7 Quickline trains has invested in new timetabling software. The number of complaints received from their passengers each month in the following year was modelled using an arithmetic sequence. In the first month, 152 complaints were received. This decreased to 140 complaints in the second month.

a Use this model to show that a total of 1032 complaints were received during the year.

The train company claimed that there was roughly a 60% reduction in the number of complaints received between the first six months and the last six months of that year.

b Use this model to determine whether this claim is accurate.

c Comment on the suitability of this model in the following year.

8 The number of departures from a new airport each month was modelled using an arithmetic sequence. There were 450 departures in its first month of being operational. In the first three months of the airport being operational, there were 1470 departures.

a Use this model to work out the total number of departures in the first six months of the airport being operational.

If the number of departures in any complete month exceeded 1000 then the airport authority paid an environmental fine of £5000 for that month.

b Use this model to calculate how much the airport authority was fined in its first two years of being operational.

9 Jim has trained for a new job in sales. Each year he earns a basic salary of £24 000 plus 5% commission on the value of any sales made during that year. In his first working year, Jim earned £27 500. In his second working year, he made sales worth £80 000. The amount Jim earned each year was modelled using an arithmetic sequence.

a Use this model to work out

  i The total amount Jim earned in his first five working years,

  ii The total value of sales Jim made in his first five working years.

At the end of each working year, Jim paid 8% of the amount earned that year into a pension fund. The amount paid in each year formed an arithmetic sequence.

b Calculate the minimum number of whole years Jim will need to work for these pension contributions to have a total value of more than £30 000

c Give one criticism of using an arithmetic sequence to model the amount Jim earned each year.

E/P 19 The first term of a geometric series is 130. The sum to infinity of the series is 650.

    a Show that the common ratio, r, is $\frac{4}{5}$ **(3 marks)**

    b Find, to 2 decimal places, the difference between the 7th and 8th terms.   **(2 marks)**

    c Calculate the sum of the first 7 terms.   **(2 marks)**

The sum of the first n terms of the series is greater than 600.

    d Show that $n > \dfrac{-\log 13}{\log 0.8}$ **(4 marks)**

**E/P** 20 The adult population of a town is 25 000 at the beginning of 2012.
A model predicts that the adult population of the town will increase by 2% each year,
forming a geometric sequence.

    a Show that the predicted population at the beginning of 2014 is 26 010.   **(1 mark)**

The model predicts that after n years, the population will first exceed 50 000.

    b Show that $n > \dfrac{\log 2}{\log 1.02}$ **(3 marks)**

    c Find the year in which the population first exceeds 50 000.   **(2 marks)**

    d Every member of the adult population is modelled to visit the doctor once per year.
    Calculate the number of appointments the doctor has from the beginning of 2012
    to the end of 2019.   **(4 marks)**

    e Give a reason why this model for doctors' appointments may not be appropriate.   **(1 mark)**

E/P 21 Kyle is making some patterns out of squares. He has made 3 rows so far.

Row 1

    a Find an expression, in terms of n, for the number of squares
    required to make a similar arrangement in the nth row.   **(3 marks)**

    b Kyle counts the number of squares used to make the pattern   Row 2
    in the kth row. He counts 301 squares. Write down the value
    of k.   **(1 mark)**

    c In the first q rows, Kyle uses a total of p squares.   Row 3
       i Show that $q^2 + 2q - p = 0$.   **(3 marks)**
       ii Given that $p > 1520$, find the minimum number of rows
          that Kyle makes.   **(3 marks)**
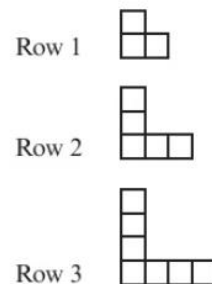
E/P 22 A convergent geometric series has first term a and common ratio r. The second term of the
series is −3 and the sum to infinity of the series is 6.75.

    a Show that $27r^2 - 27r - 12 = 0$.   **(4 marks)**

    b Given that the series is convergent, find the value of r.   **(2 marks)**

    c Find the sum of the first 5 terms of the series, giving your answer to
    2 decimal places.   **(3 marks)**

1 For each function

   i sketch the graph of $y = f(x)$

   ii state the range of the function.

     a $f: x \mapsto 4|x| - 3, x \in \mathbb{R}$

     b $f(x) = \dfrac{1}{3}|x + 2| - 1, x \in \mathbb{R}$

     c $f(x) = -2|x - 1| + 6, x \in \mathbb{R}$

     d $f: x \mapsto -\dfrac{5}{2}|x| + 4, x \in \mathbb{R}$

1 Using data from Camborne, Heathrow, Leuchars, Hurn and Leeming in 1987, the average daily total hours of sunshine during June in the UK is modelled by a Normal distribution with mean 4.38 hours and variance 14.0 hours^2. The sunshine levels are measured in those locations during June 2015 to see whether it was a particularly sunny month by comparison.

   a State null and alternative hypotheses for this test.

