

UNIT 8 *Data Handling*

Activities

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- 8.1 Stem and Leaf Plots
 - 8.2 Misuse of Statistics
 - 8.3 Vehicle Registrations
 - 8.4 Testing Physical Fitness
 - 8.5 Sampling Fish
 - 8.6 Sampling in a Village
- Notes and Solutions (2 pages)

ACTIVITY 8.1

Stem and Leaf Plots

There are many ways of representing data. For example, you are probably familiar with

histograms and bar charts

but there is another very simple way which quickly gives an overall view of the general characteristics of the data. This is called a

Stem and Leaf Plot

The following example illustrates how it works.

Example

The marks gained out of 50 by 15 pupils in a Biology test are given below.

27	36	24	17	35	18	23	25
34	25	41	18	22	24	42	

We form a *Stem and Leaf Plot* by recording the marks with the tens as the 'stem' and the units as the 'leaf', as shown opposite.

Stem	Leaf
0	
1	7 8 8
2	7 4 3 5 5 2 4
3	6 5 4
4	1 2

The leaf part is then reordered to give a final plot as shown.

This gives at a glance both an impression of the spread of the numbers and an indication of the average.

Stem	Leaf
0	
1	7 8 8
2	2 3 4 4 5 5 7
3	4 5 6
4	1 2

- Form a Stem and Leaf Plot for the following data.

21	7	9	22	17	15	31	5	17	22	19	18	23
10	17	18	21	5	9	16	22	17	19	21	20	

There is no *one* correct way of representing data. The best representation depends on the purpose for which the data is being used.

- The ages of drivers involved in fatal road accidents in England during one week are given below.

17	82	40	48	21	35	23	24	18	57	62	45
20	21	33	27	24	37	58	69	65	19	15	21
28	71	43	31	73	26	18	21	34	35	51	63
23	65	22	45	23	27	18	19	32	25	61	36

- Illustrate the data using
- Stem and Leaf Plot
 - Histogram
 - Pie Chart

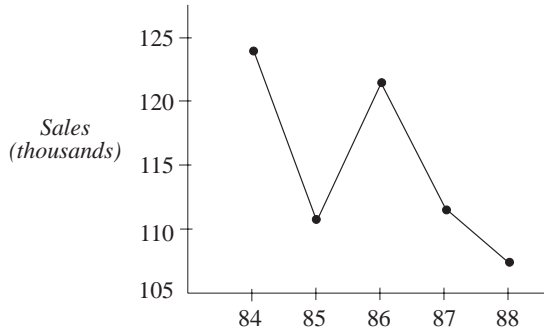
Which do you think is the most informative way of representing the data?

ACTIVITY 8.2

Misuse of Statistics

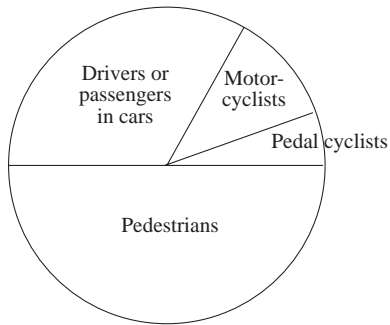
The diagrams below illustrate various data from a variety of statistics. Look carefully at the presentations and suggest ways in which each could be improved.

1. Sales of 'singles', 1984-88



- What does this graph show?
- Why is it misleading?

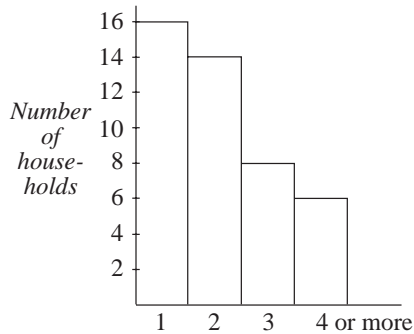
2. Road deaths in Scotland



- What conclusion can be drawn?
- What other information is needed?

