BOWLAND
MATHS

Reducing Road Accidents

A Mathematics Case Study

Teacher's Guide

Shell Centre
for Mathematical Education

FOREWORD

This case study is designed to help develop real problem solving in mathematics. It is intended for a class of KS3 pupils working with a teacher. We hope you find that the work contained within this case study provides interest and support for all pupils, yet still has the potential to challenge high attainers.

This case study has been designed by:

Malcolm Swan

and the software designed by:

Daniel Pead

with the MARS, Shell Centre team at the University of Nottingham.

The case study has been developed in classrooms with teachers and their pupils. We are grateful to them all. The feedback from classroom observation, the comments of teachers and pupils, and an analysis of their work have enabled the materials to be developed and refined.

We welcome further comments, particularly from those who have used the materials in class. Please forward your comments to Shell.Centre@nottingham.ac.uk

We hope you and your pupils enjoy this case study, as others have.

Shell Centre Team
School of Education
University of Nottingham

CONTENTS

INTRODUCTION

Mathematics can save lives and can make the world a safer place for everyone.

Overview

Pupils imagine that they live in a small town where, over the past year, there have been a large number of road accidents. The town council has set up an enquiry to see what may be done about improving the situation. The council has allocated £100,000 to spend on reducing the number of deaths and serious injuries. Pupils can choose from a wide range of possible initiatives. They might, for example, decide to build new road crossings or roundabouts, install traffic lights, design publicity campaigns for specific groups of people and so on. They will work in small teams to plan the most effective way to allocate the money. To support this work, the police have provided data on all the road accidents. Pupils use a specially constructed computer program to analyse this data and build a convincing case.

This case study offers an excellent example of how mathematics is used in the real world to analyse a complex problem and arrive at a solution that can save lives. It is similar to real-life experiments that have been carried out in the UK and overseas. Mathematically, the case study offers pupils opportunities to develop numerical, spatial and data handling concepts while at the same time developing problem solving and social skills. Pupils will work collaboratively to analyse a complex situation, interpret data presented in a range of different ways and communicate their thinking orally and visually.

Mathematical content

This case study addresses all of the Key Concepts and Key Processes in the new KS3 National Curriculum Programmes of Study. Pupils are expected to represent a situation from the real world, analyse it using mathematical procedures, interpret and evaluate the evidence and communicate and reflect on their results. As with all open problem solving activities such as this, pupils will need to choose which mathematical concepts and techniques to use. This choice will probably include:

Number and Algebra: Using rules of arithmetic applied to calculations and manipulations with rational numbers; Applying ratio and proportion. *E.g. Calculating the cost of a cycle lane that costs £60 per metre from a map*.
Shape and Space: Using points, lines and shapes in 2D coordinate systems. *E.g. locating the scene of an accident on a map from a photograph or coordinates on a police report*.
Statistics: Using the handling data cycle; presenting and analysing grouped and ungrouped data. *E.g. Selecting data from the Accidents database; using paper and ICT to generate maps, bar charts, pie charts; finding patterns in the data, interpreting data, drawing conclusions and presenting the results*.

The context differentiates by outcome and allows pupils to demonstrate their competence at a wide range of levels. It is helpful if pupils already have some acquaintance (but not necessarily mastery) of different ways of representing data including two-way tables, bar charts and pie charts.

Organisation and pedagogy

This case study supports 5-6 one-hour lessons of classroom activity, interspersed with modest amounts of homework, either on successive days or more spread out. It contains a teacher's guide, pupil materials, and computer software. It is suitable for all pupils in Years 7, 8 or 9, although it will take longer with younger or low attaining groups. The highest attainers may extend the challenge by importing and analysing the data set with more sophisticated software, such as *Excel* or *Fathom*.
The sequence of activities is as follows (the timings are only indicative):

- **Stage 1: Making hypotheses** (1 hour). Pupils are given hard copies of the raw data in a folder. This includes a map of the town and charts, tables and incident reports showing the locations, times of accidents, persons involved, their severity and so on. Using this data (which are too much to analyse in this format) pupils make initial hypotheses on what they would do.
- **Stage 2: Exploring a computer database** (1-2 hours). Pupils are now given access to computers and they are able to organise, sort and select data in order to test their initial hypotheses and explore possible causes of accidents. They print out particular graphs (e.g. accidents by: day; time of day; grid reference on map; age of casualties and so on) that they believe may be significant.
- **Stage 3: Making a case** (2 hours). Pupils work in groups assembling a case for their chosen expenditure of money. They make reports or posters to present this case to the whole class.
- **Stage 4: Presenting their case** (1 hour). Pupils present their arguments in a mock ‘town council' meeting, and have a debate in which the data are presented and a conclusion reached.

A mixture of class, group and individual work is involved, as in the real world. Your role is to set pupils realistic targets, challenge pupils to think and reason for themselves, and manage discussions and plenary reporting sessions. You should only demonstrate techniques as a last resort. Throughout the goal is to develop pupils' ability to work and think independently.

Resources

The resources provided in this case study are as follows:

- **A teacher's guide**.
  This contains the suggested lesson plans.
- **Pupil handouts**.
  The ten handouts should be photocopied and distributed to pupils as outlined at the beginning of each stage in the teacher's handbook.
- **The software: *Accidents***
  This should be loaded onto computers so that each pair of pupils can explore the database and prepare their presentation in Stages 2 and 3.

