NUMERACY ON THE LINE

Language Based Numeracy Activities for Adults

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Calculators - a tool to use

Purpose

The activities in this section are designed to build confidence in the use of calculators for simple computation. They are particularly aimed at people who have not learned mathematics in English or not used calculators before.

Often, when trying to learn about workplace calculations, people are unable to follow instructions given to them because they do not understand the words spoken.

Words to do with arithmetic such as add, multiply, subtract, divide are not often used in ordinary conversation. As a result many people have not acquired this vocabulary and are confused in mathematical learning situations. They cannot hear the words "divide by" and immediately find the correct calculator button. If they are unfamiliar with a calculator, as well as the related language, they tend to become anxious and subsequently do not learn about the calculator nor the particular process such as finding an average or a range.

These activities promote discussion of the arithmetic words, practice at hearing and speaking them and relating them to the appropriate calculator keys.
Background
The attitude of individuals towards calculators varies enormously. Some people feel uncomfortable using them, or some are reluctant to use them at all. On the other hand many people see calculators as a panacea to all their problems with mathematics, whilst yet others see their use as cheating.

Calculators offer a speedy way of doing calculations and as such are a very valuable tool that should be used. However, they in themselves do not teach understanding. As well calculators can vary from calculator to calculator in the way they operate. We believe it is important that trainees become both competent and confident in their use of calculators.

What to prepare
For each trainee you will need to make:
◆ a photocopy of the following sheets
   □ Key words
   □ Using your calculator
   □ Key words summary sheet
   □ Calculator symbols
   □ Listen and match
   □ Pressing work
   □ At home with calculators
   □ Calculators at work

For convenience you may need to make transparencies of:
□ Key words
□ Using your calculator
□ Listen and match
□ Listen and match - Trainer's Sheet

For each group of trainees have two labelled envelopes or plastic bags containing:
◆ Key word cards
◆ Hear it right!

Photocopy pages 13, 16 and 17 onto cardboard, two different colors if possible then cut these into separate cards.
Outline of section

Part 1
Key words and calculators

Develops understanding of common words for +, -, x, ÷, =, decimal points and zero. Links common 'key' words to the buttons/symbols on a calculator.

Part 2
Listen hear

Gives practice at hearing and saying mathematical words in English and relating them to the correct symbols on a calculator. Links hearing and saying mathematical statements to written statements.

Part 3
Further practice

Gives extra practice at using calculators. Uses work related questions.

END
Part 1: Key words and calculators

Activity - Key words

Put calculators on tables before the class begins.
Hand out Activity Sheet Key words and get trainees to look at the pictures, work out answers however they feel most comfortable, (with or without calculators) and to write their answers on the activity sheet beside the pictures.

Presentation

Using a transparency of this Activity Sheet and projecting the overhead projector onto a whiteboard is very effective for the discussion to follow. Otherwise draw four sections on the board. Begin with the top left of the sheet.

Possible questions to ask:
♦ What answer did you get for this?
♦ What did you do?
♦ What language did you think in?
♦ What were the words that you used in your first language?

To begin this, as you discuss some of the words they were 'thinking', ask for volunteers to write their own language word for this process on the board.

Do not push this too much if people are unwilling. Some will have forgotten the words because they have not used them for a long time, others may not have learned to write in their own first language. However, there are likely to be some people keen to contribute. Where possible, trainees should write their own language word.

Spend some time on discussion and comparison of words from all languages before going on.

The first part of this activity gives trainees a chance to show that they can instinctively do simple arithmetical calculations and to relate the operations they do to words and symbols used in English.

To validate their knowledge from their past, it is important to acknowledge words from trainees' first language and give them equal status during this discussion. Also to have them written on trainees' own record sheets.

Calculators - a tool to use  p.4  NAITB, Marr, Anderson & Tout, 1994
Possible questions:
Now point to the empty calculator button in this section and ask:
♦ What is the sign, symbol, or shorthand that will go on this calculator button?
♦ What sign or shorthand do we use instead of these words?
♦ How do you know which button to press on the calculator?

Go through the other sections of the activity sheet.
For each section, the class should:
• agree on the arithmetic answer
• briefly discuss some words
• agree on the symbol to place in the empty calculator key.

Trainees could sit in language groupings and decide themselves which words of their first language to put on their sheets.

Switch off the projector. Hand out envelopes of cut up symbols and words (one to each pair of trainees) - Key word cards.

Each pair should together arrange these on one of their sheets, placing the words and symbol cards in the correct sections.

After five minutes discuss their results and see if all agree on which English words and symbols go together.

Make sure they have heard you say the correct pronunciation and encourage all trainees to say the words aloud.

Give out the Key words summary sheet for trainees to take home - (advise them to pin it up somewhere where they will see it often.) Ask them also to write any other key words they had written before - especially those in their own language.
Activity

Hand out Activity Sheet *Using your calculator* (same illustrations but now more complex prices to ensure calculators are useful).

Ask trainees to calculate the answers, using their calculators this time, and write them down beside the picture again. Allow enough time for everyone to have a go at this - encourage trainees to help one another if the calculators are new to them.

Discussion

Begin with addition first. Again a transparency of this activity sheet projected on the board is useful. Ask for and compare trainees' answers. On the board (under the illustrations) write down the calculation as it would appear on paper.

\[ 59.95 + 32.49 + 19.60 = ? \]

Ask a few people to have a go at reading it aloud in English with particular focus on the words for plus, and saying the numbers correctly. (At this stage money expressions such as fifty-nine ninety-five are acceptable.)

Discussion - Introducing \[=\] \[\leq\] and \[\geq\]

Two further symbols which need discussion appear in the first problem. When you come to the = sign, discuss alternative English words used, particularly 'equals', 'is' and 'makes' and those in other languages if time permits.

Also in this problem, the answer, 112.04 contains a 'zero' or '0' - both ways of saying this should be mentioned. Make sure trainees see that it cannot be left out. Discuss different values of $112.04 and $112.4 (forty cents) if they do.

Secondly discuss the subtraction calculation because this leads to discussion of the decimal point outside of a money situation.
Again write out the calculation (or ask someone else to volunteer).

\[ 193 - 148.5 = ? \]

Encourage several people to read it aloud with particular focus on saying "one hundred and forty-eight point five" as well as the words "take away", "minus" or "subtract".

Discuss any other words used for the decimal point in English or other languages.

Also discuss other symbols which some people use eg. ‘,’. Acknowledge that it is not wrong, but that to be understood here in English, we need to use ‘.’ - pronounced point.

Locate the point on the calculator and get the class to practise two or three calculations that you read aloud.

\[
\begin{align*}
\text{eg.} & & 23.2 - 15.6 & & \text{Answer} & & 7.6 \\
& & 100 - 89.7 & & \text{Answer} & & 10.3 \\
& & 19.0 - 13.1 & & \text{Answer} & & 5.9
\end{align*}
\]

The multiplication example should be straightforward.

Division could lead to a longer discussion because it is important that the numbers are said in correct order.

\[ 119.10 \div 3 = ? \]

One hundred and nineteen divided by 3 or 3 into 119.10

Some people may use different symbols. It may be worthwhile discussing these.

\[
\begin{align*}
\text{eg.} & & \frac{119.10}{3} & & 3 \overline{119.10}
\end{align*}
\]
Let as many people as possible try to say these sentences out loud in English and make sure everyone has calculated them using the correct calculator keys.

If it has not already been done give out the **Key words summary sheet** for them to take home.

**Part 2: Listen hear**

Hand out Practice Sheet **Calculator symbols** which gives further practice on the key words used with calculators. You may need to explain the meaning of the word “double” as in double 0 double five, before they begin.

**Activity - Listen and match**

To each pair or person give one copy of Activity Sheet: **Listen and match**. Give trainees a moment to look at it before going on. Read aloud statement number 1, then allow time for them to

- find the statement on their sheet
- put 1. beside it
- write the correct symbol in the calculator key below the statement.

The purpose here is to connect the sounds to the words and the symbols, it would be best if people could do it individually. However, if necessary allow them to work in pairs. Check that everyone knows what to do and continue reading the numbered statements until all have been read out. The suggested order for this activity is provided on the **Listen and match - trainer’s sheet**, which is on page 17.

An overhead projection transparency of the Activity Sheet: **Listen and match** can be a helpful way to check at the end. Allow trainees to tell you which statements they chose for each number and which key they used for each statement.

Finish off by asking trainees to use their calculators to find an answer to each statement. They can check their answers using a transparency of the Trainers’ sheet.
**Activity - Hear it right!**

To each pair of trainees distribute a calculator and a pack of *Hear it right!* cards. The cards should be shuffled and placed between two people.

In each pair, have one trainee pick up a card and read out (but not show) the question in English. The other trainee is to enter it into the calculator and read out the answer. The trainee with the card listens and compares the answer read out to the written answer on the bottom of the card. If they agree, move on. If not, both should look at the card, review what was said and look for any mistake.

Have the trainees take turns reading a card and using the calculator until all cards have been used.

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**Part 3: Further practice**

Hand out Practice Sheet *Pressing work*. This Practice Sheet allows trainees to gain confidence in locating and using the calculator keys.

It needs to be started off in the class so you can assist with any difficulties but could be finished at home for practice.

One of the main things to watch is attention to the decimal points as some people tend to ignore them.

The importance of decimal points should be stressed in this exercise. Relating it to money or to measurements relevant to trainee's work should help.

*At home with calculators* and *Calculators at work* give further practice using calculators.
Your notes and ideas
Key words

How much?

Jacket $45
Shirt $30
Shorts $20

$3.00 each

190 cm
110 cm

$63? share between 3 people?

Calculators - a tool to use! — NAITB, Marr, Anderson & Tout, 1994 —
### Key word cards

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>and</strong></td>
<td><strong>difference between</strong></td>
</tr>
<tr>
<td><strong>add</strong></td>
<td><strong>multiply</strong></td>
</tr>
<tr>
<td><strong>plus</strong></td>
<td><strong>times</strong></td>
</tr>
<tr>
<td><strong>take away</strong></td>
<td><strong>by</strong></td>
</tr>
<tr>
<td><strong>subtract</strong></td>
<td><strong>divide</strong></td>
</tr>
<tr>
<td><strong>minus</strong></td>
<td><strong>into</strong></td>
</tr>
<tr>
<td><strong>is</strong></td>
<td><strong>makes</strong></td>
</tr>
<tr>
<td></td>
<td><strong>equals</strong></td>
</tr>
</tbody>
</table>
### Key words summary sheet

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Word</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>plus</td>
<td>add</td>
</tr>
<tr>
<td>×</td>
<td>times</td>
<td>multiply by</td>
</tr>
<tr>
<td>−</td>
<td>minus</td>
<td>take away subtract</td>
</tr>
<tr>
<td>÷</td>
<td>divide</td>
<td>into</td>
</tr>
<tr>
<td>0</td>
<td>zero</td>
<td>0</td>
</tr>
<tr>
<td>.</td>
<td>point</td>
<td></td>
</tr>
<tr>
<td>=</td>
<td>equals</td>
<td>makes is</td>
</tr>
</tbody>
</table>

Your words:

Your words:

Your words:

Your words:

- *Calculators - a tool to use!*  
  - *NAITB, Marr, Anderson & Tout, 1994*
Calculator Symbols

1. Write the symbol from your calculator in each square.

- **Add**: [ ]
- **Point**: [ ]
- **Zero**: [ ]
- **Subtract**: [ ]
- **Times**: [ ]
- **Multiply**: [ ]
- **Is**: [ ]
- **Minus**: [ ]
- **Take away**: [ ]
- **Plus**: [ ]
- **By**: [ ]
- **0**: [ ]
- **Divide**: [ ]
- **Makes**: [ ]
- **Equals**: [ ]
- **Into**: [ ]

2. Fill in the blank squares. (You may not have to use all the squares each time.)

- **Zero point six**: [ ] [ ] [ ] [ ] [ ]
- **Point 0 five**: [ ] [ ] [ ] [ ] [ ]
- **Double 0 double one**: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]
- **One point 0 seven**: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]
- **Double 0 eight**: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]
- **Ten point 0 three**: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

Calculators - a tool to use  
NAITB, Marr, Anderson & Tout, 1994
Listen and match

Write down the symbol (+, -, x or ÷) you would use on the key below each statement.

24.6 divided by 3

35.5 subtract 24.6

35.5 add 24.6

24.6 times 3

24.6 plus 35.5

3 into 24.6

35.7 minus 24.6

35.5 take away 24.6

3 by 24.6

multiply 246 by 3
Listen and match- trainer's sheet

Read out the questions in the order given below. Correct the answers with the group afterwards.

1. 35.7 minus 24.6  \[ \boxed{11.1} \]
2. 24.6 plus 35.5  \[ \boxed{60.1} \]
3. 24.6 divided by 3  \[ \boxed{8.2} \]
4. 35.5 take away 24.6  \[ \boxed{10.9} \]
5. 35.5 add 24.6  \[ \boxed{60.1} \]
6. 24.6 times 3  \[ \boxed{73.8} \]
7. 3 by 24.6  \[ \boxed{73.8} \]
8. multiply 246 by 3  \[ \boxed{738} \]
9. 35.5 subtract 24.6  \[ \boxed{10.9} \]
10. 3 into 24.6  \[ \boxed{8.2} \]
<table>
<thead>
<tr>
<th>Expression</th>
<th>Answer</th>
<th>Pronunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$12.6 \times 3.7$</td>
<td>$46.62$</td>
<td>Forty six point six two</td>
</tr>
<tr>
<td>$0.09 \times 15$</td>
<td>$1.35$</td>
<td>One point three five</td>
</tr>
<tr>
<td>$84.09 - 57.6$</td>
<td>$26.49$</td>
<td>Twenty six point four nine</td>
</tr>
<tr>
<td>$58.07 + 23.9$</td>
<td>$81.97$</td>
<td>Eighty one point nine seven</td>
</tr>
<tr>
<td>$273.1 + 302$</td>
<td>$575.1$</td>
<td>Five hundred and seventy five point one</td>
</tr>
<tr>
<td>$600.1 - 493.6$</td>
<td>$106.5$</td>
<td>One hundred and six point five</td>
</tr>
<tr>
<td>$52.1 \div 4$</td>
<td>$13.025$</td>
<td>Thirteen point zero two five</td>
</tr>
<tr>
<td>$72.08 \div 0.5$</td>
<td>$144.16$</td>
<td>One hundred and forty four point one six</td>
</tr>
</tbody>
</table>
### Hear it right!

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Answer</th>
<th>Pronunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$15.63 + 18.42$</td>
<td>$34.05$</td>
<td>Thirty four point zero five</td>
</tr>
<tr>
<td>$54.6 \times 1.7$</td>
<td>$92.82$</td>
<td>Ninety two point eight two</td>
</tr>
<tr>
<td>$20.4 - 17.39$</td>
<td>$3.01$</td>
<td>Three point zero one</td>
</tr>
<tr>
<td>$24.5 \div 16$</td>
<td>$1.53125$</td>
<td>One point five three one two five</td>
</tr>
</tbody>
</table>
Pressing work

Use a calculator to find the answer to each problem. Then, find your answer at the bottom of the page.

1. 12.4 + 25.8 = 
2. 63.58 + 47.06 = 

3. 29.53 - 14.88 = 
4. 48.6 - 29.73 = 

5. 8.7 \times 6 = 
6. 12.4 \times 0.7 = 

7. 19.6 \div 14 = 
8. 2.56 \div 1.6 = 

9. 19.07 + 8.98 = 
10. 583 - 489 = 

11. 254 + 187 = 
12. 17 \times 23 = 

13. 7350 \div 24.5 = 
14. 100.70 \div 19 = 

15. 4.3 \times 2.07 = 
16. 200.07 - 108.09 = 

MIXED UP ANSWERS

<table>
<thead>
<tr>
<th>14.65</th>
<th>94</th>
<th>18.87</th>
<th>1.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>110.64</td>
<td>1.4</td>
<td>5.3</td>
<td></td>
</tr>
<tr>
<td>8.68</td>
<td>28.05</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>91.98</td>
<td>8.901</td>
<td>52.2</td>
<td></td>
</tr>
<tr>
<td>441</td>
<td>38.2</td>
<td>391</td>
<td></td>
</tr>
</tbody>
</table>

Calculators - a tool to use! — NAITB, Marr, Anderson & Tout, 1994 — p. 20
At home with calculators

Use a calculator to answer the questions. Find the answer from the list.

1. Bill bought an air filter for $11.45 and oil for $12.85. What was the total cost?

2. How much did Joe save when he bought the washing machine on special?

3. Mario bought 4 new tyres at $83.95 each. What is 4 times $83.95?

4. Ivan bought 5 kg of potatoes for $8.00. How much did he pay for each kg?

5. Dave cut a 2.05 m piece of wood down to 1.76 m. How much did he cut off?

6. A bag of 36 chocolate bars is shared between 8 children. How many bars does each child get?

ANSWERS:

<table>
<thead>
<tr>
<th>49.95</th>
<th>0.29</th>
<th>1.60</th>
<th>24.30</th>
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<tbody>
<tr>
<td>335.80</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculators - a tool to use — NAITB, Marr, Anderson & Tout, 1994
Calculators at work

Use a calculator to answer the questions. Find your answer from the list.

1. Joe earns $661.80 per week. His partner Anne earns $705.50 per week. What is the total per week?

2. 28 workers make an average of 57 car parts each per week. How many is this in total?

3. 12 workers make a total of 315 parts in a day. About how many each is this?

4. This is part of Bill's pay slip. What is his net pay?

5. For 45 hours work Nunzio earned $636.75. What did he earn per hour?

6. Charlie now earns $470.60 per week. Previously he earned $441.30. How much more does he earn now?

ANSWERS:

1596 26.25 1367.30 14.15 747.88 29.30
### Pressing work

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<td>1</td>
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<td>2</td>
<td>110.64</td>
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<tr>
<td>3</td>
<td>14.64</td>
</tr>
<tr>
<td>4</td>
<td>18.87</td>
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<td>5</td>
<td>52.2</td>
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<td>6</td>
<td>8.68</td>
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<td>1.4</td>
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<td>1.6</td>
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<td>9</td>
<td>28.05</td>
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<td>10</td>
<td>94</td>
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<td>11</td>
<td>441</td>
</tr>
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<td>12</td>
<td>391</td>
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<td>15</td>
<td>8.901</td>
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<td>16</td>
<td>91.98</td>
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</table>

### At home with calculators

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<thead>
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<tbody>
<tr>
<td>1</td>
<td>$24.30</td>
</tr>
<tr>
<td>2</td>
<td>$49.95</td>
</tr>
<tr>
<td>3</td>
<td>$335.80</td>
</tr>
<tr>
<td>4</td>
<td>$1.60</td>
</tr>
<tr>
<td>5</td>
<td>0.29 m</td>
</tr>
<tr>
<td>6</td>
<td>4.5 bars</td>
</tr>
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</table>

### Calculators at work

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<tbody>
<tr>
<td>1</td>
<td>$1367.30</td>
</tr>
<tr>
<td>2</td>
<td>1596 parts</td>
</tr>
<tr>
<td>3</td>
<td>26.25 parts</td>
</tr>
<tr>
<td>4</td>
<td>$747.88</td>
</tr>
<tr>
<td>5</td>
<td>$14.15</td>
</tr>
<tr>
<td>6</td>
<td>$29.30</td>
</tr>
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*Calculators - a tool to use*
Decimals - what's the point?

Purpose

This is the first of two sections on decimals and this section concentrates on the first decimal place. The activities in this section are designed to clarify many aspects of decimal numbers. Part 1 looks at the meaning of the decimal point drawing on trainees' common sense and prior knowledge. Part 2 introduces rounding off decimals. The remaining part covers reading, writing, and saying decimals; how they relate to fractions; and reading and plotting decimal numbers on scales in the context of measurement and graphs.
Background

The first activity uses a story set in a familiar context, with everyday quantities, so that trainees can begin by finding out what they already know about placing decimal points. Beginning mathematical ideas with things people know about, makes them feel comfortable and confident to go on and learn further skills.

The first part of this activity is done in pairs or small groups. There are many reasons for this:

♦ it involves people actively at the beginning of the session rather than the trainer doing most of the talking;
♦ it is less threatening for most people than starting off alone;
♦ talking and discussing are effective ways of learning;
♦ there is a chance for the class members to share what they know with each other;
♦ people in the class who don't know where to start will not feel stupid or left out;
♦ it gives the trainer a chance to find out what people know, early in the session, rather than assuming they know nothing.

What to prepare

For each trainee you will need:

♦ a copy of the following Practice and Activity Sheets

  □ Dials, gauges and scales
  □ It was one of those days
  □ Sensible numbers
  □ Looking at tenths
  □ Scales
  □ Temperature
  □ Bill's drive to work
  □ Button Industrial Estate
  □ Dicing with decimals - game 1
  □ Dicing with decimals - game 2

Optional

Make an overhead projection transparency of each of the following sheets:

□ It was one of those days
□ Temperature
□ Scales
□ Tenths grid

Equipment needed

Dice (6 or 10 sided) - see Dicing with decimals
Outline of section

Review: Dials, gauges and scales

Were trainees able to complete most of this activity?

Yes

Part 1
Decimals - What's the point?

No

Similar examples need to be practised until the group is confident with reading scales before proceeding.

Part 1
Decimals - What's the point?

Shows the necessity and the meaning of the decimal point.

Part 2
Using sensible numbers

Introduces, and provides practice of, rounding off decimals to whole numbers.

Part 3
The first decimal place

The concepts of tenths is shown in diagrammatic form, 0.9 is linked to 9/10, and plotting of tenths on a scale is practised.

END

The next section on decimals, Decimals - further places, looks at the second and third decimal places, hundredths and thousandths.
Part 1: What’s the point?

Review - Dials, gauges and scales

Ask trainees to pair up with someone they feel comfortable with. (Use small groups of 3 - 4 if you prefer). Hand out Activity Sheet: *Dials, gauges and scales*

Ask them to work through the sheet and check their progress as you move around the room. Use this activity to decide whether the trainees are competent at reading whole number scales, before progressing onto the rest of the section. Give further practice if necessary.

Activity - It was one of those days

To each pair or group give one copy of *It was one of those days*. Give them a chance to look at it before going on. If the reading level of the group is not good it will be helpful to read the first sentence aloud while the trainees follow it on the page.

Ask:

♦ Can you see something strange in the first sentence?

Hopefully, someone will say that he is far too tall, or the engine is too big. Say that it doesn’t make sense because there aren't any decimal points.

Ask:

♦ Can you fix the whole story by putting them in?

Give the pairs or groups a few minutes to do this before discussing their responses. (If necessary read the whole story aloud, stopping at each quantity as you go.)

Discussion may lead to some explanations of car engine size: many adults don’t know that 3.9 litres is the total volume of the cylinders of a car.

Most of the items should be general knowledge to some people in the class. So when you go through the story let individuals supply the correct answers, rather than giving them yourself. (See below for the most likely solution.)

The story can be used to introduce some metric units, such as how big is a litre? How tall is 1.92 metres? How tall are members of the class? You could measure everyone later, as practice.
If class members get stuck with the size of the petrol tank, help them use calculators to experiment with the price of petrol times size of tank, until they come up with a likely price to pay, compared to filling the tank on their own cars. Make sure everyone is satisfied about where to put the points.

**Now ask:**

♦ What does the decimal point actually do?

**Answers to It was one of those days.**

*Bill who was 1.92 metres high was excited about picking up his bright new red car with its 3.9 litre engine.*

The first problem was the weather, it was a hot day. Bill, all hot and sweaty, got to the car dealer and handed over his cheque for $21999.00. Then he started the short, ten minute drive home, 7.6 km away.

Bill tried to tune his new radio into FOX 101.9 FM but found he could only get AM stations. He heard the temperature was 38.7 °C.

Just then the car spluttered to a stop - it was out of petrol.

Bill was embarrassed to be pushed into his local service station by the small 52.5 kg woman, who was the only person to stop and help him. After quickly thanking her, he filled the car right up with 65.78 litres of petrol at 69.8 cents per litre and angrily paid $45.91.

To cool down Bill bought a 1.25 litre bottle of Coke.
Part 2: Using sensible numbers - rounding off

Ask:
♦ If Bill was telling a friend how much he paid for the car, what would he be likely to say?

Discuss with the class how people usually talk about numbers.

