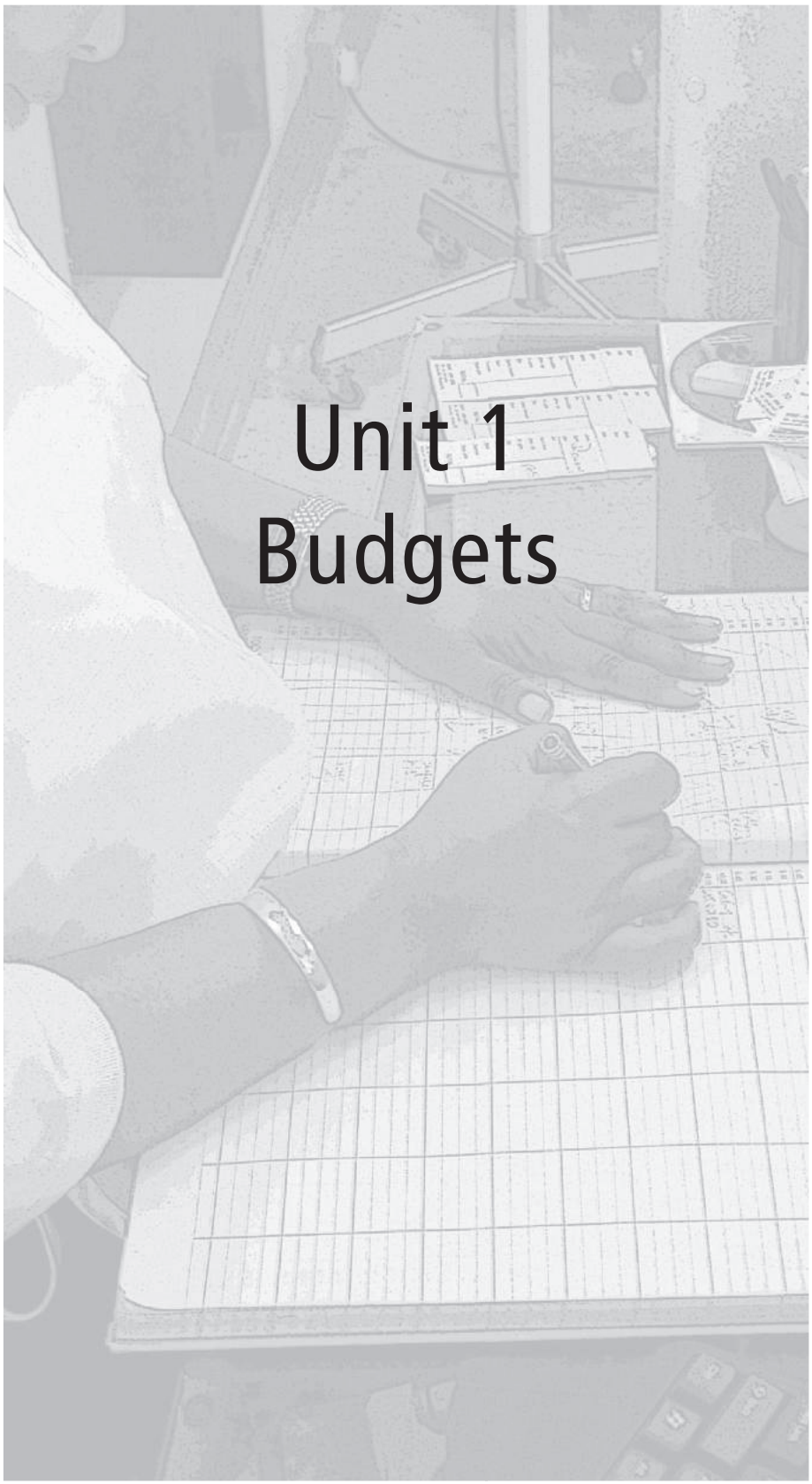
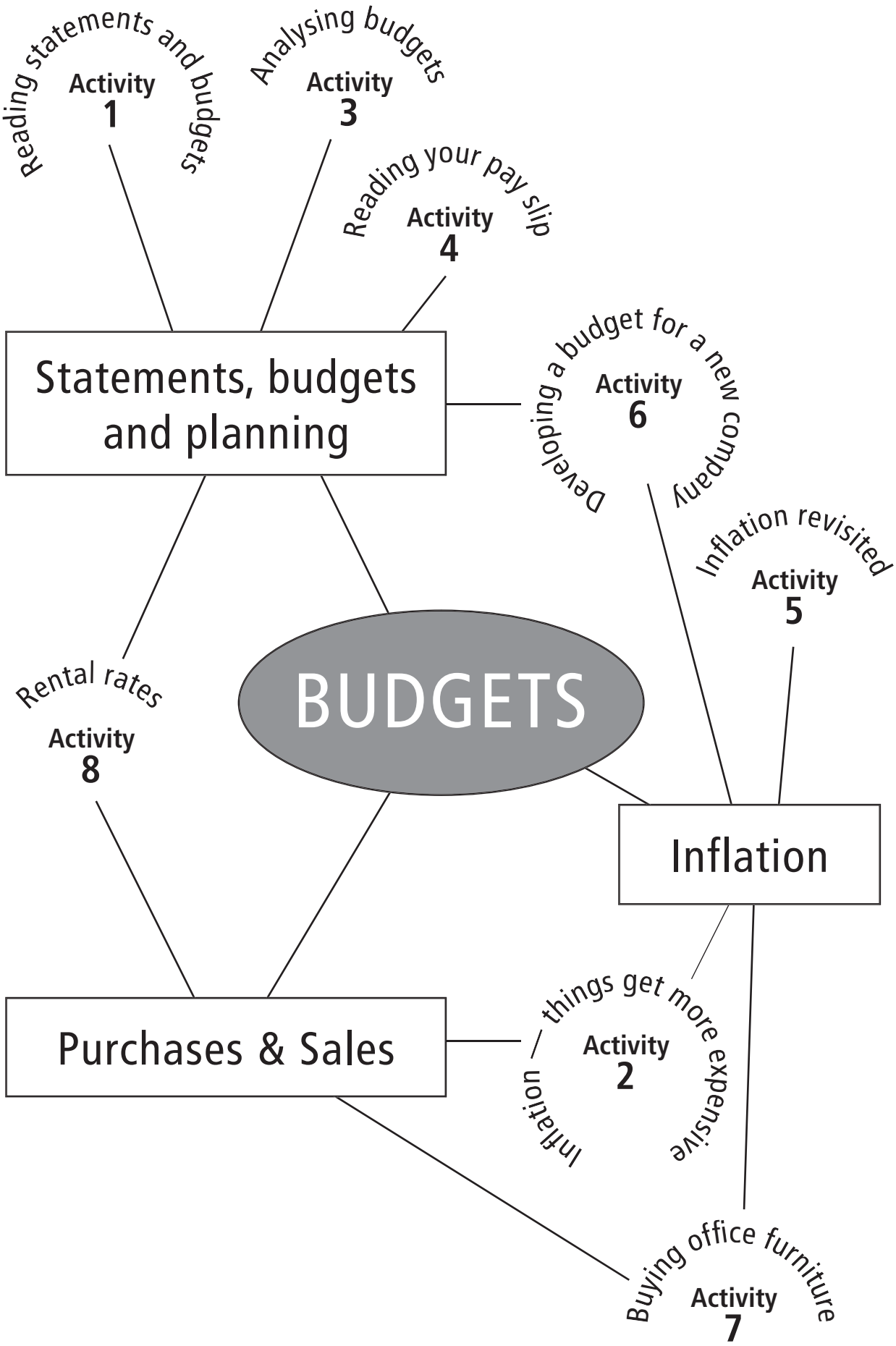
Mathematical Literacy

NQF LEVEL 4



Unit 1
Budgets

Generic Business Administration


Reading statements and budgets
Activity 1
Analysing budgets
Activity 3
Reading your pay slip
Activity 4
Statements, budgets and planning
Developing a budget for a new company
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Activity 5
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BUDGETS
Inflation
Purchases & Sales
things get more expensive
Activity 2
Inflation
Buying office furniture
Activity 7

Overview

This unit aims to increase learners' familiarity with and understanding of the financial aspects relating to the running of a hair salon business.

Students should gain an understanding of what income and expenditure statements are. The relationship between budgets on a small scale business level and those on a large scale national level is highlighted.

Inflation has a significant effect on individuals as well as on all businesses. It is imperative that students gain a clear understanding of what inflation is and how to run a business whilst making allowances for the effects of inflation.

Aspects of national economy are also considered. This unit gives the student an understanding of what the sources of government income are and how government uses it's resources. Government budgeting is also carefully looked at.

This unit consists of eight activities. Each activity is a stand-alone activity, but they rely on an understanding of the concepts that have been raised preceding each activity. Having worked through this unit, students should have a greater ability to deal with some of the financial aspects of running a successful business. They should also have a greater understanding of the country's national budget.

Activity 1: Reading statements and budgets
In this activity we want students to gain an understanding of how to read budget statements. This is because many of the later activities in this unit relate back to budget statements.

We start by asking students to reflect on their own personal income and expenditure statements. Three budget statements are included with the activity: one is for Seaside Rental Company and the others are the provincial and national income and expenditure statements. It is important for students to recognise the similarities that exist between all budget statements.

Activity 2: Inflation — things get more expensive
This activity introduces the concept of inflation, and gives students the opportunity to discover for themselves that prices go up over time. It allows students to realise that not all items increase in price by the same amount over a fixed period of time. The ideas of simple and compound interest are also introduced.

Activity 3: Analysing budgets
In this activity we will combine the ideas learnt in the first two activities and explore how inflation plays a significant role in preparing and understanding budgets.

Unit outcomes

The following Unit Standards, Specific Outcomes and Assessment Criteria are addressed by this unit:

Use Mathematics to investigate and monitor the financial aspects of personal, business and national issues (9014)

- Use Mathematics to investigate and analyse regional and/or national budgets and income (SO1).
  - Regional and/or national budgets from the media and other sources are accessed, and income and expenditure are described realistically.
  - Calculations are carried out efficiently and correctly using computational tools.
  - Solutions obtained are verified in terms of the context.
  - Different ways of representing budgets are critically analysed and related.
  - Actual income and expenditure is analysed and compared to planned income and expenditure. Variances are identified.

- Use compound growth to make sense of inflationary effects on the national economy (SO2).
  - Methods of calculation are appropriate to the problem types.
  - Computational tools are used efficiently and correctly and solutions obtained are verified in terms of the context or problem.
  - Solutions to calculations are interpreted in terms of base rates or indices.
  - Appropriate formulae are understood and used to calculate solutions to problems.

- Use Mathematics to critique and debate aspects of the national economy (SO3).
  - Values are calculated correctly.
  - Mathematical tools are used to compare the effects of changes in different sectors of the national economy.
  - Critique and debating points are based on well-reasoned arguments and are supported by mathematical information.

Activity 4: Reading your pay slip
This activity looks at pay slips in detail and gives students the opportunity of understanding the information that is provided on a pay slip. In addition, it shows students how tax and UIF is calculated based on income and takings.

Activity 5: Inflation revisited
This activity enables students once again to interact with the important concept of inflation. We look at two newspaper articles which deal with different aspects of inflation. The concepts learned are then applied to the running of a business.

Activity 6: Preparing budgets
This activity is designed to be used as an assessment activity. It is intended to recap principles that have been learnt in the first five activities. There is an opportunity for students to make their own judgments about how a business develops and to draw up a budget accordingly. If time allows it may be worthwhile for students to share their budgets with each other, explaining the reasons behind their decisions.

Activity 7: Buying items office furniture
In this activity we expose students to the different payment options available when purchasing items on credit. We also consider the various factors at play when deciding which option is most suitable.

Activity 8: Rental rates
In this activity we consider the effect of exchange rates on the cost of renting properties in South Africa from foreign countries.

9014	**Use mathematics to investigate & monitor the financial aspects of personal, business and national issues**										
		ACTIVITY	1	2	3	4	5	6	7	8
SO1	Use mathematics to investigate and analyse regional and/or national budgets and income										
	AC1	Regional and /or national budgets from the media and other sources are accessed, and income and expenditure are described realistically.	✓		✓		✓		✓	✓
	AC2	Calculations are carried out efficiently and correctly using computational tools.		✓	✓		✓	✓	✓	✓
	AC3	Solutions obtained are verified in terms of the context.	✓	✓	✓		✓	✓		✓
	AC4	Different ways of representing budgets are critically analysed and related.	✓		✓	✓		✓		✓
	AC5	Actual income and expenditure is analysed and and compared to planned income and expenditure. Variances are identified.	✓		✓	✓		✓		✓
SO2	Use compound growth to make sense of inflationary effects on the national economy.									
	AC1	Methods of calculation are appropriate to the problem types.	✓	✓	✓	✓	✓	✓	✓	✓
	AC2	Computational tools are used efficiently and correctly and solutions obtained are verified in terms of the context or problem.		✓	✓	✓	✓	✓	✓	✓
	AC3	Solutions to problems are interpreted in terms of base rates or indices.		✓	✓	✓	✓	✓	✓	✓
	AC4	Appropriate formulae are understood and used to calculate solutions to problems.		✓	✓	✓	✓	✓	✓	✓
SO3	Use mathematics to critique and debate aspects of the national economy.									
	AC1	Values are calculated correctly.	✓	✓	✓	✓	✓	✓	✓	✓

Activity 1 — Reading statements and budgets

ABOUT THIS ACTIVITY

This activity focuses on income and expenditure. Students will represent and analyse their own personal income and expenditure as well as that of Seaside Rental Company. They will also look at a national budget statement and make comparisons and identify links between this and the other budgets. Basic budget layout and terminology will be introduced in this activity. Students will be expected to extract appropriate values from the budgets – showing their understanding of the various rows and columns shown on a budget.

This activity is aligned with unit standard 9014 and addresses AC 1,3,4,5 of SO1; AC 1 of SO2 and AC 1,3 of SO3.

MANAGING THIS ACTIVITY

For this activity, students will need a set of handouts (5 pages containing Shazia Lakay's pay slip, the Seaside Rental Company budget, Western Cape budget framework and South African budget framework and additional representations of the Western Cape expenditure).

1.1.1 Sources of income could include any of the following: bursary, loan, pocket money, part-time wages.

1.1.2 The main expenses incurred during the month could include the following: rent, groceries, toiletries, electricity, telephone and/or cell phone, transport, entertainment, clothes, birthday presents, sundries.

1.2 Example of a completed income and expenditure table:

Summary of income and expenditure for: Natasha de Villiers For the period: July 2004					
Income			Expenditure		
Date	Description	Amount	Date	Description	Amount
01/07	Withdrawal from savings	R1 000	01/07	Rent	R2 000
05/07	Bursary	R2 000	03/07	Electricity	R150
	Part-time wages	R1 200		Groceries	R500
				Transport	R200
				Entertainment	R650
			23/07	Telkom account	R267
			24/07	Truworths account	R120
				Sundries	R213
Total		R4 200		Total	R 4 100
				Surplus of	R100

1.3.1 The word "EARNINGS" is used to refer to Shazia's income. She receives a basic salary and she also receives a year-end bonus this month.

1.3.2 The word "DEDUCTIONS" is used to refer to Shazia's expenses. Money is deducted from her income for TAX and for UIF.

1.3.3 For the month of December 2004, Shazia received an income of R10 980,29 after the deductions. This is more than every other month as she only gets a bonus at the end of each year. Every other month she would receive a basic salary of R6 350 and she would have a UIF deduction of R63,50 (127,00 ÷ 2) and a tax deduction of R796,36 (1592,71 ÷ 2). Therefore, in every other month she would be banking a net pay of R5 490,14.

1.4.1 Other words used to describe earnings are "income" and "revenue".
Examples of different incomes:
- Seaside Rental: Rental and recoveries.
- Provincial: National transfer and own revenue.
- National: Tax revenue and departmental and other receipts.

1.4.2 Other word used to describe deductions are "expenses" and "expenditure".
The 3 largest expenses incurred in 2002:
- Seaside Rental: Salaries, security and maintenance and office rental.
- Provincial: Education, health and social services and poverty alleviation.
- National: Provincial equitable share, justice and protection services and State dept cost.

1.4.3 If an organisation plans to spend money on certain things then these things are listed in the column labelled "budget" or "estimate". The "budget" or "estimate" column contains descriptions of costs that have not yet been incurred. The figures in this column are, therefore, merely the expected or estimated figures and are determined before payment is actually made. Once an expense is incurred (something is paid for) this expense would then be placed in a column marked "actual" and the figure represented next to this item would now be the "actual" (real/correct) amount incurred for this expense. In summary, a budget is prepared before the start of the year in order to guide behaviour during the year while the income/expenditure statement is a reflection of actual spending and can only be prepared at the end of the financial year.

1.4.4 The financial year for Seaside Rental Company runs from January – December, therefore simply saying 2002 implies from January 2002 – December 2002. However, the provincial and national financial year does not run from Jan – Dec but for a revolving period of 12 months. Another example of a revolving period is the tax year. The tax year runs from the beginning of March in one year till the end of February of the following year.

1.5 Students are expected to identify that the figures in the national and provincial budgets are given in million rands, whereas the Seaside Rental Company budget figures are simply the rand values.

1.5.1 National budget: R326 956 000 000, 00

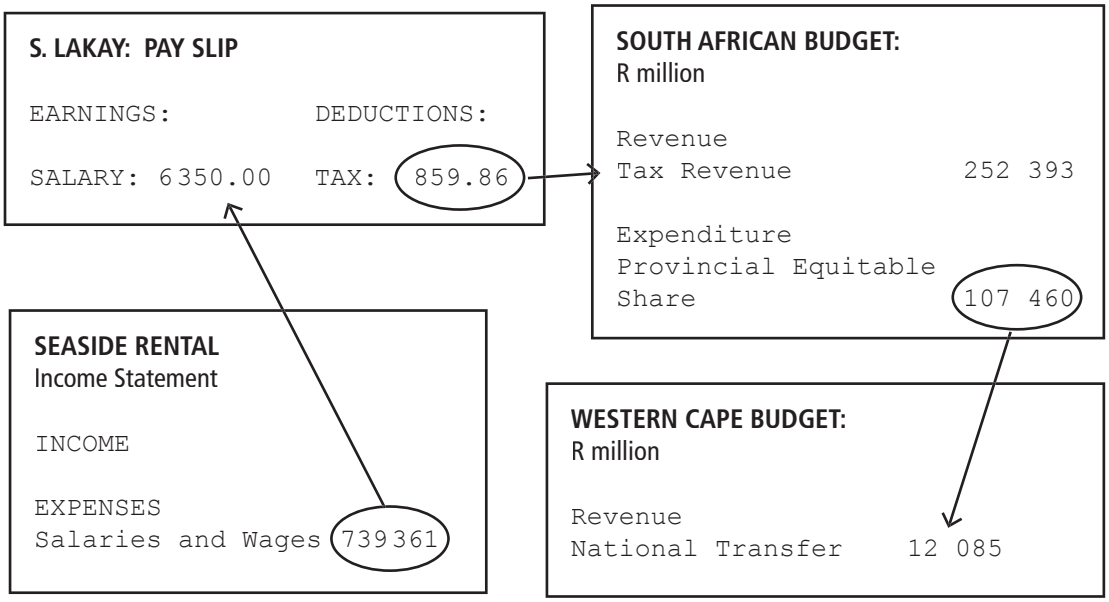
1.5.2 Western Cape budget: R17 372 000 000,00

1.5.3 Seaside Rental budget: R1 36 1106,00

1.6 No. The actual amount in the bank would be reflected in a statement of assets and liabilities, which is often another element of a financial report. The income and expenditure statements are plans of reports but are not in themselves an indicator of cash-in-hand.

1.7 No. For example, "salary" tells us the total amount spent on salaries but it does not tell us how many people are employed or what each employee earns. Similarly, "office telephone" does not tell us how many local/long distance/cellular calls are made, only the total amount spent on telephone calls.

1.8



1.9 For Shazia to earn a higher salary from Seaside Rental, Seaside Rental would need to produce a larger income. For Western Cape to receive more revenue from the national funds, people like Shazia would need to pay more taxes. Of course, this is very simplified.

1.10 Above each box is a total. Inside the box is an itemised list of each of the individual entries that make up this total. Not all statements use this layout. Some statements only show a total at the end of each major section (e.g. on the national and provincial budgets). It is not always necessary to use boxes, especially in larger budgets that do not show as much detail and a breakdown of individual figures.

1.11 One method of showing a deficit/loss is to put brackets around a number e.g. the Seaside Rental income statement shows a deficit at the end of the 2003 column as (296 696), meaning –R296 696,00. Another method of showing a deficit/loss is to use a negative sign before the number e.g. the Western Cape statement shows a deficit at the end of the 2002/2003 column as –648, meaning –R648 000 000,00.

Activity 1 — Reading budgets

Money is very important to a company—without money you cannot run your business. In this activity we will be looking at financial planning and management. There are two key aspects to managing the finances of a business. Firstly, you need to keep a record of actual income and expenditure and secondly, you need to plan ahead. The record is usually summarised on an income/expenditure statement while planning is done by means of a budget, which reflects anticipated (expected) income and expenditure. Income and expenditure statements as well as budgets should be prepared on a monthly and yearly basis for the crèche, as well as for any specific projects undertaken.

1.1 Before we go any further, think about your personal income and expenditure over the last month.

1.1.1 Make a list of all the sources of your income and also the amounts (e.g. bursary, loan, pocket money, part-time wages, etc.).

1.1.2 Make a list of all the main expenses you incurred during the month as well as the amount for each (e.g. rent, transport, groceries, toiletries, entertainment, clothes, etc.).

1.2 Draw and complete a table such as the one below for the income and expenditure you listed above. You will have to add more rows and you will almost certainly not remember the dates—this is not a problem for now.

Summary of income and expenditure for: _____(insert name here)_____ For the period: ____(insert month here)_____					
Income			Expenditure		
Date	Description	Amount	Date	Description	Amount
	Total			Total	
			Surplus or deficit (total income – total expenses)		

If your income exceeds your expenses you have a surplus: money you can save or carry over to the next month or project. If your expenses exceed you income you have a deficit: money you will have to take out of your savings or cover with a loan.

For the next set of questions you must refer to the handout, which includes the following:

- An income and expenditure statement (in the form of her payslip) for Shazia, a lease administrator employed by Seaside Rental company.
- The income expenditure statement for the Seaside Rental Company.
- The national income and expenditure statement presented by the National Minister of Finance to parliament and by local member of the executive council (MEC) for finance to the Western Cape government.
- Two different representations of how the Western Cape Education Department (WCED) will spend the 2004/2005 Western Cape education allocation.

1.3 Refer to Shazia's pay slip and determine the following:

1.3.1 What word does the pay slip use to refer to income?

List the different forms of income that she receives.

1.3.2 What word does the slip use to refer to expenses? List the different types of expenses that she incurs.

1.3.3 How much money did Shazia receive in her bank account at the end of the month? Is this the same for every other month of the year? If not, how much do you think she banks during other months?

1.4 Refer to the income statement of the Seaside Rental Company, as well as the national and provincial budgets, and determine the following:

1.4.1 What different words do these documents use to refer to income? List two of the different forms of income that each institution receives.

1.4.2 What different words do these documents use to refer to expenses? List the three largest forms of expense that each institution incurred in 2002.

1.4.3 You will notice that each of these documents has different columns for different years. Some are labelled "actual" while others are labelled "budget" or "estimate". Why are these different labels used?

1.4.4 You will notice that the national and Western Cape budgets refer to years as 2002/2003 etc. while the Seaside Rental Company refers simply to 2002 and 2003. Why is there this difference?

1.5 Give the total (in rands) of the following amounts of money referred to in each of the following statements:

1.5.1 National budget: 326 956 (estimated revenue 2004/2005)

1.5.2 Western Cape budget: 17 372 (estimated revenue 2004/2005)

1.5.3 Seaside Rental Company: 1 36 1106 (budgeted income 2004)

1.6 Can you tell from the Seaside Rental Company statement (or the national and Western Cape statements) how much money is in their bank account at any time?

1.7 Can you tell from the Seaside Rental Company statement (or the national and Western Cape statements) how the money allocated to a particular expense is actually spent?

1.8 Examine the income and expenditure columns of the four documents. Can you link these together? You should be able to see how some income items on the statements link to specific expenditure items on others. Draw a diagram of this cash flow.

1.9 What are the implications of the links you have identified above for individuals and organisations within a province and country?

1.10 The table below is an extract from the Seaside Rental company financial statement. Why are there boxes around some of the entries? Why do these boxes not appear in all the statements?

1 320 000
12 880
5 280
7 600
38 500
11 500
27 000
1 371 380

1.11 The different statements provided use two different ways to indicate a deficit/loss. What are these?

SEASIDE RENTAL COMPANY	EMP. CODE:	018	PERIOD END DATE:	31/12/2005
25 HOUTAN CLOSE	EMP. NAME:	S. LAKAY	DATE ENGAGED:	01/04/2003
HOUT BAY, 7806	JOB TITLE:	LEASING ADMINISTRATOR	ID NUMBER:	7506246578083

ADDITIONAL INFORMATION		EARNINGS		DEDUCTIONS	
BASIC SALARY:	82550.00	BASIC SALARY:	6350.00	TAX	1592.71
NORMAL HOURS:	162.50	BIRTHDAY BONUS:	6350.00	UIF	127.00
OVERTIME HOURS:					
LEAVE DAYS DUE:	8				
YEAR-TO-DATE TOTALS					
TAXABLE EARNINGS:	57150.00				
TAX	7167.20				
UIF	571.50				
CURRENT PERIOD					
TOTAL PERKS:	0.00	TOTAL EARNINGS:	12700.00	TOTAL DEDUCTIONS	1719.71
CO.CONTRIBUTIONS	127.00				
				NET PAY	10980.29

Income statement for the year ended 28 February 2004 presented to the director at Annual General Meeting.

	Actual 2002	Actual 2003	Budget 2004
INCOME			
Rental	1 320 000	1 544 400	1 266 408
Interest	12 880	16 913	11 700
Interest from bank	5 280	6 178	5 200
Interest on late rental	7 600	11 000	6 500
Recoveries	38 500	82 396	82 998
Refuse recovery	11 500	23 000	26 000
Water recovery	27 000	59 396	56 998
TOTAL INCOME	**1 371 380**	**1 643 709**	**1 361 106**
EXPENSES			
Bank charges	20 000	22 400	19 000
Capital expenses	0	762 704	0
Electricity for offices	6 000	7 000	8 000
Consumables - cleaning and maintenance	18 000	19 000	17 000
Water	3 600	4 000	4 500
Office printing, postage & stationery	7 000	7 500	8 000
Office telephones	15 000	17 000	18 000
Office rental	72 000	82 800	0
Insurance	36 000	38 000	41 000
Marketing	69 504	78 000	85 000
Security and maintenance	325 000	335 000	442 000
Salaries and wages	525 000	567 000	739 361
TOTAL EXPENSES	**1 097 104**	**1 940 404**	**1 381 861**
NET SURPLUS (DEFICIT)	**274 276**	**(296 696)**	**(20 755)**

Western Cape Budget Framework
Based on the Budget speech of the Provincial Minister of Finance, Economic Development and Tourism, Ebrahim Rasool, on 3 March 2004[1]

R million	2001/2002 Actual	2002/2003 Actual	2003/2004 Estimate	2004/2005 Estimate
Revenue				
National transfer	12 085	13 314	14 963	16 342
Own revenue	954	834	1 015	1 030
Total Revenue	**13 039**	**14 148**	**15 978**	**17 372**
Expenditure				
Provincial administration	280	396	307	312
Provincial parliament	20	24	29	31
Provincial treasury	48	69	200	145
Community safety	97	118	140	147
Education	4 273	4 678	5 030	5 356
Health	3 581	3 871	4 291	4 504
Social services and poverty alleviation	2 384	3 216	3 762	4 324
Housing	382	460	519	547
Environmental affairs	93	121	122	129
Transport and public works	1 060	1 379	1 543	1 641
Agriculture	114	139	169	198
Local government	30	65	63	63
Economic development and tourism	52	152	80	61
Cultural affairs and sport	90	108	137	143
Total expenditure	**12 504**	**14 796**	**16 392**	**17 601**
Surplus/Deficit(-)	**535**	**-648**	**-414**	**-229**

[1] Based on details sourced at: http://www.capegateway.gov.za/eng/pubs/budgets/2004/52862 (June 2004)

South African Budget Framework

based on the Budget speech of the Minister of Finance, Trevor Manuel, on 18 Feb 2004[1]

R million	2001/2002 Actual	2002/2003 Actual	2003/2004 Estimate	2004/2005 Estimate
Revenue (National Revenue Fund)				
Tax revenue	252 398	282 180	303 318	333 694
Departmental and other receipts	4 169	4 587	6 704	6 590
Less: SACU	-8 205	-8 259	-9 723	-13 328
Total Revenue	**248 362**	**278 508**	**300 299**	**326 956**
Expenditure				
Statutory appropriations				
State debt cost	47 581	46 808	47 326	50 432
Provincial equitable share	107 460	123 457	144 743	159 971
Skills development funds	2 541	3 259	3 700	4 300
Other	335	350	183	197
Appropriated by vote				
Central government administration	11 841	14 914	19 032	23 188
Financial and administrative services	9 552	10 791	13 113	14 961
Social services	19 806	19 859	23 655	28 573
Arts and culture	442	592	926	1 141
Education	8 616	9 314	10 584	11 344
Health	6 223	7 059	7 695	8 787
Labour	1 396	1 283	1 054	1 191
Science and technology	701	801	1 068	1 276
Social development	2 327	639	2 100	4 548
Sports and recreation	101	171	228	286
Justice and protection services	44 051	49 956	53 792	58 269
Economic services and infrastructure	19 427	22 090	25 922	25 283
Standing appropriations	294	30	46	34
Total expenditure	**262 888**	**291 514**	**331 512**	**365 208**
Surplus/Deficit(-)	**-14 526**	**-13 006**	**-31 213**	**-38 252**

NATIONAL TREASURY

[1] Based on details sourced at: http://www.finance.gov.za/ (June 2004)

Activity 2 — Inflation — things get more expensive

ABOUT THIS ACTIVITY

This activity focuses on inflation. By looking at some shopping item prices of 1988 and comparing these with current prices for these items (or similar equivalents) students notice that although some items have increased more than others, on average the prices are in line with inflation. We use this context as an opportunity to introduce simple and compound increase.

This activity is aligned with unit standard 9014 and addresses AC 2,3 of SO1; AC 1,2,3,4 of SO2 and AC 1,2,3 of SO3.

MANAGING THIS ACTIVITY

For this activity students are required to collect current prices of certain items from the supermarkets. Therefore, this part of the activity may be given as a homework task (and possibly could be shared out among the students in the class if necessary) in order to save time in class.

2.1 Students are required to do research in order to determine the current prices of each of the items listed in the "shopping basket table". Some of the brands may not be available or may have been discontinued. Where necessary, students should select an appropriate substitute in order to complete the table.

2.2 Students are required to fill in the following information (note: letters have been used in the "current" column in order to show the correct calculations — the students will fill the actual amounts in here):

Comparison of the cost of a 1988 shopping basket with the current cost			
	Total cost (by category) of the items in the basket		2.3 % increase
	1988	Current	
Clothing	R 569,89	C	$\frac{C - 569,89}{569,89} \times 100$
Groceries	R 56,04	G	$\frac{G - 56,04}{56,04} \times 100$
Household	R 1 330,88	H	$\frac{H - 1330,88}{1330,88} \times 100$
Motor	R 87,45	M	$\frac{M - 87,45}{87,45} \times 100$
Sport	R 240,34	S	$\frac{S}{240,34} \times 100$
Total	R2 284, 60	= C+G+H+M+S	$\frac{(C + G + H + M + S) - 2284,60}{2284,60} \times 100$

2.4 The answers to these questions will depend on the current prices.
2.4.1 = the category with the highest % increase (the value in the last column).
2.4.2 = the category with the lowest % increase.
2.4.3 = any of the categories whose % increase is larger than the increase shown here.
2.4.4 = any of the categories whose % increase is less than the total increase.

2.5.1 No, this does not seem reasonable. Students may not yet understand why, but the reason is to do with something called compound increase which is dealt with in the following question.
2.5.2 No, this is still not realistic. If one looks at the year-on-year inflation rates between 1988 – 2003, (see question 2.7), the lowest inflation rate shown is 5,2% (in 1999) and the highest inflation rate shown is 15,6% (in 1991). Therefore 17,8% still seems an unrealistic annual % increase.
2.5.3 The average inflation rate over the past 14 years is approximately 10%. Therefore, a reasonable estimate would be somewhere between 6% and 12%.
2.5.4 Students may not yet know why there is a difference between their estimate and the above calculation, but they will develop a greater understanding of this during the activity.
2.5.5 One example of a very large inflation rate is in Zimbabwe. For more details of this example refer to the handout used in Activity 5.

2.6

	Simple Interest Account		Compound Interest Account	
	Interest earned	Balance	Interest earned	Balance
		100,00		100,00
After 1 year	10,00	100,00	10,00	110,00
After 2 years	10,00	100,00	11,00	121,00

Interest earned = balance × 10% **Balance** = interest + previous balance

Eg: (110 × 10%) = 11,00 11,00 + 110,00 = R 121,00
And: (121 × 10%) = 12,10 12,10 + 121,00 = R133,10 etc

Solutions:

After 3 years	10,00	100,00	12,10	133,10
After 4 years	10,00	100,00	13,31	146,41
After 5 years	10,00	100,00	14,64	161,05

2.7 If we were to show a total column at the end of the table in the previous question it would look like this:

	Simple Interest	Same Balance	Compound Interest	Balance
TOTAL	50,00	100,00	61,05	161,05

Simple interest earned is only R50,00 over the five years, but the compound interest is over R60,00.

Predicted price for items based on the South African inflation figures

	Year-on-year inflation	Tuna price	Argus price
1988		1,49	0,40
1989	14,5	1,71	0,46
1990	14,3	1,95	0,52
1991	15,6	2,25	0,61
1992	13,7	2,56	0,69

1989 tuna price
= 1988 tuna price × 14,5 % + 1988 Tuna price
= 1,49 × 14,5% + 1,49
= 1,71

1992 Argus price
= 1991Argus price × 13,7% + 1991 Argus price
= 0,61 × 13,7% + 0,61
= 0,69

Year-on-year inflation							Shopping basket
Total in 1988		Students are required to calculate the sum of all the items in the 1988 shopping basket (from the table given at the end of this worksheet)					**2 284,58**
1989	14,5	The calculation is then the same as for the others: **1990 price of shopping basket:** = 1988 price × 14,5% + 1988 price = 2 284,58 × 14,5% +2 284,58 = 2 615,84					2 615,84
1990	14,3						2 989,91
1991	15,6						3 456,34
1992	13,7						3 929,85
1993	9,9	2,82	0,76				4 318,91
1994	8,8	3,06	0,82				4 698,97
1995	8,7	3,33	0,89				5 107,78
1996	7,3	3,57	0,96				5 480,65
1997	8,6	3,88	1,04				5 951,99
1998	6,9	4,15	1,11				6 362,68
1999	5,2	4,37	1,17				6 693,53
2000	5,4	4,60	1,24				7 054,99
2001	5,7	4,86	1,31				7 457,12
2002	9,3	5,32	1,43				8 150,63
2003	5,8	5,62	1,51				8 623,37
Current price		4,25	3,00				

2.8 Inflation causes the price of commodities to change from year to year (almost always up). Commodities therefore get more expensive from one year to the next. If your income (salary) increases in line with inflation your spending remains unchanged – that is, you can still buy exactly the same shopping basket. If, however, your income (salary) increases at less than inflation, your spending power has decreased – you can no longer afford the same shopping basket even though your salary has increased (you are earning more).

Activity 2 — Inflation: things get more expensive

You will no doubt remember a time when you paid a lot less for an item than you do today. What did you pay for a soft-drink five years ago? Was there a time when you could go to the movies for less than you pay today? Of course! We call the annual increase in prices inflation. Not only does inflation play an important role in our day to day lives, it also impacts on financial planning. That is why you will have noticed that the projected amounts for items in the budgets for any year in Activity 1 are higher than the actual amounts spent on them in earlier years. In this activity we will try to develop a better understanding of what inflation is.

For the next few questions you will have to refer to handout 2, which consists of a table of items as well as the price you would have paid for each of the items in 1988.

2.1 Share the items among the members of your group and collect the current prices for the items by visiting shops near to you. You may have to find similar items if the actual product is no longer available.

Complete the table.

2.1 At the end of this worksheet you will find a table of items that you might have bought during 1988 as well as the price of each of the items.

Share the items among the members of your group and collect the current prices for the items by visiting shops near to you. You may have to find similar items if the actual product is no longer available.

Comparison of the cost of a 1988 shopping basket with the current cost			
	Total cost (by category) of the items in the basket		% increase
	1988	Current	
Clothing			
Groceries			
Household			
Motor			
Sport			
Total			

2.3 It is hard to compare the categories to see which increased the most and which increased the least since the amounts are all different. In order to be able to compare the changes we will calculate the % increase for each category and for the total. Complete the '% increase' column by using the following formula:

$$\% \text{ increase} = \frac{\text{current price} - \text{1988 price}}{\text{1998 price}} \times 100 \quad \text{or} \quad \%\text{increase} = \frac{\text{current price}}{\text{1998 price}}$$

2.4 Answer the following questions based on the percentage increases you have calculated in your table:

2.4.1 Which category appears to have increased the most?

2.4.2 Which category appears to have increased the least?

2.4.3 Which categories have shown a greater increase than the increase of the total basket?

2.4.4 Which categories have increased less than the increase of the total basket?

2.5 In completing the '% increase' column for the table you will have calculated some rather large numbers, maybe even as high as 700 or 800%.

In 2004 the calculation for the Cape Argus was:

$$\%\ increase = \frac{3{,}00 - 0{,}40}{0{,}40} \times 100 \approx 650\%$$

and for Pick 'n Pay 'no name brand' tuna the calculation was:

$$\%\ increase = \frac{4{,}25 - 1{,}49}{1{,}49} \times 100 \approx 185\%$$

2.5.1 You might conclude that the Cape Argus increased by

$\frac{650}{16} \approx 40{,}69\%$ per year

(1988 – 2004 is 16 years) Do you think this is correct? Give a reason for your answer.

2.5.2 Do you think that

$\frac{185}{16} \approx 11{,}6\%$

for tuna is more realistic?

2.5.3 What do you think is a reasonable estimate of annual increase?

2.5.4 Try to give a reason for the difference between your expectation and the calculation above?

2.5.5 Do you know of any situations/countries where prices do increase by amounts like 50% per year? If so, make a list of these

While it is true that in South Africa we do not typically experience annual increases of 50% for items, the calculation giving 700% for the 16 year period is not incorrect. How do we explain this? The effect can be explained by the term compound increase.

To understand compound increase, consider a simple example in which we compare two kinds of interest: simple interest and compound interest. Banks offer these two forms of interest on savings accounts. With simple interest you earn interest every year (or month) and the interest is paid out—it is not added to the account. With compound interest you earn interest every year (or month) and the interest earned is added to the amount in the savings account.

2.6 Let us say that the bank offers you 10% interest per year for money in your savings account. Complete the table below for the two kinds of account.

	Simple Interest Account		Compound Interest Account	
	Interest earned and paid out to client	Balance	Interest earned and added to the bank balance	Balance
		100,00		100,00
After 1 year	10,00	100,00	10,00	110,00
After 2 years	10,00	100,00	11,00	121,00
After 3 years				
After 4 years				
After 5 years				

You should notice from the table above that you earned 5 × R 10,00 = R 50,00 interest in the simple interest account over the five year period and the balance remained unchanged. By comparison you earned more than R 60,00 interest in the compound interest account. This is because you earned "interest on interest" in the compound interest account. This principle explains how a much less than 44% increase per year can nonetheless appear to look like 700% over 16 years.

2.7 *Statistics South Africa* is responsible for publishing financial statistics for the country. Among other figures, they publish year-on-year inflation figures.

Use the year-on-year inflation figures provided in the table to complete the table for the Cape Argus newspaper and three other items from your shopping basket, as well as for the entire shopping basket.

Predicted price for items based on the South African inflation figures[1]							
	year-on-year inflation	Tuna price	Argus price	Item 1	Item 2	Item 3	Shopping basket
1988		1,49	0,40				
1989	14,5	1,71	0,46				
1990	14,3	1,95	0,52				
1991	15,6	2,25	0,61				
1992	13,7	2,56	0,69				
1993	9,9	2,82					
1994	8,8	3,06					
1995	8,7	3,33					
1996	7,3	3,57					
1997	8,6	3,88					
1998	6,9	4,15					
1999	5,2	4,37					
2000	5,4	4,60					
2001	5,7	4,86					
2002	9,3	5,32					
2003	5,8	5,62					
Current price		4,25	3,20				

As you can see from the table, some items (*Cape Argus*) have increased more than we may have predicted in terms of inflation, while other items (tuna) have not increased as much as we may have expected. This is because inflation measures the 'average' increase of the shopping basket.

2.8 How does inflation impact on your life? Answer this question by thinking about the cost of living (you may want to refer to the income expenditure statement you prepared in activity 1).

[1] Figures supplied by Statistics South Africa.

Shopping Basket		Price in Rands	
Item	**Category**	**1988**	**Current**
Jeans - Denim	C	39,95	
Ladies' Jackets (pastel shades)	C	19,99	
Ladies' Matching Skirts (to go with above)	C	19,99	
Ladies' Matching Slax (to go with above)	C	19,99	
Men's Suits - Mohair (Monatic), each	C	199,99	
Men's Suits - Pure Wool (Monatic), each	C	139,99	
Men's Suits - Wool & Trevira (Monatic), each	C	129,99	
Ceres fruit juice, 1 litre	G	1,29	
Coke, 2 litre	G	1,69	
Edib Sunflower Oil	G	1,58	
Eggs- large, 1doz.	G	1,66	
Frozen Turkeys (whole), per kg	G	4,68	
Klipdrif Brandy, 750 ml bottle	G	8,77	
Peaches - Koo, 410 g tin	G	0,69	
Peas (Helderberg), 410g tin	G	0,69	
Peas Frozen (I & J), 1 kg	G	3,69	
Picnic Shoulder Ham (DAK), 900 g tin	G	7,29	
Potatoes - Class 1 Medium, 5kg pocket	G	2,49	
Quality Street sweets, 1 kg	G	8,99	
Renown pork sausages, 500 g	G	2,49	
Salticrax - Pyotts, 200 g carton	G	0,99	
Sunshine D Margarine, 500 g block	G	1,58	
Tuna (P&P No Name), 200g tin	G	1,49	
Wine - Bellingham Johannesberger, 750 ml bottle	G	2,99	
Wine - Graca, 750 ml bottle	G	2,99	
Cape Argus	H	0,40	
Duvets, double - Trevira	H	39,99	
Duvets, single - Trevira	H	26,99	
Electric Auto Jug Kettle - 1,7 litre (Safeway De Luxe)	H	59,99	
Electric Fry Pan (Sunbeam Master Fryer)	H	79,99	
Electric Kettle - 2.2 litre	H	19,95	
Electric Sandwich Toaster (Safeway De Luxe)	H	49,99	
Electric Steam Iron (Salton Teflon coated)	H	34,95	
Electric Stove - 4 plate (Westpoint)	H	999,95	
Foreign Exchange - One £ UK Sterling	H	3,52	
Foreign Exchange - One US $	H	0,51	
Non Stick Frying Pan	H	14,65	
Engine Oil - Multigrade, 5 litre	M	8,95	
Tyres - Steel Radials (165 SR × 13), each	M	78,50	
Gym Shoes -Adidas Sportive	S	66,95	
Roller Skates - with boots	S	49,95	
Running Shoes - Reebok Royale	S	99,95	
Skateboard	S	19,99	
Tennis Balls - Slazenger, pack of 2	S	3,50	

Activity 3 — Analysing budgets

ABOUT THIS ACTIVITY

Through comparing the national, provincial and business budgets the students are introduced to the idea that, generally speaking, the budget items increase with inflation. Students should notice some anomalies, which can be explained in terms of the other items in the respective budget.

This activity is aligned with unit standard 9014 and addresses AC 1,2,3,4,5 of SO1; AC 1,2,3,4 of SO2 and AC 1,2,3 of SO3.

MANAGING THIS ACTIVITY

Students will need to refer back to the handout pages from activity 1 in order to complete this activity.

3.1 Calculated figures in bold.

	2001/2002	Percent increase/ decrease	2002/2003	Percent increase/ decrease	2003/2004	Percent increase/ decrease	2004/2005
Income							
National	248 362	12,14%	278 508	**7,82%**	**300 299**	**8,88%**	**326 956**
W. Cape	13 039	**8,51%**	14 148	**12,93%**	**15 978**	**8,72%**	**17 372**
Sunny Days			114 256	**19,86%**	**114 256**	**-17,19%**	**113 400**
Expenditure							
National	262 888	**10,89%**	291 514	**13,72%**	**331 512**	**10,16%**	**365 208**
W. Cape	12 504	**18,33%**	14 796	**10,79%**	**16 392**	**7,38%**	**17 601**
Seaside Rental			1 097 104	**76,87%**	**1 940 404**	**-28,78%**	**1 381 861**

3.2 No, it does not matter, because each time a percentage increase or decrease was calculated we either compared rands with rands (in the Seaside Rental row) or billion rands with billion rands (in the national and W.Cape rows). At no point did we compare rands with billion rands – this would be an incorrect calculation.

3.3 Seaside Rental Company
From 2002 to 2003 Seaside Rental Company 's income increased by about 20%, but from 2003 to 2004 it decreased by about 17%. From 2002 to 2003 Seaside Rental Company 's expenditure increased by about 77% but from 2003 to 2004 it decreased by about 29%.

3.4 The students should notice that in 2003 Seaside Rental Company paid out R762 704,00 on capital expenses. They had not previously incurred such an expense and had not budgeted to do so in 2004. This unusual expense has therefore had a significant effect on the percentage increases/decreases shown in the table.

