

DATA COLLECTION

Text

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Data Collection

1



Questionnaires and Surveys

Note

When designing a questionnaire to use as part of a survey, bear in mind the following guidelines.

- The questionnaire should try to find out the information you need.
- You should know how you are going to collect your responses.
- Questions should be clear and concise with no ambiguity.
- Do not ask for information you do not need.
- Allow for all possible responses.
- Questionnaires should be fair and not biased in any way.
- The people asked to complete the questionnaire should be from a variety of backgrounds.

It should also be noted that if you need to design a questionnaire for any project work, it is strongly recommended that you first try it out with a small number of people. This is called a *pilot* survey.

Questions can be designed in two distinct ways, namely those that require a specified response to be chosen from a number of options or by giving a number, and those that allow more detailed responses. The first group are often referred to as *closed* questions; the second as *open* questions. Here are some examples.

Closed

"Did you watch the football match on TV last night?"

YES / NO

"How many hours of TV did you watch last night?"

Choose from '0 – 1, 1 – 2, 3 – 4, 4 – 5, more than 5'

The second example of a closed question shows an example with multiple responses – by which we mean more than 2. So 'YES / NO' is not regarded as a multiple response.

There is though a problem with these responses as there is potential overlap. i.e. in which category do you place 1 hour or 2 hours, etc.? It should be made clear, i.e. 0 – 1 includes everything up to and including 1, etc.

Open

"What sort of TV programmes do you like to watch, and why?"

"Where did you go for your holiday last year?"

The second example is good for a *face to face* discussion, as it allows a wide range of answers. The questioner will then be able to react to these answers, and continue the discussion. This example is bad for a *questionnaire* for the same reason! Any answer is possible but the writer of the questionnaire does not have the chance to follow up answers. It could though be modified and become a closed question with multiple responses: for example,

"Please tick a box to show which of these countries you would most like to visit."

Canada USA France UK

Greece Other (please name country) _____



Worked Example 1

Consider this questionnaire:

Are you concerned about the environment?

Are you concerned about the level of pollution caused by vehicles?

Do you think the health of young children is at risk due to exhaust fumes from vehicles?

Is there too much traffic congestion in towns?

Is public transport under-used?

Do you think vehicles should be banned from main shopping streets?

Comment on the questions given here.



Solution

This questionnaire is very biased and has been designed to lead people towards answering 'yes' to the last question. There are no questions about the advantages of cars, the problems of using public transport or other ways of reducing pollution.



Worked Example 2

What is wrong with the following survey, used to find the favourite sports of the students in one school?

Which is your favourite sport?

Tennis

Rugby

Netball

Basketball

Swimming

Snooker

Other



Solution

The question used in this survey does not cover all the possible responses well. Many students might have, for example, football as their favourite sport and so would tick the box marked 'Other'. This would give unhelpful results. Also, students are asked to make only one choice although they may well like more than one sport.

The following wording would produce more useful responses.

"Please tick one box in each row to show your preference."

	<i>I really enjoy this sport</i>	<i>I like this sport</i>	<i>I've no great preference</i>	<i>I dislike this sport</i>	<i>I hate this sport</i>
<i>Tennis</i>					
<i>Rugby</i>					
<i>Netball</i>					
<i>Basketball</i>					
<i>Swimming</i>					
<i>Snooker</i>					
<i>Please put any other sport that you like here</i>					



Exercises

- Consider the following two sets of questions.

<i>Is meat a good source of protein?</i>	<i>Is all meat obtained from dead animals?</i>
<i>Is protein an important part of your diet?</i>	<i>Do you like killing animals?</i>
<i>Do you like eating meat?</i>	<i>Do you like eating meat?</i>

- Comment on the way that the last question might be answered in each case.
- Write a better set of questions to find out if people like eating meat.

2. Design a questionnaire that would encourage students at a school to say:
- that school uniform is a good policy,
 - that school uniform should be abandoned.

3. Wendy asks her class the following question.

<i>Which of these foods would be your choice for breakfast?</i>		
Cereal	Bacon and Egg	Porridge

She then says that her class's favourite breakfast food is Bacon and Egg.