With trainees working in their small groups or pairs -

Ask:
♦ If you were to rewrite the story without decimal points, how would the numbers be written to be the most dramatic but still accurate?

Alternatively, ask:
♦ Suppose you didn’t have a ‘.’ on the typewriter, how could you use whole numbers to keep the facts true but interesting?

When they are doing this encourage the trainees to talk a lot and exchange ideas. Saying kilometres and kilograms in full should be stressed in order to practise the language aspects of metric measurement. Also encourage trainees to use common sense, and appropriate real language to give responses such as:

Bill is nearly 2 metres tall (very tall)
His car’s engine is almost 4 litres
He paid 22 thousand dollars ($22,000)
He lived about 8 kilometres away.

We can’t really round off 101.9 but to find it on the dial we would look at about 102.

The temperature was almost 40°C.

People usually try to keep stories interesting by rounding off - this makes it easier to get an idea of how big the amount is, such as saying 'twenty-two thousand dollars' instead of giving the exact price of $21,999.
The small woman: 52.5 kg could be called 52 1/2 kilograms or rounded up to 53 kilograms. (Mention that it is common practice to round up to the next whole number when at a half or more).

He put about 66 litres of petrol in.
Petrol cost nearly 70 cents per litre.
Bill paid almost $46.

The large coke was over a litre. (Notice that for decimals less than one half (.5) we tend to round down.)

The Practice Sheet Sensible Numbers can now be used to reinforce these ideas either in class or at home. However, make sure that you discuss the choices of words with the group afterwards. There are no unique correct answers but choices such as 'just over' or 'just under' would be inappropriate in some cases.

Part 3: The first decimal place

Presentation

Ask:
♦ Which numbers in It was one of those days had only one number after the decimal point?

Write these down on the board:
3.9, 7.6, 101.9, 38.7, 52.5, 69.8

Circle the numbers after the decimal point:
3.9 7.6 101.9 38.7 52.5 69.8
saying that we call this the first decimal place.

Ask:
♦ What do these numbers after the decimal point mean?
♦ How do you say these numbers?
Draw the following grid on the board or use a transparency of the grid supplied on page 36.

![Grid]

Ask:
- Can we show .9 on this grid?
- How many strips do we have to shade in?

When you have shaded 9 out of the 10 spaces ask:
- How can we write 9 out of 10?
- How do you say it?

On the black board write:

\[
\begin{align*}
9 \text{ out of } 10 &= \frac{9}{10} \\
\text{said as nine tenths}
\end{align*}
\]

Refer back to the numbers on the board 3.9, 7.6, etc. and ask class members to say them aloud both ways. So they would verbalise both:

- 3.9 - three point nine
- \(3 \frac{9}{10}\) - three and nine tenths.

Write some other numbers with one decimal place, such as 5.7, 22.3, 19.6, on the board and get trainees to take turns to read them out loud - again encourage saying them as decimals: 'five point seven', and as fractions: 'five and seven tenths'.

Also ask them to write the numbers in mixed fraction form:

\[
5.7 = 5\frac{7}{10}
\]

Hand out the Practice Sheet: *Looking at tenths.*
Activity - Scales

Hand out Practice Sheet: Scales
Together look at the first example 3.9 which is done for them. If necessary draw the scale roughly on the board or use an overhead projector transparency of the worksheet.

Once this is understood ask trainees to plot the other 5 decimals on the appropriate scales.

Some trainees might have difficulty with the graduations on scales. You may need to go through this carefully and provide further numbers such as 51.1, 70.3 etc. for them to plot until they are confident.

Hand out Practice Sheet: Temperature which gives further practice at plotting and reading scales. It can be used as a class activity or as a take home exercise to reinforce plotting on scales.

Activity - Bill's drive to work

Hand out Activity Sheets: Bill's drive to work and Button Industrial Estate.
Get trainees to work in pairs through each of the questions. By walking around, listening and observing, check that trainees understand the mathematical content involved.

Activity - Dicing with decimals

You could play the games Dicing with decimals - games 1 and 2. These games are designed to increase trainees' understanding of decimal place value, enhance their skills at estimation with decimals, and to provide a quick chance to teach or revise addition of decimals.

They can be introduced at any time after the introduction to the first decimal place, and would probably be best suited to be used in the first or last 10-15 minutes of a session to begin or finish it in a positive way.

The main point here is that to plot tenths, you need to divide each whole number part into ten equal bits. Trainees should be encouraged to take time to examine the scale to find out if it is marked out in .1 intervals or .2 intervals before plotting the measurement.
The games can be played with either a normal 6 sided dice or a 10 sided dice. (10 sided dice can be found in most games shops. They are good mathematical tools because they have all of the digits from 0 to 9.)

Game 1
To each trainee hand out a copy of Game 1. Explain that the aim of the game is to get a total as close to, but not more than 9.9. A score greater than 9.9 will put you out of that game or as they say in 'pontoon' or '21' you have gone 'bust'.

Read out the procedure for the game:

♦ I will toss the dice once.
♦ You have to write the number in the first line in the space you choose, either before or after the decimal point.
♦ I will toss the dice again and we will repeat the process until you have seven numbers written.
♦ Now add the numbers to find your total.
♦ If you are over 9.9 you are out or bust.
♦ The closest total to 9.9 is the winner.

On a sheet of four games the first one could be used for a practice round. The other three games then can be used competitively - with a winner decided each game.

Extension
To include subtraction skills in the game you can get an overall score for three games as follows.

For each game, every player subtracts their total from 9.9. In other words they find the difference between their total and 9.9. This becomes the score for that game.

At the end the three scores are added, and the person with the lowest score wins.

A person who has 'busted' in a game cannot be an overall winner but may be a winner of individual games.
Examples of the play are shown below:

A six sided die was used.

<table>
<thead>
<tr>
<th>Number rolled</th>
<th>Player A</th>
<th>Player B</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

Target 9.9  Target 9.9

Player A went out or bust  Player B wins

Optional:
Player B has a score of 9.9
- 8.3
1.6

Score is 1.6

Game 2
Hand out a copy of the game sheet to each person.

Explain the rules of the game:

♦ This time I will toss the dice 6 times.
♦ Each time I toss it you have to fill in one space in the grid.
♦ This must be done before the dice is tossed again.
♦ The space you fill can be anywhere above the double line - this time it doesn't need to be line 1, then line 2 etc.
♦ At the end of 6 tosses all of the spaces should be filled in.
♦ Now all the numbers should be added as in game 1.
♦ If you are over 9.9 you are out.
♦ The closest to 9.9 wins the round.
**Extension**

Scores can be worked out as in game 1 - the difference between your total and 9.9 is your score.

Examples of play are shown below. A six sided dice was used.

<table>
<thead>
<tr>
<th>Numbers rolled</th>
<th>Player A</th>
<th>Player B</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,5,3,2,1,1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

**Target 9.9**

Optional Score

9.9

-9.7

0.2

Optional Score

9.9

-7.0

2.9

Player A wins the round with the lowest score of .2

**Your notes and ideas**
Dials, gauges and scales

Can you read these?

1. ______ litres
2. ______ volts
3. ______ °C
4. ______ kPa
5. ______ °C
6. ______ mg
7. ______ watts
8. ______ kg
9. ______ RPM

Decimals - what's the point? — NAITB, Marr, Anderson & Tout, 1994 — p.13
Bill who was **192 metres** high was excited about picking up his bright new red car with its **39 litre** engine.

The first problem was the weather, it was a hot day. Bill, all hot and sweaty, got to the car dealer and handed over his cheque for **$2199900**. Then he started the short, ten minute drive home, **76 km** away.

Bill tried to tune his new radio into **FOX 1019 FM** but found he could only get AM stations. He heard the temperature was **387 °C**.

Just then the car spluttered to a stop - it was out of petrol.

Bill was embarrassed to be pushed into his local service station by the small **525 kg** woman, who was the only person to stop and help him. After quickly thanking her, he filled the car right up with **6578 litres** of petrol at **698 cents per litre** and angrily paid **$4591**.

To cool down Bill bought a **125 litre** bottle of Coke.
Sensible Numbers

Make a new sentence for each statement using whole numbers - no decimals.

Choose from:

<table>
<thead>
<tr>
<th>about</th>
<th>nearly</th>
<th>almost</th>
<th>approximately</th>
</tr>
</thead>
<tbody>
<tr>
<td>just over</td>
<td>just under</td>
<td>a bit over</td>
<td></td>
</tr>
</tbody>
</table>

Example:

Rump steak was $7.95 per kilo.

*A kilo of rump steak was almost $8.00.*

1. Swiss cheese was $5.99 a kilo.

*A kilo of swiss cheese was ___*

2. Carlos weighed himself. He read 71.6 kilograms.

*Carlos weighs ___*

3. The trip meter of my car showed 22.2 kilometres to Ford.

*My trip to Ford was ___*

4. Michelle’s new jacket cost $45.90.

*The jacket cost ___*

5. The stop watch read 38.2 minutes to machine a part.

*It takes ___*
Looking at tenths

1. Give the fractions that are shaded in each of the grids.

   ![Grids]
   a. Shaded area: \( \frac{10}{10} = 0.\_ \)
   b. Shaded area: \( \frac{10}{10} = 0.\_ \)
   c. Shaded area: \( \frac{10}{10} = 0.\_ \)

2. Shade the fraction in on the grid or circle.

   a. Shade in: \( \frac{0.6}{10} \)
   b. Shade in: \( \frac{8}{10} = 0.\_ \)
   c. Shade in: \( \frac{10}{10} = \_ \)
   d. Shade in: \( \frac{1.2}{10} = 1\frac{1}{10} \)
   e. Shade in: \( \frac{2.6}{10} = 2\frac{1}{10} \)

3. Use a calculator to find:

   a. \( \frac{9}{10} \) is the same as: \( \frac{9 + 10}{10} = \_ \)
   b. \( \frac{16}{10} \) is the same as: \( \frac{16 + 10}{10} = \_ \)

Decimals - what’s the point? — NAITB, Marr, Anderson & Tout, 1994
Mark on the scales these numbers: 38.7, 7.6, 101.9, 52.5, and 69.8. 3.9 is done as an example.
Temperature

1. The average daily temperature during April was **twenty three point one °C**. Write this temperature in figures.

   _______________

2. Ludmilla had her temperature taken.
   The thermometer looked like:

   ![Thermometer Image]

   What was her temperature? ________________

3. For what temperature is this thermostat set?

   ![Thermometer Image with Setting Indicated]

   Setting: ________________

4. A comfortable room temperature is **20.8°C**.
   Show this on the thermometer.

   ![Thermometer Image with 20.8°C Marked]

5. A summer temperature was **32.7°C**.
   Show this on the thermometer.

   ![Thermometer Image with 32.7°C Marked]
Bill's drive to work

Bill works at the Button Car Company. Use the map Button Industrial Estate to answer the following questions.

1. Bill turns right from Marr Road and heads north along David Drive. How far is it from Marr Road to these spots?
   a. The picnic and sports ground entrance. 1.5 km
   b. The road into the Durable Tyre Co.
   c. Anderson Street.
   d. The Button Car Factory entrance.
   e. The Club Hotel exit.

2. Now write your answers to 1 in fractions.
   a. 1.5 = 1\frac{5}{10}
   b. 
   c. 
   d. 
   e. 

3. How far is it between the following spots?
   a. From St. Johns to the Button Car Factory.
   b. From the Club Hotel exit to Anderson Street.
   c. From the Picnic and sports ground to the Button Car Factory entrance.
Button Industrial Estate

ACTIVITY SHEET

The Button Car Factory

St. John's

Snackers Food Bar

Joe's Self Serve Petrol Station

Decimals - what's the point? NAITB, Marr, Anderson & Tout, 1994

p. 20
Tenths grid
Dials, gauges and scales

1. 15 litres  
2. 14 volts  
3. 27°C  
4. 170 kPa  
5. 75°C  
6. 40 mg
7. 26 watts  
8. 54 kg  
9. 750 RPM  
10. 450 mL  
11. 440 grams  
12. 1380 cc

Sensible numbers
Different words could be used. The answers should be discussed as a group.

1. $6 a kilo
2. 72 kilograms
3. 22 kilometres
4. $46
5. 38 minutes

Looking at tenths

1. Give the fractions that are shaded in each of the grids.
   a. Shaded area: \( \frac{3}{10} = 0.3 \)
   b. Shaded area: \( \frac{7}{10} = 0.7 \)
   c. Shaded area: \( \frac{5}{10} = 0.5 \)

2. Shade the fraction in on the grid or circle.
   a. Shade in \( \frac{6}{10} = 0.6 \)
   b. Shade in \( \frac{8}{10} = 0.8 \)
   c. Shade in \( \frac{10}{10} = 1.0 \)
   d. Shade in \( 1.2 = 1\frac{2}{10} \)
   e. Shade in \( 2.6 = 2\frac{6}{10} \)

3. Use a calculator to find:
   a. \( \frac{9}{10} \) is the same as \( 0.9 \)
   b. \( \frac{13}{10} \) is the same as \( 1.3 \)

Scales

Mark on the scales these numbers: 3.9, 7.6, 10.9, 52.5, and 69.8
3.9 is done as an example.
Bill's drive to work

1. b. 2.7 km  c. 5.5 km  
   d. 4.4 km  e. 2.3 km

2. b. 2 \frac{7}{10}  c. 5 \frac{5}{10}  
   d. 4 \frac{4}{10}  e. 2 \frac{9}{10}

3. a. 3.4 km  b. 3.2 km  
   c. 2.9 km

---

### Temperature

**Practice Sheet**

1. The average daily temperature during April was twenty three point one °C. Write this temperature in figures.
   
   \[23.1^\circ C\]

2. Ludmilla had her temperature taken. The thermometer looked like:

   What was her temperature? \[39.7^\circ C\]

3. For what temperature is this thermostat set?

   ![Thermostat setting](image)

   Setting: \[19.3^\circ C\]

4. A comfortable room temperature is 20.8°C. Show this on the thermometer.

   ![Thermometer showing 20.8°C](image)

5. A summer temperature was 32.7°C. Show this on the thermometer.

   ![Thermometer showing 32.7°C](image)
This is the second section on decimals. It introduces the second and third decimal places in two parts which cover: reading, writing, and saying decimals; how they relate to fractions; comparing their values; and reading and plotting decimal numbers on scales in the context of measurement and graphs.
**What to prepare**

For each trainee you will need:
- a copy of the following Practice and Activity Sheets
  - Looking at hundredths
  - How tall is 1.92 metres?
  - Paint thickness
  - Hundredths - the second decimal place
  - Data sheet
  - Rounding off
  - Reading thousandths
  - Decimal place value chart
  - Dicing with decimals - game 3

For each group of 3 or 4 trainees:
- photocopy **Double zero three and nine activity**, part 1 and part 2. It is preferable to photocopy them onto a different coloured card for each page. Cut the pieces up and place into envelopes or plastic bags labelled:
  - Double zero three and nine - part 1
  - Double zero three and nine - part 2

- prepare separate labelled envelopes or plastic bags containing one set of the cut up cooperative logic activities and a set of the digits from page 28:
  - What's the number? - 1, 2, 3 and 4
  - What's the number? - numbers

It is best to photocopy each of these activities onto different coloured cardboard.

**Optional**

Make an overhead projection transparency of each of the following sheets:
- Paint thickness
- 100 square grid

**Equipment needed**

Dice (6 or 10 sided) - see **Dicing with decimals**
Tape measures - see **How tall is 1.92 metres?**
Outline of section

Section: Decimals - What's the point?

Were trainees able to complete most of the activities in the section?

Yes

Part 1
The second decimal place

Introduces the first decimal place - tenths. Needs to be completed before starting this section.

No

Similar examples need to be practised until the group is confident with tenths.

Part 2
The next decimal place

Looks at hundredths as decimals, fractions, and plotted on scales. Also compares decimals such as .28 and .3

Part 3
All three together

Looks at thousandths, and puts together the three decimal places, including the use of place value charts.

Uses a group activity and cooperative logic problems to review the skills and knowledge covered in the two decimals sections.

END
Part 1: The second decimal place

Presentation

Get trainees to refer back to *It was one of those days* from *Decimals - What's the point?*

Ask:
◦ Which numbers in this have two figures after the decimal point?

Write these on the board:

1.92  21999.00  65.78  45.91  1.25

Ask:
◦ How do you say these?
◦ Remember that 3.9 can be said as "three and nine tenths"
◦ Can you say these numbers as fractions?

Discuss the different ways of saying and writing these.

1.92 - one point nine two
or
1 2/100 - one and ninety two hundredths.

Discuss that the second decimal place indicates hundredths, written as 1/100ths eg. 2/100 is two hundredths which has a much smaller value than two tenths.

Using your transparency refer back to the grids from the tenths exercise.

Ask:
◦ How could we show 1/100 on this grid?
◦ How many squares would we need?

Encourage trainees to use 'ninety-two hundredths' as well as 'point nine two'.

Hopefully trainees will tell you that you would need to divide the strips into 10 pieces as well.
Draw a 100 square grid on the board or use one on an overhead projector transparency (see page 15).

Ask trainees to explain how you could use this grid to show \( \frac{1}{100}, \frac{2}{100}, \frac{92}{100} \) etc. (shading in 1, 2, 92 out of 100 spaces).

Ask trainees to use question 1 on the Practice Sheet: 
*Looking at hundredths* to shade in the decimal parts of the other numbers on the board .78 .25 .91

Also get them to write the number as a fraction in the space below the grids. Similarly they should do question 2, writing the decimals in fraction form.

As a group go through their responses to the first two questions on the sheet and ask them to say the numbers aloud both in decimal and fraction form.

**Ask:**
- Why shouldn't you say point "twenty-eight?"

**Now ask:**
- What would a number like .03 look like on the grid?
- What fraction is it?
- Is the zero important?
- Why?

Ensure that everyone understands that .03 is \( \frac{3}{100} \) and that it is much smaller than \( \frac{3}{10} \). Compare on the 100 grids if necessary.

Trainees should complete the Practice Sheet by shading in the .03, .09, and .20 examples, and writing out questions 3 and 4 as fractions.
To finish off, write some more numbers with one and two decimal places, such as 6.28, 5.4, 15.73, 11.06, 40.5 on the board, and get trainees to take turns to say them out loud - encourage them to say them as digits, "six point two eight" and as fractions, "six and twenty-eight hundredths, or five and four tenths."

As they do this ask them also to write them down as fractions. eg. $6\frac{28}{100}$, $5\frac{4}{10}$, and to make a rough sketch of them using a quick grid. Drawing a grid for themselves as a final step will reinforce the difference between tenths and hundredths and allow you to see if the group members really have understood the concepts.

**Activity - How tall is 1.92 metres?**

**Say:**
Remember Bill from the *It was one of those days* story?
♦ He was 1.92 metres tall.

**Ask:**
♦ Is there anyone here taller than Bill?
♦ How tall is 1.92 metres?
♦ Do you know your own height?
♦ Do you know it in metrics?

Use their responses to link 1.92 metres and 1 metre 92 centimetres. (Centimetres are hundredths of a metre.)

Hand out the *How tall is 1.92 metres?* Activity Sheet.

Get trainees to work in pairs and encourage them to discuss their responses. Allow time for people to measure their heights and complete the sheet.

**Ask:**
♦ Who is the tallest here?
Write all the heights on the board as decimals and get trainees as a whole group to put the heights in order.

To further reinforce the language and understanding of the second decimal place hand out the *Paint thickness* Practice Sheet.
When trainees have completed the sheet, check their understanding by roughly drawing the line on the board or using a prepared OHP transparency of the practice sheet and getting trainees to tell you where to plot the paint thicknesses.

Check that they know which thicknesses are below 0.85 mm or above 1.15 mm. Also use the sheet to check the use of subtraction when subtracting the smallest value from the biggest to work out the range.

**Activity - Dicing with decimals**

**Game 3**

Game 3 extends the thinking from Dicing with decimals - games 1 and 2, into the second decimal place. It also emphasises the small value that numbers in the hundredths space really have.

It follows the same rules as Game 2 except that the dice will be tossed nine times and there are nine spaces to be filled in. The target in 9.99

This game really tests players strategies and understanding, as, on the whole, high numbers need to be put in the third column (the hundredths) to avoid going out.

Hand out a copy of the game *Dicing with decimals* - game 3 to each person.

Explain the rules of the game:

- This time I will toss the dice 9 times.
- Each time I toss it you have to fill in one space in the grid.
- This must be done before the dice is tossed again.
- The space you fill can be anywhere above the double line - this time it doesn’t need to be line 1, then line 2 etc.
- At the end of 9 tosses all of the spaces should be filled in.
- Now all the numbers should be added as in game 1 and game 2.

*NAITB, Marr, Anderson & Tout, 1994*
If you are over 9.99 you are out.
The closest to 9.99 wins the round.

Extension

Scores can be worked out as in games 1 and 2 (see Decimals - What's the point?) the difference between your total and 9.9 is your score.

Examples of play are shown below. A six sided dice was used.

<table>
<thead>
<tr>
<th>Numbers rolled</th>
<th>Player A</th>
<th>Player B</th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 5, 3, 2, 1, 1, 6, 3, 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 + 4</td>
<td>2</td>
<td>4 + 5</td>
</tr>
<tr>
<td>1 + 3</td>
<td>6</td>
<td>2 + 6</td>
</tr>
<tr>
<td>3 + 1</td>
<td>5</td>
<td>1 + 5</td>
</tr>
<tr>
<td>9 + 9</td>
<td>3</td>
<td>8 + 6</td>
</tr>
</tbody>
</table>

Optional Score

Player A wins the round with the lowest score of 0.06.

Finish off by handing out Hundreds - the second decimal place Practice Sheet, which reviews and reinforces the ideas covered so far.

Part 2: The next decimal place

Review

Handout Data sheet and Rounding off Activity Sheets and use these to review the first and second decimal places before starting on the third decimal place - thousandths.
Presentation

Say:
So far we have looked at the first two decimal places.
The first decimal place is the tenths.
The second is the hundredths.

Ask:
♦ Do you know what the next decimal place represents?
♦ What numbers do you know of that use three decimal places?
  - Anything you buy?
  - Anything you see at home or use at work?

Use trainees answers to collect some applications that use thousandths. Some examples could be:

1. Weights of shopping items: kilogram, kg and gram, g.

![export quality rump steak](image)

1.056 kg = 1 kg 56 g

0.266 kg = 266 g

2. Lengths in metre, m and millimetre, mm. For example from car sizes:

![car diagram](image)

- Capacity 2.164 litres
- Power 93 kW @ 5,200 rpm
- Torque 185 Nm @ 4,400 rpm
- 0 - 100 km/h 12.5 sec
- 0 - 400 m 18.4 sec
- 80 - 100 km/h 8.4 sec
- 80 - 120 km/h 9.8 sec
- Stop from 100 km/h 52.7 m 76.9 g
- Overall consumption 9.6 l/100 km
- Kerb mass 1,365 kg
- Towing 1,100 kg

E.g. 4725 mm = 4.725 m

Decimals - further places
Hand out Practice Sheet *Reading thousandths*, which gives practice at writing decimals to three decimal places.

**Activity - Decimal place value chart**

Use the *Decimal place value chart* sheet to work through writing decimal fractions as both digits and words.

Work through the first three examples (done on the sheet) with the group. Discuss any issues that arise - particularly about putting in the zeros.

Get trainees to fill in the gaps in the rest of the *Decimal place value chart*.

There is a blank *Decimal place value chart* included on page 25 if you need it for further practice. You could read out numbers and ask trainees to fill them in on the sheet.

In particular, get trainees to look at parts g), h), i), which are all variations of 5.8.

**Ask:**

✦ What is the difference between the answers to g), h), and i), - 5.8, 5.80, and 5.800.

Discuss these answers and point out that we can assume that there are zeros at the end after a decimal point so 5.8 = 5.80 = 5.800

**Part 3: All three together**

**Activity - Double zero three and nine**

To each group of two or three trainees distribute an envelope containing the activity *Double Zero Three and Nine - Part 1.*
Say:
* Take out the cards and find the three cards containing the shaded grids. (Hold up a card containing a grid and show it to the trainees)
* Lay the three grid cards in a row on the table. These cards will be at the head (top) of three columns.
* Pick up another card. Read it and together, place it in the column with the grid that has the same meaning.
* Keep doing this until all the cards have been placed.

