A risky business

In this activity you will use official data about accidents to calculate the relative frequencies and probabilities of different accidents happening.

Information sheet

Life is a risky business. Whatever you are doing, at work, at home or somewhere else, there is always the risk that you will have an accident of some sort. People have even been known to hurt themselves doing something as simple as getting out of bed or putting on their socks! But obviously some activities and places are more dangerous than others.

Information about this is used by insurance companies when they set their premiums.

A Activities and accidents

The Consumer Safety Unit of the Department of Trade & Industry collected data for the year 2000 relating to home and leisure accidents from a sample of hospitals.

The data in the table below are their national estimates of the annual number of accidents requiring hospital treatment which occurred during home or leisure activities. The table does not include accidents at work.

Source: http://www.hassandlass.org.uk

Think about …

- What could 'Basic needs' include?

- What could be included in the 'Other/Unspecified' activities?

- DIY is often seen as a dangerous activity.
  Why is the number in the table less than for other activities like shopping?

- Which type of activity seems most dangerous?
  Do you think this is the case?

Relative frequencies can be used to compare the proportions of hospital casualties from home or leisure accidents that occurred during these activities.

Activity	Number of accidents
Household activity	5286
DIY/Maintenance	15 236
Shopping	71 514
Education/Training	172 895
Sport (excluding education)	784 220
Leisure/Hobby	574 745
Travelling/Touring	415 238
Basic needs	222 608
Other/Unspecified	805 016
Total	**3 066 758**

$$\text{Relative frequency} = \frac{\text{Number of accidents that occurred whilst doing the activity}}{\text{Total number of home or leisure accidents}}$$

Shopping example

Relative frequency of accidents occurring during shopping $= \dfrac{71\,514}{3\,066\,758}$

$= 0.023$ (to 3 dp).

Relative frequencies can be given as fractions, decimals or percentages. When the values in the numerator and denominator of the fraction are large and difficult (as they are here), the decimal version is more convenient. To find the corresponding percentage, multiply by 100.

Try this A

1 Complete the rest of the table below.

Activity	Number of accidents	Relative frequency	Percentage
Household activity	5286		
DIY/Maintenance	15 236		
Shopping	71 514	0.023	2.3
Education/Training	172 895		
Sport (excluding education)	784 220		
Leisure/Hobby	574 745		
Travelling/Touring	415 238		
Basic needs	222 608		
Other/unspecified	805 016		
Total	**3 066 758**		

2 Each relative frequency gives an estimate of the **probability** that a hospital casualty who had a home or leisure accident was taking part in that particular activity when the accident occurred.

Use the relative frequencies to put the activities in order of the likelihood that a hospital casualty was involved in the activity when the accident occurred.

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B Accidents at work

The following table gives government figures for the number of people employed in each of the major industrial sectors in the year 2000. It also gives the number of accidents that occurred in each sector during the course of the year.

The accidents are divided into three categories: fatal accidents, non-fatal major accidents, and more minor accidents that caused the worker to be off work for 3 or more days. Very minor accidents that did not cause 3 or more days absence are not included.

	Number of accidents			Number employed
Industry Type	**Fatal**	**Major**	**Over 3 days**	**(thousands)**
Agriculture, forestry, and inland fishing	36	726	1456	314
Energy and water supply and mining	7	506	2511	189
Manufacturing	41	8038	39 460	3950
Construction	81	4749	10 504	1177
Service	55	15 296	82 182	19 707
Total	**220**	**29 315**	**136 113**	**25 337**

Sources: www.hse.gov.uk , www.statistics.gov.uk

Think about …

- How could you compare how dangerous each industry is to work in?
- How could you estimate the number of accidents that would occur in a particular workplace with a given number of employees?
- How could you estimate the probability that a particular worker doing a particular job in a particular workplace has a minor, major or fatal accident during his/her whole career?

The probability of a worker having an accident during a year that was not major, but caused him/her to be off work for over 3 days, can be estimated by using relative frequency where:

Relative frequency =

$$\frac{\text{Number of workers who had an accident causing 3 or more days off work}}{\text{Total number of workers}}$$

The probability of a worker having such an accident during a year

$$= \frac{136\,113}{25\,337\,000} = 0.0054 \text{ (to 2 sf)}$$

This overall probability can be compared with the probabilities for particular types of industry.

For example, the probability of a construction worker having an accident during a year that is not major but results in more than 3 days off work

$$= \frac{10\,504}{1\,177\,000} = 0.0089 \text{ (to 2 sf)}.$$

This suggests that a construction worker is much more likely to have such an accident than the 'average' worker.

Note that these probabilities are rough estimates, rather than accurate values. They assume that none of the workers had more than one accident during the year. Also because the number of accidents varies from one year to the next, another year's results would give different probabilities.