In addition to the above resources, teachers have found it helpful to use a data projector or interactive whiteboard for the classroom presentations.

STAGE 1: EXPLORING THE SITUATION

Aim of this stage

The purpose of the first stage is to set the scene in a lively and vivid manner, and help pupils to take on their roles and begin to understand the nature and extent of the problem.

Time needed

About one hour

Resources needed

Each pupil will need copies of the following sheets. These should be photocopied, cut out and arranged in folders. One folder will be needed for each pair of pupils.

S1 *Instructions for session 1*
S2 *Map of the town* (this should be enlarged to A3 if possible)
S3 *Six casualty report forms* (cut out)
S4 *Photographs of accident locations* (cut out)
S5 *Ideas for reducing road accidents*.

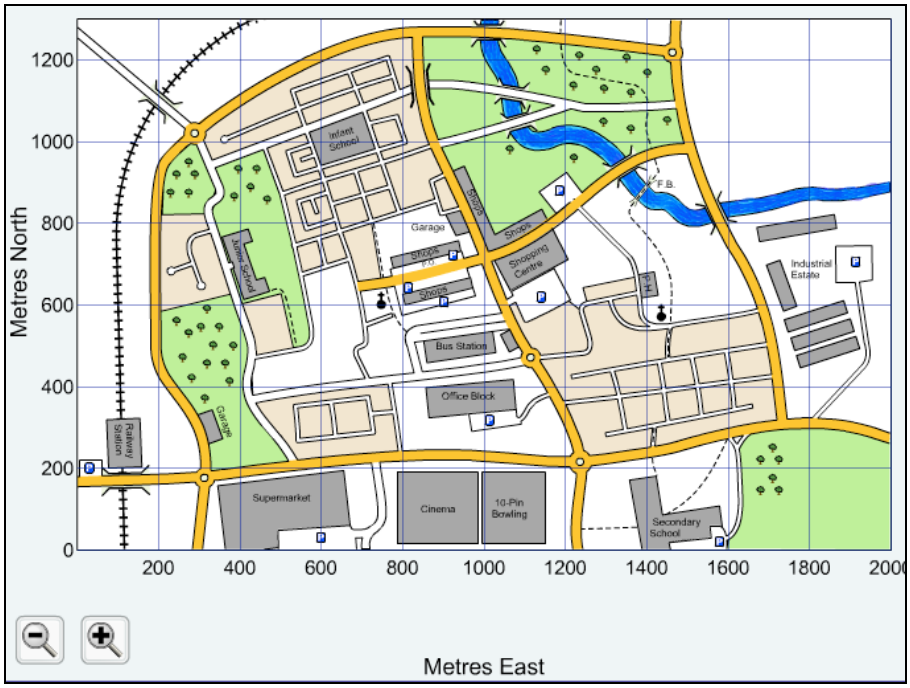
Note that if the cards on S3 are laminated and written on in felt pen, they may be wiped and reused at a later date.

Suggested sequence of activities

Introduction: Presenting the problem

Group pupils in pairs and give each pair the folder containing: S1 *Instructions for session 1*; S2 *Map of the town* (this should be enlarged to A3 if possible); S3 *Six casualty report forms* (cut out); S4 *Photographs of accident locations* (cut out); S5 *Ideas for reducing road accidents*.

Display the map of the town using the software on the IWB or on the OHP:



Imagine you live in this small town. In this town, the number of people injured or killed on the roads has increased steadily over the past four years.
Your job is to investigate what could be done about this worrying situation.

You have a budget of £100,000 to spend on reducing road deaths and injuries.
Your job is to work in small teams to plan the most effective way of spending the money.
Solving this problem will take us several lessons.

To start with, I have given you a file containing some police data on road accidents.
There has been an accident at the map reference 1225m East, 225m North.
Can you find this location on the map? (It is near a roundabout)
What accident might have occurred here? (E.g. Cyclist knocked off a bike).

In this way remind the class how they can locate positions on the map using coordinates. Discuss possible locations and the accidents that might occur there.

Group activity: Matching reports, photographs and locations

Explain that casualty reports are filled out by the police at the scene of an accident. The folders contain similar information, but are simplified versions of the ones that police normally use.

A simplified police report and matching photo:

Police Record 1			
Time: *08.45*	Day: *Monday*	Date: *8th September*	Year: *1*
Location of accident: *Ratrun Lane*		Map Reference: *East 475 m North: 1010 m*	
Name of casualty: *Sarah Crowe*		Age of casualty: *30*	

Vehicle	~~Pedestrian~~	Cyclist	~~Car~~	~~Motorbike~~	~~Other vehicle~~	
Road Conditions	Dry	~~Wet~~	~~Snow~~	~~Frost/Ice~~		
Speed limit	~~10~~	~~20~~	30	~~40~~	~~50~~	~~60~~	~~70~~
Severity	~~Fatal~~	Serious	~~Slight~~			

Description of accident
Sarah was cycling along Ratrun Lane when the door of a parked car was opened suddenly. This knocked Sarah off her bike. She had a head injury.