Allow time for this to be completed. Check that the cards have been appropriately placed by comparing group responses or alternatively by moving around as they do it and asking trainees to reconsider if you see anything out of place.

Now hand out to each group the second envelope: *Double zero three and nine - part 2.*

Say:
* This time the cards all have decimal fractions or measurements on them.
* Arrange them into the three groups already in the table.
* Again do them one at a time, as a group.
* Don't worry if there are different numbers of cards in each column.

Allow plenty of time for the placement of these cards. Again offer assistance when it is needed.

The quickest way to check their placement would be to give each group a copy of the answer sheet and ask them to check it themselves.

Finish the activity by asking:
* Which did you find the most difficult?
* Is there anything you are still unsure of?

Response to these questions, as well as your own observations, should indicate whether more time needs to be spent on any aspect of this section.
Activity - Cooperative logic problems

This activity uses a cooperative problem solving structure to reinforce what students have learned about decimals. It encourages them to use the language of number and decimals whilst solving the problems together to find the unknown numbers.

Each person has clues important to the solution of each problem. By combining these clues the group can reach a unique solution.

Presentation

Divide the class into groups. Four is an ideal number.

Say:
♦ In each envelope there are clues to help your group find a mystery number.
♦ Each problem is to be solved co-operatively, and you need to work together to find an answer.
♦ You all have different clues, so it is important to listen as each clue is read.
♦ Your clue should not be shown to anyone else - it must always be read aloud.

(If any student finds the clues hard to read, help them by reading the sentence over with them before they begin.)

Give each group an envelope of numbers (or digits) - tell them to open it and leave the numbers in the middle of the table to use with all of the four problems.

Then hand to each group, an envelope containing problem What is the number? - 1

Say:
♦ Open the envelope.
♦ Share out the clue cards. (Some trainees may receive two cards depending on the size of the group.)
♦ Take turns to read your clues aloud to the group. (Do not show your clue to anyone else.)
♦ As you read each clue move the numbers on the table around.
Keep reading your clues aloud until you all agree that you have an answer.
Finally, check all your clues again to make sure your answer is OK.
Ask for the next problem.

Give the problems to the groups one at a time in the order they are numbered (approximate order of difficulty).

We have included moveable pieces in these problems in order to discourage students from using pencil and paper. When members of a small group start to work out solutions by writing, one person usually dominates, and co-operative problem solving is replaced by individual problem solving.

Although answers have been included it should not be necessary to check them or to ask the teacher for correction. The group should be satisfied for themselves that they have met all the conditions. This is the beginning of the notion of self checking which should constantly be reinforced by you as a trainer/teacher, eg. checking subtraction by addition.

Your notes and ideas
Looking at hundredths

1. Shade the grids

   ![Grids for shading]

   a) $0.78 = \frac{78}{100}$
   b) $0.25 = \frac{25}{100}$
   c) $0.91 = \frac{91}{100}$

2. Write these decimals as mixed number fractions.

   a) $4.32 = 4 \frac{32}{100}$
   b) $8.54 = $
   c) $7.43 = $
   d) $9.77 =$
   e) two point eight six =
   f) three and seventeen hundredths =

3. Shade the grids and fill in the spaces.

   ![Grids for shading]

   a) $0.03 = \frac{3}{100}$
   b) $0.09 = \frac{9}{100}$
   c) $0.20 = \frac{20}{100}$

   = three hundredths

4. Write as mixed number fractions.

   a) $2.02 = 2 \frac{2}{100}$
   b) $4.06 = $
   c) $7.08 = $
   d) $8.30 = $
Looking at hundredths

1. Shade the grids
   a) 0.78 =
   b) 0.25 =
   c) 0.91 =

2. Write these decimals as mixed number fractions.
   a) 4.32 =
   b) 8.54 =
   c) 7.43 =
   d)sv =
   e) three and seventeen hundredths =

3. Shade the grids and fill in the spaces.
   a) 0.05 =
   b) 0.09 =
   c) 0.20 =

4. Write as mixed number fractions.
   a) 2.02 =
   b) 4.06 =
   c) 7.08 =

Paint thickness
This is a section of an SPC Chart for paint thickness.

How tall is 1.92m?
Read the heights of the people below. Write them down in metres (m) and centimetres (cm) as shown.

Hundredths - The Second Decimal Place
1. Draw a line joining up the matching items.
   a) 2.74
   b) 13.9
   c) 6.35
   d) 6.59
   e) 0.18
   f) 36.7
   g) 1.82

2. Joe was feeling well and went to the First Aid Centre.
   Every half hour he had his temperature.

   Time | Temperature °C
   -----------------
**Rounding Off**

In groups use the Data Sheet to answer these questions.

1. Is it O.K. to round off all these measurements to whole numbers? Should some stay as they are?

   Paint thickness depends on the purpose. Distances definitely O.K. to round off. Rain times should stay as they are.

2. Arrange the data from smallest to biggest.

   **PAINT THICKNESS:**
   - 1.07
   - 1.1
   - 1.12
   - 1.2

   **DISTANCES:**
   - 294.7
   - 385.2
   - 388.3
   - 406.9

   **TIMES:**
   - 9.86
   - 9.9
   - 9.93
   - 9.97

3. Finish these sentences using words from the box and numbers rounded off - no decimals.

   - a. Carl Lewis ran (**many choices**) 10 sec. in his last 4 100m races.
   - b. The paint on our cars is (**many choices**) 1 mm thick.
   - c. Bill travels (**many choices**) 100 km on a full tank of petrol.

---

**Reading thousandths**

- a. Draw a line to match the tag to the correct number.

   **PRODUCTION**
   - SHEET 11 1697-11
   - **WEIGHT kg 0.78**

   **MEASUREMENTS**
   - 4.163 kg
   - 2.91 kg

   **USE BY 30 OCT 93**
   - **PRICE/kg 0.95**
   - **NET WT kg 2.91**
   - **TOTAL PRICE $ 2.72**

- b. Write the weight in grams. 1000 grams (g) = 1 kilogram (kg)

   - **PRICE/kg**
   - **USE BY**
   - **NET WT kg**
   - **TOTAL PRICE**

   **1.25 kilogram**
   - 4.93 grams
   - 78.9 grams

---

**Decimal place value chart**

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<th>Number in words</th>
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**Decimal - further places**

- **NAITB. Marr, Anderson & Tout, 1994**

p. 23
Double zero three and nine

3\(\frac{1}{1000}\) three and nine thousandths
three point zero zero nine
3 kg and 9 g
3 m and 9 mm

3\(\frac{1}{100}\) three and nine hundredths
three point zero nine
three dollars and nine cents
3 m and 9 cm

3\(\frac{3}{10}\) three and nine tenths
three point nine
three dollars ninety
3.9  3.90  3.900

What's the number?

1.  2.049
2.  12.34
3.  5.39
4.  24.5
Percentages of your life

Purpose

The idea of percentage pervades every workplace. % is one of the most commonly seen symbols when workplace figures are recorded or presented. It is used to describe market shares, quality of production, rates of attendance, wage rises and deductions, and countless other statistics. Percentages are used repeatedly in workplace charts and tables designed to motivate workers to greater productivity and company involvement.

It is important therefore that workers have a clear idea of what percentages are telling them and how to calculate with them with understanding.
Background

The activity begins with familiar things that your trainees will probably have heard of through work, the union, banking, and shopping. Most have been in the news quite often.

Beginning maths ideas with things people know about, makes them feel comfortable and confident to go on. This activity combines the idea or concept of percentage with a chance for people to share what they know about and express their opinions on some issues which affect them as well.

The first part of this activity is done in small groups. There are many reasons for this:
♦ it involves people actively at the beginning of the session rather than the trainer doing most of the talking;
♦ it is less threatening for most people than starting off alone;
♦ talking and discussing are effective ways of learning;
♦ there is a chance for the class members to share what they know with each other;
♦ people in the class who may not know something will not feel stupid or left out;
♦ it gives the trainer a chance to find out what people know, early in the session, rather than assuming they know nothing.

What to prepare

Photocopy pages 10 and 11, one set for each group of four trainees in your class (best on coloured cardboard if you have some). Cut out the shapes and store each set in labelled envelopes ① and ② as follows. In each envelope number ① there should be:

♦ 7 different short statements (eg. A Wage Rise);
♦ 7 different percentage squares (eg. 4%); and
♦ 7 different complete sentences (eg. for every $100 you earn you will get an extra four dollars).

In each envelope ② there should be the set of cut out diagram cards (page 12).

For each trainee you will need to make:
♦ a photocopy of the following sheets
  □ Summary sheets
  □ People and their jobs
  □ People and their jobs - sheets 1 & 2
  □ Calculators
Trainees match up a series of sentences and percentages in order to focus their existing knowledge of percentages and to emphasise that percentage means out of one hundred.

Sentence cards are matched with diagrams of pie charts and 100 square grids to concentrate on familiar percentage diagrams, encourage visualising, and further develop the idea of percentage.

Give worksheets from *Strength in Numbers* to practice with. Pages FP 35, 42, 43

Development of in the head methods to work out rough percentages of people's wages.

Use of the calculator percentage button to calculate exact percentages.

Examples from the workplace would be best. More practice problems can also be found in *Mathematics a New Beginning*, page FA 15 (FA 16 for students with good language skills).

The next section on percentages, *Percentages at work*, looks at expressing numbers as percentages.
Part 1: Familiar percentages

Presentation

Arrange trainees into working groups of four at the beginning of the session - grouped around the tables is best - not in a line.

Ask each group to empty their envelopes and match each short statement with the most likely percentage square, and the most appropriate sentence. Hold up one of each to make it clear to the group.

Walk around among the groups to encourage argument and discussion.

When they have finished, ask one group to give their solutions and check that the others agree. Any disagreements should be discussed by the whole class.

To make sure that the relevant of 100 is discussed, get class members to read out one or two of the sentences and ask why the 100 is in them. eg. A Wage Rise, Holiday loading.

Statements which are likely to provoke useful discussion are:

♦ 100% - Pure New Wool - Completely one thing - trio.
   Remember the main point is 100% means the lot or the whole thing. You could compare this with similar common labels such as 100% cotton, 100% pure fruit juice, all of which mean the whole lot, pure, complete.

   Ask trainees to think of other expressions which use 100% and analyse their meaning.

♦ 150% - Time and a half - $12 becomes $18. People can be confused by a percentage which means more than a whole - the emphasis is on getting all you have already (100%) and then an extra 50% as well. The diagrams of the next part may help.
• .05% - Blood Alcohol Content - may also confuse if people try to look at its true meaning. (It really means that in every litre (1000 ml) of blood there is half a millilitre of alcohol.) Much less than 1 in every 100 or 1%

It would be better to talk about the .05% and 150% when you have the diagrams in front of the groups. Another percentage to mention is the Medicare Levy which has risen from 1.25% to 1.4%.

**Part 2: What do percentages look like?**

**Activity**

With the pieces still laid out in front of the groups, give out envelope 2 - percentage diagrams.

**Presentation**

Ask the groups to match up as many of these pictures as possible with the percentage groups in front of them.

Warn them that not all diagrams will match up.

Allow time for discussion.

When groups have matched all possible diagrams, check that they all agree and then ask the following questions:

♦ Were there any diagrams which were tricky to match up? Why?

♦ Look at the diagrams which do not match up and see if you can decide what percentages they are.

Hopefully the sharing of thoughts within the group will mean you do not have to explain too much. However it would be good to summarise quickly the main percentages (25%, 50%, 75%, 100%). You can use the $\frac{1}{3}$ picture to introduce briefly the idea that $\frac{1}{3}$ of 100 is 33$\frac{1}{3}$% or 33.33%
Part 3: Focus on four percent

Activity
Get groups to put away all cards except the 4% pay rise set. With trainees still sitting and discussing in small groups, pose the next question and advise them to use the cards in front of them to get a rough answer.

Ask:
♦ If you got a 4% pay rise tomorrow, approximately how much would you get?

As the groups are discussing - walk around and listen to how much they are able to work out for themselves.

Optional questions:
Put these questions to small groups who are having trouble getting started.
♦ The sentence on the card here says: "For every $100 you earn you get extra $4. So if you get $100 a week now, what would your rise be?"
♦ If you get $200 a week now, what would your rise be?
♦ How many hundreds of dollars do you earn each week - roughly?
♦ Do you earn closer to 300 or 400 dollars each week: So about how many extra $4 dollar bits would you get?

Give groups a chance to discuss thoroughly.

Summarise with the whole group:

4% of $100 is 1 x $4 or $4
4% of $200 is 2 x $4 or $8
4% of $300 is 3 x $4 or $12

Ask:
♦ If you were an executive manager who gets $900 per week, what would the rise be?
♦ What did you do to work that out?
♦ Is there a pattern or rule?

Try to get trainees to say this in their own words. Ask questions to help them explain their methods until everyone feels confident.
Activity - People and their jobs

Use the sheet of People and their jobs to allow the class to practice this technique until they are confident. Make up questions as you go, such as:
- 5% of the cleaner's weekly salary
- 3% of the accountant's weekly salary
- 10% of the teachers weekly salary.

Agreement among the group is usually a good check of correct answers but if in doubt use a calculator to check (see next section for the method.) Use the Practice sheet Sheet 1 - People and their jobs to reinforce and practice these skills.

When students are dealing easily with 300, 400, 900, try the annual salaries from People and their jobs, with questions like:
- What is a 4% pay rise?
- What is a 6% pay rise?
  eg. $30,000 - find 4%
      30 000 is 300 hundreds
      so we want 300 lots of $4
      300 x $4 = $1200

Use the Practice sheet Sheet 2 - People and their jobs to reinforce and practice skills with larger amounts.

Activity - Percentage discounts

Another short cut method for finding percentages is the "cents in the dollar" method. In this case the percentage matches the number of cents in each dollar.
  e.g. 4% means 4 cents in each dollar
       10% means 10 cents in each dollar, etc

Give an example:

  a discount of 4% off an item costing $20 is:
  4% means 4 cents in each dollar
  so 4c x 20 = 80c discount.

To practice this "cents in the dollar" method hand out the Practice sheet Percentage discounts.
Part 4: Using the calculator

Presentation

Suggest to the class that sometimes you need to be able to check figures like this exactly. For instance, to make sure the pay office has got it right on your cheque after a 4% pay rise.

The quickest, easiest and most accurate way is with a calculator.

Ask:
♦ How would you go about calculating exactly 4% of $465 on a calculator?

Give out sets of calculators and allow a few minutes for people to try out ideas.

Briefly acknowledge any ideas which lead to correct answers but go on to highlight the particular use of the % button.

On the board write this sequence of buttons for students to follow:

4 6 5 x 4 %

Try out a few problems together such as:
♦ What would be a 12% discount on a $635 video?
   Answer: $76.20

♦ What would be a 15% tax on a $130 food bill?
   Answer: $19.50

♦ What would be a 1.4% Medibank levy on a salary of $32,650?
   Answer: $457.10

♦ What would be time and a half on an hourly pay rate of $18.62?
   Answer: $27.93
Possible questions:
- How much would you trust the calculator?
- What happens if you press the wrong button?
- How could you check your answer?

Briefly discuss how previous methods of rough calculation should be used in conjunction with calculator methods.

For example with the video,

$635 \text{ is close to } 600$
$600 \text{ is 6 hundreds}$
$12\% \text{ is } 6 \times 12 \text{ or } 72.$

The calculator gave $76.20$. Our rough estimate tells us the decimal point is in the right place and the answer is reasonable.

Give out the **Calculators** Practice Sheets which will provide some examples for them to take away and practise to be sure they can remember it all in a few days.

**Your notes and ideas**
### Percentages of your life

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
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<tbody>
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<td>A Wage Rise</td>
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<td>Blood Alcohol Content (BAC)</td>
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<td>A Home Loan Interest Rate</td>
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<td>Holiday Loading</td>
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<td>Time and a Half Overtime Rate</td>
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<td>Pure New Wool</td>
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<td>Half Price Sale</td>
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## Percentages of your life

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<th>Description</th>
<th>Calculation/Details</th>
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<td>An extra $17.50 for each $100 of your wage</td>
<td>To make up for loss of overtime.</td>
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<tr>
<td>For every $100 you earn you will get an extra four dollars.</td>
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<td>A pay rate of $12 per hour becomes $18 per hour.</td>
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<td>A product normally costs $60 but now costs only $30.</td>
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<td>For every year of the loan you have to pay almost $10 interest for each $100 borrowed.</td>
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<td>A percentage much lower than 1%</td>
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<td>Completely one thing.</td>
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*Percentages of your life* — NAITB, Marr, Anderson & Tout, 1994
### Percentages of your life

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<td>![Diagram 1]</td>
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<td>![Diagram 4]</td>
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<td>![Diagram 7]</td>
<td>![Diagram 8]</td>
<td>![Diagram 9]</td>
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**Percentages of your life** — *NAITB, Marr, Anderson & Tout, 1994*
People and their jobs

Bill, the car mechanic, earns $24,700 a year which is about $475 each week.

Sophie, the cleaner, earns about $400 each week which is about $21,000 over a year.

Tibor, the doctor earns $57,200 per year which is about $1,100 a week.

Mary, the accountant earns $36,400 annually which is about $700 per week.

Jake, the carpenter, earns around $550 each week which is about $28,600 for a year.
People and their jobs - Sheet 1

Using the Activity sheet *People and their jobs* estimate answers to these questions.

① Bill, the car mechanic, gets a 4% pay rise. Roughly, how much more will he earn each week?

② Jake, the carpenter, saves about 10% of his salary each week for a holiday. About how much is this each week?

③ 7% of Tibor’s weekly income pays for cleaning. Approximately, how much does it cost him?

④ Each week 12% of Tran's pay is spent on child care. About how much is this?

⑤ Sophie spends 7.5% of her weekly earnings on petrol. How much does she pay for petrol each week?
People and their jobs - Sheet 2

Using the Activity Sheet People and Their Jobs estimate answers for these questions.

1. About 2% of a doctor's annual earnings pays for membership fees. How much would Tibor spend each year on memberships?

2. 3% of Tran's annual salary is paid to her superannuation fund. How much approximately, is this each year?

3. In Mary's firm, the accountants receive a 5% allowance for travelling. About how much is this for Mary each year?

4. Jake uses about 6% of his annual pay to buy tools. What amount of money is this roughly?

5. For which of the six people is a flat rate pay rise of $10 per week better than a 2% pay rise?
Percentage discounts

What would a 5% discount be for:

E.g. The soccer ball? \(5\% \text{ means } 5 \text{ cents in each dollar}\)
\[ 5c \times 29 = 145c = \$1.45 \text{ discount}. \]

The hammer? ___________________

What would a 12% discount be for:

The folder? ___________________

The hammer? ___________________

What would a 30% discount be for:

The hammer? ___________________

The soccer ball? ___________________
Calculators

Use the % on your calculator to answer these.

≈ Approximate - do an answer without a calculator to make sure your answers are sensible.

1. A bed priced at $575 is discounted by 12%. What is the discount?

≈ approximate: 
575 nearly 600
6 hundreds
12% = 6 x $12 = $72

exact answer from calculator:

$69.00

2. A refrigerator is advertised at $788. You have a 15% discount offer. How much will you save?

≈ approximate: 

exact answer from calculator:

---

3. Mina pays about $180 for petrol each month. If there was an extra 2% tax on petrol. How much would it cost?

≈ approximate: 

exact answer from calculator:

---
4. A car plant makes a weekly average of 920 cars. This week production was about 3% above average. How many more did they make this week?

\[ \approx \text{ approximate: } \]

exact answer: ____________

sensible answer: ____________

5. There are 645 workers in a company. 7% were away on Tuesday. How many were not there? How many were at work?

\[ \approx \text{ approximate: } \]

effect answer: ____________

sensible answer: ____________
at work: ____________
**People and their jobs - sheet 1**

1. Roughly $20
2. About $55
3. Approximately $77
4. About $95
5. $30

**People and their jobs - sheet 2**

1. About $1140, $1144 or $1200 are all ok.
2. Approximately $1230.
3. About $1800, $1820 or $2000 are ok.
4. Roughly, $1716 or $1800
5. Sophie and Bill would be better off with the flat rate pay rise of $10 per week.

**Percentage discounts**

1. 60 cents
2. 48 cents, $1.44
3. $3.60, $8.70

**Calculators**

1. $69
2. $118.2
3. $3.60
4. Exact answer 27.6  
   Sensible answer 28
5. Away: exact answer 45.15  
   Sensible answer 45  
   At work 6.00

---

*Percentages of your life* — *NAITB, Marr, Anderson & Tout, 1994*
Hundredths grid
How tall is 1.92 m?

Read the heights of the people below. Write them down in metres (m) and centimetres (cm) as shown.

Bill's height is 192 cm
= 1 m 92 cm
= 1.92 m

Joe's height is ______ cm
= ____ m ____ cm
= ________ m

Marco's height is ______ cm
= ____ m ____ cm
= ________ m

Mary's height is ______ cm
= ____ m ____ cm
= ________ m

Elle's height is ______ cm
= ____ m ____ cm
= ________ m

What's your height?
Get a workmate to help you measure your height. Use a tape measure or ruler
My height is ______ cm = ____ m ____ cm
= ________ m
This is a section of an SPC Chart for paint thickness.

Use it to plot the facts below.

eg. 1.14mm is done as an example.

1. The digital readout for hour 1 was 0.90 mm.

2. At the end of the second hour the readout was 1.20 mm.

3. Bill called out, "Zero point eight five" for Aden to plot for hour 3.

4. Hour 4, one and eleven hundredths.

5. Aden shouted "One exactly" for Bill to plot for hour 5.


7. One and three hundredths was the reading for hour 7.

8. "Oh point seven nine" said Aden to Bill.

Which of these are outside the range 0.85 - 1.15 mm?

What is the range (the difference between the smallest and largest)?
Dicin with decimals - game 3
9 throws. Target is 9.99
**Hundredths - The Second Decimal Place**

1. Draw a line joining up the matching items.

   - 2.74
   - 13.9
   - 6.35
   - 6.59
   - 0.18
   - 6.05
   - 38.7
   - 1.82

2. Joe was not feeling well and went to the First Aid Centre. Every half hour the nurse took his temperature.

<table>
<thead>
<tr>
<th>Time</th>
<th>1.00pm</th>
<th>1.30pm</th>
<th>2.00pm</th>
<th>2.30pm</th>
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</thead>
<tbody>
<tr>
<td>Temperature °C</td>
<td>38.37</td>
<td>38.4</td>
<td>38.29</td>
<td>38.08</td>
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</tbody>
</table>

a) When was his temperature the highest? 

b) Put the temperatures in order.

________________________ ____________ ____________ ____________
smallest highest

---

Decimals - further places — NAITB, Marr, Anderson & Tout, 1994 — p.19
Data sheet

**PAINT THICKNESS**  On a car:

- 1.07 mm
- 1.2 mm
- 1.12 mm
- 1.1 mm

**DISTANCES**  Bill travelled on a full tank of petrol:

- 388.3 km
- 379.7 km
- 401.9 km
- 385.2 km

**TIMES**  Carl Lewis' last 4 times for the 100m:

- 9.97 sec
- 9.86 sec
- 9.93 sec
- 9.9 sec

---

Decimals - further places  
NAITB, Marr, Anderson & Tout, 1994  
p. 20
Rounding Off

In groups use the Data Sheet to answer these questions.

1. Is it O.K. to round off all these measurements to whole numbers? Should some stay as they are?

2. Arrange the data from smallest to biggest.

   PAINT THICKNESS: _____ _____ _____ _____
   smallest biggest

   DISTANCES: _____ _____ _____ _____

   TIMES: _____ _____ _____ _____

3. Finish these sentences using words from the box and numbers rounded off - no decimals.

   about nearly almost approximately
   just over just under a bit over

   a. Carl Lewis ran ________________ in his last 4
      100m races.

   b. The paint on our cars is ____________________.

   c. Bill travels ________________ on a full tank of
      petrol.
Reading thousandths

1. Draw a line to match the tag (or reading) to the correct number.

2. Write the weight in grams. 1000 grams (g) = 1 kilogram (kg)

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<thead>
<tr>
<th>Product No.</th>
<th>B2657-54</th>
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<td>Weight kg</td>
<td>.078</td>
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<tr>
<th>PRICE/kg</th>
<th>USE BY</th>
<th>NET WT kg</th>
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<td>$ 6.98</td>
<td>16.10.93</td>
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<tr>
<td>1.056</td>
<td>$ 7.37</td>
<td>TOTAL PRICE</td>
</tr>
</tbody>
</table>

1 kilogram

\[ \frac{56}{1000} \text{ kilograms} = \_ \_ \_ \_ \text{ grams} \]

Four point one eight three kg

\[ \_ \_ \_ \_ \text{ grams} \]

Seventy-eight thousandths of a kilogram

\[ \_ \_ \_ \_ \text{ g} \]

Point two six six kg

\[ \_ \_ \_ \_ \text{ grams} \]

Decimals - further places — NAITB, Marr, Anderson & Tout, 1994 — p.22
Use the diagram to answer the questions below.

