

SMILE WORKCARDS

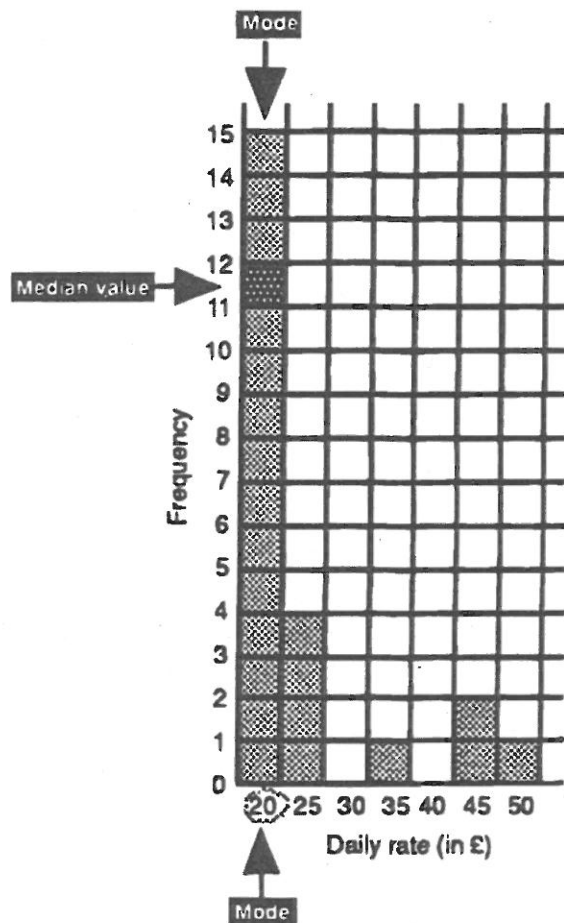
Analysing and Interpreting Data Pack Two

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Frequency Graphs

This frequency graph shows the daily rates of pay of the employees of a small company.



The information from the graph is displayed in this table:

Daily rate	Frequency	Daily rate x Frequency	Total
£20	15	£20 x 15	£300
£25	4	£25 x 4	£100
£30	0	£30 x 0	0
£35	1	£35 x 1	£35
£40	0	£40 x 0	0
£45	2	£45 x 2	£90
£50	1	£50 x 1	£50
Total employees	23	Daily total	£575

The **mean** daily rate is £25 ($£575 \div 23$).

The **median** daily rate is £20 (see graph).

The **modal** daily rate is £20 (see graph).

- Why is the mean misleading?

A survey of the number of students absent from each tutor group in a school is shown below.

Number of absentees in the tutor group	Frequency of tutor groups with this number absent	No. of absentees x Frequency	Total
11	1	11 x 1	11
9	2	9 x 2	18
8	1		
6	7		
4	10		
3	5		
1	1		
Total number of tutor groups.			

Copy and complete the frequency table.

1. Find the total number of absentees.
2. Find the mean number absentees in each tutor group.
3. Find the median number of absentees in each tutor group.
4. Draw a frequency graph to show the above information.
5. Mark the mean and the median on your graph.

Members of a club took part in a sponsored walk. The number of sponsors for each walker was recorded in the following table:

Number of sponsors	Frequency of walkers with this number of sponsors	No. of sponsors x Frequency	Total
46	1	46 x 1	46
35	2		
29	2		
25	9		
24	2		
21	3		
20	9		
18	3		
Total number of walkers			

Copy and complete the frequency table.

1. Make a frequency graph showing this information.
2. Calculate the mean.
3. Find the median.
4. What do you notice about the mean and the median?

Best Marks

Three classes 9S, 9M and 9L all took the same test.

Here are the test marks for each class.

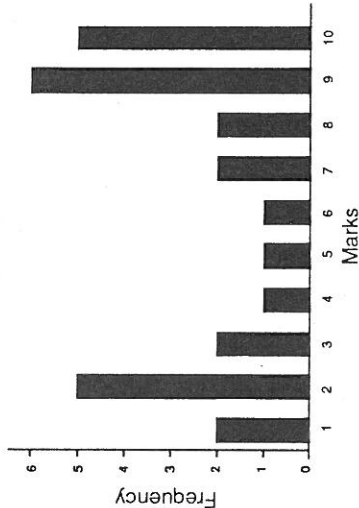
9S	9M	9L
9	7	8
2	3	7
7	2	8
9	9	3
2	9	1
3	10	8
10	1	9
9	6	6
1	9	5
10	6	6
5	3	9
8	10	6
9	9	7
2	1	5
2	3	3
1	1	2
10	2	8
7	8	8
10	3	1
4	5	4
3	6	8
9	10	10
10	10	8
8	10	9
6		8
2		4
9		

Here is an analysis of the marks for class 9S.

Tally chart

Mark	Tally	Frequency
1	//	2
2	###	5
3	//	2
4	/	1
5	/	1
6	/	1
7	//	2
8	//	2
9	###/	6
10	###	5

9S	
9	
2	
7	
9	
2	
3	
10	
9	
1	
10	
5	
8	
9	
2	
2	
1	
10	
7	
10	
4	
3	
9	
10	
8	
6	
2	
9	
Total	167



$$\text{Mean} = 6.185 \quad \frac{\text{total marks}}{\text{number of students}} = \frac{167}{27} = 6.185 \text{ to 3 decimal places.}$$

Mode = 9 The mark 9 occurs most frequently.

Median = 7 The middle value when the marks are arranged in order of size is 7.

$$\text{Range} = 9 \quad \text{The highest mark minus the lowest mark} = (10 - 1) = 9$$

1. Make similar analyses for the other two classes.
2. Which class do you think did best in the test? Justify your answer.

What Does Average Mean?

Smile
0805A

retribution.—
aveng'ress) one who avenges
to seek retribution).
avenue (av'e-nū) *n.* principal approach bor-
dered with trees to a mansion; any road in
park bordered with trees; a wide street with
houses and shops on each side;
(Fig.) a way to a goal.
to declare
to assert; to allege.—*pr. p.* av-
erred—**av'erment** *n.* the act of
averring; a positive assertion; (Law) proof
of a plea [L. *ad, to, verus, true*].
average (av'e-rāj) *a.* containing a mean
proportion; ordinary; normal;—*n.* a medial
estimate obtained by dividing the sum of a
number of quantities by the number of
quantities.—*v. t.* to reduce to a mean (O. Fr.
average, cattle or possessions; fr. L. habere,
to have).
averse (a-vers') *a.* reluctant (to do) or disin-
clined for; unwilling; set against (foll. by
to);—*adv.* with repugnance.
and
turned away).
avert (a-vert') *v. t.* to turn away from or aside;
to ward off.—*avert'ed a.*—*avert'edly adv.*—
capable of being avoided [L.
—*ary n.*

The word 'average'
is used in many
different ways.....

- (1) Work through cards B to I and look out for different meanings of 'average'.
- (2) Copy out the definitions of the three averages most often used in mathematics (see page 8).
- (3) Look back at cards B to I and decide which of these three averages (if any) is appropriate.

Average Shoe Size (B):

You probably chose the mode, possibly the median.

