Exercise 3A

Table 1 shows the monthly and annual rainfall for Sydney (Observatory Hill) from 2002 to 2011. Measurements are to the nearest millimetre.

Table 1: Rainfall for Sydney (mm)

Year	J	F	M	A	M	J	J	A	S	O	N	D	Annual
2002	98	348	45	68	93	28	24	20	22	6	32	75	860
2003	14	59	132	192	349	76	58	43	6	103	109	60	1200
2004	51	129	101	33	8	39	44	153	60	234	67	76	995
2005	68	125	154	33	48	79	63	2	51	43	125	25	816
2006	121	51	40	10	40	177	140	86	192	17	45	74	994
2007	45	108	65	180	10	511	67	152	41	27	170	123	1499
2008	57	258	63	147	3	127	90	44	99	67	73	54	1083
2009	25	128	61	153	126	130	53	6	16	180	13	67	956
2010	36	239	51	30	168	147	115	27	42	85	130	83	1154
2011	54	18	192	206	136	94	282	52	72	37	148	78	1369

1 In this time period, which year had the:
- **a** highest annual rainfall?
- **b** lowest annual rainfall?

2 How much rain fell in:
- **a** January 2006?
- **b** May 2007?
- **c** November 2011?

3 Which month had the highest rainfall in:
- **a** 2004?
- **b** 2010?

4 Which month had the lowest rainfall in:
- **a** 2003?
- **b** 2007?

5 Which year had the wettest:
- **a** January?
- **b** June?
- **c** December?

6 Which year had the driest:
- **a** February?
- **b** May?
- **c** November?

7 Considering winter to be the months June, July and August, which year had the:
- **a** wettest winter?
- **b** driest winter?

Table 2 summarises the rainfall statistics for Sydney for all records kept from 1859 to 2011.

Table 2: Rainfall statistics for Sydney (mm)

	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Mean	102	118	130	127	121	131	98	80	69	77	84	78	1215
Lowest	6	3	8	1	3	4	2	0	2	1	2	3	583
Median	79	94	99	95	91	100	75	55	53	56	67	60	1160
Highest	387	631	521	622	585	643	336	483	356	285	517	402	2194

8 Consider the annual rainfall statistics for Sydney shown in Table 2. What is the annual:
a mean? **b** median?

9 **a** For the month of September, what is the:
i mean rainfall? **ii** median rainfall?
b Suggest why the 2000 Olympic Games were held in Sydney in the month of September.

10 On average, which month of the year is the:
a wettest? **b** driest?

11 **a** What is the least amount of rain that has fallen in any month?
b In which month did this occur?

12 **a** What is the greatest amount of rain that has fallen in any month?
b In which month did this occur?

13 Which month has the smallest difference between the mean and the median rainfall?

Use tables 1 and 2 to answer questions **14** and **15**.

14 For the period 2002–2011, in which years was the annual rainfall in Sydney greater than the long-term mean rainfall?

15 For the period 2002–2011, what percentage of years had rainfall that was less than the long-term median rainfall?

Table 3 shows the country of birth of settler arrivals in Australia for the year July 2010 to June 2011.

16 How many settlers arrived from:
a United Kingdom? **b** Vietnam? **c** Iraq?

17 The total number of settler arrivals in Australia, from more than 200 countries, was approximately 127 640 from July 2010 to June 2011. Determine the percentage of arrivals who came from:
a New Zealand **b** China **c** India
d South Africa **e** Sri Lanka.

18 How many more arrivals came from:
a New Zealand than from Iraq?
b the United Kingdom than from Sri Lanka?

Table 3: Country of birth of settler arrivals in Australia (July 2010 to June 2011)

Country of birth	Number of arrivals
New Zealand	25 772
China	14 611
United Kingdom	10 944
India	10 566
Philippines	5 048
South Africa	4 752
Vietnam	3 339
Sri Lanka	3 225
Iraq	2 988

Table 4 shows the top 15 countries of birth of Australian residents in 2006 and 2010 (excluding Australian born).

