Solutions Unit Five Reading: Exercises on Teaching Data Handling

From the module:
Teaching and Learning Mathematics in Diverse Classrooms

South African Institute for Distance Education

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For permission to adapt the following study guide for the module:

UNISA (2006). *Learning and teaching of Intermediate and Senior Mathematics (ACE ME1-C).* Pretoria: UNISA

For permission to use in Unit Five

- UNISA (2006). Study Units 7 to 10: *Learning and Teaching of Intermediate and Senior Phase Mathematics.*
- MM French (1979). *Tutorials for Teachers in Training Book 7*
- RADMASTE Centre, University of the Witwatersrand (2005). *Data Handling and Probability* (EDUC 187) Chapters 3, 8 and 9.

Contents

How the solutions for the module are presented

Overview of content

As an introduction to each activity notes about the teaching and learning of the mathematical content in the activity are given. These notes are intended to inform both lecturers using the materials in a teacher education context and teachers who may wish to use the materials in their own classes. The solutions to the activities are all given in full. Diagrams are given to provide visual explanations where necessary.

How the solutions unit is structured

The unit consists of the following:

- General points for discussion relating to the teaching of the mathematical content in the activities.
- Step-by-step mathematical solutions to the activities.
- Annotations to the solutions to assist teachers in their understanding the maths as well teaching issues relating to the mathematical content represented in the activities.
- Suggestions of links to alternative activities for the teaching of the mathematical content represented in the activities.

How to find alternative content material

The internet gives you access to a large body of mathematical activities, many of which are available for free downloading if you would like to use them in your classroom. There are different ways of searching the web for material, but a very easy way to do this is to use Google. Type in the address http://www.google.co.za/ to get to the Google search page. You can then search for documents by typing in the topic you are thinking of in the space provided. You will be given many titles of articles (and so on) which may be appropriate for you to use. You need to open them in order to check which one actually suits your needs. To open an article you click on the title (on the screen) and you will be taken to

the correct web address for that article. You can then check the content and see whether or not it suits your needs. When you do this search you will see that there are many sites which offer worksheets open for use by anyone who would like to use them. You need to check carefully that the material is on the right level for your class and that there are no errors in the text. Anyone can miss a typographical error and web material may not be perfect, but you can easily correct small errors that you find on a worksheet that you download.

You can also use a Google image search, to find images relating to the topic you are thinking of. This usually saves you a lot of time, because you will quickly see which images actually relate to what you are thinking of and which do not. When you click on the image you like (on the screen), this will take you to the full page in which this image is actually found. In this way you can get to the worksheet of your choice. You can then copy and download the material.

Unit Five Reading Solutions: Exercises on Teaching Data Handling

Exercise 1: Collecting data

Collecting data for a project, for research or for Statistics S.A. can be quite a challenge. We want our learners to learn how big our sample size should be and what biases can occur which we need to factor in.

At school level, the main requirement is that we **think**

- before we choose what the sample should be
- and how big it should be.

The practical aspects of how to collect the data and the need to be as accurate as possible are all factors which need to be taken into account . These are ideas that learners will begin to learn about in school level data handling exercises.

Exercise 1

1 A survey was conducted to find the ten most spoken languages in the world and the number of people speaking them. The results were written out as follows:

Chinese:	700 million	German:	119 million
English:	400 million	Spanish:	240 million
Russian:	265 million	Japanese:	116 million
Bengali:	144 million	Arabic:	146 million
Hindustani:	230 million		

Organise the information into an ordered list in two different ways.

2 In an experiment I toss a dice 50 times and keep a record of the number that appears each time. The numbers are shown below:

2 ; 4 ; 3 ; 3 ; 1 ; 5 ; 6 ; 3 ; 2 ; 2
2 ; 2 ; 6 ; 1 ; 5 ; 5 ; 3 ; 3 ; 4 ; 2
2 ; 3 ; 4 ; 3 ; 6 ; 5 ; 1 ; 1 ; 2 ; 1
3 ; 5 ; 6 ; 3 ; 1 ; 2 ; 2 ; 5 ; 5 ; 1
6 ; 2 ; 2 ; 4 ; 1 ; 6 ; 2 ; 3 ; 3 ; 5

Complete the tally table and then answer the questions.

