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$$

# Coefficient determination

## *Coefficient of determination*

The coefficient of determination allows us to determine how confident we could be with any predictions made based on a given regression analysis. It measures how much of the variation in the dependent ( $y$ ) variable can be explained by regression of the independent ( $x$ ) value.

The symbol for the coefficient of determination is  $r^2$ . It is literally the square of the correlation coefficient and is always between 0 and 1. Note:  $0 \leq r^2 \leq 1$

The closer  $r^2$  is to the value of 1, the more confidence we can have in the regression analysis. The closer  $r^2$  is to 0, the less confidence we have in the regression analysis.



# Data Analysis Report

Data analysis is converting data into a usable format then drawing out themes, patterns and other information.

When data is collected it can be in the form of nominal, ordinal or interval scales.

A nominal scale is where the response to a question is done by 'nominating' one of the available choices.

e.g. gender, occupation, geographic area, nationality

Ordinal scales are used for placing responses in 'order' or ranking.

e.g. first to last, highest to lowest, excellent-good-fair-poor-very poor

Interval scales allow for responses between two values at any point along pre-set intervals. They are sometimes called 'measurement data'.

e.g. temperature, weight, quantity, distance, % marks

Nominal and ordinal scales are considered 'descriptive' because statistical analysis can't be applied to the data itself. On the other hand, data collected on an interval scale can be statistically analysed.

# Report Brief

## *The Report Brief*

Planning a report is essential. A report is like a project - it has a specific purpose, a time deadline for completion and other people rely on it.

If you've been requested to produce a report your first step is to ask for a report brief. This is the outline of the...

- issue to be reported on,
- intended audience,
- expected length of the document,
- any other particulars to be included.
- purpose of the report,
- scope of included information,
- deadline for completion, and



# Scoping a report

## Scoping a report

Scoping a report is about figuring out what goes into it, and what doesn't. Without clear guidelines about the detail required, a report could end up being thousands of pages long! The scope helps you focus on what's relevant and important.

# Targeting Reader

## *Targeting the Reader/s of the Report*

Reports are written as though there is only one reader - the person who needs the information or will make decisions based on it. If a report is written for a group, that group is considered to be a single reader.

# Questions for report

- Who requested the report? Is it the same person who'll read it or use it?
- How much does my reader already know about the issue? Writing to suit the level of the reader's knowledge is important when writing a report. If your report is pitched too high, the reader won't be able to understand it. If it's pitched too low they may consider it unprofessional and dismiss the information in it.
- Why do they need the report? Most reports are requested because the reader has a problem to solve or a decision to make. Knowing how the report is going to be used will help you focus on including relevant information.
- What does the reader expect from the report? Most people reading a report expect it to be
  - easy to understand,
  - include all the information they need,
  - accurate and relevant,
  - structured logically, and
  - correct in terms of grammar, punctuation and spelling.

# Questions for report

- What preferences do they have with regard to the way the report is written and/or presented? Some readers like things written in a particular way. They may like lots of heading or none at all. They may prefer the use of bullet points rather than long paragraphs. Some readers like the use of tables, graphs and other diagrams to indicate what the information is saying. Very often, managers prefer to have the detail left until the end of the report so they can refer to it if and when they want to. If you know the preferences of the reader you can tailor your report to suit them.

# Information

## Types of information

When you've noted everything you know about the issue it's time to look for other sources. Where you look will depend on the type of information you want. **Quantitative** information is objective, factual and often able to be measured or counted. For example, names, addresses, dates, numbers, statistics, engineering specifications.

**Qualitative** information is subjective, based on opinion or perspective. For example, feelings, values, preferences, interpretations.



# Source of information

## Sources of information

Finding the information you want or need can be time consuming. Those who are familiar with the internet will prefer that as their source. Others will be more familiar with libraries, databases, registries or information sources inside their own organisation.