Table 4: Country of birth of Australian residents

Country of birth	Estimated population 2006	Estimated population 2010
United Kingdom	1 153 000	1 193 000
New Zealand	477 000	544 000
China	203 000	380 000
India	154 000	341 000
Italy	220 000	216 000
Vietnam	180 000	211 000
Philippines	136 000	177 000
South Africa	119 000	156 000
Malaysia	104 000	136 000
Germany	115 000	129 000
Greece	126 000	127 000
South Korea	49 000	100 000
Sri Lanka	71 000	92 000
Lebanon	87 000	90 000
Hong Kong	76 000	90 000

19 How many people who were resident Australian in 2010 were born in:
a New Zealand? **b** the Philippines? **c** South Africa? **d** Vietnam? **e** Greece?

20 What was the country of birth of the highest proportion of residents in:
a 2010? **b** 2006?

21 What was the country of birth of the lowest proportion of residents in:
a 2010? **b** 2006?

22 There was a decrease in the resident population from 2006 to 2010 of people born in which country?

23 In 2010 approximately 5 994 000 (≈27%) of the Australian population were born outside Australia. What percentage of those born outside Australia came from:
a China? **b** India? **c** South Korea? **d** Sri Lanka? **e** Lebanon?

24 In 2010 the resident population of Australia was approximately 22 370 000. What percentage of all Australian residents were born in:
a China? **b** India? **c** South Korea? **d** Sri Lanka? **e** Lebanon?

25 From 2006 to 2010, what was the percentage increase in the resident population of people born in:
a China? **b** India? **c** South Korea? **d** Sri Lanka? **e** Lebanon?

Answers

Exercise 3A

1 **a** 2007 **b** 2005

2 **a** 121 mm **b** 10 mm **c** 148 mm

3 **a** October **b** February

4 **a** September **b** May

5 **a** 2006 **b** 2007 **c** 2007

6 **a** 2011 **b** 2008 **c** 2009

7 **a** 2007 **b** 2002

8 **a** 1215 mm **b** 1160 mm

9 **a** **i** 69 mm **ii** 53 mm

b September has the lowest average rainfall.

10 **a** June **b** September

11 **a** 0 mm **b** August

12 **a** 643 mm **b** June

13 September **14** 2007, 2011

15 70%

16 **a** 10 944 **b** 3339 **c** 2988

17 **a** 20.2% **b** 11.4% **c** 8.3%

d 3.7% **e** 2.5%

18 **a** 22 784 **b** 7719

19 **a** 544 000 **b** 177 000 **c** 156 000

d 211 000 **e** 127 000

20 **a** UK **b** UK

21 **a** Hong Kong/Lebanon **b** South Korea

22 Italy

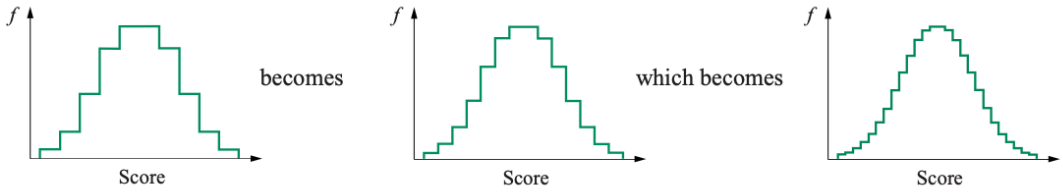
23 **a** 6.3% **b** 5.7% **c** 1.7% **d** 1.5% **e** 1.5%

24 **a** 1.7% **b** 1.5% **c** 0.4% **d** 0.4% **e** 0.4%

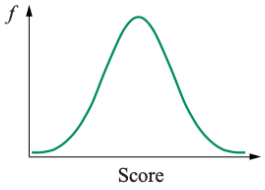
25 **a** 87.2% **b** 121.4% **c** 104.1% **d** 29.6% **e** 3.4%

B The shape of displays

As the number of scores in a sample increases, the overall shape of the frequency histogram changes.



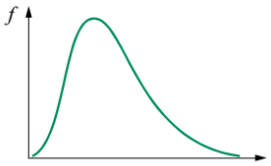
The general shape of a distribution can provide information about the scores. Here is the graph of a symmetric distribution, also referred to as a bell-shaped curve or a normal distribution.



