

# FURTHER MATHS- CHAPTER 1: UNIVARIATE DATA

## Exercise 1.2

- 10 When reading the menu at the local Chinese restaurant, you notice that the dishes are divided into sections. The sections are labelled chicken, beef, duck, vegetarian and seafood. What type of data is this?
- 11 NASA collects data on the distance to other stars in the universe. The distance is measured in light years. What type of data is being collected?
- A Discrete                      B Continuous                      C Nominal  
D Ordinal                        E Bivariate
- 12 The number of blue, red, yellow and purple flowers in an award winning display is counted. What type of data is being collected?
- A Nominal                      B Ordinal                        C Discrete  
D Continuous                    E Bivariate
- 13 Students in a performing arts class watch a piece of modern dance and are then asked to rate the quality of the dance as poor, average, above average or excellent. What type of data is being collected?
- 14 Given the set of data: 12, 6, 21, 15, 8, 2, describe what type of numerical data this data set is.
- 16 The height of the players in the basketball team is measured. The data collected is best described as:
- A categorical and nominal                      B categorical and numerical  
C numerical and discrete                        D numerical and continuous  
E none of the above

## Exercise 1.3

- 1 **WE3** The number of iPads sold in a month from a department store over 16 weeks is shown.

|    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|
| 28 | 31 | 18 | 48 | 38 | 25 | 21 | 16 |
| 33 | 42 | 35 | 39 | 49 | 30 | 29 | 28 |

Construct a stem plot to display the number of iPads sold over the 16 weeks.

- 10 The ages of the mothers of a class of children attending an inner-city kindergarten are given below. Construct a stem plot for these data. Based on your display, comment on the statement 'Parents of kindergarten children are young' (less than 30 years old).



|    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|
| 32 | 30 | 19 | 28 | 25 | 29 | 32 |
| 28 | 29 | 34 | 32 | 35 | 39 | 30 |
| 37 | 33 | 29 | 35 | 38 | 33 |    |

- 12 The 2015 weekly median rental price for a 2-bedroom unit in a number of Melbourne suburbs is given in the following table. Construct a stem plot for these data and comment on it.

| Suburb     | Weekly rental (\$) | Suburb          | Weekly rental (\$) |
|------------|--------------------|-----------------|--------------------|
| Alphington | 400                | Moonee Ponds    | 373                |
| Box Hill   | 365                | Newport         | 380                |
| Brunswick  | 410                | North Melbourne | 421                |
| Burwood    | 390                | Northcote       | 430                |
| Clayton    | 350                | Preston         | 351                |
| Essendon   | 350                | St Kilda        | 450                |
| Hampton    | 430                | Surrey Hills    | 380                |
| Ivanhoe    | 395                | Williamstown    | 330                |
| Kensington | 406                | Windsor         | 423                |
| Malvern    | 415                | Yarraville      | 390                |

- 13 A random sample of 20 screws is taken and the length of each is recorded to the nearest millimetre below.

|    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|
| 23 | 15 | 18 | 17 | 17 | 19 | 22 |
| 19 | 20 | 16 | 20 | 21 | 19 | 23 |
| 17 | 19 | 21 | 23 | 20 | 21 |    |

Construct a stem plot for screw length using:

- a the stems 1 and 2  
b the stems 1 and 2 split into halves  
c the stems 1 and 2 split into fifths.

Use your plots to help you comment on the screw lengths.

- MASTER** 17 The following data was collected from a company that compared the battery life (measured in minutes) of two different Ultrabook computers. To complete the test they ran a series of programs on the two computers and measured how long it took for the batteries to go from 100% to 0%.

| Computer 1 | 358 | 376 | 392 | 345 | 381 | 405 | 363 | 380 | 352 | 391 | 410 | 366 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Computer 2 | 348 | 355 | 361 | 342 | 355 | 362 | 353 | 358 | 340 | 346 | 357 | 352 |

- a Draw a back-to-back stem plot (using the same stem) of the battery life of the two Ultrabook computers.  
b Use the stem plot to compare and comment on the battery life of the two Ultrabook computers.