Your sources may include:

- Bibliographies
- Dictionaries
- Government documents
- Local government records
- National and international standards
- Opinion surveys
- People
- Company records
- Directories
- Journals
- Maps
- Newspapers
- Parliamentary papers
- Observations/experiments

# Credibility of information

## **Credibility of information**

When you're gathering information for your report you need to consider the credibility of the source. There's an old saying – don't trust everything you read. This is a reminder that just because something is in print doesn't mean it's true or accurate.

The internet is becoming more and more relied on as a source of information. However, there's no way to know who published that information or whether it's already been plagiarised from another source. There's nothing wrong with using information that others have gathered as long as you acknowledge them as the original source.

# Writing a report

## *Writing in plain English*

Being able to communicate effectively in writing is an essential skill in the workplace. Unlike verbal communication, written words are long lasting and often read by other than the originally intended audience.

To ensure your document is read and understood you need to ensure that you

- write clearly,
- engage the reader, and
- use a visually engaging style.

# Writing a report

The Plain English Campaign [ <http://www.plainenglish.co.uk/plainenglishguide.html> ] explain plain English by saying what it isn't.

- It's not 'cat sat on the mat or 'Peter and Jane' writing. Almost anything - from leaflets and letters to legal documents - can be written in plain English without being patronising or over-simplifying.
- It doesn't mean reducing the length or changing the meaning of your message. Most of the UK's biggest insurance companies produce policies that explain everything fully in plain English.
- It's not about banning new words, killing off long words or promoting completely perfect grammar. Nor is it about letting grammar slip.
- It is not an amateur's method of communication. Most forward-looking senior managers always write in plain English.
- And finally, it is not as easy as we would like to think.

# Writing a report

Unfortunately, there's so much badly written English around that we tend to get used to it; we ignore it rather than complain or do something about it. However, as the Plain English Campaign point out, plain English has several advantages...

- “it is faster to write;
- it is faster to read; and
- you get your message across more often, more easily and in a friendlier way. “



# Writing a report

Engaging your readers is about speaking to them directly and clearly. Writing in “first person” makes the reader feel as though you are talking directly to them. “You” gives the impression the document is intended for the reader in a way that “he”, “she” or “they” cannot. Using “we” to refer to your own organisation makes the reader feel they are engaging in a conversation. Your organisation will have its own protocols about whether or

not to write in 1<sup>st</sup> or 3<sup>rd</sup> person and those should be followed. However, if none exist, remember that 1<sup>st</sup> person is a plainer form of English.

# Writing a report

## Organising the content

It's important to organise the information in the document in a structure that reflects the readers' interests. People read documents to find information or get answers. They want to know how to do something or what happens if they take a particular course of action. Hence, it makes sense to organise your document around the questions your audience is likely to be asking.

One way to do this is to use a question-and-answer format. This can be done by writing the subheadings as questions. By doing this the reader can scan the document and find the information they want. They may also see a question they hadn't thought of but need to know the answer to.

It helps to think through the questions the readers might ask and organise your document in that order. After each heading, answer the question immediately.

# Writing a report

## Use short sentences

Long complicated sentences are difficult to read. Take care to express only one idea in each sentence. Shorter sentences force you to break up the information into smaller, easier-to-process chunks. Compare the two versions of the same passage on the next page.

Long sentence structure...

Short sentence structure...

For good reasons, the Secretary may grant extensions of time in 30-day increments for filing of the lease and all required bonds, provided that additional extension requests are submitted and approved before the expiration of the original 30 days or the previously granted extension.

The Secretary may extend the time you have to file the lease and required bonds. Each extension will be for a 30-day period. To get an extension you must write to us giving the reasons that you need more time. We must receive your extension request in time to approve it before your current deadline or extension expires.

# Writing a report

## Use the present tense

Present tense avoids the confusion of compound verbs. Past tense or future tense should only be used when actually writing about something that has already happened or has not yet happened.