Number	Tally	Frequency
1		
2		
3		
4		
5		
6		
Total		

Notice:

- The tally total is the same as the frequency total
- The data can go across or down the page.
- The 'items' come first in the table.
- Do not confuse the frequency with the number on the dice

- How many threes were tossed?
- What number was tossed the most times?
- Why do you think more sixes were not tossed?
- How many more times was a two tossed compared to a five?
- Do you think this dice is a fair dice? What does fair mean in this question?

Solutions to Exercise 1: Collecting data

1. Two ways of organizing the information into an ordered list:

ALPHABETICAL

Arabic: 146 million
Bengali: 144 million
Chinese: 700 million
English: 400 million
German: 119 million
Hindustani: 230 million
Japanese: 116 million
Russian: 265 million
Spanish: 240 million

IN DESCENDING ORDER OF NUMBERS OF PEOPLE

Chinese: 700 million
English: 400 million
Russian: 265 million
Spanish: 240 million
Hindustani: 230 million
Arabic: 146 million
Bengali: 144 million
German: 119 million
Japanese: 116 million

2.

Number	Tally	Frequency
1	𝍸 III	8
2	𝍸 𝍸 III	13
3	𝍸 𝍸 I	11
4	IIII	4
5	𝍸 III	8
6	𝍸 I	6
Total	50	50

- Eleven threes were tossed.
- Two was tossed the most times.
- More sixes were not tossed because the numbers appear randomly.
- A two was tossed five times more than a five.
- This dice seems to be fair. Fair means a relatively even spread of the frequency of the numbers.

3. The survey of the learners' birthdays in your class will be an individual solution.

Suggested links for other alternative activities:

- http://www.teachervision.fen.com/pro-dev/teaching-methods/48944.html (information on collecting data)
- http://score.kings.k12.ca.us/standards/fourth.html#statistics (some ideas that could be used in lesson planning)

Exercise 2: Representing data

The representation of data is one of the most important aspects of data-handling. A well-organised representation of data can make any task involving data much simpler. It is far easier to analyse the data trends if the data is represented effectively by first tallying and then using some sort of graphical representation such as bar charts, pictograms, line graphs or pie charts.

Your learners need to find out about all of the different forms of graphical representation of data. So you need to be sure to given the activities in which they are called on to use each of the different forms, once they know how to use them.

Exercise 2

1 The table below shows the estimated percentage HIV prevalence per province in South Africa in 1998.

Province	%
Eastern Cape	16
Free State	22
Gauteng	22
KwaZulu-Natal	33
Mpumalanga	30
Northern Cape	10
Limpopo	12
North West	21
Western Cape	5
South Africa	**22**

This means that 16% of the population of the Eastern Cape is estimated to be HIV positive.

- Show this information in a pictogram. Use  as a symbol that represents 5 %.
- Draw a vertical bar chart to show the information. Put the provinces on the horizontal axis and percentages on the vertical axis.
- From what you know about the HIV/AIDS pandemic do you think the graph would look the same today? Discuss this with your group.