3.5 By taking out the capital expenses of R762 704 (incurred in 2003) we bring the total expenses down to a more realistic R1 177 700,00. This makes the net amount a surplus of R466 009,00 rather than a deficit of R296 696,00. This makes the increase from 2002 – 2003 about 70% which is a lot higher than the national and provincial increases.

SR

SEASIDE RENTAL

Income statement for the year ended 28 February 2004 presented to the director at the Annual General Meeting.

	Actual 2002	Actual 2003	Budget 2004
INCOME			
Rental	1 320 000	1 544 400	1 266 408
Interest	12 880	16 913	11 700
Interest from bank	5 280	6 178	5 200
Interest on late rental	7 600	11 000	6 500
Recoveries	38 500	82 396	82 998
Refuse recovery	11 500	23 000	26 000
Water recovery	27 000	59 396	56 998
TOTAL INCOME	**1 371 380**	**1 643 709**	**1 361 106**
EXPENSES			
Bank charges	20 000	22 400	19 000
Capital expenses	0	0	0
Electricity for offices	6 000	7 000	8 000
Consumables - cleaning and maintenance	18 000	19 000	17 000
Water	3 600	4 000	4 500
Office printing, postage & stationery	7 000	7 500	8 000
Office telephones	15 000	17 000	18 000
Office rental	72 000	82 800	95 220
Insurance	36 000	38 000	41 000
Marketing	69 504	78 000	85 000
Security and maintenance	325 000	335 000	442 000
Salaries and wages	525 000	567 000	739 361
TOTAL EXPENSES	**1 097 104**	**1 177 700**	**1 477 081**
NET SURPLUS (DEFICIT)	**274 276**	**466 009**	**(115 975)**

A reasonable budget rental fee for 2004 (approximately a 15% increase is shown from 2002 to 2003, therefore we can do the same from 2003 to 2004) of R95 220,00 is added in. This, however, makes a deficit for the net 2004 budget of R115 975,00. The company would need to budget on collecting more rental in order to avoid a deficit for this year.

3.6 Seaside Rentals Company had a surplus of R274 276,00 at the end of 2002 which would have provided more funds for the following year. Refer back to the earlier comment about balance statements not showing assets and liabilities.

3.7 Generally one would expect that salaries would be increased each year, by roughly the same percentage. However, from 2002 to 2003 the salary increase is about 8%, but the budgeted amount for 2004 is much higher (about 30%). This suggest that perhaps Seaside Rental in fact employed more people the following year since a 30% increase in salary expenditure is way above the increase recommended by the South African government.

3.8 From the Seaside Rentals Company income statement it is clear that a total of R1 381 861,00 is the total budgeted for expenses for 2004, of which salaries makes up R739 361,00.

To calculate a percentage: $\frac{\textit{specific amount}}{\textit{total amount}}\% = \frac{739\,361}{1\,381\,861}\% \text{ or } \left[\frac{739\,361}{1\,381\,861} \times 100\right]$

$= 53{,}5\%$

3.9 Seaside Rentals Company spent 47,8% of its expenditure on salaries and wages in 2002, therefore in 2004 they had budgeted an increase in line with this percentage

Activity 3 — Analysing budgets

In activity 1 we looked at different representations of income and expenditure statements and budgets. In activity 2 we looked at inflation: what it is and the impact it has on the cost of living. In this activity we are going to revisit the income and expenditure statements and budgets of activity 1 in order to analyse them in terms of inflation.

3.1 Use the handouts from activity 1. Copy and complete the table below and calculate the percentage increase or decrease from year to year (see the sample calculation). We will take the 2002/2003 financial year on the national statement as being equivalent to the 2002 financial year on the Great Styles Salon statement (therefore 2003/2004 will be the equivalent to 2003, etc.)

	2001/ 2002	Percent increase/ decrease	2002/ 2003	Percent increase/ decrease	2003/ 2004	Percent increase/ decrease	2004/ 2005
Income							
National	248 362	12,14%	278 508				
W. Cape	13 039		14 148				
Seaside Rental			1 371 380				
Expenditure							
National	262 888		291 514				
W. Cape	12 504		14 796				
Great Styles			519 736				

Calculated as follows:

$$\frac{278508 - 248362}{248362} \times 100 = 12{,}14\%$$

3.2 You will recall from activity 1 that the amount 278 505 (income on the national statement for 2002/2003) represents R 278 505 000 000,00 while the amount 1 371 380 for the Seaside Rentals Company in the same year represents R1 371 380,00.

Does it matter that we calculated the percentage increase/decrease in the table above ignoring this difference in meaning?

3.3 For which of the three (national, provincial or Seaside Rentals Company) are the percentage increases/decreases from one year to the next significantly different from those of the others?

3.4 Study the details of the statement for the organisation you identified above. Why is there this unusual trend?

3.5 Analyse the income statement for the Seaside Rentals Company. You will have noticed (in 3.4 above) that they had an unusual expense in 2003: "capital expense." In 2003 the Seaside Rentals Company built a new office which accounts for this amount. You will notice that they do not budget for any office rental cost in the following year, now that they will have this new office that they own.

Remove the capital expense cost from the budget and adjust the expense amounts to be in line with the other years on the statement.

Now recalculate the total income and total expenditure for the year 2003 and recalculate the year-on-year percentage increases/decreases in income and expenditure for the company.

How do the figures for the Seaside Rentals Company compare to the national and provincial figures now?

3.6 You will notice that the Seaside Rentals Company statement suggests that they suffered a great loss in 2003. How do you think they survived this?

3.7 There seems to be a big discrepancy between the salary increase from 2002 to 2003 and the budgeted amount for 2003. Can you suggest any reason for this?

3.8 Calculate the budgeted percentage of expenditure to be spent on salaries by the Seaside Rentals Company in 2004.

3.9 How does this compare with the percentage of expenditure that was spend on salaries in 2002?

Activity 4 — Reading your pay slip

ABOUT THIS ACTIVITY

This activity focuses on analysing pay slips in order for the students to realise that their own income and expenditure is also similar to a budgets statement. In particular, this activity concentrates on the deductions on the pay slip. Students will learn what these deductions represent and how they are calculated using the Annual Deduction Table supplied by the South African Revenue Services (SARS).

This activity is aligned with unit standard 9014 and addresses AC 2,3 of SO1; AC 1,2,3,4 of SO2 and AC 1,2,3 of SO3.

MANAGING THIS ACTIVITY

Students will need to refer to the 4 page handout containing the Annual Deduction Table supplied by the South African Revenue Services (SARS) as well as the handout from activity 1 with Shazia's pay slip.

4.1 This pay slip is for the month ending 31 December 2005. At the top right-hand corner of Shazia's pay slip it states "PERIOD END DATE: 31/12/2005".

4.2 Shazia has been working for Seaside Rentals Company for 2 years and 9 months (in other words 2¾ years). At the top right-hand corner of Shazia's pay slip, underneath the period end date, it states "DATE ENGAGED: 01/04/2003". This means that she has been employed there since 1 April 2003.

4.3 The first 6 digits of a person's ID number is that person's birth date. It states "ID NUMBER: 7506246578083" underneath the date engaged on Shazia's pay slip. This means that 75/06/24 is Shazia's birth date. Therefore, at the time of receiving this pay slip, Shazia is 30 years old.

4.4 Seaside Rentals Company deducts TAX and UIF from Shazia's basic (gross) salary.

4.5 R12 700,00 (Shazia's gross salary) –R1 592,71 (tax) –R 127,00 (UIF) = R10 980,29. Her net pay listed on the pay slip is R10 941,84, meaning she received that exact amount in her bank account that particular month.

4.6 No. This is more than every other month as she got an end-of-year bonus this month. Every other month she would receive a basic salary of R6 350 and she would have a tax deduction of R796,36 (1592,71 ÷ 2) and a UIF deduction of R63,50 (127,00 ÷ 2). Therefore, in every other month she would be banking a net pay of R5 490,14.

4.7 Since "The amount of the contribution payable by an employee must be 1% of the remuneration paid to him by his employer", Shazia's UIF contribution should be 1% of her basic (gross) salary which is calculated as follows: 12 700 × 1% = 127 (R127,00).

4.8 "CO. CONTRIBUTION: 127.00" means that her employer (Seaside Rentals Company) is also contributing 1% of her salary to UIF on her behalf, as it should do according to SARS guidelines: "The amount of the contribution payable by the employer in respect of any one of its employees must be equal to 1% of the remuneration paid to that employee."

4.9 Shazia earns an annual salary of R82 550,00, calculated as follows: R6 350,00 × 13 payments (12 months + her end-of-year bonus, which is sometimes referred to as a "thirteenth cheque). Therefore, since her annual salary is between R82 486,00 and R82 735,00 and she is also under 65 years of age, she falls into the category on the annual deductions table shown below (row 12 in the table provided):

Remuneration *Besoldiging*	*Under 65/Onder 65*		
	SITE	PAYE	Total
82486 - 82735	5400.00	4952.63	10352.63

This means that she is required to pay a total of R10 352,63 per year i.e. R796,36 per payment (R10 352,63 ÷ 13 = R796,36). Since this month is her bonus month, and therefore she receives two monthly payments at once, she is also required to pay two instalments of R796,36 in tax. R796,36 × 2 = R1 592,71 which is why Shazia paid R1 592,71 in taxes this month.

4.10 A "tax year" runs from the beginning of March in one year till the end of February of the following year. The "taxable earnings" total (R57 150,00) on Shazia's pay slip is made up of 9 payments of R6 350,00 (R57 150,00 ÷ R6 350,00 = 9) .

The 2004 "tax year" would run from 1 March 2004 - 28 February 2005 and, so far, Shazia has been paid:

- R6 350,00 on 31 March 2004 (for working the month of March 2004);
- R6 350,00 on 30 April 2004 (for working the month of April 2004);
- R6 350,00 on 31 May 2004 (for working the month of May 2004);
- R6 350,00 on 31 June 2004 (for working the month of June 2004);
- R6 350,00 on 31 July 2004 (for working the month of July 2004);
- R6 350,00 on 31 Aug 2004 (for working the month of August 2004);
- R6 350,00 on 31 Sept 2004 (for working the month of September 2004);
- R6 350,00 on 31 Oct 2004 (for working the month of October 2004); and
- R6 350,00 on 31 Nov 2004 (for working the month of November 2004)

This give a total earnings of R57 150,00 so far for this "tax year" (it does not yet include her payment this month — this is shown in the earnings column).

4.11.1 Shazia would change into the following category:

Remuneration *Besoldiging*	*Under 65/Onder 65*		
	SITE	PAYE	Total
82986 – 83235	5400.00	5077.63	10477.63

and her annual deduction would then be R10 477,63.

4.11.2 Shazia would change into the following category:

Remuneration *Besoldiging*	*Under 65/Onder 65*		
	SITE	PAYE	Total
83736 - 83985	5400.00	5265.13	10 665.13

and her annual deduction would then be R10 665,13.

4.11.3 Shazia would change into the following category:

Remuneration Besoldiging	Under 65/Onder 65		
	SITE	PAYE	Total
84486 - 84735	5400.00	5452.63	10 852.63

and her annual deduction would then be R10 852,63.

4.12.1 An 8% increase on her annual salary of R82 550,00 can be calculated as follows:

82 550 × 8% + 82 550 = 89 154

= R89 154, 00

She has been given an amount of R6 630,00 which is actually 8,03%:

(6 630 ÷ 82 550) % = 8,03%

in other words, the increase is a little more than 8%.

4.12.2 Since her new annual salary is R8 9180,00, this means that in a typical month, she would receive a basic (gross) salary of R6 860,00 (89180 ÷ 13). From this, she would have tax and UIF deductions.

Shazia would fall into the following category:

Remuneration *Besoldiging*	*Under 65/Onder 65*		
	SITE	PAYE	Total
88986 - 89235	5400.00	6515.13	11915.13

and her annual deduction would then be R11 915,13. Therefore, in a typical month she would have to pay R916,55 in taxes (R11 915,13 ÷ 13).

She would also have to pay 1% of this new monthly salary (R68,60) to UIF.

Therefore her net (take home) salary would be
R6 860 – R916,55 – R68,60 = R5 874, 85.

Shazia's pay slip would look something like this:

SEASIDE RENTALS	EMP. CODE:	018		PERIOD END DATE:	???????????
25 HOUTAN CLOSE	EMP. NAME:	S. LAKAY		DATE ENGAGED:	01/04/2002
HOUT BAY, 7806	JOB TITLE:	LEASING ADMINISTRATOR		ID NUMBER:	7506246578083
ADDITIONAL INFORMATION	EARNINGS			DEDUCTIONS	
BASIC SALARY:	89180.00	BASIC SALARY:	6860.00	TAX	916.55
NORMAL HOURS:	162.50	BIRTHDAY BONUS:	0	UIF	68.60
OVERTIME HOURS:					
LEAVE DAYS DUE:	8				
YEAR-TO-DATE TOTALS					
TAXABLE EARNINGS:	???????				
TAX	???????				
UIF	???????				
CURRENT PERIOD					
TOTAL PERKS:	0.00	TOTAL EARNINGS:	12700.00	TOTAL DEDUCTIONS	985.15
CO.CONTRIBUTIONS	68.60				
				NET PAY	5874.85

4.12.3 Her net pay is now R5 874,85 and it used to be R5 490,14 (in a typical month). Therefore, her monthly salary is now R384,71 more per month.
To calculate the % increase: (384,71 ÷ 5490,14) = 7,01%.
Therefore her net pay has increased by only 7,01%.

4.13 The same calculations as for question 4.12 will yield the following answers to 4.13.1 – 4.13.3:
(Remember that Shazia's original net monthly salary was R5 490,14)

INCREASE	NEW ANNUAL SALARY	NEW GROSS MONTHLY SALARY	DEDUCTIONS	NEW NET MONTHLY SALARY	% INCREASE in NET PAY
5%	R87 100,00	R6 700,00	UIF: R 67,00 TAX: R882,89	R5 750,11	4,09%
10%	R91 000,00	R7 000,00	UIF: R 70,00 TAX: R959,82	R5 970,18	8,74%
15%	R45 630,00	R7 305,00	UIF: R73,05 TAX: R10 31,93	R6 200,02	12,93%

4.14 Look at the year-on-year inflation statistics given in activity 2 question 2.7. Over the 15 year period 1988 – 2003 the inflation rate averaged 9%. Therefore, Shazia could motivate that an increase of about 10% would be a "fair" increase. Since she was employed in 2002, inflation has averaged approximately 7,5%, therefore Shazia might motivate that an increase of about 7,5% would be a "fair" increase.

In addition to the inflationary increase she could well argue that she has gained experience and is taking on more responsibility in the company, all of which warrant a further % increase.

In summary, she could probably argue for any percentage between 10-15%.

In the event that the board argues that they cannot afford this kind of increase, Shazia could respond that the company has only itself to blame, since it did not budget to increase its income enough to cater for this kind of justifiably "fair" increase.

Activity 4 — Reading your pay slip

An employer is obliged to supply every employee with a pay slip at the end of each month. This pay slip must show the employee how his/her salary has been calculated.

Use Shazia Zola's pay slip, supplied with activity 1, to help you answer the following questions.

4.1 For what month is the pay slip? Explain how you worked this out.

4.2 How long has Shazia been working for Seaside Rental Company? Explain how you determined this.

4.3 How old is Shazia? Discuss how you determined this.

4.4 List the different deductions that the company takes from Shazia's salary.

4.5 How much does Shazia actually receive in her bank account for the month represented by the pay slip?

4.6 Is the amount Shazia is being paid this month the same as for every other month? If not, how much does she earn in a typical month?

UIF: UIF stands for "unemployment insurance fund". It is compulsory for all employees and employers to make a monthly contribution to this fund. The South African Revenue Service (SARS) Guidelines for Employers – Tax Year 2005 states: "The amount of the contribution payable by an employee must be 1% of the remuneration paid to him by his employer" and also that: "The amount of the contribution payable by the employer in respect of any one of its employees must be equal to 1% of the remuneration paid to that employee."

4.7 You will notice that Shazia is contributing R127,00 to UIF for this month. Show how this has been calculated.

4.8 In the bottom left hand corner of the pay slip you will notice the entry "Co. Contributions." This stands for "company contribution." Discuss where this amount comes from.

INCOME TAX: Income tax is inevitable—we must all pay tax on the money we earn. To determine the tax liability (how much tax must be paid) of an employee we refer to the tax tables (EMP 10) provided by SARS.

4.9 Use the extract from the 2005 tax tables provided on handout 4 to explain why Shazia is paying R1 631,17 in taxes this month.

4.10 How many months of salary are represented by the "taxable earning" in the "year-to-date totals" column? Explain how the number of months represented here and the actual month of the year of this pay slip are different.

4.11 What would Shazia's annual tax deduction be if her annual salary was:

4.11.1 R83 000,00 ?

4.11.2 R83 750,00 ?

4.11.3 R84 500,00 ?

4.12 The Seaside Rentals Company has decided to offer Shazia an increase of 8% per annum. They say that she will now receive an annual salary of R89 178,00.

4.12.1 Does this increase actually represent 8%?

4.12.2 By calculating the deductions (using the tax tables in the handout provided), determine her net pay in a typical month after the increase.

4.12.3 Does her net pay (the amount she takes home) also increase by 8%? Substantiate your answer.

4.13 Repeat the calculations you did in question 4.12 to determine the actual and percentage increases in monthly net pay for each of the following annual increases:

4.13.1 5% increase, new annual salary: R87 100,00.

4.13.2 10% increase, new annual salary: R 91 000,00.

4.13.3 15% increase, new annual salary: R 94 965,00.

4.14 Refer back to the budget and inflation activities completed so far. Develop an argument that Shazia might present to the general management meeting in which she motivates what she considers a "fair" increase in salary for 2005.

ANNUAL DEDUCTION TABLE / JAARLIKSE AFTREKKINGSTABEL

Remuneration Besoldiging	Under 65 / Onder 65			Over 65 / Bo 65		
	SITE SIBW	PAYE LBS	Total Totaal	SITE SIBW	PAYE LBS	Total Totaal
39210 - 39259	1,262.21	0.00	1,262.21	0.00	0.00	0.00
39260 - 39309	1,271.21	0.00	1,271.21	0.00	0.00	0.00
39310 - 39359	1,280.21	0.00	1,280.21	0.00	0.00	0.00
39360 - 39409	1,289.21	0.00	1,289.21	0.00	0.00	0.00
39410 - 39459	1,298.21	0.00	1,298.21	0.00	0.00	0.00
39460 - 39509	1,307.21	0.00	1,307.21	0.00	0.00	0.00
39510 - 39559	1,316.21	0.00	1,316.21	0.00	0.00	0.00
39560 - 39609	1,325.21	0.00	1,325.21	0.00	0.00	0.00
39610 - 39659	1,334.21	0.00	1,334.21	0.00	0.00	0.00
39660 - 39709	1,343.21	0.00	1,343.21	0.00	0.00	0.00
39710 - 39759	1,352.21	0.00	1,352.21	0.00	0.00	0.00
39760 - 39809	1,361.21	0.00	1,361.21	0.00	0.00	0.00
39810 - 39859	1,370.21	0.00	1,370.21	0.00	0.00	0.00
39860 - 39909	1,379.21	0.00	1,379.21	0.00	0.00	0.00
39910 - 39959	1,388.21	0.00	1,388.21	0.00	0.00	0.00
39960 - 40009	1,397.21	0.00	1,397.21	0.00	0.00	0.00
40010 - 40059	1,406.21	0.00	1,406.21	0.00	0.00	0.00
40060 - 40109	1,415.21	0.00	1,415.21	0.00	0.00	0.00
40110 - 40159	1,424.21	0.00	1,424.21	0.00	0.00	0.00
40160 - 40209	1,433.21	0.00	1,433.21	0.00	0.00	0.00
40210 - 40259	1,442.21	0.00	1,442.21	0.00	0.00	0.00
40260 - 40309	1,451.21	0.00	1,451.21	0.00	0.00	0.00
40310 - 40359	1,460.21	0.00	1,460.21	0.00	0.00	0.00
40360 - 40409	1,469.21	0.00	1,469.21	0.00	0.00	0.00
40410 - 40459	1,478.21	0.00	1,478.21	0.00	0.00	0.00
40460 - 40509	1,487.21	0.00	1,487.21	0.00	0.00	0.00
40510 - 40559	1,496.21	0.00	1,496.21	0.00	0.00	0.00
40560 - 40609	1,505.21	0.00	1,505.21	0.00	0.00	0.00
40610 - 40659	1,514.21	0.00	1,514.21	0.00	0.00	0.00
40660 - 40709	1,523.21	0.00	1,523.21	0.00	0.00	0.00
40710 - 40759	1,532.21	0.00	1,532.21	0.00	0.00	0.00
40760 - 40809	1,541.21	0.00	1,541.21	0.00	0.00	0.00
40810 - 40859	1,550.21	0.00	1,550.21	0.00	0.00	0.00
40860 - 40909	1,559.21	0.00	1,559.21	0.00	0.00	0.00
40910 - 40959	1,568.21	0.00	1,568.21	0.00	0.00	0.00
40960 - 41009	1,577.21	0.00	1,577.21	0.00	0.00	0.00
41010 - 41059	1,586.21	0.00	1,586.21	0.00	0.00	0.00
41060 - 41109	1,595.21	0.00	1,595.21	0.00	0.00	0.00
41110 - 41159	1,604.21	0.00	1,604.21	0.00	0.00	0.00
41160 - 41209	1,613.21	0.00	1,613.21	0.00	0.00	0.00
41210 - 41259	1,622.21	0.00	1,622.21	0.00	0.00	0.00
41260 - 41309	1,631.21	0.00	1,631.21	0.00	0.00	0.00
41310 - 41359	1,640.21	0.00	1,640.21	0.00	0.00	0.00
41360 - 41409	1,649.21	0.00	1,649.21	0.00	0.00	0.00
41410 - 41459	1,658.21	0.00	1,658.21	0.00	0.00	0.00
41460 - 41509	1,667.21	0.00	1,667.21	0.00	0.00	0.00
41510 - 41559	1,676.21	0.00	1,676.21	0.00	0.00	0.00
41560 - 41609	1,685.21	0.00	1,685.21	0.00	0.00	0.00
41610 - 41659	1,694.21	0.00	1,694.21	0.00	0.00	0.00
41660 - 41709	1,703.21	0.00	1,703.21	0.00	0.00	0.00

R39210 — R41709

TABLE / TABEL D

SARS

GUIDELINES FOR EMPLOYERS

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ANNUAL DEDUCTION TABLE / JAARLIKSE AFTREKKINGSTABEL

Remuneration Besoldiging	Under 65 / Onder 65			Over 65 / Bo 65		
	SITE SIBW	PAYE LBS	Total Totaal	SITE SIBW	PAYE LBS	Total Totaal
41710 - 41759	1,712.21	0.00	1,712.21	0.00	0.00	0.00
41760 - 41809	1,721.21	0.00	1,721.21	0.00	0.00	0.00
41810 - 41859	1,730.21	0.00	1,730.21	0.00	0.00	0.00
41860 - 41909	1,739.21	0.00	1,739.21	0.00	0.00	0.00
41910 - 41959	1,748.21	0.00	1,748.21	0.00	0.00	0.00
41960 - 42009	1,757.21	0.00	1,757.21	0.00	0.00	0.00
42010 - 42059	1,766.21	0.00	1,766.21	0.00	0.00	0.00
42060 - 42109	1,775.21	0.00	1,775.21	0.00	0.00	0.00
42110 - 42159	1,784.21	0.00	1,784.21	0.00	0.00	0.00
42160 - 42209	1,793.21	0.00	1,793.21	0.00	0.00	0.00
42210 - 42259	1,802.21	0.00	1,802.21	0.00	0.00	0.00
42260 - 42309	1,811.21	0.00	1,811.21	0.00	0.00	0.00
42310 - 42359	1,820.21	0.00	1,820.21	0.00	0.00	0.00
42360 - 42409	1,829.21	0.00	1,829.21	0.00	0.00	0.00
42410 - 42459	1,838.21	0.00	1,838.21	0.00	0.00	0.00
42460 - 42509	1,847.21	0.00	1,847.21	0.00	0.00	0.00
42510 - 42559	1,856.21	0.00	1,856.21	0.00	0.00	0.00
42560 - 42609	1,865.21	0.00	1,865.21	0.00	0.00	0.00
42610 - 42659	1,874.21	0.00	1,874.21	0.00	0.00	0.00
42660 - 42709	1,883.21	0.00	1,883.21	0.00	0.00	0.00
42710 - 42759	1,892.21	0.00	1,892.21	0.00	0.00	0.00
42760 - 42809	1,901.21	0.00	1,901.21	0.00	0.00	0.00
42810 - 42859	1,910.21	0.00	1,910.21	0.00	0.00	0.00
42860 - 42909	1,919.21	0.00	1,919.21	0.00	0.00	0.00
42910 - 42959	1,928.21	0.00	1,928.21	0.00	0.00	0.00
42960 - 43009	1,937.21	0.00	1,937.21	0.00	0.00	0.00
43010 - 43059	1,946.21	0.00	1,946.21	0.00	0.00	0.00
43060 - 43109	1,955.21	0.00	1,955.21	0.00	0.00	0.00
43110 - 43159	1,964.21	0.00	1,964.21	0.00	0.00	0.00
43160 - 43209	1,973.21	0.00	1,973.21	0.00	0.00	0.00
43210 - 43259	1,982.21	0.00	1,982.21	0.00	0.00	0.00
43260 - 43309	1,991.21	0.00	1,991.21	0.00	0.00	0.00
43310 - 43359	2,000.21	0.00	2,000.21	0.00	0.00	0.00
43360 - 43409	2,009.21	0.00	2,009.21	0.00	0.00	0.00
43410 - 43459	2,018.21	0.00	2,018.21	0.00	0.00	0.00
43460 - 43509	2,027.21	0.00	2,027.21	0.00	0.00	0.00
43510 - 43559	2,036.21	0.00	2,036.21	0.00	0.00	0.00
43560 - 43609	2,045.21	0.00	2,045.21	0.00	0.00	0.00
43610 - 43659	2,054.21	0.00	2,054.21	0.00	0.00	0.00
43660 - 43709	2,063.21	0.00	2,063.21	0.00	0.00	0.00
43710 - 43759	2,072.21	0.00	2,072.21	0.00	0.00	0.00
43760 - 43809	2,081.21	0.00	2,081.21	0.00	0.00	0.00
43810 - 43859	2,090.21	0.00	2,090.21	0.00	0.00	0.00
43860 - 43909	2,099.21	0.00	2,099.21	0.00	0.00	0.00
43910 - 43959	2,108.21	0.00	2,108.21	0.00	0.00	0.00
43960 - 44009	2,117.21	0.00	2,117.21	0.00	0.00	0.00
44010 - 44059	2,126.21	0.00	2,126.21	0.00	0.00	0.00
44060 - 44109	2,135.21	0.00	2,135.21	0.00	0.00	0.00
44110 - 44159	2,144.21	0.00	2,144.21	0.00	0.00	0.00
44160 - 44209	2,153.21	0.00	2,153.21	0.00	0.00	0.00

R41710 — R44209 TABLE / TABEL D

RIGLYNE VIR WERKGEWERS SARS

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ANNUAL DEDUCTION TABLE / JAARLIKSE AFTREKKINGSTABEL

Remuneration Besoldiging	Under 65 / Onder 65			Over 65 / Bo 65		
	SITE SIBW	PAYE LBS	Total Totaal	SITE SIBW	PAYE LBS	Total Totaal
44210 - 44259	2,162.21	0.00	2,162.21	0.00	0.00	0.00
44260 - 44309	2,171.21	0.00	2,171.21	0.00	0.00	0.00
44310 - 44359	2,180.21	0.00	2,180.21	0.00	0.00	0.00
44360 - 44409	2,189.21	0.00	2,189.21	0.00	0.00	0.00
44410 - 44459	2,198.21	0.00	2,198.21	0.00	0.00	0.00
44460 - 44509	2,207.21	0.00	2,207.21	0.00	0.00	0.00
44510 - 44559	2,216.21	0.00	2,216.21	0.00	0.00	0.00
44560 - 44609	2,225.21	0.00	2,225.21	0.00	0.00	0.00
44610 - 44659	2,234.21	0.00	2,234.21	0.00	0.00	0.00
44660 - 44709	2,243.21	0.00	2,243.21	0.00	0.00	0.00
44710 - 44759	2,252.21	0.00	2,252.21	0.00	0.00	0.00
44760 - 44809	2,261.21	0.00	2,261.21	0.00	0.00	0.00
44810 - 44859	2,270.21	0.00	2,270.21	0.00	0.00	0.00
44860 - 44909	2,279.21	0.00	2,279.21	0.00	0.00	0.00
44910 - 44959	2,288.21	0.00	2,288.21	0.00	0.00	0.00
44960 - 45009	2,297.21	0.00	2,297.21	0.00	0.00	0.00
45010 - 45059	2,306.21	0.00	2,306.21	0.00	0.00	0.00
45060 - 45109	2,315.21	0.00	2,315.21	0.00	0.00	0.00
45110 - 45159	2,324.21	0.00	2,324.21	0.00	0.00	0.00
45160 - 45209	2,333.21	0.00	2,333.21	0.00	0.00	0.00
45210 - 45259	2,342.21	0.00	2,342.21	0.00	0.00	0.00
45260 - 45309	2,351.21	0.00	2,351.21	0.00	0.00	0.00
45310 - 45359	2,360.21	0.00	2,360.21	0.00	0.00	0.00
45360 - 45409	2,369.21	0.00	2,369.21	0.00	0.00	0.00
45410 - 45459	2,378.21	0.00	2,378.21	0.00	0.00	0.00
45460 - 45509	2,387.21	0.00	2,387.21	0.00	0.00	0.00
45510 - 45559	2,396.21	0.00	2,396.21	0.00	0.00	0.00
45560 - 45609	2,405.21	0.00	2,405.21	0.00	0.00	0.00
45610 - 45659	2,414.21	0.00	2,414.21	0.00	0.00	0.00
45660 - 45709	2,423.21	0.00	2,423.21	0.00	0.00	0.00
45710 - 45759	2,432.21	0.00	2,432.21	0.00	0.00	0.00
45760 - 45809	2,441.21	0.00	2,441.21	0.00	0.00	0.00
45810 - 45859	2,450.21	0.00	2,450.21	0.00	0.00	0.00
45860 - 45909	2,459.21	0.00	2,459.21	0.00	0.00	0.00
45910 - 45959	2,468.21	0.00	2,468.21	0.00	0.00	0.00
45960 - 46009	2,477.21	0.00	2,477.21	0.00	0.00	0.00
46010 - 46059	2,486.21	0.00	2,486.21	0.00	0.00	0.00
46060 - 46109	2,495.21	0.00	2,495.21	0.00	0.00	0.00
46110 - 46159	2,504.21	0.00	2,504.21	0.00	0.00	0.00
46160 - 46209	2,513.21	0.00	2,513.21	0.00	0.00	0.00
46210 - 46259	2,522.21	0.00	2,522.21	0.00	0.00	0.00
46260 - 46309	2,531.21	0.00	2,531.21	0.00	0.00	0.00
46310 - 46359	2,540.21	0.00	2,540.21	0.00	0.00	0.00
46360 - 46409	2,549.21	0.00	2,549.21	0.00	0.00	0.00
46410 - 46459	2,558.21	0.00	2,558.21	0.00	0.00	0.00
46460 - 46509	2,567.21	0.00	2,567.21	0.00	0.00	0.00
46510 - 46559	2,576.21	0.00	2,576.21	0.00	0.00	0.00
46560 - 46609	2,585.21	0.00	2,585.21	0.00	0.00	0.00
46610 - 46659	2,594.21	0.00	2,594.21	0.00	0.00	0.00
46660 - 46709	2,603.21	0.00	2,603.21	0.00	0.00	0.00

R44210 — R46709 TABLE / TABEL D

SARS *GUIDELINES FOR EMPLOYERS*

Activity 5 — Inflation revisited

ABOUT THIS ACTIVITY

Using two newspaper articles as a case study, students explore the implications, for consumers and businesses, of inflation. This knowledge is then applied in order to debate and critique certain arguments and appropriate responses to the questions.

This activity is aligned with unit standard 9014 and addresses AC 1,2 and 3 of SO1; AC 1,2,3 and 4 of SO2 and AC 1,2 and 3 of SO3.

MANAGING THIS ACTIVITY

Handout 5, with the case study newspaper articles headed "Phuket hotels that withstood tsunamis doubled their rates" and "Upswing expected to continue in new year" from the Weekend Argus (1 January 2005), is required for this activity.

5.1 There could be a range of different responses to this question. One option from activity 2 was the Cape Argus newspaper, which increased more than we would have predicted in terms of inflation. What is the most dramatic price rise for an item or service that you can recall? (Refer back to activity 2 to help you decide.)

5.2 No. For the hotels to have "doubled" their rates so suddenly does not seem reasonable at all.

5.3 One of the ways that prices increase is that each year there is still a demand for certain products, but at the same time consumers have more money with which to purchase these same products since, in general, people's salaries increase on an annual basis. Therefore, since people have more money, higher prices can be paid by consumers and yet products will still be purchased. In this example, the demand for the hotel accommodation has been extremely exaggerated. Many people have flocked to Phuket in order to escape the tsunamis and have nowhere else to stay except in these hotels. In addition, as Phuket was also effected by the tsunami, many of its hotels were destroyed therefore there was less accommodation available. In this case, the product (being the hotel room) stayed exactly the same, i.e. no extra intrinsic value was added to it, but because there was more demand for the rooms and more money supply (more people therefore more money supply), the hoteliers knew that they could double their rates and still fill the hotel rooms.

5.4 The hotels' income would now be much higher, so if their expenses remained the same during this period their profits would be dramatically increased (since Profit = Income – Expenses).

5.5

		Economic Position
Case 1:	If there is an increase in income which is proportionate to an increase in expenditure then …	suffer no "economic hardship" i.e. the spending power remains the same.
Case 2:	If there is an increase in income which exceeds the increase in expenditure then …	are thriving i.e. the spending power has increased.
Case 3:	If there is an increase in income which is less than the increase in expenditure then …	suffer "economic hardship" i.e. the spending power diminishes.
Case 4:	If the income remains the same but there is an increase in expenditure then …	suffer more severe "economic hardship" i.e. the spending power has decreased dramatically.

5.6 It makes sense that activity would tail off from the middle of December until early January as most people are on leave during this time and so, in general, business is very quiet.

5.7.1 There is a lag time between approving finance for projects and actually giving the finance that was approved earlier in 2004. The bank only earns its fees once the finance is given, which will most likely be in the first half of 2005.

5.7.2 There would again be a lag time between approving finance for new applications and actually giving the finance once it is approved. Therefore again the bank only earns its fees once the finance is given, which will most likely be in the latter half of 2005.

5.8 A 1% drop in prime bank interest rate would have the following effects:

5.8.1 A property developer would benefit because this drop in the interest rate would create a decrease in costs and hence an increase in the profit that the developer can earn.

5.8.2 A property owner would benefit because the owner of the property would pay a smaller bond payment each month and therefore would have more money to spend each month.

5.9 It would be more sensible to build for the lower to middle income market since this is where the greatest demand is and therefore the properties would sell more easily.

5.10 If you built 80 houses in 2004 and sold them all as soon as they were built and if GDP growth is anticipated to be at least 5% or higher in 2005, then you could expect to be able to build at least 5% more houses and sell them with as much ease. Therefore the calculation works as follows: $80 + 80 \times 5\% = 84$ houses. The anticipated GDP shows that there is room in the economy for extra demand and therefore you could build 84 houses.

5.11 If the Waterfront is built to capacity and the area is busy then more and more people will live, work in and visit this area. After a while more people will want to settle in this area. Since it is already built to capacity the areas closest to it will then also begin to become popular and therefore be good investment areas.

5.12 Option B is more profitable. See calculations below.

Option A		Option B	
Start	R 260 000,00	Start	R 260 000,00
11% interest	R 28 600,00	Transfer fees	R 10 000,00
5% of initial investment	R 13 000,00	Cost of property	R 250 000,00
Subtotal	R 301 600,00	Total after yr 1	R 287 500,00
11% interest	R 33 176,00	Total after yr 2	R 330 625,00
11% interest	R 33 176,00	Total after yr 3	R 380 218,75
	R 367 952,00	Selling price	R 380 218,75

5.13 The only item on the budget that would not automatically be linked to the inflationary trends would be the company's salaries expenditure. All the other items such as bank charges, electricity, consumables, water, office printing, telephones etc. are all costs that are likely to have followed inflationary trends to some extent.

5.14 Provided that the tenants are earning more money (i.e. their salaries have increased in line with or more than inflation), then they would be willing to pay higher rental fees. However, rental fees are also linked to how much demand there is for the premises and therefore the fees may increase more than inflationary trends. In this case some tenants may no longer be able to afford the rental.

5.15 No. Not all of the items mentioned in 5.13 will increase by the same inflationary percentage. Remember that, in the shopping basket exercise, some of the items increased more while others increased by less.

5.16

ADVANTAGES	DISADVANTAGES
• One would expect that, on the whole, the rental company's expenses are likely to have increased in line with inflation. Therefore, increasing the rental fees in line with inflation would help to ensure that the company's financial status remains that of Case 1 in question 5.5 where this decision does not place them in a position of economic hardship. • If we assume that the tenants' income increases in line with inflation, then increasing the rental fees in line with inflation (rather than more than inflation) might help to ensure that the tenants can still afford to rent these premises from this company.	• If the rental fees are increased in line with inflation, but tenants' incomes are not, then tenants may no longer be able to afford to rent these premises and therefore the rental company's income may in fact decrease. • If the rental fees are increased in line with inflation, but the company's expenses have increased more than the inflationary rate (or they have had additional expenses that year i.e. Seaside Rental had a big "capital expense") then they will be running at a loss because (unless they find extra income/funding from elsewhere) their expenses would exceed their income.

5.17 Some of the students' responses to this question could overlap with those of question 5.16.

If rental fees are increased significantly less than inflation	If rental fees are increased significantly more than inflation
• If the rental fees are increased significantly less than inflation, but their expenses have increased in line with or even more than the inflationary rate, then they will be running at a loss (unless they find extra income/funding from elsewhere) because their expenses would exceed their income.	• If the rental fees are increased significantly more than inflation, but tenants' incomes are not, then tenants may no longer be able to afford to rent this particular premises and therefore the rental company's income may in fact decrease. • Alternatively, if the rental fees are increased significantly more than inflation and tenants' incomes are also increased significantly more than inflation, then rental company may be able to make a profit (provided that their expenses remain relatively constant). This is, however, quite unlikely.

5.18 The national economy would effect the rental fees in that the rental fees may increase in line with or more than inflationary trends in order for the company to maintain its income potential. The tenant's personal financial situation would also effect the rental fees since the rental fee must be set in line with what the tenant can afford to and is willing to pay.

5.19 It is very unlikely that a company will decide to reduce its rental fees. The only circumstance that might precipitate this is if the company needs to fill a big vacancy. If properties remain vacant then the company receives no rental fees, therefore they might reduce the rental fees to attract more tenants.

Activity 5 — Inflation revisited

In order to understand how inflation can dramatically affect prices, let us study an example of inflationary effects in two articles from the Weekend Argus – 1 January 2005.

Read through the handouts headed "Phuket hotels that withstood tsunamis doubled their rates" and "Upswing expected to continue in new year" from the Weekend Argus (1 January 2005) and answer the following questions.

5.1 What is the most dramatic price rise for an item or service that you can recall? (Refer back to activity 2 to help you decide.)

5.2 Do you think it sounds reasonable for hotels to have increased their prices so dramatically in such a short space of time?

5.3 What was the motivation for such a dramatic price hike?

5.4 If these hotels' expenses remained the same during this period, what would be the effect on these hotels' profits?

5.5 Changes in a person's or business's income or expenditure have a big impact on the financial status or economic position of that person or business. Complete the last column of this table by describing the economic position in each of the cases.

		Economic Position
Case 1:	If there is an increase in income which is proportionate to an increase in expenditure then …	
Case 2:	If there is an increase in income which exceeds the increase in expenditure then …	
Case 3:	If there is an increase in income which is less than the increase in expenditure then …	
Case 4:	If the income remains the same but there is an increase in expenditure then …	

Refer to the second article headed "Upswing expected to continue in new year":

5.6 Why does Peter Smith say that he expects activity to tail off from the middle of December until early January?

5.7 Part of Peter Smith's job description is to provide finance for property developers to develop property. In this article he identifies two factors contributing towards the expected excellent levels of new property business in 2005. Why do you think that:

5.7.1 projects approved earlier in 2004 are a contributing factor?

5.7.2 the processing of new applications is another contributing factor?

5.8 How would a 1% drop in prime bank interest rate affect:

5.8.1 a property developer?

5.8.2 a (bonded) property owner?

5.9 If you were a property developer and you were developing property in a market similar to the one described in this article, would you build for the lower, middle or higher income groups? Give a reason for your answer.

The term GDP (mentioned in the article) refers to gross domestic product. Gross domestic product is a measure of a country's economic growth (i.e. its productivity) and it is calculated as follows:

GDP = Consumption + Investment + Government spending + (Exports – Imports)

At the start of 2004, South Africa's GDP was approximately 3,5%.

5.10 If you built 80 houses in 2004 and sold them all as soon as they were built and if GDP growth is anticipated to be at least 5% or higher in 2005, how many houses would you expect to be able to build and sell with just as much ease in 2005? Show your calculation and give a reason for your answer.

5.11 Ian Slot gives some valuable advice on the art of predicting new markets. He refers to the Waterfront slowly being built to capacity and the neighbouring areas (Greenpoint and Mouille Point) now being good investment areas. Why does he draw this conclusion about the surrounding areas?

5.12 Dr. Andrew Golding is confident that a year-on-year (compound) increase of 12% - 15% will prevail for years to come. Analyse the investment options below and choose which option will be more profitable. You must show all calculations.

OPTION A
You have R260 000 to invest with a bank for a period of three year.
The bank offers you the following terms:
You may not withdraw either the initial investment or the interest earned thereon for 36 months.

- The bank will pay you simple interest at a rate of 9% per annum for the first year on the initial investment, payable at the end of the twelfth month.
- At the beginning of the thirteenth month, in addition to the simple interest earned the bank will give you 5% of the initial investment by adding it to the total investment.
- The bank will pay you simple interest at a rate of 9% for the second and third year of the investment.

OPTION B
You have R260 000 with which to purchase a property. You pay R250 000 for the property and pay R10 000 to the government in transfer duty. The value of the property increases year-on-year by 15% and at the end of a 3 year period you sell the property. You avoid estate agent's commission by doing a private sale.

Let us now consider how inflation affects the running of a business such as Seaside Rental.

5.13 In what ways will inflation affect the running of a business? Mention as many budget items as possible that you think will be affected by inflation.

5.14 Would tenants be prepared to pay more in rental fees in a year's time compared to what they are currently paying? Why do you say this?

5.15 Will all of the items mentioned in 5.13 increase by the same inflationary percentage?

5.16 What are the advantages and disadvantages for the Seaside Rental of calculating the new rental prices by multiplying the price by the annual inflationary rate?

5.17 What problems could arise for the business if the rental prices are increased by significantly more or significantly less than inflation?

5.18 In what ways do the national economy and the tenants' personal financial situations affect the rental fees that Seaside Rental can charge?

5.19 Can you think of any circumstances under which a rental company may decide to reduce its rental fees?

WEEKEND ARGUS

January 1, 2005

Phuket hotels that withstood tsunamis doubled their rates

By Helen Bamford

Unscrupulous hotel owners ripped off their customers in the midst of untold devastation just hours after the killer tsunamis struck the Thai island of Phuket.

Hotels that survived the colossal waves doubled their rates for accommodation and beverages, report Cape Town honeymooners Lindzay and Winston Lee. They returned to Cape Town yesterday after having to flee for their lives to escape the massive waves last weekend.

The couple from Bellville told Weekend Argus that moments after the tsunamis struck, hotel staff had run for their own safety, ignoring desperate tourists who were confused and panic-stricken about what was going on.

Mrs Lee said the hotels then doubled their prices.

"They were ripping tourists off. Even the price of a drink doubled." The assistance at the airport had been fantastic "but the hotels really need to do something about their staff," she said.

Four South Africans have been confirmed dead in Phuket while a number are still missing on the resort island. The Lees, who were on their first overseas holiday, had been due to leave Phuket five hours after the tsunamis struck.

Mr Lee said they were having breakfast in their hotel when they heard screaming and saw the waves coming.

"Being from Cape Town we're used to waves but then they started getting bigger and we had to turn and run."

He said people were screaming and running for higher ground. The Lees managed to outrun the killer waves.

"We saw one guy running out of his hotel on the beach naked. He was covered in blood."

The couple said it was difficult to find out what was going on because few people could speak fluent English and the television news was in a foreign language. They arrived in Cape Town via Nairobi yesterday and Mrs Lee said she spent the flight with her face pressed up against the window of the aeroplane, desperate for the first glimpse of Cape Town.

"I just couldn't wait to come home and now we're going to party. We have plenty to celebrate."

Relieved family and friends flocked to the airport to greet the couple.

Mrs Lee's father Ben Turner, deputy director general in the Western Cape premier's office, wouldn't relax until he actually saw his daughter walking towards him. He said the 10-hour wait from the time the tsunamis struck to hearing from them had been agonising.

"It was simply horrible because you imagine the worst, especially after watching those terrible images of people being dumped into mass graves. But I never doubted their safety."

WEEKEND ARGUS
January 1, 2005

Upswing expected to continue in new year

By Graham Norris

The property upswing is expected to continue in 2005 — especially in the lower and middle-income residential categories — and should extend into the commercial and industrial sectors.

Peter Smith, Regional Head of Commercial Property Finance for Nedbank Corporate, says there is no sign of the usual end-of-year slowdown this year.

"Normally, we would experience a tailing off of activity from about the middle of December until the end of the year, followed by a fairly slow start-up in early January - but this year we are closing with record levels of new business and were kept hard at it throughout the holiday season."

This, he said, is a result of two main factors: the start of many projects approved earlier in 2004 and the processing of new applications for which developers and investors want finance approved for start-up early in the new year.