## Subjects and objects

Keeping subjects and objects close to their verbs makes it easier for the reader to work out who is doing what to whom. A **SUBJECT** is a **NOUN** that is the **FOCUS** of the sentence.

# Writing a report

## Modifiers

A 'modifier' explains or slightly alters a word. Some modifiers, especially simple modifiers (*only, just, nearly, barely*) have a bad habit of slipping into the wrong place in a sentence.

Modifiers need to be placed carefully in sentences. If they're in the wrong place the whole meaning of your sentence can alter. The following examples show how this can happen.

INCORRECT: He barely kicked that ball twenty yards.

[How can you 'barely' kick a ball?]

CORRECT: He kicked that ball barely twenty yards.

INCORRECT: The table was bought by a lady with sculpted legs.

[This is a very unusual way to describe someone's legs!]

CORRECT: The table with sculpted legs was bought by a lady.



# Writing a report

## Sentence sequence

In English we write our sentences so that the most important information is at the beginning. Here are some examples.

I went to the office yesterday.

[By placing “I” first, the author is emphasising who went to the office.]

Yesterday, I went to the office.

[By placing “yesterday” first, the author is emphasising when the trip to the office was made.]

# Writing a report

*Examples of plain English (not)*

**Before**

High-quality learning environments are a necessary precondition for facilitation and enhancement of the ongoing learning process.

**After**

Children need good schools if they are to learn properly.

# Writing a report

## Before

If there are any points on which you require explanation or further particulars we shall be glad to furnish such additional details as may be required by telephone.

## After

If you have any questions, please ring.

## Before

It is important that you shall read the notes, advice and information detailed opposite then complete the form overleaf (all sections) prior to its immediate return to the Council by way of the envelope provided.

## After

Please read the notes opposite before you fill in the form. Then send it back to us as soon as possible in the envelope provided.

# Writing a report

## Before

Your enquiry about the use of the entrance area at the library for the purpose of displaying posters and leaflets about Welfare and Supplementary Benefit rights, gives rise to the question of the provenance and authoritativeness of the material to be displayed. Posters and leaflets issued by the Central Office of Information, the Department of Health and Social Security and other authoritative bodies are usually displayed in libraries, but items of a disputatious or polemic kind, whilst not necessarily excluded, are considered individually.

Thank you for your letter asking permission to put up posters in the entrance area of the library. Before we can give you an answer we will need to see a copy of the posters to make sure they won't offend anyone.

**Finally**, if you thought those examples were bad, here's the longest sentence I've been able to find. It's a perfect example of just how complicated things can be if attention isn't paid to some of the simple suggestions made in this module. If you want to know how to write plain English, just do the exact opposite to everything shown in this example!

# Documents

Documents have both a *purpose* and an intended *audience*. Purpose is the intended outcome or result. For example, the purpose of a quotation is to inform the client of costs involved in a project. Audience is the intended or potential person/s who'll read the document. For example, the audience of a quotation is the client requesting the project.

Some documents have more than one purpose and more than one audience.

For example...

The purposes of a technical specification might be to ensure correct manufacture or to assist with repairs and/or maintenance. The audiences would include manufacturing staff, technicians and tradespersons.

The purposes of a tender document are to describe the capability of an organisation to complete a specified project, to outline the required budget, costs, time frames and other relevant information. The audience is the client financing the project or the project manager acting on their behalf.



# Documents

For each of these documents, write what you think the purpose and audience/s might be

Document	Audience/s	Purpose
Letter of demand		
Standard Operating Procedure		
Technical Specification		
Bill of Quantities		

# Language

## Formal language

Many workplace documents should be written in **formal** language. This is a style of writing very different than the casual tone of a letter to a friend or an email to a colleague. Formal language uses no slang or colloquialisms, does not contract words and has an impersonal tone.

Here is an example of a letter written in **informal** or **casual** language.

G'day Charlie. It was great to get your letter the other day. I'm glad to hear you're getting along OK in the new branch office.