## Exercise 1.4

- 1 **WE6** The number of questions completed for maths homework each night by 16 students is shown below.

|    |   |   |   |    |    |   |   |
|----|---|---|---|----|----|---|---|
| 5  | 6 | 5 | 9 | 10 | 10 | 6 | 8 |
| 10 | 9 | 8 | 5 | 7  | 8  | 7 | 9 |

Display the data as a dot plot.

- 5 **WE8** The number of fish caught by 30 anglers in a fishing competition are given in the frequency table below.

|                  |   |   |   |   |   |   |   |
|------------------|---|---|---|---|---|---|---|
| <b>Fish</b>      | 0 | 1 | 2 | 3 | 4 | 5 | 7 |
| <b>Frequency</b> | 4 | 7 | 4 | 6 | 5 | 3 | 1 |



Display these data on a histogram.

- 7 **WE9** The following table shows how many goals each of the 18 AFL team's leading goal kickers scored in the 2014 regular season. Construct a segmented bar chart to represent this data.

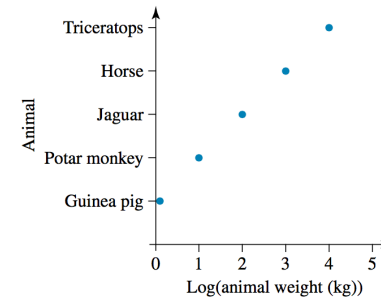
| Club              | Goals |
|-------------------|-------|
| Adelaide Crows    | 51    |
| Brisbane Lions    | 33    |
| Carlton           | 29    |
| Collingwood       | 39    |
| Essendon          | 27    |
| Fremantle         | 49    |
| Geelong Cats      | 62    |
| Gold Coast Suns   | 46    |
| GWS Giants        | 29    |
| Hawthorn          | 62    |
| Melbourne         | 20    |
| North Melbourne   | 41    |
| Port Adelaide     | 62    |
| Richmond          | 58    |
| St Kilda          | 49    |
| Sydney Swans      | 67    |
| West Coast Eagles | 61    |
| Western Bulldogs  | 37    |

- 9 **WE10** The following table shows the average weights of 10 different adult mammals.

| Mammal         | Weight (kg) |
|----------------|-------------|
| Black wallaroo | 18          |
| Capibara       | 55          |
| Cougar         | 63          |
| Fin whale      | 70000       |
| Lion           | 175         |
| Ocelot         | 9           |
| Pygmy rabbit   | 0.4         |
| Red deer       | 200         |
| Quokka         | 4           |
| Water buffalo  | 725         |

Display the data in a histogram using a log base 10 scale, using class intervals of width 1.

- 10 The following graph shows the weights of animals.



If a gorilla has a weight of 207 kilograms then its weight is between that of:

- A** Potar monkey and jaguar.      **B** horse and triceratops.  
**C** guinea pig and Potar monkey.      **D** jaguar and horse.  
**E** none of the above.

- 11 **WE11** The Richter scale measures the magnitude of earthquakes using a log (base 10) scale.

How many times stronger is an earthquake of magnitude 8.1 than one of magnitude 6.9? Give your answer correct to the nearest whole number.

- 12 The pH scale measures acidity using a log (base 10) scale. For each decrease in pH of 1, the acidity of a substance increases by a factor of 10.

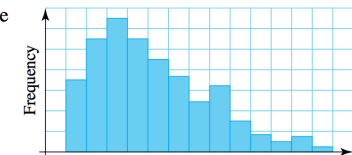
If a liquid's pH value decreases by 0.7, by how much has the acidity of the liquid increased?



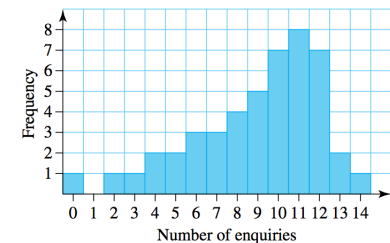
## Exercise 1.5

- 6 The distribution of the data shown in the histogram could be described as:

- A** negatively skewed  
**B** negatively skewed and symmetric  
**C** positively skewed  
**D** positively skewed and symmetric  
**E** symmetric



- 7 The average number of product enquiries per day received by a group of small businesses who advertised in the Yellow Pages telephone directory is given at right. Describe the shape of the distribution of these data.