- (4) Explain why the mean is not very useful here.
- (5) Calculate the mode and the median,
- (6) Six more join the class. Their shoe sizes are 6, 8, 9, 6, 8 and 10.

Have the mode and the median changed ?

How? Comment.

Average Ability and Average Mark (C,D):

For both of these you could have chosen the median or the mean — probably the median for Bill's geography mark and the mean for his average mark.

- (7) Explain why the mode is useless in instances such as these.

Average Breakfast Cereal (E):

If the data is not in figures the mode is the most appropriate.

- (8) Explain why.

Average Wage (I):



We want a pay rise!

You already earn £5000 on average.

You're joking! Our average wage is only £3500.



- (11) Which average suits the boss best?
- (12) Which average suits the workers best?

Average Speed and Average Weekend (F,G):

Mean, median and mode are all unsuitable here.

- (9) Which average did you use for each of these?

Explain in each case, what the word average does mean.

Average Weight (H):

- (10) Can you use the mean, median or mode to enable Bill to be more precise?

Your wage is in a different class than ours. If you don't count your wage, you can use any average you like.

- (13) How does it affect the different averages if you do not count the director's salary?

SMILE
0805
B



In Bill's class there are 25 pupils. Their shoe sizes are:

3, 7, 7, 5, 6, 8, 5, 7, 9,
7, 4, 4, 6, 9, 7, 6, 5, 6,
5, 8, 7, 3, 10, 7, 6.

Bill's shoe size is average. What do you think it is?

Average Ability

SMILE
0805
C

Bill's geography teacher said his mark was average.

The marks for the whole class were:

84, 77, 77, 76, 76, 76, 70, 69, 64, 60
55, 52, 52, 51, 50, 49, 49, 47, 46, 45,
45, 45, 44, 44, 41

How many marks do you think Bill scored?

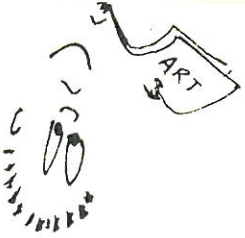
Average
Mark

SMILE
0805
D

These are Bill's exam marks:

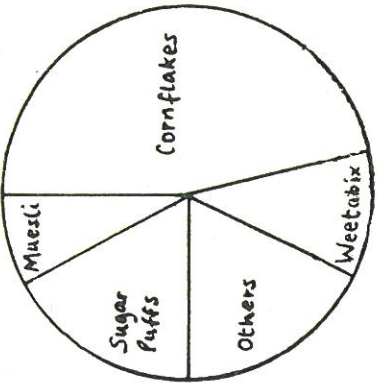
William Peters	
Form 4	
Art	28%
Home Economics	24%
English	65%
Maths	88%
French	66%
Music	38%
Geography	52%
R.E.	50%
History	73%
Science	46%

Work out Bill's average mark.



Average Breakfast Cereal

E
5080
SMILE

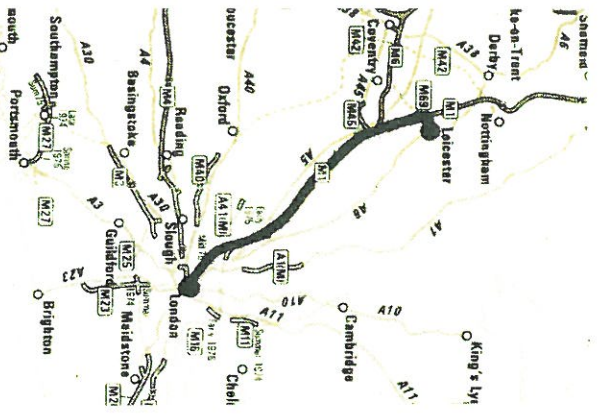


Bill's average breakfast is that which is eaten by the greatest number of pupils. What is the average breakfast eaten by the greatest number of pupils?

Draw a pie chart to show the distribution of preferences for the different cereals.

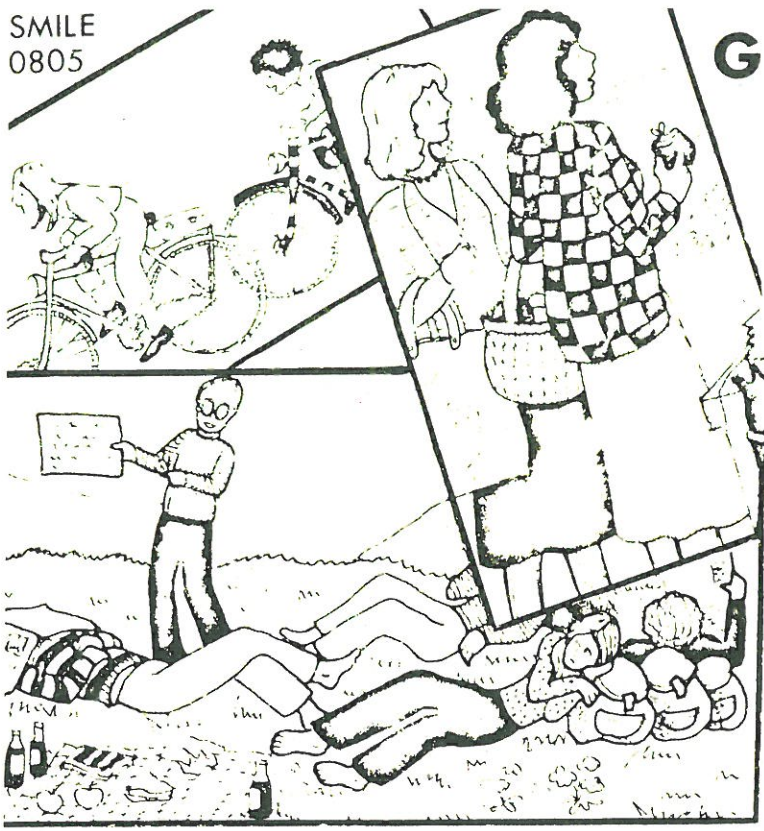
Average Speed

SMILE
0805 F



The distance from London to Leicester is 100 miles.

- (1) A car does the journey in 2 hours. What is the average speed?
- (2) The car takes 3 hours to come back. What is the average speed for the return journey?
- (3) What is the average speed for the 200 mile round trip?

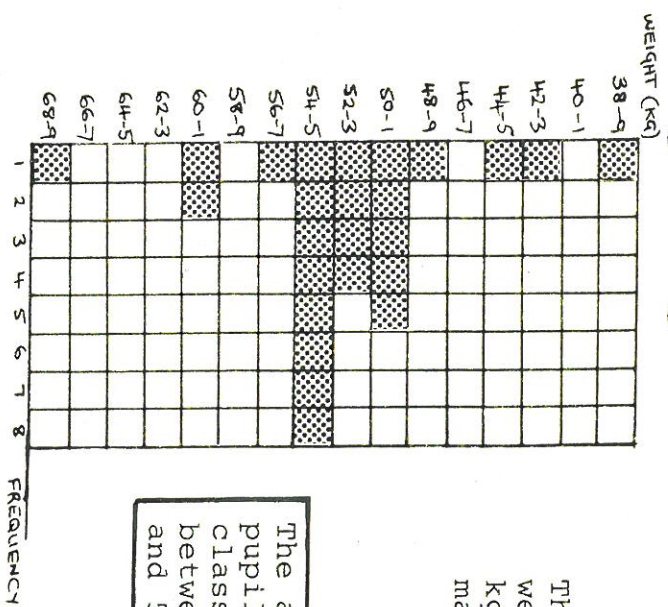


Write down briefly what you do during an average weekend.