Were you able to hire all the staff you needed or will you have to have another go at it? Don't forget I can come down and help out if you want.

Anyway, take care mate. See you later.

Sam Kronchite

# Language

Here is the same letter written in **formal** language.

Dear Charles,

Thank you for your letter of Wednesday 25<sup>th</sup> June. We were pleased to hear of your progress establishing the new branch office.

Please notify us of your progress with staff recruitment. I remind you that we're able to provide in-person support if necessary.

We look forward to your reply.

# Languages

**Colloquialisms** are slang terms or words only used in casual, everyday language.

**Contractions** are two words merged together such as it's (it is), who're (who are), can't (can not) or we're (we are).

Rewrite the following letter in a formal tone.

This guy, Ken Trent, dropped into the office last week sometime to see if we can do a job for him. He knows what he wants but needs someone to draw up the plans and get them checked out so the equipment and installation will meet all the regulations and stuff.

I reckon we should do the job even though it's not going to be much money for us. We did some work for him before, a big job, and I reckon we might get another big one out of him if we treat him right.

Can you let me know what your blokes are doing in the next week or so and if they can fit this in? I have to get back to Ken by the end of this week with some figures so be quick.  
OK?

# Word processing

This is a bullet list

- line one
- line two
- line three

This is a number list

1. item one
2. item two
3. item three
4. item four

This paragraph has been positioned two “tabs” from the margin. Note that all the lines in the paragraph have been moved - not just the first line.



# Title page

## Title Page

Your report should have a professional title page. Using the business logo or symbol adds credibility and promotes the organisation.

Sample Title Page



**A Comparison Of  
Programmable Logic Controllers  
from Supplier A and Supplier B**

for Kwan Ho

Director, Design Engineering

by

Frederick Bathstone

Electronics Engineer

August 2002

# Executive summary

## **Executive Summary**

A long report often includes a brief summary so that the reader can decide whether to read the whole document. The main point(s) of each section of the report should be included in this summary.

# Table of contents

## Table of Contents

The section headings of the report should be listed, using a consistent numbering system. Page numbers for each section should also be included.

### (SAMPLE) Table of Contents

Executive Summary	i
1.0 Introduction	1
2.0 The intended purpose for Programmable Logic Controllers (PLCs)	1
3.0 Characteristics of PLCs from Supplier A	2
3.1 Selected technical specifications	2
3.2 Special features	4
3.3 Price schedule	5
4.0 Characteristics of PLCs from Supplier B	6
4.1 Selected technical specifications	6
4.2 Special features	7
4.3 Price schedule	8
5.0 Comparison chart	9
6.0 Conclusion and recommendation	11
Appendix A - Full technical specifications	12

# Introduction

## **Introduction**

The introduction needs to include the purpose and scope of the report, background information, and an outline of the main points of the report.

# Body of report

## **Body of the Report**

Headings are used to divide the report into a logically organised presentation of the results of your investigation and research. The numbering system and headings should correspond to your table of contents.



# Conclusion, Recommendation, Bibliography, Appendices

## **Conclusion**

You need to draw conclusions based on the evidence you have presented in your report.

## **Recommendations**

Sometimes you'll be asked to make recommendations for further action. These should be specific, concrete actions based on the conclusions you have reached. If a recommendation can't be supported by the information and conclusions in the report - it should not be included.

## **Bibliography**

List the sources of information you have used to compile the report whether you have referred to them in the text or not.

## **Appendices**

You may need to attach (or append) extra information to your report. For example: technical data, specification sheets or a table of results. These appendices should be clearly labeled (for example 'Appendix A') and included in your bibliography.

# Using graphics

## *Using graphics*

Some workplace documents include information that can be displayed in the form of graphs and charts. For example, the following graph may be used to indicate the dollar value of contracts entered into by engineering teams in the three regions of the organisation.