Read through card S1 with pupils and get them going:

> *Match the reports with the photographs.*
>
> *The accident report forms are not complete.*
> *Work out where the accidents took place on the map and estimate the missing map references. You may also be able to write some road names on the map.*
>
> *The final accident report form is blank. Using the remaining photograph, make up your own accident report for this location. Use your imagination!*

In trials we found that most pupils correctly identified the school as the remaining photograph, but some did not and their stories reflected different locations.

Whole class discussion: Sharing reports

Read out a few reports from pupils. In trials we found that some enjoyed the chance for creative writing and made up some stories with quite graphic content!
For example:

> *Molly was very excited. It was 3pm on a Friday. School Avenue. Molly was 11. The speed limit was 20 mph. It was the last day of school. She did a triple back flip and wasn't harmed....*

Whole class discussion: Causes and preventative measures

This should lead to the final sheet S5 *Ideas for reducing road accidents*. Introduce this to the class.

> *On this sheet you should try to decide what might be the most common causes of road accidents. Write these down in the left hand column. Next to each one, write down at least two ideas that might be put in place to help prevent these accidents occurring.*

Pupils will normally suggest physical changes like:

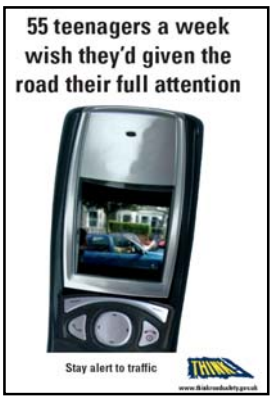
Causes of accidents	How could they be prevented?
Vehicles driving too fast	• Speed bumps • Speed cameras • Narrowing roads (Chicanes)
Dangerous junctions	• Traffic lights • Roundabouts • Mirrors • Better road signs
Pedestrians crossing dangerous roads	• Crossing patrol • Zebra crossing • Pelican crossing • Traffic islands • Parking restrictions • Lollipop lady
Cars hitting cyclists on dangerous roads	• Cycle lanes • Bus lanes

Encourage pupils to discuss their own experiences of traffic situations in their own locality and to discuss the effectiveness of road safety measures:

> *Do you know of any measures for preventing accidents near this school?*
> *Are they effective? Why or why not?*

Pupils will also suggest prevention measures that cannot be tackled by physical changes to the environment, but only by changing peoples' attitudes and behaviour. For example:

> *Make drivers take a break when they are tired.*
> *Don't talk on mobile phones while crossing the road.*
> *Ban drinking and driving.*
> *Make cyclists wear reflective jackets.*
> *Make elderly drivers take driving tests again.*



Explain that some of these may only be tackled by changes in the law or by running an advertising campaign. Ask pupils if they can remember any examples of these.

Conclude the session the class again of the overall aim of this work:

Remember that you will have a budget of £100,000 to spend on reducing road deaths and injuries. You will be able to select from a range of these measures to try to solve the problems in this town.

Suggested homework

Either:

Ask pupils to make a list of all the measures they know of that are used for reducing road accidents around their own town. They should show where these are on a map of the town, the type of measure and the behaviour they are designed to prevent.

or:

Ask pupils to make a list of all the road safety campaigns that they an their families can remember. What types of behaviour were these trying to change? If they have internet access at home, they can see and hear recent campaigns on the website (TV, radio and poster):

http://www.thinkroadsafety.gov.uk/mediacentre/mediapage.htm

Some solutions

Police record	Map ref.	Photo	Incident ID (computer)
1	(475,1010)	2	14
2	(1375,975)	6	15
3	(875, 700)	4	16
4	(685, 500)	1	37
5	(1225, 225)	5	38
6	Near school	3	

STAGE 2: FORMULATING HYPOTHESES

Aim of this stage

Pupils are given a large data set showing 120 casualty reports that have occurred over a four-year period. This is provided on paper and also on computer via a purpose-built database. In this Stage, pupils explore the data and try to find patterns in accident locations, times, weather conditions, vehicle usage and so on.

Time needed

About one to two hours

Resources needed

For the introduction you will need:

- An interactive whiteboard (IWB) displaying the *Accidents* software.

Each pair of pupils will need access to:

- A computer, loaded with the *Accidents* software.
  If no computers are available, then a whole class discussion may be held using the IWB - but this will prevent pupils from being able to freely explore their own ideas.

Each pair of pupils will need:

S6 *Accident database.*
S7 *Making notes on your ideas* (optional)
S8 *Some possible lines of enquiry* (optional)

Sheets S7 and S8 are intended to offer some structure to pupils who find it difficult to get started or who fail to 'dig in' to the data. These sheets should be withheld from pupils who can manage without them.

See the separate guide *Using the Software* for details of how to install and operate the software.

There may be a few more confident pupils who would like to use more sophisticated data analysis tools. For this reason we have also included the raw data in c.s.v. and .xls formats so that it may be imported into other data analysis packages such as *Excel* or *Fathom*.