"This activity will lead to excellent levels of new business payouts into 2005," said Smith.

Earlier in 2004 Smith had warned that there was a danger of the Cape residential market becoming overheated, and of speculators being hyped-up by some developers to over-invest in this sector.

Now, he says, the strong likelihood of a further one percentage point interest rate drop, general business confidence, the anticipated gross domestic product growth rate of 5% or higher, the rapidly increasing demand for home ownership at the lower end of the residential market and the revival of demand for commercial and office space are factors which will result in ongoing buoyancy for the property market.

Seeff Regional Committee Chairperson Ian Slot said: "For the next year I see continuation of a healthy economy and a sound interest rate. 2005 will see a more mature bull property market, with a slowing of the upward trend and tempering of maximum prices achieved.

"Any market has its spikes and lows, its periods of slowing and of growing. The art lies in being able to spot these and to work with them. For example, don't overlook places just because nobody else is buying there, because dynamics can and do change," said Slot.

"The classic example here is that of Green Point and Mouille Point. Capetonians overlooked them, and meanwhile the Waterfront was coming along and the whole CBD was developing. Changes can range from gentrification and building of new schools to development of new shopping and business areas; all of these impact on an area and its prices."

Dr Andrew Golding, chief executive of the Pam Golding Property group, said with business confidence at a 23-year high, record growth of 5.6% in the third quarter of 2004, and the current low interest rates expected to continue, all the economic fundamentals are in place to see sustained and steady growth in the residential property market.

"The South African property market has just experienced a particularly buoyant 5-6 year period - the most prolonged period of stability in more than two decades. While some believe this level of investment cannot be sustained, the PGP group is confident that a year-on-year price increase of between 12% and 15% is sustainable.

"This assessment is based on the influence of factors such as the buying power of the burgeoning black middle class which is rapidly emerging in South Africa, the country's sound macroeconomic principles and strong interest from foreign investors. The latter includes an increasingly evident trend among South African expatriates investing in property here," said Dr Golding.

Activity 6 — Developing a budget (assessment task)

ABOUT THIS ACTIVITY

This activity brings together much of the knowledge, skills, attitudes and values acquired in activities 1 – 5 and as such could be used as an assessment activity. Students are required to draw on their understanding of budget statements and inflation in order to prepare a budget for the Seaside Rental Company.

This activity is aligned with unit standard 9014 and addresses AC 2,3,4,5 of SO1; AC 1,2,3,4 of SO2 and AC 1 of SO3.

MANAGING THIS ACTIVITY

Students will need the handout page which has the budget and actual income and expenditure statements for 2002 and 2003 as well as a blank column for 2004.

6.1 The budgeted number of flats was 20. However, 2 of these are expected to be vacant. Therefore the budgeted income generated from the 18 annual rental payments was R 1 280 000,00. However, the statement shows that this figure was calculated from an expected 95% collection.
95% of the total income expected from rental = 1 280 000

$\therefore$ Total income expected from rental × 95% = 1 280 000

$\therefore$ Total income expected from rental = $\frac{1\,280\,000}{95\%}$

$\therefore$ Total income expected from rental = R1 347 368,42

Note: 96% of the rental was collected, but this does not mean that 96% of the tenants paid. (96% of 18 = 17,28 tenants?). It means that some tenants may have paid only a portion of the rental.

If 100% of the rental had been paid then the Seaside Rental should have received this full amount of R1 347 368,42.
This would mean that the annual rental per flat was set at $\frac{24\,000}{18}$ = 74 853,80
Therefore, in 2002, the annual rental per flat was R74 853,80.

6.2 Seaside Rental had only budgeted to receive 95% of the rental payments. The reason for this could be that, in an average year, the company is not able to collect 100% of the rental payments – in other words, not all tenants always pay the full amount of rental owing to Seaside Rental.

6.3 Yes. 95% of budgeted rental income in 2003 for 19 flats is R1 560 000,00 therefore the total amount (100%) would be R1 642 105,26. This makes the annual rental per flat 1 642 105,26 ÷ 19 equal to R86 426,59. Since the annual rental per flat for 2002 was R74 853,80 we can see that there has been an increase in the rental price.

6.4 Since the annual rental per flat has increased from R74 853,80 to R86 426,59 this is a total of R11 572,79 ÷ R74 853,80 = 15,5% increase. A rental increase is not obliged to be in line with inflationary trends but is in fact simply a reflection of the demand for the premises. Companies increase or decrease their rental according to the supply and demand – therefore a 15,5% increase is not inappropriate but reflects the demand for these premises.

6.5

- If Seaside Rental had increased its rental fees by 9,2% (in line with inflation) the annual rental per flat would have increased from R74 853,80 to R81 740,35 for 2003. This is calculated as follows:
  R74 853,80 × 9,2% + R74 853,80 = R81 740,35.
- If they had then further increased the rental by 5,8% (in line with inflation) the annual rental per flat would have increased from R81 740,35 to R86 481,29 for 2004.This is calculated as follows:
  R81 740,35 × 5,8% + R81 740,35 = R86 481,29.

6.6 Students' answers will vary for this question, here is an example solution:

SEASIDE RENTAL

Income statement for the year ended 28 February 2004 presented to the director at Annual General Meeting.

	Budget 2002	Actual 2002	Budget 2003	Actual 2003	Budget 2004
NOTES					
No. of flats to rent	20	20	20	20	20
% rental collected	95%	96%	95%	94%	95%
Average no. of vacant flats	2	2	1	1	0
Tenants pay directly for own electricity.					
Landlord pays for all water and divides this proportionately among tenants.					
INCOME					
Rental	1 280 000	1 320 000	1 560 000	1 407 191	1 900 000

The rental income is calculated as follows: 20 × 86426,59 × 15,5%= R1 996 454,23

of which 95% is collected : R27 727,80 × 95% = R1 896 631,52.

2003 budget annual rental price per flat.

Therefore we have calculated a 15,5% increase on the 2003 budget income per flat and multiplied it by 20 (since there we might predict no vacant flats). We could then round off this budget figure to R1 900 000,00 (which is about a 15,7% increase).

6.7

SEASIDE RENTAL

Income statement for the year ended 28 February 2004 presented to the director at Annual General Meeting.

	Budget 2002	Actual 2002	Budget 2003	Actual 2003	Budget 2004
Rental	1 280 000	1 320 000	1 560 000	1 507 191	1 900 000
Interest	12 000	12 880	16 000	16 913	21 000
Interest from bank	4 500	5 280	6000	6 178	8 000
Interest on late rental	7 500	7 600	10 000	11 000	13 000
Recoveries	38 000	38 500	50 000	52 396	65 000
Refuse recovery	10 000	11 500	17 500	18 000	23 000
Water recovery	28 000	27 000	32 500	34 396	42 000
TOTAL INCOME	**1 330 000**	**1 371 380**	**1 626 000**	**1 576 500**	**1 986 000**

6.8 The percentage increase in budgeted income from 2002 to 2003 is calculated as follows:
1 626 000 – 1 330 000 = 296 000, which as a percentage is about 22%:

$$\frac{296\,000}{1\,330\,000}\% = 22\%.$$

A figure of 1 986 000 is budgeted for 2004. This is an increase of 360 000 which as a percentage is also about 22%: . Therefore the percentage increase is in line with that for the budget figures for 2002 and 2003.

6.9

	2002	**2003**
% expenditure spent on salaries and wages	$\frac{525\,000}{1\,097\,104}$ % = approx. 48%	$\frac{567\,000}{1\,177\,700}$ %= approx. 48%
Rate of inflation	9,2%	5,8%

Budgeted income for 2004 was R1 986 000,00. This is about a 22% increase in income since 2003. If the Seaside Rental wishes to continue spending 48% of its expenditure on salaries, it would need to consider the other budgeted expenditure items. The amount paid out for salaries in 2003 was R567 000,00. However, we cannot use this figure and calculate an exact percentage increase because Seaside Rental may be employing more people in 2004 than in 2003.

We are not sure how many people are employed at Seaside Rental but we remember from activity 4 that a person given a gross increase of 10% would only bank an increase (net increase) of about 8% . These are all factors for the company to take into account.

If we consider the inflationary effect over the past two years as being approximately 7,5%, then we would hope that the company would also try to ensure that its budgeted figure for salaries in 2004 was at least 7,5% up on that for 2003. This would be R609 525,00 (calculated as follows: 525 000 × 7,5% +525 000).

Taking the above into account, a reasonable decision would be for the company to budget to spend about R600 000,00 on salaries for 2004.

6.10

SR

SEASIDE RENTAL

Income statement for the year ended 28 February 2004 presented to the director at Annual General Meeting.

	Budget 2002	Actual 2002	Budget 2003	Actual 2003	Budget 2004
EXPENSES					
Bank charges	21 000	20 000	20 000	22 400	22 000
Capital expenses	0	0	0	0	0
Electricity for offices	5 800	6 000	6 000	7 000	7 000
Consumables - cleaning and maintenance	19 500	18 000	18 000	19 000	19 000
Water	3 200	3 600	3 800	4 000	4 200
Office printing, & stationery	6 000	7 000	7 000	7 500	7 500
Office telephones	14 600	15 000	16 000	17 000	18 000
Office rental	72 000	72 000	82 000	82 800	97 520
Insurance	34 700	36 000	37 000	38 000	40 100
Marketing	72 500	69 504	75 000	78 000	87 540
Security and maintenance	320 000	325 000	330 000	335 000	340 000
Salaries and wages	520 800	525 000	550 000	567 000	600 000
TOTAL EXPENSES	**1 091 100**	**1 097 104**	**1 144 000**	**1 177 700**	**1 252 385**

Notice that R600 000 is 48% of R1 252 385. Therefore we have maintained 48% of the total expenditure being spent on salaries.

6.11 Total income: R1 986 000,00

Total expenditure: R1 252 385,00

Therefore there would be a net surplus of R733 615,00.

This seems to be a little high. The actual figure may be lower, but if Seaside Rental manage to achieve their target income (i.e. by making sure that rental collection is kept as high as possible by chasing up tenants' payments) then it is quite possible that they will make such a healthy profit.

Activity 6 — Developing a budget (assessment task)

In this activity we will use many of the skills we developed in the earlier activities to produce a budget for the Seaside Rental Company. You will need the handout which has the Seaside Rental budget and actual income and expenditure statements for 2002 and 2003 as well as a blank column for 2004 (these figures have been slightly altered from those in activity 1). By answering the questions that follow, you will develop a budget for 2004.

Income:

6.1 Study the budgeted rental income (i.e. not the actual amount collected) for 2002 as well as the notes to the budget. Calculate the annual rental per flat (assuming tenants are charged the same rental for each flat) that each tenant was expected to pay during 2002. Show your working.

6.2 Why does Seaside Rental not expect 100% of the fees to be paid?

6.3 Was there an increase in rental per flat from 2002 to 2003?

6.4 If not, is this realistic? If yes, what was the percentage increase and was this appropriate?

6.5 Remember that the year-on-year inflation for 2001 to 2002 was 9,2% and for 2002 to 2003 was 5,8% (see activity 5). If Seaside Rental had kept rental increases within the limits of inflation, what would the new total budgeted rental income be for 2003 and for 2004?

6.6 Seaside Rental vacancy has in fact decreased from 2002 to 2003 even though they imposed a 15,5% increase in rental per flat. Assume that the number of flats for rental remains constant and anticipate an appropriate budgeted percentage increase for 2004. Now complete "No. of flats to rent"; "% rental collected"; "Average no. of vacant flats" and "Rental income" amounts on the 2004 budget.

Other income:

6.7 Complete the remaining income details and complete the total budgeted income for 2004.

NOTE: You may need to review the decisions you have taken so far at a later stage when you have a better sense of the expenses. This is why accountants do a lot of their early work in pencil.

6.8 What was the percentage increase in total budgeted income from 2002 – 2003? Is your 2004 budget figure in line with this percentage increase?

Salaries and wages:

6.9 In order to budget an amount to be spent on salaries, take into account the following points:

(1) Seaside Rental's expenses cannot exceed its income;
(2) the % of the expenses spent on salaries over the last two years;
(3) the rate of inflation from 2001 to 2002 and from 2002 to 2003;
(4) the income you have budgeted for 2004; and
(5) the impact of taxes on employees' "earnings" (recall activity 4).

Decide how much the company should budget for salaries in 2004. Motivate your answer.

Other expenses:

6.10 By studying the trend in budgeted and actual expenditure from 2002 to 2003 for the remaining expenses, determine budgeted figures for each item for 2004.

6.11 Complete the total budgeted expenditure for 2004.

Balancing the budget:

6.12 You need to check that the budgeted expenses do not exceed the budgeted income for 2004. Determine the net surplus/deficit for your budget. Are you happy with the anticipated surplus or deficit? If yes, argue why. If no, propose changes you can make to the budget to address your concern.

SR

SEASIDE RENTAL

Income statement for the year ended 28 February 2004 presented to the director at Annual General Meeting.

	Budget 2002	Actual 2002	Budget 2003	Actual 2003	Budget 2004
NOTES					
No. of flats to rent	20	20	20	20	
% rental collected	95%	96%	95%	94%	
Average no. of vacant flats	2	2	1	1	
Tenants pay directly for own electricity.					
Landlord pays for all water and divides this proportionately among tenants.					
INCOME					
Rental	1 280 000	1 320 000	1 560 000	1 507 191	
Interest	12 000	12 880	16 000	16 913	
Interest from bank	4 500	5 280	6000	6 178	
Interest on late rental	7 500	7 600	10 000	11 000	
Recoveries	38 000	38 500	50 000	52 396	
Refuse recovery	10 000	11 500	17 500	18 000	
Water recovery	28 000	27 000	32 500	34 396	
TOTAL INCOME	1 330 000	1 371 380	1 626 000	1 576 500	
EXPENSES					
Bank charges	21 000	20 000	20 000	22 400	
Capital expenses	0	0	0	0	
Electricity for offices	5 800	6 000	6 000	7 000	
Consumables - cleaning and maintenance	19 500	18 000	18 000	19 000	
Water	3 200	3 600	3 800	4 000	
Office printing & stationery	6 000	7 000	7 000	7 500	
Office telephones	14 600	15 000	16 000	17 000	
Office rental	72 000	72 000	82 000	82 800	
Insurance	34 700	36 000	37 000	38 000	
Marketing	72 500	69 504	75 000	78 000	
Security and maintenance	320 000	325 000	330 000	335 000	
Salaries and wages	520 800	525 000	550 000	567 000	
TOTAL EXPENSES	1 091 100	1 097 104	1 144 000	1 177 700	

Activity 7 — Buying office furniture

ABOUT THIS ACTIVITY

In this activity, the context of buying office furniture for the new Property Investment Company is used to introduce different purchase options. In particular, a comparison is made between hire purchases and bank loans.

This activity is aligned with unit standard 9014 and addresses AC 1,2 of SO1; AC 1,2,3,4 of SO2 and AC 1,3 of SO3.

MANAGING THIS ACTIVITY

Interest calculations will be made in this activity and therefore a calculator would be useful to speed up the answering process.

7.1 The students will have different responses to this question. For the purposes of showing the calculations required, the following cash prices will be used:
New office chair price: R500,00
New computer desk cash price: R650,00
New meeting table with 4 chairs cash price: R2 600,00

7.2 The total cash price = R3 750,00. To calculate an increase of 20% on R3 750,00:

$3\,750 \times 20\% + 3\,750 = 4\,500$ or $3\,750 \times \frac{20}{100} + 3\,750 = 4\,500$

Therefore, the total non-cash price for the office furniture is R4 500,00.

7.3 The deposit (15% of non-cash price) is R675,00, calculated as follows:
$4500 \times 15\% = 675$

7.4 You still owe: non-cash price – deposit:
4 500 – 675 = R3 825,00.

7.5 Amount owing + R100 + R4 = R3 825,00 + R100 + R4 = R3 929,00.

7.6 The calculations are as follows:

Amount owing	R3 929,00
Repayment period	6 months
Interest	6,5%
Interest amount	**R255,39**
Total Due:	**R4 184,39**

R3 929,00 × 6,5% = R255,39

R3 929,00 + R255,39 = R4 184,39

Amount owing	R3 929,00	R3 929,00	R3 929,00
Repayment period	12 months	18 months	24 months
Interest	12,5%	17,8%	24%
Interest amount	R491,13	R699,36	R942,96
Total Due:	**R4 420,13**	**R4 628,36**	**R4 871,96**

No, this is not the full amount that you will pay. You also have to pay the deposit therefore the full amount will be more than these totals.

7.7 Monthly payment = $\frac{\text{total due}}{\text{number of payments}}$

Repayment period	6 months	12 months	18 months	24 months
Total due	R4 184,39	R4 420,13	R4 628,36	R4 871,96
Due per month	R697,40	R368,34	R257,13	R203,00

7.8

Repayment period	6 months	12 months	18 months	24 months
Total due	R4 184,39	R4 420,13	R4 628,36	R4 871,96
+ Deposit	R675	R675	R675	R675
Total cost	R4 859,39	R5 095,13	R5 303,36	R5 546,96
	– original cash price		R3 750,00	
Extra Paid	**R1 109,39**	**R1 345,13**	**R1 553,36**	**R1 796,96**

Therefore you have to pay this much more for each of the payment plans.

7.9 Students are required to compare the deposit, calculated in question 7.3, and the monthly payment amounts, calculated in question 7.7, with the advertised monthly payment amounts listed in their advertisement.

Any of the following responses could be given:
- The deposit in the advert is less/more than 15% (as we calculated it).
- The monthly payments we calculated are less/more than those in the advert.
- The non-cash price in the advert is less/more than 20% (as we calculated it).

7.10 For the purpose of showing the calculations, assume that the cash price was R 4 000,00.

7.11 Minimum monthly repayment = $\frac{4\,000}{40}$ = R100,00.

7.12 This table is drawn up as an example based on a cash price of R 4 000,00 and monthly repayment of R710,00, and an interest rate of 21% per annum (this amount will change from time to time).

Previously outstanding total + interest:
4 000,00 + 70,00 = 4 070,00

	Interest on outstanding balance	Outstanding total	Payment	Remaining balance
Start of loan period	0,00	4 000,00	0,00	4 000,00
End of 1st month	70,00	4 070,00	710,00	3360,00
End of 2nd month	58,80	3 418,80	710,00	2 708,80
End of 3rd month	47,40	2 756,20	710,00	2 046,20
End of 4th month	35,81	2 082,01	710,00	1 372,01
End of 5th month	24,01	1 396,02	710,00	686,02
End of 6th month	12,01	698,03	698,03	0.00
		Total paid to the bank	4 248,03	

Since the interest rate is quoted per annum but the interest is calculated monthly, the monthly interest rate is

$\frac{21\%}{12}$ = 1,75% and 4000 × 1,75% = 70

or $4000 \times \frac{1,75}{100} = 70$

7.13

	Interest on outstanding balance	Outstanding total	Payment	Remaining balance
Start of loan period	0,00	4 000,00	0,00	4 000,00
End of 1st month	70,00	4 070,00	375,00	3 695,00
End of 2nd month	64,66	3 759,66	375,00	3 384,66
End of 3rd month	59,23	3 443,89	375,00	3 068,89
End of 4th month	53,71	3 122,60	375,00	2 747,60
End of 5th month	48,08	2 795,68	375,00	2 420,68
End of 6th month	42,36	2 463,04	375,00	2 088,04
End of 7th month	36,54	2 124,59	375,00	1 749,59
End of 8th month	30,62	1 780,20	375,00	1 405,20
End of 9th month	24,59	1429,79	375,00	1 054,79
End of 10th month	18,46	1 073,25	375,00	698,25
End of 11th month	12,22	710,46	375,00	335,47
End of 12th month	5,87	341,34	341,34	0.00
		Total paid to the bank	**R4 466,34**	

7.14 Again, each student's responses will be based on his/her own original cash price.

For these calculations, assume the cash price of the fridge and the stove together was R4 000.

This means that the total non-cash price that Table Mt Furnishers would require is R4 800,00 of which you would have to pay a R720 deposit and 6,5% (or 12,5% for 12 months) interest on the remaining R4 080.

	Payments over 6 months	Payments over 12 months
Blue Bank Loan	R4 248,03	R4 466,34
Table Mt Hire Purchase	R5 065,20	R5 310,00

7.15 Calculations are done in the same way as those in questions 7.12 and 7.13.

7.16

BLUE BANK LOAN		TABLE MT HIRE PURCHASE	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
• no deposit required • avoid the non-cash price increase • interest payable decreases after every payment • you only have to pay a minimum payment per month	• you have to be 21 years or older, have a clean bank record and be earning a minimum of R 3 000,00 • if you only pay the minimum payment per month it could take a lot longer to pay off than on a 24 month hire purchase plan	• avoid having to arranged finance with the bank first i.e. purchase straight away	• non-cash price is 20% higher than cash price • deposit of 15% of non-cash price price is required (i.e. you have to pay 18% of the cash price upfront)

Activity 7 — Buying office furniture

Sometimes we are unable to pay for the things we want to buy because we simply do not have the full amount in cash.

When purchasing a property, for example, very few people have sufficient money to be able to pay the full amount in cash. They need to borrow money from the bank in order to pay the purchase price of the property. An agreement will need to be reached between the purchaser and the bank as to how much money is going to be borrowed, how long the borrower has to pay it back, what the interest rate is going to be and what the monthly payments will be. The agreed repayment period for purchasing a house is usually between 20 and 30 years.

When purchasing items from a furniture or home appliance store or an office supplies store the repayment period is likely to be shorter, often no more than 24 months.

Consider the following scenario:
The Property Investment Company needs to buy an office chair, a computer desk and a meeting table with chairs for the new company office. Since this business is new, there is not enough money to pay cash for the office furniture. Let us explore two options: the company (1) pays the furniture store over a period of time, or (2) takes a loan with the bank.

7.1 Look through the newspaper for advertisements for brand-new office chairs and computer desks. Choose a chair, a computer desk and a meeting table with 4 chairs that you think you would like to buy for an office such as this. Determine the cash price for these items.

Buying over 24 months from the furniture store
The questions that follow are based on actual information supplied by a furniture store in Cape Town—let us call the store Table Mountain Furnishers. To determine what the monthly repayments will be for your purchase you need to do the following:

7.2 **Step 1: Determine the non-cash price of the item(s).** Because you will not be paying cash, Table Mountain Furnishers adds 20% to the cash price. Calculate the non-cash price for the items you have selected.

7.3 **Step 2: Determine the deposit you must pay.** Table Mountain Furnishers expects you to pay a deposit of 15% of the non-cash price. How much deposit must you pay?

7.4 **Step 3: Calculate the outstanding amount.** How much do you still owe for the items once you have paid the deposit?

7.5 **Step 4: Add standard costs.** Before calculating the monthly repayment, Table Mountain Furnishers adds some standard costs to the amount still owing. They add a R100 delivery charge and R4 for stamp duty (on the contract you are about to enter into) to the amount you still owe. What is the total you now owe?

7.6 **Step 5: Calculate the interest.** Table Mountain Furnishers now add a percentage to the amount owing. They call this interest. The percentage is dependent on the number of months over which you plan to pay for the items. The table below lists the different percentages (these will change from time to time):

Repayment period	6 months	12 months	18 months	24 months
Interest	6,5%	12,5%	17,8%	24%

Calculate the interest amount you owe for each of the different repayment periods and add this to the amount you owe. Is this is the full amount you will pay?

7.7 **Step 6: Calculate the monthly repayments.** Calculate how much you have to pay Table Mountain Furnishers each month by dividing the full amount owing by the number of months over which you are going to pay the amount.

7.8 For each of the different repayment periods calculate how much you will actually pay for the fridge and the stove. How much more is this than the cash price?

7.9 Return to the advertisements you used at the start of the activity and compare the deposit and monthly repayment amounts you have just calculated with the amount shown in the advertisement.

Buying the office furniture using a bank loan

Instead of entering into a hire-purchase agreement with Table Mountain Furnishers you might choose to take a loan with the bank. Provided you meet certain conditions, such as being 21 years or older, having a clean bank record and earning a minimum of R 3 000,00 per month, the bank will happily give you a loan. The repayment of the loan is, however, calculated quite differently. The questions that follow are based on actual information supplied by a bank in Cape Town—let us call the bank Blue Bank.

7.10 **Step 1: Minimum loan amount.** Blue Bank sets a minimum amount of R 3 500,00 for a loan. You will not need to pay any deposit. Since you will in effect be paying cash for the office furniture, confirm that the total cash price for the office furniture exceeds R 3500,00.

7.11 **Step 2: Determine the minimum monthly repayment.** Blue Bank allows you to determine your own monthly repayment on the loan with the understanding that the monthly repayment exceeds a certain minimum. Calculate the minimum by dividing the amount of the loan by 40[1].

7.12 **Step 3: Choose a monthly repayment amount and calculate how long it will take to repay the loan.** First choose the monthly repayment that you would have had to pay Table Mountain Furnishers if you had paid for the office furniture over 6 months (see question 7.7 above). Draw a table such as the one below and complete it for your amounts—the example is based on a cash price of R 3 750,00, a monthly repayment of R 698,00 (R697,40 rounded up to the nearest rand) and an interest rate of 21% per annum (this amount will change from time to time).

[1] Presumably this number—40—will vary depending on the interest rate.

	Interest on outstanding balance	Outstanding total	Payment	Remaining balance
Start of the loan period	0,00	3 750,00	0,00	3 750,00
End of first month	65,63	3 815,63	697,40	3 118,23
End of second month	54.57	3 172,79	697,40	2 475,39
End of third month	43.32	2 518,71	697,40	1 821.31
End of fourth month	31,87	1 853,19	697,40	1 155,79
End of fifth month	20,23	1 176,01	697,40	478,61
End of sixth month	8,38	486,99	486,99	0.00
Total paid to the bank			3 973,99	

Since the interest rate is quoted per annum but the interest is calculated monthly, the monthly interest rate is

$\frac{21\%}{12} = 1{,}75\%$ and $3750 \times 1{,}75\% = 65{,}63$

7.13 Create a table such as the one above for the cash price of your items but this time using the monthly repayment amount if you had paid for the items over 12 months.

7.14 Compare the total amount you would pay for the office furniture if you bought the items through Table Mountain Furnishers with the amount if you bought them through a loan from the bank, for both the 6 and 12 month periods.

7.15 You could repeat the calculations above for the 18 and 24 month amounts as well. However, you may find that this takes a lot of calculations and a lot of time. If you can use a spreadsheet, you may want to try to use a spreadsheet for these calculations.

7.16 List the advantages and disadvantages of the two ways of financing the purchase.

Activity 8 — Rental rates

ABOUT THIS ACTIVITY
This activity focuses on introducing the students to foreign exchange. Students are required to study tables and graphs and to calculate rental costs using the given exchange rates.

This activity is aligned with unit standard 9014 and addresses AC 1,2,3,4,5 of SO1; AC 1,2,3,4 of SO2 and AC 1,2,3 of SO3.

MANAGING THIS ACTIVITY
Calculators will be necessary for this activity in order to do accurate decimal calculations.

8.1 On Monday 6 December the flats would have cost the least in rand terms. You have to multiply by the figure in the table to calculate the rand price. On Monday the figure in the table is the lowest, therefore the rand price would be the least.

8.2

South African Rands to 1 USD				
Monday 6 Dec 2004	Tuesday 7 Dec 2004	Wednesday 8 Dec 204	Thursday 9 Dec 2004	Friday 10 Dec 2004
5,726	5,751	5,875	5,820	5,808
Rand price (priced at $13,87) on each day				
R79,42	R79,77	R81,49	R80,72	R80,56

5,726 × 13,87 =

8.3 You could use these figures as a gauge – in other words you could expect that the following week's figures would be roughly between 5 and 6 South African rands to 1 US dollar, but this would only be an estimate. These exchange rates can fluctuate dramatically over time and therefore you could not accurately predict the exchange rates for the next week or month.

8.4 Students should look this up in their local newspaper which will give the daily exchange rate for the rand against many major currencies.

8.5 This should be calculated as follows:

The rand-US dollar exchange rate on 3 January 2005 was 5,6425. This means that it would the income generated from renting these properties would be less on this particular day than it would have been if the booking was made in the week in December shown in the table. (Rental fee, if booked on 3 January 2005, would be R78,26 per day, since 5,6425 ×13,87 = R78,26 per day).

8.6.1

Name	Details	Area	Monthly rental	Rate per m²
Manor Park	2 bed	60m²	$516,00	$8,60
Terrace View	3 bed	80m²	$1 184,00	$14,80
Belle Corsa	3 bed	70m²	$1 172,50	$16,75

8.6.2 The rental income generated, in US dollars, from renting out Terrace View for 1 month is $1 184,00. With the exchange rate at R5,325:US$1,00 this would amount to R6 304,80 (11843 × 5,325). For three months we multiply this figure by three to get a total of R1 8914,40.

8.7.1 The monthly rental for Belle Corsa is $1 172,50, therefore the total fee for transferring enough money to pay for 2 months is $2 712,75, calculated as follows:

	Amount in US dollars
2 months rental	2 345,00
15% of total	351,75
Fee	16,00
TOTAL	$2 712,75

8.7.2 The monthly rental for Terrace View is $1 184,00 and the total amount that the family can spend is $2 500. Therefore (see diagram below) if you subtract the fee and 15% of what is left in the budget, they have $2 156,40. For $2 156,40 they could stay at Terrace View for 1,82 months (2 156,40 ÷ 1 184 = 2,82). Since their stay begins in December and would end sometime in January your January rental would be calculated pro rata. There are 31 days in January, therefore 0,82 × 31 = 25 days. The family's total stay could be from 1 December until 25 January (1 month and 25 days) and they would not have exceeded your budget of $2 500,00.

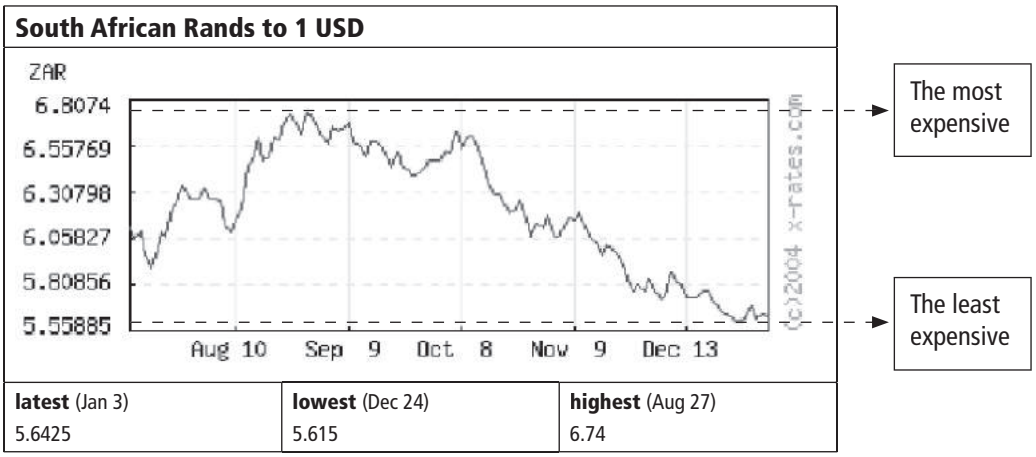
	Amount in US dollars	Balance
TOTAL		2 500,00
Minus fee	-16,00	2 484,00
Minus 15%	-372,60	$2 156,40

8.8 We can see from question 8.7.1 that it would cost each family $2 712,75 to stay at Belle Corsa for 2 months i.e. the total would be $5 425,50. However, if one payment is made and they get 5% of the rental fee then the total would be $5 139,83, calculated as follows:

So they save a total of $285,67 (5425,50 – 5139,83 = 285,67).

	Amount in US dollars
2 months rental × 2	4 690,00
-5%	-234,50
15% of total	668,33
Fee	16,00
TOTAL	5 139,83

8.9



The rate per square metre for Terrace View is $14,80.

At the most expensive point (27 August), the rand-US dollar exchange rate was 6,740. Therefore the price at this point would have been $14,80 × 6,740 = R99,75.

At the least expensive point (24 December) the rand-US dollar exchange rate was 5,615. Therefore the price at this point would have been $14,80× 5,615 = R83,10.

Activity 8 — Rental rates

Some of the clients wishing to rent property from Seaside Rental are not from South Africa and are therefore charged US dollar-based rates for premises instead of the ordinary local rate. In general it is a more expensive rate, but the US dollar rate may sometimes be more economical than the local rate. You will need to convert South African rands to the US dollar rates or other currencies.

8.1 Refer to the table below which gives the rand-US dollar exchange rate for each day of the week starting Monday 6 December 2004. On which day would a rate per square metre have cost the least in rand terms?

South African Rands to 1 USD				
Monday 6 Dec 2004	Tuesday 7 Dec 2004	Wednesday 8 Dec 204	Thursday 9 Dec 2004	Friday 10 Dec 2004
5,726	5,751	5,875	5,820	5,808
Data sourced at: http://www.x-rates.com (Jan 2005)				

8.2 If the rental fee for a particular 50m² flat was $13,87 per day, calculate the rental fee in rands for each of the days of the week listed in the table above. Do your answers support your answer to question 8.1?

8.3 The exchange rates in the table are for a particular week in December. Can you use these rates to predict the exchange rates for each of the days of the next week? Can you use these rates to predict the exchange rates for each of the days of the next month?

8.4 What is the current rand–US dollar exchange rate? You should look this up in your local newspaper which will give the daily exchange rate for the rand against many major currencies.

8.5 Do the Seaside Rental agents earn more or less rental income per square metre now compared to the week in December?

8.6 Consider the following scenario:

An overseas family would like to rent a flat from Seaside Rentals for the summer vacation. Seaside Rental has suggested 3 suitable flats but the rental fee is different for each. The rental fee is charged as a monthly rate and because they are overseas tenants they are charged in US dollars. The pricing is as follows:

Name	Details	Area	Monthly rental
Manor Park	2 bed	60m²	$516,00
Terrace View	3 bed	80m²	$1 184,00
Belle Corsa	3 bed	70m²	$1 172,50

8.6.1 Calculate the monthly rate per m² (in US dollars) of each of the listed listed flats.

8.6.2 If the exchange rate on the day of booking was R5,325:US$1,00, calculate the rental income (in rands) that Seaside Rentals would earn if Terrace View was rented for 3 months.

8.7 To make an international payment into Seaside Rental's bank account, the US bank charges $16 plus 1,5% of the value of the amount transferred.

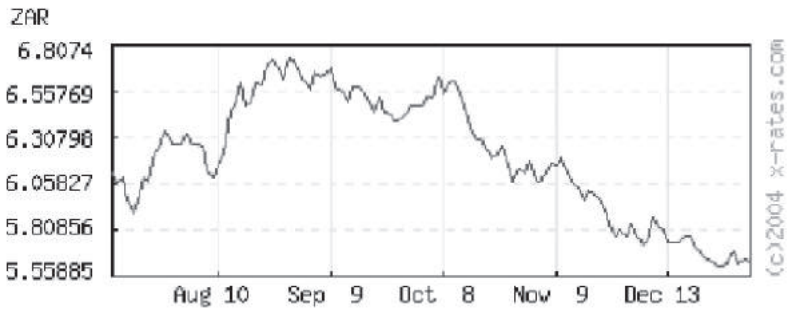
8.7.1 Calculate the total cost that the US family would incur in order to rent Belle Corsa for 2 months.

8.7.2 If they really wanted to stay at Terrace View from 1 December 2004, but their budget was only $2 500,00, work out how long they can stay (assume extra days are charged pro rata).

8.8 Two US families decide to rent from Seaside Rental. Each family would rent a flat at Belle Corsa for 2 months. Seaside Rental have agreed to give you a 5% discount if you make this double booking. What is the total amount that you would save by making this double booking and paying with one payment rather than each family separately?

8.9 Refer to the graph below (sourced at http://www.x-rates.com) and determine the most and least that Seaside rental would have received in rental fees (in rands) for Terrace View, per square metre, during the period given from 13 July 2004 – 3 January 2005.

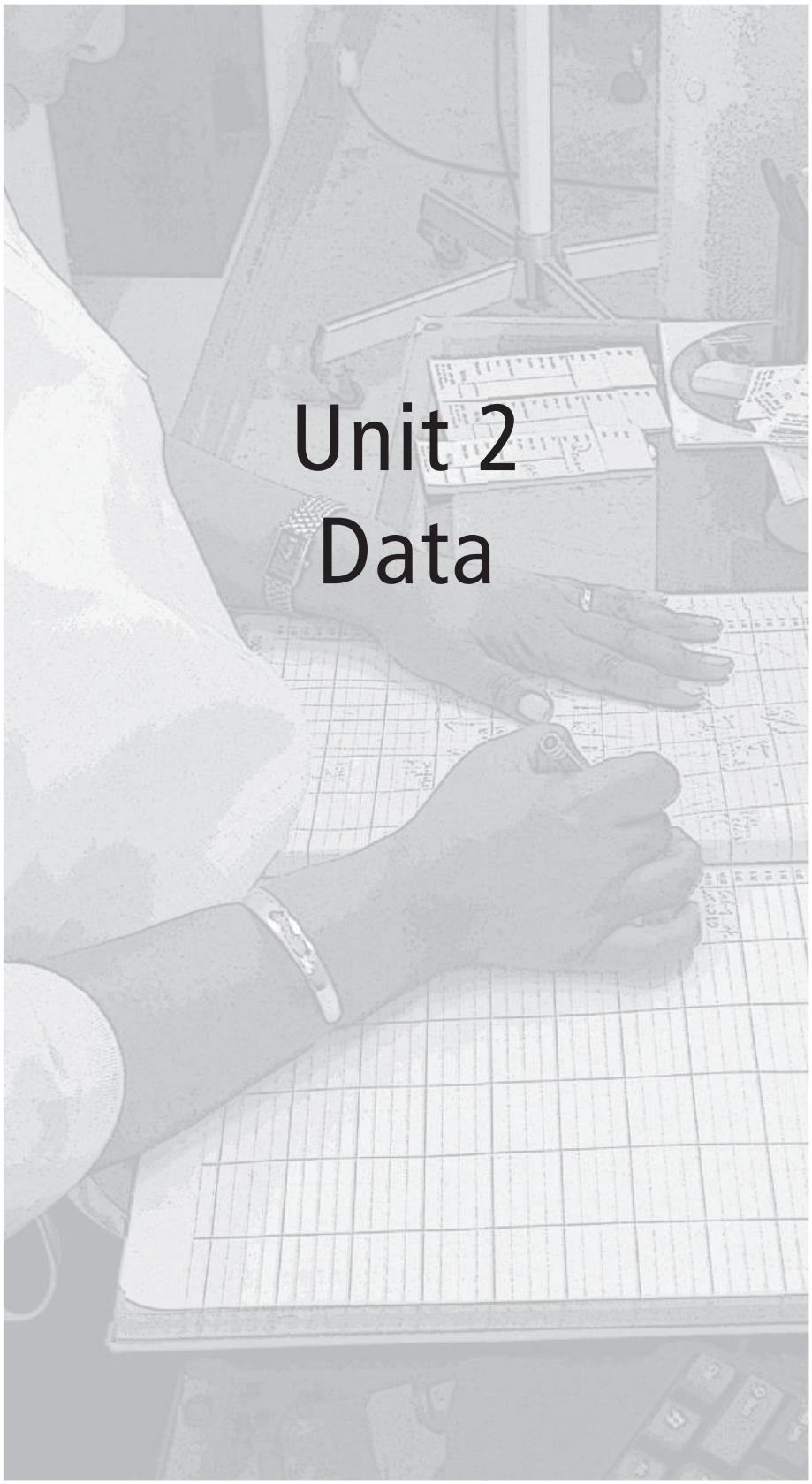
South African Rands to 1 USD



latest (Jan 3)	**lowest** (Dec 24)	**highest** (Aug 27)
5.6425	5.615	6.74

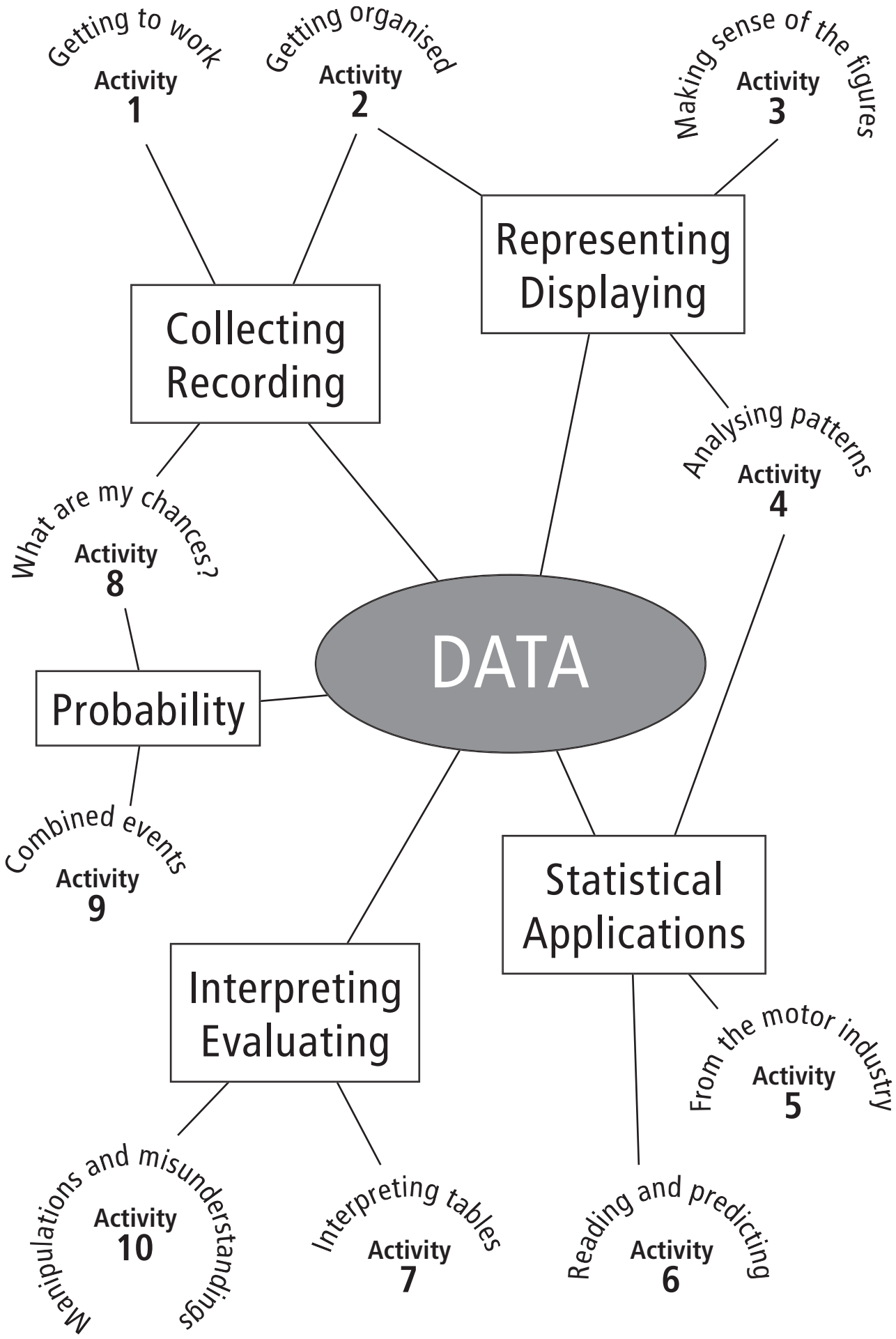
Mathematical Literacy

NQF LEVEL 4



Unit 2
Data

Generic Business Administration


Getting to work
Activity 1
Getting organised
Activity 2
Making sense of the figures
Activity 3
Representing Displaying
Collecting Recording
Analysing patterns
Activity 4
What are my chances?
Activity 8
DATA
Probability
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Activity 9
Statistical Applications
Interpreting Evaluating
From the motor industry
Activity 5
Manipulations and misunderstandings
Activity 10
Interpreting tables
Activity 7
Reading and predicting
Activity 6

Overview

In this unit students develop a variety of mathematical skills including:

- Data collection and organisation, using the context of different means of transport for getting to work.
- Graphical representation of data using data similar to their own collected data.
- Analysis of data to answer questions, using graphs and tables from the motor industry.
- Reading and interpreting the figures in a newspaper report on the Top Ten Brands survey.
- Finding connections and correlations between data, and predicting trends.
- Analysis of existing data to aid decision making, in the context of the National Skills Fund.
- Verification of experimental results by analysis and probability calculation, using the lotto as a context.
- Calculating probabilities involving more than one event.
- Analysing and critiquing ways in which data can be manipulated and misunderstood.

Activity 1: Getting to work
This is a preliminary activity designed to raise some of the issues involved in data collection. Students will collect their own simple data about different means of transport and decide what conclusions can be drawn. In order to locate this in a wider context, an information handout has been included that defines some common statistical terms and ideas. Problems such as sample size and representativeness are introduced.

Activity 2: Getting organised
This activity involves the organisation and representation of raw data on a frequency table, a bar graph and a pie chart. Students use data similar to that which they collected in the previous activity to answer simple questions and to determine the different central tendencies of the data.

Activity 3: Making sense of the figures
This activity involves reading figures from tables and bar graphs. Students are given three graphs and two tables taken from the Sunday Times / Markinor Top Brands Survey. They analyse the data type and sample size, and read off various simple results. They do calculations and suggest some conclusions that could be drawn from them.

Activity 4: Analysing patterns
In this activity students work with patterns and distribution of data. The extend the idea of 'measuring the centre' to measuring variance from the mean and understanding the 'spread' of the data. They identify data items that seem 'not to fit the pattern' (outliers) and analyse the effect these have on the mean. They draw scatterplots to illustrate various distributions using additional data taken from the Sunday Times / Markinor Top Brands Survey.

Unit outcomes

The following Unit Standards, Specific Outcomes and Assessment Criteria are addressed by this unit:

Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life-related problems. (Math Lit 9015).