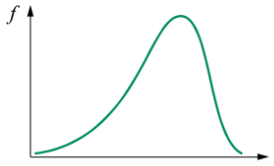
If the distribution is not symmetric then it is said to be **skewed**.

A distribution is **positively skewed** if most of the data is on the left-hand side of the distribution. The data has a 'tail' to the right as shown in the diagram on the left below.

A distribution is **negatively skewed** if most of the data is on the right-hand side of the distribution. The data has a 'tail' to the left as in the diagram on the right below.

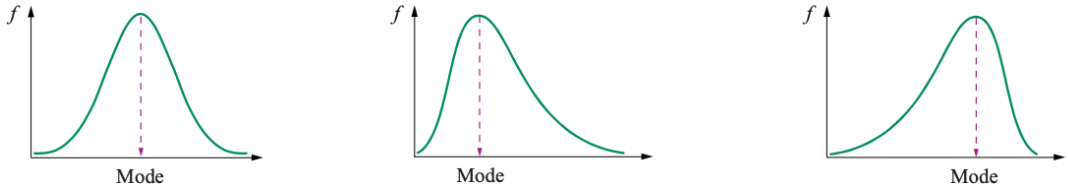


Positively skewed

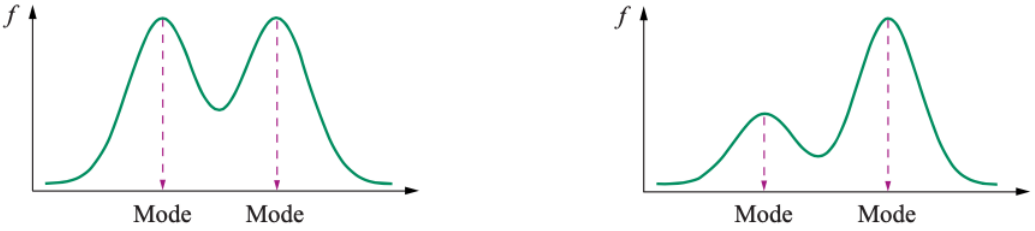


Negatively skewed

The mode is the score with the highest frequency. The mode for the normal and skewed distributions above are shown below.



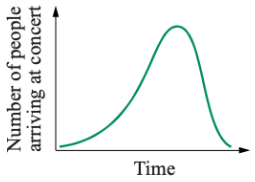
Some distributions have two modes. This is called a **bimodal** distribution. As long as the distribution has two distinct humps, not necessarily with the same frequency (height), then it is said to be bimodal. Two examples are shown below.



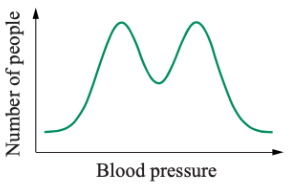
Exercise 3B

1 Describe the shape of the following distributions as symmetric, positively skewed, negatively skewed or bimodal.

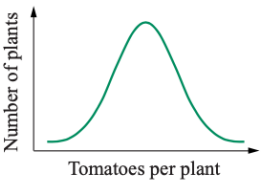
a



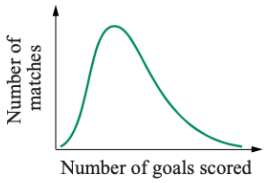
b



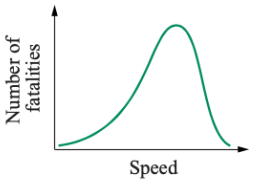
c



d



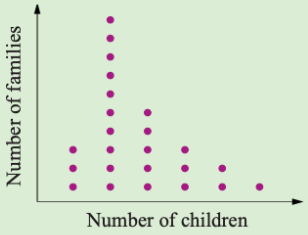
e



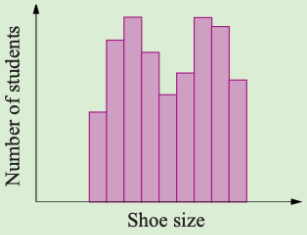
EXAMPLE 1

Describe the shape of each distribution as symmetric, positively skewed, negatively skewed or bimodal.