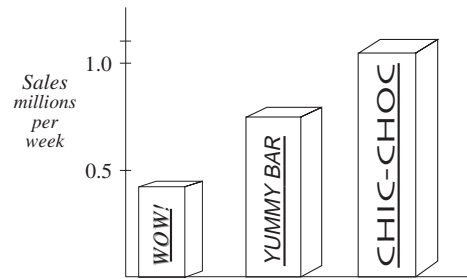
3. Number of TV sets per household

The results from a survey of 50 houses is shown below.



- What is missing from this illustration?
- What other data would be relevant?

4. Chocolate bar sales (average/week)



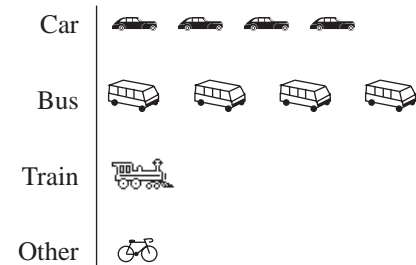
- Why is this illustration misleading?

5. Methods of travelling to work

A survey of how 1000 people travel to work gave these results.

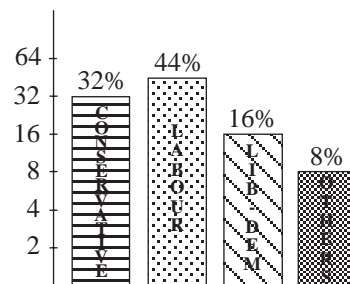
Car:	430	Bus:	356
Train:	136	Other:	78

This is illustrated in the pictogram below.



- What is wrong with this pictogram?

6. Voting intentions



- Why is this misleading?

ACTIVITY 8.3, Sheet 1

Vehicle Registrations

Monthly figures for first registration of vehicles in the UK, from August 1982 to November 1996

	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	Total
1982/83	281810	264010	179053	167764	108563	180743	177950	215833	195212	182274	187430	136772	2277414
1983/84	299555	259181	169285	194756	113970	164938	188186	215183	182403	206397	184536	130729	2309119
1984/85	256358	260947	213138	147767	86223	159011	199674	226325	176871	184830	188039	177981	2277164
1985/86	274089	213512	228415	178794	86194	204457	185068	179643	257346	143815	182350	188930	2322613
1986/87	295411	223604	207734	166125	112622	196746	192095	199123	196214	173108	194594	183616	2340992
1987/88	282217	321586	216251	185901	124758	222710	208554	244933	207857	184458	261182	159392	2619799
1988/89	424146	254448	214169	229554	99941	170364	228211	302605	244365	260126	248050	143878	2819857
1989/90	427593	287632	207508	213042	105249	256550	200750	193385	217345	228331	190645	117109	2645139
1990/91	382829	226536	207341	138734	87436	188430	146148	146751	199569	141076	137605	98825	2101280
1991/92	300698	204270	148461	126352	84496	150627	142183	143290	169824	148494	152987	115559	1887241
1992/93	307375	185437	137795	129778	107834	167344	159589	180311	167986	154286	149867	120390	1967992
1993/94	334245	223745	157307	157190	112081	180830	175880	210163	180644	174173	168306	129268	2203832
1994/95	318394	278181	158648	163676	101608	188234	185743	195563	165714	185666	191025	128060	2260512
1995/96	362051	226780	181340	161330	122141	191217	192432	203172	201384	175571	189835	159012	2366265
1996/97	342516	257407	199371	164630									

ACTIVITY 8.3, Sheet 2

Vehicle Registrations

The figures on Sheet 1 give total monthly new registrations of all cars, buses, lorries, etc. in the UK.

They can be analysed in a number of ways; the appropriate method depends on the purpose for which the data is being used. Our purpose here is to analyse the totals in order to gain insight into future trends of registrations of new vehicles.

1. Draw a histogram to illustrate the trends in the yearly totals from 1982/83 to 1995/96. (It is easier, and sufficiently accurate, to work in 1000s of vehicles.)

Although this gives us an insight into overall trends, if we look closely at the figures we see that the August figures (the first month of the new registration letter) are crucial ones.

