# MODULE TWO

## Data

# MODULE TWO – DATA

## Contents

# UNIT 1

# Data – an overview

**DICTIONARY:**

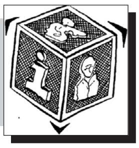
**predict – think what might happen**

## In this unit you will address the following:

**Unit Standard 7449**
**SO3:**
Critically analyze the use of mathematics in social relations. (Social differentiation: gender, social mobility, race; historical and possible future contexts, e.g. employment equity; apartheid policies.)

**Unit Standard 7451**
**SO1:**
Identify situations for investigation and data collection and collect numerical data.

To do this you will:
- explain the different elements that make up the data handling process;
- identify sources of data for collecting and sorting;
- describe ways of collecting data;
- collect data to answer questions.



## 1. Data

Data means information. You collect data about a topic and use that information to predict, come to conclusions and make decisions. When you work with data you usually begin with one or more questions. These questions are usually about the way people live, work and think. For example, governments need to know how many people live in a particular area, what their living conditions are like, and how many jobs are available in the area. Answers to these questions will help governments make decisions about providing roads, services, schools and clinics. Companies need to find out which products people like most and why. In order to find out this information researchers ask questions and use the answers to the questions to plan and make decisions about the future.

You can collect data in a number of different ways – by asking questions, conducting surveys, doing research on the internet, conducting interviews and investigations, and reading articles in books, newspapers and magazines.

After that you can summarise your findings and produce statistics to back up your findings. Here are some examples of statistics:

- 79% of teenagers say that they want a cell phone more than anything else
- 40% of South Africans are unemployed
- The average temperature has increased by 1% worldwide over the last thirty years
- The average shoe size for adult women is 5.

**DICTIONARY:**

**findings – results**
**data handling – working with data**
**recurring – happens again**
**numerical – of numbers**
**represent – show**

Statistics is what you call the study of data. Data is always collected for a purpose and the findings can be used to predict likely outcomes and make changes in real life situations. Data handling is a process which follows these steps:

- Collecting
- Sorting and organising
- Presenting or displaying
- Interpreting and analysing

You need to follow these steps to be sure that the information you have is reliable. Once you have the data you can identify trends in the data. A trend is a recurring pattern that helps you to interpret data and make predictions about things that may or may not happen.

You can collect two different kinds of numerical data:
- Data that can be counted – the number of people in a town, the number of products on a supermarket shelf. You call this discrete data.
- Data that can be measured – a child's height from year to year, growth in a company's sales over a particular period. This is called continuous data.

When you learn about drawing graphs you will see that you represent discrete and continuous data differently.

## Activity 1:
## Sorting data

**Time needed 30 minutes**

**Work alone**
Data that has been collected, but not yet sorted is called raw data. It needs to be sorted or classified before you can work with it. For example a shopkeeper taking stock of his food products wants to find a way to classify them to make it easy for him to record how much of each product there is. There are many ways he could do this.

| | | | |
|---|---|---|---|
| Apples | Shoes | Yoghurt | Wheat |
| Potatoes | Bread | Cake | Jam |
| Eggs | Mealies | Cabbages | Beetroot |
| Milk | Butter | Wine | Cheese |
| Tomatoes | Beef | Sugar | Pork |
| Peaches | Chips | Bacon | |

1. Choose a way to sort this data into different categories.

**Work in Pairs**

2. Compare the way that you have sorted it with another person.
3. Think about and discuss the advantages and disadvantages of the different ways you tried.

### What have you learned?

- The context that you worked with data here is an example of discrete data - data that was to be counted and sorted rather than measured.
- Data may be sorted in more than one way. Here are some ways you may have sorted the data in the activity:
  - Products from animals, products from plants
  - Vegetables, fruit, animal products
  - Alphabetically

- You sort data differently to answer different questions. For example someone who is compiling a dictionary will not be interested in the question "Which products come from animals", but would rather choose to sort things alphabetically.

## 2. Questionnaires

Think about getting information about your learners' homes, their background and their medical history. You need the same information from all the learners. The easiest way to get this information is to ask all parents or care givers to fill in a questionnaire.

### Activity 2:
### Using data in your own work

**Time needed 30 minutes**

**Work in pairs**

Look at the application form for Bantwana Bami on the following page and then answer these questions.

1. Can you think of any other questions you would like to ask the parents or guardians to help you get enough information about each child? Write them down.
2. Discuss with a partner why you think the questions in the application and the ones you have added are important to include.

## Bantwana Bami Day Care

**Application / Enrolment Form**
**CHILD**

Surname: ______________________ Name: ______________________
______________________ Date of Birth: ______________________

**PARENTS**

Name of Mother: ______________________ Name of Father: ______________________
ID number: ______________________ ID number: ______________________
Occupation: ______________________ Occupation: ______________________
Address: ______________________ Address: ______________________
______________________ ______________________
Tel (h): ______________________ Tel (h): ______________________
Tel (w): ______________________ Tel (w): ______________________

**FAMILY / FRIEND WHO CAN FETCH your CHILD**

Name: ______________________ Tel: ______________________

CHILD'S HEALTH AND WELL-BEING

Type of birth: normal delivery______________ cesarean section______________
instrument delivery____________ difficult birth______________
Complications after birth: breathing problems____________ birth injury______________
other problems______________________________
Any problems since birth______________________________
Has your child ever been in hospital?______________ Why?______________
What is your child allergic to?______________________________

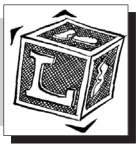
**Type of feeding:**

Breastfeeding: ______________ how long: ______________ still breastfeeding? ______________
Bottle-feeding: ______________ name of formula: ______________ How many feeds per day? ____________
Time of feeds: ______________
How much in each bottle? ______________
Have you introduced solid food yet? ______________ At what age did you give solid food? ______________
What food have you given? ______________
Is there anything your child should not eat? ______________________________

**General:**

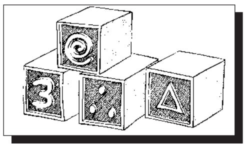
Has your baby been to a day mother, crèche, or care centre before? ______________________
Full day _____ Half day _____
Please provide a copy of:
birth certificate ___ clinic card ___

Signed Parent: ______________________ Signed principal: ______________________
Date: ______________ Date: ______________ Mrs Maseko



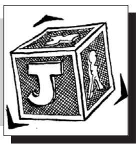
## What have you learned?

- There is always a purpose to the data handling process. The information you collect should help you to make predictions and come to conclusions that affect your lives.
- You need information in order to manage your lives and your careers more efficiently. The more you know about something, the better you can work with it.
- The information you have collected should be easily accessible so that you can find it quickly in an emergency.



## Linking your learning with your ECD work

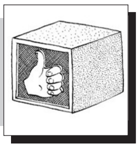
- You can build on this skill by asking children to collect leaves, seeds, flowers and pictures to sort and classify. You can ask children questions about why they sort in different ways. Remember, there can be more than one way to sort things. Be careful to give clear instructions for sorting things. You can also accept good reasons a child gives you for sorting things differently.
- They can learn words like sort, collect, organise and group to talk about what they have done and what they are thinking.
- Think about some of the activities you already use in your classroom, which help children to understand this concept. How can you extend these activities to improve young learners' classification skills?



## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about collecting data?
b. How do you think you will be able to improve your understanding of data?
c. Write down one or two questions that you still have about collecting data.
d. Write down one or two questions that you still have about data and data collection.
e. How will you use what you learned about the data handling process in your every day life and work?

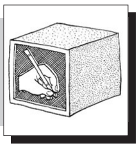


## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Explain the different elements that make up the data handling process | | | | |
| 2. Identify sources of data for collecting and sorting | | | | |
| 3. Describe ways of collecting data | | | | |
| 4. Collect data to answer questions | | | | |



## Assignment 1:

- Study the application forms at your ECD site and the responses that are filled in each form.
- Now think about a way to summarise the information you have about all the children at your centre under broader categories to get an overall picture of the profile of the children at your Centre, without your having to look at each child's individual profile. For example you could summarise the detailed information under broad categories like the ages of the children; their general health condition, their home details e.g. number of children with or without parents etc.
- Compare the way you have done this with another colleague, working on the same task. Discuss the advantages and disadvantages of the different ways you might have approached this.

# UNIT TWO

# Organising and recording data

**DICTIONARY:**

**previous – before**

## In this unit you will address the following:

**Unit Standard 7451**
**SO2:**
Classify and analyze numerical data. (grouped and ungrouped data.)

**SO3:**
Summarize and display organized numerical data. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

**SO4:**
Extract, interpret and critically evaluate information from various forms of display. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

To do this you will:
- organise and record data using tallies and tally tables;
- interpret and design tally and frequency tables;
- organise verbal data that has been written down;
- design and use data collection sheets to collect data.

## 1. Surveys, tallies and frequency tables

In the previous unit you saw an example of a questionnaire to get information from a certain group of people. Another way to get information is to conduct a survey. In a survey someone asks a group of people to answer a set of questions. Maybe someone has asked you questions about a product, or maybe someone from a company or organisation visited you in your home. They were probably conducting a survey.

In a survey, a representative sample of people answers questions. Representative means enough people to make good decisions from the information you collect. This is different from a census. In a census a whole population answers questions on a variety of issues.

You can use tallies to count a large number of objects or responses from many people. Tallies are marks that you make on a table. Tally tables are often used in surveys.

**Time needed**
**40 minutes**

## Activity 1
## Surveys, tallies and frequency tables

**Work alone**

Here is an example of a frequency table from a survey on soap powders. People going into a supermarket were asked which soap powder they used.

| Product | Tally | Frequency |
|---|---|---|
| **Brightest** | 卌 卌 卌 卌 卌 卌 卌 卌 l | **41** |
| **Whitest** | | **23** |
| **Kleenest** | | **27** |
| **Quik-wash** | | **45** |
| **Total no of people interviewed** | | |

In the first column different products are listed.

In the second column is a record of the responses. For each response a tally mark was made (l). Every fifth response was marked as a diagonal line across the others 卌. This makes it easy to count in groups of five. You usually count tallies in fives. These marks 卌l 卌l 卌l are easier to count than llllllllllllll.

In the third column you record the frequency of each of the different kinds of responses. Frequency means the number of times something happens. So this column should show the total number of responses to each product.

Complete the frequency table by filling in the correct number of tallies for each product according to the number shown in the frequency column. (The first one has been done for you).

2. Discuss these questions about the table.
   a. How many people took part in the survey?
   b. Which was the most popular brand?
   c. Which was the least popular brand?
   d. Which two brands were more or less the same?

### What have you learned?

If you added up all the numbers in the frequency column you should have got a total of 136. This is the total number of people who took part in the survey. Most people prefer the product called Brightest. Quick-wash is the least popular product.

- Tallies are used to help you count many things quickly – passing cars, people, answers to questions from many people
- The number of times something happens or is counted is called the frequency
- You can use tally tables and frequency tables to count and record quickly
- You can interpret (read and understand) the tables to get information

## 2. Range

Range is the word you use to describe how much data you are working with and how it is spread. Read the example of Mrs Maseko in Activity 3. There are 50 children in her care so that range cannot be more than 50. In the list of attendance figures the smallest number is 39. This means that there were never less than 39 children attending. So the range is between 39 and 50. In a tally table of attendance at Bantwana Bami ECD Centre the number of learners at school will start at 39 and end at 50.

### Activity 2
### Attendance Figures

Time needed
40 minutes

**Work alone**

Mrs Maseko is the principal of the Bantwana Bami ECD centre. She is looking at the school register to get an idea of attendance for Term 2. There were 47 days in the term. There are 50 children in her care. These are the attendance figures she found.

48 47 49 50 46 50 50 50 43 46 49 44 50 49 50 41 44 42 49 49 50 40 43 46 44 40 41 39

39 40 44 43 40 45 47 48 47 50 50 50 50 49 44 47 48 50 50

1. Draw up a frequency table like the one on the next page. Fill in all the numbers in the range for the first column. Begin at the beginning of the list of attendance figures and make a tally mark in your table for each number.

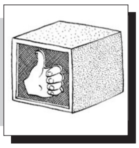


**TABLE SHOWING ATTENDANCE AT BANTWANA BAMI ECD CENTRE 2ND TERM 2005**

| Number of learners at school | Tally | Frequency |
|---|---|---|
| 39 | | |
| | | |
| | **Total** | |

2. Share your table with someone else and get feedback on it. Now discuss these questions.
   a. What was the range of the number of children attending?
   b. What was the most common (i.e. most frequently occurring) number of learners at school?
   c. There are many different reasons for learner absenteeism. Discuss what some of the most common reasons at your place of work are. What steps if any can you take to try and address this problem?

Time needed
40 minutes

## Activity 3
## More organisation tables

**Work alone**
Sometimes you are given information that needs to be organised to help you understand it better.

1. Read this information:

   Nhlanhla is the last born daughter of Joyce. She attends Bantwana Bami ECD Centre but she is going to Grade 1 next year. She has had preschool vaccinations for polio, DWT and MMR. Martha is younger than Nhlanhla. She had her polio vaccination and one for DWT. She needs to have a vaccination for MMR. Sibusiso is Martha's twin brother. He had the same vaccinations as Martha. Zinhle came to the centre one week ago. Her mother told Mrs Maseko that she has had no vaccinations yet.

   The local clinic is coming to Bantwana Bami to give children their pre-school vaccinations for polio, DWT and MMR. They need to know which children.
   - Have already had all three vaccinations
   - Have had one or more but not all three
   - Have had no vaccinations

2. Write down the information that the clinic needs.

3. Read the information again. This time use the table below to help you to answer the questions above by filling in the missing information under each relevant heading.

| Child | Polio vaccination | DWT vaccination | MMR vaccination |
|---|---|---|---|
| Nhlanhla | | | |
| Martha | | | |
| Sibusiso | | | |
| Zinhle | | | |
| **Total:** | | | |

**Work in pairs**

4. Discuss how the table helped you to answer the three questions above.

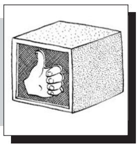
## What have you learned?

- From doing this activity you found how to take out information from a text and organise it into a table.
- You will have noticed that it is easier to answer questions when data has been organised in that way.
- Organising information in a systematic way is an important skill in data handling.

## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about tally tables and frequency tables?
b. How do you think you will be able to improve your understanding of designing and using tally tables?
c. Write down one or two questions that you still have about designing and using data collection sheets.
d. How will you use what you learned about designing and interpreting tally and frequency tables in your every day life and work?



## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Organise and record data using tallies and tally tables | | | | |
| 2. Interpret and design tally and frequency tables | | | | |
| 3. Organise verbal data that has been written down | | | | |
| 4. Identify important kinds of information to collect that could help me to manage my work with young children more efficiently | | | | |

# UNIT THREE

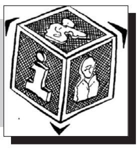
# Samples and Populations

## In this unit you will address the following:

**Unit Standard 7451**
**SO1:**
Identify situations for investigation and data collection and collect numerical data. Situations for data collection are identified in terms of the purpose for data collection.

**SO2:**
Classify and analyze numerical data. (grouped and ungrouped data.)

To do this you will:
- distinguish between samples and populations;
- understand the differences between the mean, median and mode as measures of frequent tendency.



## 1. Samples

When you talk about populations, you mean all the possible people in a place or situation. So, for instance, the population of Gauteng consists of all the people who live there and the population of a school would be all the learners in that school. When you want information about a whole population and aspects of their lifestyle, like number of houses with running water or electricity, you conduct a census that will give you facts and figures about the lives of all the people you are carrying out the survey on.