Suggested sequence of activities

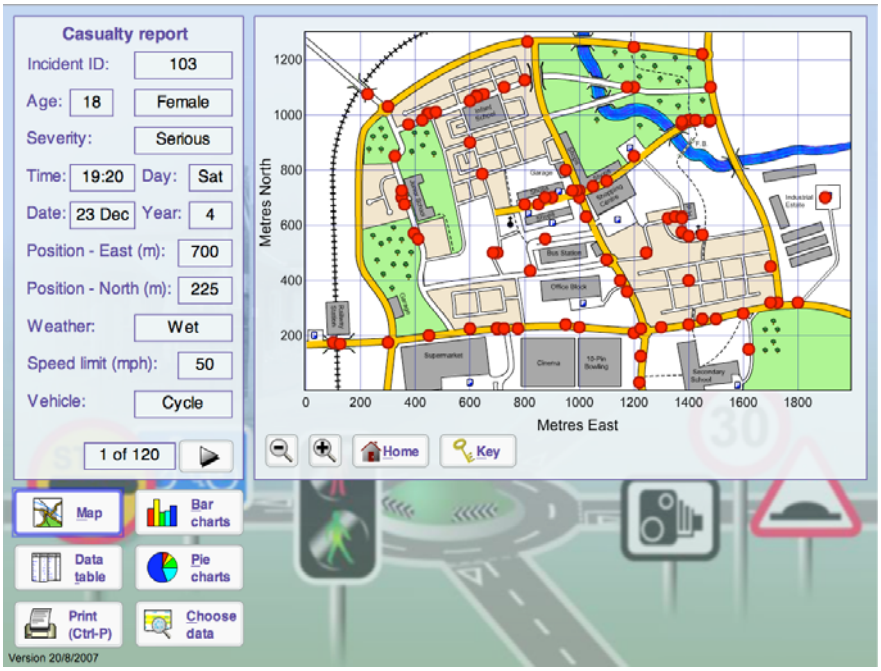
Introduction: Introducing the software

Reissue the folders from the previous session. Explain that in this session, you will look at 120 different casualty reports that have occurred over a period of four years.

Using the interactive whiteboard, demonstrate how the software works, showing how you can see the map, the raw data and how you can sort and graph the data in different ways.

The first computer screen shows a map of the town and a single casualty report.

You can flip through reports as if they were on a card index.
When specific victims are selected, the accident location lights up on the map.
You can also click on the map locations to see the corresponding record.

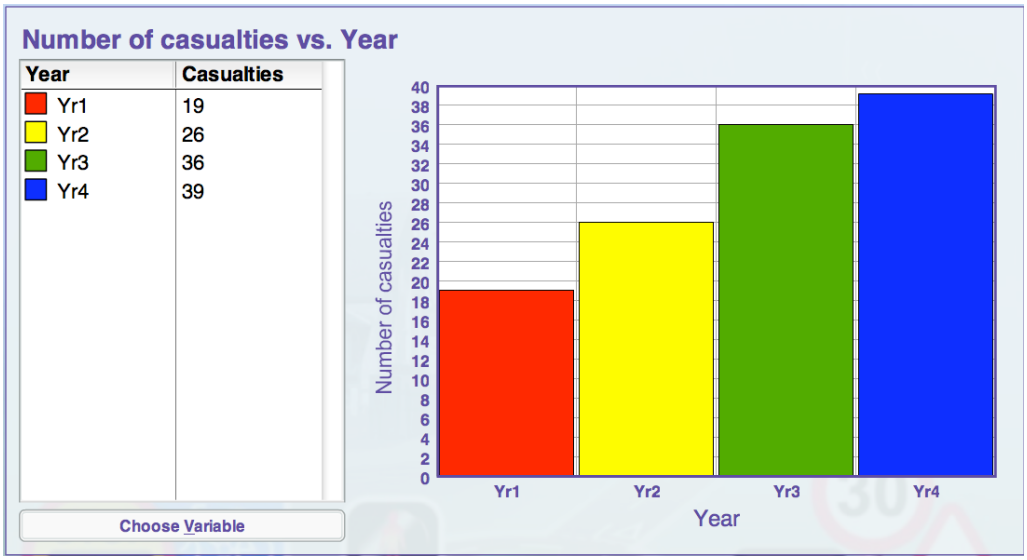


If we select the button "Data table" we can see all the records on S6.

