1 What is special about academic English?

A Everyday words and academic uses

Many words in academic English are the same as everyday vocabulary, but they are often also used with a slightly different meaning, which may be specialised.

everyday or academic use	*meaning*	*academic use*	*meaning*
Standards of **discipline** in schools have declined.	ability to control oneself or other people	Nanotechnology is a relatively new **discipline.**	area of study
Underline your family name on the form.	draw a line under it	The research **underlines** the importance of international trade agreements.	gives emphasis to
The lake was frozen **solid.**	not liquid or gas	We have no **solid** evidence that radiation has caused the problem.	certain or safe; of a good standard

B Vocabulary and academic style

- In writing, academics use many expressions which are neutral, but they also use rather formal expressions which are not common in everyday language. Knowing whether an expression is formal or just neutral is important.

neutral	*more formal*	*neutral*	*more formal*
in short, briefly, basically	in sum, to sum up	try	attempt
only	sole(ly)	mainly/mostly	primarily
almost / more or less	virtually	typical of	characteristic of

  However, very informal vocabulary may be used in *spoken* academic styles in classes and lectures. Learn to understand such language when you hear it but be careful not to use it in essays and written assignments. Here are some examples of teachers using informal language.
  'OK. Have a shot at doing task number 3.' [more formal: Try/Attempt to do ...]
  'There's no way schools can be held responsible for failures of government policy.' [more formal: Schools cannot in any way be held ...]
- Academic language tries to be clear and precise, so it is important to keep a vocabulary notebook (see page 8) and learn the differences between similar words, as well as typical word combinations (underlined here).
  The building is a prime example of 1920s architecture. [excellent in quality or value]
  The group's primary concern is to protect human rights. [main / most important]

C Noun phrases

Academic language puts a lot of information into noun phrases rather than spreading it out over a whole sentence. For example, instead of saying *Radiation was accidentally released over a 24-hour period, damaging a wide area for a long time,* an academic might say *The accidental release of radiation over a 24-hour period caused widespread long-term damage.* It is therefore important to learn the different forms of a word, for example:

noun	*verb*	*adjective(s)*	*adverb(s)*
accident		accidental	accidentally
quantity/quantification	quantify	quantitative/quantifiable	quantitatively/quantifiably

Finally, be aware of 'chunks' or phrases which occur frequently, and learn them as whole units. Examples: *in terms of, in addition, for the most part, in the case of,* etc. (See Unit 16.)

Exercises

1.1 Each word in the box can be used in two ways, one an everyday way, the other a typically academic way. Complete each pair of sentences using the same word for both sentences and making any necessary grammatical changes.

generate	turn	solid	confirm	identify	underline	character	pose	nature	focus

1 A She loves to _____ for photographs in front of her fabulous house.
  B The events _____ a threat to stability in the region.
2 A It was difficult to _____ the camera on the flower as it was so small.
  B We should _____ our attention on the most important issues.
3 A I called the airline and _____ my reservation.
  B The data _____ my hypothesis that animal-lovers enjoy better health.
4 A The power plant _____ electricity for the whole region.
  B This issue always _____ a great deal of debate among academics.
5 A The murderer was _____ from fingerprints discovered at the scene.
  B In this theory of history, progress is closely _____ with technology.
6 A She became interested in _____ conservation.
  B The first lecture in the series was on the _____ of human communication.
7 A Jim's a very interesting _____ . I hope you meet him.
  B The book attempts to explain the fundamental _____ of social life.
8 A I saw her _____ to her husband and whisper something in his ear.
  B Let us now _____ to the subject of town planning.
9 A He always _____ every new word when he's reading.
  B The study _____ the fact that very little research exists.
10 A The liquid became _____ as the temperature was lowered.
  B The study lacks _____ evidence and therefore its conclusions are doubtful.