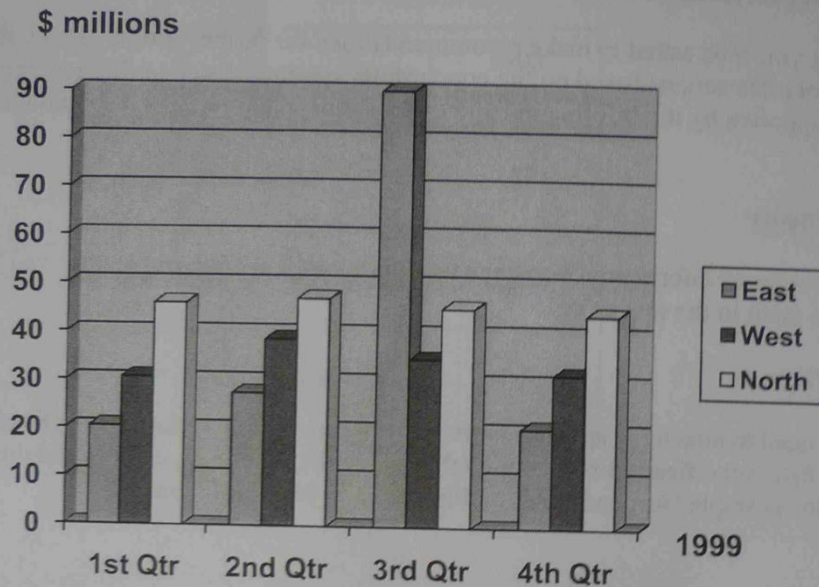


Figure 1 - Value of contracts entered into by engineering teams in 1999

# Writing consistently

## *Writing consistently*

Some documents are difficult to read, not because of the content, but because of the way they're written. To make a document easy to read you should take care with...

- the language used,
- the tone of the document,
- spelling, grammar and punctuation, and
- the structure of the document.

# Language Tone

## **Language**

One aspect of analysing your target audience is determining whether or not they're experts, technicians, executives or non-specialists. The amount of technical 'jargon' you use should vary to suit the audience. Obviously you can use more technical language if the primary audience is made up of experts. On the other hand, you need to limit the use of technical language if the audience is intended to be non-specialists.

## **Tone**

Another important aspect of a document is the tone. Some documents need to be quite formal. Others are more effective if they're kept friendly and casual. This was discussed in a previous section of this workbook.

# Spelling, Grammar ,Punctuation

## Spelling, Grammar and Punctuation

Spelling, grammar and punctuation are an integral part of writing whether you're a professional writer or just want to write a note to a colleague. Together they help get your point across effectively and focus attention on **what** you have to say instead of how you choose to say it. The following are absolute essentials to good writing that everyone should master.



# Agreement

*Agreement* – Agreement in a sentence refers to all of the parts of the sentence working well with each other. It's important that the subject of a sentence and the verb associated with it are both singular or both plural.

For example, you wouldn't say "John have two pieces of toast and I has three."  
You would instead say, "John has two pieces of toast and I have three."

# Tense

*Tense* – Tense refers to time. What time is it in your sentence? Whatever time it is, it should remain consistent throughout your whole piece of writing. If it was last week you are talking about, stay there. There are three tenses in writing, past tense, present tense and future tense.

Here is an example of writing with mixed tenses: “Julie wondered how she is going to finish in time, but Joe will help her.”

This sentence contains all three tenses. “wondered” = past tense, “is” = present tense and “will” = future tense. Pick a tense and stick to it! The sentence could read “Julie wonders how she will finish in time, but Joe will help.”

Find more information on “tense” at  
<http://www.shared-visions.com/explore/english/tense.html>

# Point of view

*Point of View* – The point of view refers to whoever is telling the story or “speaking.” When you write a letter you are writing in “first person” which includes I, me, my, we and our. Second person writing occurs when we talk about you and yours and third person includes he, she, they and theirs. In third person writing, the author does not put him/herself into the story.