Eg. a. How long is the car? \[\text{4725 mm} = \frac{4725}{1000} \text{ m} = 4.725 \text{ m}\]

b. How high is the car? \[\text{_____ mm} = \frac{_____}{1000} \text{ m} = _____ \text{ m}\]

c. What is the headroom for the front seat? \[\text{_____ mm} = \frac{_____}{1000} \text{ m} = _____ \text{ m}\]

d. What is the headroom for the back seat? \[\text{_____ mm} = \frac{_____}{1000} \text{ m} = _____ \text{ m}\]

e. What is the wheelbase (the distance between the front and rear wheels)? \[\text{_____ mm} = \frac{_____}{1000} \text{ m} = _____ \text{ m}\]
## Decimal place value chart

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<tr>
<th></th>
<th>100's</th>
<th>10's</th>
<th>1's</th>
<th>1/10ths</th>
<th>1/100ths</th>
<th>1/1000ths</th>
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<td>a.</td>
<td>2</td>
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<td>two point five</td>
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<td>b.</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>6</td>
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<td>seventy-eight and thirty-six hundredths</td>
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<td>c.</td>
<td>1</td>
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<td>fourteen and twelve thousandths</td>
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</table>
# Double zero three and nine

## part 1

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>3(\frac{9}{100})</td>
<td>three and nine hundredths</td>
</tr>
<tr>
<td>3(\frac{9}{10})</td>
<td>three and nine tenths</td>
</tr>
<tr>
<td>3(\frac{9}{1000})</td>
<td>three and nine thousandths</td>
</tr>
</tbody>
</table>

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### Decimals - further places

NAITB, Marr, Anderson & Tout, 1994

p.26
## Double zero three and nine

### part 2

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>3.900</td>
<td>three point nine</td>
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<tr>
<td>3.009</td>
<td>three dollars ninety</td>
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<tr>
<td>3.9</td>
<td>three point zero nine</td>
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<tr>
<td>3.09</td>
<td>three dollars and nine cents</td>
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<tr>
<td>3.90</td>
<td>three point zero zero nine</td>
</tr>
<tr>
<td>3 kg and 9 g</td>
<td>3 m and 9 mm</td>
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<td>3 m and 9 cm</td>
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</tbody>
</table>

![Ruler Image 1](image1)

![Ruler Image 2](image2)

---

*Decimals - further places* — NAITB, Marr, Anderson & Tout, 1994
### What's the number? - numbers

<p>| | | |</p>
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### What's the number? - 3

<table>
<thead>
<tr>
<th>The number has 3 digits</th>
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<tbody>
<tr>
<td>The number is bigger than five</td>
</tr>
<tr>
<td>The number is smaller than 6</td>
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<tr>
<td>The middle digit is 3</td>
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<tr>
<td>The last digit is three times the second digit</td>
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<tr>
<td>All the digits are odd numbers</td>
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</tbody>
</table>
**What's the number? - 4**

<table>
<thead>
<tr>
<th>Condition</th>
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<tbody>
<tr>
<td>The decimal point is not at the end</td>
</tr>
<tr>
<td>Only the digits 1 to 4 are used</td>
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<tr>
<td>There are no thousandths</td>
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<tr>
<td>The digits are in order from small to big</td>
</tr>
<tr>
<td>There are more hundredths than tenths</td>
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<tr>
<td>It is a decimal number with four digits</td>
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</tbody>
</table>
Part 1 of this activity is to reinforce the trainees' understanding of the concept of percentages. Part 2 is to help trainees develop shortcuts for calculating percentages from quantities such as 6 out of 200, 12 out of 300 etc. It uses hands-on material that should allow trainees to develop their own "in the head" methods for these calculations.

Part 3 is similar to Part 2, but is for quantities such as 6 out of 50, 6 out of 20 etc.

Part 4 concentrates on how to calculate percentages (that are less obvious) from quantities such as 14 out of 450, 62 out of 80 and 37 out of 40, using calculators.
Background

In this session we have encouraged the use of **hands-on materials**: the cut out pieces and grids used to clarify percentage calculations. Workplace trainers will know that in the factory, hands on experience, or doing it yourself, is basic to all training and learning. The learning of mathematics is no different. Using hands-on materials in teaching maths to adults encourages visualisation and understanding of ideas and mathematical rules.

By manipulating concrete objects, students learn by exploration and discovery, and become active in their own learning. This seems the best way to distance students from the realms of the 'mystifying magic tricks' that maths teachers displayed to them when they were at school.

Teachers who try the hands-on approach with adults, have consistently been rewarded with cries of "I see", "Now it makes sense" or "Why didn't they do it this way at school?" So the effort of cutting out the bits and pieces is worthwhile and important.

Another advantage of hands-on materials is that students can return to them confidently if they forget the process or the rule, or if they wish to check their reasoning.

Many teachers and trainers involved in adult education were the victims of similar educational methods as their students. Having learnt maths using traditional paper and pencil methods they may not feel very confident with alternative approaches. Trainers using hands-on materials for the first time may also fear the reaction from trainees when they produce materials which they may think belong in kindergarten or primary school! But it is important to overcome these initial reservations. Once you have used them and seen how effective they are, hands-on materials will become a valuable part of your training.
**Note - Using grids**

The grids are used to allow trainees to see how quantities such as 6 out of 200, 6 out of 25 can be related to 'out of 100'. From previous work, (see *Percentages of your life* activity) the trainees should know that 2 out of 100 is 2%.

For example, for 6 out of 300, the 6 have to be spread evenly over the 100 Grid Sheets.

6 out of 300 looks like:

![Grid Sheets](image)

This hands on approach should help trainees see that 6 out of 300 is the same as 2 out of 100, which is 2%.

**What to prepare**

For each trainee you need a copy of:
- Defective parts
- Percentage attendance
- Working percentages
- Percentages - major facts

For each group of 2 or 3 trainees you will need an envelope or a plastic bag containing:
- Three 100 Grid Sheets
- Two 50 Grid Sheets
- Four 25 Grid Sheets
- A set of small square pieces

NAITB, Marr, Anderson & Tout, 1994
Photocopy the Grid Sheets onto light coloured cardboard.

Photocopy the small square pieces onto dark coloured cardboard.

To make the 25 and 50 Grid Sheets photocopy the *Hundred grid* (p. 16) onto light coloured cardboard. Then cut the sheet into four 25 Grid Sheets or two 50 Grid Sheets.

To make the small square pieces photocopy the *Hundred grid* sheet onto dark coloured cardboard. Then cut these into individual squares. One or two sheets cut up into squares will provide plenty of these pieces.
Outline of section

Part 1
Percentages of what?

Introduces the idea that to find a percentage you always need to know the total. Percentage means 'out of 100', and is written as %.

Part 2
Lots of hundreds

Introduces and develops shortcuts to change quantities such as 12 out of 400, 18 out of 300 to percentages.

Part 3
Faulty parts

Extends the ideas above for numbers less than one hundred such as 7 out of 50, or 7 out of 25.

Part 4
Using calculators

Shows how calculators can be used to express quantities such as 7 out of 45 as a percentage.

END

NAITB, Marr, Anderson & Tout, 1994

Percentages at work p. 5
Part 1: Percentages of what?

Presentation
Put this question to the group.

Six people ring in to say they are sick, so they will be absent. What percentage of workers are away sick?

Possible questions:
♦ Can anyone tell me the answer?
♦ Is it possible to answer this?
♦ Is there enough information?
♦ What do we need to know?
♦ What is percent?
♦ Are the six from this section? plant? company?

Now take this further by supplying some necessary information.

Presentation
Ask:
♦ Suppose the six are from a plant that employs 100 people, what percentage are away?

Discuss this question long enough to remind trainees of the meaning of percent.

Ask:
♦ What other ways can we write or say this?

Possible responses could be recorded such as:
- 6 out of 100
- 6 in every 100
- 6 per 100
- 6%
- 6 over 100 or \(\frac{6}{100}\)

Distribute the envelopes containing the grid sheets and get the class to model this 6 percent using the 100 grid sheets.

Note: If you have not used the grids please see: Note on Using Grids

This questions cannot be answered without further information. It is like asking "how long is a piece of string?"

To find out the percentage, we need to know the total number of people employed in the section, plant, or company.

The emphasis should be 6% means 6 out of 100

NAITB, Marr, Anderson & Tout, 1994

Percentages at work p. 6
Part 2: Lots of hundreds

Presentation

Say:
♦ Suppose the six are from a plant that employs 200 people.

Ask:
♦ Will this give a different percentage?
♦ What is it?

Get the trainees in groups to share the grids, and model this situation. This will make sure they have a real picture before starting to do calculations.

They will have to put two grids together like this:

eg. 6 out 200 is the same as

The six have to be spread evenly over the two 100 grids (for 200) or three 100 grids (for 300)

Ask:
♦ How many squares are covered on each grid?

Say:
♦ Suppose the 6 are from a plant of 300.

Repeat the steps above to demonstrate that 6 out of 300 is 2%.

Now say:
♦ If we didn't have grids to look at, what calculations could we do to get these answers?
   First look at 6 out of 200.
The trainees might say or do some of the following:

*Just halve the six six divided by two*

Try to get reasons for their responses?
If someone says divided by 2 ... ask why 2?
This will help the others.

Some people may say they cancelled, meaning:

\[
\frac{6}{200} = \frac{3}{100}
\]

in other words, dividing by 2

If people are using cancelling then point out that this is the same as dividing and is just as valid.

Use their responses to link \(\frac{6}{200} = \frac{3}{100} = 3\%\)

or 6 out of 200 is the same as 3 out of 100 which is 3%.

Don't bring up the cancelling routine if it isn't mentioned by your trainees first. Logic is more powerful in the long run.

Repeat also for 6 out of 300.

**Presentation**

**Ask:**

- What percentage would it be if there are eight sick people from a plant of:
  - (a) 200 ?
  - (b) 400 ?
  - (c) 800 ?
- How are you getting the answers?

Hopefully these sort of responses can be pulled together to arrive at a general rule:

*For 200 divide by 2*
*For 400 divide by 4*
*For 800 divide by 8*

Use their words if possible. to explain a rule of shortcut.

They may say something like: How ever many 'lots of 100s you have, then just divide by that many'.
Go on making up your own examples until everyone seems confident. Using the hands-on material, allowing discussion amongst the trainees and getting them to give reasons for their responses, helps provide a range of explanations and methods.

This makes clear that there is not just one way to calculate these percentages quickly. This should benefit the trainees: even those who already know some of the shortcuts will have their understanding reinforced.

**Part 3: Faulty parts**

Distribute the 50 and 25 Grid Sets.

**Ask:**

- Six parts in each batch are faulty. What percentage are faulty if the batches have 50 parts?

6

\[
\begin{array}{c}
\text{with} \\
50
\end{array}
\]

6

\[
\begin{array}{c}
\text{gives} \\
50
\end{array}
\]

12

\[
\begin{array}{c}
\text{which is} \\
100
\end{array}
\]

the same as 12 in one hundred

or 12%
What percentage are faulty if the batches contain 25 parts?

6 6 6 6

25 25 25 25
gives

24

which is

the same as 24 in one hundred or 24%

Ask:
♦ How did you use the grids?
♦ How can we do these questions without the grids?

Discuss by writing their responses on the board and use these to link:

6 out of 50 is the same as 12 out 100, and
6 out of 25 is the same as 24 out of 100.

Trainees will give responses based on the methods they use in their heads.

Encourage them to do these questions mentally. This will lead to short cuts, which are desirable. If someone says multiply by 4 .... ask why 4? Try to get reasons for their responses, which will help others to understand.

Encourage trainees to do these in their heads.

NAITB. Marr, Anderson & Tout, 1994
Some may say multiply top and bottom by four, or demonstrate this method:

\[ \frac{6}{25} \times \frac{4}{4} = \frac{24}{100} \quad \text{(The opposite of cancelling)} \]

\[ \frac{6}{25} = \frac{24}{100} = 24\% \]

Put these questions to the group:

What percentage would it be if the six faulty parts were from a batch of:

a) 20 ?

b) 10 ?

Use the short cut methods developed to show

\[ \text{6 out of 20} \rightarrow 6 \times 5 = 30 \text{ out of 100} = 30\%, \text{ or} \]

\[ \text{6 out of 10} \rightarrow 6 \times 10 = 60 \text{ out of 100} = 60\% \]

Now hand out the Practice Sheet \textit{Defective parts} to each trainee. Discuss the idea behind the tables before trainees attempt them.

Ask:

\* Can you see what this table is about?
\* What does the \# symbol mean? etc.

This sheet can be done in class or at home. It is designed to give practice at using some shortcuts to calculate percentages.

Finally hand out the next Practice Sheet \textit{Percentage Attendance}. Again this can be done in class or at home using short, in the head methods. Ensure that trainees have a chance to discuss the table's meaning before attempting the calculations.

---

\textit{TRAINERS' NOTES}

\textit{Do not emphasise formal writing down. Just relate it to other methods or rules if it comes up.}

\textit{NAITB, Marr, Anderson & Tout, 1994}
Part 4: Using calculators

Activity

Now ask trainees to consider how they would do calculations like these on calculators when numbers are not as simple, like 6 out of 47.

Start with some familiar calculations first, e.g.

a) 6 out of 50  
   b) 6 out of 25  
   c) 6 out of 20

Possible questions:

♦ Can you do them on your calculator?
♦ Which buttons did you use?
♦ Do you get the same answer as before?

Demonstrate using one of the questions as an example, how to do it using the % button.

\[
\frac{6}{25} \rightarrow 6 \div 25 \% 
\]

Discuss whether the key is needed or not.

It does not matter if some trainees divide and then multiply by 100 if this is a method they feel more comfortable with:

\[6 \div 25 \times 100\]

Now practise with more complex examples like 6 out of 47:

\[6 \div 47 = \underline{12.76595}\]

Use answers like this to discuss issues of rounding off.

Now hand out the Practice sheet Working percentages.

NAITB, Marr, Anderson & Tout, 1994

Percentages at work  p. 12
Your notes and ideas
1. Finish the table.

<table>
<thead>
<tr>
<th>Week</th>
<th>5/4 - 9/4</th>
<th>Part</th>
<th>Axles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>5/4</td>
<td>6/4</td>
<td>7/4</td>
</tr>
<tr>
<td># Defective</td>
<td>12</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td># Produced</td>
<td>200</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>% Defective</td>
<td>6%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Finish the table.

<table>
<thead>
<tr>
<th>Week</th>
<th>12/4 - 16/4</th>
<th>Part</th>
<th>Tailshafts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>12/4</td>
<td>13/4</td>
<td>14/4</td>
</tr>
<tr>
<td># Defective</td>
<td>14</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td># Produced</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>% Defective</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Finish the table.

<table>
<thead>
<tr>
<th>Week</th>
<th>19/4 - 23/4</th>
<th>Part</th>
<th>Axles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>19/4</td>
<td>20/4</td>
<td>21/4</td>
</tr>
<tr>
<td># Defective</td>
<td>21</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td># Produced</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>% Defective</td>
<td></td>
<td>6%</td>
<td></td>
</tr>
</tbody>
</table>
### Percentage attendance

1. Finish the table.

#### Paint shop

<table>
<thead>
<tr>
<th>Week</th>
<th>Section</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3/5 - 7/5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>M</td>
<td>T</td>
</tr>
<tr>
<td>Attendance</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>% Attendance</td>
<td>80%</td>
<td></td>
</tr>
</tbody>
</table>

2. Finish the table.

#### Paint shop

<table>
<thead>
<tr>
<th>Week</th>
<th>Section</th>
<th>Green</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10/5 - 14/5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>M</td>
<td>T</td>
</tr>
<tr>
<td>Attendance</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>% Attendance</td>
<td>72%</td>
<td></td>
</tr>
</tbody>
</table>

3. Finish the table.

#### Paint shop

<table>
<thead>
<tr>
<th>Week</th>
<th>Section</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>17/5 - 21/5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>M</td>
<td>T</td>
</tr>
<tr>
<td>Attendance</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>% Attendance</td>
<td>70%</td>
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</table>
Working percentages

How many of these can you do in your head?
Use a calculator for the others.

1. 8 people out of 200 are away from a factory because of illness. What percentage of people are away?

2. A bad production run caused 9 panels out of 20 to be faulty. What percentage is faulty? What percentage is OK?

3. On Tuesday 34 people were present out of a total of 40 people. Calculate the percentage of people who were there.

4. From a batch of 480 rotor shafts, only 12 were found to have defects. What is the percentage of defective rotor shafts?

5. This table for December 1992 shows vehicle registrations for each car company.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>No. of Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ford</td>
<td>10,162</td>
</tr>
<tr>
<td>Holden</td>
<td>8,848</td>
</tr>
<tr>
<td>Mazda</td>
<td>2,057</td>
</tr>
<tr>
<td>Nissan</td>
<td>2,313</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td>5,499</td>
</tr>
<tr>
<td>Toyota</td>
<td>5,981</td>
</tr>
<tr>
<td>Other</td>
<td>6,163</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41,023</strong></td>
</tr>
</tbody>
</table>

(Source: A.B.S December 1992)
PRACTICE SHEET

Hundred grid

<p>| | | | | | | | | | |</p>
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Percentages at work — NAITB, Marr, Anderson & Tout, 1994
PERCENTAGES - MAJOR FACTS

• To find a percentage you always need to know the total.
• Percentage means: "out of 100", "in every 100", "per 100"
• Percentage is written as \%.

**EXAMPLE**
What percentage is 15 out of 300?

For 15 out of 300, then
how many out of 100?

15 out of 300 looks like:

So 15 out of 300 is the same as 5 out of 100.

which is 5%.

**EXAMPLE**
What percentage is 8 out of 25?

For 8 out of 25, then
how many out of 100?

8 out of 25 looks like:

Putting 4 of these together to make 100 gives:

8 out of 25 is the same as 32 out of 100.
So, 8 out of 25 is 32%.

**EXAMPLE**: Percentages on your calculator
What percentage is 96 out of 512? Press:

So, 96 out of 512 is 18.75%.

---

Percentages at Work - NAITB, Marr, Anderson and Tout, 1994
Working percentages

1. 8 out of 200 is 4%
2. 9 out of 20 is 45%
3. 34 out of 40 is 85%
4. 12 out of 480 is 2.5%
5. a) Fords - 24.77%
   b) Holdens - 21.57%
   c) Mitsubishis - 13.40%
   d) Toyotas - 14.58%

Percentages at work — NAITB, Marr, Anderson & Tout, 1994
Charts & Graphs - reading for meaning

Purpose

Graphs, or charts, are an effective means of conveying a great deal of information quickly. They are used widely in the modern workforce. However, to many of the workers unfamiliar with them, they remain a mysterious tool which they do not understand. Others, who do appreciate the messages told by graphs, lack the English language vocabulary to express their thoughts to other workers or supervisors.

The activities in this section are designed to help with the reading and plotting of charts and graphs and the use of English to discuss their messages. Part 1 contains activities to help trainees tune into the overall pictures or stories that graphs can convey. Part 2 uses the trainees' common sense and prior knowledge to analyse particular graphs in terms of the big picture, as well as reading specific points. To complete this section trainees sketch their own graphs, an activity which requires them to think about suitable scales.

Some of the different types of graphs that may be encountered in the workplace, such as run charts (line graphs), bar charts and Pareto diagrams, are covered in Parts 3, 4 and 5. Part 4 focusses on pie charts, whilst the final part requires calculations to be made, and gives trainees practice in plotting points and analysing charts.
Background

The initial activities in *Charts and Graphs* use quick group activities with cut out pieces to manipulate. These are used for a number of reasons:

- they allow for the introduction of technical language in a non-threatening way;
- the activities can be done quickly without having to take the time worrying about copying and spelling new vocabulary or language introduced during the class;
- it is less threatening to move cut outs around than to cross out and re-write answers;
- the use of the cut outs also decreases the feeling of being 'wrong' and usually furthers both confidence and understanding;
- having only one set of pieces in the centre of the table also assists the small group to work together and talk about their decisions. This way, they will use more of the language than if they were using an individual worksheet.

While these activities take slightly longer to prepare than a standard worksheet the benefits from their usage make this extra preparation worthwhile. Anyway, once cut out, these activities can be reused many times.

What to prepare

- For each individual trainee you will need a copy of the following Practice and Activity Sheets:
  - *Pumping petrol 2*
  - *Pumping petrol 2 - statements*
  - *Types of charts*
  - *Pie charts*
  - *Reading pie charts*
  - *The ups and downs of attendance*
  - *Graphing production*
  - *Pareto plots problems*

- For each group of 2 or 3 trainees you will need separate labelled envelopes or plastic bags containing the cut up pieces from:
  - *Getting a line on graphs - statements*
  - *Comparable graphs - statements*
  - *Pumping petrol 1 - words*
  - *Blank grid*
  - *Which charts work?*

It is best to photocopy each of these activities onto different coloured cardboard.
For each group of 2 or 3 trainees you will need a copy of the following Activity Sheets:

- Getting a line on graphs
- Comparable graphs
- Pumping petrol 1

Optional

Make an overhead transparency of each of the following sheets:

- Pumping petrol 1
- The ups and downs of attendance
- Graphing production
- Pareto plots problems
Part 1
Understanding charts

Introduces the reading of graphs or charts in order to help trainees gain overall pictures of the information within them, such as trends and variations.

Introduces English words to describe sections of a graph: both common usage and more specific mathematical words. It requires the reading of the scales and specific points on the graph, as well as reinforcing the language. Trainees also sketch their own graph to do with a workplace situation.

Part 2
Pumping petrol

Different types of commonly encountered workplace charts are identified and some reasons for their use discussed.

Covers the reading and understanding of pie charts, with trainees also able to sketch their own charts.

Part 3
The type of chart

Part 4
Understanding pie charts

Part 5
Understanding the plot

Run charts, bar charts and Pareto diagrams are plotted and analysed.

END
Part 1: Understanding charts

Activity - Getting a line on graphs

Hand out to each group a *Getting a line on graphs* sheet and an envelope containing the *Getting a line on graphs statements*.

Ask groups to match each statement with a graph or chart. Hold up one statement and the graph sheet to make this clear.

Allow time for groups to complete the activity. Move amongst the groups to help generate discussion.

Check understanding when they have finished by discussing solutions and asking trainees to say why they matched each statement to a particular chart.

Use the questions below to introduce and develop understanding of the words: range, fluctuating, increasing, decreasing, and trend.

Ask:
- Which of these charts would make the employer happy? Why?
  
  *Answer: Probably charts 1 and 3 - attendance rising or already high.*

  For each graph ask:
  - Was the range of attendance small or large?
    *Answer: Chart 3 small - others probably high.*
  - Was attendance increasing, decreasing or fluctuating?
    *Answer: Fluctuating for charts 2 and 4.*
  - Do any of these charts show a trend? Which one(s)?
    *Answer: Chart 1 - the trend is increasing.*

Activity - Comparable graphs

To each group distribute a *Comparable graphs* sheet and an envelope containing the *Comparable graph statements.*
Ask groups to match each statement card with a chart.

Move around the room to prompt discussion within the groups as they complete the activity.

As before discuss their solutions and the reasons behind them.

Ask:
• Look at Chart 1. How else could it be described?
  Answer: Day not as good as night.
• Which of these charts would make the employer happy?
  Answer: Chart 2 as both shifts improving. Possible other responses: chart 3, happy with day shift; and chart 1, happy with night shift.
• Which of the charts has the widest range?
  Answer: Chart 3, night shift.
• Is there any way that the chart could be redesigned to make the trends and range clearer?
  Answer: Using a bigger scale on a vertical axis would help - only need to show 60% or 70% up to 100%.