1.2 Use more formal alternatives to the words in bold. Make any necessary grammatical changes.

1 The book is **mainly** concerned with the problem of policing the internet.
2 **Almost** every school in the county had reported problems with the new system.
3 The work of the Institute is **not only** devoted to cancer research.
4 **Basically,** we believe we have demonstrated a significant link between the two events.
5 We **tried** to find a new way of understanding the data.
6 The study is a **really good** example of the way sociologists collect their data.
7 The reaction is **typical** of the way large corporations keep control of their markets.
8 **There's no way** London can be compared to Sydney as a place to live and work.

1.3 Read the text and then answer the questions.

> The production of plastics depends heavily on petroleum, but a novel way of making plastics out of sugar could reduce our reliance on oil. The discovery that a chemical in sugar can be converted relatively easily into a substance similar in structure to the material obtained from petroleum has led to the claim that plastics could soon be produced cheaply using the new method.

1 Underline two verbs with adverbs after them which it would be useful to learn as pairs.
2 Underline two adverbs next to each other which it would be useful to learn together.
3 What are the noun forms of the verbs *produce, rely, discover* and *claim*?

6 Phrasal verbs in academic English

Although phrasal verbs occur most frequently in more informal spoken and written English, they are also not uncommon in an academic context. You will hear them used in lectures and will read them in serious journals. From this unit only **go/look back over** and **work out** are not appropriate for a formal written assignment.

A Phrasal verbs and one-word synonyms

Phrasal verbs often have one-word synonyms. These are usually of Latin origin and sound more formal than their phrasal verb equivalent but both are appropriate when writing or talking about academic subjects. Vary your language by using both.

phrasal verb	*synonym*	*example*
put forward (an idea/view/opinion/ theory/plan)	present	In her latest article Kaufmann **puts forward** a theory which is likely to prove controversial.
carry out (an experiment / research)	conduct	I intend to **carry out** a series of experiments.
make up	constitute	Children under the age of 15 **make up** nearly half of the country's population.
be made up of	consist of	Parliament is **made up of** two houses.
point out	observe	Grenne **points out** that the increase in life expectancy has led to some economic problems.
point up	highlight	The study **points up** the weaknesses in the current school system.
set out (to do something)	aim	In his article Losanov **sets out** to prove that ...
set out	describe	The document **sets out** the terms of the treaty.
go into	discuss	In this book Sergeant **goes into** the causes of the Civil War in some depth.
go/look back over	revise, review *	Please **go/look back over** this term's notes.
go through	check	**Go through** your calculations carefully.

* *Revise* is the BrE synonym and *review* the AmE synonym. (*Revise* in AmE only means to edit or change something to make it better; *review* is not used in BrE in the context of preparing for a test as focused on here.)

B Carrying out research

After completing her first degree in zoology Meena **went on to**[1] apply to graduate school. She wanted to **work on**[2] animal behaviour at a well-known institute in New Zealand. She **set up**[3] a series of experiments investigating how bees communicate. She has noticed some curious behaviour patterns but has not yet **worked out**[4] why her bees behave as they do. What she has observed seems to **go against**[5] current theories of bee behaviour. When she has completed all her research she will have to **write** it all **up**[6].

[1] do something after doing something else [2] study, work in the field of [3] prepared, arranged [4] come to a conclusion about [5] not be in agreement with [6] (of an important document) write in a final form

TIP Consult a good dictionary when you use phrasal verbs in your writing. For example, a good dictionary tells you when the object can be used before the particle (e.g. *write your results up*) and when it cannot (e.g. *this goes against current theories*).

Exercises

6.1 Rewrite the sentences replacing the underlined word in each sentence with a phrasal verb from A. Note that both versions of each sentence are equally appropriate.

1 We conducted a series of experiments to test out our hypothesis.
2 Before the test you should revise Chapters 7 and 8 of your textbooks.
3 In his article on the American Civil War Kingston discusses the reasons why the situation developed in the way it did.
4 Cole presents some fascinating theories on the development of language in his latest book.
5 The psychologist observed that it was very unusual for a young child to behave in this way.
6 Please check your work again carefully before handing it in.
7 In this article Simpson aims to prove that the Chinese reached America long before the Vikings.
8 Women now constitute over half the student population in most universities in this country.