9 The mass (correct to the nearest kilogram) of each dog at a dog obedience school is shown in the stem plot.

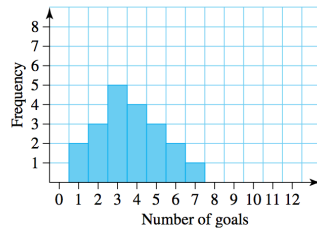
- a Describe the shape of the distribution of these data.  
b What does this information tell us about this group of dogs?

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

Key: 0|4 = 4 kg

11 Statistics were collected over 3 AFL games on the number of goals kicked by forwards over 3 weeks. This is displayed in the histogram.

- a Describe the shape of the histogram.  
b Use the histogram to determine:  
i the number of players who kicked 3 or more goals over the 3 weeks  
ii the percentage of players who kicked between 2 and 6 goals inclusive over the 3 weeks.



12 The number of hours a group of students exercise each week is shown in the stem plot.

- a Describe the shape of the distribution of these data.  
b What does this sample data tell us about this group of students?

| Stem | Leaf          |
|------|---------------|
| 0    | 0 0 0 0 1 1 1 |
| 0    | 2 2 2 3       |
| 0    | 4 4           |
| 0    | 6             |
| 0    | 8 8 9         |
| 1    | 0 0 1         |
| 1    | 2 2 2 3       |

Key: 0|1 = 1

## Exercise 1.6

10 Write down a set of data for which  $n = 5$ , the median is 6 and the range is 7. Is this the only set of data with these parameters?

11 Give an example of a data set where:

- a the lower quartile equals the lowest score  
b the IQR is zero.

13 For each of the following sets of data find the median, the interquartile range, the range and the mode.

a

|    |    |   |    |    |    |    |    |    |    |
|----|----|---|----|----|----|----|----|----|----|
| 16 | 12 | 8 | 7  | 26 | 32 | 15 | 51 | 29 | 45 |
| 19 | 11 | 6 | 15 | 32 | 18 | 43 | 31 | 23 | 23 |

b

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 22 | 25 | 27 | 36 | 31 | 32 | 39 | 29 | 20 | 30 |
| 23 | 25 | 21 | 19 | 29 | 28 | 31 | 27 | 22 | 29 |

c

|     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1.2 | 2.3 | 4.1 | 2.4 | 1.5 | 3.7 | 6.1 | 2.4 | 3.6 | 1.2 |
| 6.1 | 3.7 | 5.4 | 3.7 | 5.2 | 3.8 | 6.3 | 7.1 | 4.9 |     |

15 For the data in the stem plots shown, find the range, median, mode and interquartile range.

a

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

b

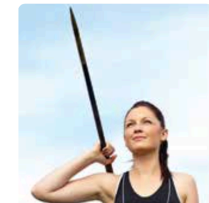
| Stem | Leaf              |
|------|-------------------|
| 40   | 3 5 7             |
| 41   | 1 1 1 3 4 6 7 8 9 |
| 42   | 0 2 3 6 7 8 9     |
| 43   | 2 3 3 6 8         |
| 44   | 1 2               |
| 45   | 0                 |

Key: 40|3 = 403

Key: 0|1 = 1

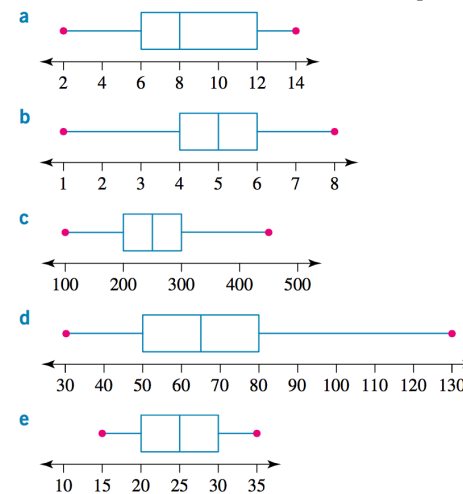
17 The following data represents distances (in metres) thrown during a javelin-throwing competition. Use CAS to calculate the interquartile range and median.

|      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|
| 40.3 | 42.8 | 41.0 | 50.3 | 52.2 | 46.1 | 44.5 |
| 41.6 | 44.3 | 47.4 | 45.1 | 48.8 | 46.1 | 44.5 |
| 45.3 | 42.9 | 41.1 | 49.0 | 47.5 | 40.8 | 51.1 |

