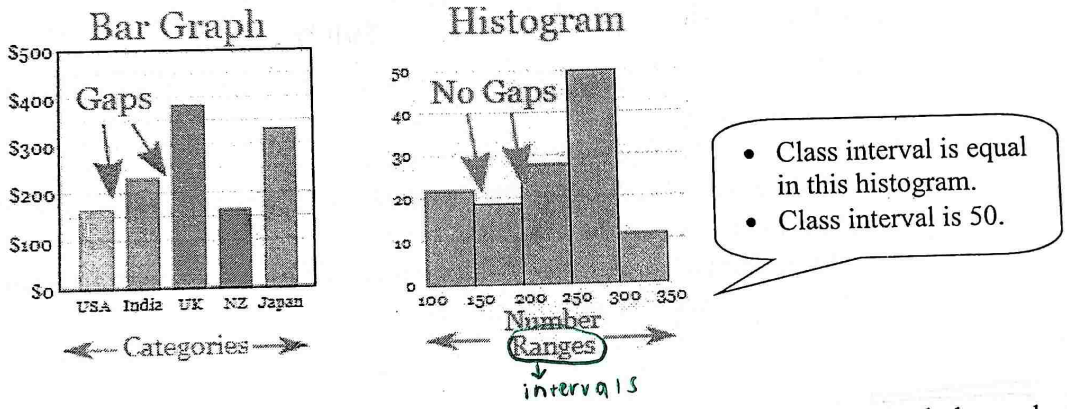
Sunman High School MATHEMATICS department	Name		Reg. No	Class
	Deadline	Presentation		
		Accuracy		
		Units		

Statistics (Chapter 13): Worksheet 1

Histogram and its features

- A histogram is similar to a vertical bar graph but a histogram groups numbers into ranges, which means the horizontal axis is continuous like a number line.
- There are no gaps between the adjacent rectangles.
- Base of each rectangle represents the class interval / width.



1 A group of 25 students sat for a Mathematics test in which all marks scored are whole numbers. The frequency table below shows the distribution of the marks obtained.

Mark (x)	Number of students (Frequency)
$40 < x \leq 50$	1
$50 < x \leq 60$	2
$60 < x \leq 70$	$2a$ 8
$70 < x \leq 80$	9
$80 < x \leq 90$	$0.75a$ 3
$90 < x \leq 100$	2

x is greater than 80

(a) Calculate the value of a.

(b) The same information is represented using a histogram. Part of the histogram is shown below. Complete the histogram.

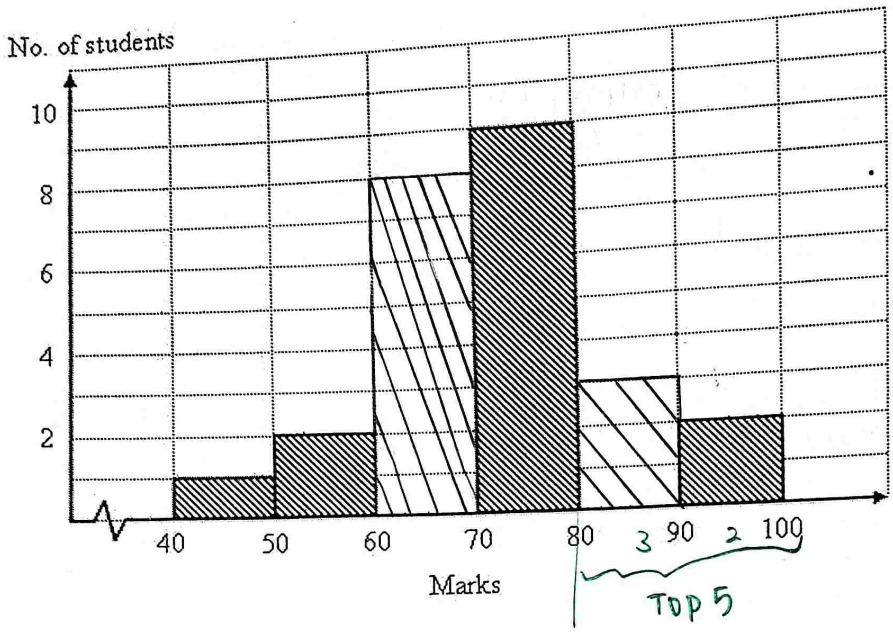
$1 + 2 + 2a + 9 + 0.75a + 2 = 25$

$2.75a = 11$

$a = 4$

a) value of $a = 11 \div 2.75$

$= 4$



(c) Given that 20% of the students scored a distinction, find the minimum mark for a student to score a distinction.