6.2 Fill in the missing words in this paragraph.

As part of my MA I've been doing some research on language acquisition. I've been working (1) _____ how young children learn their mother tongue. I've been carrying (2) _____ some experiments to see how much reading to young children affects their language development. I've had a great supervisor who has helped me set (3) _____ my experiments and she's also pointed (4) _____ lots of interesting things in my data that I hadn't noticed myself. I'm busy writing my work (5) _____ now and I think I should be able to put (6) _____ some useful ideas. It's been really fascinating and I hope I may be able to go (7) _____ to do a doctorate in the same field although I certainly never set (8) _____ to do a PhD.

6.3 Match the beginning of each sentence with the most appropriate ending.

1 Feudal society was made	forward a convincing theory with regard to this question.
2 Carlson was the first to put	up the flaws in the school's testing methods.
3 Her results appear to go	out the solution to the algebra problem.
4 The investigation pointed	out a lot of basic information about all the world's
5 It took him a long time to work	countries.
6 The geography book sets	against what she had found in her earlier studies.
	up of clearly defined classes of people.

6.4 Answer these questions.

1 What sort of things might a scientist carry out?
2 If you want to study something in more depth, what might you go on to do after getting a first degree?
3 What do postgraduate students typically have to write up at the end of their studies?
4 What sort of things do good students regularly look back over?
5 What sorts of things do scholars typically put forward in their lectures or articles?
6 Why is it sensible to go through any maths calculations that you had to make as part of a research study before you draw any conclusions?

23 Sources

A Referring to source materials

Look at these extracts where the writers are talking about their sources. Although these writers occasionally use 'I', many academic departments advise against doing this in writing if possible.

This paper begins with **a review of the literature on**[1] patient communication. **The medical literature suggests** that patients with serious illnesses tend to communicate poorly, especially if the disease is not considered by the patient to be particularly threatening.

[1] a summary and evaluation of all the important works written on a particular subject

This essay **draws its data** from the most important **primary source**[2] of information on manufacturing in Nigeria: the Central Bank of Nigeria. I shall **make reference**[3] to this source throughout this essay. Several recent **secondary sources**[4] were also **consulted**.

[2] an original document or set of documents giving information about a subject [3] slightly more formal alternative to *refer to* [4] books or articles about a subject, not original documents

For this project, I consulted the county **archives**[5] in an attempt to explain why there were so many deaths in 1846 and 1847. These proved a **valuable resource**. I also **surveyed the literature on**[6] agricultural production during the 1840s. However, I only directly **cite**[7] those works which are particularly relevant in **the present study**.

[5] a collection of documents of historical importance [6] searched for all the important works, summarised and evaluated them [7] refer to for illustration or proof

An **extensive body of literature**[8] **exists** on the effects of wildfires[9]. Wildfires have burned across the western United States for centuries, but their effects are not fully known or **documented**[10]. The present study **draws primarily on**[11] the work of Gordon (1996).

[8] also 'body of knowledge'; note how it combines with *extensive* and *exist* [9] fires starting naturally, not caused by human action [10] written about [11] uses information mainly from

As noted[12] in a recent report, Australia has been at the forefront of developments in e-learning. This success **is often attributed to**[13] Australia's geographical position, but the factors **catalogued**[14] in the report reveal a more complex picture.

[12] given special mention [13] people often say that this is the cause [14] recorded, listed

B More ways of referring to sources

Beeching's **seminal**[1] work **laid the foundations**[2] for the field of functional analysis.
Keynes's ideas **were set out**[3] in his book, *The General Theory of Employment, Interest and Money*, published in 1936. This work changed the way we look at how economies function.
Elsewhere[4], Keynes claimed to be developing classical economic theory.
Design of compact heat exchangers **is dealt with** in Appendix A of the report, treated[5] separately from the **main body**[6] of the report.