But sometimes it is not possible to get information from the whole population so when you conduct surveys you use samples. A sample is a portion of the population, and a representative sample is represents the total population. Sample sizes vary (change) but they should be large enough to give a good overall picture and they should be suitable to the aims of the survey. For example, it is not helpful to ask people in a vegetarian restaurant to evaluate meat products.

**Time needed**
**45 minutes**

### Activity 1:
### Samples

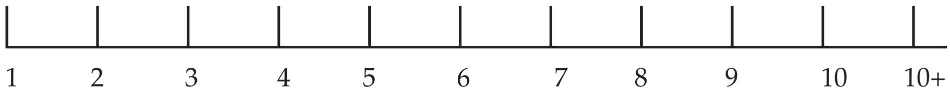
**Work alone**

1. In this exercise, you will assume that a class of adults represents the whole population. A group within the class of 4 people, out of 20, or $\frac{1}{5}$ of the total class, is a sample. You will conduct a survey using information from the sample about shoe sizes.

**DICTIONARY:**

**respondents – people who answer the survey**

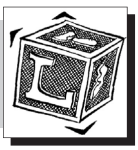
a. Copy the number line below.




**Shoe size**
**(Sample)**

b. Ask at least $\frac{1}{5}$ of the adults what their shoe size is. Make a cross above the number that they give you. If their number is the same as one already recorded, write a cross above the cross that is already there. Keep an equal space between each cross.

2. Answer these questions:
   a. What is the most common shoe size?
   b. What is the smallest size?
   c. What is the largest size?
   d. What is the range of shoe sizes among your respondents?
   e. Do you think that this sample is big enough to represent the whole population (i.e. the whole class)?



## What have you learned?

- A population is the whole of something that could be counted – the whole country, the whole class, the whole membership of SADTU
- A sample is a part of a population
- A representative sample is one that is valid enough to be a true picture of the population as a whole to be said to represent it. This means that you must get responses form a fair spread of people and from a reasonable number of people.

For example it would make no sense to find out what the favourite brand of juice is among the children at your ECD Centre is you only ask the boys and not the girls or if you only ask one or two children what their choice is. When statisticians run sample surveys they use mathematical formulae to decide on how many respondents out of a total population they need to ask in order for the survey to be a representative sample.

Time needed
45 minutes

### Activity 2
### Populations

**Work alone**

1. Draw a number line the same as the one in Activity 1.
2. Ask every person in the class to tell you their shoe size.
   Record all the information on the number line.
3. Now answer these questions.
   a. What is the most common shoe size?
   b. What is the smallest size?
   c. What is the largest size?
   d. What is the range of shoe sizes in the class?
   e. Has your answer to Question a above changed? Give reasons.

### What have you learned?

- When working with data collected in a sample and then comparing that with data collected from a population, the results should be similar if your sample was large enough and representative.
- Data collected in small samples may, or may not be similar to that collected in the population, but the more data you add to what you have, the more likely you are to reflect the situation in the population at large.
- When choosing a sample, you should be sure that you have chosen a large enough sample and also that the questions you are posing are questions that that particular sample of people is in a position to answer. The more data you have to work with the more accurate information you will have about a situation.
- If you collect information from a small group of people, you cannot assume that the results will be the same if you increase the size of the sample, but samples are useful if they are carefully selected, in situations where it is not possible to canvass the whole population.

### Stop and think

If you were doing this exercise with children only or adults and children together, what range of shoe sizes would you choose?

## 2. Mean, median, mode and range

Most of you are familiar with averages. You understand what is meant by the average mark in a class, or the average weather for an area in a particular month. However, averages can be calculated in more than one way. In the example of an average mark, you usually work this out by taking all the marks in a class and adding them up and then dividing them by the number of learners. This kind of average is called the mean.

You can also look at the mark that occurs most frequently in the list of class marks. For instance, in a class of 21 learners, you get this situation

| Mark | No of learners |
|---|---|
| 60% | 9 |
| 80% | 5 |
| 10% | 3 |
| 100% | 2 |
| 20% | 2 |
| | |

Here, the most common or most frequently occurring score is 60% because more learners obtained this mark than anything else. This is what you call the mode.

If you wanted to find the mean in this case you can add all the marks and divide by 20, which would give you an answer of 56,4%.

If you wanted to find the median, you look for the middle score of all the scores you have collected. You could then arrange the scores (in numerical order) like this:

10 10 20 20 60 60 60 60 60 60 60 60 60 80 80 80 80 80 100 100

There are twenty-one scores here. The middle score is eleventh from the left if you count from left to right and eleventh from the right, if you count from right to left. It is the middle score of all the scores you have and you call it the median score. (Median means middle) Because 21 is an odd number, there is a middle number – eleven.

If there are 20 scores:

10 10 10 20 20 60 60 60 60 60 60 60 60 60 80 80 80 80 80 100

You would have taken the two middle numbers and divided them by 2 and you would still, in this case, have got 60 as your median score.

The median score gives you sense of the dispersion of the data; how many scores fall to the left and to the right of the middle score.

All three of these are called measures of central tendency and you use all of them in data handling for different purposes. All three of them are a type of average. You will look at this in greater depth in another unit.

Time needed
30 minutes

## Activity 3:
## Calculating the Mean

**Work alone**

**Average Age**
Calculate the mean age of the children in Kholeka's ECD group of children using the method you learnt above.

5,5; 4; 5; 3,5; 5; 4,5; 3; 5; 5; 4,5; 6; 3,5; 4; 3; 3;5; 3,5; 4; 3; 3; 4; 3; 3,5

## What have you learned?
To work out the mean or average age ion this case, you added all the ages together, which should have come to 80. You then divided this by the number of children in the class which was 20 to give you an average class age of 4.

Time needed
30 minutes

## Activity 4:
## Average Marks

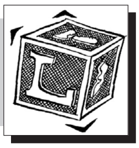
**Work alone**
Mandisa gave a mark out of 10 to assess how well she thought her class of children performed in a set of numeracy activities. Mandisa kept a record of the scores she gave for each of the 6 activities.

**Work alone**

| Date of Activity | 3 May | 10 May | 17 May | 24 May | 31 May | 7 June |
|---|---|---|---|---|---|---|
| Mark (out of 10) | 4 | 5 | 7 | 5 | 8 | 7 |

Table 1: Scores for Six Numeracy Activities

Now answer these questions
1. What was the class' average score for the 6 activities the class did?
2. On the 14$^{th}$ of June the class did a 7$^{th}$ activity for which Mandisa gave them a score of 7. Without calculating, say what will happen to the class' average if she includes this score. Explain your reasoning to a partner.
3. Mandisa hopes that the class will score an average of 8 after they do the 8$^{th}$ activity on the 21$^{st}$ June. What would their class score have to be for this to be possible? Explain your reasoning to a partner.



## What have you learned?

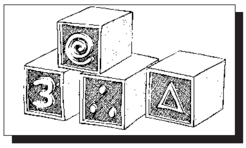
One of the import things that statistics help you to do is to work out averages. There are three common forms of averages. In this activity you worked with the mean average. To find the average score you added all the marks in the table and divided by the number of activities like this:

$4 + 5 + 7 + 5 + 8 + 7 = 36$

$38 \div 6 = 6$

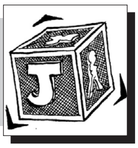
So the average mark was 6.

You could then use this information to predict what the average score would by after they completed a 7th task and how much better their score would have to be if after the 8th task Mandisa wanted the class to have an average of 8.



## Linking your learning with your ECD work

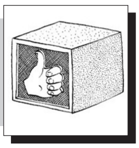
- Small children cannot of course do calculations like these to find the mean. But they do work intuitively with another kind of average which refers to the most popular or most common. So for example you could have a discussion with them where you run a survey together and ask the children questions to find out which is the class or group's favourite colour or choice of food. You could record their choices using a simple pictograph.



## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about samples and populations?
b. What did you learn from this unit about mean, median and mode measures of frequency?
c. Write down one or two questions that you still have about mean, median and mode measures of frequency.
d. How will you use what you learned about samples and populations in your every day life and work?



## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Tell the difference between samples and populations | | | | |
| 2. Understand the differences between the mean, median and mode as measures of frequent tendency | | | | |

# UNIT FOUR

# Displaying and interpreting data

**DICTIONARY:**

**display – show**
**title – heading**

## In this unit you will address the following:

**Unit Standard 7451**
**SO2:**
Classify and analyze numerical data. (grouped and ungrouped data.)

**SO3:**
Summarize and display organized numerical data. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

**SO4:**
Extract, interpret and critically evaluate information from various forms of display. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

To do this you will:
- draw, read and interpret pictographs;
- critically analyse data in tables and diagrams to draw conclusions and make predictions.

## 1. Pictographs

In previous units you learned how to record data in an organised way so that it is easier for you (and other people) to read and understand it. But what do you do with that data after you have recorded it?

You need to display your data in a way that will be easy to read and understand. You can use diagrams to make the information stand out without using too many words or explanations.

There are different diagrams that display information. Examples of these are:
- pictograms
- bar graphs
- line graphs
- pie charts and
- scatter graphs.

In the following activities you will work with examples of these and you will have the opportunity to decide which kind of diagram is best for different purposes.

A pictograph uses simple pictures or symbols to show data. If the pictograph has a clear title and a key you can usually see the information at a glance without reading much text.  Always read the title and the key first. The title tells you what the graph is about and the key tells you what the symbols or pictures represent.

**Time needed**
**40 minutes**

## Activity 1
## Pictographs

**Work alone**

Look at the pictograph below. Write down the information it is giving you. Discuss this in your groups and compare answers.

| Number of learners in Zones 1, 2 and 3 attending Jabulani School | |
|---|---|
| Zone 1 | ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺<br>☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ |
| Zone 2 | ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ |
| Zone 3 | ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺ ☺☺☺☺☺<br>☺☺☺☺☺ ☺☺☺☺☺ |

1 ☺ = 1 child at Jabulani School

In this pictograph 1 ☺ represents one child. You can also use 1 ☺ to represent more than one child. This will make the pictograph less full and will use less space. So, the same information could be represented like this:

| Number of learners in Zones 1, 2 and 3 attending Jabulani School | |
|---|---|
| Zone 1 | |
| Zone 2 | ☺ ☺ ◖ |
| Zone 3 | |

☺ = 10 learners at Jabulani School

◖ = 5 learners

1. Fill in the right number of symbols to show the number of children in Zone 1 and 2 using the scale above.

## What have you learned?

Pictographs display data in a way that is easy to see at a glance. Pictographs need to be clearly labelled and they need a title and a key. This is the same for all tables, diagrams and graphs in data handling.

## Activity 2: Draw a pictograph

Time needed
40 minutes

**Work alone**

Mrs Moketse is a member of the parents' committee at Bantwana Bami ECD Centre. She organised a morning market to raise funds. At the end of the day, she recorded the number of different items sold. This is what she found.

DICTIONARY:

reproduce – repeat
satisfactory – good enough

| Items on sale at morning market | Number sold |
|---|---|
| Ice cream cones | 225 |
| Cans of fruit juice | 400 |
| Cakes | 75 |
| Hot dogs | 130 |
| Potato chips | 345 |

1. Draw a pictograph to summarise her sales.
   a. Make sure that it has a title and a key
   b. Decide beforehand what symbols to use and what number each symbol will represent.
2. Answer these questions
   a. Which items were the most popular?
   b. Which were the least popular?

## What have you learned?

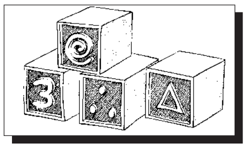
From this activity, you became aware of some disadvantages of pictographs.

- They often take a long time to draw. Your symbols need to be very simple and easy to reproduce.
- Pictographs are not very accurate. For example, in this graph, if your symbol represented 25 items, it would be difficult to represent 130 hot dogs accurately. You could do this by drawing part of a hot dog to show part of 25, but this is not always satisfactory.

There are advantages of pictographs too.

- Pictographs give a strong picture of the information. This means that people who are not very literate or numerate can read and understand the information in a pictogram easily.
- Pictograms are very useful for introducing data presentation to very young learners.

Now that you are more aware of pictograms, look out for examples in newspapers that use pictograms in different ways. Use the key provided to interpret the information and analyse the trends (patterns).



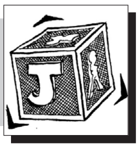
## Linking your learning with your ECD work

You can introduce data collection to young learners easily through a weather chart.

- Children can take turns to fill in the chart daily for a whole month. Together you can identify the weather patterns for the month. This is a chart for January 2005.

| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |

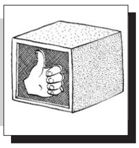
- Record what the children predict the weather will be and check if their predictions were right or not. You can make copies of coloured pictures to show the different types of weather that they can stick on one chart to record their predictions and then have another to record the actual weather that occurs. This will help them to compare their predictions with the actual weather for the day or week.
- Encourage the children to use language like: 'There were mostly sunny days' or 'There were more sunny days than cloudy days this month'.



## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about pictographs?
b. How do you think you will be able to improve your analysis of pictographs?
c. Write down one or two questions that you still have about analysing data in pictographs.
d. How will you use what you learned about pictographs in your every day life and work?



## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Draw, read and interpret pictographs | | | | |
| 2. Critically analyse data in tables and diagrams to draw conclusions and make predictions | | | | |

# UNIT FIVE

# Bar graphs

## In this unit you will address the following:

**Unit Standard 7449**

**SO2:**

Critically analyze the use of mathematical language and relationships in the economy. (Budgeting, banks: interest rates, mortgage, service charges; fuel prices; pensions; inflation; value of the rand and exchange rates.)

**SO3:**

Critically analyze the use of mathematics in social relations. (Social differentiation: gender, social mobility, race; historical and possible future contexts, e.g. employment equity; apartheid policies.)

**SO4:**

Critically analyze use of mathematics & mathematical language & relationships in political relations (Income distribution; census; elections; voting; opinion polls.)

**Unit Standard 7451**

**SO2:**

Classify and analyze numerical data. (grouped and ungrouped data.)

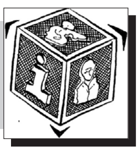
**SO3:**

Summarize and display organized numerical data. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

**SO4:**

Extract, interpret and critically evaluate information from various forms of display. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

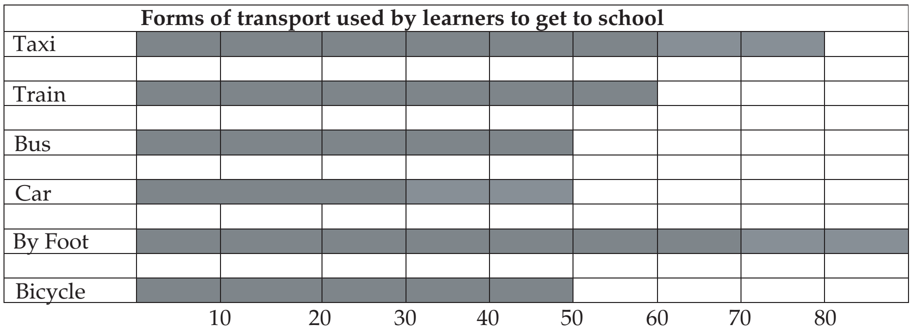
To do this you will:
- read and understand bar graphs and double bar graphs;
- draw bar graphs;
- group raw data into appropriate intervals;
- interpret and analyse bar graphs and double bargaraphs, find trends, do calculations and draw conclusions.



## 1. Bar Graphs

In this unit you focus on bar graphs. These are another way of representing data. Bar graphs display data in bars that go across or up the page. The length of each bar represents the size of the data. It is easy to compare the data simply by looking at the length of each bar.