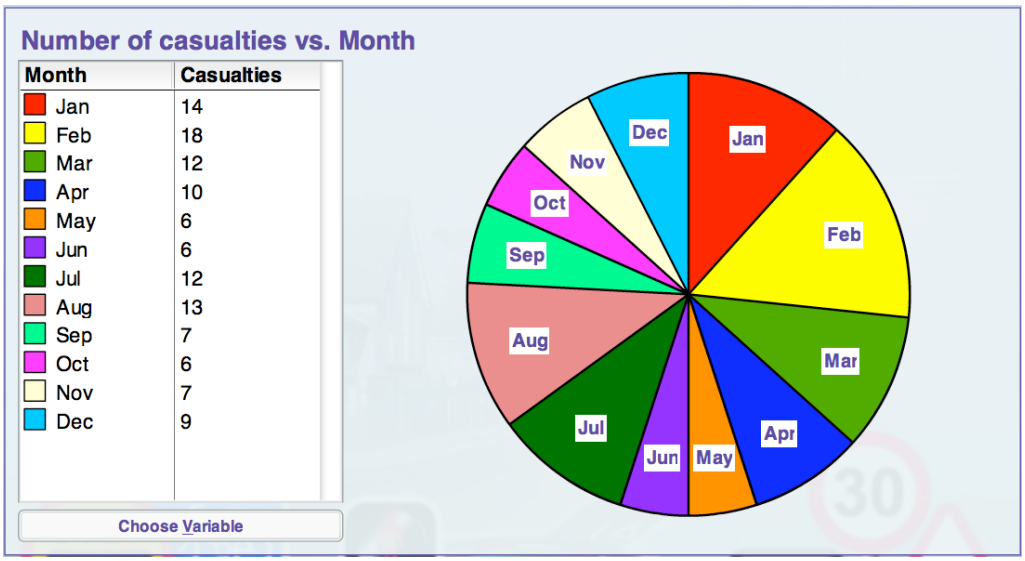
Incident	Year	Date	Day	Time	Age	Sex	Vehicle	Weather	Limit	Severity
1	Yr1	1 Jan	Wed	01:30	24	Male	Pedestrian	Ice	30	Fatal
2	Yr1	7 Jan	Tue	08:30	16	Male	Pedestrian	Wet	50	Slight
3	Yr1	8 Feb	Sat	22:45	19	Male	Car	Frost	50	Slight
4	Yr1	10 Feb	Mon	17:15	45	Female	Car	Frost	30	Serious
4	Yr1	10 Feb	Mon	17:15	34	Male	Motorbike	Frost	30	Serious
5	Yr1	5 Mar	Wed	08:30	9	Female	Pedestrian	Wet	30	Serious
6	Yr1	22 Mar	Sat	13:25	55	Male	Car	Dry	30	Serious
7	Yr1	11 Apr	Fri	15:45	10	Male	Pedestrian	Dry	30	Serious
8	Yr1	13 Apr	Sun	09:35	40	Male	Pedestrian	Wet	30	Slight
9	Yr1	3 May	Sat	02:30	23	Male	Motorbike	Dry	30	Slight
10	Yr1	5 Jun	Thu	15:50	27	Male	Car	Dry	30	Serious
11	Yr1	18 Jul	Fri	16:30	16	Female	Cycle	Dry	50	Fatal
12	Yr1	1 Aug	Fri	08:45	9	Female	Pedestrian	Dry	30	Slight
13	Yr1	8 Aug	Fri	23:15	24	Male	Car	Wet	50	Slight
14	Yr1	8 Sep	Mon	08:45	30	Female	Cycle	Dry	30	Serious
15	Yr1	14 Sep	Sun	15:30	38	Male	Pedestrian	Dry	30	Serious
16	Yr1	18 Sep	Thu	12:30	60	Male	Car	Wet	30	Slight
17	Yr1	12 Nov	Wed	15:45	8	Female	Pedestrian	Wet	30	Serious

Can you see any of the casualty reports from the previous lessons in this data?
How can we find them?
(Here is one method. Look at police record 1 on handout S3. It happened at 8.45 in the morning. Sort the data by time of day by clicking on that column heading. Then search for 08.45. There were four casualties at this time, but only two in year 1 and only one of these involved a cyclist, so incident number 14 is the one required.)

How many casualties were there in each of the four years?
What is the best way to show this?
(A bar chart is better than a pie chart as it shows a trend and displays the values.)
Click on the bar chart, then choose year as the variable.
You can see how the number of accidents is rising - we must try to put a stop to this trend!

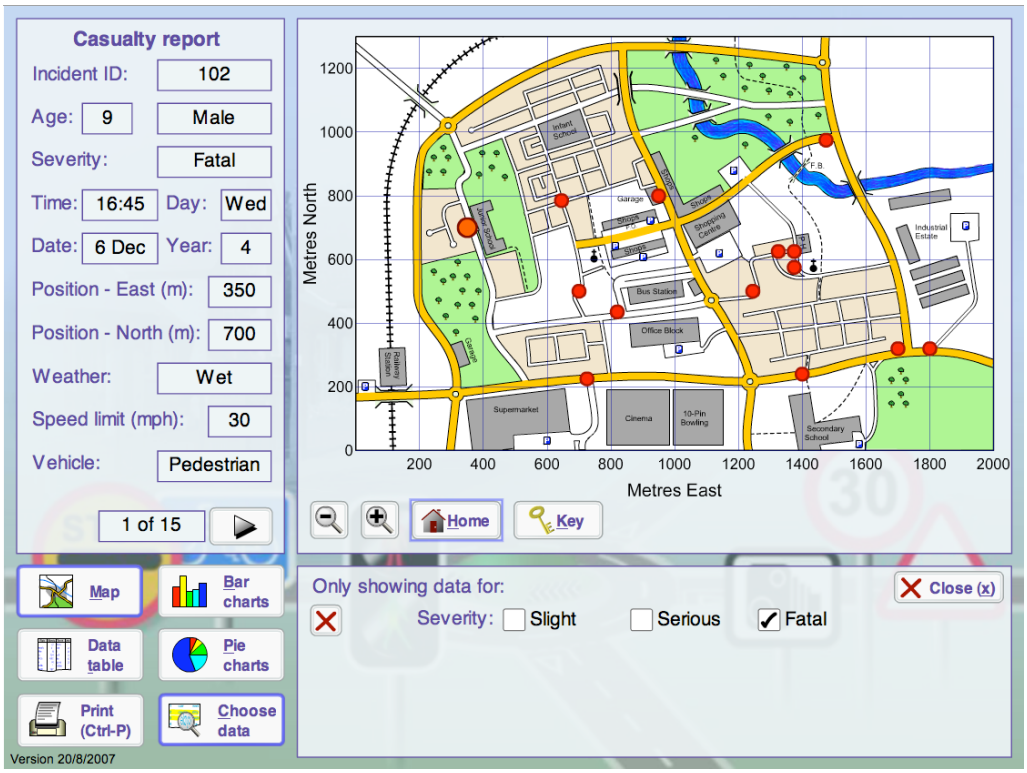


In which months are there most accidents? Do you have a hypothesis? How can we test this?
(If we choose pie chart and choose month as the variable, we will see the proportions)
About what proportion of victims were injured or killed in the winter months, January to March? (About one third). These look the most dangerous.