- Critique and use techniques for collecting, organising and representing data (SO1).
  - o Correctly identify and interpret situations and issues involving statistics, including problems with samples and contamination (AC1, 3, 4).
  - o Use methods of collecting, recording, organising, representing and calculating correctly (AC2, 5 , 6, 7).
  - o Use graphs, summaries and resolutions consistently and correctly (AC8, 9).
- Use theoretical and experimental probability to develop models (SO2).
  - o Correctly use experimental data and simulation to model a situation and make predictions (AC1, 2).
  - o Interpret, communicate and verify results in terms of the real context (AC3, 4).
- Critically interrogate and use probability and statistical models (SO3).
  - o Make meaningful interpretations, predictions and judgements (AC2, 4).
  - o Critique assumptions (AC3).
  - o Identify bias, errors and misuse of statistics (AC5).

Activity 5: From the motor industry
In this activity students read and interpret tables. The context is sales, manufacturing and productivity in the motor industry. They calculate percentage increase, productivity ratio and labour index in simplified examples. They represent the information tables on a bar graph and a broken line graph.

Activity 6: Reading and predicting
In this activity students read data and make predictions by analysing trend lines. They observe patterns and measure important connections between variables. They identify variance from the mean as well as outliers, suggesting what implications these may have in real life situations.

Activity 7: Interpreting tables
This activity involves the reading and interpretation of information from tables. Students are given a table showing the amounts allocated to various provinces by the National Skills Fund for the training of unemployed people in South Africa. They are also given a table showing the number of people trained per programme and are required to cross-reference these tables, make calculations, interpret the relationship between the rows and columns and draw various conclusions.

Activity 8: What are my chances?
This activity introduces the idea of probability. A preliminary handout has been included with background information on some of the common applications and terminology used in this branch of statistics. The students work with single events in the context of the 'Lotto draw', comparing 'counted' results with calculated probability. In this way students work with the mathematical verification of experimental results.

Activity 9: Combined events
In this activity students move from the probabilities involving single events, to probabilities of combined events. They work with the multiplication principle and are introduced to the ideas of dependent, independent and mutually exclusive events. A handout has been included with further information necessary to answer a selection of probability questions.

Activity 10: Manipulations and misunderstandings
In this activity students critique the ways that data is used to support arguments. They identify how data is manipulated and how one can be misled by incomplete statistics, inappropriate samples and graphical methods.

9015	Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems											
		ACTIVITY	1	2	3	4	5	6	7	8	9	10
SO1	Critique and use techniques for collecting, organising and representing data.											
	AC1	Situations or issues that can be dealt with through statistical methods are identified correctly.		✓	✓	✓	✓		✓			
	AC2	Appropriate methods for collecting, recording and organising data are used so as to maximise efficiency and ensure the resolution of a problem or issue.	✓	✓	✓							
	AC3	Data sources and databases are selected in a manner that ensures the representativeness of the sample and the validity of resolutions.	✓		✓							
	AC4	Activities that could result in contamination of data are identified and explanations are provided of the effects of contaminated data.						✓				✓
	AC5	Data is gathered using methods appropriate to the data type and purpose for gathering the data.		✓								
	AC6	Data collection methods are used correctly.	✓									
	AC7	Calculations and the use of statistics are correct.	✓	✓		✓	✓	✓	✓	✓	✓	
	AC8	Graphical representations and numerical summaries are consistent with the data, are clear and appropriate to the situation and target audience.		✓		✓	✓	✓				
	AC9	Resolutions for the situation or issue are supported by the data and are validated in terms of the context				✓		✓	✓			
SO2	Use theoretical and experimental probability to develop models.											
	AC1	Experiments and simulations are chosen and/or designed appropriately in terms of the situation to be modelled.								✓		
	AC2	Predictions are based on validated experimental or theoretical probabilities.								✓	✓	
	AC3	The results of experiments and simulations are interpreted correctly in terms of the real context.								✓	✓	
	AC4	The outcomes of experiments and simulations are communicated clearly.								✓		
SO3	Critically interrogate and use probability and statistical models.											
	AC1	Statistics generated from the data are interpreted meaningfully and interpretations are justified or critiqued.				✓	✓		✓	✓	✓	
	AC2	Assumptions made in the collection or generation of data and statistics are defined or critiqued appropriately.			✓		✓	✓	✓			
	AC3	Tables, diagrams, charts and graphs are used or critiqued appropriately in the analysis and representation of data, statistics and probability values.			✓	✓	✓	✓	✓			✓
	AC4	Predictions, conclusions and judgements are made on the basis of valid arguments and supporting data, statistics and probability models.				✓	✓	✓	✓	✓	✓	
	AC5	Evaluations of the statistics identify potential sources of bias, errors in measurement, potential uses and misuses and their effects.			✓			✓				✓

Activity 1 — Getting to work

ABOUT THIS ACTIVITY

This is a preliminary activity designed to raise some of the issues involved in data collection. Students will collect their own simple data about different means of transport and decide what conclusions can be drawn. In order to locate this in a wider context, an information handout has been included that defines some common statistical terms and ideas. Problems such as sample size and representativeness are introduced. This activity addresses the following Specific Outcomes and Assessment Criteria of unit standard 9015: SO1 — AC 1, 2, 3, 6, 7.

MANAGING THIS ACTIVITY

The students need to be familiar with the terms and ideas in the handout. This could be done as a teacher-led discussion, a question and answer session, or a student-led presentation where students find out the meanings of key words and explain them to the class. It would be useful for each student to have a copy of *Handout 1* and for students to suggest their own simple examples to illustrate each statistical idea. These terms will be used often in the next few activities.

Give each student a copy of *Worksheet 1* with instructions that they should choose any 20 people and fill in the data sheet. This will take a bit of time and is best done outside of the classroom to achieve a greater variety of data. Back in class, students should now combine their totals on a new sheet to collect as much data as possible. We call this *cumulative data*, and these combined totals should be filled in on the cumulative tables given on the worksheet. It may be necessary to discuss the idea of a *cumulative* table — this is a table that adds the data from all the sheets together and records the totals. The students are now in a position to answer the questions and complete the worksheet.

1.1 A variety of answers would be expected here. Students may mention that commonly used types of transport differ significantly in different age groups. They could pick up differences or similarities in the transport patterns of males and females. They may find some people had difficulty calculating a monthly expense from a daily expense. They may be surprised by high transport costs etc.

1.2 A survey with closed-ended questions was used. No opinions were asked, only facts.

1.3 Students collected information from 20 people, so the sample size is 20.

1.4 The size of the class sample is calculated by multiplying the number of students in the class by 20. So in a class of 30, the cumulative sample would be $30 \times 20 = 600$.

1.5 Students should describe the group of people they questioned in terms of how representative they are of other groups in South Africa. Their samples are likely to be poor representations because they probably collected information from family and friends, which means there may be too many in a similar age group or socio-economic group. There is unlikely to be a representative spread of urban and rural respondents etc.

1.6 To calculate the percentage, students should count the number of people who travel by train in their sample, divide it by 20 (the number of people in the whole sample) and multiply by 100. For example if 8 people in a sample of 20 usually travel by train, the percentage is $8 \div 20 \times 100 = 40\%$. In the cumulative sample, take the total number who travel by train, divide by the number of people in the whole cumulative sample, and multiply by 100. For example $150 \div 600 \times 100 = 25\%$.

1.7 The sample size is bigger, so one would expect a greater variety of answers.

1.8 In general, the larger the sample the more representative the results, so the combined results would be more reliable. However, a sample of 600 is still a very small sample and would be considered very unrepresentative in a larger context.

1.9 This is clearly not representative of the percentage of people who use trains as transport in South Africa. Only some cities have any public train service at all, and an entirely different set of results would be expected in a rural context. The sample is too small and too unrepresentative to allow any valid conclusions to be drawn.

1.10 A variety of answers would be expected, depending on the sample. It may be interesting to explore the reasons why patterns of travel may or may not be different for males and females. It would be an opportunity to raise a few gender issues and safety issues for discussion among class members.

1.11 Students read from their own data and compare with the cumulative data.

1.12 Students read from their own data the number of people between 20 and 35 years who travel in their own cars, divide this by 20 and multiply by 100 to find percentage.

Activity 1 — Getting to work

Identify any 20 people and fill in the following table of data, using ticks to indicate to which category they belong and M or F to indicate male or female.

Name		Age (years)			Gender	What type of transport do you use most often?				Approximately how much do you spend per month on transport?			
		0-18	19-35	35+	M/F	Train	Taxi	Own car	Cycle/walk	R0 – R200	R200–R300	R300-R400	R400+
1													
2													
3													
4													
5													
6													
7													
8													
9													
0													
1													
2													
3													
4													
5													
6													
7													
8													
9													
0													
	Totals												

Complete the following tables of combined cumulative data from your class:

Numbers in each age group and type of transport used most often.				
Age (years)	Train	Taxi	Own car	Cycle / Walk
0 – 18				
19 - 35				
35 +				
TOTALS				

Number of males / females and type of transport used most often.				
	Train	Taxi	Own car	Cycle / Walk
Male				
Female				
TOTALS				

Numbers of people and their monthly expenditure estimates.				
	R0 – R200	R200 – R300	R300 – R400	R400 +
TOTALS				

Now answer the following questions:

1.1 Did you find anything that was interesting or surprising about the data you collected? Note any problems that you encountered.

1.2 What data collection method did you use to get this information?

1.3 What was the size of your own sample ?

1.4 What was the size of your class sample (give exact numbers)?

1.5 Does your sample represent the population of South Africa accurately? You should raise issues of age, gender, socio-economic level, urban/rural etc.

1.6 Calculate the percentage of people who usually travel by train in your own sample and compare this with the percentage who usually travel by train in the combined cumulative results.

1.7 Discuss the reasons for any differences in the percentages above.

1.8 Which sample do you think is the more representative?

1.9 Could we say this is an accurate estimate of the percentage of people who mostly use train travel in South Africa?

1.10 Was there a notable difference between the type of transport used by males and females?

1.11 Approximately how much do most people in your sample spend on transport per month? Is this the same as the amount spent by most in the combined results?

1.12 What percentage of people in your sample, aged between 20 and 35, travel in their own car most often?

Statistics (background information for students and teacher)

Data handling involves the collecting, organising, representing and analysing of information, in order to make accurate and informed decisions and recommendations. The accuracy of these methods depends on asking the right questions, choosing the right data and knowing how to use this data to come to useful conclusions. Having an understanding of factors that may contaminate data and mislead the analysis is essential too.

Data can be collected in a variety of ways:

- **Observation**. By simply watching people and their reactions, one can gain informal data intuitively.
- **Personal Interviews**. A set of questions is asked of individuals in the hope that they will supply useful information. The questions could be open or close-ended. When the questions are closed (only facts, no opinions), we speak of a *survey*. Some problems of this method are interviewer bias or interviewer influence (by manner and reactions). Some people are also uncomfortable about giving certain information to strangers and may not answer honestly.
- **Telephone Interview**. This is a time- and cost-effective method of gaining information, but not everyone answers questions honestly and the same problems as with personal interviews will still be a factor.
- **Mail Questionnaire**. This is cheap and a good way to avoid interviewer bias, but many mail questinnaires are ignored and the response is usually very poor. Those who do respond are often interested in the topic and so are not a suitable sample to analyse a bigger part of the population.

Information is collected and analysed in order to help us make effective and useful decisions and recommendations. *Population* is a term that refers to all measurements or observations of interest. For example, if we were studying 18-year-old girls in South Africa our population would be every single *18-year-old girl in South Africa*. Collecting information from this number of people would be an impossible task, so we would be much more likely to select a smaller group to represent 18-year-old girls in South Africa This selected part of a population is called a *sample*.

Two factors are important when selecting a sample — size, and representivity. Generally speaking, the bigger the sample, the more accurate the data. Selecting a completely representative sample is difficult because there are many possible variations that need to be taken into account. These include factors such as age, gender, geographical location (urban, rural), and social and economic differences. A *random sample* is a sample chosen completely by chance and tends to be more representative than any other.

Activity 2 — Getting organised

ABOUT THIS ACTIVITY

This activity involves the organisation and representation of raw data on a frequency table, a bar graph and a pie chart. Students use data similar to that which they collected in the previous activity to answer simple questions and to determine the different central tendencies of the data. The Specific Outcomes and Assessment Criteria addressed are: S01 – AC 1, 2, 5, 7, 8 of Unit Standard 9015.

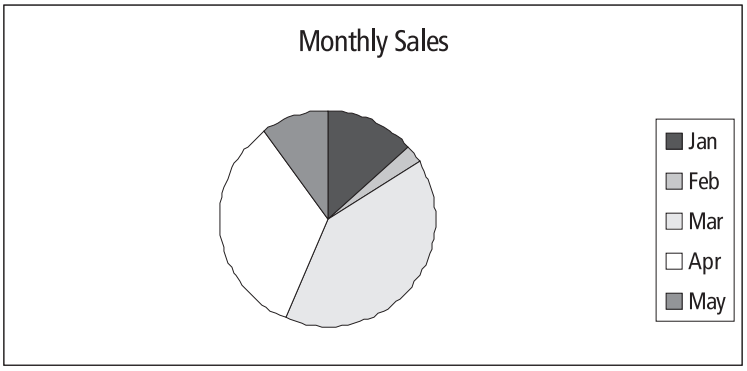
MANAGING THIS ACTIVITY

The lesson should start with a class discussion around what the students already know about organising data. The teacher should ask key questions which would try to draw the following information from the students (many students will be familiar with these ideas):

Raw data is information that has not been counted or organised in any way. A useful method for counting raw data is the tally, where data is counted in groups of 5 using four vertical lines and a slash (IIII). The word frequency means 'how many times' and we draw a frequency table to show how many times an item occurs in the data. Pie graphs and bar charts are commonly used representations of data and can be found in newspapers, magazines and on the internet. Features common to these graphs include labelled axes, scale, key and heading.

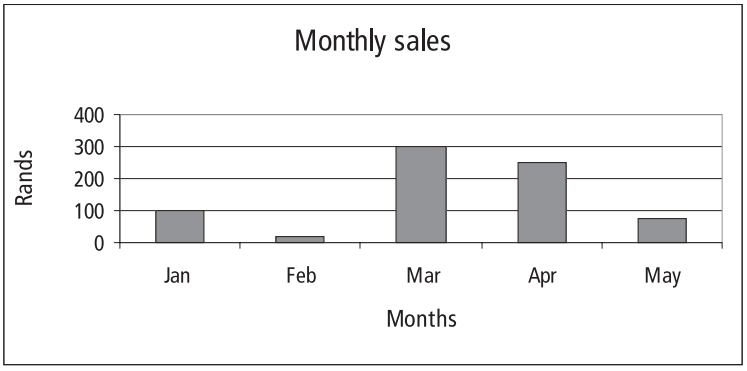
It may be necessary to remind students how to calculate the sizes of the pie 'slices' (the fraction we want, multiplied by 360°, will give the size of the angle). It will not be necessary at this point to measure angles accurately, but students should be familiar with a half-circle, where the angle is half of 360° = 180°, as well as the quarter-circle = 90°, one-third of a circle = 120° and two-thirds of a circle = 240°. Examples of a pie chart and bar graph are shown below:

Example of a pie chart



Notice that the actual figures are not always shown on a pie chart, but the comparison between 'slices' is easily seen. Figures and percentages can sometimes be used, depending on what is being illustrated.

Example of a bar graph:



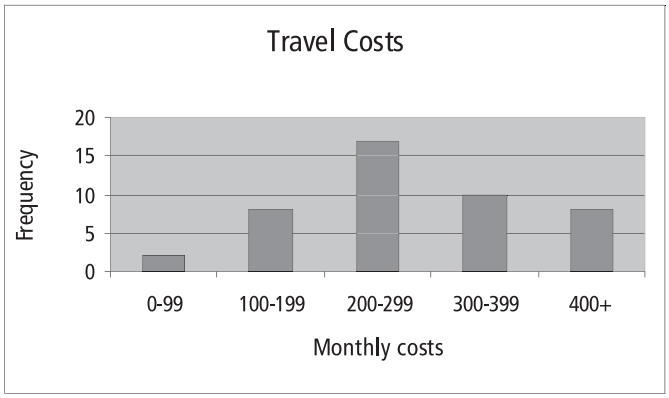
Students should be given the definitions of the different measures of central tendency of the data and should be encouraged to discuss their own examples of when each one may be useful:

- Mean (average) is the sum of all items divided by the number of items. Useful when finding the class average in a test.
- Median is the 'middle' term if the data is arranged in order (ascending or descending). If there is an even number of terms, we calculate the median by taking the average of the two in the middle. Useful when finding the 'middle' of data that has a few very high or very low items that could 'skew' the average.
- Mode is the term that occurs most frequently. Useful for the owner of a shoe store who needs to know what size shoe is the most popular, rather than the average foot size of his/her customers!

At this point students should each be given a copy of *Worksheet 2*.

2.1 The completed table follows:

Monthly cost (Rands)	Tally	Frequency
0 – 99	//	2
100 – 199	~~////~~ ///	8
200 – 299	~~////~~ ~~////~~ ~~////~~ //	17
300 – 399	~~////~~ ~~////~~	10
400 +	~~////~~ ///	8
TOTAL		45



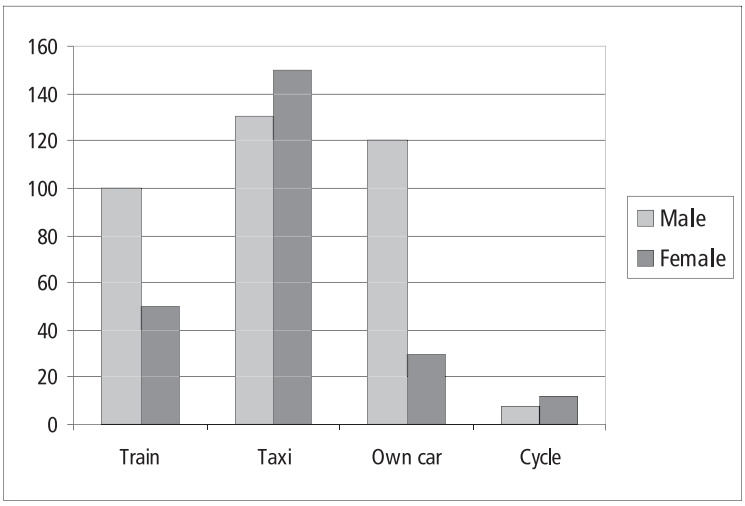
2.2 The completed bar graph is shown above.

2.3 To find the mean monthly cost, add all the costs and divide by 45. This is best done by adding columns first, then finding the total of the columns and dividing the result by 45. The required figures are 12 180 ÷ 45 = R270,67.

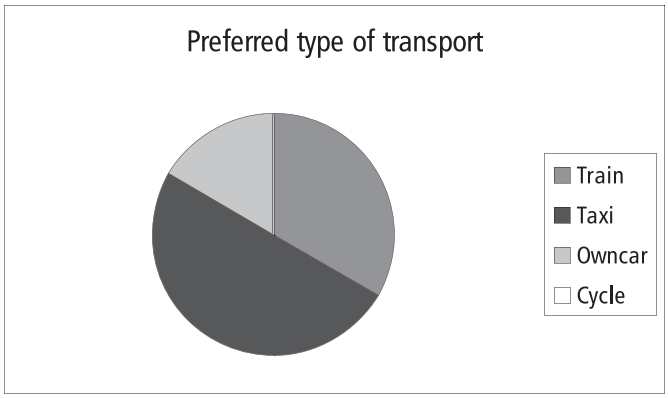
2.4 The modal cost interval in this sample is R200 – R299 because the greatest number of cost items lie in this interval. It has the highest frequency and is the highest bar.

2.5 The range is R520 – R90 = R430.

2.6 The completed bar graph:



2.7 The completed pie graph – taxi (half-circle), train (third of a circle), own car (a sixth).



2.8 Calculate 200 ÷ 600 × 100 = 33.3%.

2.9 Taxis are used by the highest number of people, therefore taxi is the modal type of transport.

2.10 Various answers are expected — cost, distance, safety and time should be mentioned.

Activity 2 — Getting organised

A student collecting data in the previous activity was surprised by the monthly transport costs of her friends and decided to ask 45 people to give a more accurate estimate of what they spent on transport each month. These were the results, in rands, rounded to the nearest ten.

150	200	210	190	320	430	220	90	320
120	270	280	150	310	450	300	100	200
450	100	230	340	210	220	90	390	450
240	310	400	260	230	290	180	240	390
200	370	520	450	200	140	350	400	220

2.1 Complete the following frequency table for the data above:

Monthly cost (Rands)	Tally	Frequency
0 – 99		
100 – 199		
200 – 299		
300 – 399		
400+		
TOTAL		

2.2 Draw a bar graph illustrating this information about 'Travel Costs', labelling the horizontal axis 'Monthly costs' and the vertical axis 'Frequency'.

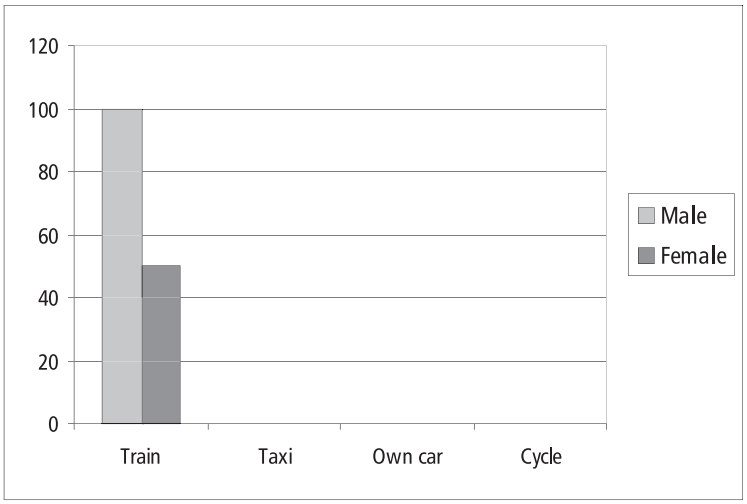
2.3 What is the mean monthly cost of travel in this sample?

2.4 What is the modal cost interval?

2.5 If we define range as the highest item minus the lowest item, what is the range of monthly travel costs?

2.6 Study the completed cumulative table from the previous activity (shown below) and then complete the comparative bar graph. Extend the vertical axis to accommodate all the necessary measurements.

Showing numbers of male/female and type of transport used most often.				
	Train	Taxi	Own car	Cycle / Walk
Male	100	130	120	8
Female	50	150	30	12
TOTALS	150	280	150	20



2.7 Use a pie graph to illustrate the data given in the following table:

Showing total numbers of people and type of transport.				
Train	Taxi	Own car	Cycle / Walk	
200	300	100	0	600

2.8 What percentage of people use the train in 2.7 above?

2.9 What is the modal means of travel in 2.7 above?

2.10 What are some of the issues that determine what type of transport people use?

Activity 3 — Making sense of the figures

ABOUT THIS ACTIVITY

This activity involves reading figures from tables and bar graphs. Students are given three graphs and two tables taken from the Sunday Times / Markinor Top Brands Survey. They analyse the data type and sample size, and read off various simple results. They do calculations and suggest some conclusions that could be drawn from them. The Specific Outcomes and Assessment Criteria addressed are as follows: SO1 – AC 1, 2, 3, 5, 7, 8; SO3 – AC 1, 2, 3 of Unit Standard 9015.

MANAGING THIS ACTIVITY

No further information is needed for students to start this activity. However, the extract from the newspaper could be difficult to understand and it may be a good idea to give students a copy of Handout 3 immediately and read it together as a class with some teacher input about the context, before tackling the questions. Explain that a business-to-consumer survey means that consumers (ie. customers) answer questions about businesses, whereas a business-to-business survey means that businesses answer questions about other businesses. 'Down-weighting' means that scores are reduced by a percentage. 'Top-of-mind awareness' means that the consumer may have a certain business at the top of his/her mind because of advertising or promotions. Ask the class to what extent they think that advertising is successful in gaining top-of-mind customer awareness and to what extent this affects their choices.

Now give students a copy of Worksheet 3.

3.1 The research was conducted by the Sunday Times and Markinor.

3.2 Interviews were used to collect the data in metropolitan as well as rural areas. The type of research is a survey, so we assume the questions were closed-ended and respondents indicated their chosen brands in various categories.

3.3 The two modules are: business-to-consumer and business-to business.

3.4 In the business-to-consumer module, the sample size was 3 500 (2 000 in the metropolitan areas and 1 500 in the rural areas). In the business-to-business module the sample was 400 (executives in South Africa's business community).

3.5 The business-to-consumer sample is not representative of a whole population as no-one under 16 years was interviewed (perhaps they would not be considered independent consumers anyway) and only those living in residential homes were interviewed. However, the sample did comprise all races and all geographical areas, both urban and rural. 3 500 gives us greater confidence in the representativeness of the study than 35 could, but it is not and cannot be 100%.

3.6 The business-to-business module involved only business executives from companies with a staff base of 100 or more, so this module does not represent a whole population. It does, however, provide opinions of top executives from large companies in South Africa. Mention to students that of course not all surveys are interested in representing the whole population and many intend to sample only a defined section of the population.

3.7 Short term loyalty means that customers buy a different brand this time only, usually because there is a good price or an advert caught their eye and they decided to try a new brand, but they go back to their usual brand next time.

3.8 Eskom — read from the bar graph titled 'Most admired South African brand'.

3.9 2,9% of the total 3 500, which is 102 mentions. ($2{,}9 \div 100 \times 3500 = 102$).

3.10 Vodacom gets 2% of the mentions, read from the bar graph. This is 70 mentions ($2 \div 100 \times 3500 = 70$).

3.11 Coca-Cola (read from the graph). It also has by far the longest 'bar'.

3.12 Sprite, read from the graph or the table.

3.13 Liquifruit is the only pure fruit juice in the top ten, which is interesting, and it may be valuable to other pure fruit juice manufacturers to do further research on why this is so. One cannot assume that it is only to do with lack of health consciousness – other facts need to be considered eg. price, advertising, awareness, availability, etc.

3.14 Oros is the only concentrate.

3.15 Liquifruit has the greatest difference of 82,8 – 10,0 = 72,8.

3.16 To find this mean percentage: add all items in the column '% brand relationship scores' in the table and divide by the number of stores: 150,8 ÷ 10 = 15%.

3.17 To find the median, add the middle two scores and halve: (87,8 + 77,5) ÷ 2 = 82,7.

3.18 The range is 84,8 – 78,5 = 6,3. Hyperama is the furthest away from the median, but only by 4,2. We can conclude that there is a very high level of trust in all the stores with little variation from the middle.

3.19 Woolworths scored low in weighted awareness. Possibly Woolworths does less advertising, has less special offers or has fewer food outlets with easy access.

3.20 Pick 'n Pay; Spar; Shoprite — read off the graph or the table.

Activity 3 — Making sense of the figures

Study the data given on Handout 3 and then answer the following questions:

3.1 Who conducted the research that generated this data?

3.2 What type of data collection method was used?

3.3 What are the two modules that are being considered in this survey?

3.4 What is the sample size in each of the modules?

3.5 Is the business-to-consumer module representative of the whole population? Explain your answer.

3.6 Is the business-to-business module representative of the whole population? Explain.

3.7 What do we mean by short term loyalty and how is it achieved?

ALL THE RESULTS GIVEN ARE BUSINESS-TO-CONSUMER

3.8 What is the most admired South African brand?

3.9 If Telkom has 2,9% of the total mentions, how many actual mentions did Telkom get?

3.10 What percentage of mentions did Vodacom get? How many actual mentions does this represent?

3.11 What soft drink has the highest % brand relationship score?

3.12 Which soft drink has a brand relationship score of 19%?

3.13 Only one of the top ten soft drinks is pure fruit juice – can we draw any conclusions about the health consciousness of South Africans?

3.14 Only one of the top ten is a concentrate – which one?

Study the tables of figures to answer the next questions:

3.15 Which soft drink shows the greatest difference between weighted awareness and weighted trust?

3.16 Calculate the mean % brand relationship score of the top ten grocery stores.

3.17 What is the median weighted trust score of the top ten grocery stores?

3.18 What is the range of these weighted trust scores? Which store is furthest from the median weighted trust score? Could we draw any conclusion from this?

3.19 In which weighted score did Woolworths score low? Can you suggest why?

3.20 Which three stores show the highest % brand relationship score?

Data Sheet

The data given on this sheet is a short extract adapted from the Markinor/Sunday Times Top Brands survey of 2004 as reported in the Sunday Times Business Times, 19 September 2004.

How the survey works

A business-to-business module has been added to the business-to-consumer survey conducted by Sunday Times and Markinor. The module comprises research conducted among 400 top executives in South Africa's business community.

The outcomes of this module of the survey provide businesses, investors and the public with a brand health measurement, based on the opinions of South Africa's top management.

The business-to-consumer module's universe comprised all adults 16 years and older, living in residential homes in South Africa. The survey thus comprised all races and all geographic areas – urban as well as rural.

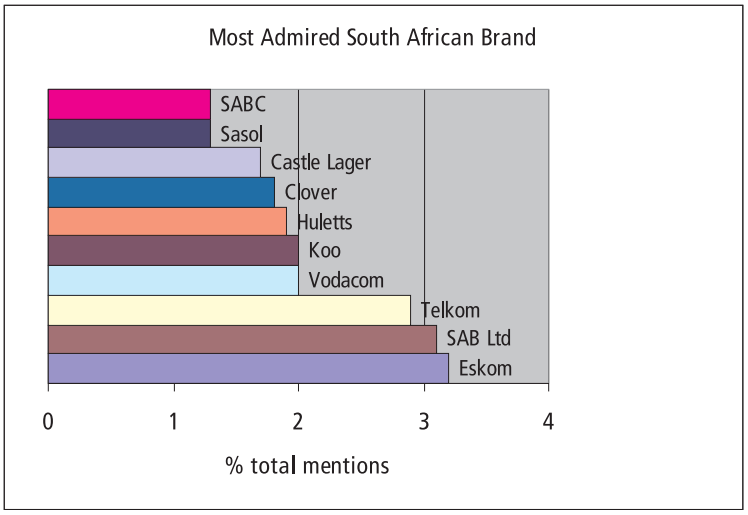
A total of 3 500 interviews were conducted: 2 000 interviews were conducted in metropolitan areas and 1 500 were conducted in rural areas.

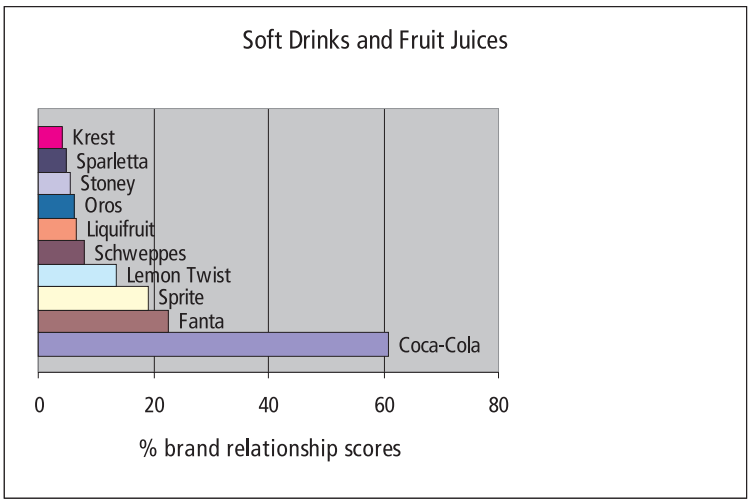
The sample for the business-to-business model was extracted from companies with a staff base of 100 or more.

The brand relationship score is based on a measure of customer loyalty to the brand. Some brands achieve short-term behavioural loyalty through discounting or promotions. For this reason the brand relationship score is expressed as a percentage.

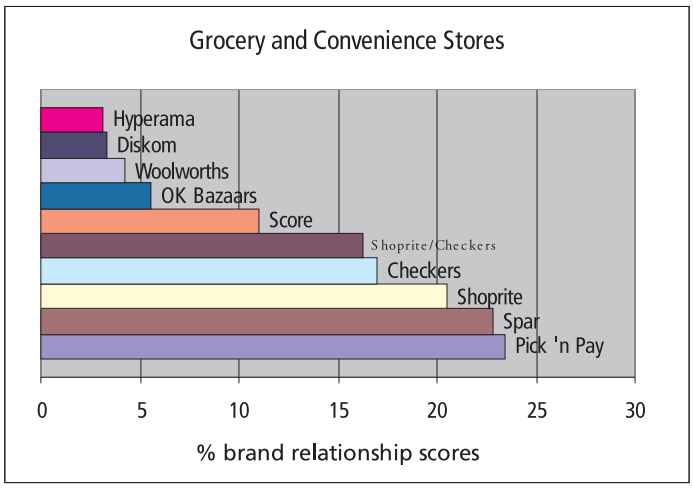
This score is down-weighted by the extent to which the trust and confidence score falls short of the maximum. This down-weighted score is further reduced by shortfalls in the brand's top-of-mind awareness.

The result is a brand relationship score based on customers' behavioural commitment to the brand, taking into account weaknesses in 'liking' and top-of-mind awareness.





Soft drinks	% brand relationship scores	Overall ranking %		
		Weighted awareness	Weighted trust/ confidence	Brand loyalty
Coca-Cola	60.7	79.1	90.5	84.9
Fanta	22.5	36.1	80.1	77.9
Sprite	19.0	30.7	79.9	77.4
Lemon Twist	13.4	22.9	77.4	75.8
Schweppes	8.0	13.2	78.7	76.6
Liquifruit	6.5	10.0	82.8	78.9
Oros	6.2	10.6	75.9	76.4
Stoney Ginger Beer	5.5	9.8	73.7	75.5
Sparletta	5.0	8.3	78.3	77.2
Krest	4.0	7.1	73.6	77.2



Grocery store	% brand relationship scores	Overall ranking %		
		Weighted awareness	Weighted trust/ confidence	Brand loyalty
Pick 'n Pay	23.4	35.5	84.8	77.5
Spar	22.8	35.8	81.3	78.3
Shoprite	20.5	27.6	88.2	84.3
Checkers	17.0	26.7	82.7	76.8
Shoprite/Checkers	16.3	22.0	87.8	84.4
Score	11.0	17.7	77.5	79.7
OK Bazaars	5.6	10.8	74.4	69.6
Woolworths	4.2	6.0	85.8	81.5
Diskom	3.3	5.9	75.6	73.4
Hyperama	3.1	5.8	78.5	68.9

Activity 4 — Analysing patterns

ABOUT THIS ACTIVITY

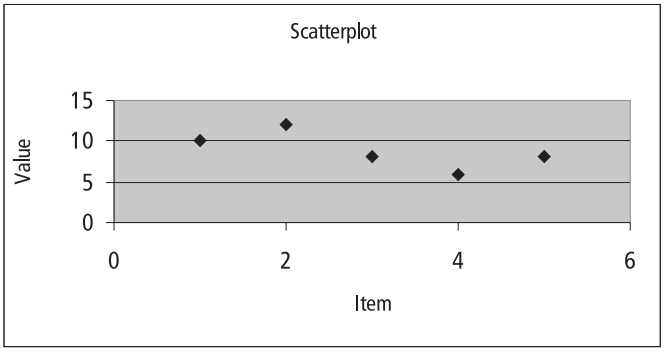
In this activity students work with patterns and distribution of data. They extend the idea of measuring 'the centre' to measuring variance from the mean and understanding the significance of the 'spread' of the data. They identify data items that seem 'not to fit the pattern' (outliers) and analyse the effect these have on the mean. They draw scatterplots to illustrate various distributions using additional data taken from the Sunday Times /Markinor Top Brands Survey. The Specific Outcomes and Assessment Criteria of Unit Standard 9015 addressed are: SO1 – AC1, 7, 8, 9; SO3 – AC1, 3, 4.

MANAGING THIS ACTIVITY

Explain to students that the various measures of central tendency (mean, median, mode) only give limited information about a set of data. If we want to analyse further, we need to know more about how the data is distributed. For example, are all the data items clustered around the 'middle' or are they are widely spread? The mean, median and mode cannot give us this information. For example:

- The numbers 1; 2; 98; 99 have a mean of 50 ([1 + 2 + 98 + 99] ÷ 4 = 50).
- The numbers 49; 50; 50; 51 also have a mean of 50 ([49 + 50 + 50 + 51] ÷ 4 = 50).

The means are the same, yet there is obviously a large difference in the range and spread of the two sets of numbers. By spread we mean distance from the mean. If the data is clustered around the mean, we say the spread is small, while if it is far from the mean, we say the spread is large. The statistical term variance is the numerical measure of the spread. Remind students that a scatterplot graph (example shown below) is a set of points where each dot represents one item of the data. A scatterplot gives a useful visual representation of distribution.



4.1 To calculate the mean, add all the numbers in the first column, titled 'weighted awareness value', and divide by the number of businesses, that is, five:
(84,2 + 79,8 + 3,4 + 2,4 + 1,5) ÷ 5 = 34,26.

4.2 Add the values in the second column and divide by 5 : 171,3 ÷ 5 = 34,26.

4.3 Add the values in the third column and divide by 5 : 171,3 ÷ 5 = 34,26.

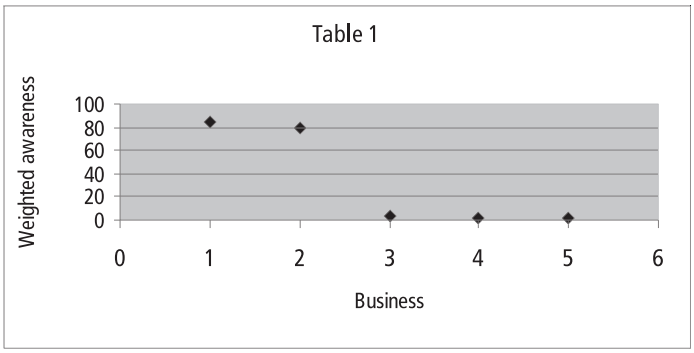
4.4 The means are exactly the same in each of the three sets of data, but the distribution is very different. In 'weighted awareness' there are two high figures and three very low figures. In 'weighted trust/confidence' there are four figures that are almost equal and one that is an odd one out. In 'brand loyalty' all five are clustered around the mean. Take this opportunity to mention to students that the 'odd one out' is called an outlier. Outliers can be the result of measurement errors or significant exceptions that need to be explained, depending on the context.

4.5 The mean of the weighted trust/confidences value of businesses 2, 3, 4 and 5 is 22,3. So business 1 raises the mean by 11,96. [ie. 34,26 – 22,3 = 11,96]

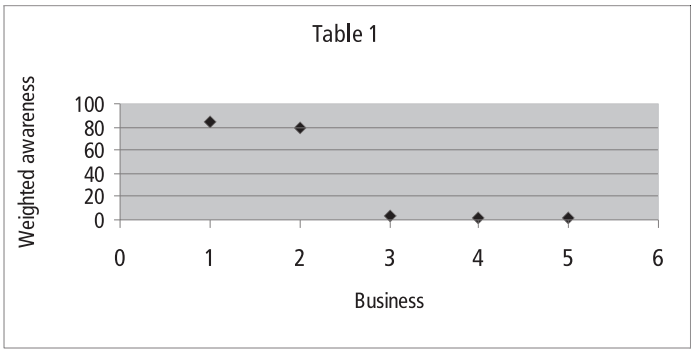
4.6 The range of 'weighted awareness' scores is the highest score minus the lowest score, that is 84,2 – 1,5 = 82,7. The range of 'weighted trust/confidence' scores is 82 – 22 = 60 and the 'brand loyalty' range is 34,2 – 32,5 = 1,7. The range of brand loyalty is very small, the range of weighted awareness is very large while the range of the weighted trust/confidence is fairly large.

4.7 In weighted awareness: 84,2 is furthest from the mean by 84,2 – 34,26 = 49,94.
In weighted trust/confidence: 82 is furthest from the mean by 82 – 34,26 = 47,74.
In brand loyalty: 32,5 is furthest from the mean by 34,26 – 32,5 = 1,76.

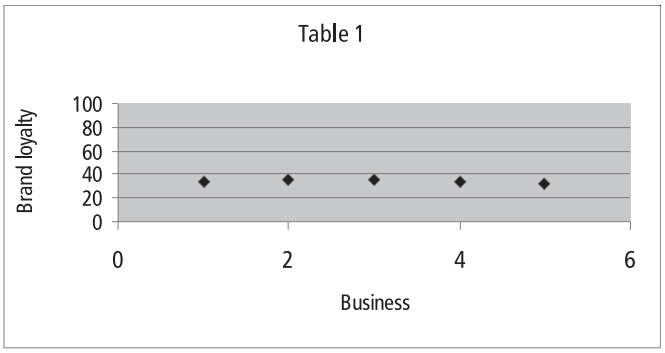
4.8



Weighted awareness scores are spread far from the mean.



Weighted trust/confidence scores are all clustered around 22 except the outlier, that is 82, which is much higher than the others and seems to be the odd one out.



Brand loyalty scores are all clustered around the mean, so the spread is small.

4.9 A variety of answers would be expected here and it would be a good opportunity for some class discussion. South African Airways has by far the highest brand relationship score at 42,9% which is more than three times higher than the second score. All the other airlines score below 13,5% and only two airlines score above the mean (average) which is 10,3%. There is a large range of scores – from 42,9% down to 0,2%. SAA has the highest weighted awareness score and a high weighted trust/confidence score, although BA Comair/British Airlines has the highest trust/confidence score. The highest loyalty score is SAA again, with SA Express Airlines a close second.

4.10 No. Kulula.com has the second highest weighted trust/confidence score of 83.3% and yet a far below average % brand relationship score of 0,3%. Students may find other suitable examples here.

4.11 A possible reason could be the low weighted awareness score. Customers could show trust and loyalty to Kulula.com, but there may be only a few customers who are aware of what they offer.

4.12 No again. Kulula.com has the highest brand loyalty score and yet a low % brand relationship score. There are many other possible examples here.

4.13 Weighted awareness seems to be a very significant factor. All tables support this, as no top % brand relationship score has a low weighted awareness score.

4.14 Increase awareness, perhaps by advertising or promotions.

Activity 4 — Analysing patterns

The following questions refer to the tables of data given in Handout 4:
Refer to Table 1:

4.1 Calculate the mean of the weighted awareness values for all the given businesses.

4.2 Calculate the mean of the weighted trust/confidence values.

4.3 Calculate the mean of the brand loyalty values.

4.4 Describe in words what is the same and what is different about these three sets of data.

4.5 Calculate the mean weighted trust/confidence value for businesses 2, 3, 4 and 5 only. What effect does business 1 have on the mean?

4.6 Calculate the range of each of the sets of data above and describe in words what you observe.

4.7 Which value is furthest from the mean in each of the three cases? By how much?

4.8 Draw three scatterplots showing these three sets of data and describe the spread in each case.

4.9 Write a paragraph analysing the % brand relationship scores of the top ten domestic airlines given in Table 2. You should mention the top scores, the range and spread of scores, how many scores were above average and any other observations about trust, loyalty etc.

4.10 Refer to Table 3. Does high trust and confidence in a car hire company guarantee a high % brand relationship score? Give an example to support your answer.

4.11 Why do you think this is the case?

4.12 Does a high brand loyalty score guarantee a high % brand relationship score? Give an example to support your answer.

4.13 What do you think the greatest factor affecting % brand relationship seems to be? Do all the relevant tables, including those on Handout 3, support this answer?

4.14 What advice would you give to companies who wish to improve their % brand relationship scores.

DATA SHEET

Table 1 is fictional data for illustrative purposes. Table 2 and Table 3 are another two short extracts from the Sunday Times /Markinor Top Brands Survey (19 September 2004). This time the data is taken from the business-to-business module.

Table 1

	Overall ranking %		
	Weighted awareness	Weighted trust/ confidence	Brand loyalty
Business 1	84,2	82	34,2
Business 2	79,8	23	36
Business 3	3,4	22,3	35,2
Business 4	2,4	22	33,4
Business 5	1,5	22	32,5

Table 2

DOMESTIC AIRLINES (BUSINESS TO BUSINESS)				
	Overall ranking %			
	% brand relationship score	Weighted awareness	Weighted trust / confidence	Brand loyalty
South African Airways	42,9	84,8	79,3	63,8
BA Comair / British Airways	13,1	33,8	82,3	47,3
Kulula.com	7,8	32,3	61,1	39,5
National Ailrlines/ Sabena/Nationwide	3,8	13,1	69,5	41,9
South African Air Link	3,1	6,6	77,2	60,2
SA Express Airlines	1,4	2,9	74,4	62,5
Sun Air	0,2	1,9	51,3	22,9

Table 3

CAR HIRE (BUSINESS TO BUSINESS)				
	Overall ranking %			
	% brand relationship score	Weighted awareness	Weighted trust / confidence	Brand loyalty
Avis Rent a Car	34,2	78,2	84,8	51,7
Imperial Car Hire	11,8	25,4	82,5	56,1
Budget Rent a Car	11,7	31,9	78,9	45,9
Hertz Rent a Car	4,7	15,6	76,2	39,1
Tempest Car Hire	1,5	4,8	76,4	40
Europcar Rental	0,6	1,7	84,6	40
Rennies Car Hire	0,5	1.9	71,4	33.3
Kulula.com	0,3	0,5	83,3	66.7
CABS Car Hire	0,1	0,2	66,7	50

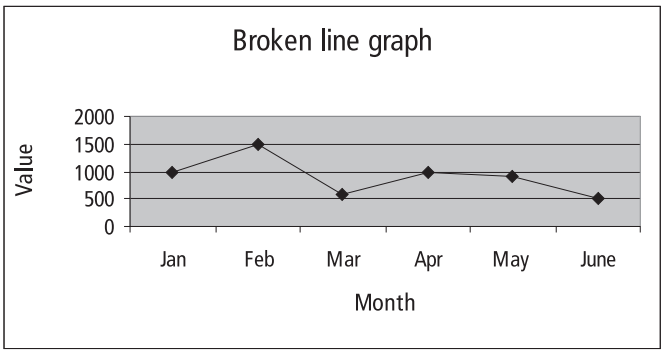
Activity 5 — From the motor industry

ABOUT THIS ACTIVITY

In this activity students read and interpret tables. The context is sales, manufacturing and productivity in the motor industry. They calculate percentage increase, productivity ratio and labour index in simplified examples. They represent the information from tables on a bar graph and a broken line graph. The Specific Outcomes and Assessment Criteria addressed are as follows: SO1 - AC1, 7, 8; SO3 - AC1, 2, 3, 4.