(d) A pie chart is used to represent the data in the table.

(i) Find the angle of the sector that represents the number of students who score more than 70 marks.

(ii) Which form of representation, histogram or pie chart, is more suitable to represent the above data? Explain your answer.

c) ~~25 x 20%~~

Number of students who scored a distinction = 25 x 20%
= 5

minimum mark for student to score a distinction = 80 ✓

minimum mark for student to score a distinction = 81 ✗

d) (i) Percentage of student scoring more than 70 marks = $\frac{8+3+2}{25} \times 100$

Number of students with more than 70 marks = 14

Total number of students = 25

$= \frac{13}{25} \times 100$

$= 52\%$ ✓

Let 1 student be x

$25x = 360°$

$x = 360° \div 25$

$= 14.4°$

$14x = 14.4° \times 14$

$= 201.6°$

$\theta = \frac{14}{25} \times 360°$

$= 201.6$

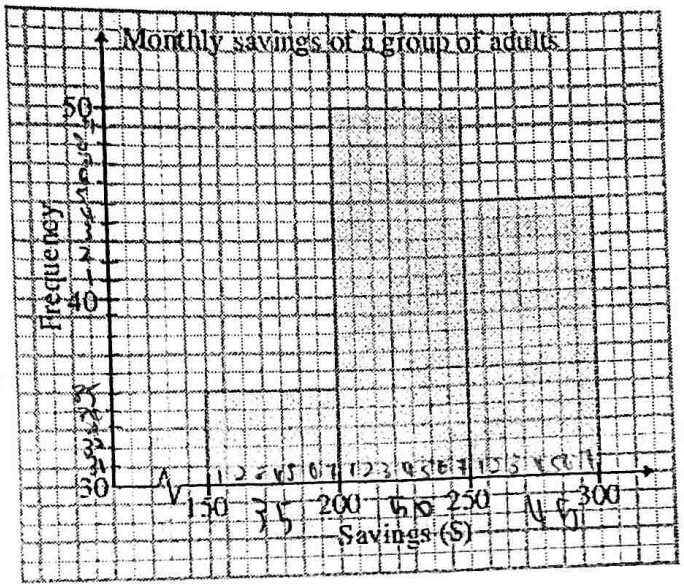
Angle of sector $= 360° \times \frac{52}{100}$

$= 187.20°$ ✗

(ii) Histogram, as it is easier to compare the number of students who got a certain mark against the number of students who got different marks. Also, the exact number of students who got a certain mark range can be clearly seen in the histogram, but not the pie chart.

(ii) A histogram. It is easier to see or compare the difference of scores.

2 The histogram shows the monthly savings ($) of a group of adults.



(a) Can we claim that there are 3 times as many adults who save $250 to $300 a month as compared to those who save $150 to $200 a month? Explain your answer.

(b) Describe how this histogram is misleading.

[Discovering Maths TB Ex 10.2 Q11]

a) No. $\frac{45}{35} \neq 3$, hence the statement is not true. ✓

b) The scale of the histogram does not start at zero. ✓

3 The masses (in grams) of 18 mobile phones are as follows:

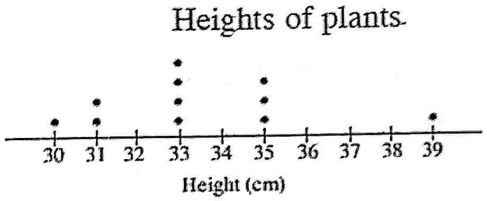
96	112	83	105	101	93	116	92	105
100	99	102	128	97	80	109	85	114

Which form of representation, a dot diagram or a stem-and-leaf diagram, would you use to present the data? Explain your answer. *[Discovering Maths TB Ex 10.3 Q8]*

A stem and leaf diagram, as there are many different values which only appear once. Hence, it would be easier to ~~make~~ use a stem and leaf diagram to present the data.