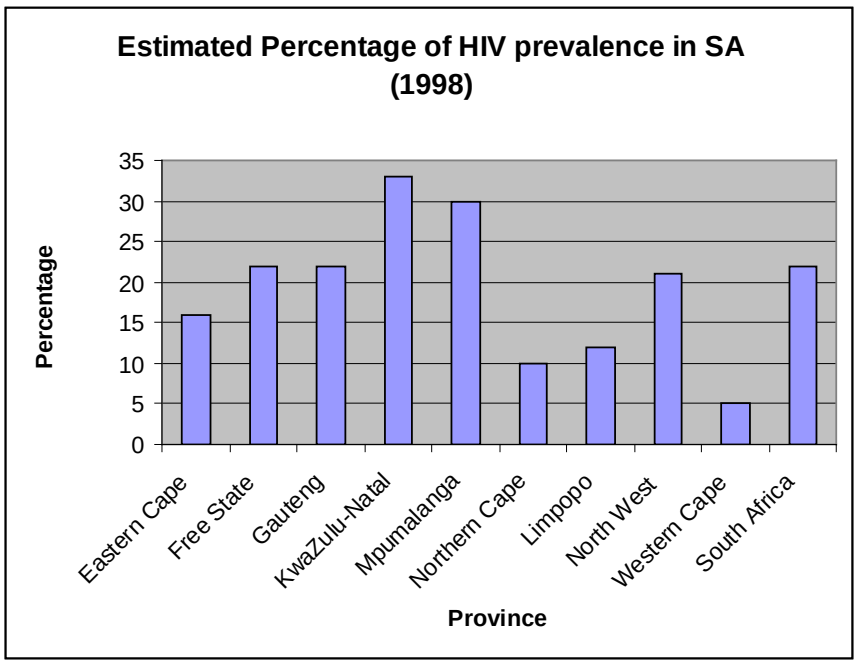
Solutions to Exercise 2: Representing data

1. A PICTOGRAM

Province	Estimated Percentage of HIV prevalence in SA (1998)
Eastern Cape	☺☺☾
Free State	☺☺☺☺☾☾
Gauteng	☺☺☺☺☾☾
KwaZulu-Natal	☺☺☺☺☺☺☾☾☾☾
Mpumalanga	☺☺☺☺☺☺
Northern Cape	☺☺
Limpopo	☺☺☾☾
North West	☺☺☺☺☾
Western Cape	☺
South Africa	☺☺☺☺☾☾

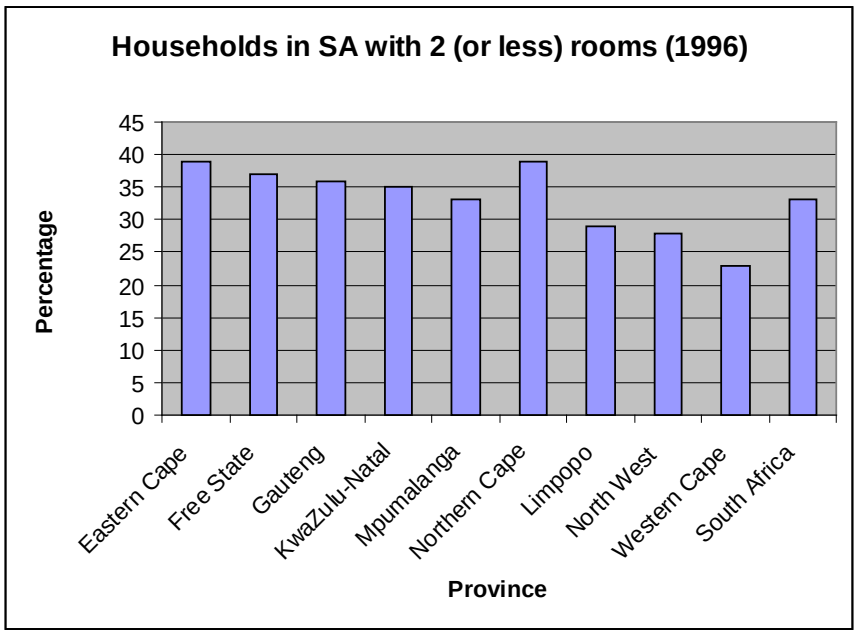
Key: ☺ = 5%; ☾ = 1%

A VERTICAL BAR CHART



The graph would not look the same eleven years later. Much misunderstanding and a dire lack of anti-retrovirals have hindered the solving of the Aids pandemic. Unfortunately the vertical bars would be much longer on a bar chart today.