2. On one graph (but using different *vertical* scales), plot yearly totals and August registration totals. Do the two sets follow similar trends?

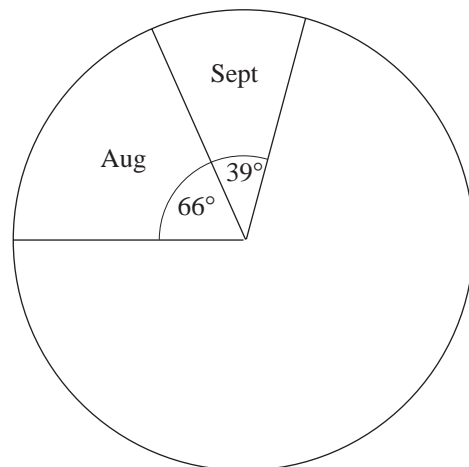
Use the August 1995/96 figure to estimate yearly sales for 1996/97.

Another way of illustrating total yearly sales and monthly variation is to draw *pie charts* for each year.

3. Draw a pie chart of radius 3 cm to illustrate the monthly figures in 1995/96.

The angle for each month is calculated from

$$\text{angle} = \frac{\text{monthly figure}}{\text{total yearly figure}} \times 360^\circ.$$



To compare a pie chart from one year to the next, we need to choose the radius so that the total areas are in proportion to yearly sales. For example, if we compare 1994/95 with the pie chart already produced for 1995/96,

then $\frac{\pi r^2}{\pi 3^2} = \frac{1994/95 \text{ total}}{1995/96 \text{ total}}$, and, since the π terms cancel, $r^2 = 3^2 \left(\frac{1994/95 \text{ total}}{1995/96 \text{ total}} \right)$. Taking

square roots of both sides we have $r = 3 \sqrt{\frac{1994/95 \text{ total}}{1995/96 \text{ total}}}$.

4. Draw pie charts for 1982/83, 1988/89 and compare them with the 1995/96 pie chart.

ACTIVITY 8.4, Sheet 1

Testing Physical Fitness

PE experts have spent much time trying to find a single test which best measures physical fitness.

Research has shown the connection between inactivity and coronary heart disease, and so emphasis has been placed on taking regular exercise. A key concept in testing physical fitness is that of a person's *pulse rate* and in particular, how quickly this returns to normal after excessive exercise.

It is vital that the pulse rate returns to normal after strenuous exercise, otherwise the heart is put under continuous stress.



Gallagher and Braihe Test

In this test, the exerciser steps onto and off a bench (or stair) of height 18 inches for boys, and 16 inches for girls. The tester shouts out "up - 2 - 3 - 4" continuously, the 'up' command coming every 2 seconds for 4 minutes. The exerciser continues for as long as possible up to the complete four minutes.

The *pulse rate* is taken at the following times after the exercise stops:

1 - $1\frac{1}{2}$ minutes; 2 - $2\frac{1}{2}$ minutes; 3 - $3\frac{1}{2}$ minutes.

In each case the number of beats in the half minute is noted, say p_1 , p_2 and p_3 .

The *fitness index* is evaluated from

$$\text{Index} = \frac{50 \times T}{(p_1 + p_2 + p_3)}$$

where T is the duration of the exercise in *seconds*, and p_1 , p_2 and p_3 are the measured pulse beats in each $\frac{1}{2}$ minute.

The grading is given in the table below.

<i>Index</i>	<i>Grade</i>
< 50	Very poor
50 - 60	Poor
60 - 70	Fair
70 - 80	Good
80 - 90	Excellent
> 90	Superb

Use this index to test your progress in physical fitness.