There are 18 mobile phones with masses varying from 80 grams to 128 grams, the range is too wide.

4 The dot diagram below shows the heights (in cm) of some plants.



(a) Find the mean height of the plants.
(b) Find the median height of the plants.
(c) Which of these two measures is a better representation of the centre in this distribution? Why?

[Discovering Maths TB Ex 10.5 Q4]

a) mean height of plants = $\frac{30 + 2(31) + 4(33) + 3(35) + 39}{11}$

= ~~33.5 (1 s.f.)~~ 33.5 cm / (3 s.f.) ✓

b) Median height of the plants = 34 cm / ×

Median height of the plants:

30, 31, 31, 33, 33, (33), 33, 35, 35, 35, 39 → 6th position

c) The mean height of the plants, as there are no plants with the actual height of 34cm in the set of plants. ×

Hence, the median height of the plant is 33cm /.

c) The median is a better representation of the centre of distribution since the mean is affected more by the extreme value of 39.

usually 2 marks → 1 mark: State and ~~the~~ 2nd mark: explain why graph is misleading

Misleading Graphs

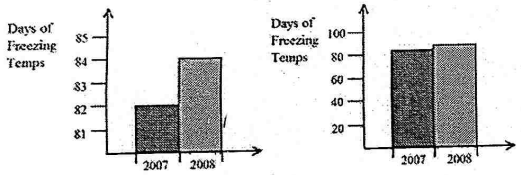
The "classic" types of misleading graphs include cases where:

Bar chart / Line graph	• Scale does not start at zero. • Vertical scale intervals made very small to make the difference in the data look very big. • Numbers are skipped in the vertical axis. • Data is left out. • Graph is not labeled properly.
Pie chart	• Pieces of a pie chart not at the correct sizes. • Percentage does not add up to 100%. • Graph does not have a title to explain what it is about.
Pictographs	• Oversized volumes of objects that are too big for the vertical scale differences they represent. • Sizes of images used for are not in standard size or shape.

Some examples:

Misleading Graphs

Compare the two graphs



Both show exactly the same data. However, the graph on the left makes the change appear to be much larger than it really is because the numbers on the vertical axis do not start at 0. Each vertical mark on the left graph represents 1 and each mark on the right represents 20 (the scale changes).

Image Source: http://www.his.washk12.org/

Misleading Graphs

The Scale does not start at zero, and makes the house price in 2006 look about seven times higher than 1975, when it is really only about two and a half times higher.

(eg. 160 000 in 2006 is about 2.5 times 60 000 in 1975).

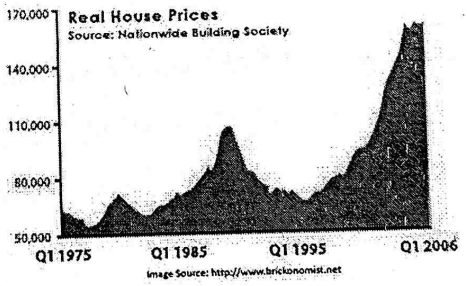


Image Source: http://www.brickonomist.net

Misleading Graphs

This pie chart is totally incorrect. The sizes of the pieces of pie have not been drawn the right sizes.

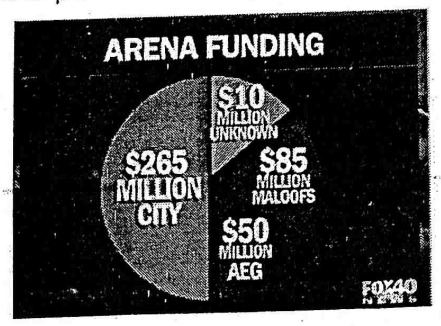


Image Source: http://www.visionjar.com

Misleading Graphs

Trick or Treat ? In this Picture Graph, there is definitely a trick being done! From the vertical scale Michael collected about twice as much candy as Shayna, but his picture is about three times bigger.