- Is her conclusion valid?
 - Criticise her question.
 - Write a better question for Wendy to use.
4. Design a questionnaire which you could use to find out:
- if people think they have a good public transport service,
 - whether the music tastes of girls and boys are different,
 - whether younger people are more likely than older people to enjoy burgers.
 - who might win the next election.

Use your questionnaire to collect some data and present your results.

5. You have been asked to estimate the percentage of each type of vehicle (car, truck, motorbike, bicycle) on the road.
- Describe how you would collect the data for a survey to answer this problem.
 - Describe any problems that might arise as you collect data.

6. Kelly did a survey to find out which colours of cars are popular.

She found that red was the most popular colour. She did not find any cars that were purple or pink.

Think about a survey which *you* could do. It must not be about the colour of cars.

- What is your survey about?
 - Write down two things which you might expect to find out.
7. In a survey of community life on a new housing development the following question is suggested.
- (A) "What do you most like about living here?"
- An alternative is proposed.

(B) "Tick the box which describes why you most like living here."

- Design of houses
- Friendliness of neighbours
- More open space

Give one advantage of each form of question.

8. A survey is done to find out which sports students would like to take part in. The results of the survey are shown below.

	% Boys	% Girls
Athletics	57.1	53.3
Basketball	12.7	4.5
Cricket	71.7	2.5
Cycling	53.1	26.0
Dancing	5.0	31.5
Football	72.0	14.5
Gymnastics	4.9	60.5
Netball	3.3	35.0
Softball	7.3	26.0
Swimming	11.8	16.3
Table Tennis	6.5	6.7
Volleyball	16.0	3.5

(a) Which sport is the most popular with **both** boys **and** girls?

(b) The question asked in the survey was:

Which sports would you like to take part in?

You want to find out more about students' interest in sport.

Write down another question that you could ask.

9. Lance thinks that students who walk to school are more likely to be late than those who do not walk to school.

In order to test whether or not this is true, he carries out a survey of 100 students from Year 7 for 5 consecutive Tuesdays.

The results are shown in the following table.

<i>Method of Travel</i>	<i>Number of Students</i>	<i>Number Late</i>
Walk	150	40
Car	50	10
Cycle	100	22
Bus	200	25
TOTAL	500	97

- (a) Do the results show that Lance is correct?
Show the working on which you base your answer.
- (b) Suggest 3 ways in which Lance could have improved his survey.
- (c) A student is selected at random from Year 7.

Lance stated:

"The probability that this student travels to school by bus
on Tuesdays is $\frac{2}{5}$."

Would you describe this statement as

correct,
or *about right,*
or *wrong?*

Choose one of the three alternatives and give reasons for your choice.

10. (a) A headline in a newspaper this year stated:

Students skip Breakfast

*Our survey shows that few students
are eating cereals, fruit, or bread
for breakfast.*

In fact they are eating nothing at all!

You are asked to conduct a survey to find out what students eat for breakfast.

Design an observation sheet to collect the data you need.

- (b) The newspaper made the following statement about the eating habits of teenagers.

**Only one in a hundred teenagers eat fruit and
vegetables each day. Over half eat no vegetables
other than chips.**

You are asked to find out whether this statement is true in your area.

Give three questions you could ask teenagers to see if what the article says is true in your area.

2 Sampling

When conducting a survey it is often impossible to ask every individual who might be concerned or involved. For example, for a political opinion poll it is only possible to ask a *sample of the population* how they would vote.

The term *population* can be any group about which information is required. For example, the following could be populations:

- Manchester United supporters,
- DVDs produced in a factory,
- adult voters in England,
- all students in a school.

Conclusions are often reached by looking at a sample taken from a population. There are three main methods for selecting a sample from a population:

Random Sample

The sample is formed by selecting members of the population at random. It is important to make sure that each member of the population is equally likely to be selected. Tables of random numbers can be used to help this process but more mundane methods, such as using numbers from a telephone directory or even choosing a number from a hat of numbers, can be used. Scientific calculators also provide you with random numbers.

Systematic Sample

This type of sample is formed by taking members of the population at regular intervals. For example, by selecting every 5th or every 10th or every 12th member of the population.

Stratified Sample

The population is split into a number of groups. Random samples are then taken from each group so that the ratio of the *sizes* of the sample is the same as the ratio of the *number of members* of the groups in the population. For example, if a population contains 1000 women and 500 men, a stratified sample of total size 75 would contain 50 women and 25 men.