MANAGING THIS ACTIVITY

Little preparation and management is needed for this activity. Students have worked with many of the ideas in previous activities, so this is well suited to an assessment task. Make sure students know the meaning of input (what goes into production - labour, materials etc), and output (the finished product - cars in this case). A base year is simply a chosen year from which other measurements are taken and against which comparisons are made. Remind students that a broken line graph consists of points that are joined by consecutive straight lines. For example:



Students should each receive a copy of Handout 5 and Worksheet 5.

5.1 A variety of answers would be expected. For example, air pollution from the use of fuel, chemical waste from manufacturing processes, noise pollution (engines, hooters, alarms), vehicles on highways, etc.

5.2 Again a variety of answers would be expected. Job creation has a major effect on development in a society — food on the table, leisure time etc.

5.3 Add the figures in the sales column under BMW to reach 2 011 new vehicles sold in September by BMW.

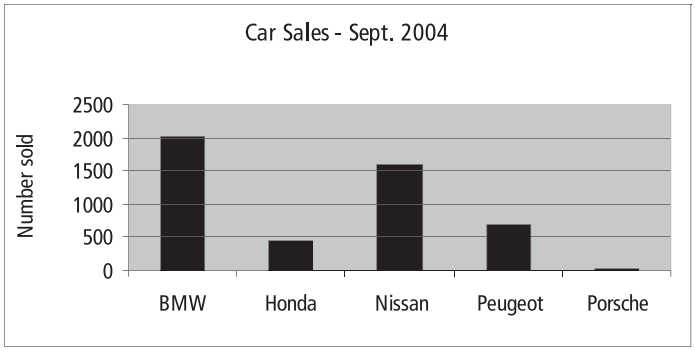
5.4 The Jazz. Read your answer by looking for the highest figure in the Honda sales column.

5.5 There were 853 Almeras sold out of a possible 1 602 Nissans, which is 53,2% (853 ÷ 1 602 = 53,2%).

5.6 Porsche only sold 3 of the model 911's, which is the smallest sale in September. This is probably because it is a very expensive car, afforded by few.

5.7 To find the average Peugeot sales per model, add all the Peugeot sales and divide by the number of models: 695 ÷ 7 = 99,2.

5.8



5.9 Manufacturer 2: (2 390 ÷ 22 123) × 100 = 10,8%.

Manufacturer 3: (960 ÷ 22 234) × 100 = 4,3%.

Manufacturer 5: (1 800 ÷ 49 000) × 100 = 3,7%.

5.10 A high productivity ratio is better. This means that more cars are produced in the given time, so efficiency is better.

5.11 No. Manufacturer 1 put in the longest hours (57 800), but manufacturer 2 produced the most cars (2 390). In fact, manufacturer 2 worked less than half the time and produced more than twice the number of cars as Manufacturer 1.

5.12 Manufacturer 2. Their productivity is very high so they are working very efficiently. Also, workers are not working very long hours so morale is probably good too.

5.13 Calculations are as follows:
For 1996, the labour index % is (81 858 ÷ 77 155) × 100 = 106,1%.

For 1997, the labour index % is (76 252 ÷ 77 155) × 100 = 98,8%.

For 1999, the labour index % is (76 300 ÷ 77 155) × 100 = 98,9%.

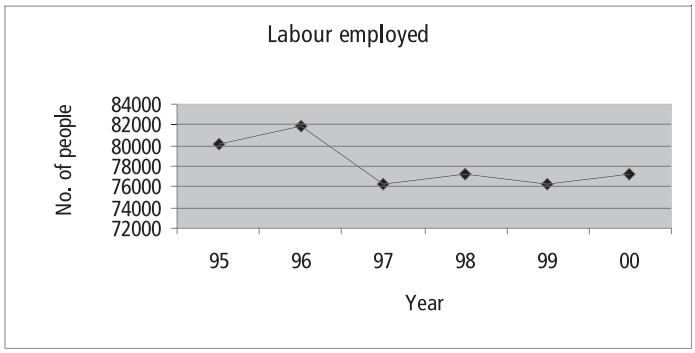
For 2000, the labour index % is (77 248 ÷ 77 155) ×100 = 100,1%.

5.14 No, the numbers decreased. The labour index also decreased from 100% to 98,9%.

5.15 The percentage increase in workers between 1999 and 2000 is:

$$\frac{77\,248 - 76\,300}{76\,300} \times 100 = 1{,}2\%$$

5.16



Activity 5 — From the motor industry

The following questions refer to the data given in Handout 5.

5.1 In what way do you think the motor industry affects the environment?

5.2 In what way do you think this industry has a social effect?

REFER TO TABLE 1

5.3 How many new passenger vehicles were sold by BMW in September 2004?

5.4 Which model of Honda sold the most in September?

5.5 What percentage of Nissan passenger vehicles sold in September were Almeras?

5.6 In the given data, which make and model showed the lowest sales in September? Suggest a reason for this.

5.7 What was the average number of cars sold per model by Peugeot in September?

5.8 Draw a bar graph comparing the monthly totals of passenger vehicles sold by BMW, Honda, Nissan, Peugeot and Porsche in September 2004.

REFER TO TABLE 2

5.9 Fill in the missing spaces in the labour productivity column, given that:

$$Productivity = \frac{output}{input}$$

5.10 Is it better for a manufacturer to have a high or a low productivity ratio? Explain your answer.

5.11 From the given data would it be true to say that the manufacturer that put in the longest hours produced the most cars? Use figures from the table to support your answer.

5.12 Which manufacturer has the best chance of doing well in business? Give a reason.

REFER TO TABLE 3

5.13 Fill in the missing spaces in the Labour Index % column given that 1998 is the base year which serves as 100% and that:

$$Labour\ Index = \frac{Quantity\ of\ labour\ in\ a\ particular\ year}{Quantity\ of\ labour\ in\ the\ base\ year} \times \frac{100}{1}$$

5.14 Is it true to say that the number of workers increased between 1998 and 1999? What happened to the labour index between 1998 and 1999?

5.15 What is the percentage increase in number of workers between 1999 and 2000?

5.16 Draw a broken line graph showing the changes in labour employed between 1995 and 2000.

Data Sheet

The following tables refer to the motor industry. This is one of the world's largest manufacturing industries and is of great importance economically and politically as well as socially. It has an effect on foreign trade, job creation and on the environment. In the tables below, you are given data concerning sales, manufacturing and productivity:

TABLE 1
New passenger vehicle sales statistics - September 2004 (adapted from *naamsa*)

Manufacturer	Model	Sales	Manufacturer	Model	Sales
BMW group	1 Series	44	Nissan	350Z	23
	3 Series	1 252		Almera	853
	5 Series	210		Micra	466
	6 Series	32		Patrol	10
	7 Series	26		X-Trail	250
	Mini	122	Peugeot	206	326
	X3	123		307	221
	X5	164		406	7
	Z4	38		407	113
Honda	Accord	32		607	4
	Civic	124		807	11
	CR-V	37		Partner	13
	Jazz	236	Porsche	911	3
	S2000	15		Cayenne	10
				Boxster	6

(reference: http://www.rgt.co.za/naamsa)

TABLE 2
Labour productivity of five manufacturers:

Manufacturer	Number of cars produced	Total number of hours worked to produce cars	Labour productivity ratio as a percentage
Manufacturer 1	1 155	57 800	2%
Manufacturer 2	2 390	22 123	?
Manufacturer 3	960	22 234	?
Manufacturer 4	678	33 456	2%
Manufacturer 5	1 800	49 000	?

(adapted MLMMS: CTA 2004)

TABLE 3
Motor industry productivity from 1995-2000:

Year	Labour employed	Labour Index %
1995	80 045	103,7%
1996	81 858	?
1997	76 252	?
1998	77 155	100
1999	76 300	?

Activity 6 — Reading and predicting

ABOUT THIS ACTIVITY

In this activity students read data and make predictions by analysing trend lines. They observe patterns and measure important connections between variables. They identify variance from the mean as well as outliers, suggesting what implications these may have in real life situations. The Specific Outcomes and Assessment Criteria addressed are as follows: SO1 – AC 4, 7, 8, 9; SO3 – AC 2, 3, 4, 5 of Unit Standard 9015.

MANAGING THIS ACTIVITY

This activity requires very little management and is well suited to an assessment task. Students are required to read, measure, calculate and interpret using ideas from the previous activities. Remind students that a trend line, or line-of-best-fit, is a line drawn as close to as many measured data items as possible. It is used to approximate and predict values that have not been measured but that are expected to follow the trend. Explain, also, the idea of a percentile – if an item is in the 60th percentile, it means that 60% of the other items are either equal to or less than this one. Discuss the idea of Body-Mass-Index, which is used as a health indicator. A BMI of between 19 and 22 is considered to be ideal.

To calculate BMI use the following formula:
BMI = Weight (kg) ÷ Stature (cm) ÷ Stature (cm) × 10 000

Students should each receive copies of Handout 6 and Worksheet 6.

6.1 Expected height measured against age.

6.2 If your height is in the 90th percentile, it means that 90% of all people are 'on' or below your height. Only 10% of people are therefore taller than you.

6.3 One set shows age against weight, the other shows age against height (stature). The scale shows both cm and inches, as well as both kg and lb (pounds). All calculations here will use cm and kg only.

6.4 173 – 152 = 21. Read this on the age 16 line from the top to the bottom trend line.

6.5 Yes. She is in the 95th percentile, so only 5% of girls are taller than she is.

6.6 No, she would be underweight. She should weigh between 24 and 47kg.

6.7 About 31kg – read off the 5th percentile line because her height is in the 5th percentile.

6.8 Weight – 33kg; height -138cm. Read off the 50th percentile line to find the average.

6.9 90cm – read off the 90th percentile line for age 2.

6.10 Body-Mass-Index – this is a measure used by health professionals to make medical decisions and recommendations. BMI = 70 ÷ 165 ÷ 165 x 10 000 = 25,7. Ideal BMI is considered to be 19 – 22, so this is higher than ideal. Of course, this remains an indicator only and variation is expected.

6.11 About 69kg – split the difference in the trend lines.

6.12 At 17 she would be about 58kg and at 18 about 59kg — draw your own trend line three steps higher than the 50th percentile to read these figures.

Activity 6 — Reading and predicting

Refer to the data sheet (Handout 6) — 2 to 20 years: Girls Stature-for-age and Weight-for-age percentiles

This interesting graph shows trend lines for the normal expected growth of girls between 2 and 20 years. The lowest trend line is the normal growth pattern expected for short or small girls and the highest line is for the tall, large girls. Most girls are expected to fall somewhere between these two, with some variation. A problem could be indicated when there is a sudden sharp drop or rise which is not the expected trend.

6.1 What does stature-for-age mean?

6.2 What does it mean to say that your height is in the 90th percentile?

6.3 here are two sets of graphs shown here. What is the difference between them?

6.4 The sets of parallel lines show the trends for the different percentiles of girls' height and weight measured over a large sample. In this data, what is the range of heights for a girl of 16?

6.5 If a young woman of 18 is 174 cm tall, is she tall for her age? In what percentile is her height?

6.6 If a girl of 10 weighs 20kg, would she be of average weight? Explain.

6.7 If a girl of 12 was 140cm tall, what would you expect her weight to be according to this data?

6.8 According to this data, what is the mean height and weight for a girl of 10?

6.9 A two-year-old is tall for her age and her height is in the 90th percentile. How tall is she?

6.10 What is BMI? Using the formula given in the table in the top left of the graph, and repeated below, calculate the BMI of a young woman of 20 who is 165 cm tall and weighs 70kg.

BMI = Weight (kg) ÷ stature (cm) ÷ stature (cm) × 10 000.

6.11 What do you think the weight of the same young woman of 20 was when she was 19?

6.12 If a girl of 14 weighs 60kg, predict her weight at 17 and 18 years if she follows the trends shown on this graph.

2 to 20 years: Girls
Stature-for-age and Weight-for-age percentiles

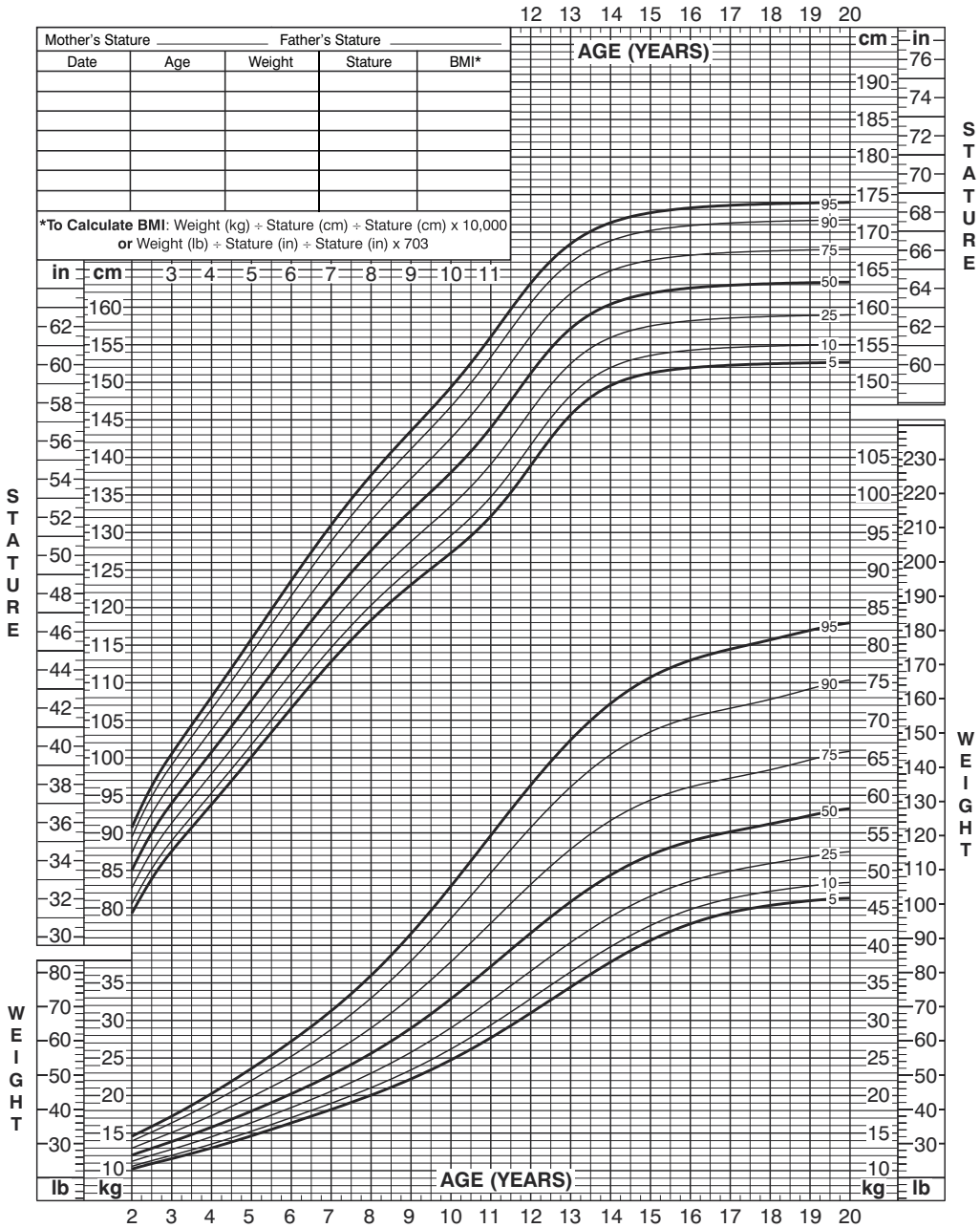
NAME _____

RECORD # _____

Mother's Stature _____ Father's Stature _____

Date	Age	Weight	Stature	BMI*

***To Calculate BMI**: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703



Published May 30, 2000 (modified 11/21/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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Activity 7 — Interpreting tables

ABOUT THIS ACTIVITY

This activity involves the reading and interpretation of information from tables. Students are given a table showing the amounts allocated to various provinces by the National Skills Fund for the training of unemployed people in South Africa. They are also given a table showing the numbers of people trained per programme and are required to cross-reference these tables, make calculations, interpret the relationship between the rows and columns and draw various conclusions. The Specific Outcomes and Assessment Criteria addressed are as follows: SO1 - AC1, 7, 8; S03 - AC1, 2, 3, 4 of Unit Standard 9015.

MANAGING THIS ACTIVITY

This activity requires little management as all the statistical terms and ideas have been discussed previously. One could introduce the activity by locating development in its social context and initiating a discussion around the great need for skills development to alleviate the unemployment problem in South Africa. Students are working with large numbers, so they need to be careful with their calculator work. Each student should be given a copy of Handout 7 and Worksheet 7.

7.1 The Eastern Cape received by far the highest funding allocation — more than double the next highest. It received an amount of two hundred and three million, and thirty seven thousand rand.

7.2 To find the mean funding per province, read the TOTAL of the total funding column and divide by the number of provinces: R689 614 000 ÷ 10 = R68 961 400.

7.3 Provincial development projects received the largest total allocation of R596 436 000, which is 596 436 000 ÷ 689 614 000 × 100 = 86,5% of the whole.

7.4 Gauteng South spent the most on people with disabilities. Read the largest figure in the 'people with disabilities' column.

7.5 The Free State spent an amount of R1 783 000 on its retrenchees programme out of a total of R43 090 000, which is 1 783 000 ÷ 43 090 000 × 100 = 4%.

7.6 The Netherlands youth project is located in Mpumalanga (read across the row).

7.7 The Western Cape trained a total of 26 697 people (read from the second table) and a total of R40 603 000 was spent by the Western Cape (read from the first table). This translates into an amount of R40 603 000 ÷ 26 697 = R1 521 per person.

7.8 The national average is found by dividing the total spent nationally by the number trained nationally, that is R689 614 000 ÷ 380 101 = R1 814. Therefore the amount spent per person by the Western Cape was less than the national average by about R300.

7.9 The amount spent per person in the Netherlands project was R1 015 000 ÷ 687 = R1477. The amount spent per person in the youth development programme in North West was R927 000 ÷ 820 = R1 130. Therefore, yes, the amounts were approximately the same, although the Netherlands project was about R350 more expensive.

7.10 Limpopo spent a total of R2 484 000 training 1 280 prisoners, so it cost them R2 484 000 ÷ 1 280 = R1 941 to train one prisoner.

7.11 The Eastern Cape spent R 13 630 000 ÷ R203 037 000 × 100 = 6,7% of its funds on its disaster relief programme. KwaZulu Natal spent R434 000 ÷ R77 242 000 = 0,6% of its funds on the disaster relief programme. So the Eastern Cape spent a much larger percentage of its total on this programme, as well as a much larger actual amount.

7.12 In Gauteng South only one youth was trained at a cost of R1 146 000.

7.13 The cost of training one youth in North West was R1 130, in the Netherlands project it was R1 477 (and the national training average was R1 814). There is thus a huge discrepancy in Gauteng South where it cost over a million to train one youth. This figure clearly needs to be questioned — there could simply be an error with the figure given, or there could be a problem with the programme concerned, or the type of training received by this youth could have been of an entirely different order to the norm.

7.14 R 179 201 000 was the biggest amount spent on a single programme (the Eastern Cape provincial development project).

7.15 A variety of suggestions would be expected here. Some points that could be made are that only three provinces allocated funds to youth development programmes, only two provinces to disaster relief programmes and only three to retrenchees programmes. Further research would be necessary to establish whether one would be justified in saying that there is a need for redistributing funds in the other provinces for development in these areas. There could well be programmes that are operating independently.

Activity 7 — Interpreting tables

The following questions are based on the data found on Handout 7.

7.1 Which province received the highest funding allocation from the National Skills Fund and how much was it (write the number in words)?

7.2 What was the mean funding allocation to each province? Consider Gauteng (S) and Gauteng (N) to be separate provinces.

7.3 Which of the programmes received the largest total allocation and what percentage of the whole was this?

7.4 Which province spent the most on people with disabilities?

7.5 What percentage of its total allocation did the Free State spend on its social plan for retrenchees?

7.6 In which province was the Netherlands youth programme located?

7.7 How many people were trained in the Western Cape and what was the average amount spent per person?

7.8 Was this amount spent per person in the Western Cape more or less than the national average?

7.9 Was the amount spent per person in the Netherlands youth programme approximately the same as the amount spent per person in the youth development programme in North West?

7.10 How much did it cost Limpopo province to train one prisoner and what percentage of their funds did they allocate to the training of prisoners?

7.11 Compare the percentages allocated to disaster relief by the Eastern Cape and KwaZulu Natal.

7.12 How much was spent on each youth trained in the Gauteng South youth development programme?

7.13 Compare the answers found in questions 7.9 and 7.12. How do you interpret the similarities and/or differences?

7.14 What was the biggest amount spent on a single programme by any province?

7.15 If you could redistribute the funds, are there any major changes you would make or any programmes you feel have been inadequately financed? Explain your answer.

DATA SHEET

The following information is from the Mail and Guardian, and is taken from a wall chart published by Independent Newspapers and the Department of Labour in response to the '10 years of Freedom' campaign in South Africa (2004). As part of the delivery of skills to its citizens, the government has allocated funds from the National Skills Fund specifically for the training of unemployed people as follows:

NATIONAL SKILLS FUND (Social Development Funding Window)
Funds spent on training of unemployed people per programme per province (2000-2004)

Province	Total funding	Funding per programme (Rands)				
		Provincial	SDI and IDZ projects	Social plan: retrenchees	People with disabilities	Training of prisoners
W. Cape	40 603 000	33 413 000	0	0	205 000	4 847 000
E. Cape	203 037 000	179 201 000	5 602 000	0	881 000	2 816 000
N. Cape	16 373 000	13 219 000	0	0	570 000	2 184 000
Free State	43 090 000	38 465 000	0	1 783 000	360 000	1 889 000
KZ Natal	77 242 000	67 002 000	34 000	0	2 813 000	2 742 000
N.West	81 905 000	69 832 000	0	963 000	1 768 000	7 803 000
Gauteng (S)	58 695 000	49 738 000	0	388 000	4 366 000	2 523 000
Gauteng (N)	39 686 000	30 703 000	0	0	3 785 000	4 533 000
	69 152 000	62 955 000	0	0	1 752 000	2 245 000
Limpopo	59 831 000	51 908 000	2 931 000	0	1 217 000	2 484 000
TOTALS	689 614 000	596 436 000	8 567 000	3 134 000	17 717 000	34 066 000
	Other minor programmes	Youth	Youth	Service: defence	Disaster relief	Working for water
W. Cape	66 000	0	0	66 000	0	2 072 000
E. Cape	57 000	0	0	57 000	13 630 000	850 000
N.Cape	0	0	0	0	0	400 000
Free State	371 000	0	0	371 000	0	222 000
KZ Natal	14 000	0	0	14 000	434 000	4 203 000
N. West	927 000	927 000	0	0	0	612 000
Gauteng (S)	1 191 000	1 146 000	0	45 000	0	489 000
Gauteng (N)	20 000	0	0	20 000	0	645 000
	1 019 000	0	1 015 000	4 000	0	1 181 000
Limpopo	29 000	0	0	29 000	0	1 262 000
TOTALS	3 694 000	2 073 000	1 015 000	606 000	14 064 000	11 936 000

Unemployed people trained per programme per province (2000 - 2004)

Province	Total trained	Numbers trained per programme				
		Provincial	SDI and IDZ programmes	Social plan: retrenchees	People with disabilities	Training of prisoners
W. Cape	26 697	16 757	0	0	310	5 512
E. Cape	131 169	118 335	4 238	0	636	2 523
N. Cape	9 937	7 835	0	0	431	1 366
Free State	25 140	21 631	0	455	351	2 255
KZ Natal	36 914	27 557	24	0	234	1 533
North West	46 861	39 018	0	375	923	4 273
Gauteng (S)	23 291	19 739	0	123	972	1 478
Gauteng (N)	20 898	16 147	0	0	873	2 828
	24 665	17 895	0	0	695	2 153
Limpopo	34 529	27 277	2 439	0	958	1 280
TOTALS	380 101	312 191	6 701	953	6 383	25 201
	Other minor programmes	Youth	Youth	Service: defence	Disaster relief	Working for water
W. Cape	22	0	0	22	0	4 096
E. Cape	21	0	0	21	2 051	3 365
N. Cape	0	0	0	0	0	305
Free State	200	0	0	200	0	248
KZ Natal	0	0	0	0	69	7 497
North West	820	820	0	0	0	1 452
Gauteng (S)	2	1	0	1	0	977
Gauteng (N)	0	0	0	0	0	1 050
	687	0	687	0	0	3 235
Limpopo	0	0	0	0	0	2 575
TOTALS	1 752	821	687	244	2 120	24 800

Activity 8 — What are my chances?

ABOUT THIS ACTIVITY

This activity introduces the idea of probability. A preliminary handout has been included with background information on some of the common applications and terminology used in this branch of statistics. The students work with single events in the context of the 'Lotto draw', comparing 'counted' results with calculated probability. In this way they work with the mathematical verification of experimental results. The Specific Outcomes and Assessment Criteria addressed are: S02 – AC1, 2, 3, 4; S03 – AC1, 4 of Unit Standard 9015.

MANAGING THIS ACTIVITY

Games of chance, gambling, betting on the horses and the national lottery are possible contexts where students have some experience of probability. A good way to introduce this topic would be for the teacher to generate a discussion around games of chance, drawing from the students some of the common words and expressions relating to probability, for example 'What are the odds?', 'The chances are..'. One could explore the idea that the chance of guessing correctly twice in a row is much less than the chance of guessing correctly once. Probability is not always an easy concept for students to grasp and it would be a good idea to spend plenty of time explaining and exploring the ideas mentioned in Handout 8. Students should then each get a copy of Handout 8 and Worksheet 8.

8.1 There were 600 numbers drawn (100 draws × 6 numbers each) and there were 120 numbers drawn between 30 and 39 (counted from the table of ticks). The fraction of the draw that includes at least one number between 30 and 39 is thus:

$$\frac{120}{600}; \quad \& \quad \frac{120}{600} \times 100 = 20\%$$

8.2 There were 119 numbers drawn from 20 to 29 (found by counting ticks), therefore there were 600 – 119 = 481 numbers not between 20 and 29. The fraction is thus:

$$\frac{481}{600} = 80\%$$

8.3 Count 52 consecutive pairs, therefore percentage is 52 ÷ 600 = 8,7%.

8.4 Count 119 multiples of 5, therefore percentage is 119 ÷ 600 = 20% approximately.

8.5 Count a total of 15 draws of the number 1. The percentage is thus 15 ÷ 600 = 2,5%.

8.6 There are 10 numbers from 30 to 39 and a possible 49 numbers in total from which to select. So the probability of selecting a number between 30 and 39 is 'number of ways to select' ÷ 'total possible equally likely selections':

$$P = \frac{10}{49} = 20{,}4\%$$

8.7 There are 39 numbers that are not between 20 and 29, so the probability that the draw will not include any numbers between 20 and 29 is:

$$P = \frac{39}{49} = 79{,}6\%$$

8.8 There are 9 multiples of five between 1 and 49, so the probability of drawing one is 9 ÷ 49 = 18,4%.

8.9 The probability that the number 1 will be drawn is 1 ÷ 49 = 2,04%.

8.10 From the calculations, we see that the experimental data was not a perfect match with the statistical calculations, but was close in each case:

20% compared to 20,4%;

80% compared to 79,6%;

20% compared to 18,4%;

2,5% compared to 2,04%. We would expect the experimental data to be more accurate the bigger the sample. But we can say that our calculations did verify the experimental results.

8.11 Each number has a 1 in 49 (about 2%) chance of being drawn every week, so in fact no number occurs more frequently than any other. The reason that numbers seem to be 'hot' is because the sample is too small and we are not getting an accurate picture. Think of flipping a coin — it is quite possible to get 4 'heads' and 1 'tail' in 5 throws, but this certainly does not mean that the probability of getting 'heads' is 80%. It simply means that the sample was too small to get an accurate result.

Activity 8 — What are my chances?

The table below shows a selection of 100 Lotto draws arranged in numerical order, without the bonus number. Analyse each draw by filling in the table using ticks in each column. Each tick indicates one number, a blank indicates no number. Then answer the questions that follow:

Numbers drawn						1 to 9	10 to 19	20 to 29	30 to 39	40 to 49	Multiples of 5	Consecutive pairs
3	10	29	30	34	45							
16	21	28	34	45	49							
16	24	26	28	38	48							
7	11	26	34	45	46							
7	22	37	38	44	46							
2	5	11	16	28	33							
15	19	24	30	31	43							
3	9	13	24	32	48							
1	9	21	31	35	46							
4	5	7	16	19	40							
5	10	13	16	26	49							
9	15	31	33	34	42							
2	4	6	32	44	49							
1	7	18	30	44	49							
1	11	29	34	43	44							
6	18	20	31	40	43							
7	16	26	27	39	44							
9	13	14	33	43	45							
5	13	15	23	26	28							
11	20	32	33	46	48							
3	9	16	17	44	45							
6	14	15	36	38	49							
2	10	12	26	30	35							
4	18	21	23	43	48							
11	22	28	37	38	46							
14	24	30	32	41	48							
6	8	28	43	46	49							
2	3	19	27	41	46							
3	8	9	30	35	45							
1	13	26	29	37	45							
13	18	19	37	45	46							
22	29	30	31	34	40							
4	6	7	34	40	46							
6	16	24	33	35	48							
23	26	28	35	44	46							
5	23	30	36	43	46							
3	12	24	28	29	33							
3	8	14	25	26	31							
2	9	15	20	28	45							
11	17	24	35	42	43							
1	7	8	10	30	38							
2	15	16	18	38	40							
16	20	30	36	39	40							

1	4	23	35	39	48							
5	6	12	22	25	44							
4	12	24	35	43	46							
4	7	19	30	47	48							
3	10	14	28	36	44							
6	8	15	21	35	48							
14	16	20	30	37	39							
1	7	17	27	28	38							
2	5	27	44	45	46							
4	18	25	32	40	44							
18	19	21	36	37	45							
23	36	42	45	46	47							
4	11	14	15	33	36							
8	14	21	24	30	33							
2	12	17	23	36	38							
17	24	27	31	34	35							
5	9	23	29	35	45							
1	12	23	30	35	48							
1	4	7	10	35	38							
11	13	15	17	24	25							
10	13	19	30	32	42							
2	9	14	29	30	40							
9	10	28	33	37	40							
1	6	8	27	31	47							
15	19	21	32	42	46							
13	17	30	38	47	49							
6	18	21	31	36	45							
12	15	24	30	39	44							
8	11	20	27	42	46							
6	11	22	28	29	34							
6	10	27	29	35	49							
4	10	14	18	26	34							
2	8	14	34	41	49							
19	20	25	29	35	43							
3	4	5	7	11	14							
1	11	22	26	32	42							
16	23	24	27	28	40							
4	10	26	28	29	45							
16	22	26	35	38	43							
4	5	11	18	31	41							
15	16	31	32	36	41							
7	12	14	27	44	46							
7	22	24	26	33	43							
4	7	11	19	33	39							
15	16	20	28	44	46							
1	4	7	16	37	38							
3	8	19	26	27	34							
25	26	27	29	40	45							
1	4	15	30	46	49							
4	15	25	35	40	48							
3	14	24	26	42	46							

1	2	3	5	20	28							
11	23	34	41	44	45							
9	10	14	17	20	48							
1	2	24	40	43	49							
6	8	13	33	35	38							
5	8	24	39	40	41							
					TOTAL							

These questions involve counting the data that was found by experiment
We refer to these as *experimental probabilities*.

8.1 What fraction of the draws includes at least one number from 30 to 39? What percentage is this?

8.2 What fraction of the draw does not include any numbers from 20 to 29? Express this as a percentage.

8.3 What percentage of the draw includes a pair of consecutive numbers?

8.4 In what percentage of draws is a multiple of 5 drawn?

8.5 In what percentage of draws is the number 1 drawn?

The next four questions involve calculating probability using the probability formula

Notice that we are answering the same questions again in a more formal way.

Use the *probability formula* to calculate each of the following.

8.6 What is the probability that the draw will include at least one number from 30 to 39?

8.7 Calculate the probability that the draw will not include any numbers between 20 and 29.

8.8 Calculate the probability that a multiple of 5 will be drawn.

8.9 Calculate the probability that the number 1 will be drawn.

8.10 Did you find a match between your experimental results and your calculated results? Have you verified your experimental results mathematically?

8.11 When we refer to 'hot' numbers in the lotto draw, we mean that they are numbers that seem to occur more frequently than others. What is the probability of a 3 being drawn? A 24? A 56? How is it then possible that a number is 'hot'?

Probability (background information for students and teachers)

Probability is the study of 'chance'. It estimates answers to questions such as:
- What are the chances that it will rain today?
- What are the odds that 45 will be one of the numbers drawn in the Lotto on Saturday?
- What are the chances that a particular drug will cure a disease?
- How likely is it that an insurance claim will be made on a particular policy?
- How much profit is likely to be made on a particular product?

Probability provides a statistical tool for describing, managing, estimating and planning many important things in society across a variety of sectors. It is a ratio expressing the chance that something will happen. It can be expressed as a fraction, a percentage or an odds ratio. The following four statements all mean exactly the same:
- The odds are 50%.
- There is a 1 in 2 chance.
- The probability is 0,5.
- There are equal chances.

The probability scale is measured from 0 to 1. A zero probability means it is impossible and a probability of 1 means it is 100% certain. A probability of ½ means that there is 50% for and 50% against, in other words equal odds. Probability is defined as:

$$P = \frac{\textit{number of desired outcomes}}{\textit{total number of equally likely outcomes}}$$

When flipping a coin, there is 1 possible outcome out of 2 equally likely outcomes that it will land on heads, so the probability of getting heads is:

$$P = \frac{1}{2} \qquad \textit{or} \qquad 50\%$$

When throwing a six sided die, there is a 1 in 6 chance that it will land on a 4 (die is the singular of dice — one die, a pair of dice). There is thus a 16,7% probability of getting a 4.

Activity 9 — Combined events

ABOUT THIS ACTIVITY

In this activity students move from probabilities involving single events, to probabilities of combined events. They work with the multiplication principle and are introduced to the ideas of dependent, independent and mutually exclusive events. A handout has been included with further information necessary to answer a selection of probability questions. The Specific Outcomes and Assessment Criteria addressed are: SO2 – AC2, 3; S03 – AC1, 4.

MANAGING THIS ACTIVITY

Explain to students that events are often combined. Instead of only considering one probability, we now consider successive probabilities and work with a number of events happening together. Spend time discussing the ideas in Handout 9, getting students to suggest more of their own illustrative examples to try and help understand the differences between dependent, independent and mutually exclusive events. Students should each get a copy of Handout 9 and Worksheet 9.

9.1.1 There are 10 faulty bottles out of 100 possible bottles, so the probability is 10 ÷ 100, or 10%.

9.1.2 There are 9 faulty bottles left out of a possible 99 bottles, so the probability is 9 ÷ 99 or 9,09%.

9.1.3 They are dependent events, because selecting one bottle leaves a different number to select from next time.

9.1.4 Using the multiplication principle:

$$P = (\frac{10}{100})(\frac{9}{99}) = (\frac{1}{110}) \quad or \quad 0{,}91\%$$

9.2.1 From a total of 127 possible people an actual 58 came in, thus the likelihood that someone who walks past will come in is: 58 ÷ 127 = 45,7%.

9.2.2 From a total of 58 possible people 25 actually bought something, thus the likelihood that a person who comes in will buy something is: 25 ÷ 58 = 43%.

9.2.3 Using the multiplication principle for successive events:

$$P = \frac{58}{127} \times \frac{25}{58} = \frac{25}{127} = 19{,}7\%$$

9.3 These are mutually exclusive events, because a pair of denim jeans cannot be too tight and too loose. Thus simply add the probabilities together : 30% + 10% = 40% probability that the jeans will not fit.

9.4 We start with a total of 10 horses. After one has been chosen there are 9 left and after two have been chosen there are 8 left. We find the combined probability using the multiplication principle for successive events. Thus the probabilities are as follows:

9.4.1 $\frac{1}{10}$

9.4.2 $\frac{1}{9}$

9.4.3 $\frac{1}{10} \times \frac{1}{9} \times \frac{1}{8} = \frac{1}{720}$

9.5 We again use the multiplication principle for successive events and multiply the two individual probabilities:

$$P = \frac{60}{100} \times \frac{60}{100} = 36\%; \qquad P = \frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$$

9.6 The probability scale is only from 0 to 1, or 0% to 100%. So 100% probability is a certainty already. Sometimes we hear people say 120% to emphasize how very certain they are, but 120% probability does not actually exist.

9.7.1 There are eight possible orders: TTT, TTF, TFT, FFT, FTF, TFF, FTT, FFF and only one way to choose TTT, therefore the probability is 1 / 8.

9.7.2 There are three ways to choose two trues and one false (TTF, TFT, FTT) therefore this probability is 3 / 8.

Activity 9 — Combined events

In this activity you have been given a number of problems to solve. You will need to decide whether you are dealing with a single event or combined events. If you are dealing with combined events, you will need to decide whether the events are dependent, independent or mutually exclusive. You will then need to use the probability formula and the fundamental counting principle to calculate the required probabilities.

9.1 In order to control the quality of a certain chemical product, a procedure is put in place where one bottle is selected at random from each batch. A second bottle is then selected without replacing the first. If both bottles are faulty, the whole batch is discarded. If a batch of 100 contains 10 faulty bottles and each bottle has the same chance of being selected:

9.1.1 What is the probability of selecting a faulty bottle on the first draw?

9.1.2 What is the probability of selecting a faulty bottle on the second draw if the first was also faulty?

9.1.3 Are these events dependent or independent?

9.1.4 What is the probability that you will select two faulty bottles in succession?

9.2 The owner of a health-shop counted 127 people who walked past her shop yesterday. Of these, 58 came into the shop and of these 58, only 25 bought something.

9.2.1 What is the likelihood that someone who walks past the shop will come in?

9.2.2 What is the likelihood that a person who comes in will buy something?

9.2.3 What is the likelihood that a person who walks past will come in and buy something?

9.3 A clothing store sells second-hand denim jeans. If you buy a pair in your usual size without trying them on, the probability that the waist is too tight is 30% and the probability that it is too loose is 10%. If you choose a pair in your usual size, what is the probability that they will not fit (too loose or too tight)?

9.4 There are 10 horses racing at a racecourse and each horse has an equally likely chance of winning.

9.4.1 What is the probability of choosing the winning horse? Give your answer as a fraction.

9.4.2 Having decided on the winning horse, what is the probability of choosing the horse that will come in second?

9.4.3 What is the probability that you will correctly choose the first three positions (1st, 2nd, and 3rd)?

9.5 A sports match ends in a draw and must be decided by a penalty shootout. One of the goal-scorers has a season record of 60% success. What are the chances that he will now score two goals in a row assuming he is allowed consecutive shots? Give your answer as a percentage and also as a fraction.

9.6 Explain why 120% cannot be the probability of some event.

9.7 Your lecturer wants to set three true-false type questions. To decide on which questions to ask, she lists all the true-false possibilities (TTF, TFT…) on slips of paper and picks one from a hat at random. A student who does not know the answers guesses that all three are true.

9.7.1 What is the probability that the student is correct?

9.7.2 What is the probability that two questions are true and one is false?

Probability of combined events (background information for students and teachers)

The probability of 'combined events' refers to the probability of two or more events happening together one after the other. For example, how likely is it that you will throw a double five on a pair of dice or guess all six lotto numbers correctly?

We say two events are independent if the occurrence of one event does not change the probability of the other happening. For example, throwing a five on one die does not have any effect on throwing a five on a second die.

We say events are dependent if the occurrence of one changes the probability of the second one happening. For example, once you have drawn one number from the possible 49 in the lotto draw, there are only 48 to draw from next time.

We say events are mutually exclusive if they cannot happen together, for example if it is a very hot day, it cannot also be a very cold day.

The Fundamental Counting Principle says that if an event A can occur in 'r ' ways and an event B can occur in 's' ways then A and B can occur in succession in r × s ways.

For example, if we want to know the probability of getting two 5's when throwing a pair of dice, we argue like this – there is a 1 in 6 probability of throwing a 5 on one die and a 1 in 6 probability of throwing a 5 on the second die, so using the fundamental counting principle:

$$P \times \frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$$

So to calculate the probability of events happening together, one after the other, we multiply the individual probabilities. This is also called the multiplication principle for successive events.
To calculate probability in the case of mutually exclusive events, we simply add the individual probabilities. For example, if 15% of the sweets in a bag are red and 5% are blue, the probability of selecting a red or blue sweet is 20%, since the sweets cannot be red and blue at the same time.

Activity 10 — Manipulations and misunderstandings

ABOUT THIS ACTIVITY

In this activity students critique the ways that data is used to support arguments. They identify how data is manipulated and how one can be misled by incomplete statistics, inappropriate samples and graphical methods. The Specific Outcomes and Assessment Criteria addressed are: S01 – AC4; S03 – AC3, 5 of Unit Standard 9015.

MANAGING THIS ACTIVITY

Introduce students to the idea that numbers are only reliable when they are correctly understood. Statistics are very easy to manipulate and one often hears arguments that sound very convincing because they are backed up by figures or graphs that support the argument. However, if we look a little more carefully, we may find that only selected data was used, the sample was inadequate or the graph was not so convincing if you examined the figures closely. Sometimes genuine mistakes are made by the statistician, but at times manipulation is done deliberately for less honest reasons. One should always read 'the numbers' with critical eyes and well-informed questions.

10.1 When presenting a group of numbers we often summarise our data using an average, and while that average may be mathematically correct, it could be highly misleading. In the case of a firm that pays an average salary of R250 000, we may find that the CEO earns R3 000 000, while the other five employees each earn less than R80 000. In this case the median or mode value would give a more representative picture and we would be better able to judge whether the firm is a fair employer and whether its members are well paid or not.

10.2 When we say 80% prefer this product, we have no idea of the sample size or the sample composition. If, for example, the sample size was only 10 people and they were all 16 years old, all we would actually know was that eight sixteen-year-olds preferred this product. This is certainly not enough information to make a business decision about the product.

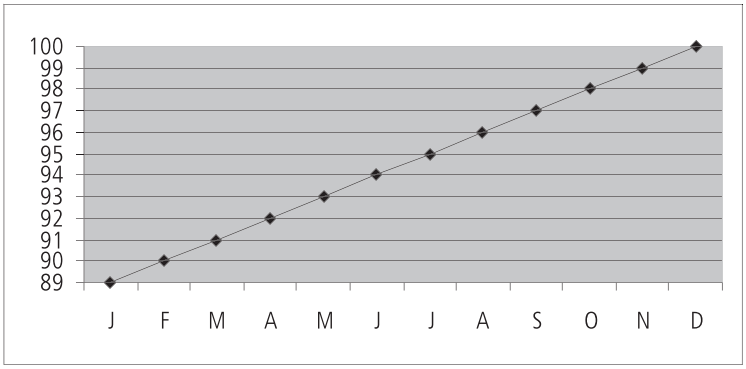
10.3 This is another example of an incomplete statement. Does this mean 22% less ink than other ink jet printers, other printers in general or printers developed 10 years ago? Without a basis of comparison, this claim is essentially worthless.

10.4 Here the problem is a misunderstanding of the difference between percentage and percentage points. A percentage point is a unit of measurement that is calculated as a portion of 100, while a percentage is a portion of a whole (where the whole isn't necessarily 100) multiplied by 100. So in the case of the microwaves, 63% ($33 \div 52 \times 100$) had a faulty component. The industry average is 35%, so this is 28 percentage points higher than the national average – that is 80% higher, because the base figure here is 35 not 100. So in order to calculate the percentage difference, you have to divide 28 by 35 and multiply by 100, giving the figure of 80%. ($28 \div 35 \times 100$).

10.5 Technically a graph should be more accurate than a statement, since it represents more of the variables of your data. However, graphs can be just as misleading when you are showing statistics. In 10.5.1, the results show slow but steady growth. In 10.5.2, the figures are exactly the same but the impression is of more rapid growth because the slope is steeper. This effect is created by starting the graph at 80 instead of 0. In 10.5.3, the slope is still greater, giving the impression of even better results although the figures remain identical. Changing the scale on the value axis thus creates quite different impressions and could easily be used to manipulate an argument. When trying to show strong growth the steeper slope would be more convincing, while when trying to encourage caution the flatter slope would be more suitable. Manipulating the scale is a simple way of dramatically altering the visual impact of a set of data.

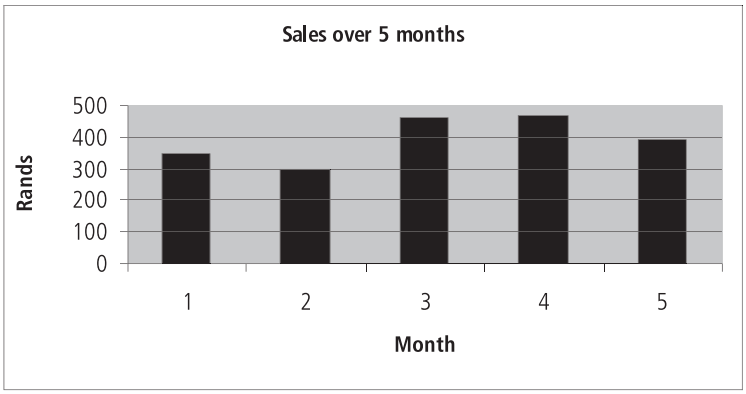
10.6 The impact of changing the scale on the axes is again illustrated in these three bar graphs. The data is identical in each case. In 10.6.1, the impression is that the sales were steady over the six months with some fluctuation. In 10.6.2 the starting point on the value axis has been shifted to create the impression that there was much more fluctuation in sales and month two was a very poor month with sales of close to zero. In 10.6.3, the scale was changed on the x-axis. This created broader bars perhaps giving the impression of solid, healthy growth. Again we notice the different visual impact that could be misleading to the careless reader.