An Average Weekend

Average Weight

SMILE
0805 H



The average pupil in my class weighs between 50 and 55 kg.

The bar-chart shows the weights (to the nearest kg) of Bill's classmates.

Average Wage

SMILE
0805 I

Bill's father is foreman in a factory employing 31 people. The incomes of the director and his 30 staff are below. What is the average wage?

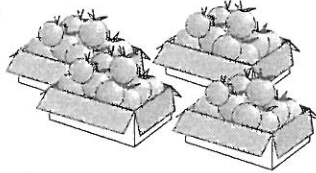
Position in firm	Number of persons	Salary	Position in firm	Number of persons	Salary
Director	1	£26,000	Foreman	1	£5,800
Manager	1	£7,000	Skilled workers	11	£4,800
Chief Clerk	1	£5,600	Unskilled workers	13	£3,500
Clerk	1	£5,300	Apprentice	1	£2,000
Secretary	1	£5,000			

Solve these problems.

1. The mean of five consecutive numbers is 12.

What is the mean of the first three of these numbers?

2. The mean mass of four boxes of fruit is 17kg.



A fifth box weighs 12kg.

What is the mean mass of the five boxes?

3. The mean age of a group of 7 students is 13 years.

Another student joins the group, the mean age is still 13 years.

How old is the new student?

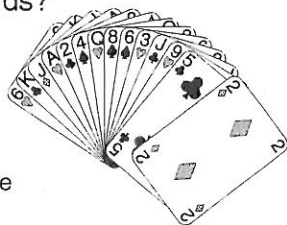
6. The mean weight of nine members of a rugby team is 95kg.

A new player joins the team, the mean weight of the ten players is 94kg.

What is the weight of the new player?

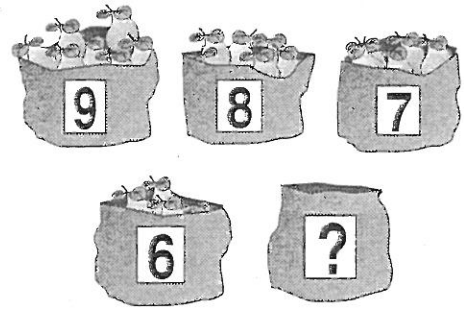
7. Robbie picked five cards from a pack. Two were the same number. The other three were all odd. The mean of the cards was 7.

What were the cards?



There is more than one possible solution.

4. The mean number of pears in these five bags is 8. Four of the bags contain 9, 8, 7 and 6 pears.



How many pears are in the fifth bag?

5. In three maths tests, Joanne scored 72%, 77% and 81%.

She wants her mean mark to be 80% or higher.

What percentage must she get in her next maths test?



Smile 2318

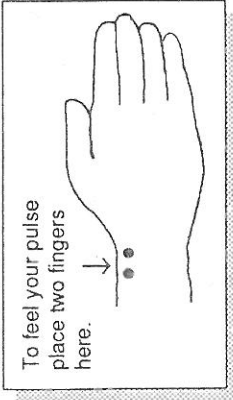
A Mean Challenge!

The **mean** of a set of values is found by finding the sum of the values and dividing it by the number of values.

$$\text{Mean} = \frac{\text{sum of the values}}{\text{number of values}}$$

Grouping Data

Take your pulse for one minute.
This is your pulse rate.



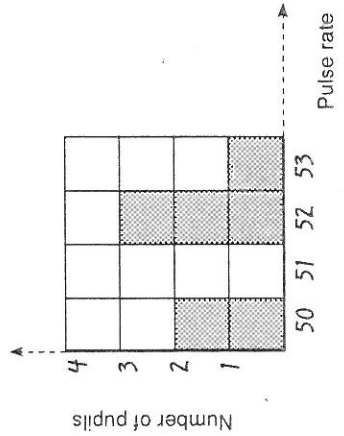
1. Find the pulse rate for each member of your class.

a) Record this data in a table.*

Pulse rate	50	51	52	53
Tally	//		///	/
No. of pupils	2	0	3	1

* You will need to collect at least 20 pulse rates. If this is not possible the Answer Book contains data from one year 9 class.

b) Display this information in a bar chart.



For this set of data:

80, 0, 4, 0, 1, 2, 1, 2, 1, 6, 2, 2, 3, 3, 5, 3, 3, 1, 7, 1, 6, 6, 1, 8, 10, 10, 4, 0, 90

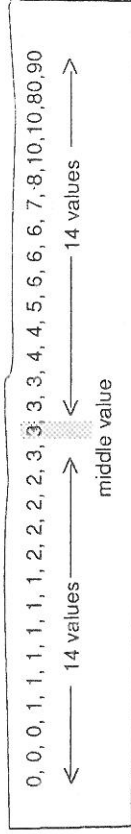
The range

The difference between the highest and the lowest value (*highest value* – *lowest value*).

So the **range** of this set of values is **90**. (90 – 0.)

There are three main types of **average**:

The median The middle value after the values have been arranged in order of size.



The **median** of the set of values is **3**.

The mode The most frequently occurring value.



The **mode** of this set of values is **1**.

The mean The sum of all the values divided by the number of values.

$$\frac{0+0+0+1+1+1+1+1+2+2+2+2+3+3+3+3+4+4+5+6+6+6+7+8+10+10+80+90}{29} = \frac{262}{29}$$

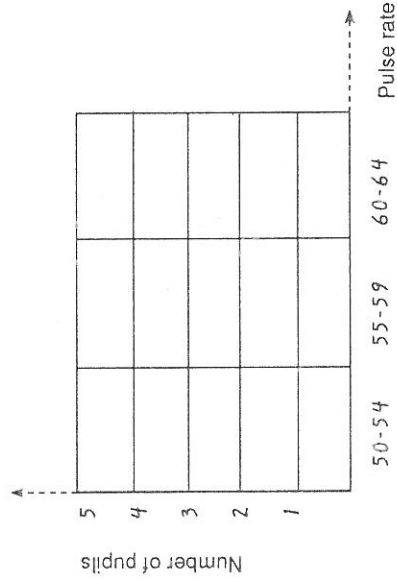
The **mean** of this set of values is **9.03** to 2 d.p.

Look at your pulse rate data.

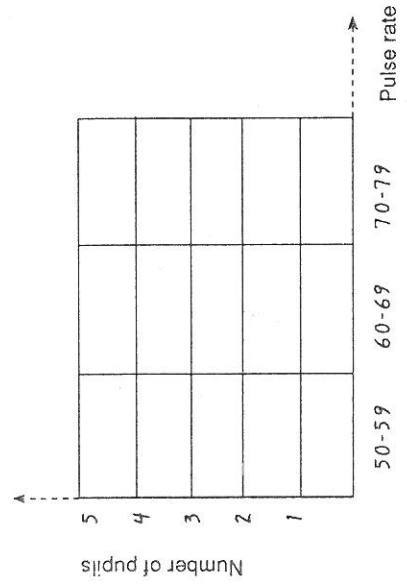
2. a) What is the **range** ?
- b) What is the **median**?
- c) What is the **mode**?
- d) What is the **mean**?