Worked Example 1

There are 12 teachers in a small school. A sample of size 4 is to be selected from this population.

- (a) Create a systematic sample for the population.
- (b) Create a random sample for the population.



Solution

- (a) As there are 12 teachers, a systematic sample could be made by selecting every third teacher from the list. This would create a sample containing:
Mrs Clarke, Mr Gordon, Mr Wright and Mr Lawrence.

- | | |
|-----|-------------|
| 1. | Mrs Powell |
| 2. | Mrs Grant |
| 3. | Mrs Clarke |
| 4. | Mrs Bailey |
| 5. | Mrs Miller |
| 6. | Mr Gordon |
| 7. | Mr Francis |
| 8. | Mr Brown |
| 9. | Mr Wright |
| 10. | Mr Gray |
| 11. | Mr Davis |
| 12. | Mr Lawrence |

80	02	86	03
23	90	18	56
84	34	73	51
31	98	73	75
28	73	32	83
52	70	53	23
47	14	69	68
15	45	05	18
59	79	80	51
75	11	01	10

(b) The list of random numbers shown here has been generated using a spreadsheet. The numbers have been arranged to give two-digit numbers. Numbers greater than 12 are not needed in this case so these numbers can be deleted.

Beginning in the top left-hand corner and working down the columns gives the result shown below.

Select Teacher no. 2

80	02	86	03
23	90	18	56
84	34	73	51
31	98	73	75
28	73	32	83
52	70	53	23
47	14	69	68
15	45	(05)	18
59	79	80	51
75	(11)	(01)	10

Select Teacher no. 5

Select Teacher no. 11 Select Teacher no. 1

The teachers selected by this are:

- No. 2 Mrs Grant
- No. 11 Mr Davis
- No. 5 Mrs Miller
- No. 1 Mrs Powell



Worked Example 2

A head teacher wishes to select a stratified sample of 50 students from Years 10, 11, 12 and 13. The table shows how many students are in each year.

Year	Number of students
10	320
11	300
12	180
13	150



Solution

First find the total number of students in the population.

$$\begin{aligned} \text{Total} &= 320 + 300 + 180 + 150 \\ &= 950 \end{aligned}$$

The fraction of the population in Year 10 is $\frac{320}{950}$.

So the number of students selected from Year 10 is given by:

$$\frac{320}{950} \times 50 = 16.84, \text{ so select 17 students.}$$

The number of students selected from Year 11 is given by:

$$\frac{300}{950} \times 50 = 15.79, \text{ so select 16 students.}$$

The number of students selected from Year 12 is given by:

$$\frac{180}{950} \times 50 = 9.47, \text{ so select 9 students.}$$

The number of students selected from Year 13 is given by:

$$\frac{150}{950} \times 50 = 7.89, \text{ so select 8 students.}$$



Exercises

1. A factory contains 24 identical machines which are labelled:

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X

- (a) Create a systematic sample containing:

- (i) 8 machines, (ii) 6 machines,
(iii) 4 machines.

- (b) Use the random numbers in the table to create random samples containing:

- (i) 5 machines, (ii) 10 machines.

- (c) Describe another way that a random sample could be made.

68	06	42	38	06	15
50	96	24	21	82	53
55	40	32	46	74	76
06	57	35	48	20	92
28	74	44	73	44	25
65	08	56	68	45	74
63	77	87	58	00	09
13	26	76	76	81	60
80	51	89	59	38	10
27	22	87	55	80	52

2. The table shows the number of students in each year of a school. How many students should be selected from each year to create a stratified sample of 80 students?

<i>Year</i>	<i>Number of students</i>
7	150
8	148
9	162
10	154
11	152
12	80
13	62

3. A company wants to form a stratified sample to discuss issues with the staff.

- (a) How many of each type of employee should be included in a sample of size 20?

- (b) If a stratified sample contains 8 manual staff, what would be the size of the complete sample?

	<i>Number employed</i>
Managers	8
Supervisors	20
Administrators	12
Manual Staff	140
Delivery Staff	30

4. In order to form a sample, a number of students are selected from a number of different teaching groups. The size of the samples and the teaching groups are given in the table below.

