

# 25

## Numbers

### A Types of numbers

Numbers in a group together may be called a **series** or **set of numbers**. If the order in which they occur is significant then they may be called a **sequence of numbers**. 1, 4, 9, 16, 25 is a sequence of numbers, for example – it represents the numbers 1 to 5 squared.

1, 3, 5, 7 ... = **odd numbers**; 2, 4, 6, 8 ... = **even numbers**; 2, 3, 5, 7, 11 ... = **prime numbers**. The highest number in a group is the **maximum** and the lowest is the **minimum**. *The room holds a maximum of 50 and we won't run the class without a minimum of 12 students.*

An **approximate** number is one which is roughly correct but is not the **precise** or **exact number**. *Look at the figures and work out in your head what the approximate answer is likely to be. Then use a calculator to find the exact number.*

An **aggregate** is a number reached by totalling a set of numbers = the **total**. *The average mark achieved in the exam is calculated by taking the aggregate of all the marks and dividing by the number of exam entries.*

A **discrete** number or unit is something which is separate and cannot be divided into smaller numbers or units of the same thing. The opposite of discrete is **continuous**. A bag of apples, for example, could be considered as consisting of discrete items whereas apple sauce could be considered – by mathematicians, at least – as continuous.

A **constant** number or quantity is one that does not change. *In the experiment we varied [changed] the amount of water in the beaker but kept the amount of salt added constant.*

A **random** number is one chosen by chance, i.e. it is not predictable.

### B Working with numbers

The word **figure** is often used to refer to the symbol used for a number. *Write the total number in words and figures.*

Verbs that are frequently used with the word **number** include **calculate** [work out] a number, **estimate**<sup>1</sup> a number, **round a number up/down**<sup>2</sup>, **total** [add up] a set of numbers. Numbers can also **tally**<sup>3</sup>. *My figures don't seem to tally with yours.* You can also **deduct** [take away, subtract] one number from another number.

<sup>1</sup> make a rough guess at    <sup>2</sup> make a fraction, e.g.  $\frac{1}{6}$  or 0.78 into the nearest whole number

<sup>3</sup> match, agree

**Values** and **variables** are also useful terms when working with numbers. **Values** are individual numbers in a set of data. *The graph shows the temperature values for different months of the year.* **Variables** are characteristics that can take on different values for different members of a group or set being studied. *In investigating living standards you must take key variables such as social provision and cost of living into account.*

The **incidence** of something refers to how frequently it occurs. *The incidence of twins in the population is growing.* When talking about numbers, **magnitude** simply refers to the size of something, whereas in other contexts it indicates large size or importance. *Write down the numbers in order of magnitude, beginning with the smallest.*

When **making calculations** in, say, an exam, it is often a good idea to make an **estimate**<sup>4</sup> first of what the answer is likely to be. Then you will see if your final answer is **in the right area**<sup>5</sup> or not. Exam candidates are also often advised to **show their workings**<sup>6</sup> so that the marker can see how they **arrived at their answer** and they may get credit for their method even if the final answer is incorrect.

<sup>4</sup> rough guess    <sup>5</sup> approximately the same    <sup>6</sup> leave all their calculations on the page

25.1

25.2

25.3

25.4

## Exercises

### 25.1 Answer these questions.

- 1 What is five squared?
- 2 What is the next prime number after 19?
- 3 How is this sequence of numbers created? 3, 9, 27, 81
- 4 What is the aggregate of this set of test marks? 6, 8, 9, 5, 6, 7
- 5 If you round up 6.66, what number do you have?
- 6  $\frac{7}{9}$  and 4 – which is a whole number and which is a fraction?
- 7 In your country is tax automatically deducted from employees' earnings?
- 8 Is an accountant pleased or displeased if figures that he/she is checking tally?

### 25.2 Dr Syal is advising one of his dissertation students who is interested in pollution in road tunnels. Complete the conversation. You are sometimes given the first letter to help you.