3. Use your original data to draw two further bar charts:

- a) with pulse rates grouped in 5's



- b) with pulse rates grouped in 10's.



4. Look at your three bar charts.

For each chart, look at the information you have displayed. Can the **range**, the **median**, the **mode** and the **mean** be found for each chart?

Explain how.

5. Which bar chart gives you the most useful information?

Give your reasons.

Turn over.

Grouped Data, Reviewed

MEAN

It is only possible to calculate an estimate for the mean from a set of grouped data. This estimate is based on the mid-values of each group.

This table shows the number of SMILE activities completed by 179 Year 8 students, grouped in class intervals of 10 activities.

Number of SMILE activities completed	Frequency
41 - 50	6
51 - 60	24
61 - 70	18
71 - 80	14
81 - 90	11
91 - 100	29
101 - 110	27
111 - 120	27
121 - 130	18
131 - 140	5
Total	179

- a) Copy this table and complete the Mid-value and the Mid-value x Frequency columns.

To get the mid-value add the end points and divide by 2.

Number of SMILE activities completed	Mid-value	Frequency	Mid-value x Frequency
41 - 50	45.5	6	273
51 - 60	55.5	24	1332
61 - 70	65.5	18	
71 - 80		14	
81 - 90		11	
91 - 100		29	
101 - 110		27	
111 - 120		27	
121 - 130		18	
131 - 140		5	
Total		179	

J. Ashby	90
J. Andrews	119
D. Bosh	338
J. Boman	137
M. Campbell	87
M. Dami	87
S. Brockway	193
J. O'Leary	37
J. O'Leary	48
A. Egan	33
A. Connors	32
S. Horvath	56
B. Luzzo	120
S. Korman	51
M. Khan	24
C. Harber	45
J. Kragelsky	134
P. Rowley	91
A. Stearn	92
A. Turner	128
I. Vona	64
M. Walsh	113
D. Williams	33
A. Woodcock	114
P. Howell	114
M. Voraan	167

S. Bosh	69
S. Bosh	63
D. Bosh	67
D. Bosh	57
J. Brown	72
A. Connors	41
A. Connors	41
S. Connors	56
D. Pajack	90
J. Pajack	94
A. Egan	79
A. Egan	68
S. Horvath	151
P. Luzzo	123
S. Korman	87
J. Vona	107
C. Harber	143
L. Brennan	138
D. Williams	110
P. Howell	114
M. Voraan	167
J. Andrews	136
D. Bosh	121
J. Boman	137
R. Connors	123
M. Dami	131
S. Brockway	186

J. Andrews	136
D. Bosh	121
J. Boman	137
R. Connors	123
M. Dami	131
S. Brockway	186
S. Deppatary	86
J. Egan	108
A. Egan	79
A. Egan	68
S. Horvath	92
S. Horvath	106
S. Korman	151
M. Khan	100
J. Kragelsky	48
C. Harber	85
E. Smith	75
D. Pajack	51
L. Brennan	124
A. Bosh	52
A. Bosh	52
A. Turner	120
L. Vona	81
R. Korman	99
J. Williams	134
A. Woodcock	69
H. Wright	89
R. Connors	63

J. Ashby	90
K. Bosh	61
J. Boman	97
D. Brock	95
D. Brock	135
J. Brown	124
S. Connors	108
S. Connors	177
L. Egan	131
A. Egan	131
P. Harber	91
T. Harber	77
T. Harber	134
R. Korman	91
P. Korman	111
S. Korman	134
M. Khan	108
S. Marlin	138
D. Pajack	119
A. Bosh	56
A. Bosh	137
L. Vona	70
L. Vona	130
J. Williams	64
S. Williams	90
J. Williams	131
A. Woodcock	121
A. Woodcock	121
S. Wright	96

Number of SMILE activities completed	Frequency
41 - 50	6
51 - 60	24
61 - 70	18
71 - 80	14
81 - 90	11
91 - 100	29
101 - 110	27
111 - 120	27
121 - 130	18
131 - 140	5
Total	179

Number of SMILE activities completed	Frequency
51 - 60	5
61 - 70	12
71 - 80	21
81 - 90	28
91 - 100	32
101 - 110	40
111 - 120	25
121 - 130	17
131 - 140	4
141 - 150	1
Total	185

The estimate for the mean is found by dividing the total of the 'Mid-value x Frequency' values by the total 'Frequency'.

$$\frac{\text{Total of Mid-value} \times \text{Frequency values}}{\text{Total Frequency}}$$

- b) Calculate an estimate for the mean number of SMILE activities completed, grouped in class intervals of 10 activities.

$$\frac{\text{Total of Mid-value} \times \text{Frequency values}}{\text{Total Frequency}} = \text{Mean}$$

The same data is given in this table but this time it is grouped in class intervals of 20 activities.

Number of SMILE activities completed	Frequency
41 - 60	30
61 - 80	32
81 - 100	40
101 - 120	54
121 - 140	23
Total	179

- c) Copy and complete this table.

Number of SMILE activities completed	Mid-value	Frequency	Mid-value x Frequency
41 - 60	50.5	30	1515
61 - 80	70.5	32	
81 - 100			

- d) Calculate an estimate for the mean number of activities completed.
 e) Can you explain why the answers to b) and d) are different?

MODAL GROUP

It is not possible to find the mode from a set of grouped data as the individual data is not available.

It is only possible to give the **modal group**.

The modal group for the number of SMILE activities completed in Year 8 when grouped in 10's is **91 - 100** because it has the highest frequency.

Number of SMILE activities completed	Frequency
41 - 50	6
51 - 60	24
61 - 70	18
71 - 80	14
81 - 90	11
91 - 100	29
101 - 110	27
111 - 120	27
121 - 130	18
131 - 140	5
Total	179

2. What is the modal group for the number of SMILE activities completed in Year 8 when grouped in 20's?

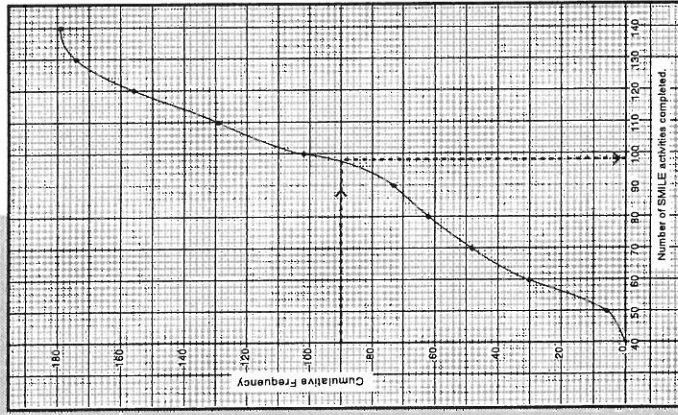
It is not possible to find the exact median for a set of grouped data, but it is possible to **estimate** the median by drawing a **cumulative frequency curve** and reading off the **median**.