Part 2: Pumping petrol

Activity - Pumping petrol 1

To each small group distribute a Pumping petrol 1 graph.

Ask the groups to look at the graph.

Explain to the whole class that the vertical axis is measuring the amount of petrol in the underground tank at a small service station.

As a group they should see if they can decide what 'story' the graph might be telling them.

If they need more prompting use specific questions, for example:
• What do the level bits tell you?
• What about these steep bits? etc
Discuss some of the ideas they come up with - see if there is agreement on each.

**Now say:**
We are going to look at the words and phrases you would use in English to describe this graph.

Give out the envelope containing the *Pumping petrol 1* words, and tell trainees that they have to place the cards from the envelope onto the graph in the most likely positions.

Use an overhead transparency of the graph and compare where groups have placed the words. It will help to write the words onto the overhead transparency or project the transparency onto a whiteboard and write the words on the board.

Point to various parts of the graph and get trainees to describe each section using their own words. Use this to build up a vocabulary list on the board.

**Activity - Pumping petrol 2**

To each group distribute a *Pumping petrol 2* graph. Explain that this looks the same as the last but this time it has numbers on the axes.

To tie in with their stories from Graph 1 and to give practice at reading from the graph, ask questions like those following, until everyone in the group has an idea of how to read the graph and understands the scales.

Give them time, as a group, to decide answers to the questions, allowing time for individuals to assist each other in reading the scales and interpreting the graph.

**Possible questions:**

♦ How much petrol was in storage when the station opened? When it closed?
  
  *Answer: Opened - 100 kilolitres, closed - 124 kilolitres.*

♦ When was there 130 kilolitres in storage?
  
  *Answer: 8.00 pm, and for an instant during filling.*
How much petrol was in storage at 6 pm, 12.30 pm and 9.15 am?

Answers:
6.00 pm: 140 kilolitres
12.30 pm: 150 kilolitres
9.15 am: 95 kilolitres

When were the busiest times?
Answer: 8.00 am to 10.00 am & 5.00 pm to 8.00 pm
- How do you know?
- Why would this be?
Answer: - Steepest slope - most petrol being sold.
- Peak hours for people driving to and from work.

What happened at 11.30 am?
Answer: A tanker arrived and filled the tanks.

How much petrol did the tanker deliver?
Answer: About 58 kilolitres.

How big do you think the underground tank is?
Answer: 150 kilolitres, providing it was filled right up.

How often do you think the tanker would need to come?
Answer: About every two days.

Can you tell which side of the road the petrol station is on: the left hand side going into the city or the left hand side coming from the city? Why?
Answer: Probably the left hand side coming from the city because sales are higher in the afternoon. Other interpretations are possible.

Hand out the *Pumping petrol 2 statements* sheet, one per person or pair.

The groups need to use both the graph and the words in the box at the bottom of the sheet to help complete the statements. In the box there are two possible words for each statement, so two spaces to fill in.

Allow time for groups to finish. Check understanding by comparing which words were used in each statement.

**Extension or Replacement Activity**

Use workplace charts or graphs to mirror this activity - place the cards on actual workplace graphs, or even slightly exaggerated versions. Make up sentences similar to the accompanying Activity Sheet, which describe your own workplace graph.
Discuss the real workplace implications of sharp rises, constant results, and gradual decreases.

**Activity - Creating your own charts**

The aim of this activity is to get trainees to create charts or graphs of their own which tell a story (similar to the petrol graph). This will involve creating their own scales and therefore gaining a greater understanding of scales and axes than they would by merely plotting points or reading from a graph.

Think of a situation, or quantity, relevant to your workplaces that changes over a 12 or 24 hour period - one which would be familiar and manageable to your group of trainees.

Examples could be:

- The number of people in the work canteen at any time over a 12 hour period.
  
  *Answer:* This would probably show peaks at morning tea and lunch times.

- The number of people working in their plant at any time over a 24 hour period.
  
  *Answer:* Should show steep rises and falls at shift change times.

- The number of particular component parts in a bin over a 12 or 24 hour period.
  
  *Answer:* Should show steep rises regularly when refilling occurs, and constant levels when no-one is working.

After deciding on one situation for the group to graph, hand out one copy of the Blank chart sheet to each pair of trainees and ask them to create their own imagined version of the graph.

Tell them to make sure that scale markings are shown clearly and axes are labelled.

Allow plenty of time for discussion.

Move around the room to give help and ask questions about their graphs.
The more experienced the trainee, the more probing your questions can be. Concentrate on making sure everyone becomes a little more skilled at creating charts or graphs than they were before.

At the end ensure that each pair's chart is looked at and their story interpreted - either by you, the Trainer, or other class members. Pairs could swap graphs between them.

**Extension**

- Ask trainees to write the story, or some short sentences, about their own, or other peoples', graphs.
- Use the word cards from *Pumping petrol* 1 to label parts of their own graph or ask them to write similar labels on their own graph in coloured pen.

**Part 3: The type of chart**

**Activity - Which charts work?**

Ask trainees to work in pairs for this activity.

Hand out on envelope containing the activity *Which charts work?* to each pair.

Say:

- Each statement or fact card matches two of the chart cards.
- Match the statements with the charts. You should have 3 groups of 3 cards.

Allow time for trainees to complete this activity. Move around the room to promote discussion.

Compare results from each group. Ask questions about how they decided which chart belongs with a particular statement.
**Ask:**

◊ Do you know what some of these kinds of charts are called? If so which ones?

If trainees do not offer suggestions you could begin by asking questions containing more pointed hints:

◊ Are any of them called Bar Charts? Run Charts? (line graphs)
◊ Do you know which is a Pareto Diagram?
◊ Do you know which is a Pie Chart?

The names will be reinforced in the next few activities so it is not necessary for trainees to learn them all at this stage. However, as a record of this activity, and to assist in the following discussion, you could hand out the *Types of charts* Summary Sheet.

Now discuss the differences between the types of charts and what they are used for. Ask trainees to keep their groupings of three cards in front of them for this discussion.

**Possible questions:**

◊ What are the differences between the two run charts 1 and 6?
  
  *Answer:* 1. is recording two things at once, while 6. records only one.

◊ What are the differences between the Bar Charts 2 and 5?
  
  *Answer:* 5. is also recording two different measures.

◊ Which ones have time along the bottom (horizontal) axis? Or which ones change over time?
  
  *Answer:* 1, 2, 5, 6.

◊ Could a Pie Chart like 4 be used to show something that changes over time?
  
  - Why or why not?

**Extension question:**

◊ What are Pareto Diagrams like 3 used for in your workplace?

---

*Pie charts and Pareto diagrams are used to show comparisons of different quantities at a given time eg percentage market share or sales figures for different companies this year; whereas run charts and bar charts are used to show trends changing over time, eg a particular company's sales figures changing over a year.*
Part 4: Understanding pie charts

Activity - Pie charts

To each pair of trainees hand a copy of the Activity Sheet 'Pie Charts'.

Ask:
♦ Which type of vehicle do they make most of?
♦ How do you know?
♦ What percentage is this type out of all the cars made?

After this introduction to Pie Charts trainees should complete the rest of Question 1.

Check their understanding by discussion.

Ask:
♦ If we add all the percentages on the pie chart what do we get?
♦ Is this true for all pie charts?

Extension Activity - Making a pie chart

♦ What type of car do you drive, 4 cyl, 6 cyl etc. Does anyone have a four wheel drive?
♦ Roughly what percentage is this of all our groups vehicles?

As a group, make a pie chart to represent type of car ownership in the class or, to get even better results, go out of the room and each ask 10 other people for their type of car. Use a photocopy of the Blank pie chart grids sheet.

Now go to question 2 on 'Pie Charts'.

Ask:
♦ What is the percentage of Asian workers?
♦ How do you know? (Refer to the whole pie being 100%).

Allow time for trainees to complete the questions. Check understanding again by going through their responses.
Possible questions for discussion:
♦ What would your workplace chart look like?
♦ What nationalities may be in the European group?
  Asian group?
♦ What nationalities may be in the 'other' group?

Extension
Give out a blank pie chart to trainees in pairs or groups -
one per group. Ask them to quickly draw what they think
will be an approximation of a similar pie chart for their plant
or factory.

Make sure that the 'slices' are labelled with their
percentage and that everyone is aware to check that the
percentages add up to 100.

When this is done the group can compare their charts and
see how similar their guesses are.

The next Practice Sheet, Reading pie charts, should be
used to follow up this sheet. It can be done in class in pairs
or at home for practice.

Part 5: Understanding the plot

Activity - The ups and downs of attendance

There are several purposes for this activity: it gives further
practice at reading and interpreting graphs; it involves the
plotting of points and therefore requires the interpretation
of a scale; and it involves the calculation of percentages
using methods similar to those used in the
workplace (although simplified a little).

To each pair of trainees hand a copy of the
Activity Sheet, The ups and downs of
attendance.

Ask them to answer the first two questions
by reading the chart (graph). If necessary
use an overhead transparency of the activity
sheet to help explain what is required.
Allow time for them to complete the two questions. Check their understanding by comparing responses. When doing this highlight reading from the graph not the table. Some trainees may obtain the percentages by calculating the figures in the table without reading the graph or chart. If so, link the figures in the table to those on the chart and make sure they can understand the scale in order to read from the graph.

Now hand out extra copies of the Activity Sheet so that everyone has their own sheet in order to complete the table and the chart.

Make sure that you discuss how to fill in the spaces in the table. Since the chart/graph shows percentage attendance it is essential to know the number per hundred.

eg. \( \frac{44}{50} \text{ is } 88\% \)

or \( 86\% \rightarrow \frac{86}{100} \text{ becomes } \frac{43}{50} \)

Move around and help where necessary. Again use the overhead transparency to check understanding.

Now get trainees to finish the rest of the sheet and to talk about their answers with each other. Again check their understanding using the overhead.

Discuss some of the messages given by the graph and practice some of the vocabulary introduced earlier with the following questions.

Ask:

- Why would the attendance fall so much in June, July and August?
  
  \( \text{Answer: Winter - sickness of employees or their children} \)

- Which months had the sharpest falls?
  
  \( \text{Answer: June and November} \)

- Which months had the steepest rise?
  
  \( \text{Answer: September and December} \)
**Activity - Plotting run and bar charts**

To each trainee distribute a copy of the Activity Sheet, 

*Graphing production.* Explain that this is a chart used in many companies to record daily production figures in each section. This section makes Cylinder Heads for car engines.

Using an overhead transparency of the sheet ask trainees to show you where the production for the first few days should be plotted. Then join the up the points with a straight line to start the line graph or run chart. Ask trainees to complete the rest of it themselves.

Allow time for them to finish and use the overhead transparency to check their solutions.

Ask:

- What might cause the production to vary from day to day?
  
  Possible answers: Machine maintenance or breakdown, workers absent, other products being made ...

Now refer trainees to the second chart. Say, that sometimes bar charts are used instead of run charts and they will now have a look at one.

Ask:

- Can anyone see what this chart is about?
- What do you think 'Percentage OK' means?
- Where would the top of the bar for Day 1 be?
- How wide should it be?
- Do you know other ways of saying or describing Percentage OK?
- What term does this factory use?
- Why would the Percentage OK (or use their terminology) vary?
  
  Possible answers: Faulty machines or settings, worker inattention, faulty parts going into machines, etc.

Let the trainees try days 2 and 3 and check their understanding using the overhead transparency. Then get them to complete the bar chart.

'Percentage OK' is the percentage of parts produced for the day which are acceptable or usable immediately.
Now ask the groups to refer to both graphs.

Ask:
• Can you see any connections between the shape of the graphs?
• When the production is high for a particular day what happens to the Percentage OK?
  Answer: Percentage OK figure drops.
• What could cause this?
  Possible answer: Rushing production could lead to more mistakes being made.

Finish off the discussion of this activity by comparing the advantages of each type of chart as follows.

Possible questions:
• Which of these two charts was easier to plot? Why?
• Would it have made any difference if the Production was plotted with a bar chart and the Percentage OK with a run chart?
  Possible answers to these questions: Probably no difference, graphs are interchangeable.
• Is it necessary to connect the points in a run chart?
• Why do people usually connect the points.

Activity - Pareto plots problems

Ask:
• Have you seen Pareto charts?
• What are they used for?

If necessary, have the overhead transparency, *Types of charts*, to remind trainees what a Pareto diagram looks like.

Hand out the Activity Sheet *Pareto plots problems*.

Say:
• These were faults found on door panels for a day. We will use these figures to draw a Pareto diagram.

Ask trainees to do Question 1.
Allow trainees time to think about the scale themselves, but if it is apparent that most need help, draw their attention to the overhead transparency of the Activity Sheet *Pareto plots problems* and discuss as follows.

**Ask (if necessary):**
- What scale do you think we should use here?
- Should we go up by ones, two, fours, fives?

When the scale is decided upon allow time for the trainees to complete the diagram. Check their understanding by using the overhead transparency. Make sure that trainees write the type of fault in the space under each bar.

Use an overhead transparency and ask the group where to draw each bar.

**Ask:**
- Why was scratches first?
  *Answer: It was the largest figure*

Now refer trainees to question 2.

**Ask:**
- How many dents were there?
  *Answer: 14*
- How do you know?
  *Answer: by counting the tally marks 5 + 5 + 4.*
- How many paint faults were there?
  *Answer: 11 (5 + 5 + 1)*
- How many other faults were there?
  *Answer: 6*
- Which bar will we draw first?
  *Answer: Dents*
- Which bar will be next?
  *Answer: Scratches*

Now ask the group to draw the Pareto diagram, choosing a scale which fills most of the graph.
Your notes and ideas
Getting a line on graphs

1. Attendance
   100%
   J F M A M J J A S O N D
   50%

2. Attendance
   100%
   J F M A M J J A S O N D
   50%

3. Attendance
   100%
   J F M A M J J A S O N D
   50%

4. Attendance
   100%
   J F M A M J J A S O N D
   50%
Getting a line on graphs - statements

- attendance getting better
- attendance falls in winter
- attendance always high
- attendance is unpredictable

Charts & Graphs - reading for meaning — NAITB, Marr, Anderson & Tout, 1994 — p.20
Comparable graphs

1. | Percentage | OK |
   | 100%       |
   | 80%        |
   | 60%        |
   | 40%        |
   | 20%        |
   | 0%         |
   | 5/7        |
   | 6/7        |
   | 7/7        |
   | 8/7        |
   | 9/7        |
   | date       |
   | Day shift  |
   | Night shift|

2. | Percentage | OK |
   | 100%       |
   | 80%        |
   | 60%        |
   | 40%        |
   | 20%        |
   | 0%         |
   | 12/7       |
   | 13/7       |
   | 14/7       |
   | 15/7       |
   | 16/7       |
   | date       |
   | Day shift  |
   | Night shift|

3. | Percentage | OK |
   | 100%       |
   | 80%        |
   | 60%        |
   | 40%        |
   | 20%        |
   | 0%         |
   | 19/7       |
   | 20/7       |
   | 21/7       |
   | 22/7       |
   | 23/7       |
   | date       |
   | Day shift  |
   | Night shift|

4. | Percentage | OK |
   | 100%       |
   | 80%        |
   | 60%        |
   | 40%        |
   | 20%        |
   | 0%         |
   | 26/7       |
   | 27/7       |
   | 28/7       |
   | 29/7       |
   | 30/7       |
   | date       |
   | Day shift  |
   | Night shift|

Charts & Graphs - reading for meaning — NAITB, Marr, Anderson & Tout, 1994 — p.21
Comparable graphs - statements

- night better
- both improved
- night has more variation
- day decreasing

- night better
- both improved
- night has more variation
- day decreasing
Pumping Period 1
Pumping petrol 1 - words

<table>
<thead>
<tr>
<th>maximum</th>
<th>maximum</th>
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</thead>
<tbody>
<tr>
<td>minimum</td>
<td>minimum</td>
</tr>
<tr>
<td>constant</td>
<td>constant</td>
</tr>
<tr>
<td>sharp rise</td>
<td>sharp rise</td>
</tr>
<tr>
<td>gradual decrease</td>
<td>gradual decrease</td>
</tr>
</tbody>
</table>
Pumping petrol 2

No. of kilolitres (kL) in storage

<table>
<thead>
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<th>2am</th>
<th>4am</th>
<th>6am</th>
<th>8am</th>
<th>10am</th>
<th>12pm</th>
<th>2pm</th>
<th>4pm</th>
<th>6pm</th>
<th>8pm</th>
<th>10pm</th>
<th>Midnight</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 kL</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>140 kL</td>
</tr>
<tr>
<td>130 kL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>130 kL</td>
</tr>
<tr>
<td>120 kL</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>120 kL</td>
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<td></td>
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<td></td>
<td>110 kL</td>
</tr>
<tr>
<td>100 kL</td>
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<td>100 kL</td>
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<td>90 kL</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>90 kL</td>
</tr>
</tbody>
</table>

Charts & Graphs - reading for meaning  NAITB, Marr, Anderson, & Tout, 1994
Pumping petrol 2 - statements

Use two words from the list below to complete each of the statements about the graph, Pumping petrol 2.

1. After 5 pm the slope was _______ than before 5 pm.

2. Between midnight and 6 am the number of kilolitres of petrol in storage was _______.

3. The amount of petrol was _______ at 12.30 pm.

4. The gradient from 6 to 8 am was _______ than from 8 to 10 am.

5. The rise was _______ between 11.30 am and 12.30 pm.

<table>
<thead>
<tr>
<th>sharpest</th>
<th>constant</th>
<th>steepest</th>
<th>maximum</th>
<th>less</th>
</tr>
</thead>
<tbody>
<tr>
<td>highest</td>
<td>steeper</td>
<td>not changing</td>
<td>smaller</td>
<td>greater</td>
</tr>
</tbody>
</table>
There are 6 main types of workplace accidents

Over 6 months the quality of work has improved.

This year production for the first 6 months is better than last year.

Charts & Graphs - reading for meaning — NAITB, Marr, Anderson & Tout, 1994
Types of charts

1. Run chart or line graph
2. Bar chart
3. Pareto diagram
4. Pie chart
5. Bar chart
6. Run chart or line graph
1. Button Car Factory makes the following types of vehicles.

Fill in the percentages using the figures from the box below.

- 4 cylinder: __________%
- 6 cylinder: __________%
- 8 cylinder: __________%
- 4 wheel drive: __________%
- Commercial vehicles: __________%
- The total is: __________%

2. Where workers come from.

These are figures from a survey.

- The largest group was ________.
- The smallest group was ________.
- The Asian group was ________%.
Find the missing percentage.

1. Victorian Manufacturing Sector
   VAITB Industry Training Plan '91-'94

2. Car sales 1992
   PAXUS Corporation Limited

3. Petroleum Products 1990
   Aust. Institute of Petroleum

4. Automotive Exports 1992
   Aust. Bureau of Statistics

5. Petrol Money 1992 - where the money went
   Black & White Data Book

6. Road deaths
   Federal Office of Road Safety, 1991

Charts & Graphs - reading for meaning — NAITB, Marr, Anderson & Tout, 1994 — p.32
The ups and downs of attendance

Read from the chart (graph) to finish these sentences.

1. The attendance in January was _____%.

2. The difference in the attendance between May and August was _____%.

3. Finish the table and chart - fill in the spaces.

4. Use the words from the box to finish the sentences.

   The _______ attendance was in December.

   From February to April the attendance was _____________.

   The minimum attendance was in _________________.

   From May to August the attendance _________________.

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
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<td>46</td>
<td>46</td>
<td>47</td>
<td>40</td>
<td>39</td>
<td>44</td>
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<tr>
<td>Total</td>
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<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
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</tr>
<tr>
<td>Percent</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>86</td>
<td>80</td>
<td>88</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Charts & Graphs - reading for meaning — NAITB, Marr, Anderson & Tout, 1994 — p.33
Graphing production

1. Draw a run chart (line graph) for the production figures given.

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number produced:</td>
<td>600</td>
<td>400</td>
<td>300</td>
<td>300</td>
<td>350</td>
<td>340</td>
<td>640</td>
<td>600</td>
<td>540</td>
<td>440</td>
<td>340</td>
<td>350</td>
<td>360</td>
<td>680</td>
<td>470</td>
</tr>
</tbody>
</table>

2. Draw a bar chart for the "Percentage O.K." figures for the same 15 days.

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent O.K.:</td>
<td>90</td>
<td>93</td>
<td>97</td>
<td>97</td>
<td>94</td>
<td>97</td>
<td>89</td>
<td>90</td>
<td>94</td>
<td>95</td>
<td>97</td>
<td>97</td>
<td>97</td>
<td>88</td>
<td>95</td>
</tr>
</tbody>
</table>
1. 120 door panels were inspected.
   The defects were:
   - Scratches: 24
   - Dents: 19
   - Paint: 17
   - Other: 14

   Draw the Pareto diagram.

2. Draw a Pareto diagram from this defect checklist.

   Defect checklist - boot panels
<table>
<thead>
<tr>
<th>Defect</th>
<th>Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scratches</td>
<td>📈</td>
</tr>
<tr>
<td>Dents</td>
<td>📈</td>
</tr>
<tr>
<td>Paint</td>
<td>📈</td>
</tr>
<tr>
<td>Other</td>
<td>📈</td>
</tr>
</tbody>
</table>

   Draw the Pareto diagram.
Pumping petrol 2 - statements

Use two words from the list below to complete each of the statements about the graph, "Pumping petrol 2."

- After 5 pm the slope was **steeper** than before 5 pm.
- Between midnight and 6 am the number of kilolitres of petrol in storage was **constant**.
- The amount of petrol was **maximum** at 12:30 pm.
- The gradient from 6 to 8 am was **less** than from 8 to 10 am.
- The rise was **sharpest** between 11:30 am and 12:30 pm.

<table>
<thead>
<tr>
<th>sharpest</th>
<th>constant</th>
<th>steepest</th>
<th>maximum</th>
<th>less</th>
</tr>
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<td>steeper</td>
<td>not changing</td>
<td>smaller</td>
<td>greater</td>
</tr>
</tbody>
</table>

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Pie charts

1. Button Car Factory makes the following types of vehicles:

   - 4 cylinder: 60%
   - 6 cylinder: 40%
   - 8 cylinder: 10%
   - 4 wheel drive: 10%
   - Commercial vehicles: 15%
   - The total is: 100%

2. Where workers come from. These are figures from a survey:

   - European: 50%
   - African: 25%
   - Asian: 15%
   - Other: 10%
   - The largest group was **European**.
   - The smallest group was **Other**.
   - The Asian group was **25%**.
The ups and downs of attendance

Read from the chart (graph) to finish these sentences.
1. The attendance in January was 80%.
2. The difference in the attendance between May and August was 15%.
3. Finish the table and chart - fill in the spaces.

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>66</td>
<td>66</td>
<td>56</td>
<td>50</td>
<td>67</td>
<td>62</td>
<td>70</td>
<td>68</td>
<td>66</td>
<td>66</td>
<td>66</td>
<td>66</td>
</tr>
<tr>
<td>Percent</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
</tr>
</tbody>
</table>

4. Use the words from the box to finish the sentences.

The **maximum** attendance was in December.
From February to April the attendance was **constant**.
The minimum attendance was in **August**.
From May to August the attendance **decreased**.

Pareto plots problems

- 120 door panels were inspected.
The defects were:
  - Scratches: 24
  - Dents: 10
  - Paint: 17
  - Other: 14

- Draw the Pareto diagram.

- Draw a Pareto diagram for the defect checklist.
  - Defect checklist - boot panels:
    - Scratches: 20
    - Dents: 15
    - Paint: 10
    - Other: 3

Charts & Graphs - reading for meaning — NAITB, Marr, Anderson & Tout, 1994
Where do we start?

Order of operations

Purpose

There is a standard order in which you have to do adding (+), subtracting (-), multiplying (x) and dividing (÷) when they are all mixed up together in a formula or a line of calculations.

These activities are designed to show the reasons behind these rules and give practice at using them with and without calculators. Calculators are very useful tools, but they need to be used carefully and effectively.
**Background**

Sometimes this order of doing the arithmetical operations may have been learnt at school or in training as the BODMAS rule. We feel that this is unnecessary, easily forgotten and confusing, and as well can be a specific problem for people whose English isn't strong.

In fact only **three main steps** need to be learnt, and using the BODMAS rule can complicate the process.