Dr Syal: You could c..... the total number of private cars that use the tunnel each week, based on the day-to-day figures, and get an a..... figure for how much carbon they're all emitting.

Melissa: How p..... would that figure have to be?

Dr Syal: Oh, it doesn't have to be exact, you just need to e..... more or less what the total pollution will be. Then you can check to see if those figures t..... with the figures that have already been published for similar tunnels. And the figure won't be c..... of course; it'll go up and down depending on lots of factors such as weather conditions, average speed, etc.

Melissa: But can we say if the figures will be true for the future too?

Dr Syal: Well, we do know that the traffic growth has been c..... over the past ten years; it hasn't ever gone down, so I think you can make some useful predictions.

Melissa: Should I present each daily total as a d..... item or can I just put them all together into one figure for each week?

Dr Syal: A weekly total is fine, and you can ..... it up or ..... to the nearest 100.

Melissa: Right, OK. Thanks so much for your help.

### 25.3 Rewrite these spoken sentences so that they are more appropriate for writing, using the word in italics in an appropriate form.

- 1 There were fewer car accidents last year. *incidence*
- 2 We made a rough guess at what the final figure might be. *estimate*
- 3 The graph shows the results from the lowest to the highest. *magnitude*
- 4 A computer program helped us work out the significance of the different variables. *calculate*
- 5 Taking x away from y will help you arrive at the correct answer. *subtract*
- 6 The results from the first experiment were not the same as those we got from the repeat experiment. *tally*

### 25.4 Fill in the gaps in this advice a maths lecturer is giving her students.

In the exam, don't forget to show all your (1) ..... as we want to see how you (2) ..... at your results. Make your (3) ..... very carefully – you'd be amazed at how many people submit answers that are hardly even in the right (4) ..... . And please write legibly – we must be able to distinguish all your (5) ..... ! When doing graphs, plot your (6) ..... carefully and if asked to describe an experiment don't forget to take all significant (7) ..... into account. Good luck!

**FOLLOW UP**

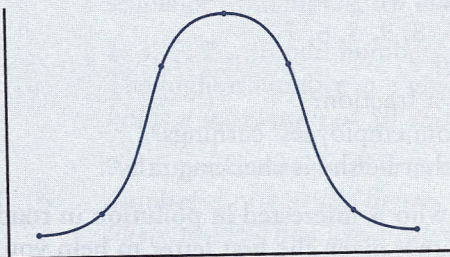
Find some examples of the use of numbers in your own subject area. Note down some interesting phrases or sentences.

# 26

## Statistics

### A Basic statistical terms

Notice the key vocabulary in these three short texts about statistics.



A **normal distribution** of data means that most of the examples in a **set of data** are close to the average, while relatively few examples tend to one extreme or the other. Normally distributed data shown on a chart will typically show a **bell curve**. It will often be necessary to work out the extent to which individuals **deviate**<sup>1</sup> from the **norm**<sup>2</sup> and to calculate the figure that represents **standard deviation**<sup>3</sup>.

Six children are 7, 8, 8, 8, 11 and 12 years old. Their **average** age is 9 years old (the **sum** of their ages divided by six). The **mode** (the most frequent value) is 8. The **median** is 8 (the **halfway point** between the two **extremes** of the **range**).

Statisticians are often concerned with working out **correlations**<sup>4</sup> – the extent to which, say, left-handedness **correlates with** intelligence. They must ensure that any data they collect is **valid**, i.e. that it is measuring what it claims to measure – all the subjects in the **sample**<sup>5</sup> must be appropriately and accurately assessed as left- or right-handed, for example. The figures must also be **reliable**, i.e. they would be **consistent**<sup>6</sup> if the measurements were repeated. Usually, statisticians hope that their calculations will **show/indicate a tendency**, e.g. that left-handed people will be shown to be **significantly**<sup>7</sup> more intelligent than right-handed people.