The cumulative frequency graph is plotted at the end of each interval.

Number of SMILE activities completed	Frequency	Cumulative Frequency
41 - 50	6	6
51 - 60	24	30
61 - 70	18	48
71 - 80	14	62
81 - 90	11	73
91 - 100	29	102
101 - 110	27	129
111 - 120	27	156
121 - 130	18	174
131 - 140	5	179
Total		179

The **median** number of activities will have been completed by the 90th student.

By using the cumulative frequency curve an **estimate** for the median value is 98.



3. a) Complete a cumulative frequency table and graph for the number of SMILE activities completed in Year 8 when grouped in 20's.

b) Is the estimated median number of SMILE activities the same when the data is grouped in 20's?

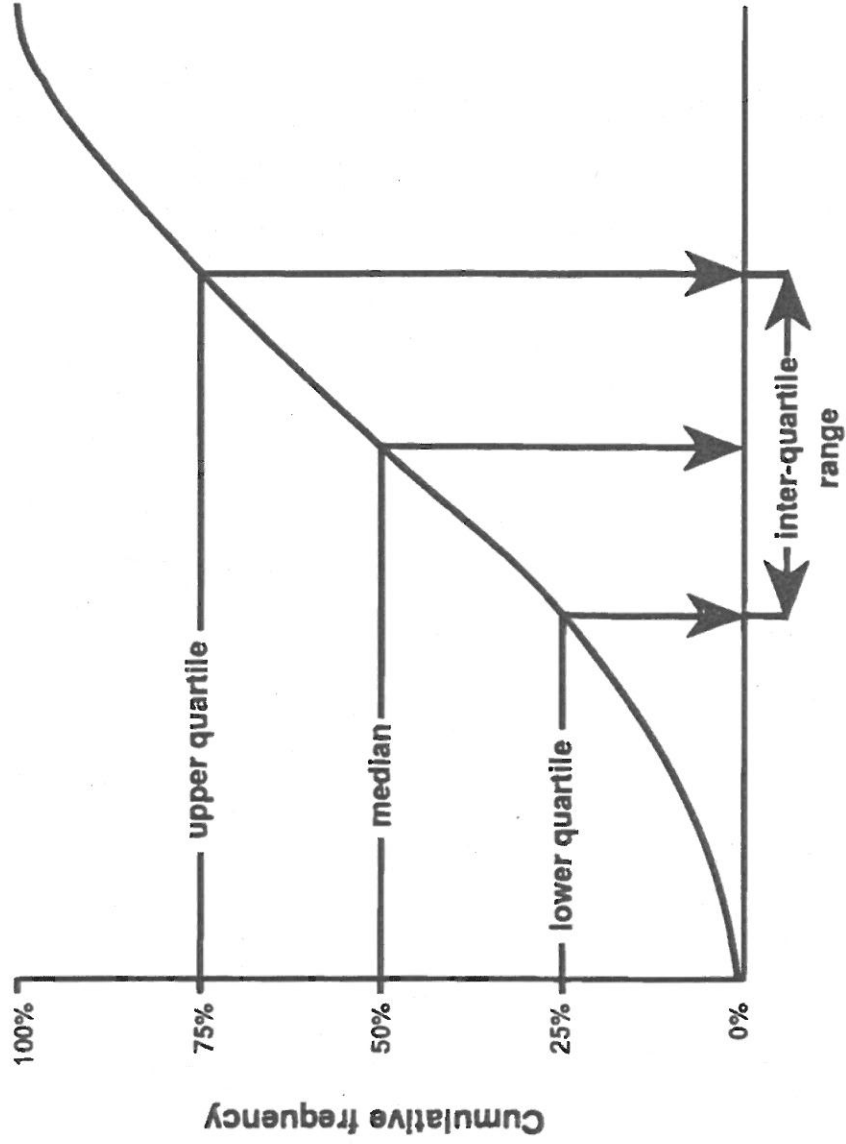
4. This set of grouped data shows the numbers of SMILE activities completed by 185 Year 9 students:

Number of SMILE activities completed	Frequency
51 - 60	5
61 - 70	12
71 - 80	21
81 - 90	28
91 - 100	32
101 - 110	40
111 - 120	25
121 - 130	17
131 - 140	4
141 - 150	1
Total	185

- Calculate an estimate for the mean.
 - Find the modal group.
 - Draw a cumulative frequency curve and estimate the median.
5. Use all the results to compare the number of SMILE activities completed by Year 8 and Year 9 students.

Cumulative Frequency and Quartiles

This activity is about **cumulative frequency curves and quartiles**. When an ordered distribution is divided into four quarters, the quarters are called **quartiles**. Each quartile contains one quarter of the total frequency in the distribution. This information is shown in the diagram below.



The difference between the lower and upper quartiles

The heights of 154 students are measured to the nearest centimetre.

Height(cm)	160	161	162	163	164	165	166	167	168	169	170	171	172
Frequency	4	5	6	9	16	22	27	25	18	11	6	3	2

The upper bound for the height of students in the 164cm group is 164.5cm

1. What is the upper bound for the height of students in the 160cm group?

The information can be set out to show the number of students below any given height. This is called the **cumulative frequency**.

2. Copy and complete the following cumulative frequency table.

Height (cm)	Frequency	Cumulative frequency	Heights of students represented by cumulative frequency
160	4	4	<160.5cm
161	5	9	<161.5cm
162	6	15	<162.5cm
163	9	24	

- What should the last entry in the cumulative frequency column be equal to? Use this to check your cumulative frequency table.

The information in the cumulative frequency table can be used to draw a **cumulative frequency curve**.

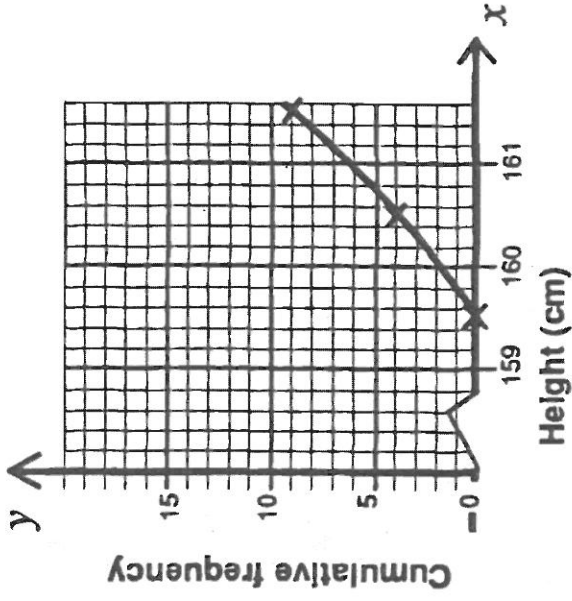
The cumulative frequency is plotted at the upper bound of each group.

3. Why does the point (159.5, 0) belong to the curve?

4. Draw a pair of axes with x values from 159cm to 173cm, and y values from 0 to 154. Draw the cumulative frequency curve.

5. Use your cumulative frequency curve to find:

- a) the median height
- b) the lower quartile
- c) the upper quartile
- d) the inter-quartile range.