How can we find out where most fatal accidents occurred? Do you have a hypothesis?
(If we choose the "Map" option, then "Choose data" then add a condition "Severity: Fatal", then we can spot the locations on the map.

(There are 15 fatal accidents, with three clustered near one of the churches. What is going on here? How can we discover the causes of these?



Working in pairs: Exploring the software

Allow pupils time to explore the software. In trials we found that pupils needed up to half an hour to just get acquainted with the options, before they began to make hypotheses.
After this period, you will need to remind them of the purpose of their work.

Use the sorting and graphing facilities to try to find out where and when accidents tend to occur and who they happen to.
Try to think of possible causes for the accidents. Write these down.
Try to make graphs and charts to show important patterns in the data.

Teachers sometimes found it helpful to give pupils a structure for keeping notes. Some suggested keeping notes under the following headings:

- What are the main possible causes of the accidents?
  Where do they occur? When do they happen? Who do they happen to?
- What is my evidence for saying this?
- What might be done to reduce the number of accidents?

If some pupils find it difficult to focus, then you may like to offer them sheet S7: *Making notes on your ideas.* As you monitor their work, encourage pupils to think more deeply and to explain their ideas to you. Pupils that fail to 'dig into' the data may be offered sheet S8: *Some possible lines of enquiry*. This sheet shows pupils how a series of *connected* questions, can help them explore the data until a hypothesis can be made. After using this, they may find it easier to ask their own questions and begin to form their own hypotheses.

Working in pairs: Keeping electronic notes

While they work, it is helpful if pupils can keep electronic notes using *Word* (or other word-processing software). You can expect most pupils to know how to use *Word* from lessons other than mathematics, but some may need support.

Pupils often tend to print out an excessive amount of data and forget their original reasons for printing them. For this reason, we suggest that they make screen 'grabs' of the maps, graphs and tables that they need, paste them into a single *Word* document, crop them appropriately, and then type their interpretation and reasoning based on the chart underneath. Full instructions for doing this are given in the appendix to this teacher's guide.

Whole class discussion: Sharing hypotheses

Towards the end of the session, ask pupils to share what they have found so far.

> *What patterns have you found in the distribution of accidents?*
> *What are the possible causes?*

Here are some of the patterns in the data reported by one class:

> *Most accidents happen to pedestrians.*
> *Most accidents happen to males.*
> *Most accidents happened between 8-9am and 3-4pm.*
> *Most accidents between 11am and 3pm happen around the shops.*
> *Most accidents happen on a Friday.*
> *People under the age of 15 are mostly injured outside school*
> *There are a number of accidents happening to cyclists near the secondary school*
> *Most people have accidents on junctions, blind bends and outside schools.*

Suggested homework

Pupils who have PCs at home may continue to explore the software. See the document *Using the Software* for details of how they can access this.

STAGE 3: PREPARING A CASE

Aim of this stage

In this stage, each group of pupils is allocated a budget of £100,000 to spend on road improvements. They work together, using their data from Stage 2 to decide how this money should be spent.

For this, pupils will use the data and charts that they have generated themselves. They will also be provided with a list of costed accident reduction measures, together with an estimate of their local effect.

Time needed

About two hours.

Resources needed

Each pair of pupils will need access to:

- A computer, loaded with the software file *Accidents*.
- *Word* or other word-processing software, or *PowerPoint* or other presentation software if presentations are to be done electronically using the IWB.
- Large A3 sheets, scissors, glue sticks, felt pens, rulers and so on if presentations are to be done using posters. One advantage of posters is they can be used to make a classroom or corridor display after the case study.

All groups will need a copy of:

S9: *Group task sheet*
S10: *Possible measures for improving road safety*

Suggested sequence of activities

Introduction: Posing the problem

Begin by issuing the folders of information that groups have assembled so far. In addition, issue each group of pupils with S9: *Group task sheet* and S10: *Possible measures for improving road safety*.

By now you should have found some patterns in the road accidents.
You should also have some hypotheses about the possible causes of the road accidents.
In this stage, you now decide how you will spend your budget of £100,000. Your task is to prepare a plan for the town council answering the following questions

1. *What are main reasons for the road accidents?*
   Where are the accidents located?
   Who do they affect most?
   When do they happen?

2. *What is your evidence?*
   Use maps, graphs and charts to back up your answer.

3. *Suggest a possible **plan** for reducing the number of these road accidents.*
   Use some of the suggestions on sheet S10. Keep within your budget!