2. A BAR CHART OF SOUTH AFRICAN HOUSEHOLDS



The percentage of households that have 2 or fewer rooms may be lower in the Western Cape for a number of possible reasons. One is that the statistics may not be accurate. Another reason may be that there are far fewer people in the Western Cape to accommodate compared to other provinces, so it may be easier to organize better housing. Also it may be possible that the Western Cape Housing Department is an efficient corrupt-free department which is organizing housing at a rapid rate!

Suggested links for other alternative activities:

- http://www.ict.oxon-lea.gov.uk/best_practice/1e_pictograms/unit%201e.html (introduction to the use of prictograms)
- http://www.technologystudent.com/struct1/model4.htm (pictograms as bar charts)
- http://www.coolschool.ca/lor/AMA11/unit1/U01L02.htm (some misleading graphs)
- http://www.blueclaw-db.com/download/barchart_access_form.htm (how to draw a bar graph on Microsoft Access)
- http://www.mrbartonmaths.com/resources/software%20tutorials/Excel%20-%20Drawing%20Charts.doc (drawing a bar chart using Microsoft Excel)

Exercise 3: Interpreting data

The pie chart is an effective way of representing data if handled properly. The diagram is divided into slices like a pie - each slice represents a part of the whole. The whole circle represents the whole population.

Exercise 3

1 Copy and complete this pie chart to represent the data about eye colour given above.

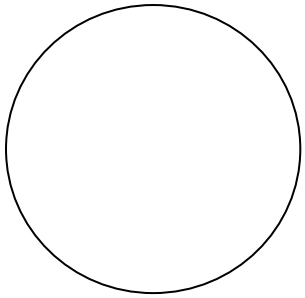
2 Draw a radius in the circle. This is where you start measuring the angles.

3 Measure the angles at the centre.

4 Give a title and a key for the pie chart.

5 Use Excel to draw the pie chart if you are able to.

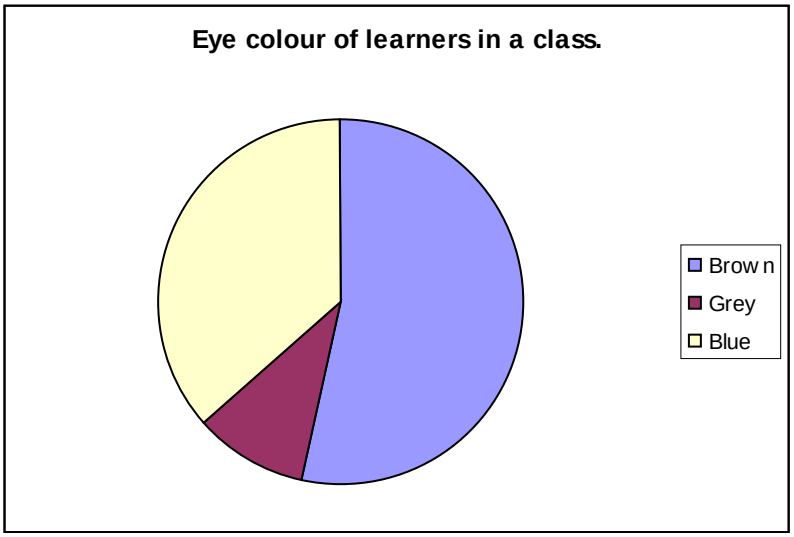
6 Compare your hand drawn graph with the computer generated graph if possible.



Solutions to Exercise 3: Pie charts

Colour	Number
Brown	32
Grey	6
Blue	22
Total	**60**

This is the table of data on eye-colour that was given on page 10 of the reading for Unit Five of the SAIDE ACEMaths materials.