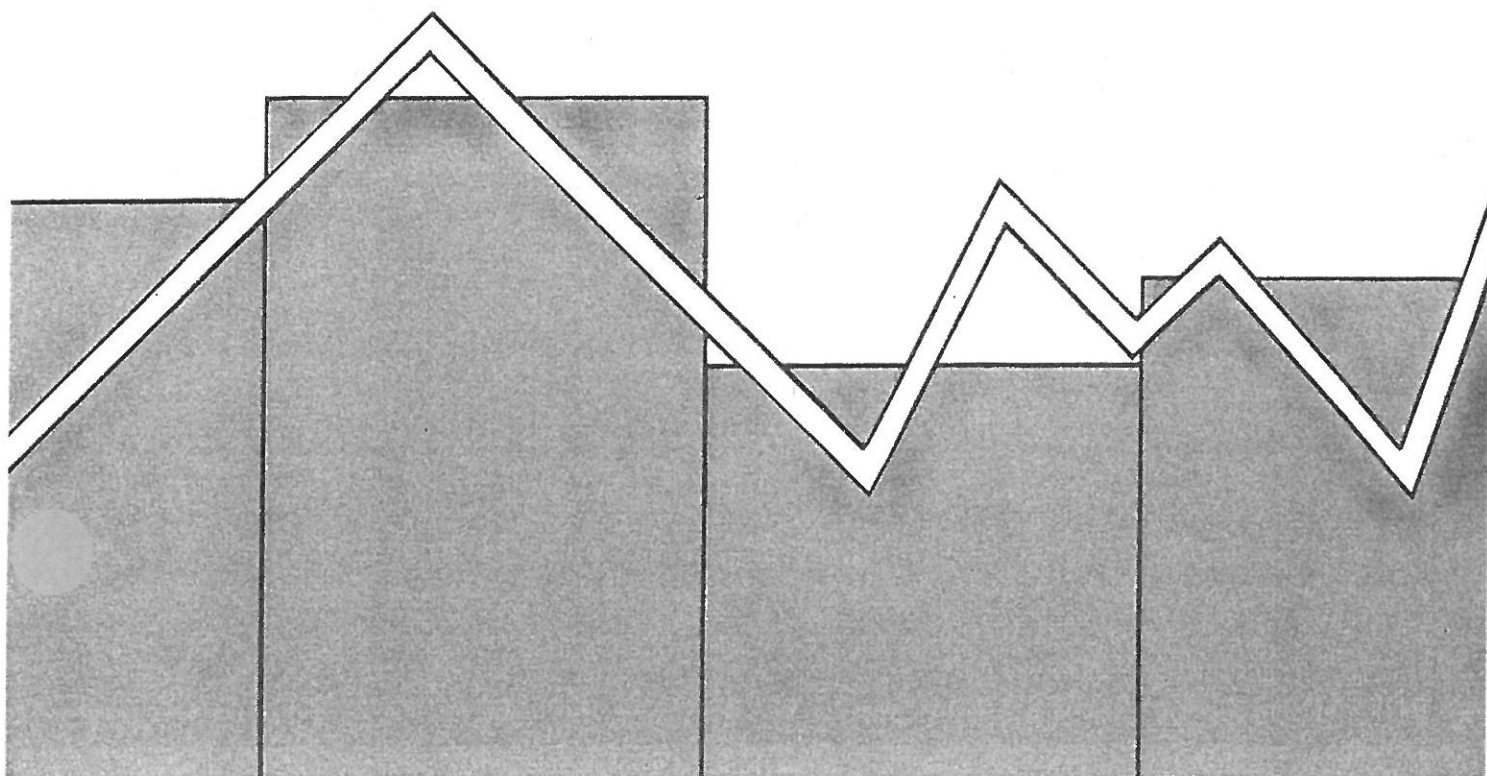
Two machines X and Y produce metal rods of diameter 12mm. 100 samples are taken from each machine, the measurements to the nearest tenth of a millimetre are:

Diameter(mm)	11.5	11.6	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4
Frequency for Machine X	0	0	3	8	11	20	20	18	15	5
Frequency for Machine Y	1	0	4	9	13	31	30	9	2	1

6. a) Construct the cumulative frequency table and draw the cumulative frequency curve for the results from each machine.
- b) Use your graph to obtain a value for the inter-quartile range in each case.
- c) Compare the reliability of the machines.

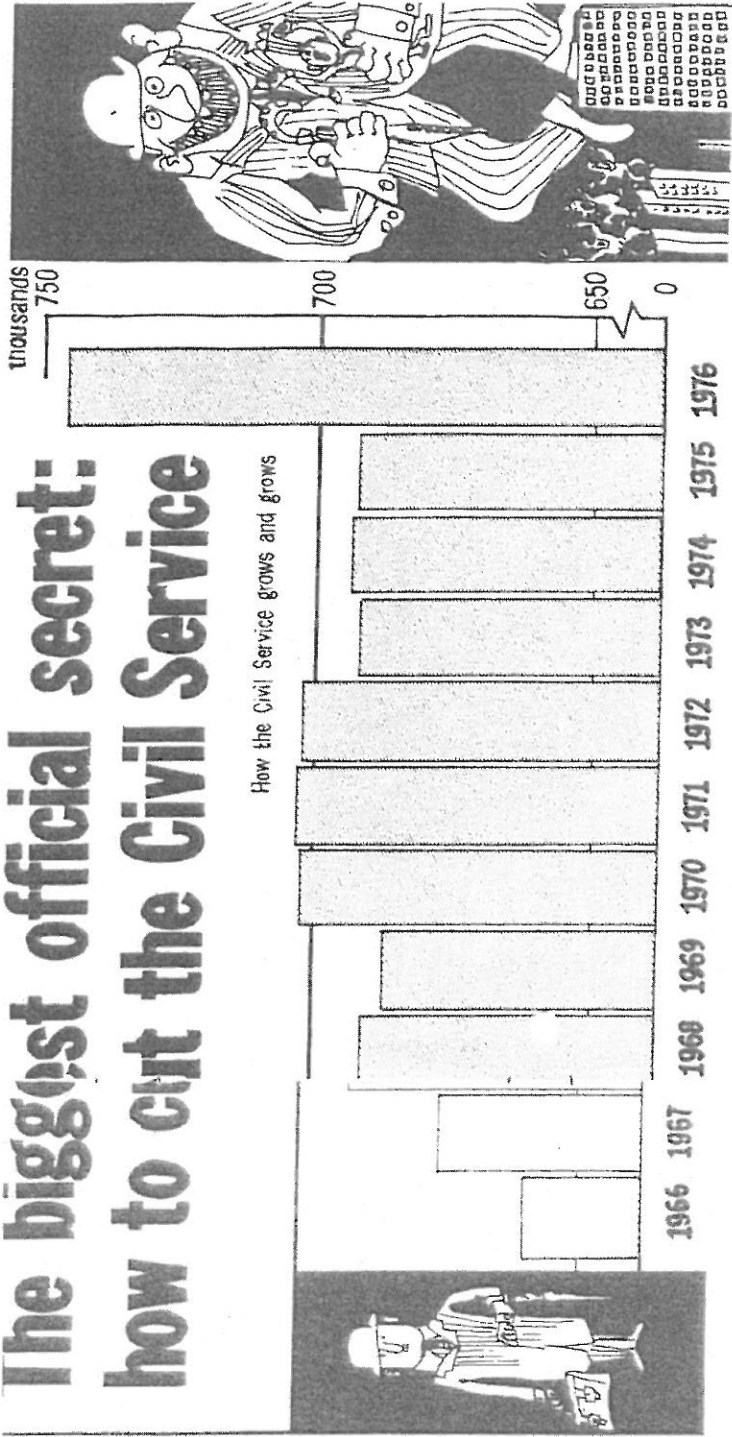
Other ways to describe cumulative frequency curves are:
cumulative frequency polygons or ogive.
 The word *ogive* is a term used in architecture.