10.5.3

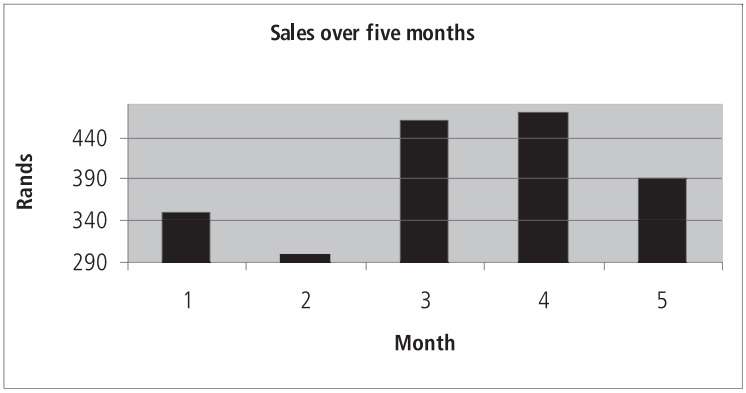


10.6 The following three bar graphs show sales over 5 months.

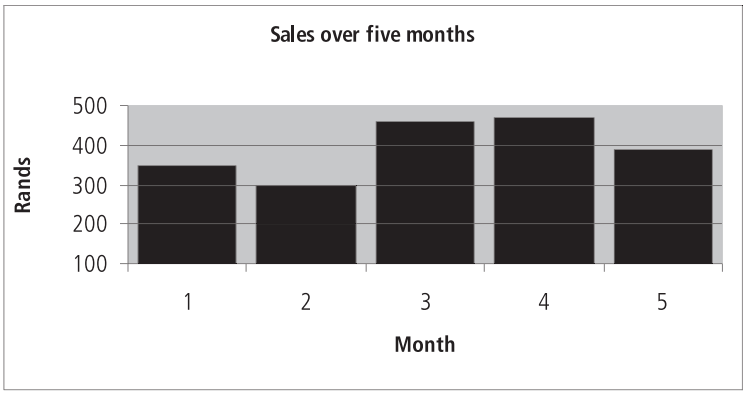
10.6.1



10.6.2

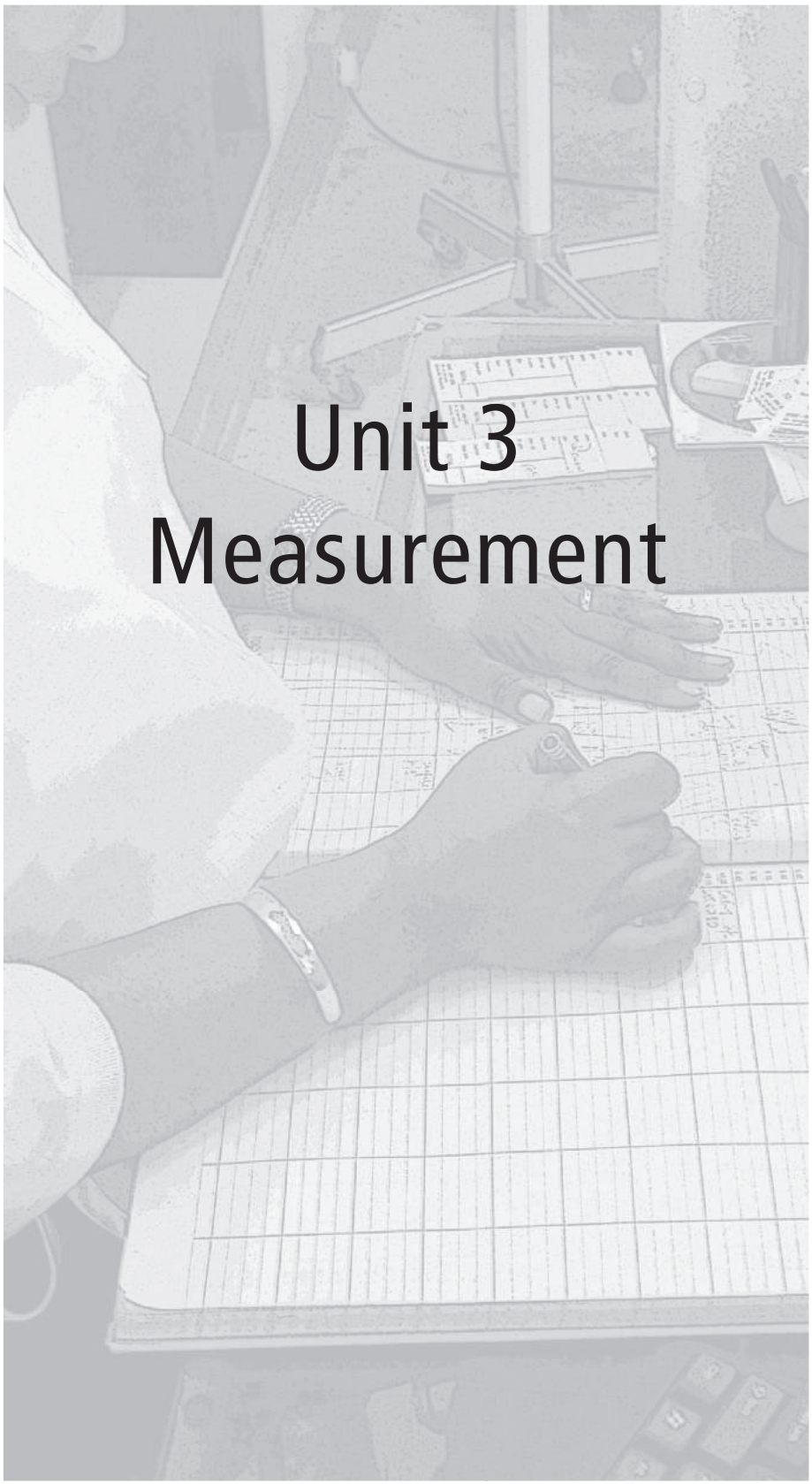


10.6.3



Mathematical Literacy

NQF LEVEL 4

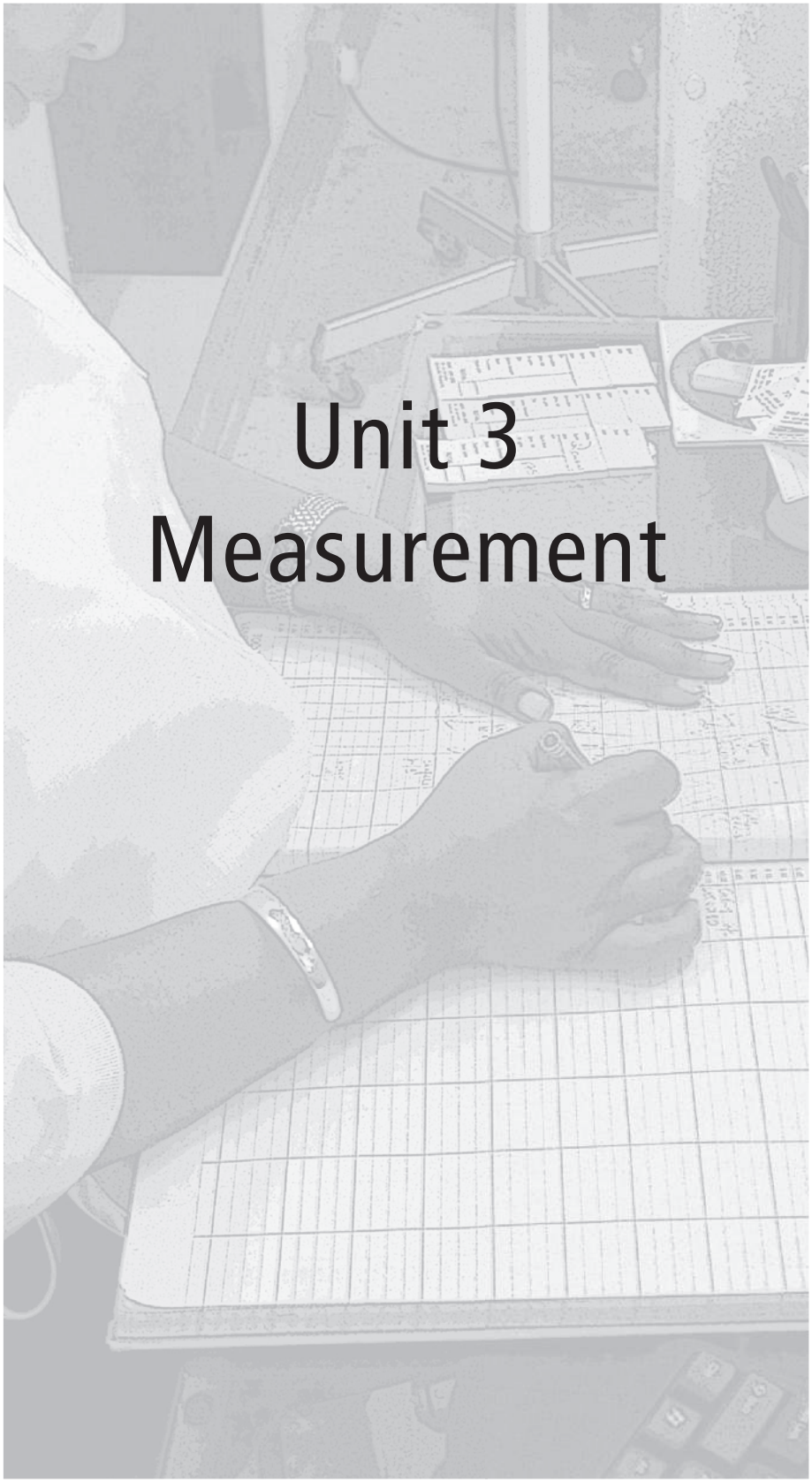


Unit 3
Measurement

Generic Business Administration

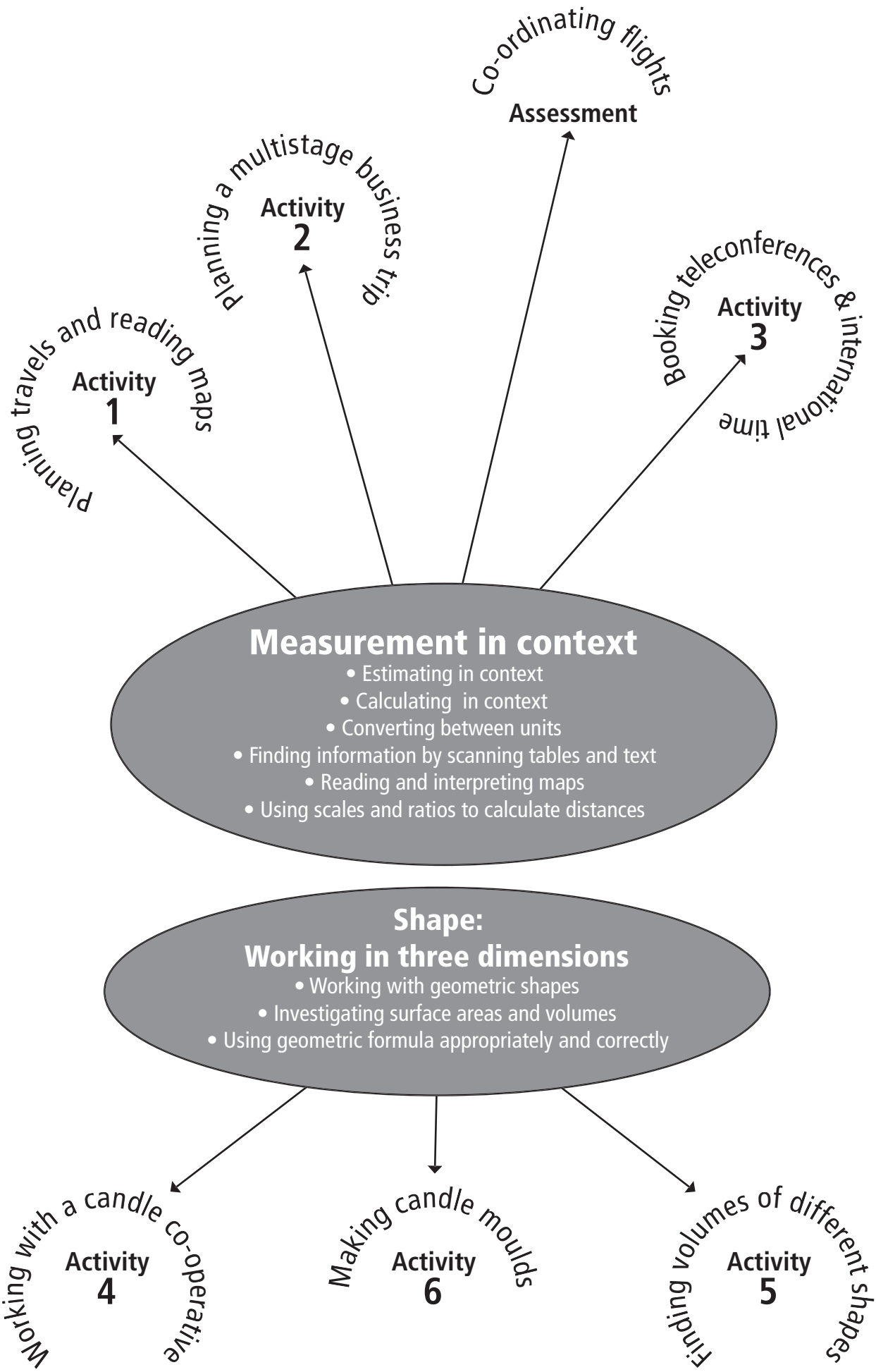
Mathematical Literacy

NQF LEVEL 4



Unit 3
Measurement

Generic Business Administration


Co-ordinating flights
Assessment
Planning a multistage business trip
Activity 2
Booking teleconferences & international time
Activity 3
Planning travels and reading maps
Activity 1
Measurement in context
• Estimating in context
• Calculating in context
• Converting between units
• Finding information by scanning tables and text
• Reading and interpreting maps
• Using scales and ratios to calculate distances
Shape:
Working in three dimensions
• Working with geometric shapes
• Investigating surface areas and volumes
• Using geometric formula appropriately and correctly
Working with a candle co-operative
Activity 4
Making candle moulds
Activity 6
Finding volumes of different shapes
Activity 5

Overview

Unit Standard 9016 has two Specific Outcomes:
- o SO 1 focuses on measurement.
- o SO 2 focuses on shape.

This unit uses a number of different contexts to develop students' understanding of measurement and shape, including:
- Thinking about the most appropriate way of measuring in a particular context.
- Thinking about how the context impacts upon the reasonableness of the measurement reading, calculation or solution.
- Using estimation techniques appropriate to the context.
- Knowing what is the appropriate unit of measurement within a particular context.
- Reading information from tables.
- Converting between units of measurement.
- Calculating areas, perimeters and volumes and understanding how contexts impact on one's answers.
- How context can impact upon decisions about what algorithms to use in calculations.
- Developing models to describe situations, to analyse them and to make predictions about them.
- Using the available technology, in particular electronic calculators, to solve problems.
- Calculating effectively, efficiently and correctly.
- Explaining the choice of algorithm and the procedures used.
- Understanding scale in sketches and maps
- Using scale bars and ratio to calculate the actual size and distances.

In addition to developing the mathematical skills of students, this unit is also intended to give students an opportunity to develop an understanding of:
- Road maps – how to read and interpret them and use them to calculate distances.
- Planning travel and meeting arrangements.
- Assisting a local co-operative in calculating volumes and costs of raw materials.

The unit consists of seven activities of which one is an assessment activity.

Mathematical literacy involves using one's knowledge of shape, space, measurement, numbers and data to make sense of the world. It also involves using one's knowledge of particular contexts to make sense of and increase one's knowledge of shape, space, measurement, numbers and data. There are several key issues in measurement and shape,

Unit outcomes

The following Unit Standards, Specific Outcomes and Assessment Criteria are addressed by this unit:

Represent, analyse and calculate shape and motion in 2- and 3-dimensional space in different contexts (US 9016).

- Estimate, measure and calculate physical quantities in practical situations relevant to the adult (SO1).
  - o Scales on measuring instruments are read correctly (AC1).
  - o Quantities are estimated to a tolerance justified in the context of the need (AC2).
  - o The appropriate instrument is chosen to measure a particular quantity (AC3).
  - o Quantities are measured to within the last step of the instrument (AC4).
  - o Appropriate formulae are selected and used (AC5).
  - o Calculations are carried out correctly and the least steps of the instruments used are taken into account when reporting the final values (AC6).
  - o Symbols and units are used in accordance with SI conventions and as appropriate to the situation (AC7).
- Explore, analyse and critique, describe and represent, interpret and justify geometrical relationships and conjectures to solve problems in two and three dimensional geometric situations (SO2).
  - o Descriptions are based on a systematic analysis of the shapes and reflect the properties of the shapes accurately , clearly and completely (AC1).
  - o Descriptions include quantitative information appropriate to the situation and need (AC2).
  - o 3-dimensional objects are represented by top, front, and side views (AC3).
  - o Different views are correctly assimilated to describe 3-dimensional objects (AC4).
  - o Available and appropriate technology is used in producing and analyzing representations (AC5).
  - o Relations of distance and positions between objects are analysed from different views (AC6).
  - o Conjectures, as appropriate to the situation, are based on well-planned investigations of geometrical properties (AC7).
  - o Representations of the problems are consistent with and appropriate to the problem context. The problems are represented comprehensively and in mathematical terms (AC8).
  - o Results are achieved through efficient and correct analysis and the manipulation of representations (AC9).
  - o Problem solving methods are presented clearly, logically and in mathematical terms (AC10).
  - o Reflections on the chosen problem solving strategy reveal strengths and weaknesses of the strategy (AC11).
  - o Alternative strategies to obtain the solution are identified and compared in terms of appropriateness and effectiveness (AC12).

and the activities in this unit attempt to address them in ways that are relevant to business administrators. Business Administration is a qualification that aims to help students develop a set of general skills as well as the flexibility to apply these in a range of contexts. In this unit we provide students with different contexts modelled on real workplace contexts. We help students to understand and think their way into each of the contexts before starting the activities. This unit develops the skills required to achieve the Assessment Criteria of Unit Standard 9016.

Activity 1 — Planning travels and reading maps

In this activity students read maps of South Africa and road maps of particular provinces. They look for key symbols (like an areoplane representing a major airport) to find out information about places. This activity extends the work they did in Activities 1 & 2 of Level 3. Students are again asked to think about scale, distance, speed and time (including how the time of day affects traffic flow and travelling time).

They use the map scale bar to calculate distances between cities and towns. They use information on the road maps to approximate driving times between various places.

Reading maps includes the skills of finding the correct block (cell) in the rows and columns, understanding that a map is a styalised view from above, and using a key to interpret symbols. This activity lays the foundation for the next activity in which they have to plan flight times and schedule meetings based on driving times and flight times.

Activity 2 — Planning a multistage business trip

This activity extends students travel arrangement skills that have been developed in Activities 1 & 2 of level 3 and Activity 1 of Level 4.

Students are asked to read aeroplane timetables and to book a multistage trip around the country. They are asked to schedule meetings that take into account flight times and driving times. Students are again asked to think about how flight times affect the time of day at which one travels, and how the time of day at which one travels can impact on the speed at which one is travelling and so impact back on possible flight options.

Usually business administrators will get someone else to find the most convenient flight to book, but it is useful for them to have an understanding of what factos limit possible suitable flights.

Activity 3 — Booking teleconferences and working with international time

In this activity we continue the use the context of scheduling (this time an international teleconference rather than a face-to-face meeting). Students need to look up and calculate time differences in different countries as the basis for finding the most suitable time for an international teleconference. They are also asked to convert between 12 hour analogue times and 24 hour digital time. Many businesses work across international boundaries and so business administrators need to know how to take different time zones into account.

Students are also asked to find out how to book and make teleconferences.

Activity 4 — Working with a candle-making co-operative

This activity extends the concepts of volumes that students have developed in Activity 5 of both Level 2 and Level 3. Here students work with volumes of cubes, cuboids, cylinders and spheres. They see what happens if the lengths of the sides of the objects are increased.

Students are asked to think about how the context impacts upon how accurate their answers need to be.

Activity 5 — Finding the volumes of different shapes

In this activity students draw candles that are shaped like right prisms from different views. Their drawings help them to understand the shapes of the candles better. Part of their training is to see what information they can gather from drawings, maps and other illustrations but also to see that by making drawings they can generate information that will help them to solve problems. Students calculate volumes of these shapes with different sizes. They think again about the relationship between area formulae and volume formulae, and how the context impacts on the level of accuracy of their answers.

Activity 6 — Making candle moulds

In this activity students think about the moulds in which candles are made. In order to work out how much they will need to pay for moulds they first calculate the surface area of differently shaped candles. Mathematically literate people are able to think about what mathematical resources to use in different situations and they are also able to find the information and mathematical resources they need to solve problems. Students are asked to find certain information and formulae that have been provided in the previous two activities.

Activity 7 — Assessment: Co-ordinating flights

In this activity students are asked to draw on what they have learned about making travel arrangements over levels 2, 3 and 4. They are asked to schedule a meeting for people which includes local people as well as people travelling from different parts of the country. This requires reading different flight timetables in relation to each other, as well as taking into consideration the driving times to and from the meeting and to and from the airports on the other side.

9016	Represent, analyse and calculate shape and motion in 2-and 3-dimensional space in different contexts								
		ACTIVITY	1	2	3	4	5	6	7
SO1	Measure, estimate, and calculate physical quantities in practical situations relevant to the adult.								
	AC1	Scales on the measuring instruments are read correctly.	✓	✓	✓	✓	✓	✓	✓
	AC2	Quantities are estimated to a tolerance justified in the context of the need.	✓	✓		✓	✓	✓	✓
	AC3	The appropriate instrument is chosen to measure a particular quantity	✓						
	AC4	Quantities are measured correctly to within the least step of the instrument.		✓			✓	✓	✓
	AC5	Appropriate formulae are selected and used.		✓			✓	✓	✓
	AC6	Calculations are carried out correctly and the least steps of instruments used are taken into account when reporting final values.		✓		✓	✓	✓	✓
	AC7	Symbols and units are used in accordance with SI conventions and as appropriate to the situation.		✓			✓	✓	✓
SO2	Explore, analyse & critique, describe & represent, interpret and justify geometrical relationships.								
	AC1	Descriptions are based on a systematic analysis of the shapes and reflect the properties of the shapes accurately, clearly and completely.				✓	✓	✓	
	AC2	Descriptions include quantitative information appropriate to the situation and need.	✓	✓		✓	✓	✓	✓
	AC3	3-dimensional objects are represented by top, front and side views.					✓		
	AC4	Different views are correctly assimilated to describe 3-dimensional objects				✓	✓	✓	
	AC5	Available and appropriate technology is used in producing and analysing representations.				✓	✓	✓	
	AC6	Relations of distance and positions between objects are analysed from different views.				✓	✓		
	AC7	Conjectures as appropriate to the situation, are based on well-planned investigations of geometrical properties.				✓	✓	✓	
	AC8	Representations of the problems are consistent with and appropriate to the problem context. The problems are represented comprehensively and in mathematical terms.	✓	✓	✓	✓	✓	✓	✓
	AC9	Results are achieved through efficient and correct analysis and manipulation of representations.	✓	✓	✓	✓	✓	✓	✓
	AC10	Problem-solving methods are presented clearly, logically and in mathematical terms.	✓	✓		✓	✓	✓	✓
	AC11	Reflections on the chosen problem solving strategy reveal strengths and weaknesses of the strategy.	✓	✓					✓
	AC12	Alternative strategies to obtain the solution are identified and compared in terms of appropriateness and effectiveness.	✓	✓					✓

Activity 1 – Planning travel and reading maps

ABOUT THIS ACTIVITY

Making travel arrangements is often a large part of the work of a business administrator. In Level 3 we gave students tasks in which they had to draw a simple map and plan the flights for one person to attend one meeting. Activity 1 and Activity 2 are linked to each other. In these activities we extend students travel planning skills.

Before an administrator can plan a trip effectively he/she needs to be aware of where the traveller's destinations are. In this activity students will practice reading maps and calculating distances and travel times.

In this activity students are asked to read a South African map. Students use the grid reference numbers and letter to describe where the places are. In Mathematical Literacy, we call these labelled systems of rows and columns co-ordinate systems.

Students use the scale bar to translate lengths of road on the map into actual distances and use these distances as the starting point for calculating driving times. This lays the ground work for them to plan a multistage trip around the country, which they are asked to do in the Activity 2. This activity prepares students to meet the following outcomes of Unit Standard 9016:

- SO 1: Measure, estimate and calculate physical quantities in practical situations: AC 1, 2, 3, 4, 5, 6, 7
- SO 2: Explore, describe and represent, interpret and justify geometrical relationships: AC 2, 8, 9, 10

MANAGING THIS ACTIVITY

Students should be given Worksheet 1 and a copy of Handout 1. If you have larger copies of maps of South Africa with grid references on them, let students use these. If you use different maps, the co-ordinates of cells may be different.

1.1 It is useful for business administrators to know that the major airports are in the following cities: Cape Town, Johannesburg, Bloemfontein, Durban, East London and Port Elizabeth. There are also airports in other centres like Upington, Kimberley, Mafikeng, Pietermaritzburg, Nelspruit, Hoedspruit, Richards Bay etc. but flights to these places do not happen frequently, so it is often more efficient to plan to fly to a major airport and to drive from there. You can use the example of Brits to help students to think about why it would make more sense to fly to Johannesburg International Airport than to fly to Mafikeng Airport.

1. 1.1 Answers are given in the table below.

1.1.2 An aeroplane symbol indicates an airport.

1.1.3 Answers are given in the table below. Help students to see that to plan a route from Johannesburg International Airport to Brits, they need to work with both the North West map and the Gauteng map. The small South African map inserts on each page should help them to see how the two maps relate to each other. They should note that the scales are different on these two maps.

1.2 There are a number of ways in which one can work out distance between towns on a map.

- o Look up the distance in a distance table. This only works for distances between major towns, and so will not help students to answer these questions.
- o Some road maps provide distances on major routes – this has not been provided on this map, and so it is not available to students in answering these questions.
- o Most maps have the scale provided as a ratio eg 1 : 2 800 000. This means that 1 unit of length on the map equals 2 800 000 units of length in reality. So 1 cm on the map equals 2 800 000 cm in reality. This is a distance of 28 km.
- o For this activity students will need to use the scale bar provided. Students can use a piece of cotton to trace the length of the roads on the map. Then lay the cotton out straight along the scale bar to work out the approximate distance of the roads.

The approximate distances are given in the table below.

When students approximate the distance between Johannesburg International Airport and Brits, check that they use the different scales provided for Gauteng and North West. Also check that they understand how the two maps fit next to each other.

1.3 Students' explanations could include using string to trace the length of the roads and then using either the scale bar or the scale ratio to translate this into approximate but real distances.

1.4 This is useful to have as a whole class discussion. Students' lists should include the following:

- Speed limit – this varies depending on the type of road on which you are traveling. National roads, out of town, in good condition allow you to travel at up to 120 km an hour, in suburban roads the speed limit varies from 40 to 60 km an hour.
- Type of road on which you are travelling – national, regional or municipal.
- Condition of road – you can travel faster on a large straight tarred road in good condition, but you need to travel more slowly if the road is dirt, bumpy, winding, or in poor condition.
- The amount of traffic, which varies but is usually more in the early morning and evening in big cities.
- Road works can cause delays in traffic.
- Accidents can cause delays in traffic.

In order to complete question 1.5 students should think primarily about the type of road on which their manager will need to travel (national or Regional). Also explain to the students that sections of the road from Port Elizabeth to Alexandria are in quite poor condition and that they should calculate time based on an average speed of 80 km per hour.

1.5 Durban to Amanzimtoti is a short distance, under 50 km, and it is on the N2. This stretch of road is good and one can travel quite fast along it, at times up to 120 km an hour. Estimate driving time is less than 1 hour.

Johannesburg to Britz is between 50 to 100 km. One travels on tarred roads all of the time, but some of this is in quite built-up areas, in which the speed limit is reduced. Estimated driving time is 90 minutes.

Bloemfontein to Welkom is between 50 – 100 km. One travels on tarred roads the whole way, so expect the average speed limit to be between 80 and 100 kilomtres an hour. Predicted driving time is 90 minutes.

Port Elizabeth to Alexandria is about 100 km. Some of this trip is on the N2 where speed limits will be 120 km an hour, but most of it is on narrow tarred roads that wind through farm land. The speed limit on these roads ranges between 60 km to 100 km an hour. Expect to take 1 hour.

1.6 Answers in the table below

Town	**Welkom**	**Alexandria**	**Britz**	**Amanzimoti**
Cell address	C2 Free State map	D4 Eastern Cape map	F2 North West map	C5 Kwa Zulu-Natal map
Closest airport city	Bloemfontein	Port Elizabeth	Johannesburg In Gauteng	Durban
Approximate driving distance between the city and town	100 – 200 km	0 – 100 km	0 – 100 km	0 - 100 km
Approximate driving time between the city and town	2 hours	1 hour	90 minutes	1 hour (or less)

Remind students to keep their table of answers handy when they do Activity 2.

Activity 1 — Planning travels and reading maps

You and your manager work in Cape Town. Your manager needs to convene a series of meetings in different parts of the country, over the next month. She has asked you to set up the meetings and to make the travel arrangements. She gives you a list of towns in which the meetings need to be held.

Meeting places for the next month

Welkom in the Free State.
Alexandria in the Eastern Cape.
Brits in the North West.
Amanzimtoti in Kwazulu-Natal.

First you need to find these places on a map. Then you need to plan a travelling route for her.

1.1 Find each of the towns above on the maps in Handout 1.

1. 1.1 In which cell on the map can you find each town. For example, Bloemfontein is in cell number C4 of the Free State map.

1.1.2 Your manager wants to fly to major centres and then drive to the various towns. How are airports shown on the maps?

1.1.3 For each town above find the city that it would be best to fly to. Think carefully about Brits: to get to Brits the best airport to fly to is in Gauteng.

1.2 Find the scale bar on the map. Use this to estimate the distance between each town and the airport city closest to it. Choose one of the following options of distances:

- 0 – 100 km
- 100 – 200 km
- 200 – 300 km

1.3 Explain how you estimated your answers in each of the above questions.

1.4 Write a list of things that affect how long a car journey will take you.

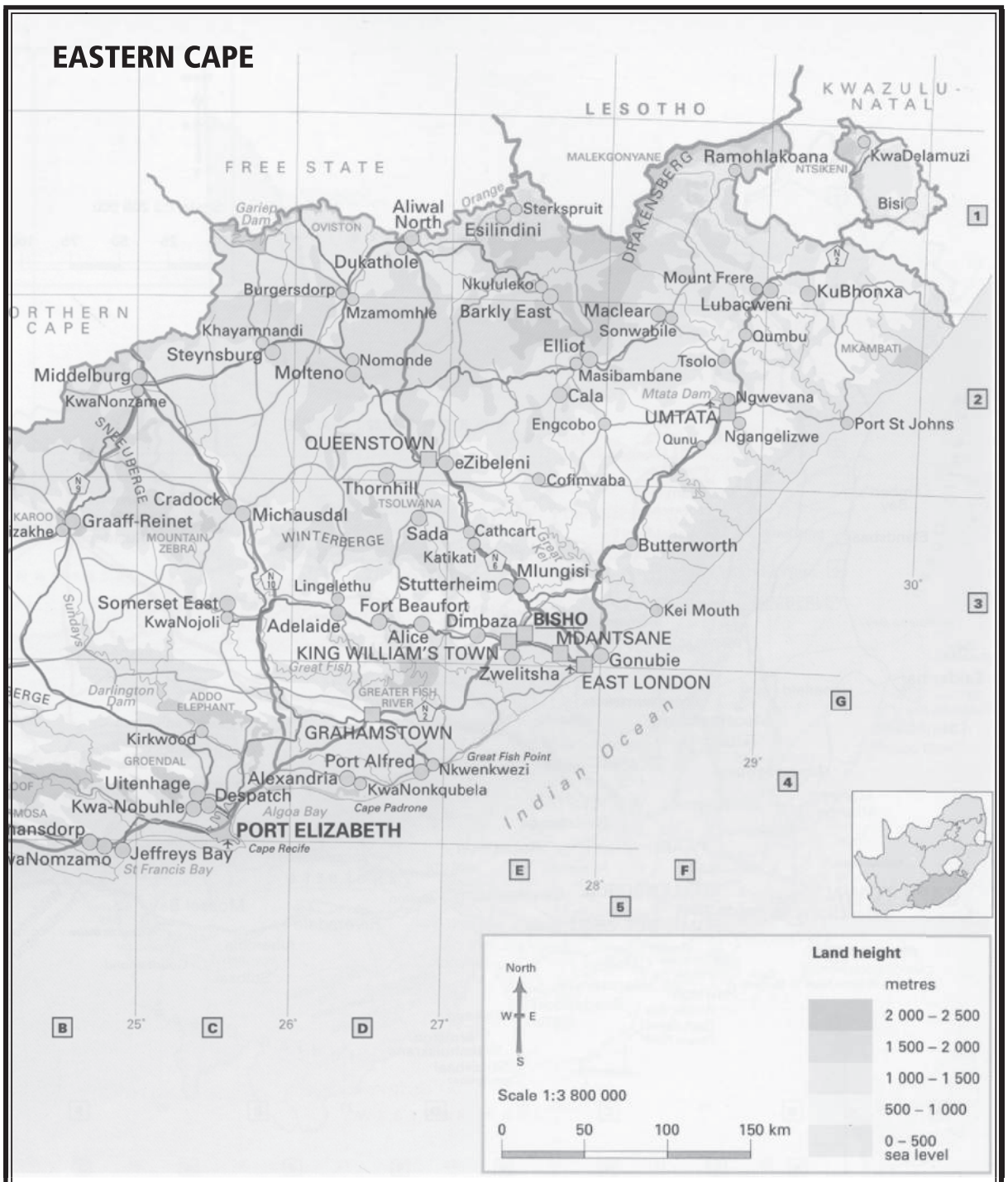
1.5 Use your estimated distances to approximate how long it will take to drive from the airport to each town. Choose one of the time periods below for each drive. Explain how you decided how long the each journey would take.

- 1 hour
- 2 hours
- 3 hours
- 4 hours

1.6 Now use all the information from your answers to complete the table below.

Town	**Welkom**	**Alexandria**	**Brits**	**Amanzimtoti**
Cell address				
Closest airport city				
Approximate driving distance between the city and town				
Approximate driving time between the city and town				

Keep your work from this activity as you will use it in Activity 2.


EASTERN CAPE
LESOTHO
KWAZULU-NATAL
FREE STATE
NORTHERN CAPE
MALEKGONYANE
Ramohlakoana
NTSIKENI
KwaDelamuzi
Bisi
DRAKENSBERG
Aliwal North
Orange
Sterkspruit
Esilindini
Garieb Dam
OVISTON
Dukathole
Burgersdorp
Mzamomhle
Nkululeko
Barkly East
Mount Frere
Lubacweni
KuBhonxa
Maclear
Sonwabile
Qumbu
MKAMBATI
Khayamnandi
Steynsburg
Nomonde
Molteno
Elliot
Tsolo
Middelburg
KwaNonzame
Masibambane
Cala
Mtata Dam
Ngwevana
UMTATA
Qunu
Ngangelizwe
Port St Johns
Engcobo
SNEEUBERG
QUEENSTOWN
eZibeleni
Cofimvaba
Thornhill
TSOLWANA
Cradock
Michausdal
KAROO
Graaff-Reinet
MOUNTAIN ZEBRA
WINTERBERGE
Sada
Cathcart
Katikati
Great Kei
Butterworth
Mlungisi
Lingelethu
Stutterheim
Somerset East
KwaNojoli
Fort Beaufort
Kei Mouth
Adelaide
Dimbaza
BISHO
Alice
MDANTSANE
KING WILLIAM'S TOWN
Gonubie
Great Fish
Zwelitsha
EAST LONDON
Sundays
Darlington Dam
ADDO ELEPHANT
GREATER FISH RIVER
GRAHAMSTOWN
Kirkwood
GROENDAL
Port Alfred
Great Fish Point
Nkwenkwezi
Uitenhage
Alexandria
KwaNonkqubela
Despatch
Kwa-Nobuhle
Algoa Bay
Cape Padrone
PORT ELIZABETH
Cape Recife
Jeffreys Bay
St Francis Bay
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30°
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2 000 – 2 500
1 500 – 2 000
1 000 – 1 500
500 – 1 000
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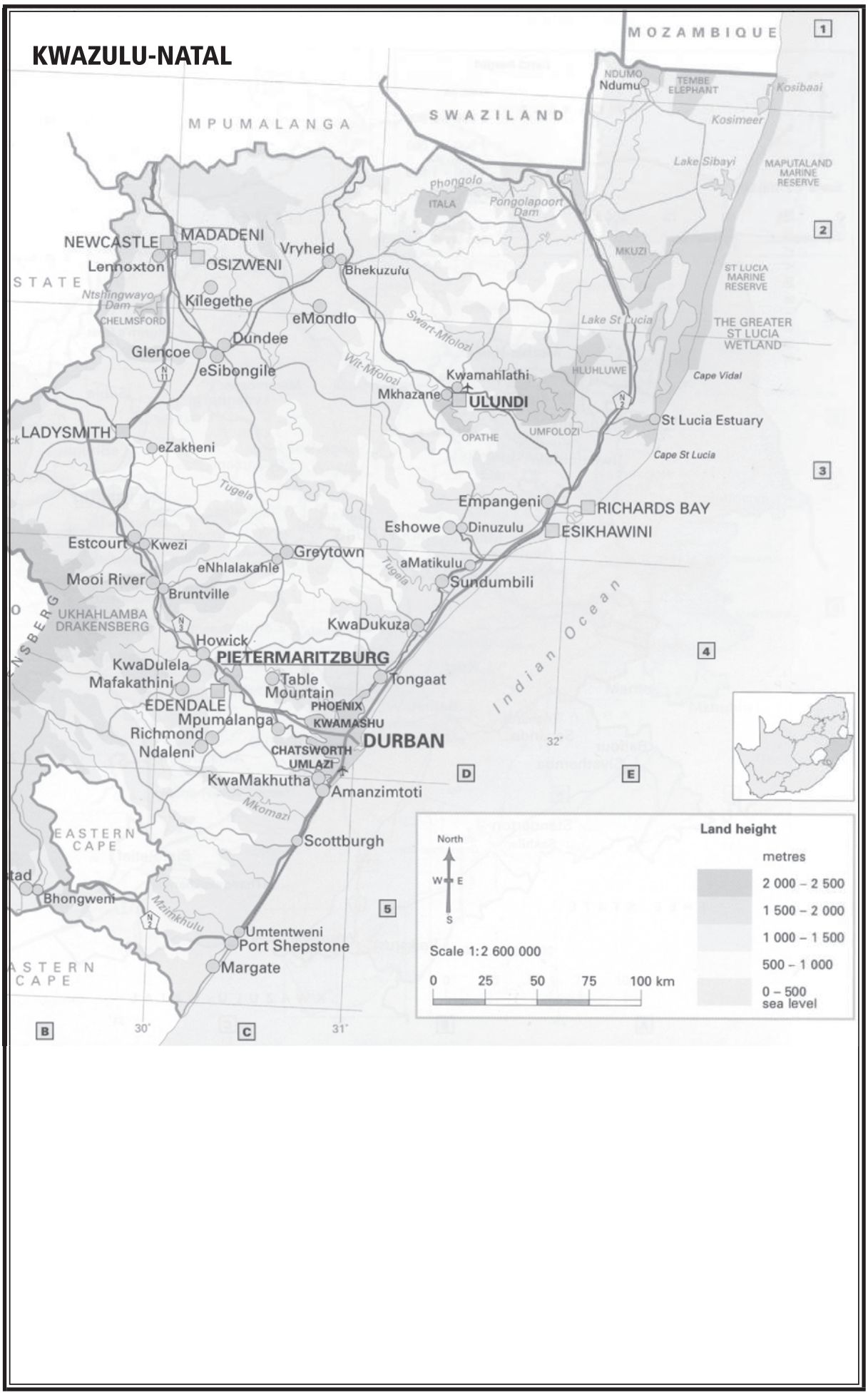
KWAZULU-NATAL
MOZAMBIQUE
SWAZILAND
MPUMALANGA
NDUMO
Ndumu
TEMBE ELEPHANT
Kosibaai
Kosimeer
Lake Sibayi
MAPUTALAND MARINE RESERVE
Phongolo
ITALA
Pongolapoort Dam
MKUZI
ST LUCIA MARINE RESERVE
THE GREATER ST LUCIA WETLAND
Lake St Lucia
Cape Vidal
St Lucia Estuary
Cape St Lucia
HLUHLUWE
UMFOLOZI
OPATHE
NEWCASTLE
MADADENI
Lennoxton
OSIZWENI
Vryheid
Bhekuzulu
STATE
Ntshingwayo Dam
CHELMSFORD
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eMondlo
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Tugela
Empangeni
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Eshowe
Dinuzulu
ESIKHAWINI
Estcourt
Kwezi
Greytown
eNhlalakahle
aMatikulu
Sundumbili
Mooi River
Bruntville
UKHAHLAMBA DRAKENSBERG
KwaDukuza
Howick
PIETERMARITZBURG
KwaDulela
Mafakathini
Table Mountain
Tongaat
EDENDALE
PHOENIX
Mpumalanga
KWAMASHU
Richmond
Ndaleni
DURBAN
CHATSWORTH
UMLAZI
KwaMakhutha
Amanzimtoti
Mkomazi
Indian Ocean
EASTERN CAPE
Scottburgh
Bhongweni
Mzimkhulu
Umtentweni
Port Shepstone
Margate
North
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Scale 1:2 600 000
0 25 50 75 100 km
Land height
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2 000 – 2 500
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GAUTENG
LIMPOPO
STERKWATER
SOSHANGUVE
ONDERSTEPOORT
NORTH WEST
MAGALIESBERG
MAMELODI
ZEMVELO
PRETORIA
Wilge
MAGALIESBERG
CENTURION
RHENS
DIEPSLOOT
RIETVLEI
JOHN NASH
MIDRAND
Halfway House
Bronkhorstspruit Dam
KROMDRAAI CONSERVANCY
TEMBISA
SANDTON
KEMPTON PARK
KRUGERSDORP
RANDBURG
ETWATWA
RANDFONTEIN
JOHANNESBURG
BENONI
BOKSBURG
MPUMALANGA
GERMISTON
SPRINGS
SOWETO
BAILEY
Khutsong
Westonaria
Lenasia
KATLEHONG
KWATHEMA
Carletonville
Ennerdale
Nigel
ORANGE FARM
SUIKERBOSRAND
Heidelberg
SEBOKENG
Rensburgdorp
VEREENIGING
Bophelong
SHARPEVILLE
VANDERBIJLPARK
Vaal
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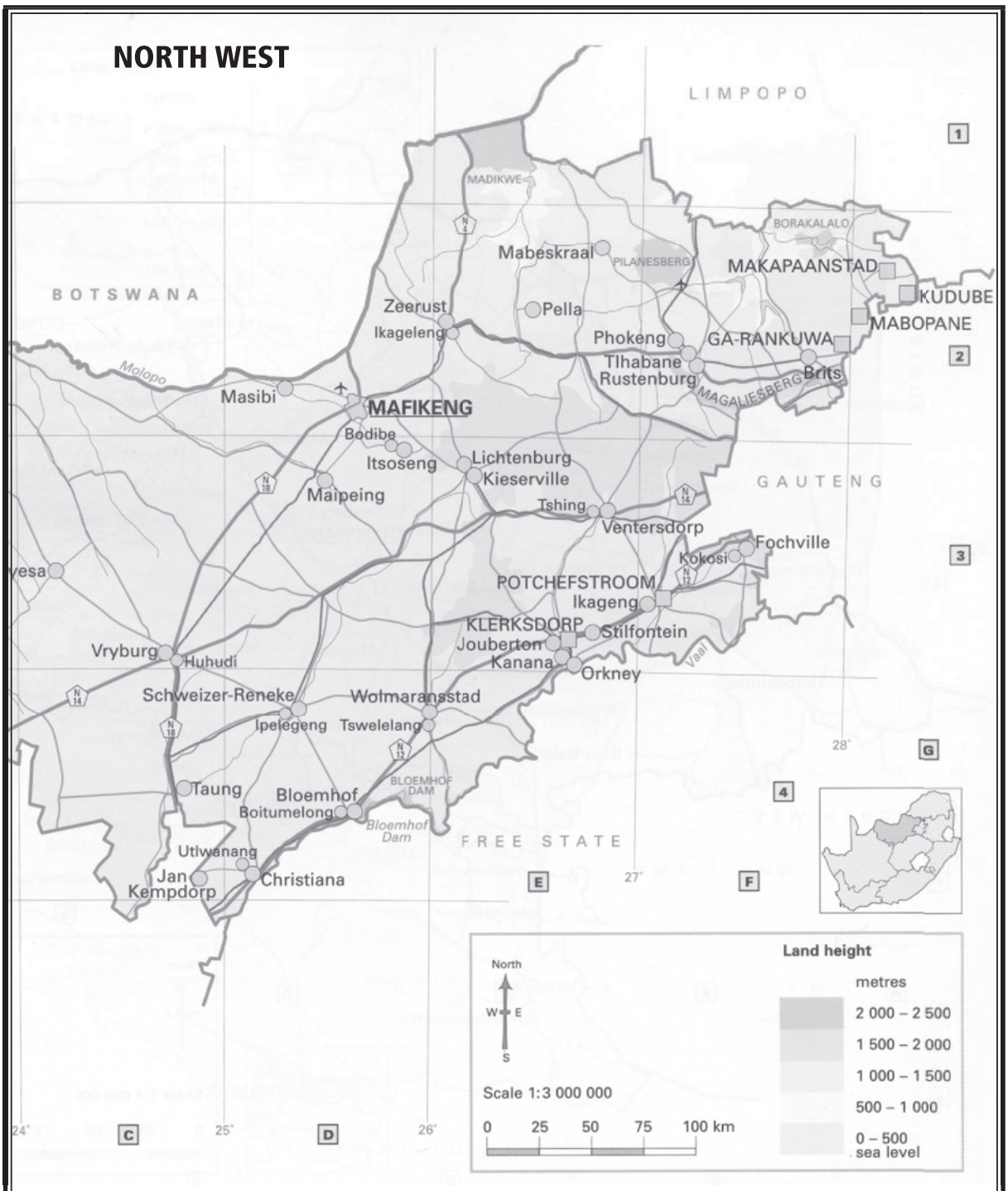
NORTH WEST
LIMPOPO
BOTSWANA
GAUTENG
FREE STATE
MADIKWE
BORAKALALO
PILANESBERG
MAGALIESBERG
Mabeskraal
MAKAPAANSTAD
KUDUBE
MABOPANE
Zeerust
Pella
Ikageleng
Phokeng
GA-RANKUWA
Tlhabane
Rustenburg
Brits
Molopo
Masibi
MAFIKENG
Bodibe
Itsoseng
Lichtenburg
Kieserville
Maipeing
Tshing
Ventersdorp
Fochville
Kokosi
POTCHEFSTROOM
Ikageng
KLERKSDORP
Stilfontein
Jouberton
Kanana
Orkney
Vaal
Vryburg
Huhudi
Schweizer-Reneke
Wolmaransstad
Ipelegeng
Tswelelang
BLOEMHOF DAM
Taung
Bloemhof
Boitumelong
Bloemhof Dam
Utlwanang
Jan Kempdorp
Christiana
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Scale 1:3 000 000
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Land height
metres
2 000 – 2 500
1 500 – 2 000
1 000 – 1 500
500 – 1 000
0 – 500
sea level

FREE STATE
GAUTENG
MPUMALANGA
NORTH WEST
KWAZULU-NATAL
LESOTHO
EASTERN CAPE
Parys
Sasolburg
Zamdela
Thumahole
Vaal
Vaal Dam
Bothaville
Kgotsong
Heilbron
Phiritona
Namahadi
Frankfort
Thembalihle
Vrede
Maokeng
KROONSTAD
Kutlwanono
Odendaalsrus
Thabong
WELKOM
Hennenman
Virginia
Reitz
Petsana
Bohlokong
BETHLEHEM
42nd Hill
Harrismith
WILLEM PRETORIUS
Allemanskraal Dam
Senekal
Matwabeng
Theunissen
Masilo
Winburg
Makeleketla
Erfenis Dam
GOLDEN GATE HIGHLANDS
QWA QWA
STERKFONTEIN DAM
Sterkfontein Dam
SOETDORING
PHUTHADITJHABA
Caledon
Ficksburg
Meqheleng
BLOEMFONTEIN
MANGAUNG
THABA NCHU
BOTSHABELO
Manyatseng
Ladybrand
Dewetsdorp
Reddersburg
Morojaneng
Ha-Rasebi
Matoporong
Wepener
Qibing
Edenburg
CALEDON
Maphodi
Zastron
Matlakeng
Bethulie
GARIEP DAM
TUSSEN DIE RIVIERE
Lepho
Orange
North
W E
S
Scale 1:2 800 000
0 25 50 75 100 km
Land height
metres
2 000 – 2 500
1 500 – 2 000
1 000 – 1 500
500 – 1 000
0 – 500
sea level

Activity 2 — Planning a multistage business trip

Activity 2 follows on from Activity 1. They both deal with making flight and other travel arrangements. They both extend the work done, at Level 3, on making travel arrangements, reading maps and finding information in rows and columns (i.e. what we call working with co-ordinate systems in Mathematical Literacy).