Using the first and second person results in an informal, conversational tone in the document. The reader feels like you’re talking directly to them.

The third person results in a formal, objective and impersonal effect. This can add credibility to the document. Academic and business documents are usually written in third person.

Find more on “person” at  
<http://www.shared-visions.com/explore/english/person.html>

# Spelling

*Spelling* – Correct spelling is essential. Without it your document, and you, have very little credibility in the mind of the reader. Spell checkers on computer programs are poor substitutes for knowing how to spell and can leave behind more errors than you realize. There are many different forms of words and your spell checker doesn't know which form you wanted to use.

For example, "When Mark washed they're care, he forgot too putt on the wacks."

A spell check program wouldn't realise this sentence should read, "When Mark washed their car, he forgot to put on the wax."

# Run on sentence

*Run-On Sentences* – A run-on sentence is one that is just too long! Not only is it too long, it is incorrect. Usually, a run-on sentence can be made into two or more sentences by using better punctuation and style.

An example of a run-on sentence might be: “We walked over to the commissary to get something to eat but it was closed so we didn’t know what to do so we kept walking until we saw a restaurant and decided to go in and get something to eat but Andrew didn’t want to eat there so we kept going for another mile.”

This sentence could have gone on for another mile too! Break the sentence into smaller, more coherent parts.

Find out more at

[http://www.wisc.edu/writing/Handbook/CommonErrors\\_Sprawl.html](http://www.wisc.edu/writing/Handbook/CommonErrors_Sprawl.html)



# Punctuation, Usage

*Punctuation* – It is very important to know your punctuation; even if you never plan on using a semicolon for the rest of your life. The most important thing to learn is where to put your commas, a common mistake among writers. Avoid using commas after conjunctions like “but” and “and.” Commas are used to separate parts of sentences that stand alone, such as those that are parenthetical.

For example “There were too many flowers, not that I minded, but they took up most of the room.”

*Usage* – If you are going to use a word, you really ought to know how to use it. Some writers think big words look impressive but actually the reverse is true if the word is used incorrectly. Words don’t have to be big to be misused, consider its vs. it’s.

# Capitalisation

*Capitalisation* – Words at the beginning of sentences aren't the only ones worthy of capital letters. Always capitalise proper names such as people and places. Titles of all kinds deserve capital letters and so do acronyms.

Information on the correct use of capitals can be found at  
<http://writing.englishclub.com/caps.htm> or  
<http://www.shared-visions.com/explore/english/capital.html>

# Sentence Fragments, wasted Words

***Sentence Fragments*** – A sentence fragment is an incomplete sentence that does not include both noun and verb. An example of a sentence fragment might be, “Really dumb.” Make sure your sentences reflect a complete thought unless you are writing dialogue.

More on sentence fragments at  
[http://www.wisc.edu/writing/Handbook/CommonErrors\\_Frag.html](http://www.wisc.edu/writing/Handbook/CommonErrors_Frag.html)

***Wasted Words*** – A big no-no. Sometimes we throw in words just to round out our sentences, or we over-describe something, like, “The really complex spreadsheet program was on the E drive.” If the purpose of the sentence is to say where the spreadsheet was, you don’t need to point out that it was really complex. Economise your words and you’ll reduce the chance of grammatical errors.

Inflated words are also a problem in report writing. Find out about them at  
[http://www.wisc.edu/writing/Handbook/CCS\\_inflated.html](http://www.wisc.edu/writing/Handbook/CCS_inflated.html)

# Referencing

## *Referencing*

If you quote or paraphrase information from another source you need to “reference” it. Referencing means showing where the information that you quoted or paraphrased originally came from. It’s OK to use someone else’s words, ideas or information in your work but you must show that they are not your own by indicating their source.

One of the reasons we reference is to distinguish between our ideas and someone else’s. If you don’t acknowledge the work of others you may be accused of *plagiarism*.