The angles (if you worked them out to draw them by hand) are:

- Brown eyes – 192°
- Blue eyes – 132°
- Grey eyes – 36°

(The sum of all of the angles must come to 360° you should check this when you work them out using your calculator. 192°+132°+36°=360°)

Suggested links for other alternative activities:

- http://en.wikipedia.org/wiki/Pie_chart (information on Wikipedia)
- http://www.fsmq.org/data//files/ihausdrawpsi-9345.doc (a very clear guide to drawing pie charts using excel)
- http://pubs.logicalexpressions.com/Pub0009/LPMArticle.asp?ID=390 (another guide to drawing a pie chart using Microsoft Excel with information about alternative graphs and their uses)

Exercise 4a: Representing and interpreting data

The learners will have fun collecting the data required by the teacher but it is much more fun and meaningful once it is correctly represented by means of a bar graph, a pictogram, a line graph or a pie graph. When the data is well-represented visually, the message is communicated so much more effectively. There are times when one representation is more effective than another. This depends on the situation presented.

Exercise 4 a

Thembi kept a record of the hours she spent on different activities during the day. This information is shown below.

1 Complete the table to show the degrees needed for each activity when drawing a pie chart.

2 Draw the pie chart.

3 Represent the information using a line graph.

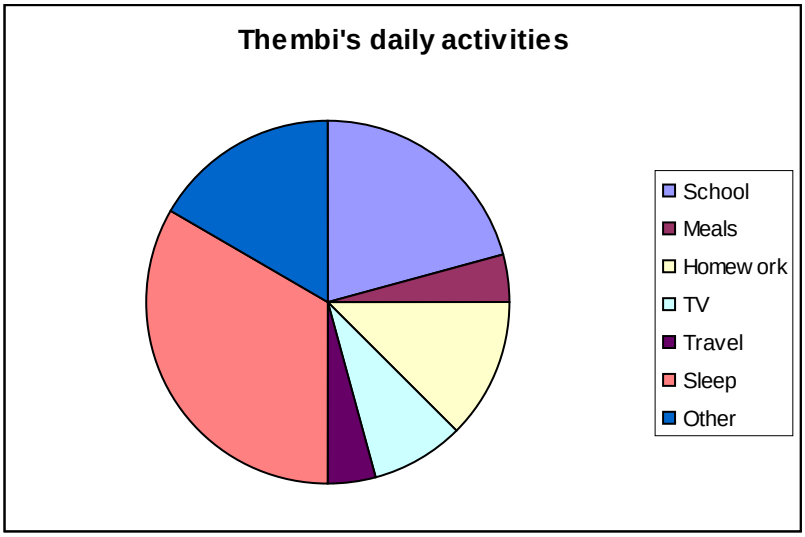
Activity	Number of hours	Number of degrees
School	5	……. x 360° = ……
Meals	1	
Homework	3	
TV	2	
Travel	1	
Sleep	8	
Other	4	
Total	**24**	

Solutions to Exercise 4a: Representing and Interpreting Data

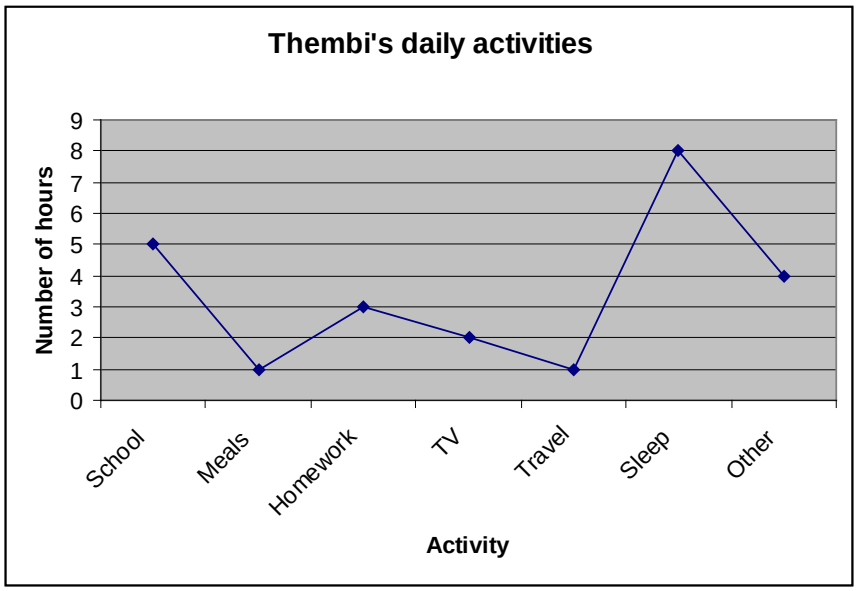
1.