4. *What would be the total cost of your four-year plan?*

5. *About how many lives will you save?*

Of course, there might be more than one problem, so there is likely to be more than one solution! Prepare your case carefully, as you will need to present your arguments to the whole class. The best case will be the one that is likely to save the most lives and keep within budget. Try to make your case persuasive and backed up with evidence.

To begin with, encourage pupils to focus on formulating their proposals on a word processor, without getting lured into the presentational ideas.

S10: Possible measures for improving road safety

Road Safety campaign 	**A poster and leaflet campaign** can be effective when it targets a particular cause of accidents. You will need to describe • the focus of the campaign, • the time of year it will appear, • the type of person it will target. You need to renew the campaign each year for it to continue having an effect.	**£20,000 per year**
Traffic lights 	Traffic lights can control the flow of traffic at junctions or other hazards, stopping some traffic while other traffic is allowed to go.	**£30,000 per junction**
Mini roundabout 	**Mini-roundabouts** are often only marked out with white paint. They are used on roads that have an average speed of 30mph or less. They are often used to reduce speed before a series of road humps.	**£10,000**
Large roundabout 	**Large roundabouts** are used to control the flow of traffic at junctions between major roads.	**£40,500**
Road narrowings 	**Road narrowings** slow traffic down by forcing one stream to give-way to the other. When they are on both sides of the road they are called **chicanes** or **pinch points**.	**£10,000**

Pelican crossing 	**Pelican crossings** control vehicle and pedestrian movements with traffic lights. Pedestrians must wait for the 'green man' before crossing the road	**£18,000**
Cycle lane 	**Cycle lanes** help keep bikes separate from other road users. They can be either on the side of the road or off-road.	**£60 per metre**
Traffic island and pedestrian refuge 	**Traffic islands** in the centre of a road to help reduce vehicle speeds and stop over-taking. If it includes a gap in the middle of the island it is called a **refuge**; it allows pedestrians to cross half the road at a time.	**£3,000**
Speed camera 	Speed cameras automatically photograph the number plates of drivers exceeding the speed limit. Many speeding drivers have been convicted by the photographic evidence.	**£25,000**
Speed humps 	**Road humps** can only be put on roads with speed limits of 30 mph or less. A series of humps should be about 50 metres apart and have a speed reducing feature at both ends, such as a road narrowing or mini roundabout.	**£1,000 per hump**
School crossing patrol 	A lollipop lady can help to ensure the safety of younger children. It is helpful if approaching traffic is slowed down by other measures.	**£5,000 per year**

Working in groups: Preparing a case

As you go round, emphasise that there may not be a single clear-cut 'correct' solution - there rarely is with real world problems. Pupils may find, for example, that accidents are clustered around 'black spots': they occur at particular times in particular places and involve particular vehicles.

You may find that some pupils state hypotheses and only back them up superficially. If this is the case, encourage them to think more deeply, using probing questions, such as:

That is interesting, you have found a cluster of accidents here.
What percentage of these accidents involved cyclists?
When exactly did these accidents happen?
What time of year was this?
Who did they happen to?
What were possible causes? Write a few ideas down.
Can you think of several different ways to tackle the problem?

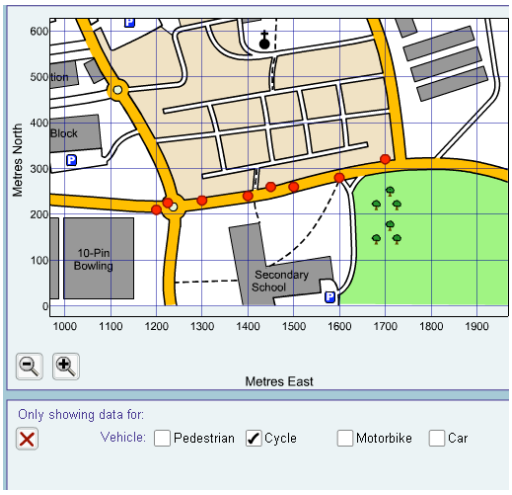
You may also find that some pupils tend to 'close ' their thinking too quickly, find a possible problem and pour all their resources into tackling it. If so, encourage them to consider other possible causes and compare alternative allocations of resources. For example, in the extract below, two Year 9 pupils have successfully identified a cluster of eight accidents involving cyclists, and have costed a possible solution. They have combined a cycle lane with speed bumps and pelican crossings, recognising that they need a traffic calming measure at both ends of the speed bumps. This group has sunk a very large portion of their budget into tackling just one cause. They need to consider others. (This work is shown here as the pupils typed it, in a *Word* document, with a 'screen grab' of the map suitably cropped and inserted).

The problems we have found are that outside the school there are a number of accidents to cyclist leaving school.

To sort out this problem we are going to put in 500 metres of cycle lanes and tracks costing £30,000 out of our £100,000.

We could also add 8 road humps costing £8,000 To help the road humps we would need 2 traffic islands and a pedestrians' refuge costing £6,000.

We should get 2 sets of pelican crossing costing £36,000 coming to a total cost of £80,000 this should reduce the accident rate by half.
Hopefully helping save pupils lives on bikes every year.



(Pupil work)

Occasionally, pupils may come up with safety ideas that aren't on sheet S10 (e.g. using gritting lorries). Encourage them to do some research on the internet to find the cost and effectiveness of such ideas.