“Lies, Damned Lies and Statistics....”



The biggest official secret: how to cut the Civil Service

How the Civil Service grows and grows



- 1) "Look at this! In 1976 the Civil Service has grown in 4 times what it was in 1966." Do you agree?
- 2) How many civil servants were there in: a) 1966 b) 1976
- 3) What is the increase over this 10 year period?
- 4) Express this as a percentage.
- 5) Why should someone think the Civil Service had quadrupled in these ten years?
- 6) Redraw the graph so that this misapprehension could not occur.
- 7) Why do you think the graph was presented this way in a well known daily newspaper?

(from a leading National Daily newspaper)

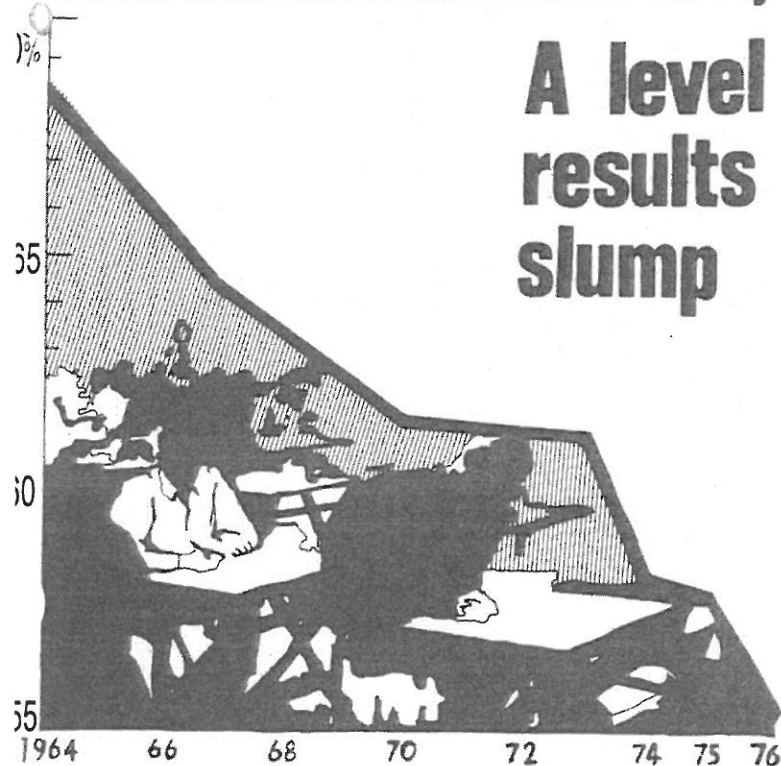
Information is often presented in a way that gives a false impression, at least at first glance. It is important not to be mis-led.

When you work through the rest of this booklet;

- 1) Write down your first impressions.
- 2) Read the questions and think again!
- 3) Write down anything important that you notice — you might need to re-draw a graph.
- 4) Compare your results with the hints in the answer book and write more if necessary.

Alarm after Manchester exam survey

A level results slump

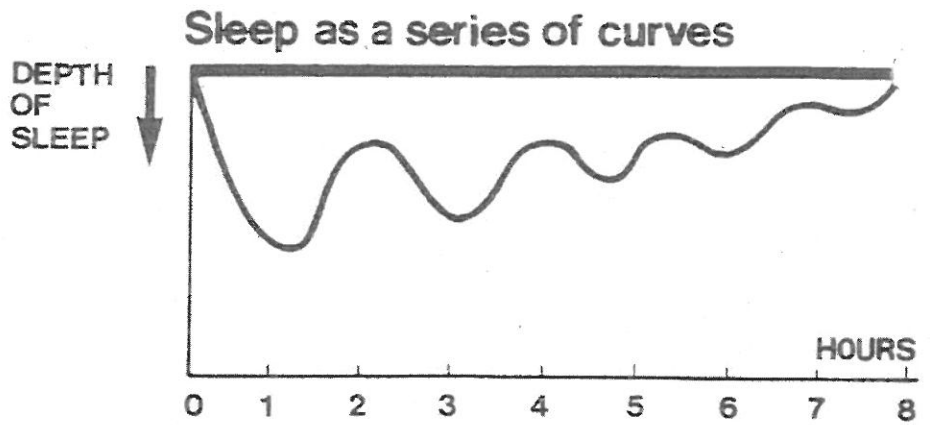


What's been happening in Manchester?

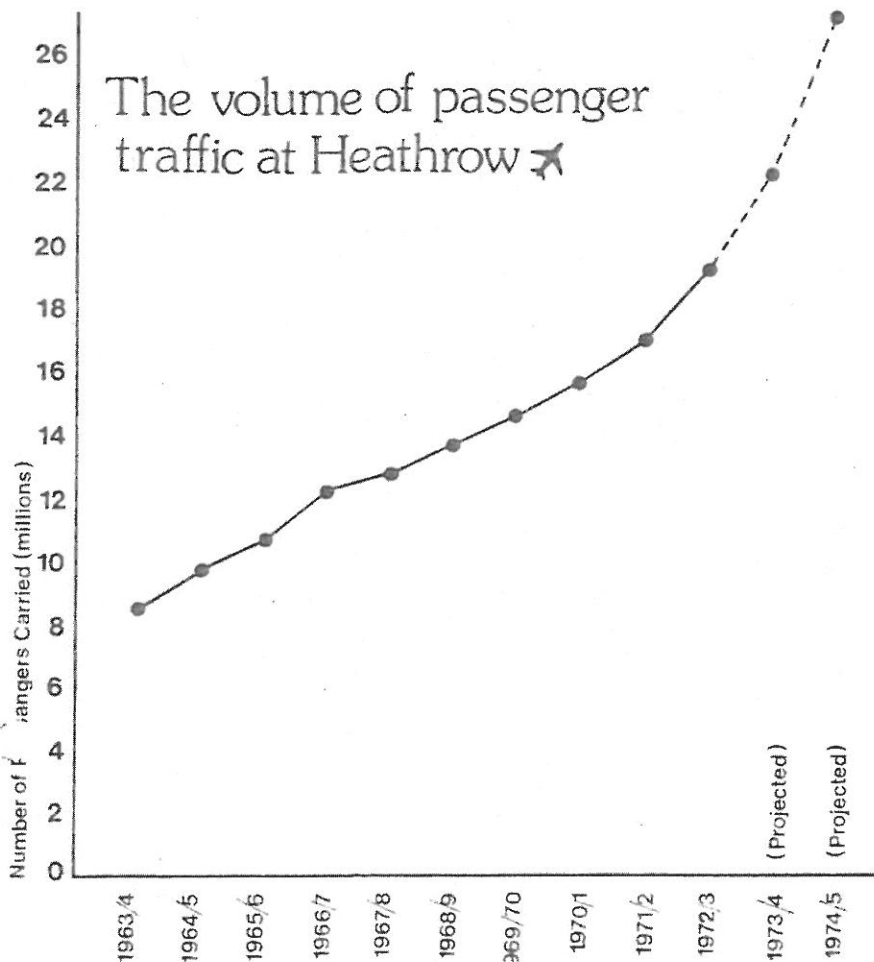
(from a leading local paper)

Downward trend: A level passes as a percentage of entries. Comprehensive reorganisation in Manchester took place in 1974.