The following graph shows the different forms of transport used by children to get to school.




Scale
1 = 10 learners

- The scale tells you how many units of data are represented in each space. If only half the space is covered this would represent 5 learners. The scale you use depends on the range of data you need to present in one graph. For large numbers, such as populations of cities and towns, one space could represent a thousand or a hundred thousand units! It is important to look at the scale before reading a graph.

**Time needed**
**40 minutes**

## Activity 1:
## Bar graphs

**Work alone**

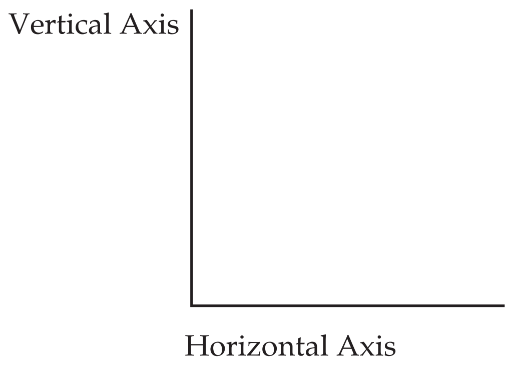
1. Look carefully at the graph above again and then answer the questions:
   a. How many learners come to school by bicycle?
   b. Which form of transport is the most common?
   c. What is the difference between the number of learners coming to school by taxi and the number coming to school by bus?
   d. Which forms of transport are used by the same number of learners?
   e. How many learners altogether were surveyed?

2. Think about how you would present the same data using a pictograph.

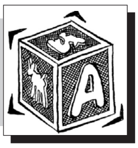
3. Which way is more efficient to represent this data, a pictograph or a bar graph? Why?

## 2. Drawing a graph

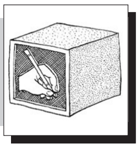
- It is easier to draw a graph if you use squared paper. This helps to make your information properly aligned and easy to read. Your graph will have two axes – a vertical axis and a horizontal axis – that meet at right angles to each other.




- If you draw a vertical graph, the vertical axis is labelled with the number of units and the horizontal axis is labelled with a description of the data.
- You need to decide on the scale before you draw your graph. This will help you to fit the graph within the available space on your page. To do this you have to look at the range and variation of the data you want to represent.
- Number the vertical axis in equal steps, e.g. in 10's, 20's, 100's to match the scale you have chosen.
- Make sure that the bars are the correct length for the data they represent. The bars should all be the same width and should have an equal space between them. Each bar must be clearly labelled.
- Give the graph a title that will make it easy for the reader to understand the information.
- If appropriate, provide a key.



Time needed
40 minutes



## Activity 2:
## Drawing bar graphs

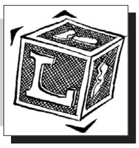
Draw your graph on a separate paper so that you can put it in your portfolio. Don’t forget to include your questions too.

**Work alone**

The parents at Bantwana Bami ECD Centre raised R3 000 to donate to the local library to buy books for young children. The library staff wanted to buy books that most young children like to take out of the library. So they surveyed 200 children and recorded the results in this table

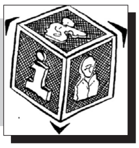
| | |
|---|---|
| **Books about insects** | 41 |
| **Fairy stories** | 17 |
| **Books about people** | 71 |
| **Books about animals** | 49 |
| **Counting books** | 22 |

Follow the steps above for drawing a vertical or horizontal bar graph. Draw either kind of graph to display this information. Make up some questions you can ask about the graph.



## What have you learned?

- Bar graphs represent data in bars alongside each other that can be horizontal or vertical
- The length of the bar tells you the size of the data that you have collected
- Gaps can be left between the bars.
- Bar graphs are a useful way of showing discrete information .This means information that can be counted.



**Time needed 40 minutes**

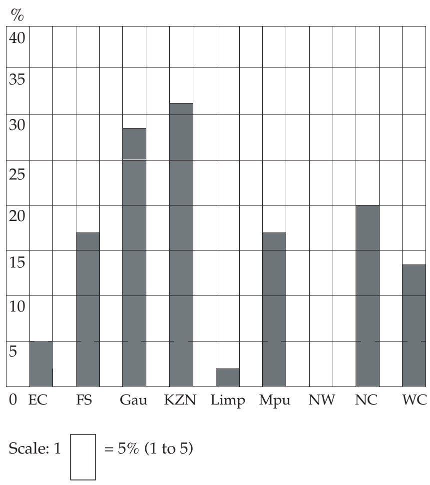
# 3. Interpreting Bar Graphs

## Activity 3:
## Double bar graphs

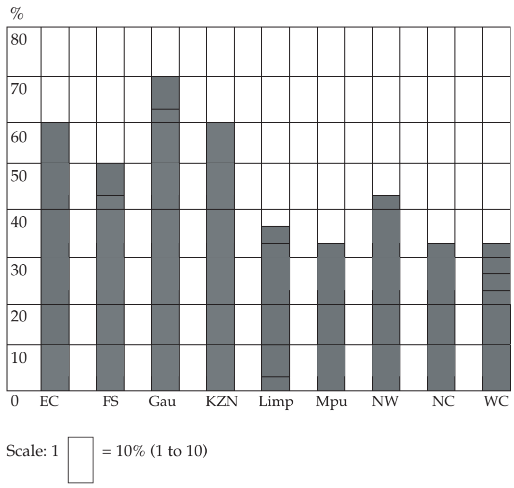
**Work alone**

Sometimes you have two sets of data that you would like to compare. Look at these two graphs. One graph shows the number of rural households in South Africa without electricity, by province, in 2002. The other graph shows the number of urban households in South Africa without electricity, by province, in 2002.

**Proportion of urban households without electricty, 2000**

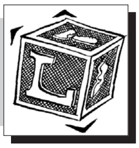



**Proportion of rural households without electricty, 2002**




Use the graphs to answer these questions:

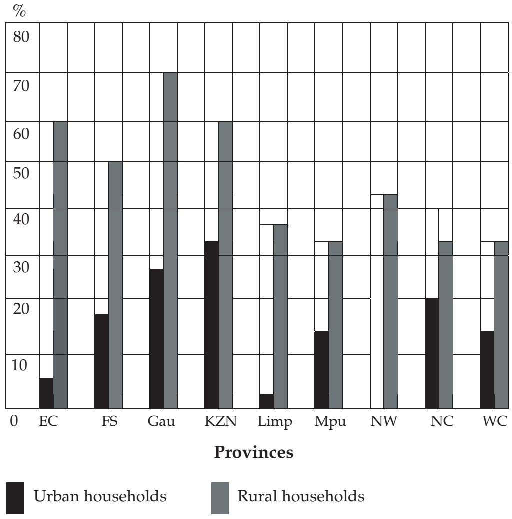
1. Is the percentage of rural households without electricity in KZN more or less than the percentage of urban households in KZN without electricity?
2. Does any province have a higher percentage of urban households without electricity than rural households?
3. Which provinces have the lowest proportion of households without electricity?



## What have you learned?

- You can see this is difficult because you need to refer back and forth from one graph to the other. It is even more difficult because the two graphs have different scales.
- It will be easier if you represent both sets of information in one graph and use the same scale for both sets of information.
- This is called a double bar graph. In the example below, there are bars of one shade to represent urban households and bars of another shade to represent rural households.

**Proportion of rural households without electricty, 2002**

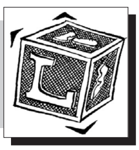



Time needed
40 minutes

## Activity 4:
## Double bar graphs

**Work in pairs**

1. Now use the double bar graph to answer the questions in Activity 3.
2. Write down four interesting facts you found from comparing these two sets of information.
3. Find the mean of the following:
   a. The % of urban households across all provinces that have electricity.
   b. The % of rural households across the country with electricity.
4. Discuss what you think some of the reasons are for the unequal distribution of electricity across urban and rural area and across different provinces.
5. How could this change? Are there signs in your area that this is changing in recent times?



## What have you learned?

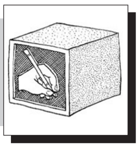
It was probably easier for you to answer the questions this time because you have all the information in one place. You did not have to worry about moving from one graph to the other, or working out the scale. You could think about and discuss the information in more detail instead.

Perhaps you found out that there are less urban households without electricity than rural households without electricity. You may have noticed that Gauteng has more rural households that do not have electricity than any of the other provinces.

Time needed
40 minutes

## Activity 5
## Drawing double bar graphs

**Work alone**
What you need:
- Squared paper
- Pencil
- Ruler



Draw your graph and answer the questions on a separate paper so that you can put it in your portfolio.

1. The following table shows the number of houses built in six developing areas from 1992 to 2002.
2. Draw a double bar graph to illustrate this. Remember to give your graph a title, to work out your scale before you begin and to leave equal spaces between each set of bars. One set of bars will represent the figures for 1992 and the other set will represent those for 2002.

| Year | Area | | | | | |
|---|---|---|---|---|---|---|
| 1992 | 479 | 680 | 500 | 195 | 48 | 232 |
| 2002 | 650 | 430 | 380 | 1 530 | 875 | 1965 |
| | Sunrise Park | Newtown | Goede Keur | Emfuleni | Ikhusi | Felotshego |

3. Answer these questions about the information you have shown:
   a. Which area had the smallest number of houses built in 1992?
   b. Which area had the most houses built in 2002?
   c. Which area had fewer houses built in 2002 than in 1992?
   d. All the houses in this survey were built by government. Looking at these figures, in which area do you think delivery was best in 2002? Give reasons.
   e. What is the difference between the number of houses built in Newtown in 2002 and those built in Felotshego in 2002?
   f. Would you say that conditions generally improved in the ten years between the two sets of data? Write a short explanation to justify your argument.
   g. Write down some more things you found out from comparing the figures over the 10 year period.

### What have you learned?

Maybe you found it easier than you expected to draw your double bar graph. Perhaps it was a bit difficult to get the bars the right length. It will get easier with practice.

A scale of one block representing 100 houses is a good one, but perhaps you chose a different scale. In any case you had to choose one that allows the graph to fit neatly onto the page.

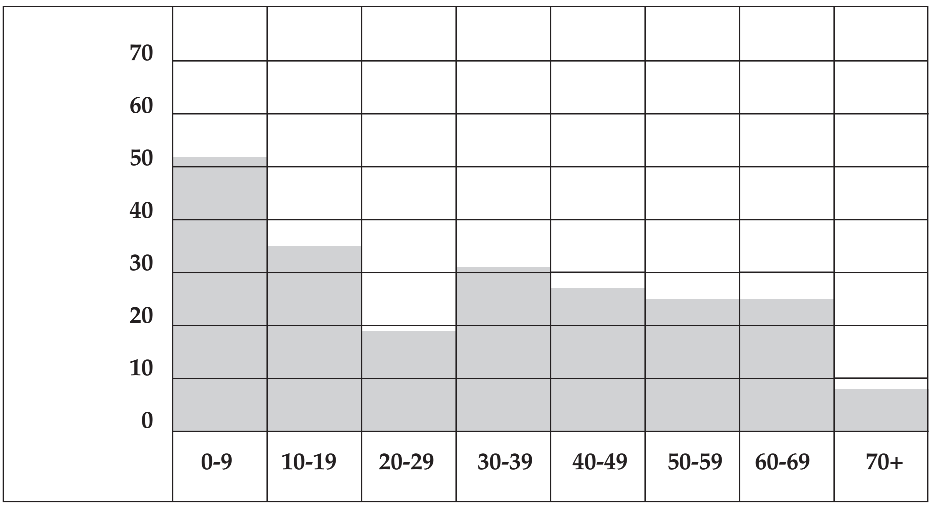
## 4. Grouping data

Sometimes it is useful to group data so that the graph is simpler and smaller, especially when you are working with large numbers. Here is an example of data that has been grouped into classes.

A new clinic is being built in a small village that has no health care facilities. Before they build the clinic, the authorities conduct a census to see which is the largest age group they will be catering for. There are 222 people in the village and this is what the authorities found.

| Age group | 0-9 | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70+ |
|---|---|---|---|---|---|---|---|---|
| No of people | 52 | 35 | 19 | 31 | 27 | 25 | 25 | 8 |

Look at the age group across the top. Each interval represents an age group. One group begins where the other group ends. You do not say 0-10, 10-20. You rather say 0-9 and 10-19. In this way every age is accounted for in the intervals. They then convert this information into a bar graph that looks like this. Note there are no spaces between the bars.



Time needed
30 minutes

## Activity 6:
## Grouping Data

**Work in pairs**

Read the graph carefully and answer these questions:

1. Write down four observations you can make from reading the data in this bar graph.
2. Compare your answers with a partner.

## What have you learned?

You can see from this graph that the clinic will have to work mostly with children between 0 and 9 years old. Perhaps this means that the authorities need to pay special attention to building a well-baby clinic. You have probably interpreted the graph in many different ways. You will notice that it is easier to read because the ages have been grouped. The graph would not fit on the page if each age had its own bar. Now try and group your own data and draw a graph.

Time needed
30 minutes

## Activity 7:
## More about Grouping Data

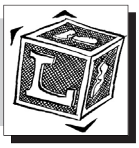
**Work alone**

Do this activity on a separate paper so that you can put it in your portfolio. Don't forget to include your questions too.

1. Forty-five people between the ages of 18-30 were asked how many people they knew who were ill or who had passed away of an HIV-Aids related illness. This was their response:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | **12** | **52** | **0** | **6** | **12** | **32** | **10** | **8** | **24** | **12** |
| **24** | **32** | **30** | **7** | **20** | **49** | **26** | **8** | **0** | **4** | **19** |
| **23** | **10** | **28** | **6** | **10** | **0** | **18** | **34** | **8** | **12** | **24** |
| **31** | **18** | **0** | **64** | **19** | **22** | | | | | |

   a. Find the range of numbers given i.e what was the lowest and highest number of people that the respondents knew who were either ill or had passed away from HIV and Aids related illnesses.
   b. Find the best way to group the data using intervals that cater for the full range of figures given. You also need to think about how much space you will need when drawing a bar graph to show the information.
   c. Draw a tally table showing the different numbers recorded.
   d. Draw a horizontal bar chart to illustrate the information.
   e. Make up questions that you could ask about the graph.
   f. Remember to label your axes and to give your graph a name.

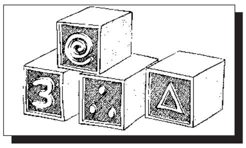


## What have you learned?

You had to think carefully about how to do the tally table but you can see how useful it is to help you to organise your data. After that it was probably easy for you to draw the bar graph. One of the questions you could ask is 'In which age group do people know the most people who have passed away from an AIDS-related illness?'

Let's summarise bar graphs:

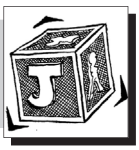
- Large collections of data can be grouped in order to fit more information into a smaller space.
- Bar graphs with grouped data have intervals that allow every number to be represented.
- When you draw bar graphs to show grouped data you do not leave spaces between the bars.
- Bar graphs are a good way to represent discrete data.



## Linking your learning with your ECD work

- Young children can make concrete graphs with blocks or counters. For example, children can take turns to place one red, one yellow and one blue counter down on the floor. They continue to place their counters above the colour that is the same as their counter. Then they can discuss which line of counters is the longest, which is the shortest. Children can count the counters in each line and find out how many there are altogether.

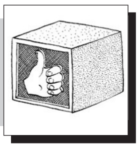
- Run a mini- survey to find out what the learners favourite colours or foods are and use pictures or symbols to record the different responses you get.



## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about bar graphs and double bar graphs?
b. What did you learn from this unit about grouping data?
c. How do you think you will be able to improve your interpretation and analysis of data in bar graphs?
d. Write down one or two questions that you still have about graphs.
e. How will you use what you learned about graphs and grouping data in your every day life and work?



## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Read and understand bar graphs and double bar graphs | | | | |
| 2. Draw bar graphs | | | | |
| 3. Group raw data into appropriate intervals | | | | |
| 4. Interpret and analyse bar graphs and double bar graphs, find trends, do calculations and draw conclusions | | | | |

# UNIT SIX

# Pie Charts

## In this unit you will address the following:

**Unit Standard 7449**

**SO2:**

Critically analyze the use of mathematical language and relationships in the economy. (Budgeting, banks: interest rates, mortgage, service charges; fuel prices; pensions; inflation; value of the rand and exchange rates.)

**SO3:**

Critically analyze the use of mathematics in social relations. (Social differentiation: gender, social mobility, race; historical and possible future contexts, e.g. employment equity; apartheid policies.)

**SO4:**

Critically analyze use of mathematics & mathematical language & relationships in political relations (Income distribution; census; elections; voting; opinion polls.)

**Unit Standard 7451**

**SO2:**

Classify and analyze numerical data. (grouped and ungrouped data.)

**SO3:**

Summarize and display organized numerical data. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

**SO4:**

Extract, interpret and critically evaluate information from various forms of display. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

To do this you will:

- interpret data presented in pie charts;
- draw your own pie charts to represent proportional shares given as either fractions or percentages;
- evaluate and explain the advantage of using pie charts to show and compare discrete sets of data;
- convert information shown in two pie charts to a double bar graph;
- use your calculator to find percentage amounts and to calculate the angles sizes you need to draw the sectors of a pie chart in their correct proportions.

## 1. Pie charts

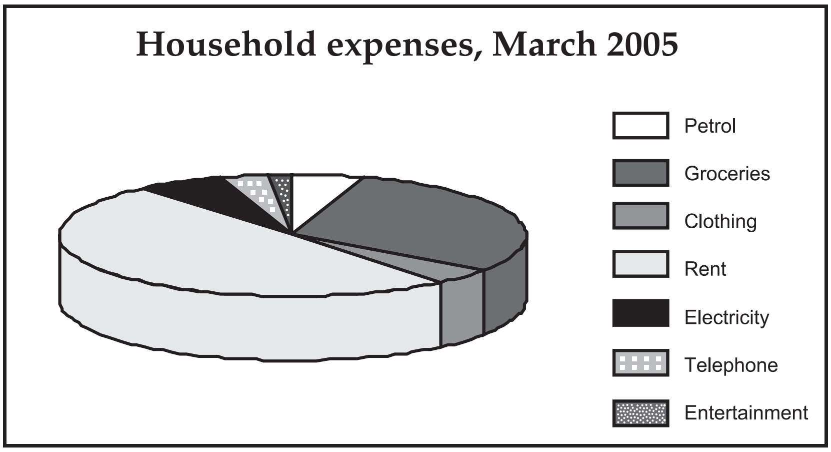
A pie chart is another way of showing discrete information (information that can be counted in some way). It is usually used to show fractional or percentage allocations.

A circle is divided up to show how different amounts have been allocated proportionally.

**Time needed 60 minutes**

### Activity 1: Understanding Pie Charts

**Work in pairs**




The pie chart represents one household's expenses for one month. Each section of the pie represents the proportion of the total budget of R4 026.50 that was spent on the different categories.

Read the pie chart and answer the questions:

1. What is the greatest monthly expense for this household?
2. What fraction of the total budget is this? How do you know?
3. Where did they spend the least amount of money?
4. Which expense was almost a quarter of the total budget?
5. Which items together make up exactly a quarter of the budget? Give two answers.
6. Write down one or two more observations you can make by looking at the pie chart.
7. Draw a sketch of a pie chart showing the way you apportion your monthly budget to different categories of expenditure. Use the same categories or include others that are relevant to you.

## What have you learned?

You can see that the greatest monthly expense is rent. The section of the pie chart that represents this is half a circle. So this tells you that rent is 50% of the monthly expenses. Groceries is the next biggest expense.

## Activity 2:
## Understanding Pie Charts

Time needed
90 minutes

**Work in pairs**

The actual expenses for each category in the above chart were as follows:

| | | | |
|---|---|---|---|
| Petrol | R195.95 | Electricity | R239.25 |
| Groceries | R1 200.35 | Telephone | R138.45 |
| Clothing | R185.00 | Entertainment | R67.00 |
| Rent | R2 000.00 | **Total:** | **R4 026.00** |

1. Use your knowledge of percentages to convert each category to a % of the whole amount. Round your answers off to the nearest whole number. (In Rand and %).
2. If the monthly income for this family is actually R3 950 then by how much are they overspending?
3. Use your calculator to find a way to express this as a percentage.
4. Compare your methods with a partner's.
5. Draw up a budget to help this family decrease their expenditure so that they spend R350 less than their income.
6. Use your calculator to express this new expenditure as a % of their total income.
7. Review the pie chart you drew again. Think if it is an accurate reflection of the percentage allocations you worked out. Draw another sketch that shows this better, if necessary. (This should only be a rough sketch. To show this accurately you have to measure the angles size of each sector with a protractor. You will learn how to do this later on in the unit)

## Activity 3:
## ECD Expenditure

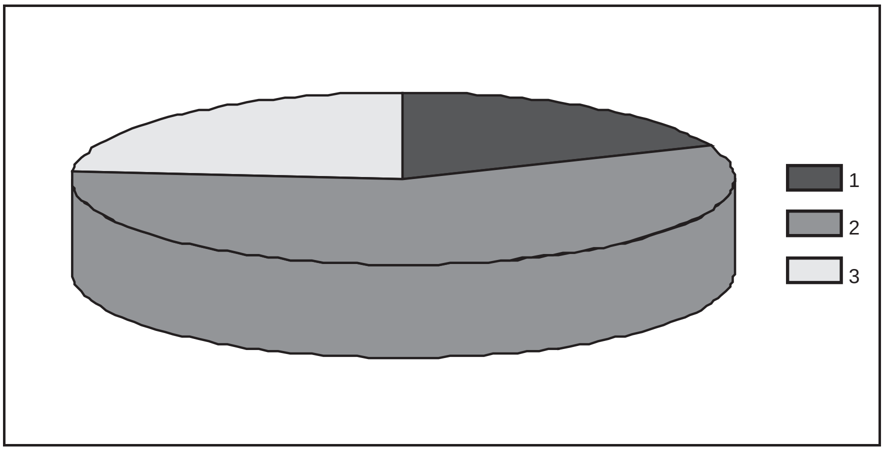
Time needed
60 minutes

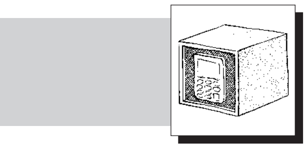
Do this activity on a separate paper and put it in your portfolio.

**Work in pairs**

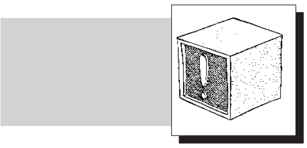
A survey conducted in 2000, showed that 837 753 learners were enrolled in South African Early Childhood Development Centres. 158 251 of these were enrolled in school-based programmes; there were 480 615 children in community-based centres and 198 887 in home-based programmes.

Here is a 3-dimensional pie chart to show this.



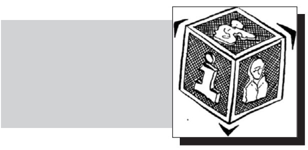



1. Use the key and the information above to find what each of the three sectors of the pie chart represent.
2. Discuss the findings of the study and suggest possible reasons for them.
3. Find what percentage each sector of the circle represents.
4. If the same study was conducted in 2010 on more or less the same population of children, what do you predict the pie chart would look like? Draw a sketch to show this. Give approximate % allocations to each sector.
5. Write a few sentences to explain the reasons for your allocations. Compare your ideas with a partner.



### Stop and think

Now that you have worked with two examples of pie charts, showing different kinds of information, think about what the advantages of this format are. Write down a few idea sand discuss these with a partner.



## 2. Drawing a pie chart

To draw a pie chart accurately you can use a protractor and measure the angles size that each sector of the pie needs to be. This can be calculated as a fraction or a percentage of the whole amount represented. The next set of activities will show you different ways to do this. You will need to use a protractor.

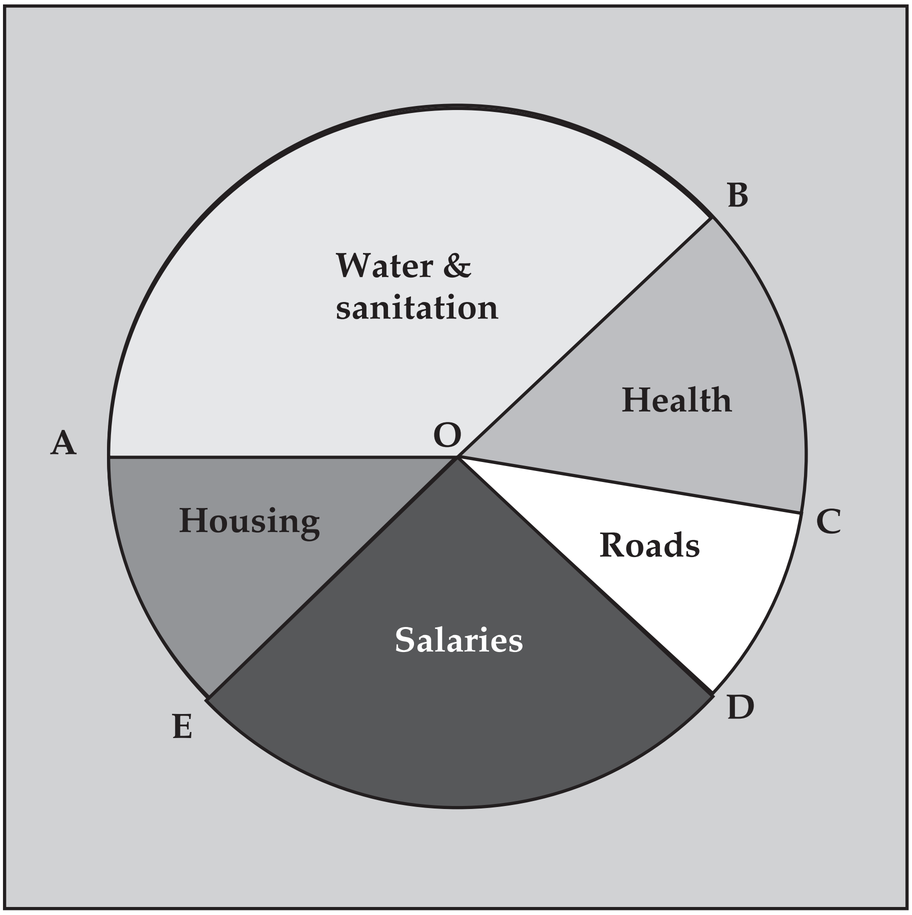
Time needed
40 minutes

## Activity 4:
## Measuring the angles on a pie chart.

**Work in pairs**

1. Look at the pie chart below. Angle AOE is 40 degrees.
2. Use your protractor to measure the angles AOB, BOC, COD and DOE, below.
3. What should the sum of all these angles be?

The pie chart gives you information about how a local government used its available funds in a certain year. You know that the total amount of money is R12 487 million. From what you found about the angle size in the activity you can now find out how much money was allocated to each local government department.




Let's look at housing. Ask yourself: What fraction of 360 degrees is 40 degrees?
Do a calculation: $\frac{40}{360} = \frac{1}{9}$

Now find what $\frac{1}{9}$ is of the total budget of R12 487 000

Use your calculator. Enter the keys as follows
1 ÷ 9 x 12 487 000 = R1 387 444.4

4. Find the total amount spent on all the other categories in the budget.
5. Check your answers. Add the different amounts you get to see that they add up to the total. (There can be some small variances to allow for rounding of the values in cases).
6. Express the allocation for each category as a percentage of the total budget.
7. Compare your answers with a partner. Make any corrections you need to.

## What have you learned?

In this activity you used your protractor to measure the angles of each sector. You then found what fraction of 360 degrees each sector was, and used this information to find out the amount (in Rands) that the different sectors represented.

In other examples, the information you are given may be different. If you know how to use your protractor and can work with fractions or percentages, you can find out the "value" or size of each sector.

You can then use the information you are given to draw a pie chart. You will now show you one example of how to do this.

## Activity 5:
## Draw your own Pie Chart

**Time needed**
**60 minutes**

**Work alone**

These are the budget allocations made by another town council.

**Housing:** R3 765 million
**Roads:** R1 289 million
**Water and sanitation services:** R2 034 million
**Public sport and recreation facilities:** R0, 807 million
**Salaries of council members and staff:** R3 789 million

1. Use your protractor to draw a new pie chart to represent the proportion of the total budget allocated to each category. Use these steps to guide you:
   a. Find the total budget.
   b. Find what fraction of the total budget each item of expenditure represents.
   c. Use your answers to work out what this fraction is in degrees i.e. of the total amount of 360 degrees.
   d. Use a ruler and your protractor to divide the circle into 5 sectors with the correct angle size for each sector.
   e. Round your answers to the nearest whole amount where necessary. (For both Rands and angle size)

2. Check your pie charts and your calculations with a partner. Decide if you need to make any corrections before moving on.
3. Calculate the total percentage allocation to each sector of this budget.
4. Write down four findings from the data that are of interest to you.

### What have you learned?

If you followed the steps carefully you managed to draw a pie chart, even if it took you a little time. If your pie chart is not the same as your partner's, try and work out together, or with your trainer to find out where you made an error.

## 3. Pie charts as fractions

You can also draw a pie chart from information that is given in fractions, by calculating what fraction of 360 degrees each sector is and then find the angle size you need to draw for each sector of the chart. Do the next activity as an example.

### Activity 6:
### Pie charts as fractions of the whole

Time needed
40 minutes

**Work alone**
Read the information first.

A certain local council estimates that it will have about R1 480 000 available to help run the ten ECD Community Centres in the area. It decides to spend $\frac{1}{4}$ of this money on health services, $\frac{2}{5}$ of the amount on a feeding scheme and the rest of the funds on building renovations. The funds are to be dispersed equally among all the ECD Centres.

1. First work on your own. You can then discuss your answers with a partner. Do not use a calculator but rather work with your knowledge of base ten and place value to help you find quick answers.
   a. How much money will the council spend on health services?
   b. How much money will it spend on the feeding scheme?
   c. What part of the available funds will be used for building renovations?
   d. What amount of each budget will each ECD Centre receive?
   e. What is the total allocation each ECD Centre will receive?
   f. Check your answer to 1e). Is this 10% of the total budget? If not find out where you made an error in your calculations
2. Now use the steps you followed in the previous activity to find out what angle size each sector should be.
3. Draw a pie chart to illustrate how the available ECD budget will be divided between health services, feeding schemes and building renovations.

### What have you learned?

- In this activity you were given the information about different budget allocations in fractions and given the total amount to be shared.

- You could use this information to find the value of each share or sector of the chart.
- You could use this information to find what fraction of 360 degrees each sector should be.
- This gave you enough information to help you to measure and draw each sector of the pie chart correctly.
- By working though all these activities you probably now feel more confident to use a protractor to measure angles and draw pie charts.

**Time needed 40 minutes**

## Activity 7: Changing trends

**Work in pairs**

Even though the number of African people living in your country is far greater than the white population, until recently fewer Africans lived in cities than white people. Study these two pie charts to see the change in the racial make up or urban populations over an eighty-year period.