<sup>1</sup> differ <sup>2</sup> the average <sup>3</sup> average difference from the norm <sup>4</sup> connections, often as cause and effect <sup>5</sup> the subjects of the experiment or group representing the total population measured <sup>6</sup> the same <sup>7</sup> noticeably

### B A probability<sup>1</sup> problem

Notice the vocabulary in this problem from a statistics textbook.

Sue picks a card **at random**<sup>2</sup> from an ordinary pack of 52 cards. If the card is a king, she stops. If not, she continues to pick cards at random, without replacing them, until either a king is picked or six cards have been picked. The random **variable**<sup>3</sup>, C, is the total number of cards picked. Construct a **diagram** to illustrate the possible **outcomes**<sup>4</sup> of the experiment, and use it to calculate the **probability distribution**<sup>5</sup> of C.

<sup>1</sup> likelihood of something happening <sup>2</sup> by chance <sup>3</sup> number or element of a situation that can change <sup>4</sup> results <sup>5</sup> assessment of probabilities for each possible value of C

### C Other useful nouns for talking about statistics

In a class of 8 women and 4 men, what **proportion**<sup>1</sup> are male? Answer: one third

In the same class what is the female to male **ratio**<sup>2</sup>? Answer: 2:1

The figures show a **trend**<sup>3</sup> towards healthier eating habits.

The study investigates the increase in the **volume**<sup>4</sup> of traffic on the roads.

<sup>1</sup> number compared with another number <sup>2</sup> relationship between two numbers showing how much bigger one is <sup>3</sup> change in a particular direction <sup>4</sup> amount, quantity



We say **10 per cent** (NOT the 10 per cent or 10 percentage) of students got an A for their exam but the **percentage** of students achieving an A has increased.

## Exercises

### 26.1 Complete the sentences.

- 1 The six subjects who took the test scored 24, 22, 16, 16, 16, and 14 points out of 30. The ..... was 16. The ..... score was 16 and the ..... score was 18.
- 2 The ..... of all donations to the charity in 2003 was \$3,938. The smallest donation was \$10 and the largest was \$130. Most were around the ..... point of \$60.
- 3 Each questionnaire item asked respondents to choose one of a ..... of six options, with the two ..... being 'very dissatisfied indeed' and 'completely satisfied'.

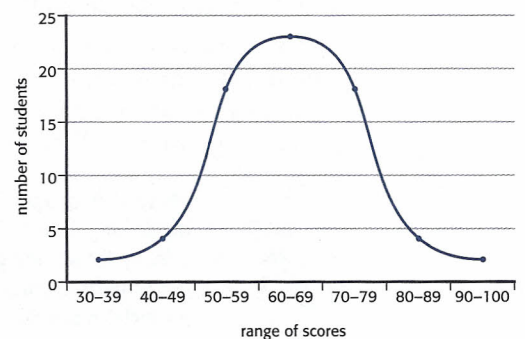
### 26.2 Use the correct form of the words in the box to complete this text.

distribute    trend    significant    probable    random    correlation    outcome    vary

Life insurance companies base their calculations on the laws of ....., that is they assess the likely ....., given the different ..... such as age, sex, lifestyle and medical history of their clients. The premiums are therefore not chosen at ..... but are carefully calculated. The ..... of ages at which death occurs and causes of death are studied to see if they ..... with other factors to be taken into account in setting the premiums. Naturally, the companies also monitor social ..... and react to any changes which might ..... affect mortality rates.

### 26.3 Answer the questions.

- 1 There are 12 male students and 6 female students in the class. What is the **ratio** of males to females? And what **proportion** of the class is male?
- 2 If I am collecting data on course choices among second-year undergraduates and my **sample** is too small, what exactly do I need to do?
- 3 If my data show that students have a **tendency** to choose the type of clothing their friends choose, does it mean that they always, often or rarely choose similar clothes?
- 4 If I repeat the same experiment three times and the results are not **consistent**, is my method **reliable**?
- 5 If 20 out of 200 students fail an exam, what **proportion**, in percentage terms, failed?
- 6 If the **average score** in a test is 56, and Barbara scores 38, by how many points has she **deviated from the norm**?
- 7 If the **volume** of court cases increases, what changes: the type of case, the size of each case or the total number of cases?
- 8 What does **standard deviation** tell us? (a) What the standard of something is, (b) what the norm is, or (c) what the average difference from the norm is?
- 9 If a general survey of teenage eating habits asks questions about what teenagers eat for breakfast and lunch, is the survey likely to be **valid**?
- 10 Here is a graph showing how many students got scores within each 10-mark band in a biology test. Are the scores **normally distributed**? What is the shape of the graph called?