Try this B

1 Complete the rest of this table.

Industry type	Probability of worker having accident during year		
	Fatal	Major	Over 3 days
Agriculture, forestry and inland fishing			
Energy and water supply and mining			
Manufacturing			
Construction			0.0089
Service			
All included industries			**0.0054**

Use the table to answer these questions.

2 In which industry is a worker most likely to have:

a a fatal accident? ……………………………………

b a non-fatal major accident? …………………………………….

c a minor accident resulting in an absence of 3 days or more? ……………………………………

3 In which industry is a worker least likely to have:

a a fatal accident? ……………………………………

b a non-fatal major accident? ..……………………………….

c a minor accident resulting in an absence of 3 days or more? ……………………………………

4 Overall which type of industry do you think is:

a the least dangerous? ………………………

b the most dangerous? ………………..………

C Accidents at home

The information in the table below was collected by the Consumer Safety Unit of the Department of Trade and Industry. It gives the number of different types of home accidents needing hospital treatment during a year from a sample of hospitals.

The sample of hospitals dealt with roughly 5% of the country's casualties from home injuries. The Consumer Safety Unit worked out national estimates for each type of injury and location by multiplying the figures given in the table by 18.29.

For example, the national estimate for the total number of people who had a fall indoors at home that required hospital treatment during one year is:

32 494 × 18.29 = 594 000 to the nearest thousand

	Fall	Struck	Cut	Bite/sting	Poisoning	Thermal	Electric	Other	Total
Kitchen	3714	2228	4507	231	315	1944	24	1604	14567
Bathroom/toilet	2468	901	506	20	85	214	3	809	5006
Living/dining-room	6653	5042	1135	541	165	523	26	3159	17244
Stairs/hall	12275	2263	371	95	26	27	3	882	15942
Porch/conservatory	1448	418	213	79	4	7	1	706	2876
Bedroom	5630	3317	766	165	211	191	20	1937	12237
Other indoor	306	166	67	9	11	24	3	125	711
Indoor total	**32494**	**14335**	**7565**	**1140**	**817**	**2930**	**80**	**9222**	**68583**
Garage	306	450	384	9	6	12	9	364	1540
Driveway/path/patio	3682	1235	446	85	16	62	17	1100	6643
Greenhouse/shed	106	120	205	9	5	3	1	90	539
Garden	8258	4017	2568	841	87	183	63	2434	18451
Other outdoor	1382	404	119	27	3	22	11	991	2959
Outdoor total	**13734**	**6226**	**3722**	**971**	**117**	**282**	**101**	**4979**	**30132**
Total	**46228**	**20561**	**11287**	**2111**	**934**	**3212**	**181**	**14201**	**98715**

Source: http://www.hassandlass.org.uk

Think about …

- How does the figure 'roughly 5% of casualties' link to multiplying by 18.29?

- Do you think it is possible to use the data to find a good estimate of the probability that a particular person will have a particular type of accident in a particular room in their house?

You can see, from the values given in the table, which types of accident are most likely at home and where they are likely to happen. For example, the most likely place for having a fall requiring hospital treatment is in the stairway and hall – more casualties had falls there than anywhere else.

The totals can also give useful information. For example, the total number of accidents indoors is 68 583, whereas the total number of accidents outdoors is 30 132. This means that an accident at home requiring hospital treatment is more than twice as likely to be indoors as outdoors.

Try this C

Use the data from the table on the previous page to answer the following questions about accidents needing hospital treatment.

1 Which of these types of accident is …

a most likely to happen at home?……………………………

b least likely to happen at home? ……………………………

2 In which room in your house are you most likely to be …

a cut?……………………………………….

b struck by something? ……………….

c burnt (thermal accident)?…………..

3 What type of accident are you most likely to have …

a in the kitchen?……………………………

b in the garden? ……………………………

c in the greenhouse or shed? ………………

4 Overall, what type of accident is most likely to happen …

a indoors at home? ………………………

b outdoors at home? ……………………

5a   From above, the national estimate for the total number of people who had a fall indoors at home requiring hospital treatment during one year is 32 494 × 18.29 = 594 315 = 594 000 to the nearest thousand

Complete the rest of the table, giving answers to the nearest thousand.

National estimate	Fall	Struck	Cut	Bite/sting	Poisoning	Thermal	Electric	Other	Total
Indoor accidents	594 000								
Outdoor accidents									
Total at home									

5b The total population of the country when this data was collected was approximately 59 756 000.

Use this information to estimate the probability that in one year a person has an accident at home that requires hospital treatment.