**Figure 1**

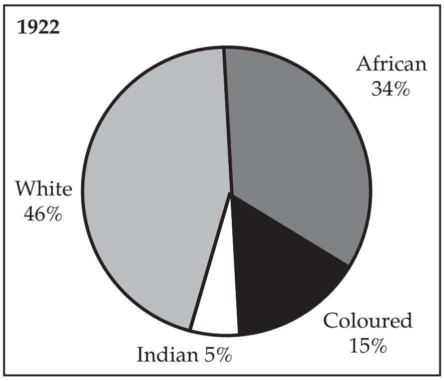
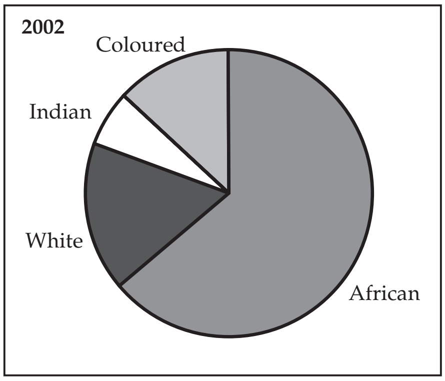
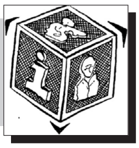



**Figure 2**

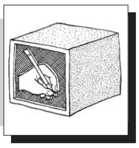



**Change In Racial Make-Up Of South African Urban Populations From 1922-2002**

1. Use the information in the two pie charts to help you answer these questions.
2. Look at the size of each sector in the second pie chart and then estimate the percentage allocations for each of the four groups. Discuss your estimations with a partner.
   a. What are some of the most noticeable differences between the two pie charts over the 80 year period?
   b. What are some the likely reasons for these changes?
3. Predict what results the same survey will come up with if it is conducted in 2022. Allocate a percentage to each racial group. Draw a rough sketch to show more or less how this would look on a new pie chart.
4. Now use what you learnt in the previous activity to find what angle size each of the four sectors in your graph should be. Draw a pie chart to show your prediction for 2022. Write a few sentences to explain your thinking.
5. Compare your predictions, your drawings and your methods of calculation with a partner.



Time needed
30 minutes



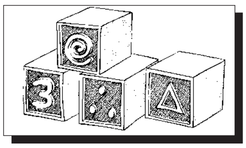
# 4. Pie Charts and Bar Graphs

## Activity 8:
## Representing information given in pie charts as a double bar graph.

Do this activity on a separate paper so that you can put it in your portfolio. Include all your calculations too.

**Work in pairs**

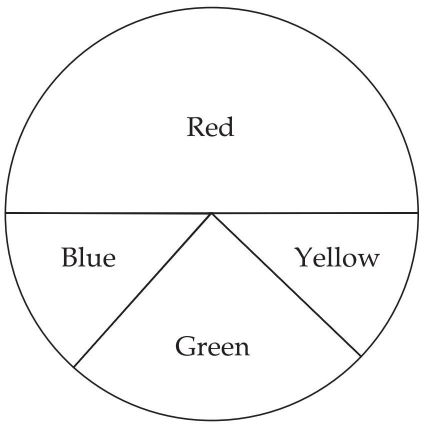
1. Show this same information given in the two pie charts in Activity 6 as a double bar graph. Here are some steps to guide you:
   a. Look back to page 23 to remind yourself about double bar graphs. Think about how a double bar graph showing the same two sets of information presented in the pie charts above would look.
   b. Round off each % in the pie charts above to the nearest whole number.
   c. Think about the % range you need to show. Then decide how big to make the intervals on the vertical axis.
   d. Decide on a key to show the bars for 1921 and 2001.
   e. Think of a title for your graph.
   f. You are now ready to draw your graph.
2. Which way of representing the same data is a) easier and b) more effective? Give reasons for your argument. Share ideas with a partner or with your trainer.



## Linking your learning to your ECD work

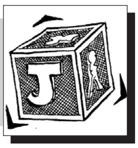
**Favourite Colours.**

Use a big circle and colour in each segment a different colour like this:



- Tell the learners that the chart tells you which colours a group of children like best.
- They can then rank the colours from the most popular to the least popular, by comparing the size of the different coloured sectors.

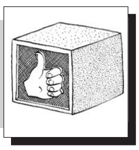
- You can follow this up by involving the learners in doing a survey in class, using tallies or coloured objects to record their favourite colours. Discuss the results and how they would look in a circle graph similar to the one you drew. i.e. which sectors would be the biggest, smallest, middle etc? Then draw a circle graph to represent their choices.



## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about drawing and interpreting pie charts?
b. How do you think you will be able to improve your understanding of pie charts?
c. Write down one or two questions that you still have about pie charts and bar graphs.
d. Write down one or two questions that you still have about drawing pie charts.
e. How will you use what you learned about pie charts in your every day life and work?



## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Interpret data presented in pie charts | | | | |
| 2. Draw my own pie charts to represent proportional shares given as either fractions or percentages | | | | |
| 3. Evaluate and explain the advantage of using pie charts to show and compare discrete sets of data | | | | |
| 4. Convert information shown in two pie charts to a double bar graph | | | | |
| 5. Use my calculator to find percentage amounts and to calculate the angles sizes you need to draw the sectors of a pie chart in their correct proportions | | | | |

# UNIT SEVEN

# More kinds of Graphs

## In this unit you will address the following:

**Unit Standard 7449**
**SO4:**
Critically analyze use of mathematics & mathematical language & relationships in political relations (Income distribution; census; elections; voting; opinion polls.)

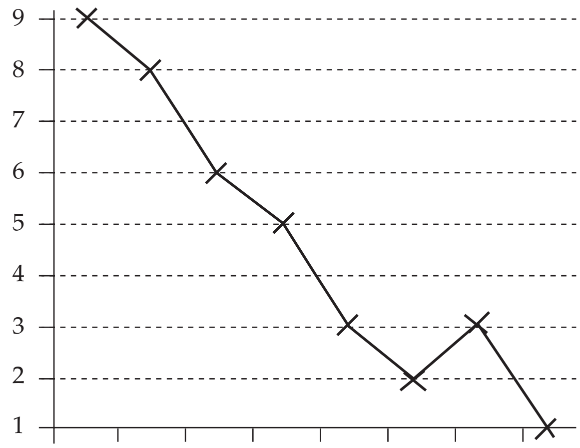
**Unit Standard 7451**
**SO2:**
Classify and analyze numerical data. (grouped and ungrouped data.)

**SO3:**
Summarize and display organized numerical data. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

**SO4:**
Extract, interpret and critically evaluate information from various forms of display. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

To do this you will:
- give examples of the kinds of data that are better to display using a particular kind of graph;
- explain the meaning of variable and distinguish between the dependent and independent variable in a given line graph;
- identify the scale used in a line graph; along both the horizontal and vertical axes;
- interpret information given in line graphs by doing calculations with the available data and observing the trend from the direction the line takes;
- follow steps to draw own bar graph on grid paper;
- work with the range of data given and choose a suitable measured scale along both axes;
- interpret information given in multiple bar graphs:
  - o explain the benefits of multiple bar graphs and give
  - o examples of the kinds of data they are useful to represent;
- decide on the most suitable measure of central tendency to calculate in different situations.

## 1. Line Graphs




**DICTIONARY:**

**trend – pattern**
**plot – mark**

- Line graphs record data as value points on a line. The line connects each value point together. This makes it possible to read the value of each point. In some graphs you can also take accurate readings between each value point. By looking at the shape of the line you can also identify and interpret a trend.
- Line graphs are a good way to record continuous data which is data that can be measured over a period of time. Bar graphs are more suitable to use for discrete data – for example to record how many family members each child in you class has. This would be shown by recording one value for each bar, with no values in between. A line graph on the other hand would be more useful to plot the growth rate of a child over a period of time. This way you can also read the values between each marked point.

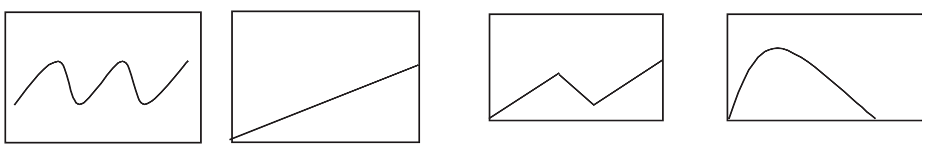
### Activity 1:
### Interpreting Trends in Line Graphs

**Time needed**
**60 minutes**

**Work in pairs**

By just by looking at the pattern that a line in a line graph forms one can get a good picture of the trend that the graph describes.

a b c d



1. Let's assume that all of these graphs described the price of potatoes in each month of the year over a four year period. The price per kilogram would be shown on the vertical axis and the months of the year on the horizontal axis.

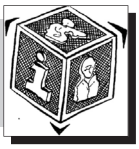
**DICTIONARY:**

**intersect – meet**

2. Write a short description to explain the price patterns for each year. As you are not given any numbers, only describe the trends you observe.
3. Compare your descriptions with a partner's.
4. Draw a line that describes the following price pattern for the cost of potatoes per kilogram in another year:

   "When the year started the price was very low. But then the price shot up dramatically and stayed high for most of the year. Towards the end of the year the price started to fall and by the end of the year the price was just a little more than it was at the beginning of the year."

5. Compare and explain your drawings to a partner



## 2. Variables

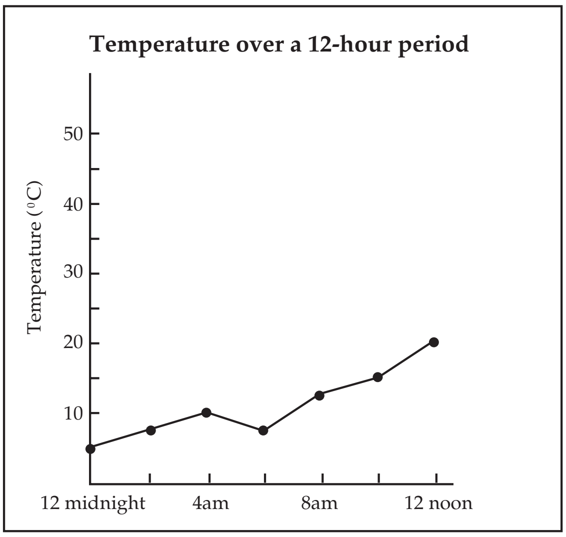
- To interpret a line graph, you look for one value along the x axis (horizontal) and read across, and read up along the vertical axis to show the other value. You can take a reading where the two values intersect on the grid.
- You call these values variables. The line you draw shows the relationship between the two variables. One variable is called the dependent variable and the other independent variable. The independent variable always goes on the horizontal axis, which you call the x-axis. The dependent variable always goes on the vertical axis, or y-axis.

**Time needed 30 minutes**

### Activity 2: Interpreting Line Graphs

**Work alone**

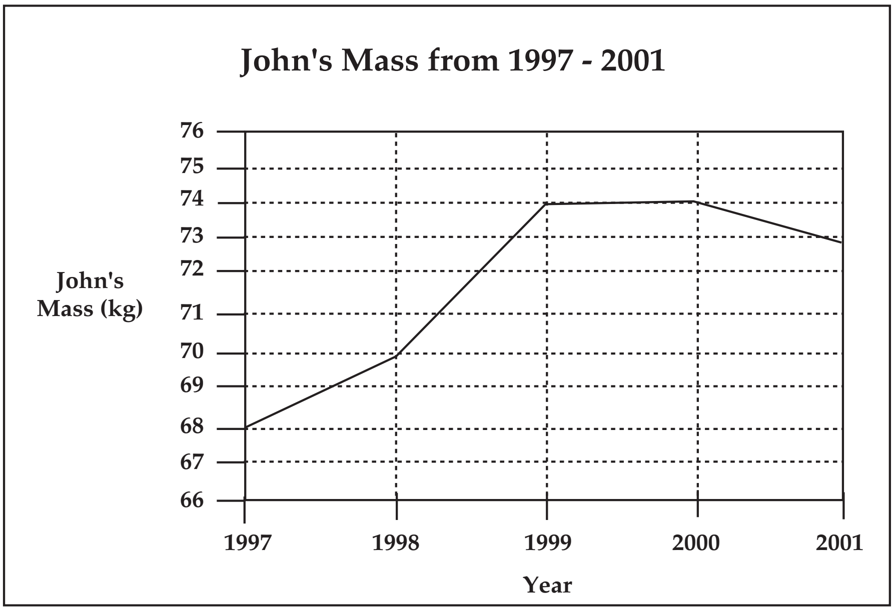
1. Refer to the graph below to answer these questions.



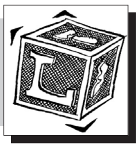

   a. What are the two variables in this line graph? What are they comparing?
   b. What scale is used to show the temperature? i.e. 1cm = ………°C

c. What scale is used to show time durations? i.e. 1cm = …… hours?
d. At what time does a slight drop in temperature occur?
e. By how much has the temperature risen from 6a.m. to midday?
f. If this were a typical early summer's day, in your province what would you expect the weather to be like for the next 12 hours i.e. from 12 noon to 12 midnight? Draw a sketch that extends both axes and the line to show your predictions of what the weather would be for the next 12 hours.

The local clinic has been monitoring the weight of one of their patients. John Mabalane. The graph above shows how John's mass varied from the beginning of 1997 to the end of 2001. The weight scale runs vertically, while the time scale is on the horizontal axis.




a. In this graph, which is the dependent variable and which is the independent variable? How do you know?
b. Follow the direction the line takes from its starting point in the left-hand corner. Use the grid lines to help you read the information along both axes. Can you see that John weighed 68kg in 2001? How much did he weigh in each of the other years?
c. From looking at the graph you can notice one obvious trend - that John's weight increased dramatically between 2002 and 2003. What other trends can you notice?
d. A further record states that John's mass more or less stabilised over the next five year period, except for a brief time when it rose sharply. Draw a rough sketch of the same graph to include the years from 2000-5 on the horizontal axis. Copy and extend the line to show what it could like, given this information.
e. Discuss and compare your sketches with a partner.

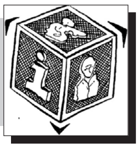


### What have you learned?

- A line graph gives you the chance to visually compare two variables – shown on each of the two axes. Specific relationships between these variables are marked as points where the two axes intersect. You can then join the points to form a continuous line.
- While bar graphs show amounts and change by the size or height of the bars, in a line graph it is the direction of the line that shows change over a period of time. Line graphs, unlike bar graphs can show values of data that fall between any two specific marked points as well, and are thus ideal for showing continuous type of data.

- Line graphs are particularly useful for showing and comparing trends in data as demonstrated by the relationships between two variables. From reading the graph, you can see how the variables relate to and are influenced by one another. For example, as it gets towards evening, the temperature drops.

- By looking for a pattern in the way the line moves, it is sometimes easy to make predictions about the results of data not yet recorded.



## 3. Drawing line graphs

To draw a line graph you need to plot the points to read information about both variables. You then join the points to form a line. Just like a bar graph, the basic line graph should have the following information.

- a heading
- a labelled scale across the bottom (the horizontal axis)
- a labelled scale on the left-hand side (the vertical axis).