By using a familiar situation that is logical, the rules can be developed easily and quickly without the need to resort to a complicated, unfamiliar rule.

As with other activities, we believe that maths is best learnt through activities, and through talking and discussing. These notes are designed for you to adapt to your own needs and situations. Please feel free to change them and to add your own ideas and activities. In particular it makes sense to add examples from your workplace.

We have prepared some handouts for you to give to your trainees at the end as a summary of the activity. This means they don't have to take notes during the session and can concentrate on joining in and understanding the ideas.

**What to prepare**

You need to have available for this unit enough of the following materials for each trainee in your group:

- photocopies of each Activity Sheet
  - Buying up the specials
  - Out to lunch
  - Can I pay for it?
  - Sharing the cost
  - More practice
- calculators - encourage each trainee to bring their own, if they have one, otherwise a class set will be needed.

**Who's it for?**

This introductory unit is suitable for trainees who are in need of support in how to calculate quickly and efficiently in their heads or using calculators. More advanced trainees may not need to cover all of this work, although it would be worth checking out whether they can use their Memory Buttons on their calculator, and are aware of the order of doing calculations.
Outline of section

Part 1
Ordering Operations

Introduces the concept of multiplying and dividing before adding and subtracting.

Part 2
Using brackets

Introduces how we can use brackets ( ) to highlight parts of calculations which need to be done first.

Part 3
More complications - 'of'

Relates how we use the word 'of' in the same ways as either $\times$ or $\div$

Do you need to cover the BODMAS rule?

No

Yes

Part 4
The BODMAS rule

Covers how the order of doing calculations relates to the formal rule - the BODMAS rule. This is ONLY needed if trainees are to meet this in their workplace training or remember it from school.

Part 5
The helpful M+ button

Shows how useful Memory buttons are on a calculator.

END

Where do we start?  p. 3

NAITB, Marr, Anderson & Tout, 1994
Part 1: Ordering operations

Activity
Give out Activity Sheet - *Buying up the specials.*
Give trainees time to solve the problems, then use the questions to begin a discussion about what they did.

Ask:
* What maths did you use?
* Which questions used what maths?
* Did you add?
* Did you multiply?
* Can you remember which came first - multiply or add?
* How can we write these sums down?

Presentation
Write up some of the problems as a sum.

e.g. Question 3

\[\text{\$5 + 2 \times \$7 + 3 \times \$9 + 4 \times \$10 + \$22 + 3 \times \$7} \]
\[= \text{\$5 + \$14 + \$27 + \$40 + \$22 + \$21} \]
\[= \text{\$129} \]

Get trainees to work the same questions out using a calculator.

Ask:
* Do we get the same answers?
* If not, why not?
* How can we get the right answers?

Presentation
Give a simple example like \(3 + 4 \times 5\) to do on the calculator. Allow a minute or two and discuss the results.
Explain that most calculators will get an incorrect answer of 35 because they perform the operations as you enter the numbers - here the addition first, then the multiplication:

\[ 3 + 4 \times 5 = \]

That is, in this example they add the 3 to the 4 first to get 7, then multiply that by the 5 to get 35.

The answer should have been 3 plus 20 is 23, because we needed to multiply first.

**Activity**

Give out Activity Sheet - *Can I pay for it?*

Give trainees time to solve the problems, then have a discussion about what maths they used this time.

**Ask:**
- What calculations did you have to do this time?
- What was different from the previous sheet?
- Did you subtract or divide as well?
- Can you remember which came first this time?

**Presentation**

Ask:
- Can we write these down as sums on one line?

Write up some of the questions as a sum.

E.g. Question 2

\[
2 \times \$1.88 + 2 \times \$1.28 + \frac{1}{2} \text{ of } \$7.98 + \frac{1}{5} \text{ of } \$7.98
\]

\[
= 2 \times 1.88 + 2 \times 1.28 + 7.98 \div 2 + 7.98 \div 5
\]

\[
= 3.76 + 2.56 + 3.99 + 1.59
\]

\[
= \$11.90
\]

Remind trainees, if necessary, that
- 'a half of' means the same as 'dividing by two',
- a 'fifth of' means the same as 'dividing by five', etc.

Point out that we now also have to do any dividing first, along with the multiplying, and then adding last.
Ask:
- We've now seen where adding, multiplying and dividing fit in. But what about subtracting?
Ask the trainees to look at Question 3.

\[
\begin{align*}
\$20.00 \times 2 & \times \$0.95 \\
= \$20.00 & \times \$1.90 \\
= \$18.10 &
\end{align*}
\]

We see that to work out the change by subtraction, we also do it last - after any multiplying (and dividing).

**Presentation**

Now you need to pull together the work so far. The summary to date is:

When we have some adding, subtracting, multiplying or dividing to do we need to think about the order in which we do the calculations. This includes when we use our calculators.

The order we need to follow is:

1. Multiplications and divisions \( \times \text{ and } \div \)
2. Additions and subtractions \( + \text{ and } - \)

\( \text{NAITB, Marr, Anderson & Tout, 1994} \)
Part 2: Using brackets

Activity

Give out Activity Sheet - *Out to lunch*. Allow trainees time to solve the problem. Have a group discussion about how we write this down.

Ask:
♦ Did you write anything down?
♦ What did you do first?
♦ Did you add?
♦ Did you multiply?
♦ Can you remember which came first?

Presentation

Method 1 - Individual items first could be presented as:

\[
\begin{align*}
5 \text{ hamburgers cost} & \times 5 \text{ times } 3 = 5 \times 3 = 15 \\
5 \text{ buckets of chips cost} & \times 5 \text{ times } 2 = 5 \times 2 = 10 \\
5 \text{ cans of cokes cost} & \times 5 \text{ times } 1 = 5 \times 1 = 5 \\
\text{This would all add up to } & \text{ } 15 + 10 + 5 = 30.
\end{align*}
\]

With the group, explore how this could be written down in one line by asking:
♦ How could this be written down in one line?
♦ How can you write down what you did in your head?

Show that this can be written down as:

\[
5 \times 3 + 5 \times 2 + 5 \times 1 = 15 + 10 + 5 = 30
\]

Expect different people to use different methods.

Each person's way of solving this is equally valid. You need to pull together these ideas. There are two main ways of doing this:
1. Individual items first.
2. Work out the total of one order first.

Stress again that you multiply first before doing the adding.

The issue here is to work out how you can answer these types of questions using a one line calculation, which relates directly to using a calculator.
Method 2 - Working out the total of one order first could be presented as:

1 hamburger at $3 + chips at $2 + coke at $1 = $6

5 people at $6 each makes 5 lots of $6 = $30

$6 

Again explore how this could be written down in one line with the same questioning as before for Method 1.

Two possible ways to write it down that could be suggested are:

3 + 2 + 1 x 5 \text{ or } 5 x 3 + 2 + 1

Ask:
♦ If we use our rules from before what is the answer to these two sums?

The two possible answers are:

1 \[ 3 + 2 + 1 \times 5 = 3 + 2 + 5 = 10 \]

or

2 \[ 5 \times 3 + 2 + 1 = 15 + 2 + 1 = 18 \]

But these are not the right answers - the total order was supposed to cost $30, as we worked out for method 1.

Possible questions:
♦ To get the right answer what parts of the sum do we have to do first?
♦ Does this mean breaking the rule of multiplying before adding?
♦ Do you know a way we can get around this problem, so that we can do the adding first?
♦ How can we write it down then so that we get the right answer of 30?
Presentation
Draw some brackets on the board.

Ask:
♦ Does anyone know how these might help?
♦ Where should we put in brackets in this question?

Put in brackets:

\[(3 + 2 + 1) \times 5 \quad \text{or} \quad 5 \times (3 + 2 + 1)\]
\[6 \times 5 \quad \text{or} \quad 5 \times 6\]
\[30 \quad \text{or} \quad 30.\]

Reinforce that sometimes we need to use brackets to highlight which bits of a sum we should do first - even before using the rule of multiplying and dividing before adding and subtracting.

Present another example to solve:
\[5 \times (4 + 3 + 5) - (12 + 6 + 2) \div 4\]

Ask trainees to try this themselves before solving it together.

Solution:
\[5 \times (4 + 3 + 5) - (12 + 6 + 2) \div 4\]
\[= 5 \times 12 - 20 \div 4\]
\[= 60 - 5\]
\[= 55\]

1. Do the brackets first - so add the numbers in the brackets
2. Now do the multiplying and dividing before the adding and subtracting
3. Finally do the taking away

Introduce the use of brackets - 

Highlight that we put brackets around the numbers we want to add first. That means we work out that part of the sum before doing the rest.

Emphasise:
Brackets are done before multiplying and dividing.

Where do we start?

NAITB, Marr, Anderson & Tout, 1994
**Part 3: More complications: 'of'**

**Presentation**

Have another look at the Activity Sheet - *Can I pay for it?*

Explain that when we solved Question 2 we used the word 'of'.

2 jars of Pasta sauce at $1.88 which works out as $2 \times 1.88$
and 2 kg of tomatoes at $1.28 which works out as $2 \times 1.28$
and \( \frac{1}{2} \) kg of steak at $7.98 which works out as $7.98 \div 2$
and \( \frac{1}{5} \) kg of silverside at $7.98 which works out as $7.98 \div 5$

The main point to bring out in the discussions is that we have already been using the word 'of', but we've turned it into either a multiply \((\times)\) or a divide \((\div)\).

**Activity**

Give out Activity Sheet - *Sharing the cost*.
Give trainees time to solve the problem.

Ask:

♦ What calculations did you have to do this time?
♦ Which came first this time?
♦ Can we write this down as a sum on one line?

**Presentation**

Stress that the important point this time is that we have to do the dividing (or sharing) by 5 right at the end, and do the other adding and multiplying first. We can either use brackets or the long line that stands for division to highlight that we need to work out the top line first.
Represent the question like:

\[
(3 \times 3 + 4 + 4 + 2 \times 1.50 + 3 \times 1 + 2 \times 1.50) \div 5
\]

\[
= (9 + 4 + 4 + 3 + 3 + 3) \div 5
\]

\[
= 26 \div 5
\]

\[
= \$5.20
\]

or

\[
\frac{3 \times 3 + 4 + 4 + 2 \times 1.50 + 3 \times 1 + 2 \times 1.50}{5}
\]

\[
= \frac{9 + 4 + 4 + 3 + 3 + 3}{5}
\]

\[
= \$5.20
\]

Either way the shared cost is $5.20 each

**Extension**

Discuss where else trainees have come across these type of calculations. If trainees have calculated averages then you could look at the formula for averages. Or refer to others like:

\[
\text{%FTB} = \frac{\# \text{ OK parts (No Rework)}}{\text{Total } \# \text{ of parts}} \times 100
\]

**Conclusion**

Pull together the rules developed so far. That is, there is an **order** in which we have to do our calculations:

1. First: **Brackets**
2. Second: **Of's, multiplies and divides**
3. Last: **Adding, subtracting**

If you do not need to cover the more formal BODMAS rule, sum up the rules to this stage for the order of operations.

*NAITB, Marr, Anderson & Tout, 1994*
Part 4: The BODMAS rule

Ask:

♦ Do you remember these rules from school?
♦ Have you heard of the BODMAS rule?
♦ How do these rules match the BODMAS rule?

Use Summary Sheet - *The BODMAS rule*, as a handout if trainees need to know about the BODMAS rule.

Practice

Give out the Sheet *More practice*, and give trainees time to work out the problems.

Use your own problems and applications if possible, or ask trainees to think of their own problems where these types of calculations come up.

Part 5: The helpful M+ button

Discussion questions:

♦ Have you ever used the M+ button?
♦ What do you think it means?
♦ What other M buttons are there, and what do you think they mean?

Helpful calculator buttons are:

- **M⁺** adds to memory
- **M⁻** subtracts from memory
- **MR** recalls the answer from the memory
- **MC** clears the numbers out of the memory

Where do we start?  p. 12

NAITB, Marr, Anderson & Tout, 1994
Get trainees to try the calculation below without using a calculator.

\[ 5 \times 3 + 4 \times 7 + 2 \times 9 \]

Now ask them to use their calculator, and check their methods.

Ask:
- How did you use your calculator?
- Did you need to write anything down?

Explain that using the \( M^+ \) button is a powerful way of using a calculator without having to write anything down. It can be useful if you were, say, adding up around a supermarket or in a stocktake where it's better not to have to use a pen as well.

Show that this would be entered on a calculator like:

\[
\begin{align*}
5 \times 3 &= M^+ \\
4 \times 7 &= M^+ \\
2 \times 9 &= M^+ 
\end{align*}
\]

**Activity**

Ask trainees to solve the problems on the Activity Sheets - *Buying up the specials* and *Can I pay for it?* using their \( M^+ \) on the calculator.

**Possible questions:**
- Can you think of other uses for \( M^+ \)?
- Could you use it at work?

To stress how this relates to the workplace brainstorm ideas and applications of where you could use \( M^+ \) from the workplace.
Extension Activity

Get trainees to work in pairs with different supermarket, or other, catalogues. Ask them to select ten items they would like to buy, estimate the total cost of these and record the estimate.

Then work out the total cost accurately using a calculator.

Ask them to imagine they have $100 to spend - can they afford to buy these items and if so how much change would they get? If not, how much more money would they need?

Remember to encourage the use of estimation - because the use of calculators without estimation can lead to ridiculous answers.

Your notes and ideas
Buying up the specials

Using the hardware catalogue items, how much would it cost to buy:

1. 2 Compact double adaptors
   3 White light tubes, and
   3 cans of Holts Dupli Colour Auto spray?

2. 3 Garden taps
   4 Stack N Nest cubes
   2 Green Lattices, and
   1 20m Extension lead?

3. 1 Elite window washer,
   2 Selleys All Clear,
   3 Coir door mats,
   4 Circuit breakers,
   1 Hills Laundry Trolley, and
   3 Stack N Nest Cubes?

Can we do these with a calculator? How?

Where do we start? NAITB, Marr, Anderson & Tout, 1994
White Tubes
20/38 [SKU: 1089/07]
$2
EA
Compact Double Adaptor
[SKU: 1004/06]
$3
EA

Elite Window Washer
[SKU: 4536/06]
$5
EA
Garden Taps
1/2" [SKU: 4144/06]
3/4" [SKU: 4927/14]
$6
EA

Selleys All Clear
[SKU: 5068/40]
$7
EA
Coir Mat
No. 2 [SKU: 3723/76]
$9
EA

20m Extension Lead
[SKU: 8441/06]
$15
EA
Green Lattice
2.945 x 1.180 x 60mm
[SKU: 2844/11]
$20
EA

Holts Dupli Colour Auto Spray
[SKU: 2369/66]
$5
EA
Stack N Nest Cubes
[SKU: 1250/09]
$7
EA
Circuit Breakers
8amp [SKU: 5127/12]
16amp [SKU: 5630/05]
$10
EA

Hills Laundry Trolley
[SKU: 637/64]
$22
EA

Where do we start? — NAITB, Marr, Anderson & Tout, 1994 —

p. 16
Can I pay for it?

Using the specials on the Coles advertising brochure, can you work out these problems?

1. How much would it cost to buy 500g of Coon Tasty Cheese, 2 packets of Vita Brits and half a kilogram of thin sausages?

2. How much would it cost to buy 2 jars of Dolmio Pasta sauce, 2 kg of tomatoes, half a kg of porterhouse steak and a fifth of a kg of sliced silverside.

3. If I paid for two packets of spaghetti and paid with $20, how much change would I get?

4. If I only have $25, could I buy 2 kg of thin sausages, half a kg of Pork leg steaks, 1 kg of porterhouse steak, 500 g of Coon tasty cheese and 2 litres of Berri Cordial?

Check your answers with your calculator. Remember though - don't always trust your calculator.
Can I pay for it?

Easy living with Coles easy food ideas.

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbecue Thin Sausages</td>
<td>2.98</td>
</tr>
<tr>
<td>Pork Leg Steaks</td>
<td>8.98</td>
</tr>
<tr>
<td>Porterhouse Steak</td>
<td>7.98</td>
</tr>
<tr>
<td>Firm Ripe Tomatoes</td>
<td>1.28</td>
</tr>
<tr>
<td>Sliced Silverside</td>
<td>7.98</td>
</tr>
<tr>
<td>Coleslaw Salad</td>
<td>3.98</td>
</tr>
<tr>
<td>Farmland Pasta 500g</td>
<td>95c</td>
</tr>
<tr>
<td>Dolmio Pasta Sauce 300g</td>
<td>1.88</td>
</tr>
<tr>
<td>Farmland TwinPk Fresh Chicken</td>
<td>7.98</td>
</tr>
<tr>
<td>Coon Tasty Cheese 300g</td>
<td>3.98</td>
</tr>
<tr>
<td>Vita Beets 780g</td>
<td>1.88</td>
</tr>
<tr>
<td>Berni Cordial 2Litre</td>
<td>2.28</td>
</tr>
</tbody>
</table>

Where do we start? — NAITB, Marr, Anderson & Tout, 1994 —

p. 18
Out to lunch

A family of five went out for lunch one day. Each person had a hamburger, a bucket of chips and a can of coke.

How much did this cost altogether?

How did you work it out? Try to write it down in words or numbers.

<table>
<thead>
<tr>
<th>Take away menu</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HOT FOOD</strong></td>
</tr>
<tr>
<td>Hamburger, with the lot</td>
</tr>
<tr>
<td>Steak sandwich</td>
</tr>
<tr>
<td>Fish &amp; chips:</td>
</tr>
<tr>
<td>Bucket of chips</td>
</tr>
<tr>
<td>Toasted ham &amp; cheese sandwich</td>
</tr>
<tr>
<td><strong>DRINKS</strong></td>
</tr>
<tr>
<td>Cake, Fanta, etc</td>
</tr>
<tr>
<td>Coffee</td>
</tr>
<tr>
<td>Tea</td>
</tr>
<tr>
<td>Cappuccino</td>
</tr>
<tr>
<td>Hot chocolate</td>
</tr>
<tr>
<td><strong>CAKES</strong></td>
</tr>
<tr>
<td>Coffee scrolls</td>
</tr>
<tr>
<td>Muffins</td>
</tr>
<tr>
<td>Carrot cake</td>
</tr>
<tr>
<td>Chocolate cake</td>
</tr>
<tr>
<td><strong>ROLLS</strong> 50c extra</td>
</tr>
</tbody>
</table>

Where do we start? — NAITB, Marr, Anderson & Tout, 1994 —
Sharing the cost

Five friends had lunch together. They shared the cost evenly between them. Altogether they had:

3 hamburgers
1 steak sandwich
1 fish and chips
2 pieces of chocolate cake
3 cans of coke and
2 cappuccinos.

How much did each pay?

Take away menu

<table>
<thead>
<tr>
<th>HOT FOOD</th>
<th>DRINKS</th>
<th>CAKES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburger, with the lot</td>
<td>Coke, Fanta, etc</td>
<td>Coffee scrolls</td>
</tr>
<tr>
<td>Steak sandwich</td>
<td>$3</td>
<td>$1</td>
</tr>
<tr>
<td>Fish &amp; chips</td>
<td>$4</td>
<td>Muffins</td>
</tr>
<tr>
<td>Bucket of chips</td>
<td>$2</td>
<td>Carrot cake</td>
</tr>
<tr>
<td>Toasted ham &amp; cheese sandwich</td>
<td>$2</td>
<td>Chocolate cake</td>
</tr>
</tbody>
</table>

| SANDWICHES                   |            |                  |
| Salad                        | $2         |                  |
| Cold meat                    | $2         |                  |
| Cheese                       | $1.50      |                  |
| Peanut butter or vegemite    | $1.50      |                  |
| ROLLS 50c extra              |            |                  |

Where do we start? — NAITB, Marr, Anderson & Tout, 1994 —
The **BODMAS Rule**

The order in which we have to do our calculations:

1. **First:** Brackets ( ) and _____
2. **Second:** Of’s, multiplies and divides of, $\times$, $\div$
3. **Last:** Adding and subtracting $+$, $-$

You may know this as the **BODMAS** rule:

\[
\begin{align*}
\text{B} & \text{rackets ( )} \\
\text{O} & \text{f Division ÷ Multiplication } \times \\
\text{D} & \text{Addition +} \\
\text{M} & \text{Subtraction -} \\
\text{A} & \text{S}
\end{align*}
\]

**Example:**

\[
\%\text{FTB} = \frac{\# \text{OK parts (No Rework)}}{\text{Total # of parts}} \times 100
\]

Where do we start?  —  NAITB, Marr, Anderson & Tout, 1994

\[
\text{Average} = \bar{x} = \frac{\text{Sum} (x_1 + x_2 + x_3 + \ldots + x_n)}{n}
\]

\[
5 \times 3 + 5 \times 2 + 5 \times 1 = 15 + 10 + 5 \quad \text{multiply first then add}
\]
Buying Up the Specials

1. \[ 2 \times 3 + 3 \times 2 + 3 \times 5 = 6 + 6 + 15 = 27 \]

2. \[ 3 \times 6 + 4 \times 7 + 2 \times 20 + 15 = 18 + 28 + 40 + 15 = 101 \]

3. \[ 5 + 2 \times 7 + 3 \times 9 + 4 \times 10 + 22 + 3 \times 7 = 5 + 14 + 27 + 40 + 22 + 21 = 129 \]

Can I Pay For It?

1. \[ 3.98 + 2 \times 1.88 + 2.98 \div 2 = 3.98 + 3.76 + 1.99 = 9.73 \]

2. \[ 2 \times 1.88 + 2 \times 1.28 + 7.98 \div 2 + 7.98 \div 5 = 3.76 + 2.56 + 3.99 + 1.49 = 11.80 \]

3. \[ 2 \times 0.95 = 1.90 - 1.90 = 18.10 \]

4. \[ 2 \times 2.98 + 8.98 \div 2 + 7.98 + 3.98 + 2 \times 2.28 = 5.96 + 4.49 + 7.98 + 3.98 + 4.46 = 26.87 \]

No, \$25 is not enough.
Out to Lunch

$$5 \times 3 + 5 \times 2 + 5 \times 1 \quad \text{or} \quad 3 + 2 + 1 = 6$$

$$= 15 + 10 + 5 \quad 5 \times 6 = 30$$

$$= 30$$

Sharing the Cost

$$3 \times 3 + 4 + 4 + 2 \times 1.50 + 3 \times 1 + 2 \times 1.50$$

$$= (9 + 4 + 4 + 3 + 3 + 3)$$

$$= \frac{26}{5}$$

$$= 5.20$$

or

$$\left(3 \times 3 + 4 + 4 + 2 \times 1.50 + 3 \times 1 + 2 \times 1.50\right) \div 5$$

$$= \left(9 + 4 + 4 + 3 + 3 + 3\right) \div 5$$

$$= 26 \div 5$$

$$= 5.20$$
The activities in this section are designed to clarify the concept of averages. They aim to go beyond a set of learned arithmetic procedures, and to ensure averages are quantities that are understood, and can be estimated, used, and interpreted in a meaningful way.

The section also includes discussion and practice sheets which focus on the ways in which averages can be used to make predictions, or to monitor output, costs or sales over extended periods of time.

The final part of this section provides practice at calculating averages as they are encountered in typical workplace charts for attendance and production, including control charts.
**Background**

**Active learning experiences**

The first activity in this section asks trainees to participate actively in a mock task using concrete objects - jelly beans, blocks, or workplace objects - in order to visualise what we mean by an average.

Physical objects are used for this activity so that the arithmetical process involved in averaging can be acted out or modelled using the actual objects. The active involvement or experience should help the learner to understand and remember the concepts far more than if they had merely sat passively listening to a trainer or teacher do all of the talking.

Workplace trainers will know that, in the factory, hands on experience, or doing it yourself, is basic to all training and learning. The learning of mathematics should not be different. Using hands-on materials in teaching maths to adults encourages visualisation and the understanding of ideas and mathematical rules. By manipulating concrete objects, students learn by exploration and discovery, and become active in their own learning. This seems the best way to distance students from the realms of the 'mystifying magic tricks' that maths teachers displayed to them when they were at school. Teachers who try the hands-on approach with adults, have consistently been rewarded with cries of "I see", "Now it makes sense" or "Why didn't they do it this way at school?" So the effort of cutting out bits and pieces and using concrete materials is worthwhile and important.