<i>Group</i>	<i>Number in Group</i>	<i>Number in Sample</i>
A	36	9
B	32	8
C	24	5
D	18	4

- (a) Is this a stratified sample?
 (b) How should it be changed to give a stratified sample?

5. For an experiment in Biology a square metre of ground has been divided into 100 squares as shown.

You are required to create a sample of 10 squares.

- (a) Describe two ways of creating a systematic sample, giving the results from each method.
 (b) Use the following list of random numbers to create a random sample.

	A	B	C	D	E	F	G	H	I	J
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

11	57	42	70	41	12	88	51
32	38	14	65	49	46	18	62
48	20	47	44	56	65	46	36
42	59	61	41	78	42	72	11
50	42	58	78	71	78	12	37
66	08	21	84	94	61	31	30
14	64	51	05	53	93	45	86
93	49	05	27	54	18	64	57
87	61	55	67	23	26	70	75
03	87	19	48	10	69	35	61
42	52	83	74	35	09	13	36
51	43	76	62	91	39	89	75

Create a second random sample, by starting in a different place in the list of random numbers.

How many squares do the two samples have in common?

6. What problems might be encountered if samples are formed in the following ways?
- (a) Selecting people at random from a telephone directory.
 (b) Selecting every third person entering a shopping arcade.
 (c) Selecting people at random at a football match.
 (d) Selecting people leaving a cricket match in red cars.

7. Describe how you might select a sample if you were asked to conduct a survey to find out if:
- the parents of primary school students are happy with their schools,
 - users of mobile phones are happy with the service provided,
 - the local sports ground is properly maintained,
 - the local public transport services are adequate.
8. (a) In a school there are 420 students in the lower school, 310 students in the middle school, and 130 students in the upper school.
- How many students from each part of the school should be included in a stratified random sample of size 100?
 - Explain why a stratified random sample should be taken rather than a simple random sample.
- (b) These 100 students were asked to keep a record of the number of hours of television that they watched in one week.

The results are summarised below.

<i>No. of hours watched</i>	0–	5–	10–	20–	30–	40–	60–	80-100
<i>No. of viewers</i>	7	3	15	35	22	10	6	2

Draw a histogram to illustrate these data.

3 Charts and Tables

This section begins with distance charts.



Worked Example 1

The chart can be used to find the mileage between some Scottish towns and cities.

	Aberdeen					
115		Edinburgh				
152	130		Fort William			
142	44	103		Glasgow		
104	156	66	169		Inverness	
81	42	103	61	115		Perth
226	123	183	84	249	145	
						Stranraer

Find the distances between:

- (a) Fort William and Perth,
- (b) Edinburgh and Stranraer.
- (c) Which two places are furthest apart?



Solution

- (a) To find the distance between Fort William and Perth look in the square where the two highlighted lines meet. So the distance is 103 miles.

	Aberdeen					
		Edinburgh				
115						
152	130					
142	44	103				
104	156	66	169			
81	42	103	61	115		
226	123	183	84	249	145	
						Stranraer

- (b) Using the same approach for Edinburgh and Stranraer gives 123 miles.

	Aberdeen					
		Edinburgh				
115						
152	130					
142	44	103				
104	156	66	169			
81	42	103	61	115		
226	123	183	84	249	145	
						Stranraer

- (c)

	Aberdeen					
		Edinburgh				
115						
152	130					
142	44	103				
104	156	66	169			
81	42	103	61	115		
226	123	183	84	249	145	
						Stranraer

The largest number in the table is 249.
Using the highlight, this is the Stranraer.
So these two places are furthest apart (249 miles).



Exercises

1. The table gives the distances, in kilometres, between some UK towns and cities.

	Birmingham						
177		Bradford					
32	193		Coventry				
67	117	66		Derby			
146	55	149	80		Doncaster		
172	16	186	111	419		Leeds	
129	57	160	93	442	67		Manchester
119	59	126	57	376	54	63	Sheffield

- (a) Find the distances between:
- Birmingham and Leeds
 - Manchester and Bradford
 - Sheffield and Coventry.
- (b) Nicole travels from Birmingham to Leeds and then to Manchester.
- How far does she travel?
 - By how many km would the distance she travels be reduced if she went from Birmingham to Manchester and then to Leeds?
- (c) Richy is going to Birmingham from Leeds. He must stop in either Bradford or Sheffield on the way. Which is the shorter route?
2. The table gives the distances in km between 3 airports, London Gatwick, Birmingham and Bristol, and some cities in the UK.
- The Jones family are planning to travel to the UK from Jamaica. They can arrive at any of the following 3 airports: London Heathrow, Birmingham or Bristol.
- Using information from the following table, answer these questions.
- They want to visit relatives in Norwich. Which of the 3 airports is the nearest?
 - They decide to land at London Heathrow and then travel to Norwich. From Norwich they will go to Plymouth and then back to London Heathrow. How far will they have to travel in total?