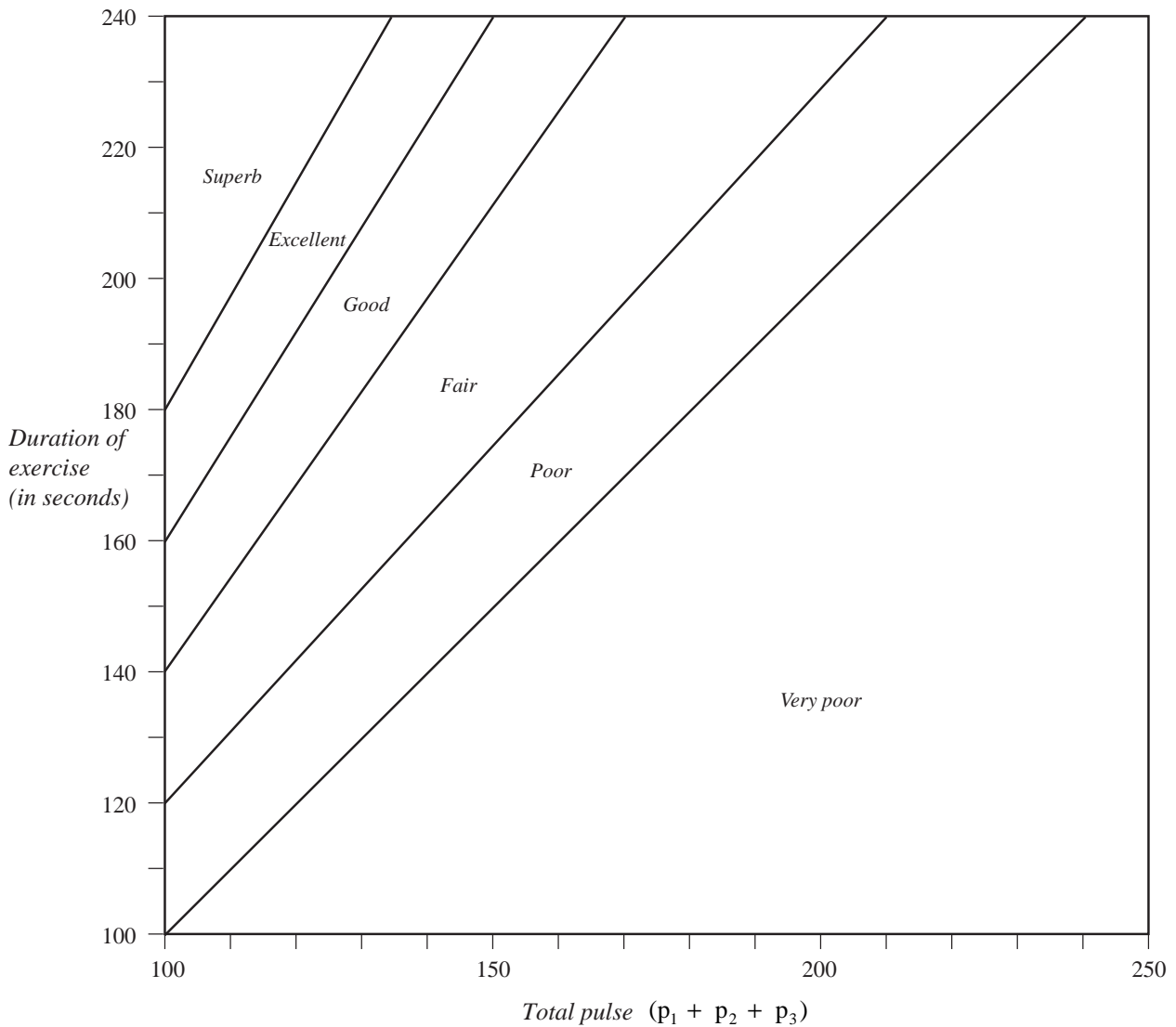
ACTIVITY 8.4, Sheet 2

Testing Physical Fitness

Geometrical Representation

A graph of total pulse, $p = (p_1 + p_2 + p_3)$ against duration of exercise, T , provides a way of representing each category. For example, the boundary between 'Poor' and 'Very poor' is given by

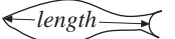
$$\text{Index} = 50 = \frac{50T}{p} \Rightarrow p = T, \text{ etc.}$$