**FOLLOW UP**

What kinds of statistical data are likely to be discussed in your discipline? Find a relevant chart, graph or table and write about it using some terms from this unit.

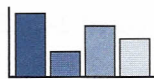
# 27

## Graphs and diagrams

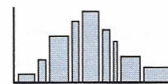
### A Types of diagrams



pie chart



bar chart



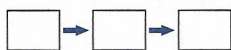
histogram

Number	Amount
1	10
2	5
3	20

table



cross-section



flowchart

Diagrams are visual ways of **presenting data** concisely. They are often also called **figures**. In an academic article they are usually **labelled** Fig. (Figure) 1, Fig. 2, etc.

A **pie chart** is a circle divided into **segments** from the middle (like slices of a cake) to show how the total is divided up. A **key** or **legend** shows what each segment **represents**.

A **bar chart** is a diagram in which different amounts are represented by thin vertical or horizontal bars which have the same width but **vary** in height or length. A **histogram** is a kind of bar chart but the bar width also varies to indicate different values.

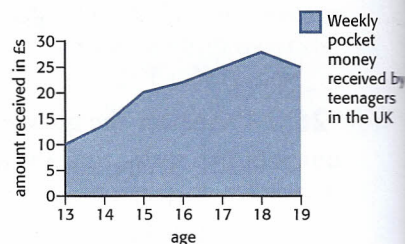
A **table** is a grid with **columns** and **rows** of numbers.

A **cross-section** is something, or a model of something, cut across the middle so that you can see the inside. A cross-section of the earth's crust, for example, shows the different **layers** that make it up. A **label** gives the name of each part of the cross-section. Cross-section can also be used to mean a small group that is representative of all the different types within the total group (e.g. *the survey looked at a cross-section of society*).

A **flowchart** is a diagram which indicates the **stages** of a process.

### B A graph

The **graph** presents data relating to teenagers and pocket money. A **random sample** of 1,000 teenagers were **surveyed** and the average pocket money received at each age has been **plotted** on the graph. The **x axis** or **horizontal axis** indicates age and the **y axis** or **vertical axis** shows the amount of money received per week. The **graph** shows that 15-year-olds receive twice as much pocket money as 13-year-olds. **From the graph we can see** that the amount received **reaches a peak** at the age of 18 and then starts to **decline**. This **decline** can perhaps be **explained** by the fact that many teenagers start earning and stop receiving pocket money at the age of 18.



Graphs are drawn by **plotting** points on them and then drawing a line to join **adjacent** points. If there are two lines on a graph – separate lines, for example, to indicate boys' and girls' pocket money – then the lines would probably **cross** or **intersect** at various points. Lines that **run parallel** to one another never intersect.

Graphs show how numbers **increase** or **decrease**. The nouns **increase** and **decrease** have the stress on the first syllable, but the verbs have the stress on the second syllable. Numbers can also be said to **rise** or **grow** and **fall**, **drop** or **decline**. The nouns **rise**, **growth**, **fall**, **drop** and **decline**, like **increase** and **decrease** are followed by **in** (to explain what is rising) or **of** (to explain the size of the change), e.g. *a rise of 10% in the number of cars*. Other verbs used about growth include **double**<sup>1</sup>, **soar**<sup>2</sup>, **multiply**<sup>3</sup>, **appreciate**<sup>4</sup> and **exceed**<sup>5</sup>.