Working in groups: Preparing a presentation

Each group may now like to produce a poster or a *PowerPoint* presentation showing their conclusions for later presentation to the whole class.

When groups are ready, give out large sheets of A3 paper, glue sticks and felt-tipped pens so that groups can begin making posters. Emphasise that these do not need to be 'beautiful' but that they do need to communicate good, sound reasoning and be understandable by others.

Some pupils are so keen to make their presentations attractive, that they don't think sufficiently about the quality of their reasoning and evidence. For example, many pupils who elect to use *PowerPoint* waste a great deal of time grabbing a graph or map, modifying this in a drawing package, then saving and pasting this into *PowerPoint*. During this lengthy process they lose the thinking behind their choice. You may need to explain that screen grabs can be directly pasted into *PowerPoint* and cropped within this software. This saves a great deal of time.

Towards the end of the stage, ask each group to prepare a short two-minute oral presentation that they will give to the whole class about their ideas. They should think about how they will divide the presentation up so that all members are involved.

Suggested homework

Pupils who have suitable PCs at home may continue to explore and develop their presentations. See the document *Using the Software* for details of how they can access the software.

STAGE 4: PRESENTING A CASE

Aim of this Stage

Groups of pupils now take it in turns to present their suggested solutions at a 'town council' meeting of the rest of the class, and have a debate in which the data is presented and a conclusion is reached.

After each presentation, or at the foot of each poster, pupils make comments on:

- What was good about the presentation/poster;
- How the presentation/poster might have been improved.

Presentations may be made orally, through whole class presentation, but if the class is a large one or time does not permit this then presentations may also be given by presenting posters in smaller subgroups or even by simply exchanging posters between groups for critical comment.

Time needed

About one hour

Resources needed

The room will need to be laid out to facilitate presentations and the ensuing discussion. This means allocating wall or desk space so that groups can view one another's posters.

Each pupil will need a copy of:

S11: *Presentation feedback sheet*.
S12: *Evaluating our own presentation*

Suggested sequence of activities

Introduction: Organising the presentations

Introduce the main activity (see below) briefly, so that the maximum time is given for the presentation and evaluation of the findings. There are several possibilities, depending on the size of the class.

Whole class activity: Presentations and evaluations

Option 1: Whole-class oral (Poster or *PowerPoint*) and feedback
This option may be preferred if the class is small or if there is no shortage of time. It can, however become quite boring for classes to sit through many consecutive presentations, so the art is to make them as interactive as possible, with groups adding/ commenting on ideas as you go along.

> *Each group has up to four minutes to present their case to the whole class. They should explain one major cause of road accidents and show the evidence they have for saying this. After each presentation, I would like the rest of you to fill in some comments about the presentation on the Presentation Evaluation Sheet (S9) in response to the three questions:*
> *What was good about the reasoning given?*
> *How could it have been improved?*
> *Were you convinced by the argument? Why?*

Option 2: A poster exhibition and comment
This option is possible if there is sufficient table or wall space to allow all posters to be displayed. It is helpful if the posters are displayed around the edge of the room so that pupils can move freely from poster to poster. One person from each group stands by each poster, while the remaining pupils go round the room reading the posters and writing their comments on the accompanying S9 *Presentation feedback sheets*.

After, say, twenty minutes, the pupils change roles, so that those who were originally moving round now stand by their own poster and those who were explaining can now move round and look at the remainder of the posters and comment on them. It is not important that every pupil comments on every poster - the quality of the comments is more important than the quantity.

> *I want you to move round the room from poster to poster, reading them carefully. Ask questions like:*
> *"How can you be sure that this is really the cause of road accidents?"*
> *"Why did you choose method X of tackling the problem rather than method Y?"*
> *"How many lives would be saved? How did you work this out?"*
>
> *After you have questioned the presenter, write down your comments on the sheet under the headings on the sheet:*
> *What was good about the reasoning given?*
> *How could it have been improved?*
> *Were you convinced by the argument? Why?*

Option 3: Small group exchange of posters
This option is the least disruptive in that the tables may be left in their original positions. Though not so much of a memorable 'event' as the other options, this may be preferred if time is short.

Ask one person from each group to take their poster to another group. They then explain their reasoning clearly, allowing time for the listener to ask questions and challenge their reasoning. After ten minutes, the listener and the presenter write down comments on the S9 *Presentation feedback sheets* under the three headings:

What was good about the reasoning given?
How could it have been improved?
Were you convinced by the argument? Why?

Now pupils return to their original groups and the process is repeated, changing roles so that listeners become the presenters and vice versa.

Option 4: Sharing proposals electronically
If proposals have been prepared using word processors, these documents may be shared and commented on electronically. This could be, for example, continued overnight for homework using the school website, if it is available.

Small group discussions: Reflecting on the evaluations

When pupils have gathered all the written feedback from their presentations, they should complete the form S10 *Evaluating our own presentation.* This sheet gives pupils the chance to reflect and evaluate their own ideas and suggest what they should have done differently. They will draw on the presentations given by others as they do this.

Concluding whole class discussion

Conclude the series of sessions by giving the whole class encouraging feedback on what you have heard. Draw on the best solutions and try to get the whole class to agree on new road safety measure for the town.
Congratulate them on the number of lives that have been saved!!