Activity	Number of hours	Number of degrees
School	5	$\frac{5}{24} \times 360° = 75°$
Meals	1	$\frac{1}{24} \times 360° = 15°$
Homework	3	$\frac{3}{24} \times 360° = 45°$
TV	2	$\frac{2}{24} \times 360° = 30°$
Travel	1	$\frac{1}{24} \times 360° = 15°$
Sleep	8	$\frac{8}{24} \times 360° = 120°$
Other	4	$\frac{4}{24} \times 360° = 60°$
Total	**24**	360°

2. Pie chart to represent the data about Thembi's daily activities.



3. Line graph to represent the data about Thembi's daily activities.



Suggested links for other alternative activities:

- http://www.fsmq.org/data//files/ihausdrawlsi-9880.pdf (how to draw line graphs using Microsoft Excel)
- http://www.ixl.com/math/practice/grade-4-line-graphs (online activities on interpreting line graphs)
- http://members.westnet.com.au/molinasantos/strands/C_D/piegraphs.pdf (interpreting pie graphs/charts)
- http://members.westnet.com.au/molinasantos/strands/C_D/piegraphs.pdf (interpreting pie graphs/charts)

- http://www.lmpc.edu.au/resources/Science/research_projects/4%20Drawing&interpreting%20grap.pdf (information on interpreting line (and other) graphs)

Exercise 4b: Representing data – selecting the best representation

Exercise 4 b

Joe did a survey of the colours of cars parked at the local sports club. The observation sheet is given below.

1 Complete the frequency table.

2 Display the data as a pictogram, a bar graph and a pie chart.

3 Which representation do you think is best? Explain your response.

Joe's observation sheet		
Colours	**Tallies**	**Frequency**
Red	𝍸 𝍸	
Blue	||	
Green	𝍸 𝍸 𝍸	
Black	𝍸	
Orange	𝍸 𝍸 ||	

Solutions to Exercise 4 b: Representing data - selecting the best representation

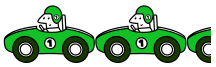
1. tallies and frequencies below:

Joe's observation sheet

Colours	Tallies	Frequency
Red	𝍸 𝍸	10
Blue	||	2
Green	𝍸 𝍸 𝍸	15
Black	𝍸	5
Orange	𝍸 𝍸 ||	12

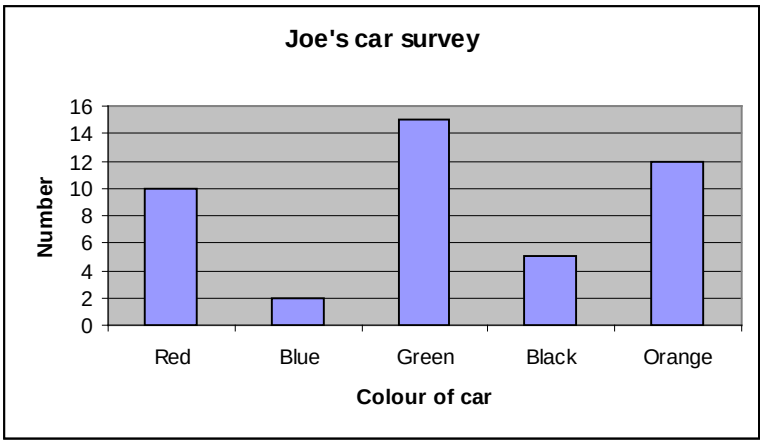
2. Pictogram, Bar graph and Pie chart graphs follow below.