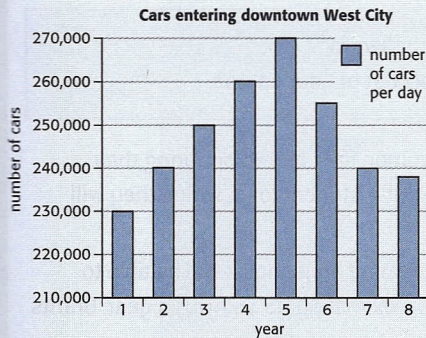
<sup>1</sup> grow to twice the size; opposite = **halve** <sup>2</sup> (dramatic word) rapid movement upwards; opposite = **plummet** <sup>3</sup> grow rapidly to a very large number <sup>4</sup> used about the value of something, e.g. a painting or car; opposite = **depreciate** <sup>5</sup> go over, expresses a number in relation to another number; opposite = **fall below**



Note that **graph** is a noun and **graphic** [relating to drawing: vivid, especially when describing something unpleasant] is usually an adjective. *The economics textbook contains a lot of fascinating **graphs**. My nephew studied **graphic** design. The book contains some very **graphic** descriptions of the massacre. **Graphics** can be used as a plural noun to refer to pictorial material, e.g. *The **graphics** in that computer game are brilliant.**

## Exercises

27.1 Look at the chart. Complete the commentary with words from the opposite page.



The chart ..... the number of cars entering the downtown area of West City each day over an eight-year period (years 1–8). The totals are listed on the ..... axis (*give two answers*), while the years are listed on the ..... axis (*give two answers*). To the right of the graph we see the ..... The number of cars ..... over the period. The total rose in the first few years and ..... a ..... in year 5, after which the numbers started to ..... This can be ..... by the ..... that a new mass transit railway was opened in year 6, which is a ..... illustration of how good public transport can dramatically affect car use.

27.2 Answer the questions.

- 1 Draw examples of a pie chart and a bar chart.
- 2 What would be the best type of diagram to present the different layers of rock in the Grand Canyon?
- 3 In a table, what is the difference between columns and rows?
- 4 What would be the best type of diagram to present the different stages in a research project you did?
- 5 How many segments are there in the pie chart opposite?
- 6 If you look at two adjacent columns in a table, are they next to each other or separated?
- 7 What is another name for a legend in a diagram?
- 8 What type of data collection are you doing if you survey the first 50 people you come across?
- 9 What do two lines on a graph do if (a) they intersect and (b) they run parallel to each other?

27.3 Make the rather informal words in bold sound more precise and academic.

- 1 The different **bits** of the pie chart show the numbers of people in each age group.
- 2 She kept a record by **marking** the midday temperature on a graph for a month.
- 3 People's salaries usually reach their **highest point** when they are in their late 40s.
- 3 This flowchart shows the different **bits** of our project over the next five years.
- 5 The two lines on the graph **cross each other** at point A.
- 6 Draw a line connecting the points that are **next** to each other.
- 7 The government's popularity in the opinion polls is beginning to **fall**.
- 8 If you look along the top line of the table you can see the figures for the 1950s.

27.4 Change the sentences using words with the same meanings as the words in bold.

- 1 Populations of some bird species in South Asia have **crashed** by 97% in recent years. The **number of cases** of death by poisoning has **increased sharply**.
- 2 In 2007 the child mortality rate was **lower than** 60 deaths per 1,000.
- 3 The average family car in the UK **goes down in value** by 20% per year. This means its value has **fallen by more than half** after just three years.
- 4 A typical piece of land on the edge of the city will **go up in value** by 15% per year, and house prices have **gone up rapidly** in the last six months.
- 5 Business courses have **increased greatly in number** while science programmes have **gone down**.
- 6 The temperature **was higher than** 45°C in some parts of the country during the heatwave.
- 7 Between 1983 and 2006, the number of this species of condor\* **went up** from 22 pairs to 273. Other bird populations have **gone up by two times** in the same period.
- 8 The numbers of old soldiers attending regimental reunions are **becoming smaller** each year.

\* large birds from South America