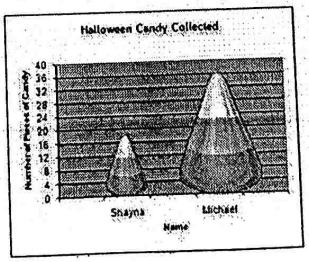
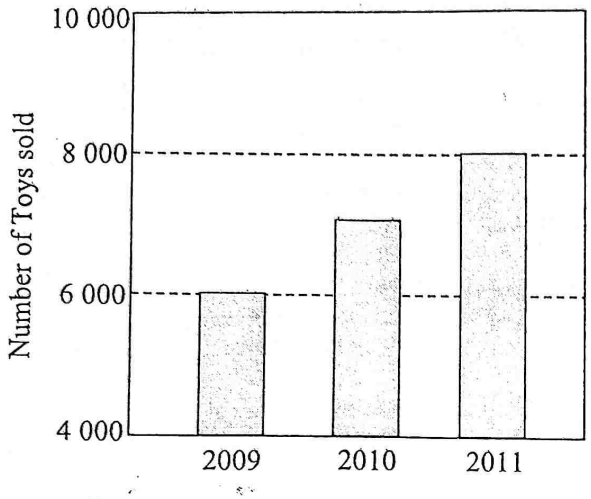


Image Source: http://www.yale.edu

Example 1

The sales manager of a toy company claims that the number of toys sold in 2011 was twice the numbe sold in 2009. Explain why this bar chart might be considered as misleading.

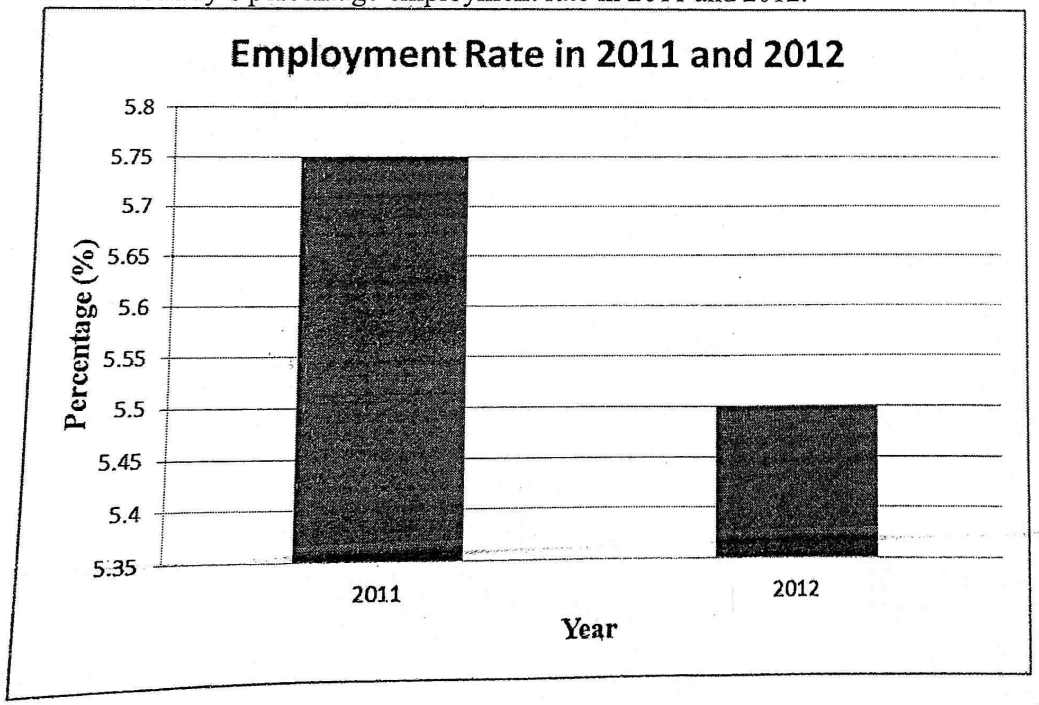


Answer Key

The bar chart might be considered misleading because the vertical axis does not start from zero. This gives the impression that the number of toys sold doubled in 2011 rather than increase by one-third in 2009.