What measurements have been made?



(from a bed-time drink label)



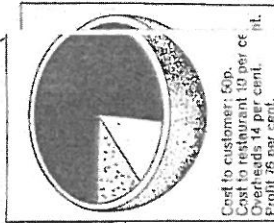
How many passengers would you have predicted for 1974/75 in 1972?

Who makes more profit: the Crown Inn or the Angus Steak House?

The way the grapefruit slices

in half, sell each half for 50p each, and appear to make 300 per cent profit or so. Is that an indication of the way they mark up the rest of the menu, the rascals? We asked *Sandra Hempel* to question restaurateurs on their mark-ups of half grapefruits; this is the result.

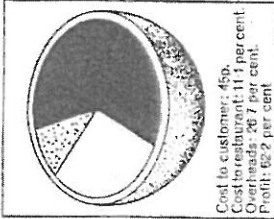
In the diagram the areas shaded black represent profit, grey is cost; white is overheads



Cost to customer: 60p
 Cost to restaurant: 10 per cent
 Overheads: 14 per cent
 Profit: 26 per cent

**Hotel Intercontinent II,
 London, W.1**

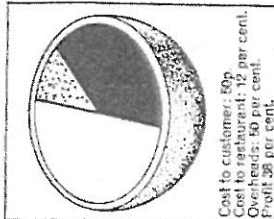
Restaurant is 14 years old in a recent 5-star hotel, cost of restaurant single room is £35 a night. Peter Kronberg, the restaurant chef, is master of the soufflé. Peter Berger, cost controller, says: "It's a high mark-up because of the low labour cost involved in the preparation of a grapefruit. Hempel says: "A cheap grapefruit, considering the high price it commands on the menu."



Cost to customer: 45p
 Cost to restaurant: 11 per cent
 Overheads: 26.7 per cent
 Profit: 62.2 per cent

**Upper Crust,
 Upper Crust, London, S.W.1**

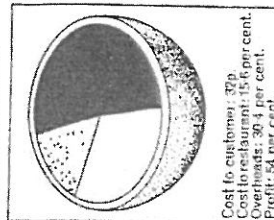
Restaurant specialises in fish. Fine kitchen atmosphere. Relaxed, professional, imaginative. Proprietor Manny Frankel says: "Anyone can cut a grapefruit in half at home, so we serve with sherry and brown sugar sauce. The comparatively high profit covers cost of more expensive ingredients on the menu."



Cost to customer: 60p
 Cost to restaurant: 12 per cent
 Overheads: 19 per cent
 Profit: 29 per cent

**Crown Inn, near
 Woking, Surrey**

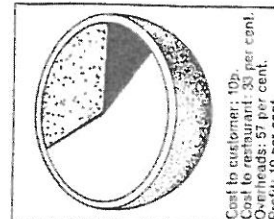
Restaurant is in a pretty pub in lovely Surrey village; classical French food. Owner Angus Lamont: "Normally our profit would be 5p on a 50p item; this is unusually high because preparation time on grapefruit is very low." Hempel says: "Coverings are done on the menu as a whole, not



Cost to customer: 37p
 Cost to restaurant: 15.6 per cent
 Overheads: 30.4 per cent
 Profit: 54 per cent

**Angus Steak House
 (typical example)**

Restaurant is part of large EMI chain (the record and leisure people). Stereotyped menu, standard bland red, black, terran decor. Strict buying and portion control. Manager: no comment. Hempel says: "Simple dishes, and emphasis on convenience. Hempel says: "Grapefruit appears to be over-underestimated. But



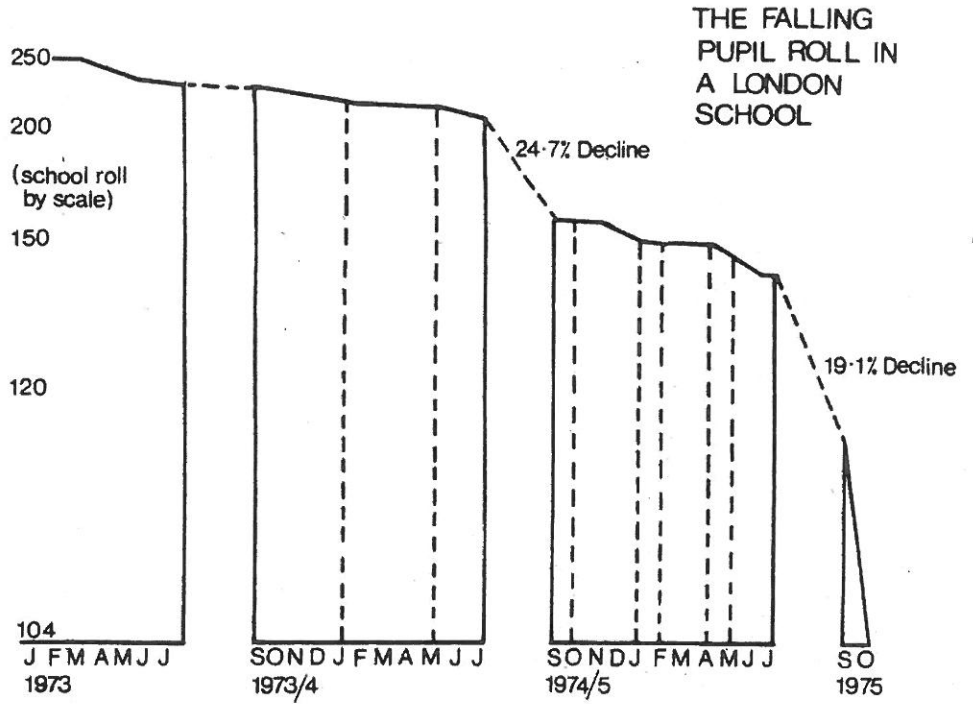
Cost to customer: 10p
 Cost to restaurant: 33 per cent
 Overheads: 57 per cent
 Profit: 10 per cent

**Grand Hotel,
 Scarborough, Yorks.**

Restaurant is a huge sparsely furnished Victorian hotel now undergoing £500,000 face-lift. New owner, Arthur Turner says: "This is a very large, old building. We work on a lower profit margin than you would in smaller, newer premises." Hempel says: "Grapefruit ap-

(from a Sunday colour supplement)

Describe the state of the school in the autumn term 1975.



(from an educational newspaper)



**What does your eye measure?
What measure represents the amount of tea?**