Pictogram:

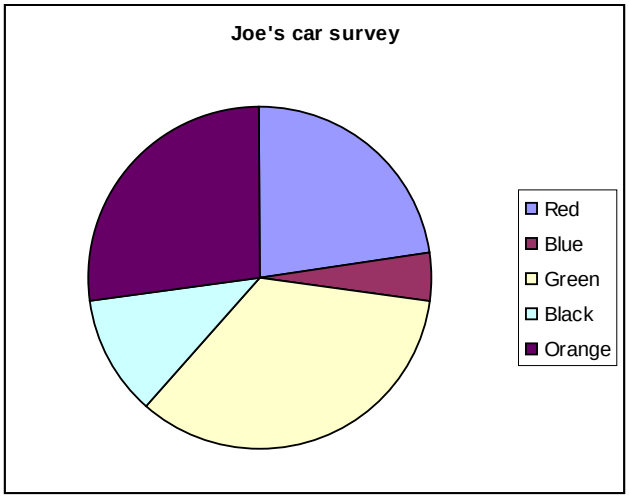
Joe's car survey	
Colours	
Red	
Blue	
Green	
Black	
Orange	

Key:  = 5 cars and  =2 cars

Bar graph:



Pie chart



3. In the example above, the pictogram, the bar chart and the pie chart are good representations of the data. Perhaps a pictogram using cars for representation would be fun here, especially if the colour of the car icons could be varied to show the particular colours of the cars he counted!

Suggested links for other alternative activities:

- http://wsgfl.westsussex.gov.uk/ccm/cms-service/stream/asset/;jsessionid=aE7nigzVl2Sf?asset_id=2554092 (information on selecting the best type of graph)

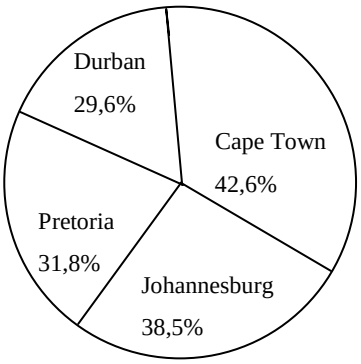
- http://42explore.com/graphs.htm (online information on selection of graphs for representing data. Also gives information on misleading data. Also a child friendly online graphing activity.)

Exercise 5: Interpreting data – impulse buyers

It is common in our media for data to be misrepresented and misinterpreted. Sometimes this can be deliberate to shock or delight us, or actually to mislead us. Other times it can be a genuine misunderstanding of the data by the journalist or reported involved. The more we as ordinary civilians know about the representation and interpretation of data, the more analytical and informed we become. If we can help our learners to confidently represent and interpret data at school level, we will be helping them to develop a tool for everyday life long after formal schooling is complete!

Exercise 5

Below are a graph and a newspaper article taken from The Star newspaper (1999) about impulse buying. Read the article carefully. Think about things like the assumptions that are made by the writer/researcher and whether the article and the graph tell the same story.



Who are the impulse buyers?

South Africa is a nation of shoppers with increasing numbers defined as impulse buyers who respond to glossy adverts and come-ons such as 'never to be beaten bargains' and 'buy one and get one free'.

This, in part, has emerged from one of the most comprehensive surveys of consumer shopping behaviour which has just been compiled by Media & Marketing Research (MMR).

MMR's research provides answers to a host of questions about South Africa and how its people buy.

Capetonians were the most likely to respond to bargains, good buys as well as advertising come-ons on TV and in newspapers (42,6%). Johannesburg shoppers came in second at 38,5%, Pretoria notched up 31,8% and Durbanites were rated at 29,6%.

The ranks of impulse shoppers were most likely to come from these 'bargain hunting' groups.