Example 2

In a newspaper article prior to an election, a government releases the following statistics on the country's percentage employment rate in 2011 and 2012.



(a) Why is the bar chart above misleading? The bar chart's vertical axis does not start from zero.
(b) What should be done to the bar chart so that it is not misleading?

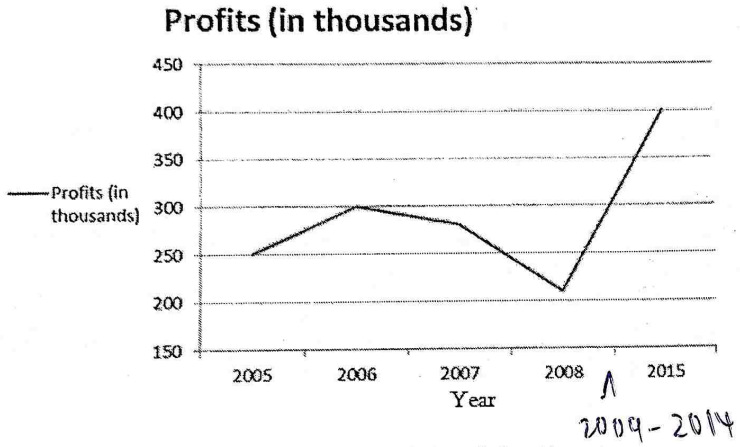
Answer Key

(a) The height of the 2012 bar is less than 50% of that for 2011, which is inconsistent to the actual employment rate where the difference is only 0.25 of the employment rate in 2011.

(b) Set the vertical axis to start at 0% employment rate.

Example 3

The line graph below shows the profits that a company has made over a few years.



2009 - 2014

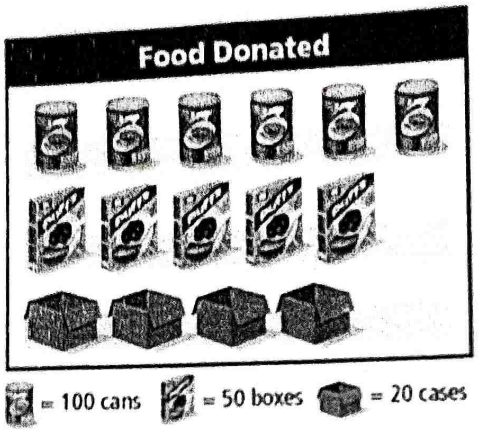
Explain one way in which the graph is misleading.

Answer Key

Misleading Feature	Effect
Inconsistent scale on ~~horizontal~~ horizontal axis	Exaggerates the different between the years
Not all years are shown	Profits could be very low from 2009 to 2014
unequal spacing of years	Misrepresents the trend
Vertical axis does not start from 0	Rate of gain in profits appear steeper

More Practice on Misleading Graphs

1(a)



~~The fe~~ quantities

The icons represent different types of food.

Explain one way in which the graph is misleading. [4]

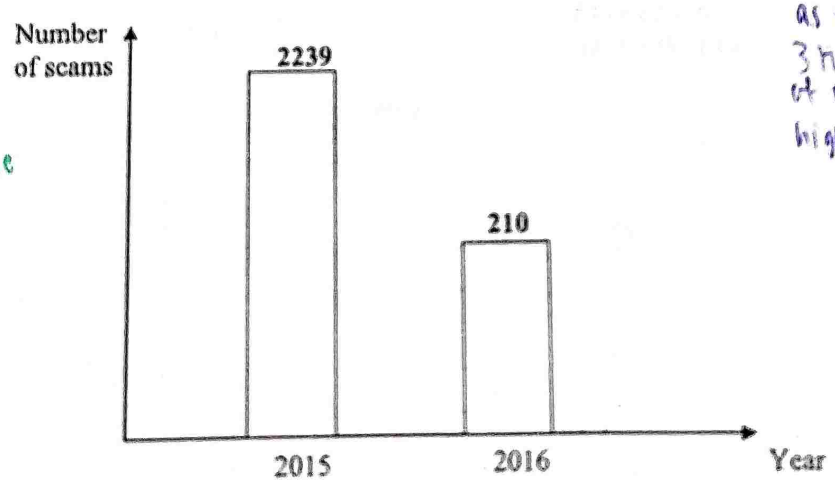
(b) Tedd got 70% on his Mathematics test.
He told his parents that the mode for the test was 70%. He said, "More students got 70% than any other grade, so I didn't actually do that poorly compared to my classmates."