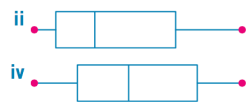
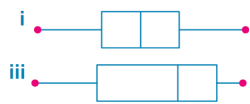
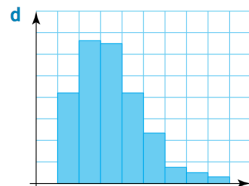
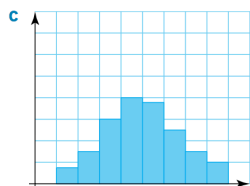
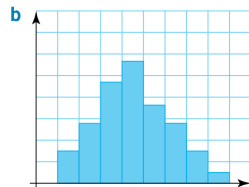
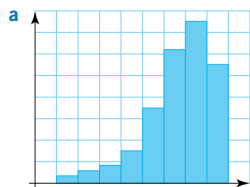


## Exercise 1.7

9 For the boxplots shown, write down the range, the interquartile range and the median of the distributions which each one represents.

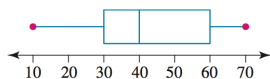


10 Match each histogram below with the boxplot which could show the same distribution.



12 For the distribution shown in the boxplot below, it is true to say that:

- A the median is 30
- B the median is 45
- C the interquartile range is 10
- D the interquartile range is 30
- E the interquartile range is 60



14 The maximum daily temperatures (in °C) for the month of October in Melbourne are:

18 26 28 23 16 19 21 27 31 23 24 26 21 18 26 27  
23 21 24 20 19 25 27 32 29 21 16 19 23 25 27

Represent these data on a boxplot.

18 You work in the marketing department of a perfume company. You completed a survey of people who purchased your perfume, asking them how many times a week they used it. Analyse the data by drawing a boxplot and comment on the existence of any outliers by finding the lower and upper fences.

|   |   |   |   |    |   |   |   |
|---|---|---|---|----|---|---|---|
| 7 | 2 | 5 | 4 | 7  | 5 | 7 | 2 |
| 5 | 4 | 3 | 5 | 7  | 7 | 9 | 8 |
| 5 | 6 | 5 | 3 | 15 | 8 | 7 | 5 |

19 For the data set shown:

|    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|
| 11 | 11 | 14 | 16 | 19 | 22 | 24 | 25 |
| 25 | 27 | 28 | 28 | 36 | 38 | 38 | 39 |

- a construct a boxplot by hand
- b comment on the presence of outliers by finding the lower and upper fences
- c construct a boxplot using CAS and compare the two boxplots.

## Exercise 1.8

2 Calculate the mean of the data set shown.

5.5, 6.3, 7.7, 8.3, 9.7, 6.7, 12.9, 10.5, 9.9, 5.1

5 Find the mean of each of the following sets of data.

a 5 6 8 8 9 (correct to 2 significant figures)

c 4.3 4.5 4.7 4.9 5.1 5.3 5.5 5.6 (correct to 5 significant figures)

e 0.4 0.5 0.7 0.8 0.8 0.9 1.0 1.1 1.2 1.0 1.3 (correct to 4 decimal places)

6 Calculate the mean of each of the following and explain whether or not it gives us a good indication of the centre of the data.

b 14 16 16 17 17 17 19 20    d 2 15 17 18 18 19 20

7 The number of people attending sculpture classes at the local TAFE college for each week during the first semester is given.

15 12 15 11 14 8 14 15 11 10

7 11 12 14 15 14 15 9 10 11

What is the mean number of people attending each week? (Express your answer correct to 2 significant figures.)

14 The number of fish eaten by seals at Sea Haven on a daily basis is shown.

Calculate the mean number of fish eaten per day.

| Number of fish | Frequency ( $f$ ) |
|----------------|-------------------|
| 0–9            | 2                 |
| 10–19          | 4                 |
| 20–29          | 5                 |
| 30–39          | 18                |
| 40–49          | 19                |
| 50–59          | 24                |

16 The number of cups of coffee drunk by 176 Year 12 students in the two weeks leading to their exams is shown.

| Number of cups | Frequency ( $f$ ) |
|----------------|-------------------|
| 0–9            | 3                 |
| 10–19          | 5                 |
| 20–29          | 7                 |
| 30–39          | 24                |
| 40–49          | 29                |
| 50–59          | 41                |
| 60–69          | 32                |
| 70–79          | 30                |
| 80–89          | 3                 |
| 90–99          | 2                 |

- a What is the mean number of cups of coffee drunk in the two-week period?
- b Calculate the median.
- c What does the median value when compared to the mean value suggest about the shape of the distribution?