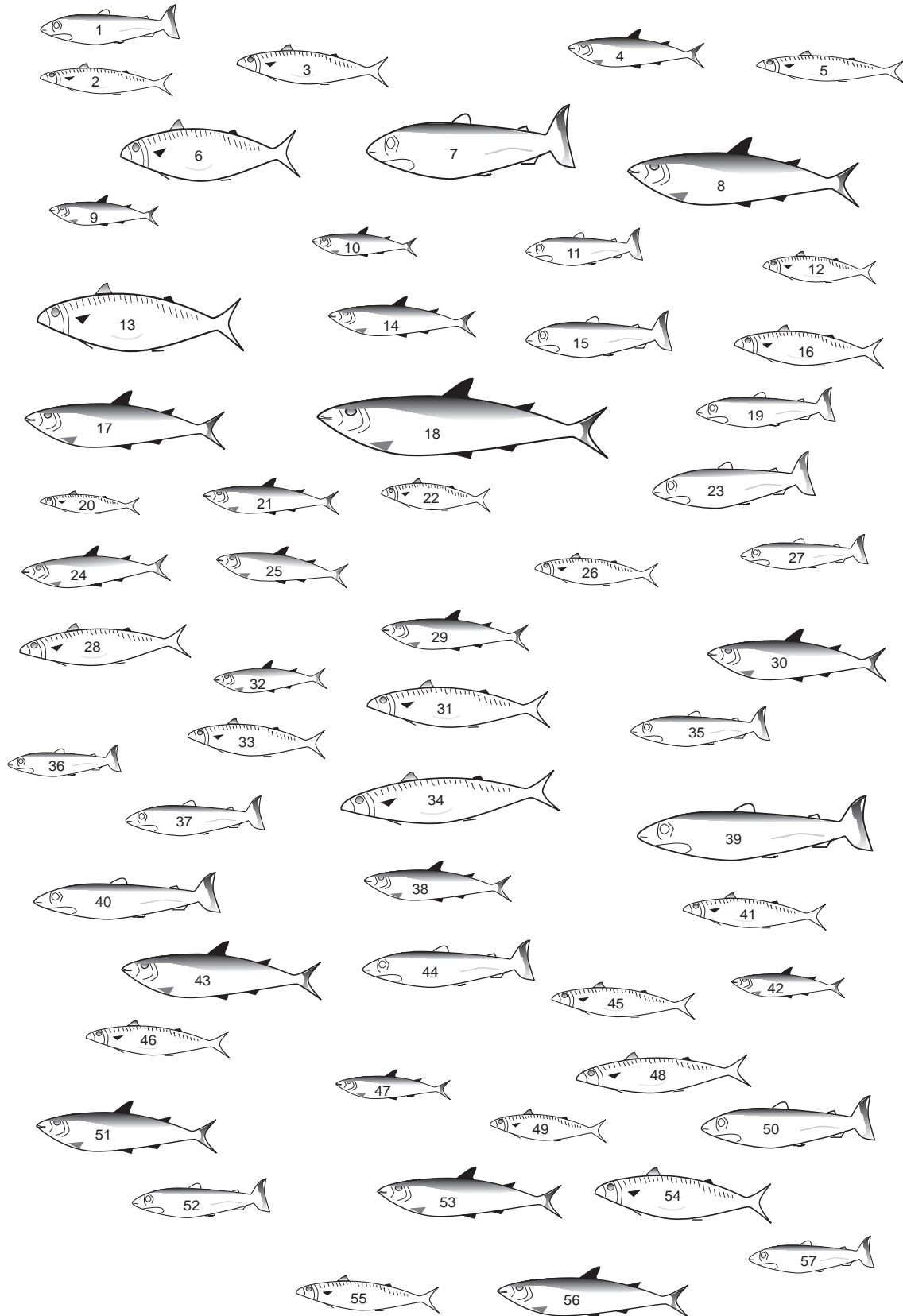


1. Find the equations of each boundary, and hence design a diagram like the one above.

ACTIVITY 8.5

Sampling Fish

Design a method of taking a sample of size (a) 5 fish, (b) 10 fish, from the population below. Use your sample to estimate the average length of fish. Length is measured .