Plagiarism occurs when you present someone else’s ideas, thoughts, information, etc, as if they’re your own. It’s plagiarism if you use someone else’s ideas and deliberately fail to acknowledge the source. It’s also plagiarism if you attempt to paraphrase or rewrite ideas in your own words but your ideas resemble the words or the original source too closely, or you don’t use indented quotations or “quotation marks” to indicate which words are yours and which ones are the words of others.



# Quoting

## Quoting the work of other authors/writers/sources

A quotation is where you put down the exact words of the original source. A quotation may be as short as one word but, if that word is significant, it must be put in quotation marks and referenced.

Quotations should include the exact words of your source inside quotation marks. For example:

"Everything we do is an experience of a kind." (Kenny 1996: 45).

If you look on page 45 in the book written by Kenny, published in 1996 you will find the words *Everything we do is an experience of a kind* with no alterations or omissions.

# Quoting

Sometimes a quotation is too long. When this is the case you can leave out a word or words by using an ellipsis. Here's an example.

## ORIGINAL

"In many academic circles in America, literary translation is still considered a secondary activity, mechanical rather than creative, neither worthy of serious critical attention nor of general interest to the public" (Gentzler 1993: 34).

## SHORTENED

"In many academic circles in America, literary translation is still considered a secondary activity . . . neither worthy of serious critical attention nor of general interest to the public" (Gentzler 1993: 34).



# Quoting

Sometimes it helps to make small alterations/clarifications to a quotation. In the following example the writer clarifies who "The engineers" are, and changes capital T to small to fit the writer's sentence structure.

## ORIGINAL

Smithson (1996) argues that, "The engineers never knew what good technical specifications were." (p.245).

## ALTERED

Smithson argues that "[t]he engineers [on the Clarke Brothers worksite] never knew what good technical specifications were." (1996: 245).

# Quoting

Where possible it's better to include quotations in your own sentence. In the following example the writer includes a quotation from Shilton in his/her own sentence. Notice how the quotation is altered to fit grammatically into the sentence. The writer has carefully chosen the point at which to start.

## ORIGINAL

"Everything we do adds to our experience." (Shilton 1994: 32).

## INCLUDED IN WRITER'S SENTENCE

It can be argued that "[e]verything we do adds to our experience." (Shilton 1994: 32).

# Quoting

If a quotation is included in your paragraph, it must be indicated with quotation marks (" . . ."). However, if you are using a long quotation it should be set in an indented block. Here's an example.

In Scandinavia, Canada, Tasmania, and the Snowy Mountains in mainland Australia, hydroelectric power is generated by running large volumes of water through low speed turbines. The water is collected at as high a level as possible in reservoirs. A power station is then built at a lower level. (Jenneson 1996:27)

# Quoting

Generally, quotations should be kept short and kept to a minimum (i.e. only use quotations when the words themselves are important). It is advisable to avoid using a large number of quotations as they mean you are letting your sources present ideas instead of you presenting your own.

# Paraphrasing

## Paraphrasing

Paraphrasing means putting another author's ideas or information into your own words. In the following example the writer has no need to use Tenn's exact words as it is his information (not his words) that are important. Paraphrasing also allows the writer to compare the author (Tenns) with another (Keffer).

### ORIGINAL

"This has led to the belief that the Macintyre method of measuring power factor is more accurate than calculation." (Tenns, 1991:54).

# Preparing the document

## *Preparing the document*

Documents need to be planned before they can be written. This is a relatively simple process. The steps involved are as follows.

Step	Task	Explanation
1	Decide the purpose of the document	Refer to Section 1 of this appendix. The purpose is the intended outcome or result. For example, the purpose of a quotation is to inform the client of costs involved in a project.
2	Determine who the audience/s is/are	Refer to Section 1 of this appendix. Audience is the intended or potential person/s who'll read the document. For example, the audience of a quotation is the client requesting the project.
3	Analyse the audience	Analysing the audience is necessary to adapt your writing to their needs, interests and background knowledge.