**Time needed**
**40 minutes**

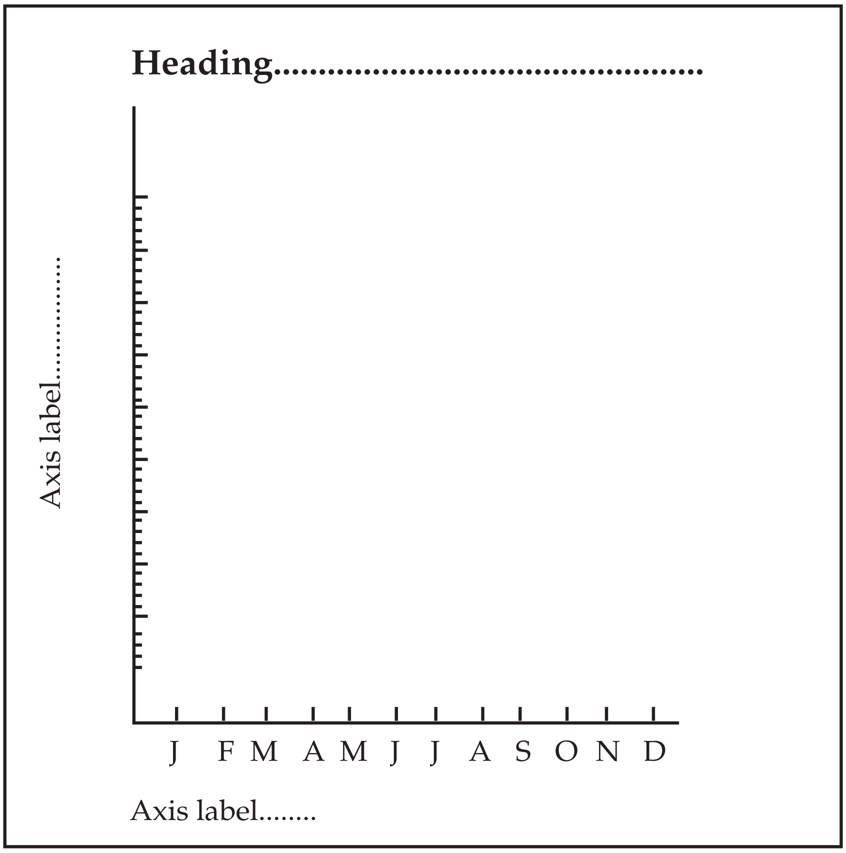
### Activity 3:
### Drawing line graphs

**Work alone**

The average monthly maximum temperatures in a Limpopo village over one year were recorded by the weather bureau in a table as follows:

| Jan | Feb | Mar | April | May | June |
|---|---|---|---|---|---|
| 33° | 29° | 31° | 26° | 24° | 21° |
| **July** | **August** | **Sep** | **Oct** | **Nov** | **Dec** |
| 20° | 23° | 29° | 33° | 31° | 30° |

1. Use the following grid to draw a line graph to show the temperatures. Follow these steps.
   a. Represent the temperatures as points.
   b. Join the six points to make a line graph




In the graph you have just drawn you are actually showing a trend in the temperatures for each month rather than exact temperatures. The temperatures for each month are calculated as an average. It would not therefore be possible, from reading this graph, to say what the temperature was in the middle of February or on a specific day of any month.

### What have you learned?

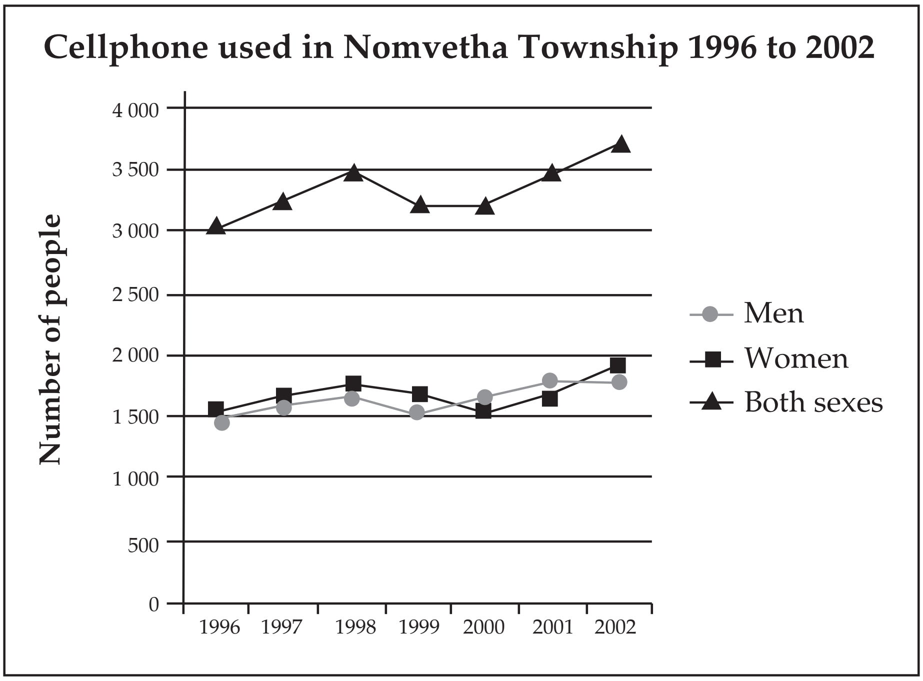
When you begin to draw a line graph you need to think about the values you want to show along each axis and what scale you will use to show these values. When you plot the values along the *y* or vertical axis, you need to think carefully about the range of values you have to show. Make sure you use a measured scale that allows you to plot each value accurately, from the lowest to the highest. You need to give the graph a heading and label both axes.

Time needed
30 minutes

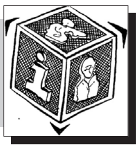
## Activity 4:
## Multiple line graphs

**Work in pairs**

You can draw a multiple line graph to compare similar variables over the same period of time. Look at this graph as one example:




Notice how well this graph is presented. Both axes are clearly labelled and tell you exactly what the data is about. As three line graphs are drawn in the same space, a clear and easy-to-use key shows you exactly what each graph is about.



## 4. Stem and Leaf Displays

A Stem and Leaf display is a way of organising information about numbers or values that can be shown to the left and to the right of a central stem. So for example, one can record ten values to the left of the central stem and unit values to the right of the stem. In this way one can analyse at a glance the values of large sets of numbers. With Stem and Leaf displays you can also find different averages and determine total scores quickly.

Here is an example of what a typical Stem and Leaf display looks like. It is a display of marks that students got out of 100 for a test.

| Test Scores Out Of 100 | |
|---|---|
| **Stem** | **Leaf** |
| 5 | 0 0 2 8 8 |
| 6 | 1 4 4 7 8 |
| 7 | 2 4 6 8 8 9 |
| 8 | 3 5 |
| 9 | 2 2 6 8 |

The Stem shows the 'tens' and the leaf shows the 'units'. At a glance, you can see that 4 students got a mark in the 90's for their test out of 100. The first two students received the same mark of 92. The last student received a mark of 58. No marks were below 50. There was no mark of 100. When you count the total amount of leaves, you know how many students took the test. In this case it was 22 students.

Time needed
45 minutes

### Activity 5:
### Stem and Leaf Display

**Work alone**

1. Try your own Stem and Leaf display with the following temperatures for December in Gauteng.

24 31 23 20 21 27 33 32 21 30 28 30 27 31 30
27 30 25 27 28 31 29 30 22 24 32 22 27 32 30

2. Work out the mean and median temperatures.

### What have you learned?

You began with the lowest temperature. The lowest temperature of the month was 20. You entered the 2 in the tens column and a 0 in the units. You found the next lowest temperature to be 21, so you entered a 1 in the ones and nothing in the tens. When you reached the temperatures in the 30s, you entered a 3 in the tens column and then entered all the scores in the units columns. You managed to work out the mean temperature by adding all the temperatures and dividing the total by 30. You worked out that the median is 28 degrees.

## 5. Splitting stems using decimal values

The masses (to the nearest tenth of a kilogram) of 30 high school learners were measured and recorded in kilograms as follows:

59.2, 61.5, 62.3, 61.4, 60.9, 59.8, 60.5, 59.0, 61.1, 60.7, 61.6, 56.3, 61.9, 65.7, 60.4,
58.9, 59.0, 61.2, 62.1, 61.4, 58.4, 60.8, 60.2, 62.7, 60.0, 59.3, 61.9, 61.7, 58.4, 62.2

You can record this data in a stem and leaf plot as follows.

The stems will be the whole number values, starting from smallest to biggest, and the leaves will be the decimal values. The data range from 56.3 to 65.7, so the stems should start at 56 and finish at 65.

| Mass of 30 learners | |
|---|---|
| **Stem** | **Leaf** |
| 56 | 3 |
| 57 | |
| 58 | |
| 59 | |
| 60 | |
| 61 | |
| 62 | |
| 63 | |
| 64 | |
| 65 | 7 |

Time needed
40 minutes

### Activity 6:
### Mean and median

**Work alone**

1. Complete the stem and leaf display above.
2. Find out the mean and median masses of the learners.
3. Write a short sentence to explain your findings.
4. Compare your answers with a partner.

## 6. Outliers

An outlier is an extreme value of the data. It is a value that is very different from the rest of the data. There may be more than one outlier in a set of data. So in this case the outliers could either be the mass amounts that were far above the mode masses or far below the mode.

Sometimes, outliers are important pieces of information and should not be ignored. Other times, they are there because of an error or misinformation and should be ignored. In the next unit you will learn more about how statistics can be manipulated to convey a particular impression. In the case of a stem and leaf display outliers might be removed in order to distort the true facts.

In the previous example, 56.3 and 65.7 could be considered outliers, since these two values were far below and far above the mode amount.

If you ignore these two outliers, the previous stem and leaf plot could be redrawn like this:

| **Mass of 30 learners without outliers** | |
|---|---|
| **Stem** | **Leaf** |
| 58 | 4 4 9 |
| 59 | 0 0 2 3 8 |
| 60 | 0 2 4 5 7 8 9 |
| 61 | 1 2 4 4 5 6 7 9 9 |
| 62 | 1 2 3 7 |

Stem and leaf plots are a useful way to summarise numbers that can be split either into tens and unit values or whole numbers and decimal values. From this display you can see the distribution quickly. You can also calculate the mean, mode and median scores easily. You can identify outliers at a glance.

**Time needed**
**60 minutes**

## Activity 7:
## Use of central tendency in producing statistics

**Work alone**

Mean, median and mode are all measures of central tendency and are used to find averages. You want to know a different kind of average for different data.

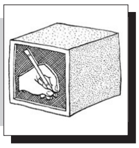
Look at this example:

Mrs Maseko is going over the Bantwana Bami ECD Centre's telephone accounts in order to plan her budget for telephones for the coming year. She rounds off the amounts to the nearest R10 to make them easier to work with. This is what she finds:

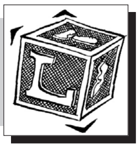
| **Bantwana Bami ECD Centre's telephone Accounts 2005** | | | |
|---|---|---|---|
| **Month** | **Amount in Rands (to nearest R10)** | **Month** | **Amount in Rands (to nearest R10)** |
| January | 490 | July | 220 |
| February | 180 | August | 970 |
| March | 160 | September | 120 |
| April | 200 | October | 300 |
| May | 140 | November | 180 |
| June | 150 | December | 110 |

Mrs Maseko knows that she makes more telephone calls in January (the beginning of the school year), April, July and October (before each new term begins.) However, this year in August, she had to make a number of phone calls to the United States, to speak to an organisation wanting to fund the Centre. The organisation later reimbursed Mrs Maseko for these calls.

1. Calculate the mean, median and mode for these accounts.
2. Identify any outliers.
3. Use the information above to decide which average is most appropriate for Mrs Maseko in budgeting for telephone calls for 2006? Give reasons for your answer.

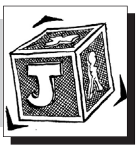


Do this activity on a separate paper so that you can put it in your portfolio. Don't forget to include your questions too.



## What have you learned?

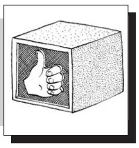
By now you can calculate the mean, median and mode quite easily. Perhaps you decided that it is not realistic to take a mean average because January and August will make it too high. The mode is 180 and the median is 185. So it would perhaps be best to use one of these as the measure of central tendency.



## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about recording data in different ways?
b. What did you learn from this unit about variables?
c. How do you think you will be able to improve your understanding of line graphs?
d. Write down one or two questions that you still have about line graphs and the use of scale.
e. Write down one or two questions that you still have about central tendencies.
f. How will you use what you learned about recording data in your every day life and work?

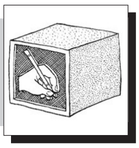


## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Give examples of the kinds of data that are better to display using a particular kind of graph | | | | |
| 2. Explain the meaning of variable and distinguish between the dependent and independent variable in a given line graph | | | | |
| 3. Identify the scale used in a line graph; along both the horizontal and vertical axes | | | | |
| 4. Interpret information given in line graphs by doing calculations with the available data and observing the trend from the direction the line takes | | | | |
| 5. Follow steps to draw own bar graph on grid paper. | | | | |
| 6. Work with the range of data given and choose a suitable measured scale along both axes. | | | | |
| 7. Interpret information given in multiple bar graphs; explain the benefits of multiple bar graphs and give examples of the kinds of data they are useful to represent | | | | |
| 8. Decide on the most suitable measure of central tendency to calculate in different situations | | | | |



## Assignment 2:

For this assignment you are going to apply all the skills you have learned so far. This means you will collect, sort, organise, record and analyse a set of data. Choose one of the following three sets of data to work with:

- Your application form, or the new Application Form that you created in the Communications Course.
  or
- Your attendance and health & accident records from the Communications Course
  or
- Observation or Progress Records that you keep of children

1. Choose which set of data you want to work with. Collect the data for one month. If you choose to work with the application forms make sure that enough parents have completed it so that you have a big enough sample.
2. Decide on a question or questions you want to find out. For example, from the application form you may want to find out how many children were breast fed and for how long. From the attendance and health records you may want to find out which illnesses children suffer from most. Or you may want to compare the number of children who are sick with the number of children who are absent. From the observation and progress records you may want to find out which activities children like to use.
3. Read the data you have chosen and organise it into tally and frequency tables.
4. After you have organised your data find a way to group your data to summarise your findings.
5. Decide on the best way to represent your data. You can choose pictographs, bar graphs, line graphs, pie charts or double bar or line graphs.
6. Draw up your data in the presentation you have chosen.
7. Find the mean, median and mode for your information.
8. Write a few sentences to describe some of main trends or patterns you notice from the data you recorded.

# UNIT EIGHT

# Critically analysing data

## In this unit you will address the following:

**Unit Standard 7449**
**SO1:**
Critically analyze the use of mathematical language and relationships in the workplace. (Wage negotiations, salary increases, and productivity as a ratio.)

**SO2:**
Critically analyze the use of mathematical language and relationships in the economy. (Budgeting, banks: interest rates, mortgage, service charges; fuel prices; pensions; inflation; value of the rand and exchange rates.)

**SO4:**
Critically analyze use of mathematics & mathematical language & relationships in political relations (Income distribution; census; elections; voting; opinion polls.)

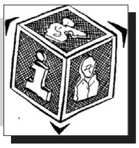
**Unit Standard 7451**
**SO1:**
Identify situations for investigation and data collection and collect numerical data.

**SO2:**
Classify and analyze numerical data. (grouped and ungrouped data.)

**SO3:**
Summarize and display organized numerical data. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

**SO4:**
Extract, interpret and critically evaluate information from various forms of display. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

To do this you will:
- critically examine and analyse data to be able to draw conclusions and make predictions;
- read and interpret data with an awareness of sources of error and manipulation to draw conclusions and make predictions;
- decide on the most suitable measure of central tendency to use in different situations;
- decide on the most suitable scale for graphs.