- (c) Their friends, the Lewis family, live in Dover. They will travel to Plymouth and then on to Cardiff and back to Dover. How far will the Lewis family travel?
- (d) Which of the cities listed is closest to Birmingham airport and which is closest to London Heathrow?

	London Heathrow	Birmingham	Bristol					
	239	160	65	Cardiff				
	123	309	313	361	Dover			
	151	32	147	180	278	Coventry		
	340	319	185	238	455	329	Plymouth	
	179	255	342	394	264	223	541	Norwich
	256	119	279	288	376	126	440	249
								Sheffield

3. In a school 37 students took exams in both Mathematics and Physics. Their results are given in this table.

		<i>Mathematics Grade</i>					
		A	B	C	D	E	F
<i>Physics Grade</i>	A	2	3				
	B	1	1	4			
	C		2	3	2		
	D			4	2	2	
	E		1	0	2	2	
	F			2	2	2	

- (a) How many students obtained the same grade in both subjects?
- (b) How many students obtained a higher grade in Physics than in Mathematics?
- (c) Which was the most common grade in Physics?

4. The table shows the favourite sports selected by a group of boys in each of their secondary school grades. In each year, each student chose just one sport.

	<i>Cricket</i>	<i>Football</i>	<i>Basketball</i>	<i>Track and Field</i>
<i>Year 7</i>	6	18	5	14
<i>Year 8</i>	5	16	7	15
<i>Year 9</i>	7	14	10	12
<i>Year 10</i>	2	12	10	19
<i>Year 11</i>	8	13	12	10

- (a) How many chose basketball in Year 8?
- (b) How many more chose football in Year 7 than in Year 10?
- (c) In which years was football the most popular sport?
- (d) (i) In which year was 'track and field' the most popular sport?
(ii) How many students were there in this year?
5. The table below shows the group cost of a week at a large holiday centre. The cost varies according to the number of people in the group and the type of accommodation booked. There is a £20 reduction for each child.

Accommodation Type

	<i>Saver</i>	<i>Comfortable</i>	<i>Luxury</i>
<i>4</i>	£180	£260	£368
<i>5</i>	£220	£320	£454
<i>6</i>	£265	£385	£541
<i>7</i>	£305	£449	£630
<i>8</i>	£340	£507	£704

Number of people in group

- (a) How much would it cost for Mr and Mrs Powell and their 4 children to stay in 'Comfortable' accommodation for one week?
- (b) How much more would it cost if they booked 'Luxury' accommodation?
- (c) How much would they save in 'Saver' accommodation compared with 'Luxury' accommodation?
- (d) (i) How much would it cost if two grandparents came with the family and they all stayed in 'Saver' accommodation?
(ii) By how much does this differ from the total in part (a)?

6. In a privatised railway company in the US, there are 84 male conductors and 56 female conductors. Conductors can either be senior or standard. There is a total of 28 senior conductors and there are 48 female standard conductors.
- (a) Copy and complete the two-way table to show the number of male and female conductors who are senior or standard.

	<i>Male</i>	<i>Female</i>
<i>Standard</i>		
<i>Senior</i>		

- (b) Comment on the results.
7. Each student in a class was asked to choose *one* sport they enjoy watching. The numbers of choices were put in a table.

		Outdoor Sports		Indoor Sports	
		Football	Cricket	Badminton	Table Tennis
Year 11	Girls	12	10	15	5
	Boys	10	15	7	19
Year 10	Girls	14	9	17	3
	Boys	15	12	11	13

- (a) How many students chose football?
- (b) How many more girls chose cricket than table tennis?
- (c) One girl says that boys usually prefer watching outdoor sports. Do the figures in the table support this view? Explain your answer.