[1] important and original work from which other works grow [2] created the first ideas from which a major set of ideas grew [3] gave all the details of his ideas, or explained them clearly (especially used about writing) [4] in another work by him [5] more formal version of *deal with* [6] the main part

Exercises

23.1 Match the beginning of each sentence with the most appropriate ending.

1 The letters proved to be a valuable	study, which focuses on metals only.
2 An extensive body of literature	body of the book; they are in the appendix.
3 Newspapers are a good primary	the literature on intellectual property rights.
4 The data are not given in the main	exists on human to animal communication.
5 Plastics are not dealt with in the present	source for the period 1980–1985.
6 The thesis begins with a review of	resource for the study of the poet's life.

23.2 Rewrite the sentences using the word in brackets.

1 The article refers to the work of Hindler and Swartz (1988). (MAKES)
2 Schunker's book was a useful critique for understanding the pre-war period. I also consulted original government papers. (SECONDARY)
3 Tanaka's book uses data from several Japanese articles on galaxy formation. (DRAWS)
4 In a different paper, Kallen reports on his research into cancer rates among farm workers. (ELSEWHERE)
5 Han consulted the documents of historical importance in the Vienna Museum. (ARCHIVES)

23.3 Complete the table. Use a dictionary if necessary. Do not fill in the shaded boxes.

noun	*verb*	*adjective*	*adverb*
	attribute		
document			
	consult		
		primary	
catalogue			
foundation			
note			
	suggest		
		extensive	
	cite		

23.4 Look at this advice about plagiarism [pronounced /'pleɪdʒ³rɪz³m/, the serious offence of using other people's work while pretending it is your own, without clearly acknowledging the source of that information] given to students by an American university. Underline words and phrases which mean:

1 Expressing the same message in different words
2 Things known by everyone
3 Stating that one has obtained one's information from that source
4 Direct repetition of what someone has written or said
5 Stating that you have benefited from someone's work

How can students avoid plagiarism?

To avoid plagiarism, you must give credit by acknowledging your source whenever you use:

- another person's idea, opinion, or theory;
- any facts, statistics, graphs, drawings – any pieces of information – that are not common knowledge;
- quotations of another person's actual spoken or written words; or
- a paraphrase of another person's spoken or written words.

24 Facts, evidence and data

Being able to use the vocabulary in this unit well will help you avoid repetition in your writing.

A Countable or uncountable nouns

Fact is a countable noun and evidence is uncountable – you can refer to one piece of evidence or to the body of evidence [large amount of evidence].
Some people consider data as a plural noun – *these data show an unexpected trend* – while others consider it as uncountable – *this data differs from last year's. This is a particularly interesting piece/item of data*. The tendency is increasingly to use data as an uncountable noun but you will see both forms and may use it whichever way you prefer yourself.

B Words often used with facts, evidence and data

Researchers try to establish the facts. They hope that the facts will bear out[1] or support their hypothesis. Most carefully check their facts before presenting them to others although there are, of course, dishonest people prepared to distort[2] the facts in order to claim that their facts are interesting, relevant[3], undeniable or little-known.

[1] confirm [2] change [3] connected to the topic being discussed

Notice how *fact* is also often used in sentences like the following:
It is hard to account for the fact that[4] share prices rose over this period.
The problem stems from the fact that[5] there is a basic conflict of interests.
The lecturer drew attention to the fact that[6] the economy was starting to improve.

[4] explain why [5] has arisen because [6] emphasised that

Researchers may look for, collect, examine and consider evidence. The evidence they collect may point to or suggest a conclusion. If the evidence is growing or widespread it may serve to support a theory. In writing up their research they aim to provide or offer sufficient evidence to support their theories. They are happy if the evidence they find is convincing or powerful and are less happy if the evidence is flimsy[7] or conflicting[8]. They are pleased if new evidence comes to light[9] or emerges and if they find abundant[10] evidence. They may talk about finding hard evidence[11].