## 1. Interpreting data

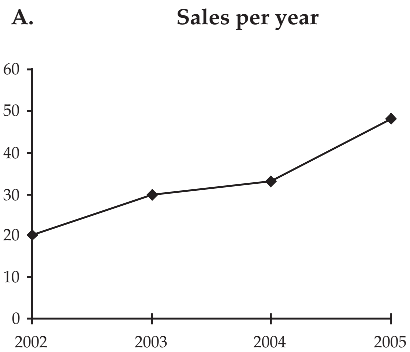
Sometimes, even when the data collected is accurate, it can be presented in a way that does not accurately represent the situation. Graphs can be drawn in ways that distort the accuracy of the data. The scale chosen for the graphs, the method used to find a central tendency and the data selected for display can all affect the way the graph is interpreted. In this unit you will look at and critically analyse graphs and diagrams to identify errors and manipulation in the presentation of data.

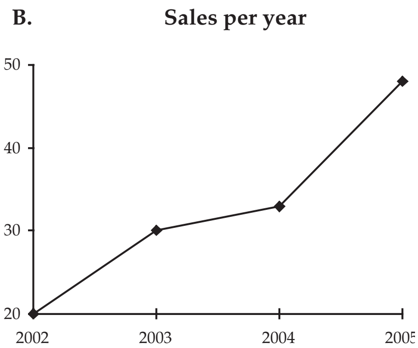
**Time needed**
**40 minutes**

### Activity 1:
### Lying with Statistics

**Work alone**

Here are two line graphs of exactly the same data, but with different scales on the vertical axis:



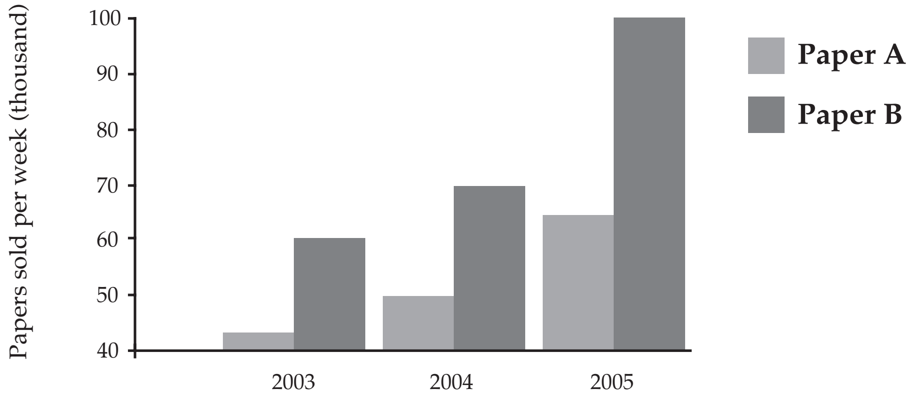




**DICTIONARY:**

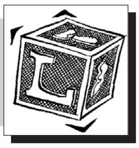
**flattering – makes it look better**

1. How many sales were made in 2005?
2. Do you agree that all the data is the same for both graphs?
3. Do these two graphs tell the same story?
4. Which graph should be used in a newspaper advertisement to boost the sales of the company? Why do you say so?
5. Is the graph a true reflection of the situation or is it a bit misleading? If it is misleading, why is this so?
6. Is there anything about the more flattering graph that is false? Explain.

Here is a bar graph representing the circulation figures for two newspapers, as published by paper B – of course!




1. Do you agree that the graph gives the impression that paper B sold about three times as many papers as A in 1999? Explain.
2. How many newspapers did each newspaper sell per week in 2005? Is paper A really such a poor seller?
3. Is the graph a true reflection of the situation or is it a bit misleading? If it is misleading, why is this so?
4. Suppose you are paper A's manager. Think about how you might use the same data but draw a different bar graph so that your paper will not look so bad in comparison to paper B.



## What have you learned?

It is possible to change the way a line graph looks even if it shows the same information. One way to do this is to change the scales on the axes. This means that the value in between each point along the axis may not be the same. This is misleading because it can show a trend that is not real. You can see in graph B above that it looks like sales increased a lot in 1995. Actually it is the same as graph A but the different scale makes it look more impressive.

Time needed
45 minutes

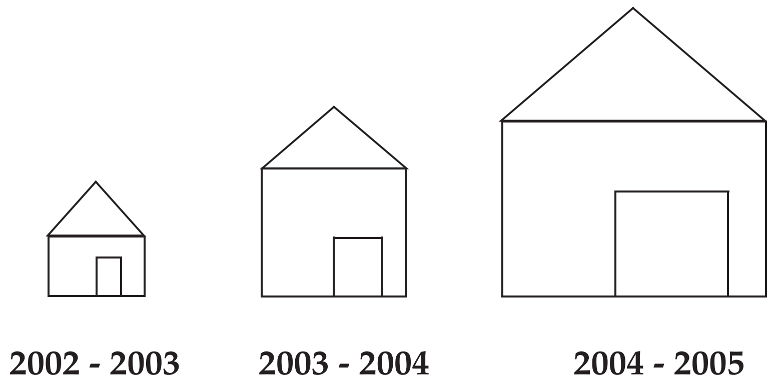
## Activity 2:
## Creating a better impression

**Work in pairs**

Edna is a graphic designer. She works for an advertising agency. His client Amakhosi Homes asks her to draw a graph to paint a rosy picture of their house sales for the first four months of the year. This is the graph she draws:

**DICTIONARY:**

**manipulate – change**

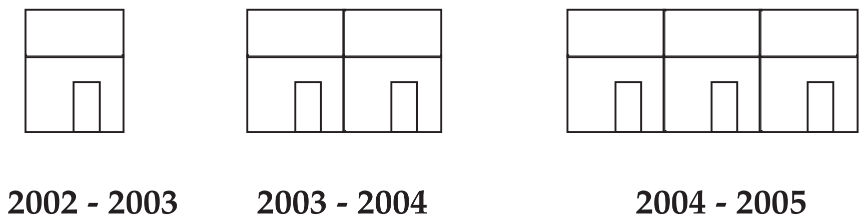


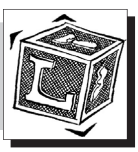

Here are statistics on which this pictograph is based:

| Year | No. of new houses built |
|---|---|
| 2002 - 2003 | 5 000 |
| 2003 – 2004 | 10 000 |
| 2004 - 2005 | 15 000 |

1. Study the picture and the information carefully. Discuss whether you think the artist has accurately reflected the statistics in the table or not.
2. Why would a housing company want to mislead the readers in this way?

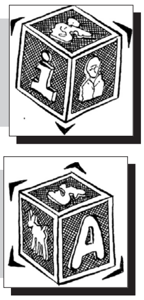
Here is another pictogram showing the same information.
3. Discuss why this version is a more accurate representation of the same data?



## What have you learned?

Pictograms are very easy to change to create a misleading impression. The size of the picture will make a difference to the way you interpret the information. To give a true reflection, the scale of the picture should be correct. Advertisers often manipulate information in pictures like these by using a scale that makes sales seem better than they really are.



Time needed
60 minutes

## 2. Selecting and grouping data

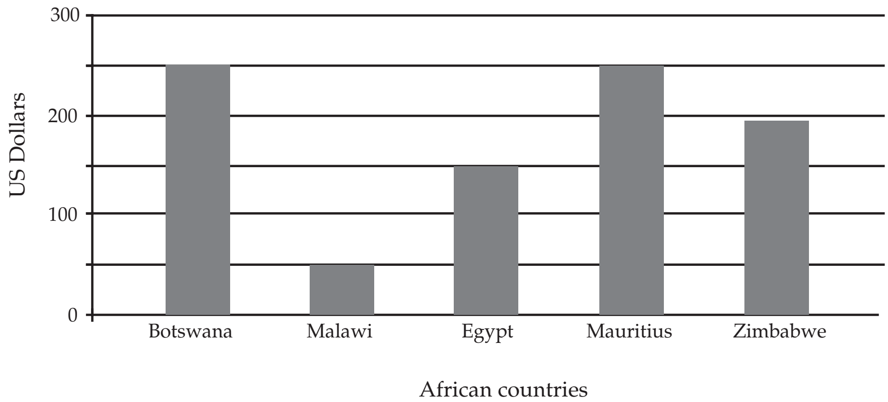
### Activity 3:
### Selection and grouping of data.

**Work alone**

Below is a graph showing the average monthly income in some African countries.

1. Read the information from the graph below and then answer the following questions:

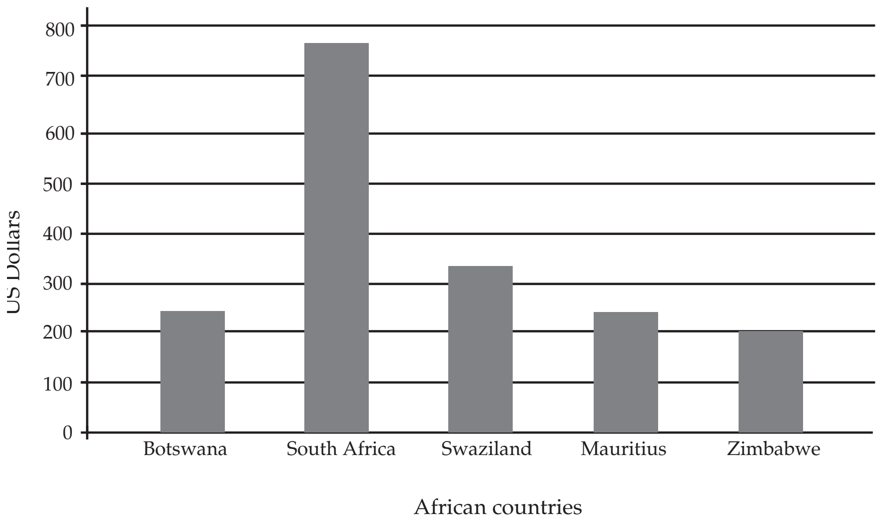
**Average monthly wages in African countries**




a. Which country earns the least in US dollars per month?
b. In which country are the most US dollars earned?
c. Write down the names of the countries in order from the highest to lowest earnings in terms of US dollars.

2. Now look at the graph below and answer the questions.

**Average monthly wages in African countries**

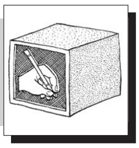


**DICTIONARY:**

**selective – only some**
**deliberately – on purpose**

a. Which country earns the least in US dollars per month?
b. In which country are the most US dollars earned?
c. Write down the names of the countries in order of the highest to lowest earnings, in terms of US dollars.

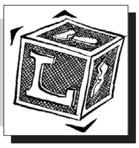
3. Both graphs show the average monthly wage in some African countries. Both graphs are accurate in terms of the number of US dollars earned by workers in those countries. However the two graphs give a different picture of the facts. Discuss how this happens.



Do the next part of this activity on a separate paper so that you can put it in your portfolio. Don't forget to include your questions too.

4. Now draw one bar graph showing the income earned by all the countries. Answer these questions:
   a. Which country earns the least in US dollars per month?
   b. In which country are the most US dollars earned?
   c. Write down the names of the countries in order of the highest to lowest earnings in terms of US dollars.

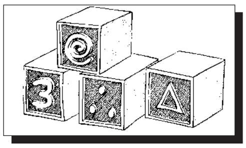
5. Why do you think people might use selective data when drawing up graphs like these? In the case of these two graphs, which graph for example would be the better one to use if you were: a) The South African Government? b) The Zimbabwean Government?



## What have you learned?

- This activity and some of the activities that came before, show you that by selecting only some data to display, you can change what people might think. This could be done in order to present a picture that is more favourable to the party that is putting out the information.
- In the case of the activity you have just worked with, by leaving out South Africa and Swaziland from the first graph, and including Malawi and Egypt, it seems as if Botswana earns the most US$ per month. Zimbabwe seems to be the third highest earner of dollars. When you include South Africa and Mauritius and exclude Malawi and Egypt, the whole picture changes. South Africa now becomes the highest earner and Zimbabwe the lowest.
- It is important to realise that a government might select data like this deliberately to promote a country's image for political or economic purposes.
- By now you have perhaps realised that you cannot always believe all the statistics that you are given and that data is often manipulated for commercial or political reasons to give a good or bad impression.

- If you understand this you can be more careful to ask questions before believing what you read or what you are told.
- If you want to be find out if data is reliable or not, you need to find out more about:
  - the source of the data;
  - the purpose for which it was collected;
  - the size of the sample;
  - the choice of data for presentation;
  - the date of the research;
  - the methods used to calculate measures of frequent tendency.



**Linking your learning with your ECD work**


- Think about how you can help children to understand the importance of getting a representative sample. For example, ask three learners out of a group of thirty for an opinion on a topic. Ask the rest of the class whether they agree. Help your learners to understand that you have to get as many opinions as possible to get a true picture.

## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about analysing data?
b. Write down one or two questions that you still have about how data can be manipulated to give different messages.
c. How will you use what you learned about data and interpreting data in your every day life and work?

## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Critically examine and analyse data to be able to draw conclusions and make predictions | | | | |
| 2. Read and interpret data with an awareness of sources of error and manipulation to draw conclusions and make predictions | | | | |
| 3. Decide on the most suitable measure of central tendency to use in different situations | | | | |
| 4. Decide on the most suitable scale for graphs | | | | |

## Assignment 3

**Time needed 120 minutes**

Do some research from newspapers, magazines or advertising fliers to find examples of different kinds of graphs? Cut them out and paste them into your journal or work book. Write as much as you can about each example. Use these questions to guide your observations:

a. What are some of the trends you notice?
b. In which cases do you think the data is "true" and in which cases do you think the data might have been distorted for a particular reason?
c. Describe why the particular format has been chosen e.g. a line graph rather than a bar graph or a bar graph rather than a table or pictograph.
d. Make up some of you own questions to ask about the data being presented. Then ask a partner to answer these.

# UNIT NINE

# Chance and Probability

## In this unit you will address the following:

**Unit Standard 7451**
**SO4:**
Extract, interpret and critically evaluate information from various forms of display. (Graphs: pie, frequency polygon, histogram, simple bar graph, stem and leaf; tables, basic tree diagrams.)

**SO5:**
Demonstrate understanding of the concept of chance and calculate simple probabilities. (limited to systematic counting strategies.)

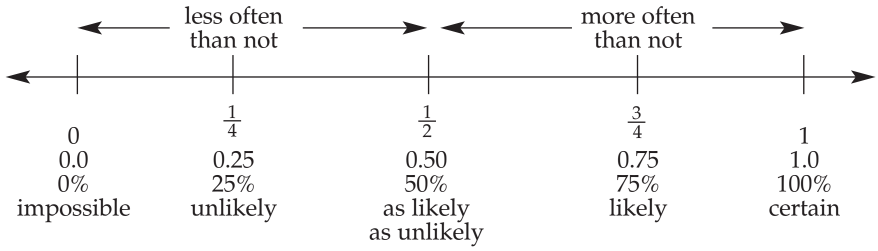
To do this you will:
- explore the chance of something happening, using both theory and experiment to predict what will happen;
- use tree diagrams, two-way tables, and calculations to work out the theoretical probability of something happening;
- carry out probability experiments in which you measure what actually happens, and from them calculate the experimental probability of a given event;
- compare what you guessed would happen in an experiment with what actually happened, and understand and explain the differences.

## 1. Probability

"There's a 20% chance of rain."
"Nine times out of ten I bump into a classmate at the weekend."
"Fifty percent of patients recover within ten days of treatment."
"His chance of growing up to be president was less than one in a million."