ACTIVITY 8.6, Sheet 1

Sampling in a Village

The map on Sheet 2 is of a village. There are 200 houses of varying types and in different areas. You represent *ISCA Surveys*, and have been asked to provide answers to the following questions.

1. Is the head of the household an immigrant?
2. Does the household have a telephone?
3. Does the household have a car?
4. Did the head of the household vote for the Conservative Party at the last General Election?

As you have time to visit only *50 houses* you need to design an effective way of choosing a sample of 50 from the 200 houses.

Possible methods of choosing the sample include:

1. Using a pin and the map (eyes closed).
2. Taking every fourth house on the map.
3. Placing a grid over the map and taking an appropriate number of houses in each grid square.
4. Numbering all the houses from 1 to 200 and taking a random sample.

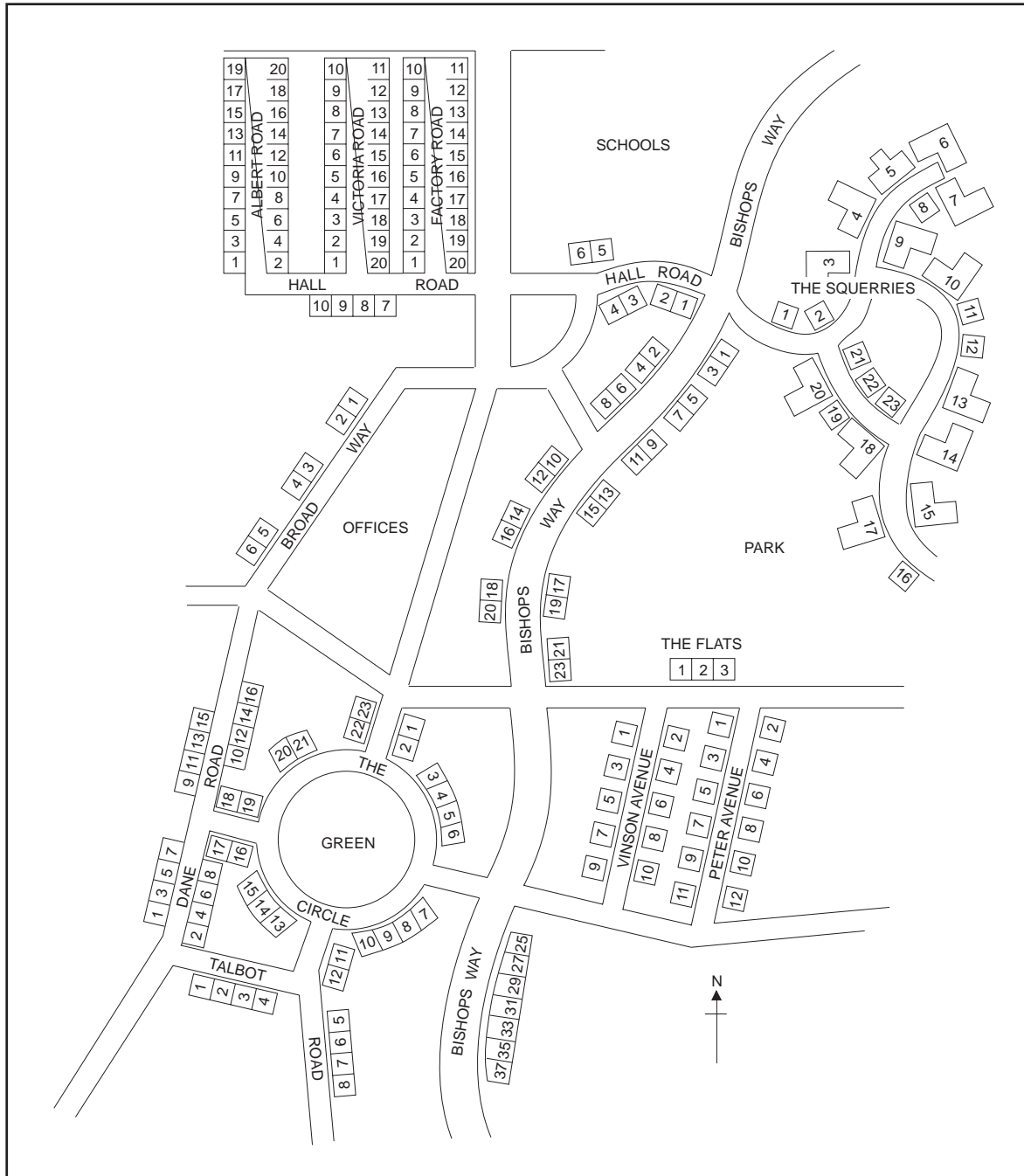
Choose one of these methods (or your own alternative) and find the answers to the four questions for your sample of 50 from the data in the table on Sheet 3. Compare your answers with the complete sample and comment on your method of sampling.