a



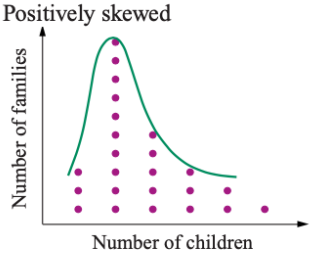
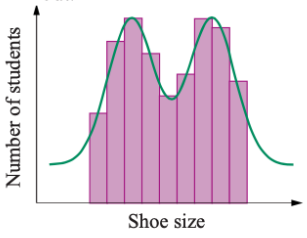
b



c

Marks on test

Stem	Leaf
0	8 9
1	3 4 6
2	2 5 8 8
3	4 4 5 7 9
4	0 1 1 2 5 6 6 7
5	1 1 2 5 9

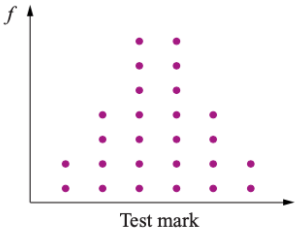
	Solve	Think	Apply
a	Positively skewed 	Draw a smooth curve to fit the tops of the columns. The tail is to the right.	Draw a smooth curve through the tops of the columns. Determine from the shape if the distribution is symmetric, positively skewed, negatively skewed or bimodal.
b	Bimodal 	Draw a smooth curve to fit the tops of the columns. The curve has two humps.	

EXAMPLE 1 CONTINUED

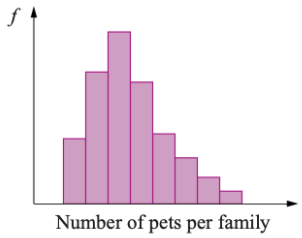
	Solve	Think	Apply
c	Negatively skewed Leaf | Stem 7 | 0 6 6 | 1 9 5 9 | 2 8 7 2 5 | 3 6 8 5 1 2 | 4 9 4 5 4 1 1 | 5 8 3 2 4 0 1	Turn the stem-and-leaf plot on its side and draw a smooth curve to fit the tops of the columns. The tail is to the left.	Turn the stem-and-leaf plot on its side so that the stems are in increasing order, from left to right. Draw a smooth curve through the tops of the columns. Determine from the shape of the distribution if it is symmetric, positively skewed, negatively skewed or bimodal.

2 Describe the shape of each distribution as symmetric, positively skewed, negatively skewed or bimodal.

a



b

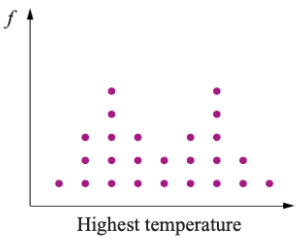


c

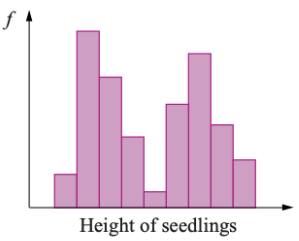
Marks on test

Stem	Leaf
1	5
2	3 4
3	5 5 7
4	2 3 3 9
5	1 4 4 6 8 9
6	0 1 3

d



e



3 **a** Construct a frequency histogram and polygon for the data in the frequency distribution table below.

b Describe the shape of the distribution as positively skewed, negatively skewed or bimodal.

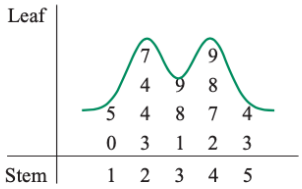
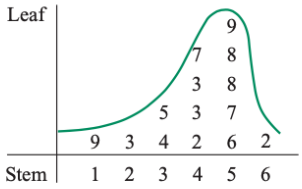
Score	Frequency
6	2
7	2
8	3
9	5
10	8
11	6

EXAMPLE 2

Describe the shape of both data sets in the back-to-back stem-and-leaf plot as symmetric, positively skewed, negatively skewed or bimodal.