Modern life is full of references to probability. Probability means what the chance is that something will happen. When you talk about probability you are really using fractions. When you say twenty per cent chance of rain you mean the chances are 20 out of 100 (per cent) that it will rain.

When you say the chance of getting heads when you toss a coin is "fifty-fifty" you mean that fifty percent of the time, or fifty times out of a hundred, it will come up heads. Actually this means that the chances of heads or tails coming up are equal. One hundred times out of one hundred ($\frac{100}{100}$) is the same as 1. So the probability of an event is a number between 0 and 1. If something definitely won't happen you can say that the probability of it happening is zero. Something which will definitely happen has a probability of 100%. If the chance of rain is 20%, then the chance that it won't rain is 80%. That is because 20% plus 80% is 100%.

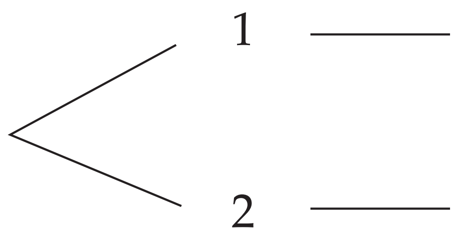



**Probability is expressed as a number between 0 and 1.**

**What are your chances of winning the lottery?**
In the national lottery 6 balls are chosen at random from 49 numbered balls. You win if your ticket has the same six numbers. The order doesn't matter. What are your chances of winning?

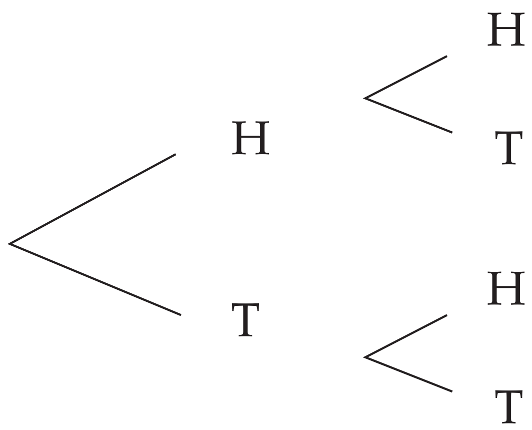
This is a complicated problem. At the end of this unit you will know how to solve it, but you will start with a simpler question first.

Pick 1 out of 2:
Suppose there are 2 balls (numbered 1 and 2), and you pick one at random.
There are two possible outcomes. You could draw a 1, or you could draw a 2. What is the probability of each? Since it is equally likely that you pick either ball, there is a 50% chance that the ball you pick is a 1.
If you draw again, what will happen?
One tool you can use to analyze outcomes is the tree diagram.




When you first draw there are two possible outcomes – you can pick a 1 or a 2. But if you don't put back the ball you drew out, on the second draw you will definitely get the other ball. So there are only two possible outcomes – a 1 followed by a 2, or a 2 followed by a 1.

Is this the same as flipping a coin? Let's think about flipping a coin twice. We'll write H for heads and T for tails. A coin has two sides and two possible outcomes, so there is a 50% chance of getting heads on the first flip. But if you flip again there will be a 50% chance of getting heads the second time, too. The tree diagram for flipping a coin twice looks like this:




The diagram shows that there are four different possible outcome – HH, HT, TH, TT. Since they are equally likely, the probability of getting any one result – say HH – is $\frac{1}{4}$ or 25%.

What is the probability of getting a double – either heads or tails? It is just the probability of getting HH plus the probability of getting TT – $\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$.

Time needed
20 minutes

### Activity 1:
### Test your understanding

**Work alone**

1. Imagine you are going to draw two coloured balls. But this time after you draw the first ball you replace it before you draw the second. Draw the tree diagram for this experiment.
2. Compare and discuss your findings with a partner.

## 2. Joint probability

Joint probability is the chance that two things will both happen. Another way to find the joint probability is to multiply the probability of the first by the probability of the second. There is a $\frac{1}{2}$ (one out of two) chance of getting heads on the first flip and a  chance of getting heads on the second flip. So the chance of getting heads both times is $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$.

Time needed
20 minutes

### Activity 2:
### Joint probability

**Work alone**

1. When you toss a coin 3 times what is the probability of getting 3 heads in a row?
2. Draw the tree diagram for flipping a coin 3 times to help find the answer.
3. Compare and discuss your drawings with a partner.

### Stop and Think

- What if you pick one ball at random from 3 balls (marked 1 to 3)?
  It is equally likely that you will draw a 1, a 2, or a 3, so the chance of each is $\frac{1}{3}$.
- What is the probability that you will draw an odd number?
- Since two out of three balls have odd numbers written on them, there is a $\frac{2}{3}$ (two out of three) chance of drawing an odd number. There is a $\frac{1}{3}$ (one out of three) chance of drawing an even number. The total probability always adds to 1. In this case, $\frac{2}{3} + \frac{1}{3} = 1$.

## 3. Odds

- An outcome of an experiment is any thing that can occur – in this case the possible outcomes are 1, 2, or 3.
- An event is a subset of possible outcomes. In this case the event is getting an odd number, so 1 and 3 are examples of that event but 2 is not.

What are the "odds" of drawing an odd number? There is a $\frac{2}{3}$ chance of getting an odd number, and a $\frac{2}{3}$ chance of not getting an odd number.
So therefore the "odds" of drawing an odd number are 2 to 1. Note that the "odds" is not quite the same as the probability. To find the "odds" you divide the probability of something happening by the probability of it not happening.

### Stop and think

If the probability of rain tomorrow is 20%, what are the "odds" it will be a sunny day?

**Roll the dice**
If you roll two dice what are all the possible outcomes? Another way to analyze the probability of two things happening together is with a two-way table. The table has rows for one die, and columns for the other. Let's say you have one blue die and one red die.

Each die can come up with any one of six numbers, so all the possible outcomes can be shown in a diagram like this. For each possible outcome, there is a pair of numbers – the number on the blue die is first, followed by the number on the red die.

| Red | Blue | | | | | |
|---|---|---|---|---|---|---|
| 1 | 1,1 | 2,1 | 3,1 | 4,1 | 5,1 | 6,1 |
| 2 | 1,2 | 2,2 | 3,2 | 4,2 | 5,2 | 6,2 |
| 3 | 1,3 | 2,3 | 3,3 | 4,3 | 5,3 | 6,3 |
| 4 | 1,4 | 2,4 | 3,4 | 4,4 | 5,4 | 6,4 |
| 5 | 1,5 | 2,5 | 3,5 | 4,5 | 5,5 | 6,5 |
| 6 | 1,6 | 2,6 | 3,6 | 4,6 | 5,6 | 6,6 |

**Two-Way Table of the Outcomes of Two Dice**

How many possible outcomes are there? What is the probability of rolling two sixes? There are 36 different outcomes. In a probability experiment, when you think about which die has which number, each different outcome is called a permutation.

Sometimes you are not interested in the arrangement or order, but only in the combination of numbers. When you have a combination of two different numbers there are two different permutations, or arrangements, of that pair. If you have a combination of 3 and 4, for example, the permutations are 3,4 and 4,3.

### Stop and think

How many different combinations are there in the table above?

## 4. Probability of the sum

Sometimes when you roll two dice it is the sum that is important. The two-way table for the sum of two dice looks like this

| | | | | | |
|---|---|---|---|---|---|
| 1,1 | 2,1 | 3,1 | 4,1 | 5,1 | 6,1 |
| 1,2 | 2,2 | 3,2 | 4,2 | 5,2 | 6,2 |
| 1,3 | 2,3 | 3,3 | 4,3 | 5,3 | 6,3 |
| 1,4 | 2,4 | 3,4 | 4,4 | 5,4 | 6,4 |
| 1,5 | 2,5 | 3,5 | 4,5 | 5,5 | 6,5 |
| 1,6 | 2,6 | 3,6 | 4,6 | 5,6 | 6,6 |

**Two-way Table of the Sum of Two Dice**

What is the probability of getting a sum of seven? To find the theoretical probability you calculate the relative frequency of an event. To do this you divide the number of times that event happens by the total number of possible outcomes. There are 36 possible outcomes, six of which add to seven (1,6 2,5 3,4 4,3 5,2 6,1), so the probability of rolling a sum of seven is $\frac{6}{36}$, or $\frac{1}{6}$.

$$\text{Probability of an Event} = \frac{\text{The Number of Ways it Can Occur}}{\text{The Total Number of Possible Outcomes}}$$

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 13 |

**Frequency Distribution of The Sum of Two Dice**

### Activity 3:
### Putting your results onto a graph

Time needed
30 minutes

**Work in pairs**

1. Use the graph above to find the relative frequency for each sum. Put a – in a box above each number for each time that sum appears in the table. The number of –'s for each sum is the frequency of that sum. The relative frequency is the number of –'s for a particular sum divided by the total number of –'s.
2. Discuss your findings with a partner

## 5. Random events happen randomly.

With probability it is important to understand that for random events you cannot predict what will happen! Actual relative frequencies in a probability experiment only correspond to the theoretical relative frequencies when you conduct a very large number of trials, that is, when you run the experiment many, many times.

Time needed
40 minutes

DICTIONARY:

hypothesis – idea

## Activity 4:
## Theoretical probability vs. experimental outcomes

**Work in pairs**

**Rolling two dice**

1. With your partner, prepare a graph like the one above. Roll a pair of dice 36 times and record the sum for each roll on the graph. To find the relative frequency for each sum, divide the number of times that sum actually occurred in your experiment by the total number of trials (36, in this case).
2. Reflect on how your results compare with the theory? If possible, add up the results from other teams. As you add the data from more trials does the result look more or less like the theoretical prediction?

Time needed
60 minutes

## Activity 5:
## Using experimental data to predict the outcome of future events.

**What you need:**

- Newspaper article and a reading book

**Work in pairs**

Most situations are too complex to calculate the probability from theory. In these cases you can do experiments, and use the results of the experiment to predict future outcomes.

1. Try this experiment
   Choose a paragraph from the news section an English language newspaper. Find the distribution of letters by counting all of the a's, b's, c's, etc. Which letter appears most often? Which comes second?
2. Now analyze other paragraphs. Take another paragraph from the same paper and choose another one from a book or other source. Do you think the same letter will occur most often? Test your hypothesis.
3. Choose two or three paragraphs from a newspaper in a different language. Do you think the result will be the same or different? Test your hypothesis.

Time needed
30 minutes

## Activity 6:
## Back to the lottery

**Work in pairs**

**Pick 2 out of 6**

- Imagine there are six balls, numbered 1 - 6, and you choose two at random. Think of two numbers in your head. If your numbers match the balls you chose then you win. The order doesn't matter. What is the chance of winning?
- There are 6 possibilities for the first number, and 5 for the second number, or $6 \times 5 = 30$ permutations all together.

**DICTIONARY:**

**permutations – arrangements**

1. Fill in the 2-way table. (The diagonals are eliminated because once a ball has been drawn it can't be drawn again.)

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | x | | | | | |
| 2 | | x | | | | |
| 3 | | | x | | | |
| 4 | | | | x | | |
| 5 | | | | | x | |
| 6 | | | | | | x |

## What have you learned?

You can see there that there are 30 possible outcomes. Each pair of numbers appears in the table twice, such as 3,4 and 4,3. The winning event is drawing a certain combination, say a 3 and a 4 in any order.

So if there are 15 different combinations possible, what is the probability that a given combination will win?

What if you pick 3 balls from six? There are 6 possibilities for the first number, and 5 for the second number, and 4 for the third. How many possible outcomes in all?

Each outcome consists of three numbers (all different). There are six ways can you arrange three different numbers?

1,2,3 1,3,2 2,1,3 2,3,1 3,1,2 3,2,1

Remember that you can calculate the number of permutations by multiplying the number of possibilities for the first number, times the number of possibilities for the second number, times the number of possibilities for the third.

If you pick three balls out of 6 there are 120 possible outcomes, but each combination appears six times, which means there are $\frac{20}{6} = 20$ combinations. Each combination has a $\frac{1}{20}$ chance of winning.

Time needed
45 minutes

## Activity 7:
## Building on what you know

**Work alone**

1. In a game where you pick four balls out of six, what are the chances of your 4-number ticket winning?

   a. Possible outcomes: $6 \times 5 \times 4 \times 3 =$
   b. Permutations of each 4 digit combination: $4 \times 3 \times 2 \times 1=$
   c. Number of combinations = # of outcomes/ # of combinations
   d. Your chance of winning = $\dfrac{1}{\text{Number of combinations}}$

2. Share your answer with a partner. Did you both get 15? If so, congratulations. If not, check your work and try again.

Time needed
40 minutes

## Activity 8:
## Back to the lottery

**Work alone**

Now you are ready to calculate the chance of your ticket winning the lottery!

1. Find the number of possible outcomes of 6 balls chosen at random from 49 by multiplying the number of possibilities for each of the 6 draws, starting with 49 on the first draw.
2. Find the number of ways each combination of six numbers can be arranged by multiplying the number of possibilities for each position, starting with 6 possibilities for first place.

   Number of combinations = # of outcomes/ # of combinations

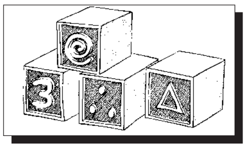
   Your chance of winning = $\dfrac{1}{\text{Number of combinations}}$

3. Share your answer with a partner.

## What have you learned?

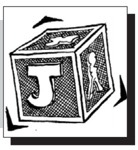
- Probability is the study of how likely it is that a particular thing will happen. The probability of a certain event is expressed as a number between 0 and 1. 0 means it is impossible, and 1 means that it will definitely happen.
- An experiment is an activity involving chance, such as tossing a coin or rolling dice.
- An outcome is one possible was an experiment could turn out.
- An event is a set of outcomes.
- A tree diagram is a branching diagram showing all possible outcomes for a given experiment.

- A two-way table shows all the possible outcomes when two conditions are taken together.
- Frequency is the number of times an event happens.
- Relative frequency is the fraction of all outcomes that produce a given event.
- Theoretical probability is the fraction of all equally likely possible outcomes that produce a given event. It can also be called the theoretical relative frequency.
- Experimental probability is the fraction of all trials in the experiment that produce a given event. It can also be called the experimental relative frequency.
- The odds of something happening is the ratio of a number of ways an event can happen to the number of ways it cannot.
- Odds are that you won't win the lottery!



## Linking your learning with your ECD work

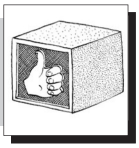
There a lots of fun opportunities to explore concepts of probability with young children through games and play. Talk to children about different events that may be possible, impossible, uncertain, certain, or never likely to happen When you play games with dice, coins and spinners ask the children what results are possible and ask them to predict what will happen and then see if their predictions were close or not.



## Journal Reflection

Think about what you have learned. Write down all your thoughts, ideas and questions about your learning in your journal. Use these questions to guide you:

a. What did you learn from this unit about probability?
b. What did you learn from this unit about tree diagrams and two-way tables?
c. How do you think you will be able to improve your ability to calculate the probability of something happening?
d. Write down one or two questions that you still have about probability.
e. How will you use what you learned about probability in your every day life and work?



## Self-assessment Checklist

Reflect on the outcomes that were set for this unit. Think about what you know, what you can do and how you can use what you have learned. Use the key in the table and tick the column next to each outcome to show how well you think you can do these things now.

I can:

| Tick ✓ as follows: 4=Very well 3=Well 2=Fairly well 1=Not well. | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| 1. Explore the chance of something happening | | | | |
| 2. Use tree diagrams | | | | |
| 3. Carry out probability experiments in which you measure what actually happens | | | | |
| 4. Compare what you guessed would happen in an experiment with what actually happened | | | | |