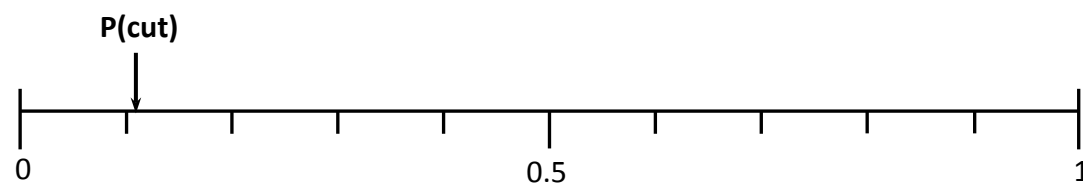## Estimates of probability using relative frequencies

Estimates of the probabilities of particular types of accidents in particular locations can be found using relative frequencies.

For example, if a person has an accident at home that requires hospital treatment, then the probability that it was a cut is $\frac{11\,287}{98\,715}$ = 0.11 (to 2 sf).

This probability is shown on the probability line below.

A probability line stretches from 0 (which represents the probability of something impossible) to 1 (which represents the probability of something certain to happen).

Probabilities that accidents at home (needing hospital treatment) are of particular types

P(cut)

0   0.5   1

Note that this is an overall probability. In practice the probability will vary widely from one person to another – can you explain why?

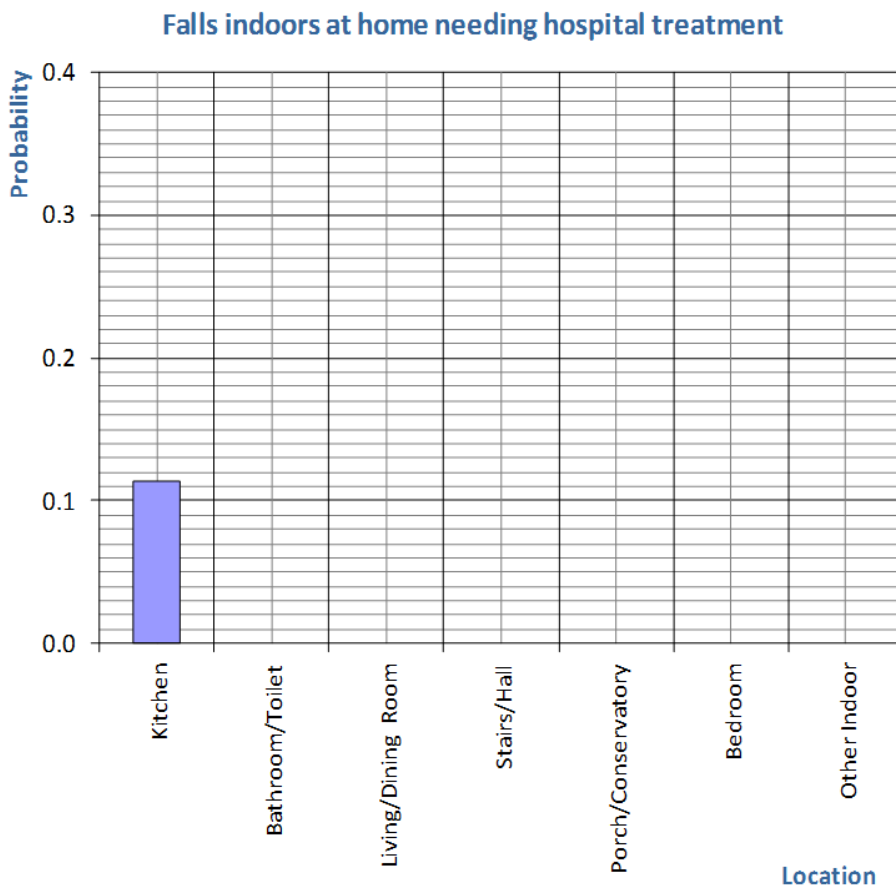**6** If a person has an accident at home requiring hospital treatment, find the probability that it was …

a a fall ………………………………………………………………………………..

b because of being struck by something …………………………………………………..

c a bite or sting …………………………………………………………………………….

Show these probabilities on the probability line on the previous page.

Probabilities can also be shown on a bar chart.

For example, if a person has a fall indoors at home, the probability that it was in the kitchen is:

$$\frac{3714}{32\,494} = 0.114 \text{ (to 3 sf). This is shown on the bar chart below.}$$

Falls indoors at home needing hospital treatment

7a Use the data on page 6 to complete the bar chart.

7b If a person has a fall indoors at home, where is it most likely to be? …………

8a Draw a similar bar chart on graph paper for falls outdoors.

8b If a person has a fall outdoors at home, where is it most likely to be? …………………………

At the end of the activity

- How accurate do you think the national estimates and probabilities are?

- Can you suggest any ways of improving their accuracy?

- What affects the probability that a particular person will have an accident at home or elsewhere?