The actual grades on the test were 70%, 70%, 70%, 75%, 82%, 85%, 90%, 94%, 95%, 96%, 96%, 97%, 98%, and 100%, but Tedd did not tell his parents the actual grades.

How did Tedd mislead his parents? [1]
[2017 Bedok North Sec Sch]

Although the mode of the grades were 70%, many students got different grades, all of which were higher than 70%. Hence, Tedd did poorly compared to his classmates, as the grade 70% appeared 3 times, but the rest of the grades were all higher than 70%

2 The bar graph below shows the drop in the number of online commercial scams from 2015 to 2016.

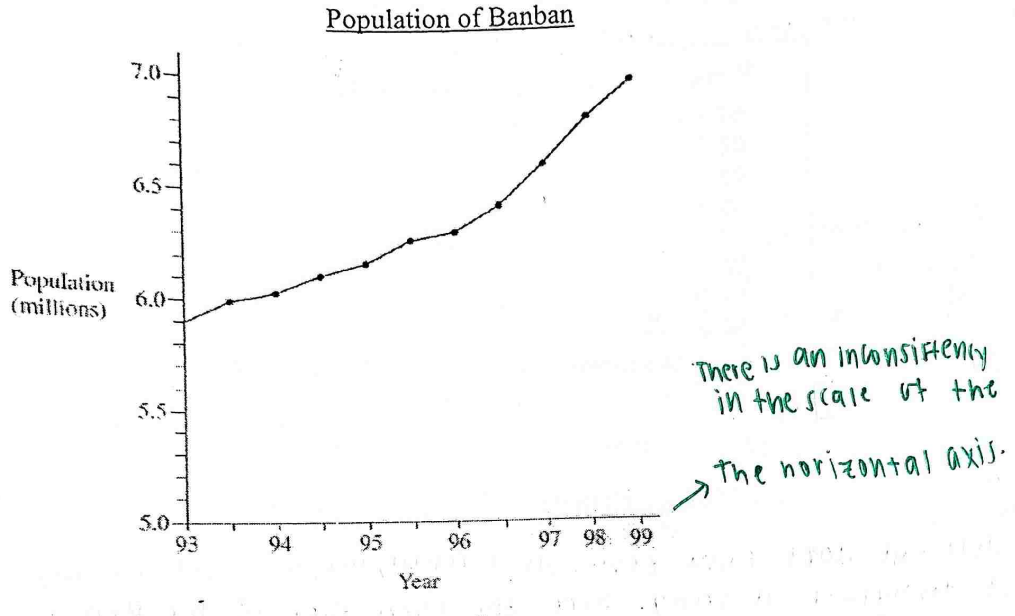


Numbers are missing from the vertical axis

Explain why this graph may be misleading. [1]
[2017 Bedok North Sec Sch]

The height of the bar for the year 2015 is twice the length of the bar for 2016. However, the actual number of scams in 2016 is clearly less than half the number of scams in 2015.

A girl draws this graph to show the population of a country, Banban for the years 1993 to 1999.