Scores on topic test

Females	Stem	Males
9	1	0 5
3	2	3 4 4 7
5 4	3	1 8 9
7 3 3 2	4	2 7 8 9
9 8 8 7 6	4	3 4
4 2	6	

Solve	Think	Apply
Male scores Bimodal  *Female scores* Negatively skewed  	For males, turn the plot on its side and draw a curve to fit the columns. For females, flip the data over the stem and turn it on its side. Draw a curve to fit the columns.	Turn each stem-and-leaf plot on its side so that the stems are in increasing order, from left to right. Draw a smooth curve through the tops of the columns and describe the shape of the distribution.

4 Describe the shape of each data set in the following distributions as symmetric, positively skewed, negatively skewed or bimodal.

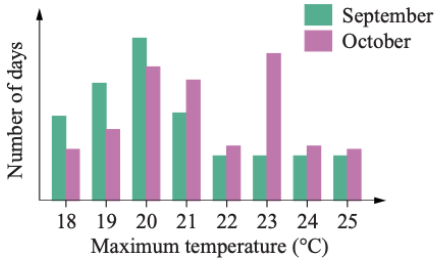
a **Scores on Science test**

Females	Stem	Males
9	0	7 7 8
4 3	1	2 3 5 7 9 9 9
7 1	2	0 1 1
9 6 4 0	3	5 7
9 7 5 5 2 2	4	6
3 1 1	5	1

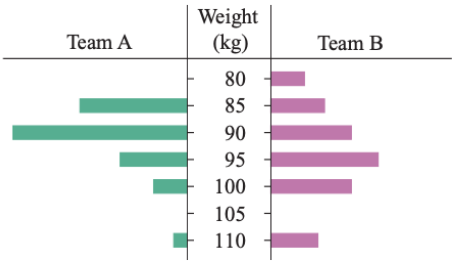
b **Scores on Mathematics test**

9 Blue	Stem	9 Red
9 9 8	4	7
8 7 2 1 1	5	3 4 7 8
4 3 2	6	1 5
5 4	7	0 5 5 6 8 9
3 0	8	3 4
1	9	2

5 **a** This distribution shows the average maximum temperatures (in °C) in Sydney for September and October. This is called a side-by-side histogram. Describe the data distribution.



b This distribution shows the weight (in kg) of players in two Rugby League teams. This is called a **back-to-back** histogram. Describe the data distribution for each team.



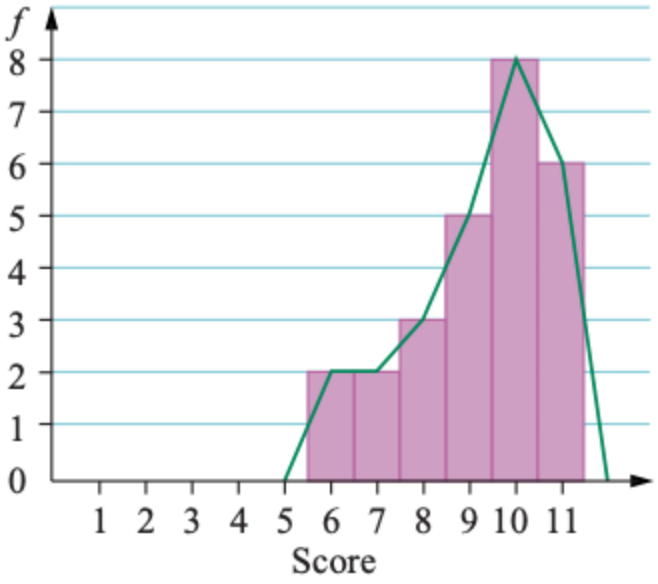
Answers

Exercise 3B

1 **a** Negatively skewed
b Bimodal
c Symmetric
d Positively skewed
e Negatively skewed

2 **a** Symmetric
b Positively skewed
c Negatively skewed
d Bimodal
e Bimodal

3 **a**



b It is negatively skewed.

4 **a** Female: negatively skewed, males: positively skewed
b 9 Blue: positively skewed, 9 Red: bimodal

5 **a** September: positively skewed, October: bimodal
b Team A: positively skewed, team B: approximately symmetrical