ABOUT THIS ACTIVITY

In Activity 1 students read a map of South Africa and calculated travelling distances between towns. In this activity they draw on this information to choose flights for a multistage trip around the country.

This activity prepares students to meet the requirements of the following outcomes of Unit Standard 9016:

- SO 1 Measure, estimate and calculate physical quantities: AC 2; 6; 7.
- SO 2 Explore, analyse & critique, describe and represent, interpret & justify geometrical relationships: AC 2; 8; 9; 10; 11; 12.

MANAGING THIS ACTIVITY

Flight timetable booklets are available from most airlines and many travel agents. Learning how to read these is a useful skill for office managers. It would be better for students to work from a flight timetable book than the preselected options given in the handout, as this will allow them to explore a number of options and to see that some routes are impractical. In planning any business travel there are two important issues to consider: the one is to save time and inconvenience for the traveller and the second is to save money. Discuss this with the students.

Copies of the relevant flight timetables are provided in Handout 1. Do not hand these out until students have already made suggestions about how to sequence the flights.

2.1.1 Amanzimtoti: 4½ hours + (1 + 1) hours = 6 ½ hours.
2.1.2 Alexandria: 4½ hours + (1 + 1) hours = 6 ½ hours.
2.1.3 Britz: 4½ hours + (1½ + 1½) hours + extra time if in peak traffic flow = 7 ½ hours+ extra time if in peak traffic flow.
2.1.4 Welkom: 4½ hours + (2 + 2) hours = 8 ½ hours.

2.2 Plan for the manager to stay overnight in
- o Johannesburg (the best plan would be to try to avoid the peak travel periods in the day)
- o Bloemfontein

The answers above are given according to the criteria outlined in the question. However, students will see that once they look at the flight times, these will impact on their decisions about where to book overnight accommodation, as well as on the routes that can be chosen.

2.3 There are several possibilities here. One of them is Cape Town – Bloemfontein – Johannesburg – Durban – Port Elizabeth – Cape Town.

Students may provide other options which for the moment may seem sensible — but on further investigation some of them are impractical. Some examples of impracticalities are given below.

- The flight schedule may be impractical e.g. CT – JHB – DB – PE – BFN is impractical as there are no direct flights between PE and BFN (students will discover this when they use the airline flight schedule booklets).
- Flights that stop in another centre take up huge amounts of travelling time. Talk to students about how much time is taken up in "layovers" at the stops en route.

Obviously, returning to Cape Town after each trip will be costly so this is not an option.

2.4 One schedule is provided below. Students may also provide others which are workable.

Day 1: Cape Town to Bloemfontein (Welkom)

Catch SA 1091: departs CT at 08:00, arrives BFN at 09:35
Estimated time of leaving BFN airport: 10:05
Expected arrival time in Welkom: 12:05
Set meeting for 13:00 to 16:00
Arrive back at BFN at about 18.00
Stay overnight in BFN

It is possible to catch flight SA 1376 which departs BFN 19:00 and arrives JHB 20:35. Accommodation could be booked for Johannesburg.

Some students may suggest the earlier flight from CT: SA 1081. Then everything will run two hours earlier and the manager could have lunch after the meeting in Welkom, which could be scheduled for 10:30 – 12.30. This would give the manager a long wait at the airport, if he/she decides to fly JHB and make it a very long day. Also it may not suit the manager to be at the airport at 05h00, which will mean leaving home at about 04h30.

Day 2: Bloemfontein to Johannesburg (Brits)

Catch flight SA 1372 from BFN departs: 0810 arrives, JHB 0945.
Estimated time of leaving JHB airport: 10:05.
Expected arrival time in Welkom: 11:35
Set meeting for 12:00 to 15:00 (this will need to include lunch).
Arrive back at Johannesburg at about 16.30.
Can stay overnight in Johannesburg near the airport or can catch flight SA 575 to Durban which leaves JHB at 18:00 and arrives DBN at 19:10.

Note: if students decide to book a flight to JHB on day 1, then also discuss that it would be best to try to avoid the traffic, so one would need to plan to leave the accommodation at 09:00.

Day 3: Johannesburg to Durban (Amanzimtoti)

Students should note that there are flights hourly between JHB and DBN. This gives them a lot of flexibility in booking flights. Also the distance between Durban and Amanzimtoti is short, so it is a short day. What is more limiting are the afternoon flights from Durban to Port Elizabeth and the afternoon flights from Port Elizabeth to Cape Town, so they should ideally plan backwards from these.

Catch flight SA 539 from JHB: departs 09:00 arrives 10:10.
Estimated time of leaving JHB airport: 10:40.
Expected arrival time in Amanzimtoti: 11:40
Set meeting for 12:00 to 15:00 (this will need to include lunch).
Arrive back at Durban at about 16.00.
Can catch flight SA 678 to Port Elizabeth: departs Durban 17:30, arrives Port Elizabeth 18:50.
Stay overnight in Port Elizabeth.

Note that staying overnight in Durban will mean only leaving PE airport at about 10:05 and this may make it difficult to catch the last flight back to Cape Town on the next day.

Day 4: Port Elizabeth (Alexandria) to Cape Town.

Leave accommodation at about 09:00.
Expected arrival time in Alexandria: 10:00
Set meeting for 10:00 to 13:00.
Arrive back at Port Elizabeth at about 15.00 (allowing for a lunch break between 13:00 and 14:00).
Catch SA 665 back to Cape Town: departs PE at 16:10 and arrives CT at 17:25. Expect to be out of the traffic at 18:00 (which will mean avoiding the worst of the traffic).

Discuss with students that in reality they should think about whether it is possible for a meeting to span a lunch time – this depends on the nature of the meeting. Also, they should plan around whether the manager prefers to start the day early or work until late.

Activity 2 — Planning a multistage business trip

Remember that your manager needs to convene a series of meetings in different parts of the country, over the next month. She has asked you to set up the meetings and to make the travel arrangements. She gave you a list of towns in which the meetings need to be held.

> *Meeting places for the next month*
>
> Welkom in the Free State.
> Alexandria in the Eastern Cape.
> Brits in the North West.
> Amanzimtoti in Kwazulu-Natal.

She explained that they meetings will take about 3 hours each.

In the previous activity you worked out how far each of the towns is from the nearest airport city. Now let's think about booking the flight schedule. Before we can think about which flights to book, we need to work out the manager's programme each day and how much travelling time to allow for. This will help us to know whether the manager needs to stay in a particular city overnight or whether she can fly on the next city in the same day. It will also give us an idea about what times of the day to schedule the flights.

Do you remember that your manager works in Cape Town?

In Level 3 Activity 2 you found out that the following all take up time when you are flying to attend a meeting:

- Time for the meeting (in this example 3 hours).
- Time to collect luggage, get the hired car and leave the airport (about ½ hour).
- Time to get to the meeting venue (in these examples the venues are out of town).
- Time to journey back from the meeting.
- Check in 1 hour before the flight – deliver car etc.

You can write a number sentence that shows the times needed each day for this trip:

Meeting time + leaving airport + travelling time to venue + travelling time back from venue + check in time

[3 hours for meeting time] + [½ hour to get out of airport] + [travelling time to town – which changes with each town] + [travelling time from venue back to airport – which changes with each town] + [1 hour to check in]

= 3 + ½ + [time travelling to and back from town] + 1

= 4½ hours + [time travelling to and back from town]

But don't forget that in the big cities there is traffic congestion between 7.00 a.m. and 9 a.m. and also between 4.00 p.m. and 6.30 p.m.

2.1 Work out the number of hours your manager will need on each of the four days of meetings. Use the information about driving times from the table in the previous activity.

2.1.1 Amanzimtoti
2.1.2 Alexandria
2.1.3 Britz
2.1.4 Welkom

2.2 If the day is longer than 6 ½ hours, plan for the manager to sleep over. At which places should the manager sleep over?

2.3 Now plan a flight route.

2.4 Look at the flight times in the handout and decide on which flights to book the manager. You may find that the flight times impact back on your decisions about the flight route. You may need to change the flight plans. Write up an itinerary for the manager.

Your itinerary should include the following for each day:

- If flying on that day
- Where he/she is flying to;
- the flight number;
- the departure time;
- the arrival time.
- If not flying, when the manager should leave the accommodation.
- The time the meeting is scheduled for.
- The decision about whether the manager should stay overnight (based on the times calculated: you need to consider how long it will take to travel back — but the manager does not need this information).
- What time the manager should expect to get either to the accommodation or to the airport and the time of the next flight if flying out.

Also remember the following:

- Allow the manager to check the itinerary before finalising the tickets — s/he may want to make changes.
- Check whether your manager has a flying loyalty membership number, and use this when you book the ticket.

Flight times from Cape Town to Bloemfontein

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0600	0735	SA 1081	Nonstop
7	0800	0935	SA 1091	Nonstop
67	1230	1405	SA 1087	Nonstop
X67	1520	1655	SA 1083	Nonstop
X6	1710	1845	SA 1085	Nonstop
X67	0800	1240	SA 314/SA1005	JHB
X7	0940	1425	SA 322/SA1007	JHB
X67	1010	1425	SA 324/SA 1007	JHB
X1	1140	1615	SA 332/SA1009	JHB
1	1155	1615	SA 332	JHB

X – Except DLY daily 1- Mon 2 - Tues 3-Wed 4- Thurs 5- Fri 6-Sat 7-Sun

Flight times from Bloemfontein to Johannesburg

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0810	0945	SA 1372	Nonstop
6	0930	1105	SA 1378	Nonstop
7	1140	1315	SA 1362	Nonstop
X6	1455	1630	SA 1374	Nonstop
DLY	1900	2035	SA 1376	Nonstop
X67	0645	1210	SA 1412/ SA 323	Nonstop
X67	0800	1310	SA 462/ SA 327	Nonstop
7	0905	1410	SA 464/ SA 333	Nonstop
X7	1040	1610	SA 1406/ SA 343	Nonstop
DLY	1235	1710	SA 476/ SA 347	Nonstop
X5	1450	1940	SA 1406/ SA 359	

Flight times from Johannesburg to Durban

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0600	0710	SA527	Nonstop
X7	0700	0810	SA 531	Nonstop
DLY	0800	0910	SA 535	Nonstop
DLY	0900	1010	SA 539	Nonstop
DLY	1000	1110	SA 543	Nonstop
DLY	1100	1210	SA 547	Nonstop
DLY	1200	1310	SA 551	Nonstop
DLY	1300	1410	SA 555	Nonstop
DLY	1400	1510	SA 559	Nonstop
DLY	1500	1610	SA 563	Nonstop
DLY	1600	1710	SA 565	Nonstop
DLY	1700	1810	SA 571	Nonstop
DLY	1800	1910	SA 575	Nonstop
DLY	1900	2010	SA 579	Nonstop
X6	2000	2110	SA 581	Nonstop
DLY	2030	2140	SA 585	Nonstop

X – Except DLY daily 1- Mon 2 - Tues 3-Wed 4- Thurs 5- Fri 6-Sat 7-Sun

Flight times from Durban to Port Elizabeth

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0615	0735	SA 670	Nonstop
67	0815	1935	SA 690	Nonstop
X67	1015	1135	SA 672	Nonstop
67	1315	1435	SA 692	Nonstop
X67	1400	1520	SA 674	Nonstop
X6	1730	1850	SA 678	Nonstop
X7	0700	1055	SA 530/ SA 405	JHB
6	0840	1245	SA 538/ SA 413	JHB
6	1440	1035	SA 562/ SA 481	JHB

X – Except DLY daily 1- Mon 2 - Tues 3-Wed 4- Thurs 5- Fri 6-Sat 7-Sun

Flight times from Port Elizabeth to Cape Town

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0820	0935	SA 661	Nonstop
67	1000	1115	SA 681	Nonstop
X 67	1220	1335	SA 663	Nonstop
67	1500	1615	SA 683	Nonstop
X 67	1610	1725	SA 665	Nonstop
X6	1940	2055	SA 669	Nonstop

X – Except DLY daily 1- Mon 2 - Tues 3-Wed 4- Thurs 5- Fri 6-Sat 7-Sun

Check-in times:
Domestic passengers are requested to check in 90 minutes before departure. Domestic check-in closes 30 minutes before departure.

Activity 3 — Booking teleconferences and working with International time

ABOUT THIS ACTIVITY

In this activity students work with international time zones. We use the context of making phone calls to other parts of the world and booking teleconferences to explore how times zones impact on international business communication.

In this activity we ask student to plan the booking of a teleconferences. Before we telephone someone in another country we need to make sure that we phone them at a time which is appropriate to them, this includes checking on time differences between their city and ours. Students are asked to think about why there are time zones and to find out what the difference in times in between South Africa and various other places in order to book an international teleconference.

This activity prepares students to meet the requirements of the following outcomes of Unit Standard 9016:

- SO 1 Measure, estimate and calculate physical quantities AC 5; 7.
- SO 2 Explore, analyse & critique, describe and represent, interpret & justify geometrical relationships AC 8; 9; 10

MANAGING THIS ACTIVITY

Set question 3.1 for homework the day before the lesson. It is extremely useful for business administrators to be able to access information and services: to be able to look up information and to find their way around tables, charts and directories — both hard copies and internet versions. It will be more useful to the students if they have the experience of looking up the information on their own, than if they are given the information on a handout.

3.1 If students use the telephone directory they should first find the "business by phone: orders, faults and services" section in the telephone book. They should dial 10116 and ask for details about the service. They could also look up the information on the internet by going to *www.telkom.co.za*. In this instance it may be faster and cheaper to use the telephone and find out from the telephone operator.

You need to dial 10116 and provide the operator with the following information:

- the date and time of the call;
- who (which telephone number) is going to pay for the call — this must be a Telkom landline; and
- the names and telephone numbers of all the participants.

3.1.1 Yes, you can include up to 24 telephone numbers anywhere in the world.

3.2 Students need to phone, fax or email all the participants to set a time which is mutually agreeable to all of them. It is useful to be able to tell people how long the call will be — try to find this out from the manager. Once a suitable time has been established, you need to email, fax or phone all participants to confirm the time. Participants may also like to get an agenda about the meeting.

3.3 Students must take account of international time zones.

3.4.1 Countries that have the same times are all on the same time zones. Countries that are far to the East or West of each other are on different time zones.

3.4.2 The earth rotates on its own axis. This has the effect that at any one time some parts of the world are exposed to the sun and experience day, whilst other parts of the world face away from the sun and experience night. In between those places that are experiencing midday and midnight, are places where it is becoming morning, afternoon and evening. Time zones are based on the geographical and physical relationship between the earth and the sun.

You may find it useful to demonstrate this to students using a torch and a ball on which you can draw the continents, before they look at a flat map with time zones marked on it.

We understand midday to be the time when the sun is highest overhead. We call this time "12 noon". Because we want this to be the same everywhere in the world, so we have divided the world into zones. Zones are strips of earth that lie in a North-South direction. People within that strip have their watches set to the same time. People in other strips have their watches set to other times. This way everyone experiences 12-noon as midday: when the sun is highest overhead.

We could change the conventions and make it 08h00 at the same time throughout the world — but then 08h00 would mean different things to different people, it could then be the middle of the night for some people.

3.4.3 If a country is very wide, we say that it has a large landmass lying in an Easterly – Westerly direction. Such countries will be crossed by many lines of longitude and they will have many time zones running across them.

You can refer to the time zones map on Handout 3 whilst pointing out the following to students:

- in the United States when it is 9 a.m. in San Francisco, it is already 12 noon in Washington.
- in Australia when it is 6 p.m. in Perth, it is already 8 p.m. in Sydney.

3.5.1 Students need to do this practically.

3.5.2 Cairo – Egypt; Kinshasa – Zaire; Washington – USA; New York – USA; San Fransisco – USA; London – Britain; Lisbon – Spain.

3.5.3 Students will use the time zones to complete the table below:

Place	Times					
South Africa	8 a.m.	10 a.m.	12 a.m.	2 p.m.	4 p.m.	5 p.m.
Cairo	8 a.m.	10 a.m.	12 a.m.	2 p.m.	4 p.m.	5 p.m.
Kinshasa	7 a.m.	9 a.m.	11 a.m.	1 p.m.	3 p.m.	4 p.m.
Washington	1 a.m.	3 a.m.	5 a.m.	7 a.m.	9 a.m.	10 a.m.
New York	1 a.m.	3 a.m.	5 a.m.	7 a.m.	9 a.m.	10 a.m.
San Francisco	10 p.m.	12 midnight	2 a.m.	4 a.m.	6 a.m.	7 a.m.
London	6 a.m.	8 a.m.	10 a.m.	12 noon	2 p.m.	3 p.m.
Lisbon	6 a.m.	8 a.m.	10 a.m.	12 noon	2 p.m.	3 p.m.

3.6.1 At 5 pm in South Africa, it is 8 a.m. in San Francisco. If people work from 8 a.m. to 5 p.m, then at least one of the groups will have to come in early or stay late, because talk time needs to be allowed for.

3.6.2 The only times that the teleconference could be arranged is for 4 p.m. South African time (then the person in San Francisco will need to come in at 7 a.m.) or for 5 p.m. South African time and then the South African and the person from Cairo will need to stay at work until after 5 p.m.

3.7

South Africa	8 a.m.	10 a.m.	12 a.m.	2 p.m.	4 p.m.	5 p.m.
Perth	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10 p.m.	11 p.m.
Sydney	4 p.m.	6 p.m.	8 p.m.	10 p.m.	11 p.m.	1 a.m.
Nairobi	9 a.m.	11 a.m.	1 p.m.	3 p.m.	5 p.m.	6 p.m.

3.7.1 Perth – you could phone between 8 a.m. and 11 a.m. South African time.

3.7.2 Sydney – you could phone between 8 a.m. and 9 a.m. South African time.

3.7.3 Nairobi – you could phone between 8 a.m. and 4 p.m. South African time.

3.8 24 hour time.

3.8.1

12 hour analogue time	24 hour digital time
12 p.m.	24h00
1 a.m.	01h00
2 a.m.	02h00
3 a.m.	03h00
4 a.m.	04h00
5 a.m.	05h00
6 a.m.	06h00
7 a.m.	07h00
8 a.m.	08h00
9 a.m.	09h00
10 a. m.	10h00
11 a.m.	11h00
12 a.m.	12h00
1 p.m.	13h00
2 p.m.	14h00
3 p.m.	15h00
4 p.m.	16h00
5 p.m.	1700
6 p.m.	1800
7 p.m.	1900
8 p.m.	2000
9 p.m.	21h00
10 a. m.	22h00
11 p.m.	23h00

3.8.2

Cape Town	09:20	13:40	18:00	20:34
Kinshasa	08:20	12:40	17:00	19:00
New York	02:20	06:40	11:00	13:00

3.9.1 10:45 South African time.

3.9.2 Allow about 2 hours for her to clear customs. It will probably be safe to telephone her after about 13:00 South African time.

Optional additional task:
You can also ask students to find out about 3-way calls. Three-way calls can be done without booking. However, they do still require co-ordinating times with the participants. There are two options for three-way calls:

- dialling the other two numbers; or
- using a speaker phone, if two of the participants are at one venue.

Similar tasks to those in the activity above could be developed for 3-way calls. More details of 3-way calls can be found in the telephone directory.

Activity 3 — Booking teleconferences and working with international time

Your manager asks you to book two different teleconferences for sometime in the next week.

Teleconference A to include the following people:

- Ms Moseneke – 012 – 538 4662
- Dr Mahlangu – 031- 763 5110
- Mr Edwards – 0466 - 52151
- Ms Gefoor – 021 – 786 2426

Teleconference B to include the following people:

- Mr Amien in Cairo
- Mr Katz in Washington
- Ms Armaretti New York
- Dr Lejeur in San Francisco
- Mr Penny in Perth
- Ms Wong in Sydney
- Ms Naidoo in Nairobi

3.1 Use the Telkom Phone Book or telephone directory to find out what number to dial to find out how to set up a teleconference.

3.1.1 Can you include international and local numbers in the same teleconference? You will find the answer in the Telkom Phone Book.

3.2 Let's start with teleconference A. You have been given the telephone numbers of all the participants. Assume that your office will pay for the call. List the steps that you would take to set the time of the call.

3.3 There is one additional step or set of information that you must find out or consider when you try to set the time of an international teleconference. This applies to many internationals calls and many other internationals dealings. What extra information do you need to consider?

3.4 Let's think about time internationally.

3.4.1 The time is always the same everywhere in South Africa. South African time is the same as Namibian time. However, when it is midday in South Africa it is not midday in Kenya, India, China, Australia, the USA etc. Why is this? You can find the answer in the map in Handout 3.

3.4.2 Why do we have time zones? Why isn't everyone on the same time?

3.4.3 South Africa is on one time zone, why do some countries have more than one time zone.

3.5 Teleconference B will include people from 7 cities that are outside South Africa.

3.5.1 Find each of the cities on the map in Handout 3.

3.5.2 Now find out which countries each of the cities are in.

3.5.3 The map in Handout 3 shows the times in different parts of the world when it is 12 noon or midday in South Africa.

Complete the table below to show how the 8 hour work day in South Africa relates to the time in the cities above. You can start by filling in the times shown on the map in Handout 3.

Place	Times					
South Africa	8 a.m.	10 a.m.	12 a.m.	2 p.m.	4 p.m.	5 p.m.
Cairo	8 a.m.					
Kinshasa	7 a.m.					4 p.m.
Washington	1 a.m.			7 a.m.	9 a.m.	
New York						
San Fransisco	10 p.m.					
London	6 a.m.					3 p.m.
Lisbon						

3.6 You need to set the teleconference up while people are at work.

3.6.1 List possible South African times at which people in all those places will be at work.

3.6.2 What is the most suitable time of day in South Africa for the teleconference?

3.7 Your manager now asks you to phone people in the cities below. Remember, you need to find times when both South Africans and the people you are phoning are at work. What possible South African times between 8 a.m. and 5 p.m could you phone someone in:

3.7.1 Perth?

3.7.2 Sydney?

3.7.3 Nairobi?

You may want to draw up a similar table to the one in question 3.5.3 to work out the possibilities.

3.8 So far, we have been working with 12-hour time. We have shown the differences between mornings and evenings by writing a.m. (mornings) and p.m. (evenings). We can also write time by using 24-hour time notation.

3.8.1 Copy and complete Table 2 from the handout.

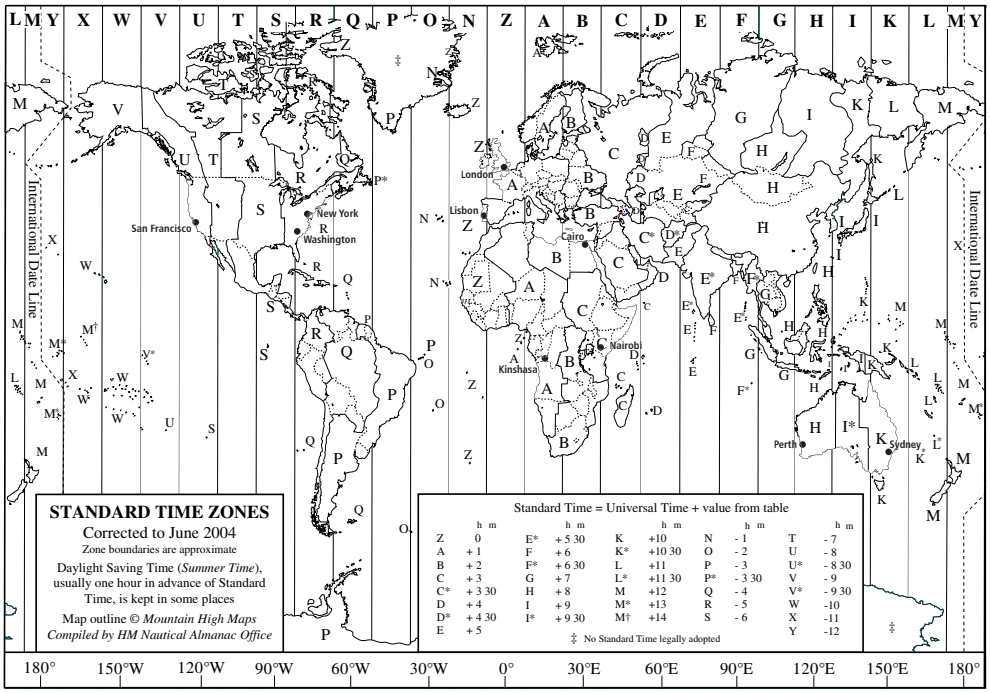
3.8.2 Instead of writing 12h00; 13h40; 16h23 etc. you can write 12:00; 13:40; 16:23. In the table below we give times in Cape Town. Write down, using 24-hour digitial time, the times in the other places.

Cape Town	09:20	13:40	18:00	20:34
Kinshasa		12:40		
New York		06:40		

3.9 Your manager is flying to London. It will be 08:45 (London time) when she arrives at Heathrow airport.

3.9.1 What time will this be in South African time?

3.9.2 You need to phone her with an urgent message. After what time (South African time) could you telephone her?



12 hour analogue time	24 hour digital time
12 p.m.	24h00
	01h00
2 a.m.	
	03h00
4 a.m.	04h00
	05h00
	06h00
	07h00
8 a.m.	
9 a.m.	
10 a. m.	
11 a.m.	11h00
12 a.m.	
1 p.m.	13h00
2 p.m.	14h00
	15h00
4 p.m.	
5 p.m.	
6 p.m.	
7 p.m.	
	2000
9 p.m.	
10 a. m.	
11 p.m.	

Activity 4 — Working with a candle co-operative

ABOUT THIS ACTIVITY

In this activity students are developing their mathematical literacy around the concept of volume. They have worked with volumes in

- Level 2 Activity 5 where they worked with the volume of cuboids.
- Level 3 Activity 5 where they worked with the volumes of cylinders.

In this activity they work with the volumes of these and other objects.

They also think about how the context impacts on rounding off.

This activity develops students competencies to meet the requirements of Unit Standard 9016 . It will help students to meet the following Assessment Criteria:

- SO 1 Measure, estimate and calculate physical quantities: AC 2; 5; 6; 7.
- SO 2 Explore, analyse & critique, describe and represent, interpret & justify geometrical relationships AC 1; 2; 4; 5; 6; 7; 8; 9; 10.

MANAGING THIS ACTIVITY

Students should be given Worksheet 4 and a copy of Handout 4.

One way to think about the volume of cubes and cuboids is to think of it as the area of the base multiplied by the height of the object. We can work out the volume of right prisms and all objects whose sides are at right angles to their base in this same way. Help students to see that this can help them to remember the formula for the volume of a cylinder when they get to question 5.6.

In this activity students work out the volumes of candles of the same shape in three different sizes. This means that they repeat the calculations using different numbers. It is an ideal opportunity for them to use an electronic spread sheet package, if you have access to computers at your college. Learning how to do repeative calculations on a spread sheet is an important mathematical literacy skill.

4.1 Check that students know how to calculate the volume of a cuboid. They learned this in Level 2 Activity 5. The following forms of expressions all describe how to find the volume of a cuboid. Check that students can work with all of them.

- Length × breadth × height
- width × thickness × height
- length × depth × height

One block of wax has a volume of:
width × thickness × height = 5 cm × 30 cm × 50 cm = 7500 cm^3.

4.2 A box of 5 blocks of wax has a volume of 5 × 7500 cm3 = 37500 cm^3.

4.3 A box of 5 blocks of wax costs: 5 × R200 = R1 000.

4.4 Volumes of cubic candles:

4.4.1 Volume of small cubic candle: l × b × h = 5 cm × 5 cm × 5 cm = 125 cm^3.

4.4.2 Volume of medium cubic candle: l × b × h = 10 cm × 10 cm × 10 cm = 1 000 cm^3.

4.4.3 Volume of large cubic candle: l × b × h = 15 cm × 15 cm × 15 cm = 3 375 cm^3.

4.4.4 The volume increased by 8 times. This is because you have multiplied each of the dimensions by two: 2l × 2b × 2 h = 8 (l × b × h).

4.4.5 The volume increased by 27 times. This is because you have multiplied each of the dimensions by three: 3l × 3b × 3h = 27(l × b × h).

4.5 Cuboidal candles:

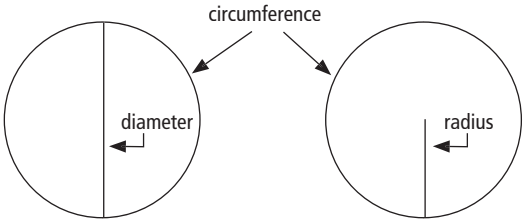
4.5.1 Volume of small cubiodal candle: l × b × h = 5 cm × 5 cm × 10 cm = 250cm^3.

4.5.2 Volume of medium cuboidal candle: = 10 cm × 10 cm × 20 cm = 2 000 cm^3.

4.5.3 Volume of large cuboidal candle: 15 cm × 15 cm × 25 cm = 5625 cm^3.

4.6 Cylindrical candles:
Before students work with the formulae for the volume of the cylinders, cones and sphere, you many need to remind them about what they know about parts of a circle and finding the area of a circle.

Parts of a circle



In level 3 Activity 4 they worked with the area of circles. They learned about the names of parts of the circle the circumference/perimeters of circles, diameters, and radii.

The base of any cylinder is a circle. The area of a circle = πr^2 . This means you take the value of the radius and square this number, then multiply by π. To help students understand and remember the formula for the volume of a cylinder, you could help them to understand that it is the area of the circular base multiplied by the height of the cylinder. To get the volume of the cylinder you multiply the area of the base of the cylinder by its height.

The formula for the volume of a cylinder is: $\pi r^2 \times h$.

The values we use for in calculations are an approximation of the real value of π.
Many people use the fraction $\frac{22}{7}$ as the value of π, but this is a very poor approximation.
We suggest that students use the value provided by their electronic calculators. If students do not have scientific calculators with a function on them, and they use the approximation $\frac{22}{7}$ their answers will be slightly bigger than those given below.

4.6.1 Volume of small cylindrical candle $\pi r^2 h = \pi \times 1{,}75 \times 1{,}75 \times 10 = 96{,}211275$ cm^3, which they can round to 96,2 cm^3.
4.6.2 Volume of medium cylindrical candle $\pi r^2 h = 577{,}26765$ which they can round off to 577,3 cm^3.
4.6.3 Volume of large cylindrical candle $\pi r^2 h = 3078{,}7608$ cm^3 which they can round off to 3079 cm^3.

4.7 Conical candles:

4.7.1 Volume of small conical candle: $\frac{1}{3}\pi r^2 h. = \frac{1}{3}\pi \times 1{,}75 \times 1{,}75 \times 10 = 31{,}070425$ cm^3 which they can round off to 32,1 cm3.

4.7.2 Volume of medium conical candle: $\frac{1}{3}\pi r^2 h = \frac{1}{3}\pi \times 3{,}5 \times 3{,}5 \times 15 = 192{,}42255$ cm^3 which they can round off to 192,4 cm3.

4.7.3 Volume of large conical candle: $\frac{1}{3}\pi r^2 h = \frac{1}{3}\pi \times 7 \times 7 \times 20$ cm3 = 1026,2536 cm^3 which they can round off to 1026,3 cm3.

4.8 Spherical candles:

4.8.1 Volume of small spherical candle: $\frac{4}{3}\pi r^3 = \frac{4}{3}\pi \times 1{,}75 \times 1{,}75 \times 1{,}75 = 22{,}449298$ cm^3 which they can round off to 22,5 cm^3.

4.8.2 Volume of medium spherical candle: $\frac{4}{3}\pi r^3 = \frac{4}{3}\pi \times 3{,}5 \times 3{,}5 \times 3{,}5 = 179{,}59438$ cm^3 which they can round off to 180 cm^3.

4.8.3 Volume of large spherical candle: $\frac{4}{3}\pi r^3 = \frac{4}{3}\pi \times 7 \times 7 \times 7 = 1436{,}755$ which they can round off to 1437 cm^3.

4.8.4 If you double the length of the radius you increase the volume of a sphere about 8 times. This is because you work with the radius cubed when calculating the volume of a sphere. Doubling is the same as multiplying by two and $2 \times 2 \times 2 = 8$.

4.9.1

Shape of candle		Volume of one candle (cm^3)	Volume of 20 candles (cm^3)	Volume of 20 candles of all 3 sizes (cm^3)
Cubic candles	small	125	2 500	90 000
	medium	1 000	20 000	
	large	3 375	67 500	
Cuboidal candles	small	250	5 000	157 500
	medium	2 000	40 000	
	large	5 625	112 500	
Cylindrical candles	small	96,2	1 924	75 046
	medium	577,3	11 546	
	large	3 078,8	61 576	
Conical candles	small	32,1	642	25 016
	medium	192,4	3 848	
	large	1 026,3	20 526	
Spherical candles	small	22,5	450	32 790
	medium	180	3 600	
	large	1 437	28 740	
Total volume of all candles				380 352

4.9.2

Total number of blocks of wax needed	380 352 cm^3 ÷7 500 cm^3 = 50,7136. This should be rounded up to 51 blocks.
Total cost of wax	51 × R200 = R10 200

To work out the number of blocks of wax they need, students should divide (the volume of wax needed for all of the candles) by (the volume of one block of wax). The answer will usually be a decimal fraction. As this is the least amount of wax they will need they should always round the answer up to the nearest whole block of wax.

Activity 4 — Working with a candle making co-operative

Your company is assisting a candle-making co-operative, run by HIV positive mothers. The company has offered to pay for the wax for a six month period. Your manager has asked you to calculate the cost of the wax.

The women in the co-operative would like to make candles that look like cubes, cuboids, spheres, cylinders and cones. They want to make three different sizes of each shape of candle.
Wax is sold in 25 kg blocks. They have the following dimensions:

- 30 cm wide
- 5 cm thick
- 50 cm high

These cost R200 each. You can buy a box of 5 wax blocks.

4.1 What is the volume of each block of wax?

4.2 What is the volume of each box of 5 blocks of wax?

4.3 What does a box of 5 blocks of wax cost?

Let's think now about how much wax we need for the different candles. The sizes of the candles are given in Handout 5. The formulae to find the volumes of the candles are also given in Handout 5.

4.4 Let's start with candles that are shaped like cubes.
All the sides of a cube are the same size.
Let's work out the volumes of cube –shaped candles or cubic candles of the three different sizes shown on the handout.

4.4.1 Small cubic candle

4.4.2 Medium cubic candle

4.4.3 Large cubic candle

4.4.4 Look at their volumes together – what happens to the volume of the candle when you double the size of the edges of the candle?

4.4.5 What happens to the volume of the candle when you triple the size of the edges of the candle?

4.5 Let's work out the volumes of cubiod –shaped candles or cubiodal candles of the three different sizes shown on the handout.

4.5.1 Small cuboidal candle

4.5.2 Medium cubiodal candle

4.5.3 Large cubiodal candle

4.6 Let's work out the volumes of candles shaped like cylinders or cylindrical candles of the three different sizes shown on the handout. Do you remember the formula for working out the volume of a cylinder: $\pi r^2 h$. You used this when you calculated the volume of urns in Level 3. Can you still see that it includes the formula for the area of a circular base multiplied by the height of the cylinder?

4.6.1 Small cylindrical candle

4.6.2 Medium cylindrical candle

4.6.3 Large cylindrical candle

4.7 Let's work out the volumes of cone –shaped candles or conical candles of the three different sizes shown on the handout.

4.7.1 Small conical candle

4.7.2 Medium conical candle

4.7.3 Large conical candle

4.8 Let's work out the volumes of sphere –shaped candles or spherical candles of the three different sizes shown on the handout.

4.8.1 Small spherical candle

4.8.2 Medium spherical candle

4.8.3 Large spherical candle

4.8.4 Look at their volumes together – what happens to the volume of the candle when you double the length of the radius of the candle?

4.9 The co-op wants to make 20 of each size of each type of candle.

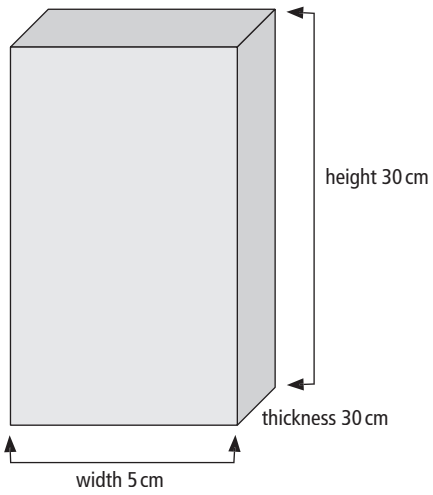
4.9.1 How much wax will they need? Fill in the table below to show how much wax they need in cubic centimetres.

Shape of candle		Volume of one candle	Volume of 20 candles	Volume of 20 candles of all 3 sizes
Cubic candles	small			
	medium			
	large			
Cuboidal candles	small			
	medium			
	large			
Cylindrical candles	small			
	medium			
	large			
Conical candles	small			
	medium			
	large			
Spherical candles	small			
	medium			
	large			
Total volume of all candles				

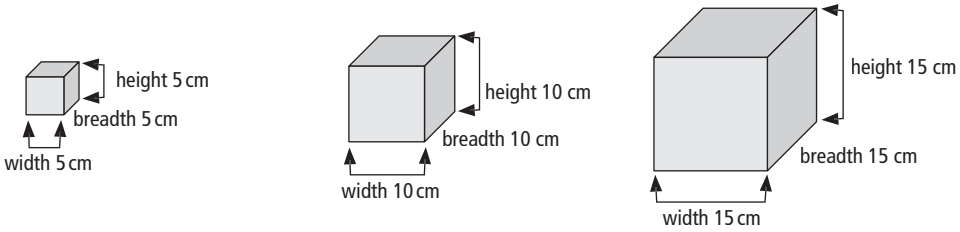
4.9.2 Now calculate how many blocks of wax this will be. Finally, estimate the cost of this wax.

Total number of blocks of wax needed	
Total cost of wax	

Block of wax

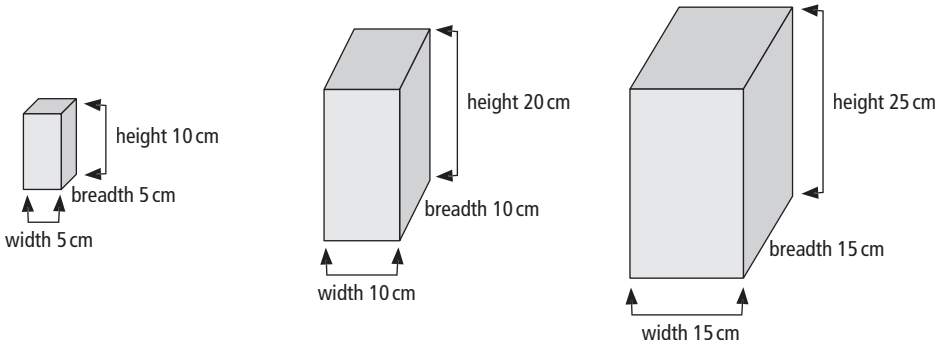


Candles shaped like cubes
We call candles shaped like cubes, cubic candles. All their edges are the same size.



small cubic candle medium cubic candle large cubic candle

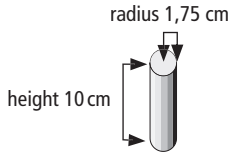
Candles shaped like cubiods.
We call candles shaped like cubiods, cubiodal candles. In a cuboid some sides are squares and some sides are rectangles.



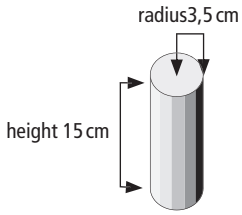
small cubiodal candle medium cubiodal candle large cubiodal candle

Candles shaped like cylinders

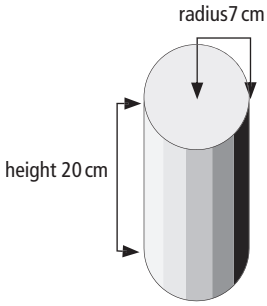
We call candles shaped like cylinders, cylindrical candles. Cylinders have circles for a base.



small cylindrical candle



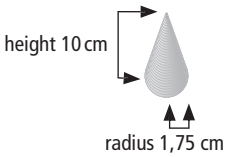
medium cylindrical candle



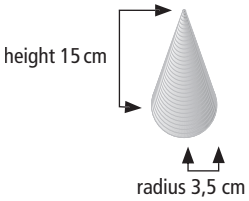
large cylindrical candle

Candles shaped like cones

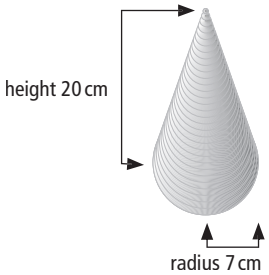
We call candles shaped like cones, conical candles. Cones have circles for a base.



small conical candle



medium conical candle



large conical candle

Candles shaped like spheres

We call candles shaped like spheres, spherical candles.

small spherical candle

medium spherical candle

large spherical candle

Formulae for the volume of some mathematical objects

Mathematical name for shape of candle	Shape of base of candle	Formula for area of base of candle	Formula for volume of candle
cube	square	$L \times b$	$L \times b \times h$
cuboid	Square/rectangle	$L \times b$	$L \times b \times h$
cylinder	circle	πr^2	$\pi r^2 h$
cone	circle	πr^2	$\frac{1}{3} \pi r^2 h$
sphere			$\frac{4}{3} \pi r^2$

Activity 5 — Finding volumes of different shapes

ABOUT THIS ACTIVITY

In this activity students extend what they learned in the previous activity about calculating volumes of candles with different shapes. However, before students can find the volumes of the candles, they must first find the area of the base of each candle. To do this they need to explore the shapes of the candles.

Students draw the candles from different views. This allows them to see that the sides of all these candles are rectangles, but that one type of candle has a triangle on the top and bottom, another kind of candle has a hexagon on the top and bottom and the third kind of candle has an octagon on the top and bottom of the candle.

One set of candles are shaped like triangular prisms: they have triangles as their base. To work out the area of a triangle students need to use Pythagoras Theorem.

They also think about how the context impacts on rounding off.

This activity develops students' competencies to meet the requirements of Unit Standard 9016. It will help students to meet the following Assessment Criteria:

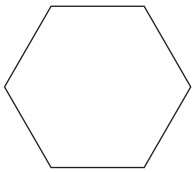
- S.O. 1 Measure, estimate and calculate physical quantities: AC 2; 5; 6; 7.
- S.O. 2 Explore, analyse & critique, describe and represent, interpret & justify geometrical relationships AC 1; 2; 3; 4; 5;6; 7; 8; 9; 10.