## Exercise 1.9

- 6 First-quarter profit increases for 8 leading companies are given below as percentages.

2.3 0.8 1.6 2.1 1.7 1.3 1.4 1.9

Calculate the standard deviation for this set of data and express your answer correct to 2 decimal places.

- 9 The number of outgoing phone calls from an office each day over a 4-week period is shown in the stem plot below.

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

Key: 2|1 = 21 calls



Calculate the standard deviation for this set of data and express your answer correct to 4 significant figures.

- 14 Aptitude tests are often used by companies to help decide who to employ. An employer gave 30 potential employees an aptitude test with a total of 90 marks. The scores achieved are shown.

67, 67, 68, 68, 68, 69, 69, 72, 72, 73, 73, 74, 74, 75, 75,

77, 78, 78, 78, 79, 79, 79, 81, 81, 81, 82, 83, 83, 83, 86

Calculate the mean and standard deviation of the data, correct to 1 decimal place.

## Exercise 1.10

- 2 Generate 10 random numbers (integers) between 1 and 250.
- 4 Generate 10 random numbers (integers) between 1 and 100.
- 7 When selecting students for a simple random sample of a year level, the students selected should be:
- A of similar age
  - B a group of mates
  - C independent
  - D female
  - E the tallest students
- 8 The students selected for a simple random sample of a year level should be selected by:
- A a group of mates
  - B a group who all dance
  - C a selection of males
  - D the students with the best test results
  - E using random numbers

- 9 Would the mean be a good measure of the centre of the distribution shown at right? Explain.

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

Key: 1|2 = 12

- 10 The mean is a good measure of the centre of a distribution if the data is:

- A skewed left
- B symmetric
- C skewed right
- D has outliers
- E bimodal

- 11 The interquartile range is 12, since  $Q_1 = 24$  and  $Q_3 = 36$ . The percentage of data that fit between 24 and 36 is:

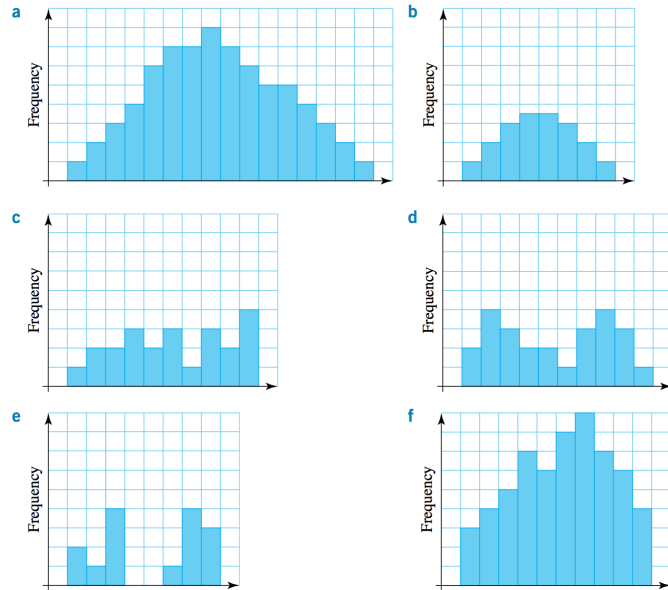
- A 12%
- B 30%
- C 50%
- D 68%
- E 95%

## Exercise 1.11

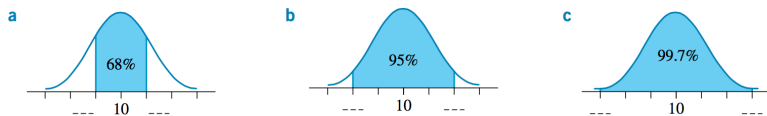
- 2 The monthly rainfall in Mathmania Island was found to follow a bell-shaped curve with a mean of 45 mm and a standard deviation of 1.7 mm. Write down the rainfall range which we would expect approximately:
- a 68% of the group to lie
  - b 95% of the group to lie
  - c 99.7% of the group to lie.
- 4 The distribution of heights of a group of Melbourne-based employees who work for a large international company is bell-shaped. The data have a mean of 160 cm and a standard deviation of 10 cm. Find the percentage of this group of employees who are:
- a less than 170 cm tall
  - b less than 140 cm tall
  - c greater than 150 cm tall
  - d between 130 cm and 180 cm in height.
- 6 The volume of fruit juice in a certain type of container is not always the same. When a sample of these containers was studied it was found that the volume of juice they contained approximated a normal distribution with a mean of 250 mL and a standard deviation of 5 mL. In a sample of 400 containers, how many would be expected to have a volume of:
- a more than 245 mL
  - b less than 240 mL
  - c between 240 and 260 mL?
- 8 In a maths exam, the mean score is 60 and the standard deviation is 12. Chifune's mark is 96. Calculate her mark as a z-score.
- 10 Ken's English mark was 75 and his maths mark was 72. In English, the mean was 65 with a standard deviation of 8, while in maths the mean mark was 56 with a standard deviation of 12.
- a Convert the mark in each subject to a z-score.
  - b In which subject did Ken perform better? Explain your answer.



11 In each of the following, decide whether or not the distribution is approximately bell-shaped.



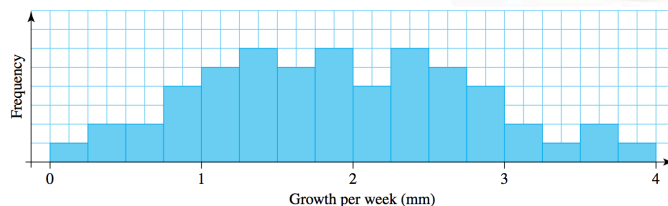
12 Copy and complete the entries on the horizontal scale of the following distributions, given that  $\mu = 10$  and  $\sigma = 2$ .



14 A research scientist measured the rate of hair growth in a group of hamsters. The findings are shown in the histogram.

The mean growth per week was 1.9 mm and the standard deviation was 0.6 mm. Write down the hair growth rates between which approximately:

- a 68% of the values fall
- b 95% of the values fall
- c 99.7% of the values fall.



15 The heights of the seedlings sold in a nursery have a bell-shaped distribution. The mean height is 7 cm and the standard deviation is 2.

Write down the values between which approximately:

- a 68% of seedling heights will lie
- b 95% of seedling heights will lie
- c 99.7% of seedling heights will lie.

16 A distribution of scores is bell-shaped and the mean score is 26. It is known that 95% of scores lie between 21 and 31.

It is true to say that:

- A 68% of the scores lie between 23 and 28
- B 97.5% of the scores lie between 23.5 and 28.5

C the standard deviation is 2.5

D 99.7% of the scores lie between 16 and 36

E the standard deviation is 5

17 The number of days taken off in a year by employees of a large company has a distribution which is approximately bell-shaped. The mean and standard deviation of this data are shown below.

Mean = 9 days      Standard deviation = 2 days

Find the percentage of employees of this company who, in a year, take off:

- a more than 15 days
- b fewer than 5 days
- c more than 7 days
- d between 3 and 11 days
- e between 7 and 13 days.

18 A particular bolt is manufactured such that the length is not always the same. The distribution of the lengths of the bolts is approximately bell-shaped with a mean length of 2.5 cm and a standard deviation of 1 mm.



a In a sample of 2000 bolts, how many would be expected to have a length:

- i between 2.4 cm and 2.6 cm
- ii less than 2.7 cm
- iii between 2.6 cm and 2.8 cm?

b The manufacturer rejects bolts which have a length of less than 2.3 cm or a length of greater than 2.7 cm. In a sample of 2000 bolts, how many would the manufacturer expect to reject?

20 In a normal distribution the mean is 58. A score of 70 corresponds to a standardised score of 1.5. The standard deviation of the distribution is:

- A 6
- B 8
- C 10
- D 12
- E 9

21 In the first maths test of the year, the mean mark was 60 and the standard deviation was 12. In the second test, the mean was 55 and the standard deviation was 15. Barbara scored 54 in the first test and 50 in the second test. In which test did Barbara do better? Explain your answer.