[7] not strong [8] contradictory [9] becomes known, see Unit 9 [10] plenty of [11] evidence which is reliable and can be proven, used mainly in spoken in English

	reliable[12].		obtain		suggests	
	comprehensive[13].		organise		reflects	
The data is	accurate.	You	analyse	data. Data	indicates	something.
	empirical[14].		interpret		shows	
			record		demonstrates	

[12] can be trusted [13] full, complete [14] based on observation rather than theory

C Giving examples

You often need to give or provide an example to illustrate the facts you're presenting. A good example can be described as striking, clear, vivid, illuminating or telling. Sometimes, particularly in written English, the word instance is used as an alternative to example. *There is a striking instance of the author's use of metaphor in the final poem. We shall now analyse one specific instance of this problem.* Say can be used in informal English instead of *for example. Try and finish writing the report by, say, next Friday.*

TIP There are many verbs in English which can be spelt either *-ise/-yse* or *-ize/-yze* depending on whether the writer is using British English or American English spelling. See Reference 4.

Exercises

24.1 **Fill the gaps in this extract from a university seminar on forest conservation. Some students are questioning aspects of a presentation given by Sandra, one of the group. The first letter of each missing word is given to help you.**

Aidan: I enjoyed your presentation, and you've e_____ some interesting facts about the loss of forests year on year, and it's u_____ that tropical forests are in danger. But I think the evidence you o_____ for your claim that sustainable forest exploitation is failing is very f_____ and not very c_____ at all. We need to c_____ a lot more data. Right now there's a lot of c_____ evidence, so we can't say for certain that it's not working.

Sandra: If you want h_____ evidence, just look at the International Tropical Timber Organisation, and read their latest report. Their evidence d_____ that only three per cent of tropical forests are being managed properly.

Petra: Well, I've read the ITTO report, and actually it d_____ attention to the fact that their previous report had found only *one* per cent of forests were properly managed, so you may be d_____ the facts a little by just looking at one year. And also, there's a lot of l_____-k_____ work being done with local people to encourage them to conserve the forests, so you could say there's g_____ evidence that things are getting *better*.

Dr Li: Hmm, I don't think we're going to agree on this. I think, as usual, it's a question of how you i_____ the data. Thanks, anyway, for your presentation, Sandra.

24.2 **The sentences below are correct. Vary them by substituting the words in bold for words or expressions with similar meanings.**

1 The data **show** that the drug education project has been successful.
2 The data in the latest study are more **complete** than in the earlier one.
3 This is the most interesting **piece** of data in the whole thesis.
4 What a **clear** example this is of the power of the human mind!
5 Unfortunately, the facts do not **bear out** the hypothesis.
6 We cannot **explain** the fact that attitudes are more negative now than five years ago.
7 The problem **arises** from the fact that the software was poorly designed.
8 The article **gives** examples of different methods which have been used over the years.
9 New evidence has **emerged** that the cabinet was not informed of the Minister's decision.
10 We need to **examine** the evidence before we can reach a conclusion.
11 The evidence suggesting that sanctions do not work is **plentiful** and very strong.
12 A considerable **amount** of evidence now exists, but we always try to get more.
13 We have a lot of **observed** data which suggest the problem is on the increase.
14 This is a clear example of how conservation can benefit local people.

24.3 **One word in each sentence does not fit the sentence. Which is it?**

1 Thorsen's aim was to *establish / check / bear out / present* the facts.
2 The evidence *suggests / points to / supports / emerges* a different conclusion.
3 Lopez *collected / reflected / obtained / recorded* some fascinating data.
4 The writer provides some *growing / telling / striking / illuminating* examples.
5 The evidence Mistry presents is *convincing / flimsy / vivid / conflicting*.

FOLLOW UP Look at any text from your discipline and see what words are used with *facts, data* and *evidence*. Are they the same as the ones in this unit? Note any different ones.

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**[1] **a number**, **round a number up/down**[2], **total** [add up] a set of numbers. Numbers can also **tally**[3]. *My figures don't seem to tally with yours.* You can also **deduct** [take away, **subtract**] one number from another number.

[1] make a rough guess at [2] make a **fraction**, e.g. $\frac{1}{6}$ or 0.78 into the nearest **whole number**
[3] 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**[4] first of what the answer is likely to be. Then you will see if your final answer is **in the right area**[5] or not. Exam candidates are also often advised to **show their workings**[6] 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.

[4] rough guess [5] approximately the same [6] leave all their calculations on the page

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.