MANAGING THIS ACTIVITY

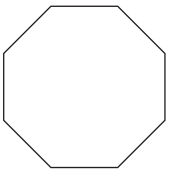
Students should be given Worksheet 5. When students have completed question 5.3 they can get a copy of Handout 5. Question 5.6 is more complicated than questions 5.4 and 5.5 .When students get to question 5.6, you will need to help them to understand the following:

- The difference between the height of the candle and what is called the height of the base of the candle.
- How to calculate the height of the base of the triangle.
- How to use this to calculate the area of the triangle, that is the base of the candle.
- How to calculate the volume of the candle.

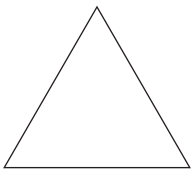
5.1 Top views



candle shaped like hexagonal prism



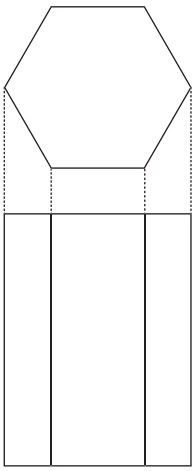
candle shaped like octagonal prism

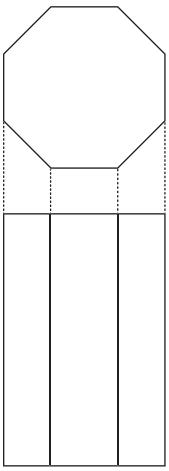


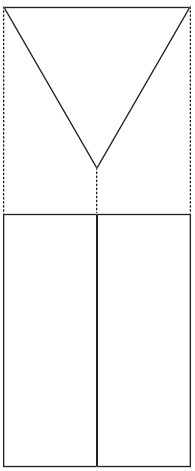
candle shaped like triangular prism

Side views

All the side views are the same. As all the sides of the candles are rectangles. However, some students may draw slightly more oblique views which show more than one side of the candle at any one time. These drawings are also acceptable.







5.2 When students draw the top views they will easily see that the tops of each of the candles have a different shape. The bottom of each of the candles is the same shape as the top of that particular candle. Mathematically we call the bottom of shapes the base. Student's drawings will show that the first candle has a hexagon for the base, the second has an octagon for the base, and the third has a triangle for a base. Because the shapes of the bases of the candles are different, the candles also have different numbers of sides. In mathematics we use the term "face" for the flat sides of three dimensional objects.

The 1st candle has 6 sides. Mathematically we say the hexagonal prism has 6 vertical faces. The top and bottom of the candle are also faces. So there are 8 faces altogether.

The 2nd candle has 8 sides. Mathematically we say the octagonal prism has 8 vertical faces. The top and bottom of the candle are also faces. So there are 10 faces altogether.

The 3rd candle has 3 sides. Mathematically we say the triangular prism has 3 vertical faces. The top and bottom of the candle are also faces. So there are 5 faces altogether.

5.3 The vertical faces of all three types of candles are rectangles.

In the sample candles shown, all edges of the hexagonal base faces are the same length, and all the edges of octagon base are the same length, and all the edges of the the triangular base are the same length. In mathematics, we call these shapes whose edges are all the same length "regular". The base of each of the candles is a regular shape.

Students can see from Handout 5, that the 3 shorter candles are the same length, namely 15 cm, and the 3 taller candles are the same length, namely 20 cm.

Volumes of candles shaped like right prisms

Before students begin do to the rest of the calculations talk with them about how to calculate the volume of the candles. In these candles the base of the candle is at right angles to the sides of the candle. We call such objects right prisms. We can calculate the volume by multiplying the area of the base by the height of the object.

5.4 Volume of candles shaped like hexagonal prisms
Note: the expression given In Handout 5 for calculating the area of a hexagon is a simplified expression that works only for regular hexagons, that is for hexagons in which all the sides are the same length. It is also a decimal approximation of the values. The more general formula for the area of any hexagon is much more complex.

5.4.1 Volume of small candle shaped like a hexagon
$3{,}4641 \times \text{side}^2 \times \text{height} = 3{,}4641 \times 32 \times 15 = 3{,}4641 \times 9 \times 15 = 467{,}6535\ \text{cm}^3$.
This can be rounded to $467{,}7\ \text{cm}^3$.

5.4.2 Volume of large candle shaped like a hexagon cm3.
$3{,}4641 \times \text{side}^2 \times \text{height} = 3{,}4641 \times 42 \times 20 = 3{,}4641 \times 16 \times 20 = 1108{,}512\ \text{cm}^3$.
This can be rounded to $1108{,}5\ \text{cm}^3$.

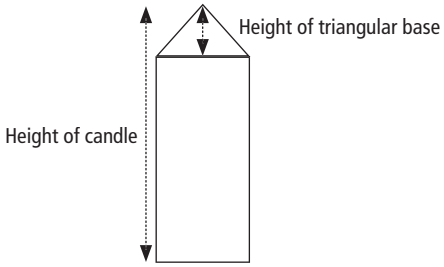
5.5 Volume of candles shaped like octagonal prisms
Note: Just as we simplified the expression for calculating the area of a hexagon so too have we simplified the expression for calculating the area of an octagon. It will only work for regular octagons, that is for octagons in which all the sides are the same length. The more general formula for the area of any octagon is much more complex.

5.5.1 Volume of small candle shaped like an octagon
$5{,}6569 \times \text{side}^2 \times \text{height} = 5{,}6569 \times 32 \times 15 = \times 9 \times 15 = 763{,}6815\ \text{cm}^3$.
This can be rounded to $763{,}7\ \text{cm}^3$.

5.5.2 Volume of large candle shaped like an octagon cm3
$5{,}6569 \times \text{side}^2 \times \text{height} = 5{,}6569 \times 42 \times 20 = 5{,}6569 \times 16 \times 20 = 1810{,}208\ \text{cm}^3$.
This can be rounded to $1810{,}2\ \text{cm}^3$.

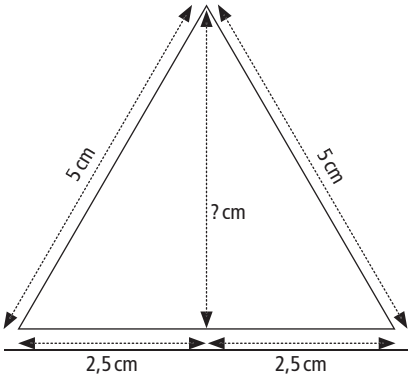
5.6 Volumes of candles shaped like triangular prisms:
To work out the volume of the candles, students first need to work out the area of the triangular base.
To work out the area of the triangular base, students first need to work out the height of the base triangle.
This means that students need to calculate the following in the order stated below:
(1) the height of the triangle
(2) the area of the triangular base
(3) the volume of the triangular candle

You may need to check that students are not confused by the concepts of the height of the candle, and the height of the base of the triangle.

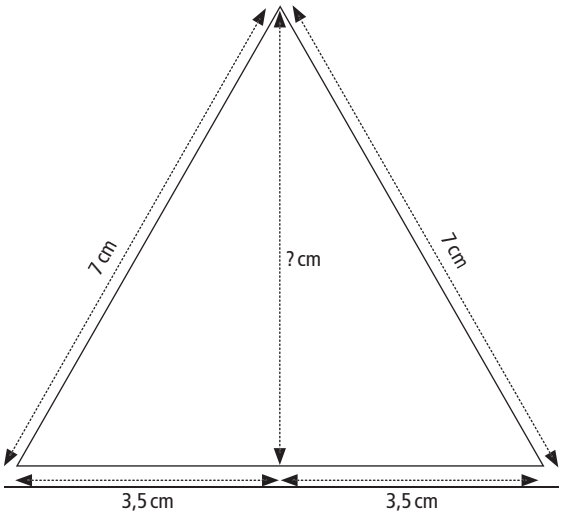


The line that divides an equilateral triangle in half from one corner to the opposite side, will also give you the height of the triangle. This line will also make a 90º angle with the opposite side of the triangle.

To calculate the height of the triangle students need to divide the triangle in half. You can demonstrate this with paper cut-outs of the triangle drawn to size.



Small triangular base



Large triangular base

To calculate the height of the triangles, students need to use Pythagoras Theorem. Pythagoras Theorem states that the (length of the hypotenuse)2 = (length of side 1)2 + (length of side 2)2. The hypotenuse is the side opposite the right angle.

To get the length of the line that is the height of the triangle, students can think of the triangle that they divided in half

(length of the hypotenuse)^2 = (length of side they divided in half)^2 + (height of triangle)^2.

So (height of triangle)^2 = (length of the hypotenuse)^2 – (length of side they divided in half)^2

Then they can take the square root of both sides.

5.6.1 Height of the base of the small candle with the triangular base:

(height of triangle)^2 = 52 – 2,52 = 25 – 6,25 = 18,75

take the square root of both sides

height of small triangle = $\sqrt{18,25}$ = 4,330127 = 4,3

5.6.2 Area of base of small candle with triangular base

$= \frac{1}{2}$ (base of triangle × height of triangle) = $\frac{1}{2}$ (5cm × 4,3cm)

5.6.3 Volume of small candle shaped like a triangular prism:

area of base of triangle × height of candle

$= \frac{1}{2}$ (base of triangle × height of triangle) × height of candle

$= \frac{1}{2}$ (5cm × 4,3cm) × 15 = 161,25 cm^3

5.6.4 Height of the base of the large candle with the triangular base:
(height of triangle)^2 = 72 – 3,52 = 49 – 12,25 = 36,75
take the square root of both sides
height of large triangle = $\sqrt{36,75}$ = 6,06217878 ≈ 6,1

5.6.5 Area of base of small candle with triangular base
= $\frac{1}{2}$ (base of triangle × height of triangle) = ½ (7cm × 6,1cm)

5.6.6 Volume of large candle shaped like a triangular prism:
area of base of triangle × height of candle
= $\frac{1}{2}$ (base of triangle × height of triangle) × height of candle
= $\frac{1}{2}$ (7 cm × 6,1 cm) × 20 = 427 cm^3.

5.7.1

Shape of candle		Volume of one candle (cm^3)	Volume of 20 candles (cm^3)	Volume of 20 candles of all three sizes (cm^3)
Hexagonal prism	small	467,7	9 354	31 524
	large	1 108,5	22 170	
Octagonal prism	small	763,7	15 374	51 578
	large	1 810,2	36 204	
Triangular prism	small	161,25	3 225	11 765
	large	427	8 540	
Total volume of wax needed				94 864

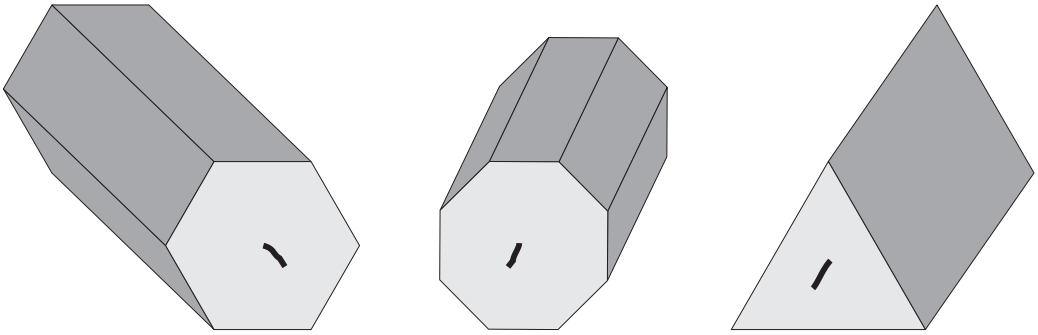
5.7.2 Students should remember from Activity 5 that one block of wax has a volume of:
Width × thickness × height: 5 cm × 30 cm × 50 cm = 7500 cm^3.

To work out the number of blocks of wax they need, students should divide (the volume of wax needed for 20 of both sizes of candles) by (the volume of one block of wax). The answer will usually be a decimal fraction. As this is the least amount of wax they will need they should always round the answer up to the nearest whole block of wax.

Total number of blocks of wax needed	94 864 cm^3 ÷7 500 cm^3 = 12,648933 This should be rounded up to 13 blocks.
Total cost of wax	13 × R 200 = R 2 600

Activity 5 — Finding volumes of different shapes

The women in the co-operative say that they are getting frequent requests for candles of different shapes. They bring you the following as sample candles. They would like to know how much wax they need to make candles with the following shapes.



They would like you to help them to work out the cost of two sizes of each type of candle.
But first let's think about the shapes of the candles. All these candles are lying on their sides. Imagine that the candles were standing upright.

5.1 Draw each candle from directly above and also from two different sides. This will help you to see better what the shapes of the candles are.

5.2 What is different about each of the candles above?

5.3 What is the same about each of the candles above?

Let's think now about how much wax we need for the different candles. The sizes of the candles are given in Handout 5.

You can find out how to calculate the area of the base of the candles in Handout 5. To work out the volume all you need to do is to multiply by the height.

5.4 Let's start with candles whose top and bottom are shaped like hexagons. We say that these candles are shaped like hexagonal prisms.

5.4.1 Small candle in the shape of a hexagonal prism

5.4.2 Large candle in the shape of a hexagonal prism

5.5 Let's work out the volumes of candles whose top and bottom are shape like octagons. We say that these candles are shaped like octagonal prisms

5.5.1 Small candle in the shape of a octagonal prism

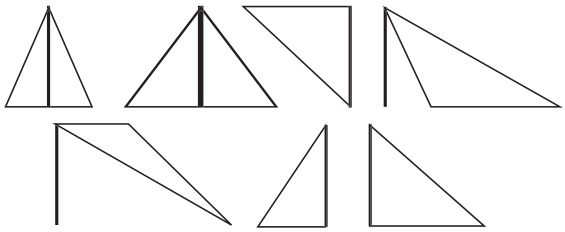
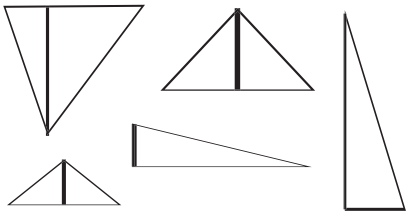
5.5.2 Large candle in the shape of a octagonal prism

5.6 Let's work out the volumes of candles that have a triangle for the top and the bottom (base) of the candle. We say that these candles are shaped like triangular prisms.

The handout explains that to work out the area of a triangle you use the formula:

$\frac{1}{2}$ (base of triangle) × height of triangle

But we first need to understand what is meant by the height of a triangle.

These triangles have the same height (the thick black line shows the height of the triangle – it is measured at 90º to the base of the triangle)	
These triangles have different heights (the thick black line shows the height of the triangle – it is measured at 90º to the base of the triangle)	

To find the height of a triangle whose sides are all equal, you can cut out the triangle and fold it in half along the base. You can then use Pythagoras Theorem to calculate the height of the triangle.

5.6.1 Calculate the height of the base of small candle shaped like a triangular prism.

5.6.2 Calculate the area of the base of the small candle shaped like a triangular prism.

5.6.3 Calculate the volume of the small candle shaped like a triangular prism.

5.6.4 Calculate the height of the base of large candle shaped like a triangular prism.

5.6.5 Calculate the area of the base of the large candle shaped like a triangular prism.

5.6.6 Calculate the volume of the large candle shaped like a triangular prism.

5.7 The co-op wants to make 20 of each size of each type of candle.

5.7.1 How much wax will they need? Fill in the table below to show how much wax they need in cubic centimetres.

Shape of candle		Volume of one candle	Volume of 20 candles	Volume of 20 candles of all 3 sizes
Hexagonal prism	small			
	large			
Octagonal prism	small			
	large			
Triangular prism	small			
	large			
Total volume of wax needed				

5.7.2 Now calculate how many blocks of wax this will be. Finally, estimate the cost of this wax.

Total number of blocks of wax needed	
Total cost of wax	

Remember that wax is sold in 25 kg blocks. These blocks of wax cost R200 each.

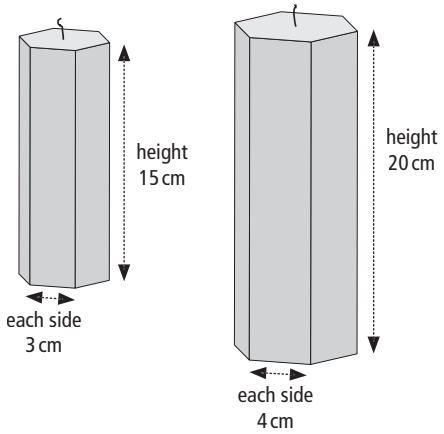
The blocks have the following dimensions: 30 cm wide; 5 cm thick; 50 cm high

How to find the volumes of the candles

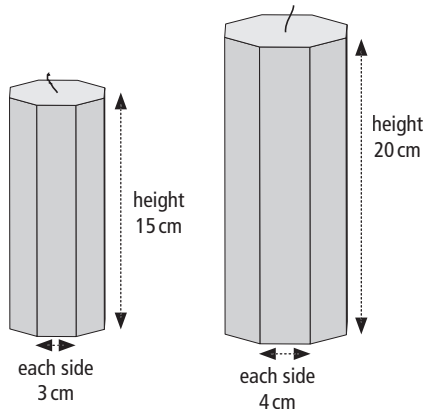
To find the volume of many shapes you multiply the area of the base of the shape by the height of the shape

Shape of base of candle	Formula for area of base of candle	Mathematical name for shape of candle	Formula for volume of candle
hexagon	$3{,}4641s^2$ s = side of hexagon	Hexagonal prism	$3{,}4641s^2 \times h$
octogon	$5{,}6569\ s^2$ s = side of octagon	Octagonal prism	$5{,}6569\ s^2 \times h$
triangle	$\frac{1}{2}$ (base of triangle) × height of triangle	Triangular prism	$\frac{1}{2}$ (base of triangle × height of triangle) × height of candle

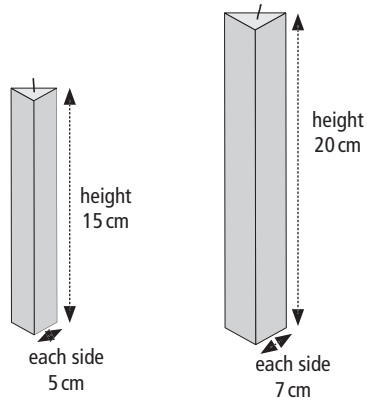
Candles that have a hexagonal for a base
These candles are shaped like hexagonal prisms.
octogon



Candles that have an octagon for a base
These candles are shaped like octagonal prisms.



Candles shaped that have a triangle for a base
These candles are shaped like triangular prisms.



Activity 6 — Making candle moulds

In this activity we continue the context of the candle making co-operative. When students worked out how much wax they needed for candles, they were working with volumes. In this activity they work with surface areas. The main idea is to be able to focus on different aspects of shapes and objects and to develop an understanding that when we want to calculate the size the outer surface of an object we are calculating surface area.

ABOUT THIS ACTIVITY

This activity prepares students to meet the following outcomes of Unit Standard 9016:

- SO 1: Measure, estimate and calculate physical quantities in practical situations: AC 4; 5; 6; 7.
- SO 2: Explore, describe and represent, interpret and justify geometrical relationships: AC 1; 2; 4; 5; 7; 8; 9; 10.

In this activity students work with the surface areas of cubes, cuboids, triangular prisms, hexagonal prisms, octagonal prisms, cylinders, cones and spheres.

Because we are using the context of mould for making candles, in most of the candles one of the surfaces is not calculated, since this is the open end into which the molten candle wax will be poured.

MANAGING THIS ACTIVITY

First talk with students about the context. Help them to imagine what shapes moulds need to be and how the area of the surface of the mould is the area that is in contact with the candle. In many candle making factories, the moulds the candles with flat sides consist of flat pieces of heat resistant material sheets that are tied together to make the shape. The flat plates that make up these moulds are cut as special angles so that they fit well together. Since students will not be able to do this with their cardboard, they will need to make a cut-out of the base shape as well. The moulds of the candles with curved sides have to be made in special ways.

Once students understand the context and have made some of the moulds they should be given Worksheet 6 and a copy of Handouts 4, 5 and 6. An important part of the activity is to recognise what information they have already been given, generated and calculated in the previous two activities. Mathematically literate people are those that know where they can find resources and information, so finding the place where they were given the information is part of their training.

6.1 Students start by making models of the moulds (of the candles with flat faces). These can be made from very stiff cardboard: 180 cardboard would be a good idea. Students can work in pairs. Each pair can make a different shaped candle. They should start by making and cutting out the base shapes. They can then arrange the upright cardboard rectangles around these base plates, and keep the upright rectangles together by tying them tightly with string.

6.2 In this question students are reminded of what they know and they collect the information into a table format. Most of this information comes from Activities 4 and 5. This question helps students to think about the outer surfaces of the candles with flat sides. This prepares them for the next question in which they calculate surface areas.

Mathematical name for shape of candle	Shape of base of candle	Formula for area of base of candle	Shape of each side or vertical face of the candle	Formula for area of each side or vertical face of the candle
Cubic candle	square	s^2	rectangle	$l \times b$
Cuboidal candle	square	s^2	rectangle	$l \times b$
Triangular prism	triangle	$\frac{1}{2}\, b \times h$	rectangle	$l \times b$
Hexagonal prism	hexagon	$3{,}4641 \times s^2$ s = side of hexagon	rectangle	$l \times b$
Octagonal prism	octagon	$5{,}6569\ s^2$ s = side of octagon	rectangle	$l \times b$

When students are doing calculations with measurements they should always bear in mind the following two things:

- What units are they working with (by now students should be comfortable with the knowledge that if they multiply length and breadth in one unit, their answer will be in that unit squared).

- The degree of accuracy needed in an answer depends on the context. Talk through with them why it does not make sense to consider the decimal parts of the areas below. Let students explain why giving the answer in the nearest square centimetres is better than giving the answer to 4 decimal places.

6.3

Shape of candle	Size of candle	Area of base (cm2)	Area of one vertical face (cm2)	Area of all vertical faces (cm2)	Total area of all surfaces of the mould of each candle (cm2)
Cubic candle	small	$5^2 = 25$	$5^2 = 25$	$4 \times 25 = 100$	$100 + 25 = 125$
	medium	$10^2 = 100$	$10^2 = 100$	$4 \times 100 = 400$	$400 + 100 = 500$
	large	$15^2 = 225$	$15^2 = 225$	$4 \times 225 = 900$	$900 + 225 = 1125$
Cubiodal candle	small	$5^2 = 25$	$5 \times 10 = 50$	$50 \times 4 = 200$	$200 + 25 = 225$
	medium	$10^2 = 100$	$10 \times 20 = 200$	$200 \times 4 = 800$	$800 + 100 = 900$
	large	$15^2 = 225$	$15 \times 25 = 375$	$375 \times 4 = 1500$	$1500 + 225 = 1725$
Triangular prism	small	$\frac{1}{2}(5 \times 4{,}3) = 10{,}75$	$\frac{1}{2}(5 \times 15) = 37{,}5$	$3 \times 37{,}5 = 112{,}5$	$112{,}5 + 10{,}75 = 123{,}25 \approx 123$
	large	$\frac{1}{2}(7 \times 6{,}1) = 21{,}35$	$\frac{1}{2}(7 \times 20) = 70$	$3 \times 70 = 210$	$210 + 21{,}35 = 231{,}35 \approx 231$
Hexagonal prism	small	$3{,}4641 \times 9 = 31{,}1769$	$3 \times 15 = 45$	$6 \times 45 = 270$	$270 + 31{,}1769 = 301{,}1769 \approx 301$
	large	$3{,}4641 \times 16 = 55{,}4256$	$4 \times 20 = 80$	$6 \times 80 = 480$	$480 + 55{,}4256 = 535{,}4236 \approx 535$
Octagonal prism	small	$5{,}6569 \times 9 = 50{,}9121$	$3 \times 15 = 45$	$8 \times 45 = 360$	$360 + 50{,}9121 = 410{,}9121 \approx 411$
	large	$5{,}6569 \times 16 = 90{,}5104$	$4 \times 20 = 80$	$8 \times 80 = 640$	$640 + 90{,}5104 = 730{,}5104 \approx 731$

6.4 When students start this problem, it would be a good idea for them practically to wrap a piece of paper around a cylindrical shape. This will help them to see that when they unwrap the piece of paper, it will be rectangular in shape. It is important that the piece of paper is exactly the correct shape and that they are no overlaps. You can then discuss with students what the relationship is between the circumference of the cylinder and the one side of the rectangular piece of paper.

Mathematical name for shape of candle	Shape of base of candle	Formula for area of base of candle	Shape of the side surface of the candle if flattened out	Formula for area of the side of the candle
Cylindrical candle	circle	$\pi r2$	rectangle	$H \times 2\pi r$

6.5

Shape of candle	Size of candle	Area of base (cm^2)	Area of side (cm^2)	Total area of all surfaces of each candle (cm^2)
Cylindrical	small	$1{,}75 \times 1{,}75 \times \pi = 9{,}6211275 \approx 10$	$2 \times \pi \times 1{,}75 \times 10 = 109{,}95574 \approx 110$	$110 + 10 = 120$
	medium	$\pi \times 3{,}5 \times 3{,}5 = 38{,}48451 \approx 38$	$2 \times \pi \times 3{,}5 \times 15 = 329{,}86723 \approx 330$	$330 + 38 = 368$
	large	$\pi \times 7 \times 7 = 153{,}93804 \approx 154$	$2 \times \pi \times 7 \times 20 = 879{,}64594 \approx 880$	$880 + 154 = 1034$

6.6 In conical candles the wax is poured in through the base end of the mould. The mould is hung upside down with the pointy end pointing downwards. You can demonstrate this to students. You may also need to work through with them how the "slanting length" of the outside of the cone was calculated.

Spherical candle are made in two hemispheres and joined when they are almost dry.

Shape of candle	Size of candle	Area of all surfaces of each candle's mould (cm2)
Conical	small	$\pi \times 1,75 \times 10,15197 = 55,81337 \approx 56$
	medium	$\pi \times 3,5 \times 15,402922 = 169,36397 \approx 169$
	large	$\pi \times 7 \times 21,18962 = 465,98400 \approx 466$
Spherical	small	$4 \times \pi \times 1,75 \times 1,75 = 38,48451 \approx 38$
	medium	$4 \times \pi \times 3,5 \times 3,5 = 153,93804 \approx 154$
	large	$4 \times \pi \times 7 \times 7 = 615,7516 \approx 616$

6.7 In this question students consolidate the areas that they have caculated into a single list. This helps make it easier to add them all up, and to work out the total cost of buying the material to make the moulds.

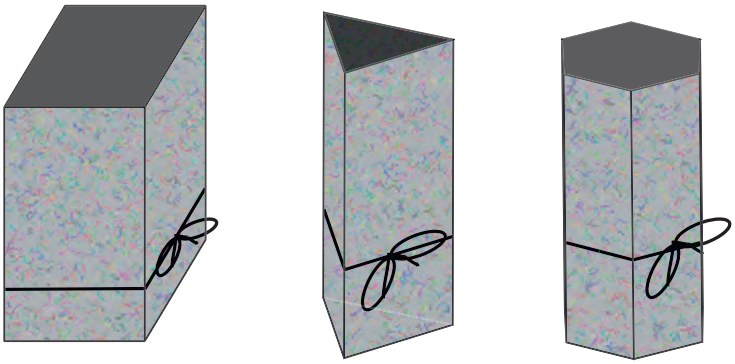
Shape of candle	size	Total surface area of moulds (cm^2)	
Cubic candles	small	125 cm^2	
	medium	500 cm^2	
	large	1125 cm^2	
Cuboidal candles	small	225 cm^2	
	medium	900 cm^2	
	large	1 725 cm^2	
Cylindrical candles	small	120 cm^2	
	medium	368 cm^2	
	large	1034 cm^2	
Triangular prism	small	123 cm^2	
	large	231 cm^2	
Hexagonal prism	small	301 cm^2	
	large	535 cm^2	
Octagonal prism	small	411 cm^2	
	large	731 cm^2	
Conical candles	small	56 cm^2	
	medium	169 cm^2	
	large	466 cm^2	
Spherical	small	38 cm^2	
	medium	154 cm^2	
	large	616 cm^2	
Total area the moulds			9 953 cm^2
Total cost of the moulds @ R1,50 per cm^2			R14 929,50

Activity 6 — Making candle moulds

You are now asked to help the candle-making co-operative calculate the cost of making the moulds for the candles.

To work out how much the moulds will cost, you need to think about the shapes and sizes of the outside surfaces of each of the candles. In Activity 5, you calculated the area of the bottom surfaces or what we can call the bases of the candles.

6.1 Before we do calculations about how much the moulds will cost, let's first make some models of moulds. This will help us to understand what the moulds look like better.
Let's start by working with the candles that only have flat sides. In many candle making factories, the moulds the candles with flat sides consist of flat pieces of heat resistant material sheets that are tied together to make the shape. The moulds of the candles with curved sides have to be made in special ways.



First cut out the base shape. Then cut out the rectangles for the sides of the mould. Now stand the rectangular sides around the base plate and tie these tightly in place with a piece of string.

Compare your model with the moulds made by other people in the class.

6.2 Let's start by working with the candles that only have flat sides. Fill in the table below so that you have the formulae for the calculations at hand. You can find all this information in Handout 4 and Handout 5.

Mathematical name for shape of candle	Shape of base of candle	Formula for area of base of candle	Shape of each side of candle. We call this the vertical face of the object	Formula for the area of each side or vertical face of the candle
Cubic candle				
Cuboidal candle				
Triangular prism				
Hexagonal prism				
Octagonal prism				

6.2 Now fill in the actual area of each surface and then work out the total area of the surfaces of each candle mould. You can round off your answers to the nearest square centimetre.

Shape of candle	Size of candle	Area of base (cm^2)	Area of one vertical face (cm^2)	Area of all vertical faces (cm^2)	Total area of all surfaces of the mould of each candle (cm^2)
Cubic candle	small				
	medium				
	large				
Cubiodal candle	small				
	medium				
	large				
Triangular prism	small				
	large				
Hexagonal prism	small				
	large				
Octagonal prism	small				
	large				

6.3 Now let's think about the side surface of a cone. Imagine that you put a piece of paper around the candle so that it fits exactly. Now imagine that you take that piece of paper off the candle and spread it out flat on the table. What shape will your piece of paper be?

6.4 Now that you know the shape of the side surface of the candle you can work out the area of the bottom and side surfaces. Fill in the table below first.

Mathematical name for shape of candle	Shape of base of candle	Formula for area of base of candle	Shape of the side surface of the candle	Formula for area of the side of the candle
Cylindrical candle				

6.5 Now calculate the area of each surface of each size of cylindrical candle.

Shape of candle	Size of candle	Area of base (cm^2)	Area of one side (cm^2)	Area of all sides (cm^2)	Total area of all surfaces of each candle (cm^2)
Cylindrical	small				
	medium				
	large				

6.6 It is more difficult to imagine how to calculate the area of the surfaces of cones and spheres, so these are given in the handout.

Work out the area of the surfaces of each size of cone-shaped and spherical candles.

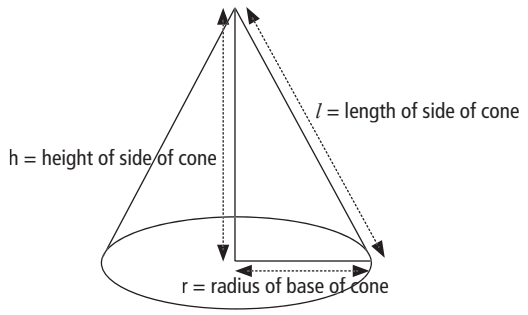
Shape of candle	Size of candle	Area of all surfaces of each candle (cm^2)
Conical	small	
	medium	
	large	
Spherical	small	
	medium	
	large	

6.7 Now you have the areas of all the surfaces of all the candles. If the material that you use for the moulds costs R1,50 per cm^2, how much will it cost to buy the material for all the moulds?

Shape of candle	Size of the candle	Total surface area of moulds (cm^2)
Cubic candles	small	
	medium	
	large	
Cuboidal candles	small	
	medium	
	large	
Triangular prism	small	
	large	
Hexagonal prism	small	
	large	
Octagonal prism	small	
	large	
Cylindrical candles	small	
	medium	
	large	
Conical candles	small	
	medium	
	large	
Spherical candles	small	
	medium	
	large	
Total area of the moulds		
Total cost of the moulds		

Surface area of a sphere = $4\pi r^2$

Surface area of cones = $\pi r l$
where l is the length of the "slanty side" of the cone. To get this length we use Pythagoras' theorem:



Use Pythagoras' theorem to calculate the length of the side of the cone:
$l2 = h^2 + r^2$

Where the radius is 1,75 cm and the height is 10 cm we get:
$l2 = 10^2 + 1{,}75^2 = 100 + 3{,}0625 = 103{,}0625$. Then l = 10,15197.

Where the radius is 3,5 cm and the height is 15 cm we get:
$l2 = 15^2 + 1{,}75^2 = 225 + 12{,}25 = 237{,}25$. Then $l = 15{,}402922$.

So where the radius is 7 cm and the height is 20 cm we get:
$l2 = 20^2 + 7^2 = 400 + 49 = 449$. Then $l = 21{,}18962$.

Assessment: co-ordinating muliple flight bookings

ABOUT THIS ASSESSMENT ACTIVITY

In this assessment students are tested on their skills at reading timetables, in the context of travel booking. They will need to draw on knowledge that they have gained over Levels 2, 3 & 4. All of these skills were practiced at level 4. Students need to read the flight timetables in relation to each other. They need to consider how one decision like setting the meeting time impacts on the possible flights, and whether people will need accommodation. In the process of preparing their answers they may find themselves adjusting one answer because of another. However, with some planning, they may be able to avoid some of this. For example, if they first start by thinking about the less frequent flights, they may find themselves adjusting their other answers less. Sometimes more than one answer/one flight is possible.

This activity assesses students to meet the requirements of the following outcomes of Unit Standard 9016:

- SO 1 Measure, estimate and calculate physical quantities AC 2; 5; 6; 7.
- SO 2 Explore, analyse & critique, describe and represent, interpret & justify geometrical relationships: AC 2; 8; 9; 10; 11; 12.

MANAGING THIS ACTIVITY

Copies of the relevant flight timetables are provided in Handout 7.

7 The conceptual basis for this work was covered both in Activity 2 both in Level 3 and Level 4. Students will need to adjust the list and the number sentences they used in Activity 2 to produce something similar to the ones below:

7.1
- Time to get from home town to nearest airport.
- Check in 1 hour before flight.
- Time to collect luggage, get the hired car and leave the airport (about ½ hour).
- Time to get the meeting venue.
- Time for the meeting (in this example 2 hours).
- Time to journey back from the meeting.
- Check in 1 hour before the flight – deliver car etc.
- Time to travel from nearest airport back home.

7.2 [travelling time to town – which changes with each town] + [1 hour to check in, at nearest airport] + [flight time to CT] + [½ hour to get out of airport CT] + [travelling time to venue] + [2 hours for meeting time] + [travelling time from venue back to airport CT] + [1 hour to check in] + [flight time home] + [½ hour to get out of airport at nearest airport] + [travelling time from venue back to airport – which changes with each town].

7.3 One needs to consider peak hour traffic, particularly in and around Johannesburg and Cape Town.

7.4 Driving times between 6.30 a.m. and 9.a.m. and 4.30 p.m. and 6.00 p.m. need to be adjusted.

7.5 Indirect flights waste huge amounts of time; and time is money. The person flying also becomes less productive in the remaining time as long flights are tiring.

7.6 The most frequent flights are between Johannesburg and Cape Town.

7.7 The least frequent flights are between Port Elizabeth and Cape Town, although if one is only considering direct flights then there are as few direct flights between Bloemfontein and Cape Town. There are also not that many direct flights between Durban and Cape Town.

7.8 If there are fewer flights to and from a particular town, then this decreases the possible meeting times. So it is the flights from these routes that will limit the possible meetings times. If you start by planning the meeting time around flights to and from Johannesburg, then you will probably need to adjust your answer (choice of flights or meeting times) when you get to the routes that have fewer flights.

It is possible to arrange the meeting so that no-one has to stay overnight either at Cape Town or their nearest airport town.

The easiest place for students to start their planning is to try out various meeting times, then to see if these times allow for each of the people to catch a flight home. Once this part of the planning has been worked out, they can then work forwards to see what the most appropriate arrival times are and then on to see whether the person would leave home at a realistic time.

One possible meeting time that works is 13:30 – 15:30. There may be other possible times.

7.9 Itinerary for Ms Bokolani from Alexandria

Catch SA 661: departs PE at 08:20, arrives CTN at 09:35 (means leaving home at about 07:20).
Estimated time of leaving CTN airport: 10:05.
Expected arrival time at meeting venue is 10:35.
About 3 hours free before the meeting.
Meeting time 13:30 to 15:30.
Return flight SA 663.
Check in at CTN airport at 17:00.
Arrive back at PE at about 19:10.
Able to be back at Alexandria at 20:10.

Itinerary for Ms Mogashoa from Brits

Catch SA 323: departs JNB at 10:00, arrives CTN at 12:10 (means leaving home between 07:00 and 08: 00 because of peak traffic). Other earlier flights are also possible.
Estimated time of leaving CTN airport: 12:10.
Expected arrival time at meeting venue is 12:45.
About 45 minutes free before the meeting.
Meeting time 13:30 to 15:30.
Return flight SA 362.
Check in at CTN airport at 16:00.
Arrives back at JNB at 19:40.
Able to be back in Britz at 21:10.

Itinerary for Dr van Vuuren from Welkom

Catch SA 1092: departs BFN at 10:05, arrives CTN at 11:45 (means leaving home at 07:00).
Estimated time of leaving CTN airport: 12:15.
Expected arrival time at meeting venue is 12:40.
About 50 minutes free before the meeting.
Meeting time 13:30 to 15:30.
Return flight SA 1085.
Check in at CTN airport at 16:00.
Arrives back at BFN at 18:45.
Able to be back in Britz at 20:45.

Itinerary for Dr Pitso from Amanzimtoti

Catch SA 607: departs DBN at 09:00, arrives CTN at 11:10 (means leaving home at 08:00).
Estimated time of leaving CTN airport: 11:40.
Expected arrival time at meeting venue is 12:10.
About 1 hour 50 minutes free before the meeting.
Meeting time 13:30 to 15:30.
Return flight SA 620.
Check in at CTN airport at 16:00.
Arrives back at DBN at 18:55.
Able to be back in Amanzimtoti before 20:00.

Assessment — Co-ordinating multiple flight bookings

Your manager has now returned from her series of meetings around the country. She asks you to arrange a 2-hour follow-up meeting in Cape Town with the following people:

Ms Mogashoa from Brits,
Dr Pitso from Amanzimtoti,
Mr van Vuuren from Welkon,
Ms Bokalani from Alexandria.

You need to organise the travel arrangements and if necessary the accommodation of the four people mentioned above.

You must decide what the best time is to schedule the meeting and which are the most convenient flights for each of the people. Remember, you will save money if none of them has to stay overnight in Cape Town or their nearest airport city.

First think about scheduling each person's time for the day.

7.1 Write a list of what time factors you need to consider for each person.

7.2 Now write a number sentence that shows the times needed for this trip.

Here are the times that it takes to get from the various towns to the nearest large airport:

- Amanzimtoti to Durban:1 hour
- Alexandria to Port Elizabeth: 1hour
- Brits to Johannesburg: 1½ hours
- Welkom to Bloemfontein: 2 hours

7.3 On which routes do you need to consider peak hour traffic?

7.4 At what times must you consider peak hour traffic?

When you have decided on flight times, you will need to think about whether peak hour traffic will affect the travelling time.

Look at the flight times in Handout 7 and decide on which flights to book each of the four people. You many find that the flight times of some people impact back on your decisions about the flight times of other people.

7.5 Why would you always try to book someone on a direct flight?

7.6 Which routes have the most frequent flights?

7.7 Which routes have the least frequent flights?

7.8 Is it best to start planning by looking at the routes with the most frequent or least frequent flights? Explain your answer.

7.9 Draw up an itinerary for each person. Your itinerary should include the following:

- Incoming flight:
  - the flight number,
  - the departure time,
  - the arrival time,.
- the meeting time

- Outgoing flight
  - the flight number,
  - the departure time,
  - the arrival time.
- If not flying on the day of the meeting:
  - when should the person expect to arrive at the accommodation?
  - when should the person leave the accommodation?

Flight times from Port Elizabeth to Cape Town

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0820	0935	SA 661	Nonstop
67	1000	1115	SA 681	Nonstop
X 67	1220	1335	SA 663	Nonstop
67	1500	1615	SA 683	Nonstop
X 67	1610	1725	SA 665	Nonstop
X 6	1940	2055	SA 669	Nonstop

Flight times from Cape Town to Port Elizabeth

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0630	0740	SA 663	Nonstop
67	0810	0920	SA 663	Nonstop
X67	1010	1140	SA 663	Nonstop
67	1310	1420	SA 663	Nonstop
X 67	1430	1540	SA 663	Nonstop
X 6	1800	1910	SA 663	Nonstop

Flight times from Bloemfontein to Cape Town

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0810	0950	SA 1082	Nonstop
7	1005	1145	SA 1092	Nonstop
X 67	1305	1445	SA 1083	Nonstop
67	1405	1615	SA 1088	Nonstop
X 6	1910	1845	SA 1085	Nonstop
X 67	0800	2050	SA 1086	Nonstop
X 67	0620	1110	SA 1016/SA317	JHB
DLY	0945	1410	SA 1004/SA 333	JHB
X57	1450	1910	SA 1008/SA357	JHB
DLY	1645	2110	SA 1012/SA 367	JHB

Flight times from Cape Town to Bloemfontein

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0600	0735	SA 1081	Nonstop
7	0800	0935	SA 1091	Nonstop
67	1230	1405	SA 1087	Nonstop
X 67	1520	1655	SA 1083	Nonstop
X 6	1710	1845	SA 1085	Nonstop
X 67	0800	1240	SA 314/SA1005	JHB
X 7	0940	1425	SA 322/SA1007	JHB
X 67	1010	1425	SA 324/SA 1007	JHB
DLY	1140	1615	SA 332/SA1009	JHB
1	1155	1615	SA 332	JHB

X – Except DLY daily 1- Mon 2 - Tues 3-Wed 4- Thurs 5- Fri 6-Sat 7-Sun

Flight times from Durban to Cape Town

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0620	0830	SA 601	Nonstop
DLY	0900	1110	SA 607	Nonstop
DLY	1130	1340	SA 613	Nonstop
X 67	1415	1625	SA 617	Nonstop
6	1535	1745	SA 619	Nonstop
X 6	1645	1855	SA 621	Nonstop
X 6	1930	2140	SA 627	Nonstop
DLY	1240	1710	SA 554/SA347	JHB
DLY	1340	1810	SA 558/SA353	JHB
DLY	1640	2110	SA 507 /SA367	JHB
DLY	1840	2310	SA 578/SA357	JHB

Flight times from Cape Town to Durban

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0630	0825	SA 600	Nonstop
DLY	0900	1055	SA 606	Nonstop
DLY	1145	1340	SA 612	Nonstop
X 67	1415	1610	SA 616	Nonstop
DLY	1700	1855	SA 620	Nonstop
X 6	1930	2125	SA 626	Nonstop
DLY	0600	1010	SA 302/SA539	JHB
DLY	1340	1810	SA342/SA571	JHB
DLY	1740	2210	SA362/SA585	JHB

Flight times from Johannesburg to Cape Town

Frequency	Depart	Arrive	Flight number	Stop/via
X 67	0600	0810	SA303	Nonstop
X 67	0630	0840	SA307	Nonstop
DLY	0700	0910	SA1521	Nonstop
6	0730	0930	SA309	Nonstop
7	0800	0940	SA313	Nonstop
X 17	0900	1010	SA317	Nonstop
DLY	1000	1200	SA323	Nonstop
X6	1000	1210	SA323	Nonstop
6	1100	1310	SA327	Nonstop
DLY	1200	1410	SA333	Nonstop
DLY	1300	1510	SA337	Nonstop
DLY	1400	1610	SA343	Nonstop
DLY	1500	1710	SA347	Nonstop
DLY	1600	1810	SA353	Nonstop
5	1645	1855	SA357	Nonstop
X 5	1700	1910	SA357	Nonstop
X 56	1730	1940	SA359	Nonstop
X 6	1800	2010	SA363	Nonstop
6	1830	2040	SA363	Nonstop
DLY	1900	2110	SA367	Nonstop
X 6	2000	2210	SA369	Nonstop
DLY	2100	2310	SA375	Nonstop

X – Except DLY daily 1- Mon 2 - Tues 3-Wed 4- Thurs 5- Fri 6-Sat 7-Sun

Flight times from Cape Town to Johannesburg

Frequency	Depart	Arrive	Flight number	Stop/via
DLY	0600	0800	SA 302	Nonstop
X 67	0620	0820	SA 304	Nonstop
X 7	0700	0900	SA 306	Nonstop
X 6	0730	0930	SA 308	Nonstop
X 7	0800	1000	SA 314	Nonstop
DLY	0840	1040	SA 316	Nonstop
DLY	0940	1140	SA 322	Nonstop
7	1010	1210	SA 324	Nonstop
DLY	1040	1240	SA 326	Nonstop
1	1155	1355	SA 332	Nonstop
1	1220	1420	SA 334	Nonstop
DLY	1340	1540	SA342	Nonstop
X 457	1440	1640	SA 344	Nonstop
457	1510	1710	SA 346	Nonstop
6	1530	1730	SA1522	Nonstop
X 2	1540	1740	SA 348	Nonstop
DLY	1610	1810	SA 352	Nonstop
DLY	1640	1840	SA 354	Nonstop
DLY	1740	1940	SA 362	Nonstop
DLY	1840	2040	SA 366	Nonstop
X 5	1940	2140	SA 372	Nonstop
X 6	2040	2240	SA 374	Nonstop

X – Except DLY daily 1- Mon 2 - Tues 3-Wed 4- Thurs 5- Fri 6-Sat 7-Sun

Check-in times:
Domestic passengers are requested to check in 90 minutes before departure. Domestic check-in closes 30 minutes before departure.