For the complete sample, the results are

- | | |
|-------------|------------|
| 1. I : 7.5% | 2. T : 80% |
| 3. C : 50% | 4. P : 35% |

ACTIVITY 8.6, Sheet 2, Map

Sampling in a Village



ACTIVITY 8.6, Sheet 3, Data

Sampling in a Village

R	S	I	T	C	P	R	S	I	T	C	P	R	S	I	T	C	P
Albert Road						Dane Road						Bishops Way, cont'd					
1	1	0	1	0	0	77	1	0	1	0	1	138	23	1	0	0	0
2	3	0	1	0	0	78	3	0	1	1	1	139	25	0	1	0	1
3	5	0	0	0	0	79	5	0	1	1	1	140	27	1	1	0	0
4	7	0	0	1	0	80	7	0	1	1	0	141	29	1	0	0	0
5	9	0	1	0	0	81	9	0	1	0	0	142	31	1	1	1	0
6	11	0	1	0	0	82	11	0	1	0	1	143	33	0	1	1	1
7	13	0	1	0	0	83	13	0	1	1	1	144	35	1	1	0	0
8	15	0	1	0	0	84	15	0	1	0	1	145	37	1	1	0	0
9	17	0	0	1	0	85	2	0	1	0	1	146	2	1	1	0	0
10	19	0	1	0	0	86	4	0	1	0	0	147	4	1	0	1	0
11	2	0	1	0	0	87	6	0	0	1	0	148	6	0	0	1	1
12	4	0	1	1	0	88	8	0	1	1	1	149	8	0	1	1	1
13	6	0	0	1	0	89	10	0	1	1	0	150	10	0	1	0	1
14	8	0	1	0	0	90	12	0	1	1	1	151	12	0	1	0	1
15	10	0	1	0	0	91	14	0	1	0	0	152	14	1	1	0	1
16	12	0	0	0	0	92	16	0	1	0	1	153	16	1	0	0	0
17	14	0	1	0	0	Talbot Road						154	18	0	1	0	1
18	16	0	1	0	0	93	1	0	1	1	1	155	20	0	1	0	0
19	18	0	0	0	0	94	2	0	1	0	1	The Squerries					
20	20	0	0	0	0	95	3	0	1	1	1	156	1	0	1	1	0
Victoria Road						96	4	0	1	1	0	157	2	0	1	1	0
21	1	0	1	0	0	97	5	0	1	0	1	158	3	0	1	1	0
22	2	0	1	1	0	98	6	0	1	1	1	159	4	0	1	1	0
23	3	0	1	0	0	99	7	0	1	0	0	160	5	0	1	1	0
24	4	0	0	0	0	100	8	0	1	0	1	161	6	0	1	1	0
25	5	0	1	0	0	The Circle						162	7	0	1	1	0
26	6	0	1	0	0	101	1	0	1	1	0	163	8	0	1	1	0
27	7	0	1	0	0	102	2	0	1	0	1	164	9	0	1	1	0
28	8	0	0	0	0	103	3	0	1	1	1	165	10	0	1	1	0
29	9	0	0	0	0	104	4	0	1	1	1	166	11	0	0	1	1
30	10	0	1	0	0	105	5	0	1	1	0	167	12	0	1	1	0
31	11	0	1	0	0	106	6	0	1	1	1	168	13	0	1	1	0
32	12	0	1	1	0	107	7	0	0	0	0	169	14	0	1	1	0
33	13	0	1	0	0	108	8	0	1	1	1	170	15	0	1	1	0
34	14	0	0	0	0	109	9	0	1	0	0	171	16	0	1	1	0