   The 150 daily readings have an average of 6.76 hours.

   b Calculate the test statistic and the critical value if the test is at the 5% level.

   c State, with a reason, whether the null hypothesis is accepted or rejected. Determine the conclusion of the hypothesis test.

2 A banana farm finds that the banana masses are well-modelled by a Normal distribution with mean 125 g and variance 150 g^2. During one summer, they are thought to be larger than usual.

a State the null and alternative hypotheses.

A sample of 42 bananas is selected and their mean mass is 131 g.

b Calculate the test statistic and hence calculate the p-value.

c State, with a reason, whether the null hypothesis is accepted or rejected at the 1% significance level.

d Determine the conclusion of the hypothesis test.

e Discuss whether it's reasonable to say that the mean mass of that summer's bananas is 131 g.

3 The average daily maximum relative humidity in Camborne in 1987 is believed to be well-modelled by a Normal distribution with mean 93.59 and variance 35.32. Measurements are taken from a weather station in Heathrow at the same time and they are checked to see if the two locations have the same average.

a State the null and alternative hypotheses.

In Heathrow, the average daily maximum relative humidities are recorded and found to have an average of 93.13

b Calculate the test statistic.

c Calculate any critical values at the 10% level.

d State, with a reason, whether the null hypothesis is accepted or rejected.

2 Some students take part in an obstacle race. The time it took each student to complete the race was noted. The results are shown in the histogram.

**a** Give a reason to justify the use of a histogram to represent this data.

The number of students who took between 60 and 70 seconds is 90.

b Find the number of students who took between 40 and 60 seconds.

c Find the number of students who took 80 seconds or less.

d Calculate the total number of students who took part in the race.
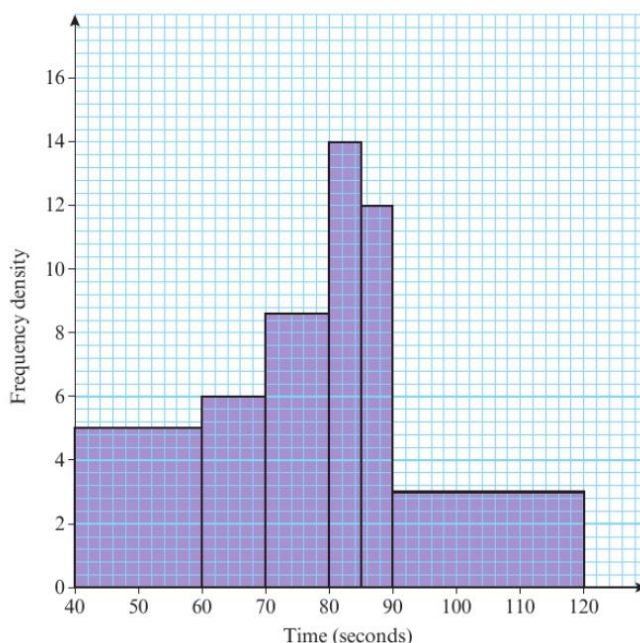
3 A Fun Day committee at a local sports centre organised a throwing the cricket ball competition. The distance thrown by every competitor was recorded. The histogram shows the data. The number of competitors who threw less than 20 m was 40.

a Why is a histogram a suitable diagram to represent this data?

b How many people entered the competition?

c Estimate how many people threw between 30 and 40 metres.

d How many people threw between 45 and 65 metres?

e Estimate how many people threw less than 25 metres.
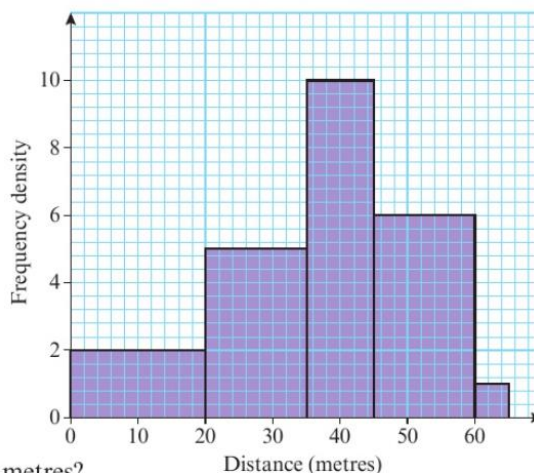
4 A farmer found the masses of a random sample of lambs. The masses were summarised in a grouped frequency table and represented by a histogram. The frequency for the class $28 \leqslant m < 32$ was 32.

a Show that 25 small squares on the histogram represents 8 lambs.

b Find the frequency of the $24 \leqslant m < 26$ class.

c How many lambs did the farmer weigh in total?

d Estimate the number of lambs that had masses between 25 and 29 kg.