As we have said before, many teachers and trainers involved in adult education were the victims of similar educational methods as their students. Having learnt maths using traditional paper and pencil methods they may not feel very confident with alternative approaches. Trainers using hands-on materials for the first time may also fear the reaction from trainees when they produce materials and active experiences which they may think belong in the kindergarten! But it is important to overcome these initial reservations. Once you have used them and seen how effective they are, alternative active approaches will become a valuable part of your training.

**Estimations and calculators**

Calculators are used extensively in workplace calculations because real measurements and workplace data do not come as simple, whole numbers, which can easily be manipulated in the head. They may come as high numbers with many figures or as decimals. For speed and accuracy calculators are used.

However, a consequence of the increase in speed provided by calculators is the increased likelihood of foolish errors. These are caused through the pressing of a wrong button, not pressing buttons hard enough, or mistakenly entering numbers more than once. Sometimes decimal points are left out, or the equals button may be pushed when not needed, causing calculations to be done twice over. Also + - x ÷ buttons pushed in the incorrect order can lead to very wrong results.
One remedy to such possible mistakes is to use "common sense" at the same time as using the technology. Always make sure that you are aware of the approximate results you expect, so that you will spot and be able to check an obvious mistake. Because average calculations involve so many entries as well as two arithmetical operations, addition and division, they can be particularly prone to mistakes. If a person is blindly following rules or a formula they are unlikely to notice a wrong final answer. However, if they are aware of an expected approximate outcome, errors can be spotted more easily.

In this section we encourage estimation of all averages before using a calculator. This estimation, of course, depends on a thorough understanding of what an average is, and what effect remarkably higher or lower figures will have on it. These concepts are addressed by the activities presented, and should be kept in mind for all calculations.

**What to prepare**

**Part 1 - Acting it out**

For the activity *The mean jelly bean* each trainee will need a copy of *The mean grid* (photocopy this onto coloured cardboard if possible) and a quantity of jelly beans or similar items in plastic cups or containers.

**Part 2 - Using averages to make predictions**

If trainees do this optional part, each trainee will need a copy of the practice sheet:

- *Using averages*

**Part 4 - Distortion of averages**

For the activity *The highs and lows of averaging* photocopy the *Average wages* (p. 29) onto light coloured cardboard, and cut up into cards. Each trainee will need one card only. Only one managers card is to be included, and there should be a higher number of production worker level 1 cards than any other cards. Place into a labelled envelope or plastic bag.

Each trainee will need a copy of:

- *Averages - Data sheet*
- *About averages - part 1*
- *About averages - part 2*
Part 5 - Averages and ranges in workplace charts.

Each trainee will need a copy of:

- Average production figures - part 1
- Average production figures - part 2

Each pair of trainees will need a copy of

- Control charts

Each pair will also need a set of the Control charts cards. These should be photocopied onto coloured cardboard and cut out and stored one set per envelope.

It would also be useful to have overhead transparencies of the charts from:

- Average production figures - part 1
- Average production figures - part 2
- Control charts
Outline of section

Part 1
Acting it out

Is the group able to explore this concept further?

Yes

Part 2
Using averages to make predictions

Extension activities to show the use and relevance of averages in making predictions.

No

Part 3
Practising and predicting averages

Gives further practice at calculating and predicting averages.

Part 4
Distortion of averages

Demonstrates how very high and low values skew averages. Introduces the middle value (median), and gives further practice at calculating and analysing averages.

Part 5
Averages and ranges in workplace charts

Relates averages and ranges to workplace production charts and control charts.

END

Uses an activity involving concrete materials to build the concept of average and begins finding an average with a calculator.
Part 1: Acting it out

Activity - The mean jelly bean

Give out a copy of The mean grid and a cup of jelly beans, or other similar items, to each trainee.

Presentation

Say:
♦ Take one of the jelly beans, from the cup and place it in a grid square so that it does not touch any of the lines.
♦ Then take another, leave one space on the grid, and place it in the next square.
♦ Continue like this, placing as many beans as you can, for a time of one minute which I, (the trainer) will time. I want you to do as well as you possibly can at this.

At the end of the minute, collect the cups of left over jelly beans and ask all trainees to look around the room and compare the numbers (just by sight at present).

Ask:
♦ Who seems to have the most?
♦ Who seems to have the least?
  - Were these more carefully placed?
    (better quality, less quantity?)
♦ Roughly, what is the difference between highest and lowest?

Since the task is not serious, encourage jokes, but not at the expense of anyone vulnerable.

♦ Who has about a middle amount?
♦ What are some of the reasons for differences?
♦ If we all now wanted to eat the jelly beans on the table, would this be a ‘fair’ way of distributing them?
♦ If we wanted to make sure everyone got the same amount from the beans on the table, how could we do it? (Encourage discussion of pooling them all and sharing out).
♦ Suppose now, we put them all in the middle and shared them out. Guess how many each person will get?
Ask each person to record their guess privately onto a piece of paper.

Before pooling all of the beans however, ask each person to count, and record, the number of beans they have on the white board. (Names are not necessary).

At this stage, with the numbers on the board, ask if anyone wishes to revise their guess. If so, they should write down the new guesses.

The aim is to get trainees to understand the idea of average as an equal share. Act out the pooling, or sharing process. Then discuss how it could be done mathematically:

- putting all the beans in the centre, is combining or adding
- sharing out is dividing.

Get trainees to add the column of figures on the board using calculators.

Record and compare totals - allowing time for checking if there is disagreement.

Now discuss how to do the division process on the calculator.

Ask:
- Which number goes in the calculator first?
- What symbol do we use?
- What do we divide by?
  Make sure everyone knows you must divide by the number of people in the group.

To finish off, compare the number of beans each trainee received when you acted out the process to the number calculated, and finally, to the numbers guessed, or predicted.
Discuss or reinforce with the group that this quantity, which is an equal share for all, is called 'The Average'. Ask if they know the equivalent word for 'average' in their own languages and record some of these on the board.

Another concept that you can discuss here is that of "The Range" which is the difference between the lowest and highest figures.

Ask:
- What was the lowest number of beans we had put out?
- What was the highest number of beans we had?
- What was the difference between the highest and the lowest?
- Do you know what we call this figure?

Explain that this figure, the range, is also often used at the same time as averages, especially in control charts.

Encourage discussion about how averages and ranges are used. This could be done as a whole class - if the group is small enough - or by pairs or small groups discussing the questions amongst themselves and comparing ideas.

Several suggestions are given in the following discussion outline. A few of the ideas may go beyond the capabilities of some groups but should be of interest to many others. Use your discretion on how far you can encourage your trainees to think about these aspects.

Optional Discussion
Ask:
- Who uses averages?
- Do you know how they are used in your workplace?
- If our average jelly bean number had been ____ , how many beans would we have shared?

Tell trainees that we also call the average value the mean.

What averages mean  p. 8

NAITB, Marr, Anderson & Tout, 1994
**Part 2: Using averages to make predictions**

**Activity**

Begin this activity with a preliminary discussion and a calculation which could be done with averages as follows:

**Ask:**
- An 'average' worker, Lan, assembles 9 products every hour. How many will she assemble in one eight hour shift?
- Imagine 5 'average' workers exactly the same as Lan. How many products will they produce in the shift?
- Is anyone exactly an 'average' worker?
- If not, does that mean that calculations like this are useless?
- What is the approximate average number of ______ we make here in a day/hour?
- If you made this average of __ each day/hour, how many would you make in a week/day?
- Does this mean you make exactly the same number each day/hour?
- Are calculations like this useful for anyone?
- Who would use them?

The next part of this activity looks at how averages can save time in calculations and provide accurate predictions.

Ask these questions to the whole group and get them to do the calculations for you to record.

**Say:**
- Suppose 5 workers in a team have different rates of working. They assemble steering wheels.

*NAITB, Marr, Anderson & Tout, 1994*
Write on the middle of the board.

Le Mai makes 11 per hour
Huang makes 9 per hour
Yasmine makes 12 per hour
Sebahat makes 8 per hour
Wendy makes 10 per hour

Now divide the rest of your board into two sections, one to record Method 1, the other to record Method 2.

Record calculations and answers as you go.

Method 1
Ask:
♦ How many would each person make in an eight hour shift?
♦ How many would the whole team make in a week (5 shifts)?

Some of the group may suggest an alternate way of doing this calculation: adding the number for the whole group for one hour then multiplying by eight then by five. Try this also if it is suggested. The answer would be the same.

<table>
<thead>
<tr>
<th>Method 1</th>
<th>Method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Le Mai</td>
<td>11/hr</td>
</tr>
<tr>
<td>Huang</td>
<td>9/hr</td>
</tr>
<tr>
<td>Yasmine</td>
<td>12/hr</td>
</tr>
<tr>
<td>Sebahat</td>
<td>8/hr</td>
</tr>
<tr>
<td>Wendy</td>
<td>10/hr</td>
</tr>
<tr>
<td>Total</td>
<td>440/week</td>
</tr>
</tbody>
</table>

Method 2
Ask:
♦ What is the average for the team per hour?
♦ If everyone produced at the average rate, how many would the whole team make in an hour?
♦ How many would they make in an eight hour shift?
♦ How many would the whole team make in a week (5 shifts)?
Now compare the answers of Method 1 and Method 2. They should be the same.

<table>
<thead>
<tr>
<th></th>
<th>Method 1</th>
<th>Method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Le Mai</td>
<td>11/hr 88/shift 440/week</td>
<td>Average for 1 person = 10/hr</td>
</tr>
<tr>
<td>Huang</td>
<td>9/hr 72/shift 360/week</td>
<td>For the whole team:</td>
</tr>
<tr>
<td>Yasmin</td>
<td>12/hr 96/shift 480/week</td>
<td>5 people = 5 x 10 = 50/hr</td>
</tr>
<tr>
<td>Sebahat</td>
<td>8/hr 64/shift 320/week</td>
<td>shift of 8 hours = 8 x 50</td>
</tr>
<tr>
<td>Wendy</td>
<td>10/hr 80/shift 400/week</td>
<td>= 400/shift</td>
</tr>
<tr>
<td>Total</td>
<td>2000/week</td>
<td>week of 5 shifts = 5 x 400</td>
</tr>
</tbody>
</table>

Review what you did using the following guide.

Say:
♦ In **Method 1** we calculated separately for each person.
♦ In **Method 2** we worked out the average and then calculated for the shift and then the week.
♦ The results were the same.

Discuss the implications using these questions.

**Possible questions:**
♦ Which method was quicker?
♦ Would using averages be a reliable way to do calculations?
♦ Does it matter that no-one is exactly average?

Hand out Practice Sheet **Using averages**. Ask trainees to either complete the work in class or you can let them use it as practice at home.
Part 3: Practising and predicting averages

Presentation

To consolidate the arithmetical steps involved in calculating averages, ask the group to calculate some averages about themselves, first making their individual predictions.

Choose from these quantities or invent your own.

- The average age of the group
- The average height of the group (all can measure their heights in centimetres)
- The average number of times the group members can click their fingers/tap their left foot etc, in 30 seconds
- The average number of people in their families
- The average time it takes to get to work
- The average distance travelled to work.

For each average to be calculated:

- Trainees write an initial guess or 'prediction'
- You, the trainer, collect individual figures or measurements on the board
- Trainees modify their guess if they wish
- All calculate the average using a calculator
- Compare answers to individual calculations
- Compare answers to initial estimates or guesses
- All calculate the range
- Compare individual calculations of ranges.

Part 4: Distortion of averages

Activity - The highs and lows of averaging

This activity is designed to highlight how one particularly high or low figure can distort a calculated average, or mean, and give a false impression.

Predicting the average first will ensure that the answers to calculations are always related back to a meaningful quantity using a reasonable prediction. This will go a long way to eliminating silly calculator mistakes.

NAITB, Marr, Anderson & Tout, 1994

What averages mean p. 12
Hand to each person in the group one card from *Average wages* (p.29). Preparation instructions are in the front of this section (p.3). Ensure that only one of the Manager’s cards is given out.

Ask each class member to read quickly what their card says. You can either record these salaries individually or wait until they are all read out and then summarise the information - recording as shown below.

**Ask:**

♦ What’s the salary for level 1?
♦ What’s the salary for level 2?
♦ What’s the salary for level 3?
♦ What other salary level was there?
♦ What do you predict the average might be? (everyone should record their guess privately).

Now collect more details by asking how many people we have at each level.

Record on the board as you go.

<table>
<thead>
<tr>
<th>Salary</th>
<th>Number of People</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Level 2</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Level 3</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Manager</strong></td>
<td></td>
</tr>
</tbody>
</table>

Looking at the information on the board, ask the group if they can see a quick way to work out the averages. Someone may volunteer the idea of doing it in subtotals as shown:

<table>
<thead>
<tr>
<th>Salary</th>
<th>Number of People</th>
<th>Subtotals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
<td>$430</td>
<td>3</td>
</tr>
<tr>
<td><strong>Level 2</strong></td>
<td>$440</td>
<td>2</td>
</tr>
</tbody>
</table>

*optional*
If this is not suggested, stick with the basic method and write down each salary separately:

\[ $430 + $430 + $430 + $440 + $440 + \ldots \]

Make sure that the number of people is counted when doing the division for the average.

Compare results of calculations with the original guesses and discuss:

**Possible questions:**
- Is the figure higher or lower than expected? Can you think why?
- Whose salary card is higher than the average?
- Whose salary card is lower than the average?
- Does this seem right?

Then ask everyone to line up in order from lowest to highest. Decide which person is in the middle.

After writing the average on a piece of paper, position yourself in the line at the appropriate position for the average.

Discuss how many are higher up than average and how many are lower.

**Possible questions:**
- Is the average salary the same as the middle salary?
- If not, why not?
- If we worked out a real average wage for this plant or factory, do you think it would be in the middle? If not, where might it be?

Now it is time to look in more detail at the effect of the manager's salary.

**Say:**
- Let's leave the manager out of this now.
- What do you predict the average will be without her/him?
Record a few guesses.

Repeat the calculations without the manager's salary.

Ask:
♦ What should we divide by this time?
   
   Answer: should be one less than before because there is one
   less person - the manager.

Discuss the results.

Possible questions:
♦ Is it what you predicted?
♦ Is it very different from before?
♦ How does it compare with the middle value now?
♦ What difference does the high salary of the manager make?

Relate these ideas back to the concrete example of the jelly beans - some had more, some less than average. A very high number either pushes the average up or is compensated by a very low number.

Say:
♦ Recall the jelly bean experiment. If someone had put out, say 60 jelly beans, how would it affect the average we calculated?
♦ In production, if you went much slower for a few hours in the morning, what would happen to your average?
♦ How could you stop it changing?

   Answer: If production slows down for a while the average can be kept the same by speeding up later.

Activity - About averages
This activity can be used either as a practice sheet for individuals - to reinforce the ideas introduced in the Highs and Lows of Averaging activity - or as an alternative classroom activity. It has an emphasis on reinforcing and developing the comparative language associated with averages. If using it as a group activity the following presentation notes should assist you.
Presentation

Hand out a copy of the *Averages - data sheet* to each trainee.

Say:
This sheet contains some information we will use to think about averages.

To familiarise trainees with the sheet

Ask:
- Who is the tallest?
  *Answer: Mike*
- Who is the oldest?
  *Answer: Rita*
- Who earns the lowest amount of money each week?
  *Answer: Con and Mike*

Now hand out the Practice Sheet *About averages - part 1* to each trainee. Ask trainees to use the sheet to write the heights, ages and wages in order. Check there is agreement about ordering before discussing the averages.

Ask:
- Without calculating, what do you think is the average height? - Circle one of the given numbers.

Discuss the choices they made and record some or all of these guesses on the board.

Repeat this process for ages and wages. Distribute calculators to each trainee to enable them to actually calculate the average height, age, and wage.

Allow time for this to be done and move around to offer help. Compare answers and refer back to their guesses on the board using the following discussion points.

Possible questions:
- Are you surprised by any of the actual answers?
- Which ones?
- Why do you think they are different from your guesses?

Ensure that the effect of very high figures in the data is discussed.
Now distribute the Practice Sheet *About averages - part 2* and explain to the trainees that they need to use the averages they have just calculated to answer questions on this sheet.

Check their answers by comparing the words or names they used in each sentence. For question 2 you could ask trainees to say or show their sentences to the person beside them and see if they agree with what's written. Ask for a selection of sentences from the group as a whole for discussion.

**Presentation**

Ask:
- Is the average always the same as the middle value?
- Which one of these three - height, age and wage - had the biggest difference between the middle number and the average?
  
  *Answer: wages*
- Why did it have such a big difference?
  
  *Answer: Ali's wage was so much higher than the others.*

If the *Highs and Lows* Activity has not been done discuss this further as follows.

Ask:
- What would be the average wage if Ali's wage was not included? - Guess first then check.
  
  *Answer: $442.50*

Allow time for trainees to do this on calculators.

- Is this closer to the middle wage?
  
  *Answer: Yes*
- Why? Can you explain?
- What reasons can you think of for the middle height and average height being the same?
- Whose age distorts or skews the average the most?
  
  *Answer: Rita*
- What would be the average age without Rita's? Guess and then check with a calculator.

*The discussion should emphasize that the average is not always close to the middle value. Very high or very low numbers will shift it considerably.*

*NAITB, Marr, Anderson & Tout, 1994*
**Part 5: Averages and ranges in workplace charts**

**Activity - Averaging production figures - part 1**

The purpose of this sheet is to give trainees practice at whole work style tasks as well as practice at calculating averages and plotting charts.

**Presentation**

To each trainee, hand out a copy of the Activity Sheet *Average production figures - part 1*. Allow trainees time to look at the sheet before discussing its purpose and whether or not such charts are familiar to the group.

The questions below will provide a chance for everyone to understand the format before starting the task.

**Ask:**

♦ Have you seen charts anything like this before?

♦ What are they called?

*Answer: Run charts or line graphs*

♦ Can you see what this one is about?

*Answer: Cylinder Head Production numbers each day for the month of July.*

When the group has had time to familiarise themselves with the graph go on to the actual details. An overhead transparency would help.

**Ask:**

♦ Where would the production figure for the 17/7 be plotted?

Ask trainees to finish plotting the production figures using the information from below the chart.

Move around the room to help where necessary.

---

*Note* - Where possible it is better to use real production charts, relevant to the group, in conjunction with the ideas presented in this section. Such charts can be altered to mirror the activities described below.

*Many workplaces call these run charts - maths teachers call them line graphs.*

---

*What averages mean* p. 18
When the trainees have finished use the overhead to check the plotted points.

Ask trainees to connect the points if they haven’t done so already. Connect the points on the transparency and discuss how this enables changes and trends to be seen more easily.

Ask:
♦ What is the highest figure shown?
   *Answer: 580*
♦ What day is it for?
   *Answer: 18/7*
♦ Where did you find the information?
   - is there only one way to see that?
   *Answer: Table or chart or both.*

Now to focus on the **monthly average**.

Ask:
♦ From looking at the graph, what do you think the average daily production for July would be?
♦ Which day’s production will bring down the average?
♦ Which day’s production will make the average better?
♦ Do the lows and the highs balance each other?

Encourage everyone to make a guess. Write some or all of the guesses on the board before going on.

Ask the group to calculate the average. If necessary prompt with the questions below.

**Possible questions:**
♦ How do we calculate the average?
♦ What figure should we divide by?
♦ How many working days were there for this work team in July?
   *Answer: 21*
♦ How do you know?

Discuss whether this group’s workplace would have a similar number of days per month. eg.
- Do you work through weekends?
- Do you have plant close down times?

*In most workplaces you can find figures from the graph/chart or from the table below.*

*You may wish to discuss the Clear Entry key on the calculator before the group commences this exercise.*

See next page.
Allow plenty of time for trainees to calculate the average on the calculator. This can take some time with people unused to calculators.

Check the answer obtained. It should be 340. Compare this with the group's initial guesses.

Ask:
♦ Was the average above target?
   Answer: Yes
♦ If you were the employer what would you use as the Target for August, 320 or 340?
♦ Why would the employer do this?

Discuss attitudes of workers and employers to this question before moving on to the next step.

Optional Discussion
The Calculator Clear Entry Key

It may be appropriate or necessary to explain the use of the CE or C key on a calculator in case trainees press a wrong key for a particular entry. Pressing CE or C should clear just the last entry and not everything else. It can be thought of as the "oops" key.

For example, if they have already entered production for the first 14 working days and make a mistake on the 15th entry, they can press the CE, clear entry, or C, Clear, to get rid of the mistake. The total for the first 14 days will still be in the calculator. Ask trainees to check this on their own calculator before starting by entering, for example

\[
10 + 20 + 30 \text{ then } + 100
\]

Say "oops" - or mistaken entry
   - we didn't want the 100
   so press C or CE

The last total of 60 should now remain in the display. The 100 should have disappeared.

Warning: the C or CE button will not work if you have already pressed the = button, so discourage its use until the very end of the calculation.
Activity - Averaging production figures - part 2

Now introduce the idea of using cumulative total as follows.

Ask:
♦ Was it easy to calculate the average?
♦ Did it take long?
♦ What made the task difficult or tedious?
♦ Can you think of ways that may make the calculation faster?
♦ Has anyone seen any other type of sheet for recording production figures?

If no-one suggests cumulative or progressive totals, introduce the idea yourself.

Say:
♦ Adding so many figures at one time can be difficult and sometimes it would be easier to add as you go. Each day you add the new figure to the total.

Demonstrate by using the overhead transparency and drawing in another row below the Production row on Average production figures - part 1.

Ask:
♦ What was the total production for the first two working days of July?
  Answer: $280 + 310 = 590$

Write the answer in the new row under 4/7.
♦ What about the total for the first three working days?
  Answer: $1080$

♦ How did you get this answer?
  Some may say they added 280, 310 and 490 together - encourage them to consider that it is just a matter of adding the third figure to the progressive or cumulative total.

Ask:
♦ Does anyone know the name given to these progressive totals? Point to 590 and 1080.
  Answer: Cumulative totals.

Write cumulative total (or Cum. Tot.) in the start of the row containing 590 and 1080.

Introduce the idea of a progressive addition of Production figures or Cumulative Total.

Compare the word cumulative with the word accumulate. One way is to imagine the idea of 'accumulating' money if each person in turn gives you a different number of dollars.
What was the total production for the first four working days?

Answer: \(1080 + 560 = 1640\)

How could we use this to help calculate the average faster?

Now distribute to each pair of trainees the Activity Sheet: **Average production figures - part 2.**

Ask:

- Looking at the sheet, what has been chosen as the Target for August?

Hand out rulers and ask trainees to draw in the Target line.

Direct their attention to the Cumulative total row and ensure they feel confident to fill it in by asking the following:

- What was the production for 22/8?
  
  Answer: 250

- What would be the Cumulative Total after 22/8?
  
  Answer: 5170

Ask them to finish the table by filling in the figures and calculating the average.

Use an overhead transparency of the activity sheet to help check answers and discuss the effectiveness of the new method using the following questions.

Ask:

- How did you calculate this?
  
  *Hopefully* \(7590/23 = 330\)

- Was this easier and quicker than having to add all the numbers at once?

- Would it be a better method in the workplace situation?

Now ask the group to plot the points on the chart and check them on the overhead.

---

By having the cumulative total at the end of the month we just need to divide this figure by 21 - instead of adding all the figures at once.

Care needs to be taken when calculating the average to count up the numbers of days. For example, there were 23 working days in August, not 21 as in July.
The following discussion points can be used to give further familiarity with cumulative totals and the meaning of monthly averages.

Possible questions:
♦ Look at the figures for the first four days.
♦ Do you think the average production of these four days would be higher than, lower than, or the same as 330?
  Answer: Higher
♦ How could you calculate the average production for these first four days quickly?
  Answer: $1540 \div 4 = 385$, using the cumulative total for the 4/8
♦ What would this mean to the workers for the rest of the month?
  - Would they start to speed up or slow down?

Activity - Control charts

To each pair of trainees hand a copy of the Control charts activity sheet.

Allow trainees a minute or so to look at the sheet. Then discuss, using an overhead projector transparency of the sheet if possible.

Possible questions:
♦ Have you seen charts like this before?
♦ Who fills them in at your workplace?
♦ What are they used for?

Point to the date, time, and readings rows.