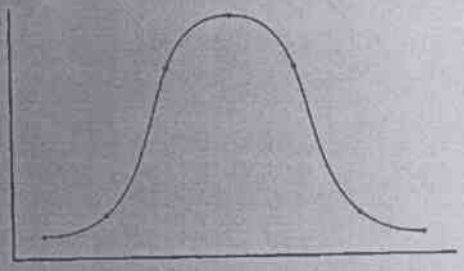
In the exam, don't forget to show all your (1) _____ as we want to see how you (2) _____ at your results. Make your (3) _____ very carefully – you'd be amazed at how many people submit answers that are hardly even in the right (4) _____. And please write legibly – we must be able to distinguish all your (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**[1] **from the norm**[2] and to calculate the figure that represents **standard deviation**[3].

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 9.5 (the **halfway point** between the two **extremes** of the **range**).

Statisticians are often concerned with working out **correlations**[4] – 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**[5] 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**[6] 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**[7] more intelligent than right-handed people.

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

B A probability[1] problem

Notice the vocabulary in this problem from a statistics textbook.

> Sue picks a card **at random**[2] 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**[3], C, is the total number of cards picked. Construct a **diagram** to illustrate the possible **outcomes**[4] of the experiment, and use it to calculate the **probability distribution**[5] of C.

[1] likelihood of something happening [2] by chance [3] number or element of a situation that can change [4] results [5] 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**[1] are male? Answer: one third
In the same class what is the female to male **ratio**[2]? Answer: 2:1
The figures show a **trend**[3] towards healthier eating habits.
The study investigates the increase in the **volume**[4] of traffic on the roads.

[1] number compared with another number [2] relationship between two numbers showing how much bigger one is [3] change in a particular direction [4] 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 19 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'.

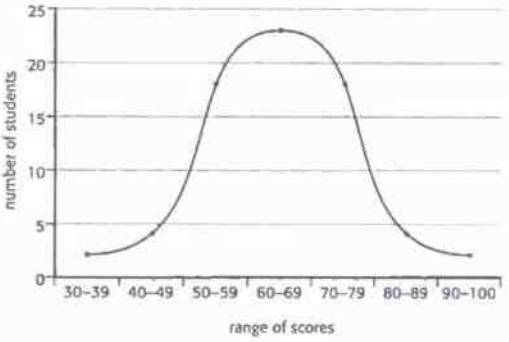
26.2 Use the correct form of the words in the box to complete this text.

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

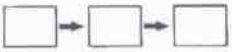

bar chart


histogram

Number	Amount
1	10
2	5
3	20

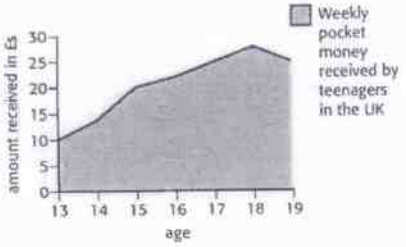
table


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.

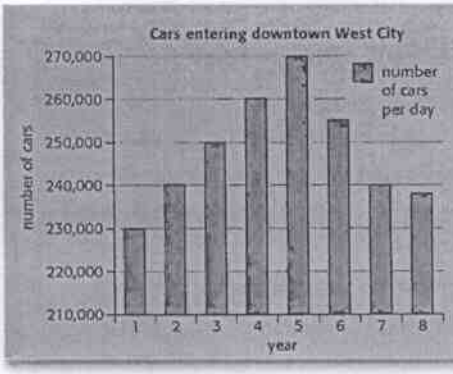
Graphs show how numbers increase or decrease. The nouns **increase** and **decrease** have the stress on the first syllable, but the verbs have the stress on the second syllable. Numbers can also be said to **rise** or **grow** and **fall**, **drop** or **decline**. The nouns **rise**, **growth**, **fall**, **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**[1], **soar**[2], **multiply**[3], **appreciate**[4] and **exceed**[5].

[1] grow to twice the size; opposite = **halve** [2] (dramatic word) rapid movement upwards; opposite = **plummet** [3] grow rapidly to a very large number [4] used about the value of something, e.g. a painting or car; opposite = **depreciate** [5] 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