1 What is wrong with the pie graph?

2 Who do you think 'impulse buyers' are?

3 Who do you think 'bargain hunter' shoppers are?

4 Redraw the given data in a more suitable and correct graph.

5 According to the researchers, what does the given data represent?

6 What does the newspaper headline suggest the data represents?

7 What assumptions are made about the meaning of results of research on 'bargain-hunting' shoppers?

8 What does the data not tell us about impulse buying?

Solutions to Exercise 5: Interpreting data - Impulse Buyers

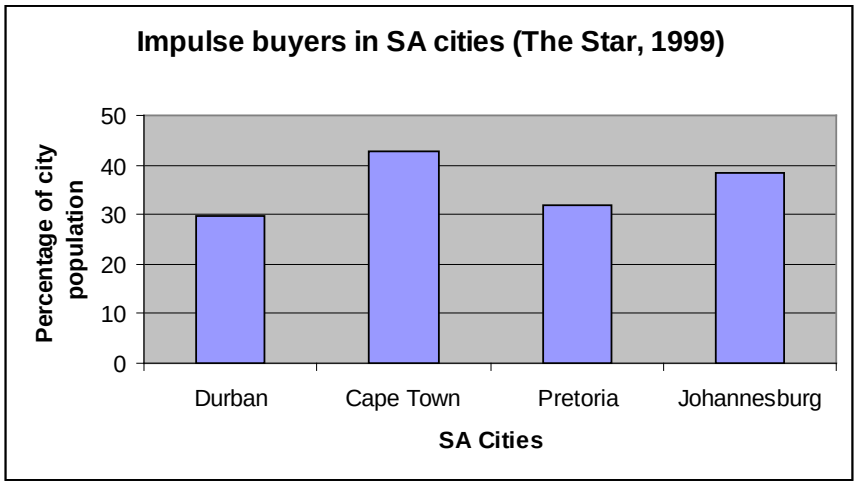
1. The percentages in the pie graph do not add up to 100%! The percentages add up to 142,5%. The pie graph should represent the spread over the total population of 100%, so these percentages are misleading.

2. 'Impulse buyers' are people who buy things on the spur of the moment. They probably do not analyse whether they really have a need for the item beforehand.

3. 'Bargain hunter' shoppers are those shoppers who look for good deals. Bargain hunters are not necessarily impulse buyers. In fact, it is quite probable that the impulse buyer does not look for a bargain and similarly, it is quite probable that the bargain hunter would not be an impulse buyer.

4. A more suitable graph would be a bar graph because the percentages represent those who are impulse buyers out of all the buyers in a particular city.

   The bar graph is shown below.



5. According to the researchers, the given data represents the percentage of people 'most likely to respond to bargains, good buys, as well as advertising come-ons on TV and in newspapers': in other words bargain-hunting shoppers. The percentages given are those of the bargain hunters out of the total shoppers in that city.

6. The headline suggests that the data represents the percentages relative to the South African population, of impulse buyers from a selection of cities in the country.

7. The assumption made is that the bargain hunters are impulse shoppers. This is not necessarily true as mentioned previously.

8. Actually the data tells us nothing concrete about impulse-buying.

Suggested links for other alternative activities:

- http://hospitality.hud.ac.uk/studyskills/usingData/InterpretingData/misleadingData.htm (info on misleading data but also other info about data representation and interpretation)
- http://www.blackgold.ab.ca/ict/Division4/Math/Div.%204/analyzingdata/misleading.htm (activity on misleading data)

Unit mathematical content summary

Summary of content covered in this unit:

- Exercise 1 involved mathematical concepts relating to the collecting and tallying of data
- Exercise 2 involved mathematical concepts relating to drawing pictograms and bar charts.
- Exercise 3 involved mathematical concepts relating to the drawing of a pie chart, using a pair of compasses and Excel on the computer.
- Exercise 4a involved mathematical concepts relating to the working out of degrees and the drawing of a pie chart/ line graph.
- Exercise 4b involved mathematical concepts relating to the displaying of data using the pictogram, a bar graph and a pie chart.
- Exercise 5 involved mathematical concepts relating to the misinterpretation of data - how data can sometimes be misrepresented by reporters in media.