♦ Can anyone here explain what goes in the top part of the table?
♦ Point to the sum and x bar ($\bar{x}$) boxes. Can you tell me what happens in these spaces?
♦ Point to the R (range) box. What goes in here? How do you work that out?

The purpose of this sheet is to give trainees practice at completing a control chart similar to those encountered in the workplace. Control charts are used to keep a check on how production processes change over time.

Sum is another word for the total when the five readings are added together, $\bar{x}$, x bar, is just a symbol for average.

What averages mean p. 23

NAITB, Marr, Anderson & Tout, 1994
This particular chart is measuring the 'gloss' or 'shine' of completed bumper bars.

Each morning and each afternoon, five finished bumper bars are taken off the production line and measured with a 'gloss meter'. These readings are put in the table and the average is plotted onto the control chart.

Get trainees to calculate together the sum and then the average and range for the 3rd of July in the afternoon (pm). Give enough time for these to be worked out using calculators.

Answers: \( Sum = 104.2, \bar{x} = 20.8, R = 2.2 \)

Note: Calculators will show 20.84 for \( \bar{x} \) but explain that 20.8 is accurate enough. In other words, the numbers are rounded off.

Now ask trainees to plot this point on the control chart. Use the overhead transparency to check.

Ask:

- Is this point between the control limits?
- Does this point show that the process is OK?
- Would we need to take any action?
- When would we need to take action?

The first point is within control limits, so no action would be needed yet.

Now ask trainees to calculate the sum and average for 4/7 am and plot the point.

Check their answers and again decide if the point is OK - between the control limits.

Now distribute a labelled envelope containing the Control chart - cards to each pair of trainees.

Ask them to open the envelopes, take out the cards and place them face down on the table between them.

Tell them the information they need to fill in the rest of the readings are on these cards.
Explain the activity as follows, or if language presents a problem act out the process with one person from the group.

**Say:**

♦ For this activity you will take turns.
♦ One person in each pair should pick up a card but not show it to the other person.
♦ The person with the card has to read out the date, time, and the readings so that the other can write them down on the sheet.
♦ Listen to the date and time and make sure you put the readings in the correct column.
♦ When this is done put that card down and change roles.
♦ Both write on the same sheet.
♦ Keep going until all cards have been read.
♦ When all the information has been recorded turn the cards up and together check to see if you agree that the readings have been written correctly in the table.

Once the pairs have reached agreement use the overhead transparency of the **Control charts** sheet, to check what they have recorded.

Now ask the pairs to work together taking turns to calculate the sum, average, and range for each column, and to plot the averages on the control chart. Again use the overhead transparency to help check the results and to assist with a discussion of the implications.

**Ask:**

♦ Were all averages within the control limits?
♦ Do you notice anything particular about the chart?
♦ What is it?
♦ Would we need to take action?

The information on the cards is written in words to give practice at reading, hearing and translating numbers. It may also simulate possible workplace practice where one person calls out the figures for someone else to write down.

Although all averages fell within control limits, the last seven points are in a downward run. This is one of the classic warning signs and action would be needed.
Your notes and ideas

What averages mean  p. 26
The mean grid
Using averages

1. Cylinder heads come off the production line at an average of 44 per hour. How many would you expect to have made:
   - in three days (with one eight hour shift per day)?
   - in a month of 21 working days?

2. A work group assembles on average 53 car heater units per hour. How many would they make in:
   - a day (one eight hour shift)?
   - a 40 hour week (5 shifts)?
   - how many would they have made in May this year?

3. Maria's team use an average of 10 brand label disks per hour. How many would they use in:
   - a day (one eight hour shift)?
   - a week (5 shifts)?

4. A car using leaded petrol emits an average of 3 grams of lead into the air for every 100 km. The car travels approximately 900 km from Melbourne to Sydney. How much lead would be given off?
About averages

1. Use the **Averages - data sheet** to write the numbers down in order:

   **heights:**
   - shortest
   - tallest
   - 152 cm

   **ages:**
   - youngest
   - oldest

   **wages:**
   - lowest
   - highest

2. Answer these questions. Tick the best answer.

   **TRY THEM WITHOUT CALCULATING**

   The average height could be approximately:
   - 160 cm
   - 175 cm
   - 200 cm

   The average age might be around:
   - 25 years
   - 30 years
   - 35 years

   The average wage is probably about:
   - $435
   - $440
   - $650

   per week.

3. Now work out the answers with a calculator.

   - Average height:
   - Average age:
   - Average wage:
About averages  

part 2

1 Use words from the box to fill the spaces.

<table>
<thead>
<tr>
<th>above</th>
<th>below</th>
<th>about</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rita is ________ average height.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Con's wage is ________ average.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ali is ________ average height.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phuong is ________ average age.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 Make up 2 sentences of your own.

- Mike __________________________
- Rita __________________________

3 Put the correct names in the spaces.

- ________ height is in the middle.
- ________ is the middle age.
- ________ gets the middle wage.

4 Use these words to fill in the spaces.

<table>
<thead>
<tr>
<th>higher than</th>
<th>decreased</th>
<th>increased</th>
<th>the same as</th>
<th>lower than</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average wage is ____________ the middle wage.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The middle height is ____________ the average.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The middle age is ____________ the average age.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without Ali the average wage would be ____________ .</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without Phuong the average height would be ____________ .</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without Rita the average age would be ____________ .</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What averages mean — NAITB, Marr, Anderson & Tout, 1994
Average production figures

MONTH: July

CYLINDER HEADS
DAILY SHIFT OUTPUT

TARGET: 320

<table>
<thead>
<tr>
<th>DATE</th>
<th>3/7</th>
<th>4/7</th>
<th>5/7</th>
<th>6/7</th>
<th>7/7</th>
<th>10/7</th>
<th>11/7</th>
<th>12/7</th>
<th>13/7</th>
<th>14/7</th>
<th>17/7</th>
<th>18/7</th>
<th>19/7</th>
<th>20/7</th>
<th>21/7</th>
<th>24/7</th>
<th>25/7</th>
<th>26/7</th>
<th>27/7</th>
<th>28/7</th>
<th>31/7</th>
</tr>
</thead>
<tbody>
<tr>
<td># Parts made</td>
<td>280</td>
<td>310</td>
<td>490</td>
<td>560</td>
<td>250</td>
<td>220</td>
<td>350</td>
<td>150</td>
<td>240</td>
<td>270</td>
<td>520</td>
<td>580</td>
<td>420</td>
<td>470</td>
<td>340</td>
<td>320</td>
<td>280</td>
<td>320</td>
<td>200</td>
<td>220</td>
<td>350</td>
</tr>
</tbody>
</table>

What averages mean — NAITB, Marr, Anderson, & Tout, 1994
Average production figures

MONTH: August

<table>
<thead>
<tr>
<th>CYLINDER HEADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TARGET: 340</td>
</tr>
</tbody>
</table>

![Graph showing production figures]

### DAILY SHIFT OUTPUT

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td># Parts made</td>
<td>370</td>
<td>280</td>
<td>470</td>
<td>420</td>
<td>360</td>
<td>290</td>
<td>220</td>
<td>330</td>
<td>210</td>
<td>290</td>
<td>350</td>
<td>390</td>
<td>370</td>
<td>340</td>
<td>330</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cum. total</td>
<td>370</td>
<td>550</td>
<td>1120</td>
<td>1540</td>
<td>1900</td>
<td>2190</td>
<td>2310</td>
<td>2640</td>
<td>2850</td>
<td>3140</td>
<td>3490</td>
<td>3880</td>
<td>4250</td>
<td>4590</td>
<td>4920</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Production figures for the last 8 days were:

- **22/8**: two hundred and fifty
- **23/8**: one hundred and seventy
- **24/8**: three hundred and eighty
- **25/8**: four hundred and forty
- **26/8**: four hundred and twenty
- **27/8**: three hundred and seventy
- **28/8**: three hundred and sixty
- **29/8**: two hundred and eighty
- **31/8**: three hundred and sixty

What averages mean: NAITB, Marr, Anderson, & Tout, 1994
# Control charts

**Button Motor Co. Control Chart**

<table>
<thead>
<tr>
<th>Plant:</th>
<th>PLASTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part name:</td>
<td>Bumpers</td>
</tr>
<tr>
<td>Characteristic:</td>
<td>GLOSS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Upper Control Limit</th>
<th>23</th>
<th>22</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{X}$</td>
<td>20</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Lower Control Limit</td>
<td>17</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATE</th>
<th>3/7</th>
<th>3/7</th>
<th>4/7</th>
<th>4/7</th>
<th>5/7</th>
<th>5/7</th>
<th>6/7</th>
<th>6/7</th>
<th>7/7</th>
<th>7/7</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME</td>
<td>am</td>
<td>pm</td>
<td>am</td>
<td>pm</td>
<td>am</td>
<td>pm</td>
<td>am</td>
<td>pm</td>
<td>am</td>
<td>pm</td>
</tr>
<tr>
<td>1</td>
<td>21.5</td>
<td>20.8</td>
<td>22.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>20.2</td>
<td>19.6</td>
<td>22.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>23.4</td>
<td>21.4</td>
<td>21.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>19.8</td>
<td>21.8</td>
<td>22.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>22.1</td>
<td>20.6</td>
<td>22.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUM</th>
<th>107.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{X}$</td>
<td>21.4</td>
</tr>
<tr>
<td>R</td>
<td>4.6</td>
</tr>
</tbody>
</table>
## Control charts cards

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/7</td>
<td>3.00 pm</td>
<td>1. Twenty one point two</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. 22.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. twenty two point eight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. twenty one and a half</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. 21.9</td>
</tr>
<tr>
<td>5/7</td>
<td>10.10 am</td>
<td>1. 17.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. twenty two and a half</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. twenty one point eight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. 23.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. twenty point one</td>
</tr>
<tr>
<td>5/7</td>
<td>3.30 pm</td>
<td>1. Twenty one exactly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. twenty two point nine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. 19.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. twenty point two</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. 20.3</td>
</tr>
<tr>
<td>6/7</td>
<td>10.30 am</td>
<td>1. Twenty point two</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. nineteen and a half</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. twenty one point two</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. 18.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. 19.4</td>
</tr>
<tr>
<td>6/7</td>
<td>3.00 pm</td>
<td>1. 20.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. eighteen point two</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. nineteen point six</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. seventeen point nine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. 18.9</td>
</tr>
<tr>
<td>7/7</td>
<td>10.40 am</td>
<td>1. 18.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. seventeen point nine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. nineteen point one</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. seventeen point seven</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. eighteen point seven</td>
</tr>
<tr>
<td>7/7</td>
<td>3.20 pm</td>
<td>1. eighteen point four</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. 17.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. eighteen point zero</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. 16.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. seventeen point nine</td>
</tr>
</tbody>
</table>

---

NAITB, Marr, Anderson & Tout, 1994

p. 36
1. Three days:
   \[ 44 \times 8 \times 3 = 1056 \text{ cylinder heads} \]
   Month (21 work days):
   \[ 44 \times 8 \times 21 = 7392 \text{ cylinder heads} \]

2. A day:
   \[ 53 \times 8 = 424 \text{ heater units} \]
   40 hour week:
   \[ 53 \times 40 = 2120 \text{ heater units} \]
   (or \( 424 \times 5 = 2120 \))
   May:
   \[ 424 \times \text{no. of working days} \]

3. Day:
   \[ 10 \times 8 = 80 \text{ brand label disks} \]
   Week:
   \[ 80 \times 5 = 400 \text{ disks} \]

4. \( 3 \text{ gm} \times 9 = 27 \text{ gm lead} \)

---

**About averages**

**PRACTICE SHEET**

**part 1**

1. Use the Averages data sheet to write the numbers down in order:

   **Heights:**
   \[ 152 \text{ cm} \quad 168 \text{ cm} \quad 175 \text{ cm} \quad 180 \text{ cm} \quad 200 \text{ cm} \]
   from lowest to highest

   **Ages:**
   \[ 25 \quad 28 \quad 30 \quad 40 \quad 52 \text{ cm} \]
   from youngest to oldest

   **Wages:**
   \[ \$930 \quad \$930 \quad \$940 \quad \$970 \quad \$1580 \]
   from lowest to highest

2. Answer these questions. Tick the best answer.

   **TRY THEM WITHOUT CALCULATING**

   The average height could be approximately
   \[ \text{160 cm} \quad \text{175 cm} \quad \text{200 cm} \]

   The average age might be around
   \[ \text{25 years} \quad \text{30 years} \quad \text{35 years} \]

   The average wage is probably about
   \[ \$440 \quad \$480 \quad \$650 \quad \text{per week} \]

3. Now work out the answers with a calculator.

   **Average height:**
   \[ \frac{175}{5} = 35 \text{ cm} \]

   **Average age:**
   \[ \frac{35}{5} = 7 \text{ years} \]

   **Average wage:**
   \[ \frac{3270}{5} = 654 \text{ per week} \]

**What averages mean** — NAITB, Marr, Anderson & Tout, 1994

---

**About averages**

**PRACTICE SHEET**

**part 2**

1. Use words from the box to fill the spaces.

<table>
<thead>
<tr>
<th>above</th>
<th>below</th>
<th>about</th>
</tr>
</thead>
</table>
   Rita is **above** average height.
   Con's wage is **below** average.
   Ali is **about** average height.
   Phuong is **below** average age.

2. Make up 2 sentences of your own.

   Mike
   Rita

3. Put the correct names in the spaces.

   **Ali's** height is in the middle.
   Phuong's is the middle age.
   Phuong's gets the middle wage.

4. Use these words to fill in the spaces.

<table>
<thead>
<tr>
<th>higher than</th>
<th>increased</th>
<th>lower than</th>
</tr>
</thead>
<tbody>
<tr>
<td>decreased</td>
<td>same as</td>
<td></td>
</tr>
</tbody>
</table>

   The average wage is **higher than** the middle wage.
   The middle height is **the same as** the average.
   The middle age is **lower than** the average age.
   Without Ali the average wage would be **decreased**.
   Without Phuong the average height would be **increased**.
   Without Rita the average age would be **decreased**.

**What averages mean** — NAITB, Marr, Anderson & Tout, 1994

---

"Using averages"

1. Three days:
   \[ 44 \times 8 \times 3 = 1056 \text{ cylinder heads} \]
   Month (21 work days):
   \[ 44 \times 8 \times 21 = 7392 \text{ cylinder heads} \]

2. A day:
   \[ 53 \times 8 = 424 \text{ heater units} \]
   40 hour week:
   \[ 53 \times 40 = 2120 \text{ heater units} \]
   (or \( 424 \times 5 = 2120 \))
   May:
   \[ 424 \times \text{no. of working days} \]

3. Day:
   \[ 10 \times 8 = 80 \text{ brand label disks} \]
   Week:
   \[ 80 \times 5 = 400 \text{ disks} \]

4. \( 3 \text{ gm} \times 9 = 27 \text{ gm lead} \)
**Average production figures**

**Part 1**

Month: **July**

CYLINDER HEADS
DAILY SHIFT OUTPUT

TARGET: **320**

<table>
<thead>
<tr>
<th>DATE</th>
<th>3/7</th>
<th>4/7</th>
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<td>280</td>
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<td>690</td>
<td>560</td>
<td>250</td>
<td>220</td>
<td>250</td>
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<td>670</td>
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**Monthly average:**

**340**

What averages mean: NAITB, Marr, Anderson, & Tout, 1994

**Average production figures**

**Part 2**

Month: **August**

CYLINDER HEADS
DAILY SHIFT OUTPUT

TARGET: **300**

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<td>280</td>
<td>399</td>
<td>370</td>
<td>340</td>
<td>330</td>
<td>250</td>
<td>170</td>
<td>280</td>
<td>460</td>
<td>620</td>
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<tr>
<td>Cum. total</td>
<td>370</td>
<td>650</td>
<td>1220</td>
<td>1560</td>
<td>1900</td>
<td>2170</td>
<td>2310</td>
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<td>2580</td>
<td>2140</td>
<td>2400</td>
<td>2800</td>
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<td>3170</td>
<td>3510</td>
<td>3720</td>
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Production figures for the last 8 days were:

23/8: two hundred and fifty
24/8: one hundred and seventy
25/8: three hundred and forty
26/8: four hundred and twenty
27/8: three hundred and seventy
28/8: three hundred and sixty
29/8: three hundred and eighty
30/8: three hundred and sixty
31/8: three hundred and eighty

**Monthly average:**

What averages mean: NAITB, Marr, Anderson, & Tout, 1994

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**What averages mean** — NAITB, Marr, Anderson & Tout, 1994 — p. 38
Control charts

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<td>1.9</td>
<td>1.8</td>
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<td>1.5</td>
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What averages mean  

NAITB, Marr, Anderson & Tout, 1994  
p. 39
Where else to go

Purpose

This section includes information about where to go for further information about teaching basic mathematics. There are contacts for chasing up other resources, and listings of other suitable resources and their availability.

As well there are detailed cross-references to worksheets from two other key adult maths books. These can be used as supporting material for supplementary work or further practice.
Where can I go for more advice?

Adult Basic Education Resource & Information Service (ARIS)
National Languages and Literacy Institute of Australia (NLLIA)
Victoria University of Technology Building
Level 9, 300 Flinders Street
Melbourne VIC 3000

Contact: Dave Tout. Phone: (03) 614 0255

Adult Literacy Information Office (ALIO)
199 Regent Street
Redfern
NSW 2016

Contact: Phone: (02) 699 8955

ARIS and ALIO have collections of reference and teaching materials suitable for teaching adults, and can refer people to other appropriate organisations or individuals. They also sell and distribute Victorian and NSW produced adult literacy and numeracy resources.

Adult Numeracy Centre
Northern Metropolitan College of TAFE
St Georges Road
Preston VIC 3072

Contact: Beth Marr. Phone: (03) 270 1512 or 270 0255

Other suitable resources

♦ **Strength in Numbers - A resource book for teaching adult numeracy**, Goddard, R., Marr, B. & Martin, J., Division of Further Education, Victoria, 1991

*Strength in Numbers* concentrates on early numeracy skills. It assumes very little knowledge of formal mathematics by teachers or trainers and so is ideal for use by people inexperienced in teaching mathematics. It also contains many new ideas for the experienced teacher. The worksheets and activities have been especially designed for adults and the language used is suitable for students with low level English literacy and language skills.
Background, strategies and rationale are given for each of the six sections. These are: Getting Started; Addition and Subtraction; Multiplication and Division; Money and Metrics; and Fractions and Percentages. The materials and methods used in this book encourage students to learn through interaction and cooperation, involving the use of discussion, practical activities and hands-on materials.

It is available from ARIS (see above for address) for $30.00 plus postage and handling.


**Mathematics: A New Beginning** details and explains appropriate and successful teaching strategies and approaches for teaching maths to adults and supports these with a wide range of student worksheets and activities. The approach taken encourages the use of hands-on materials, and promotes interaction and cooperation in maths learning with the aim of making maths relevant and enjoyable.

The areas it covers include: Exploring Numbers; Fractions; Metrics and Measurement; Estimation and Calculators; Problem Solving; and Ratio and Percentages. It is at a level higher than that covered in **Strength in Numbers**.

It is available from Northern Metropolitan College of TAFE (see above for address) for $33.00 plus postage and handling.

♦ Another resource which is available free (although there is a postage and handling charge) from ARIS is:
212

**Supplementary worksheets**

The following pages list references to other resources under a number of topics. The references are to other worksheets or activities suitable for use as reinforcement of skills, for further practice or for support for trainees having difficulty with particular topics.

**How to read the references**

The abbreviations used are:

eg.

*The book: Strength in Numbers* → **SIN** EN 17 - 22 ← The page numbers

The section called: **Exploring Numbers**

Where else to go p.3

NAITB, Marr, Anderson & Tout, 1994
Whole Number Skills Practice

General Exploratory Work
- to help assess problems students are having.
- to give them confidence about problem solving and their existing arithmetic skills.

Number Patterns - Activity One  SIN EN 17-22
Some pattern activities to practise a variety of number skills such as adding.

Number Patterns  MANB GS 23-25
More advanced pattern activities to check on the four operations, +, -, x, ÷, and understanding of fractions and decimals.

Understanding Our Number System  SIN EN 43-46  MANB EN 3-12
Assists students to understand place value - how numbers fit together.

Addition and Subtraction

Learning Addition Facts  SIN AS 7-12
A variety of strategies to assist students to memorise number facts such as 9+1=10, 7+5=12 etc. These, like multiplication tables, are important if calculating is ever going to be efficient.

Building Addition Skills  SIN AS 13-22
An explanation using hands on materials and practice worksheets, to develop understanding of how the formal method of addition with carrying works.

Concept of Subtraction  SIN AS 23-26
Four activities which enable the exploration of the idea of subtraction. These also concentrate on the language used for subtraction.

Building Subtraction Skills  SIN AS 27-36
This shows how the formal methods of subtraction work, and explanations are given for the two commonest methods. Again the approach taken uses hands-on materials and activities.

Subtraction in Stages  SIN AS 37
Explanation and practice examples of a more common sense approach to subtraction - without getting tangled in borrowing and paying back - an empowering technique.

Where else to go  p. 4

NAITB, Marr, Anderson & Tout, 1994
Addition and Subtraction - Word Problems  
SIN AS 41-50  
Plenty of practice examples for addition and subtraction in real life adult contexts - money, dates, times and measurements. Most involve making decisions about which operation to use as well as the calculations.

**Multiplication and division**

**Multiplication and Division - Introductory Notes**  
SIN MD 1-4  
Discussion for teachers on issues concerning teaching these skills, including how to deal with remainders.

**Concept of Multiplication**  
SIN MD 9-13  
A session with worksheets exploring the meaning of multiplication.

**Building Multiplication Skills**  
SIN MD 15-21  
An exploration, using hands on materials and practice worksheets, to develop understanding of how the formal method of multiplication works.

**Doubling and Some Shortcuts in Multiplication**  
SIN MD 23-30  
A look at more "in the head" methods of multiplication typically used by adults.

**Learning Multiplication Tables**  
SIN MD 31-39  
A variety of strategies and games to assist students memorise multiplication tables.

**Concept of Division**  
SIN MD 41-43  
A session using hands on materials and worksheet practice to examine the "sharing" idea of division and the notion of remainders.

**Building Division Skills**  
SIN MD 45-49  
Uses hands on materials to develop the formal method of division.

**Multiplication and Division Word Problems**  
SIN MD 55-63  
A selection of practice examples for multiplication and division in a variety of adult contexts. Most involve making decisions about the appropriate operation to use. These could also be used to practise calculator skills.

**Multiplication and Division by Powers of Ten**  
MANB EN 13-18  
A session with accompanying worksheets to examine and practise the skill of adding or removing zeroes when multiplying or dividing by 10, 100, 1000, etc.

*NAITB, Marr, Anderson & Tout, 1994*
Calculateds

Guess the Number - a Game
- confidence Builder with calculator
- develops place value
- practice in verbalising numbers
- use of memory (extension)
(could be done before the session: Where Do We Start?, in Numeracy on the Line)

Calculator and Money
- a session to go through steps of using a calculator.
- practice on work sheets
(Further practice for Where Do We Start?)

Calculator Extension Work

Large Numbers on the Calculator
Explanation and worksheet on how to use the calculator when there are too many digits to fit on the display.

Using the Calculator's Memory
More practice at use of memory extending to more complex calculations - some challenges for the more experienced.

Some Problem Solving Using Calculators
The Gym Problem
Ancestor Problem

Some Extension Activities for small groups
Two excellent games for more advanced class members that encourage and support the meaning of decimals.
Target 100
Decimal Dilemma

Where else to go p. 6
Decimals

Introduction to decimals
Support material to help understand decimals. Uses grids, fractions, rulers and calculators.

Rounding decimals
Explanations and worksheets on the rounding of decimal numbers.

Working with Decimals
Explanations, activities and worksheets on working with decimals. Some of the activities would also be good for extension work with calculators.

Percentages

The Meaning of Percent
Explanation and worksheet on the meaning of percent.

Percentage Bars
Explanation about the drawing of percentages on bars.

Using Percentages
Four worksheets and explanations about straightforward percentages. Pie charts, writing numbers as percentages, finding percentages of an amount, and discounts.

Percentage Extensions

Introduction to Percentages
Fractions to decimals to percentages and vice versa.

Finding Percentages
Practice examples of finding percentages of quantities.

Where else to go

NAITB, Marr, Anderson & Tout, 1994