35	15	0	1	0	0	110	10	0	1	1	1	172	17	0	1	1	0
36	16	0	1	0	0	111	11	0	1	1	0	173	18	0	1	1	0
37	17	0	1	0	0	112	12	0	1	1	1	174	19	0	1	1	0
38	18	0	1	1	0	113	13	0	1	1	0	175	20	0	1	1	0
39	19	0	0	0	0	114	14	0	0	0	0	176	21	0	1	1	0
40	20	0	1	0	0	115	15	0	1	1	1	177	22	0	1	1	0
Factory Road						116	16	0	1	1	0	178	23	0	1	1	0
41	1	0	0	1	0	117	17	0	1	0	1	Vinson Avenue					
42	2	0	0	0	0	118	18	0	1	1	0	179	1	0	1	1	1
43	3	0	1	0	0	119	19	0	1	1	0	180	3	0	1	1	1
44	4	0	1	0	0	120	20	0	1	1	0	181	5	0	1	0	0
45	5	0	0	0	0	121	21	0	1	1	0	182	7	0	0	1	1
46	6	0	1	0	0	122	22	0	0	1	0	183	9	0	1	1	0
47	7	0	1	0	0	123	23	0	1	1	0	184	2	0	1	1	0
48	8	0	0	1	0	The Flats						185	4	0	1	1	1
49	9	0	1	0	0	124	1	0	1	1	1	186	6	0	1	1	0
50	10	0	1	0	0	125	2	0	1	1	1	187	8	0	0	0	1
51	11	0	1	1	0	126	3	0	1	0	1	188	10	0	1	1	1
52	12	0	0	0	0	Bishops Way						Peter Avenue					
53	13	0	1	0	0	127	1	0	1	1	1	189	1	0	1	1	0
54	14	0	1	0	0	128	3	1	1	1	0	190	3	0	0	1	1
55	15	0	0	0	1	129	5	0	1	0	1	191	5	0	1	1	0
56	16	0	1	0	1	130	7	0	0	0	1	192	7	0	1	0	1
57	17	0	1	0	1	131	9	0	1	1	1	193	9	0	1	1	1
58	18	0	1	0	0	132	11	0	0	1	1	194	11	0	1	1	1
59	19	0	0	0	1	133	13	0	1	1	1	195	2	0	1	0	0
60	20	0	0	0	1	134	15	0	1	0	1	196	4	0	0	1	1
Hall Road						135	17	1	0	1	0	197	6	0	1	1	1
61	1	0	1	0	0	136	19	1	1	0	0	198	8	0	1	1	0
62	2	0	1	0	0	137	21	0	0	1	1	199	10	0	1	1	0
63	3	0	1	1	0							200	12	0	1	0	1
64	4	0	0	0	0												
65	5	0	1	0	0												
66	6	0	1	0	1												
67	7	1	0	0	0												
68	8	1	1	1	0												
69	9	0	1	0	1												
70	10	0	1	1	1												
Broad Way																	
71	1	0	1	1	0												
72	2	0	1	1	1												
73	3	0	1	0	1												
74	4	0	1	0	0												
75	5	0	1	0	1												
76	6	0	1	1	1												

KEY	R : reference number	S : house number	I : immigrant	1 : Yes
	T : telephone	C : car	P : Conservative Party voter	0 : No