# Preparing the document

4	Plan the document	This is where you create the 'skeleton' of the document. Creating a list of bullet points or subheadings is useful. Under each you can make notes of the type of information required or references to check.
5	Draft the document	This first draft can be done by hand or word processor depending on your level of computing skill. The draft is a 'working document'. This means it can be changed and rearranged.
6	Check for accuracy of information	This is one of the most important steps. Its essential that all information in a workplace document is checked and the source noted in the bibliography.

# Preparing the document

Step	Task	Explanation
7	Format the draft	Formatting is where you use a word processing package to put in headings, subheadings, lists, page numbering and other 'structural' items.
8	Check for consistency in language, tone, grammar, and document structure	Refer to Section 6 of this resource booklet. It's very difficult to read reports that aren't consistent. Not only that, spelling, grammar and punctuation errors make the document appear unprofessional.
9	Edit and reformat	This is the time to make your corrections, improve the formatting and get it looking professional.

# Preparing the document

10	If possible, have another person check the document for accuracy and consistency	Time and time again it's been shown that having a second or third person look at a document will pick up errors. The author has seen it so often they don't see the mistakes.
11	Final edit and print	After fixing up the last mistakes, print the document out in its final form.

# Investigation

## Assessment task - Conduct an investigation and report on findings

To demonstrate competence you are required to research, analyse and interpret engineering data then use your findings as the basis of an engineering report. The report and the processes you use to prepare it should address the following criteria.

- Use the internet to obtain relevant data
- Prepare a report brief that investigates an engineering problem, issue or phenomena
- Design, conduct and report on an experiment to investigate a relationship between two variables
  - collect and analyse experimental results expressed in two variables, using technology as required
  - investigate a practical problem using correlation and regression

# Investigation

- Describe the statistical method and design chosen to meet the aim of the investigation
- Carry out the statistical analysis and report results
- Comment critically on choices of model and analyses resulting from them
- Evaluate and interpret the results of the investigation
- Discuss the investigation with reference to real world applications
- Describe the chronology of the investigation and reflect on the statistical process in journal
- Present a well formatted report with a clearly stated aim, method and conclusions



# Recommended websites

## Appendix 1 - Recommended websites

The following websites cover material related to this competency. The urls were valid as at June 2009.

- Engineering Technical reports – Colorado State University
- <http://writing.colostate.edu/guides/documents/ce-trpt/> - this is an excellent resource complete with a sample report including the comments from the assessor who graded it.
- Writing technical reports – Monash University
- <http://www.monash.edu.au/lis/llonline/writing/engineering/technical-report/index.xml>
- Guide to technical report writing – University of Sussex
- <http://www.sussex.ac.uk/engineering/1-3-11-2.html>
- Report Writing Style Guide – University of South Australia
- <http://www.unisa.edu.au/ltu/students/study/specific/report-engineering.pdf>
- Sample report – Midwest Electrical
- [http://www.midwestelectrical.com/resources/pdfs/mec\\_sample\\_engineering\\_report.pdf](http://www.midwestelectrical.com/resources/pdfs/mec_sample_engineering_report.pdf)



# Recommended websites

- Research Methods Knowledge Base <http://www.socialresearchmethods.net/kb/index.php>
- STEPS statistical glossary <http://www.stats.gla.ac.uk/steps/glossary/alphabet.html>
- OECD glossary of statistical terms <http://stats.oecd.org/glossary/>
- Introduction to descriptive statistics <http://www.mste.uiuc.edu/hill/dstat/dstat.html>
- (Electronic Version): StatSoft, Inc. (2007). Electronic Statistics Textbook. Tulsa, OK: StatSoft. WEB: <http://www.statsoft.com/textbook/stathome.html>
- SISA Simple Interactive Statistical Analysis <http://www.quantitativeskills.com/sisa/>
- Survey and questionnaire design – free online tutorial <http://www.statpac.com/surveys/index.htm#TOC>