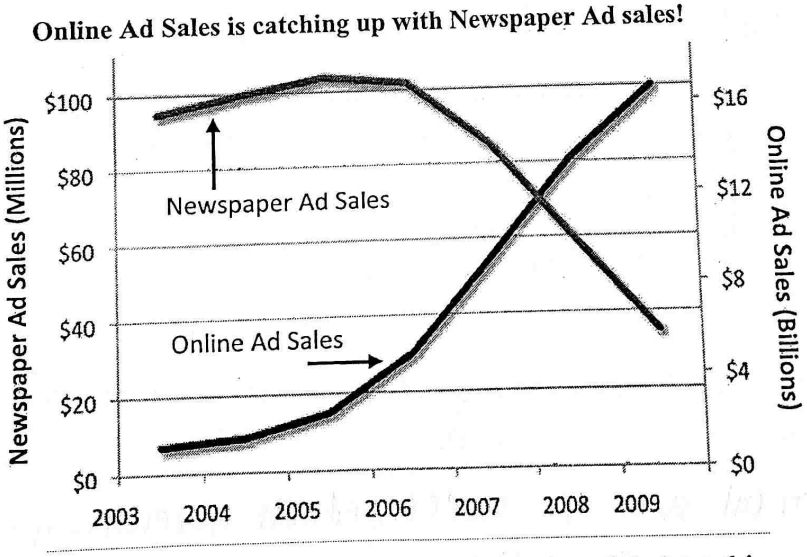


State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph. [2]

[2017 Cedar Girls' Sec Sch]

The vertical axis does not start on 0. This might lead to an exaggeration between the differences in population each year.

4 The newspaper and online advertisement sales from 2003 to 2009 is shown below.



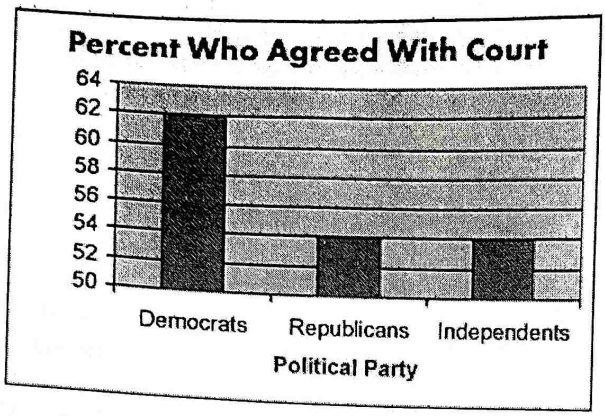
State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph. [2]

[2017 Greendale Sec]

The units on both axes are not the same, so we cannot compare them directly.

It is misleading, as readers might think that the amount of online Ad sales in lower than the amount of newspaper Ad sales from 2003 to 2008, when in fact there were more online Ad sales from 2003 to 2008 than Newspaper ~~Ad~~ Ad sales.

5 The Democrats filed a law suit against Republicans during the presidential campaign in 2016. The graph shows the percentage of Americans who agreed with the verdict.

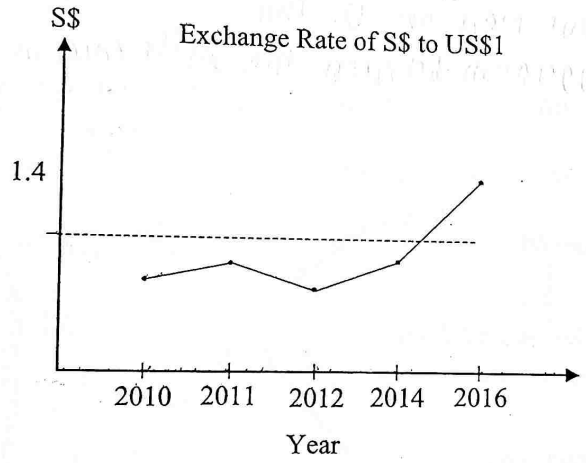


State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph. [2]

[2017 NYGH]

Vertical axis of the graph does not start from zero. As a result, people might misinterpret the number of democrats as being three ~~times~~ times that of the Republicans and Independents, when in fact there were only 8% more Democrats than Republicans and Independents.

6 The line graph below shows the exchange rate of Singapore dollars (S$) to one unit of United States dollar (US$) from 2010 to 2016.



State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph. [2]

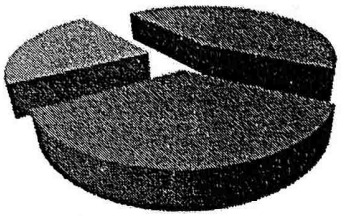
[2017 SCGS]

The vertical axis is undefined. As a result, the exchange rate for other years cannot be read properly.

7 The pie chart shows the global smartphone market share for a particular year.

The percentages of the pie chart do not add up to 100%.

Global Smartphone Market Share



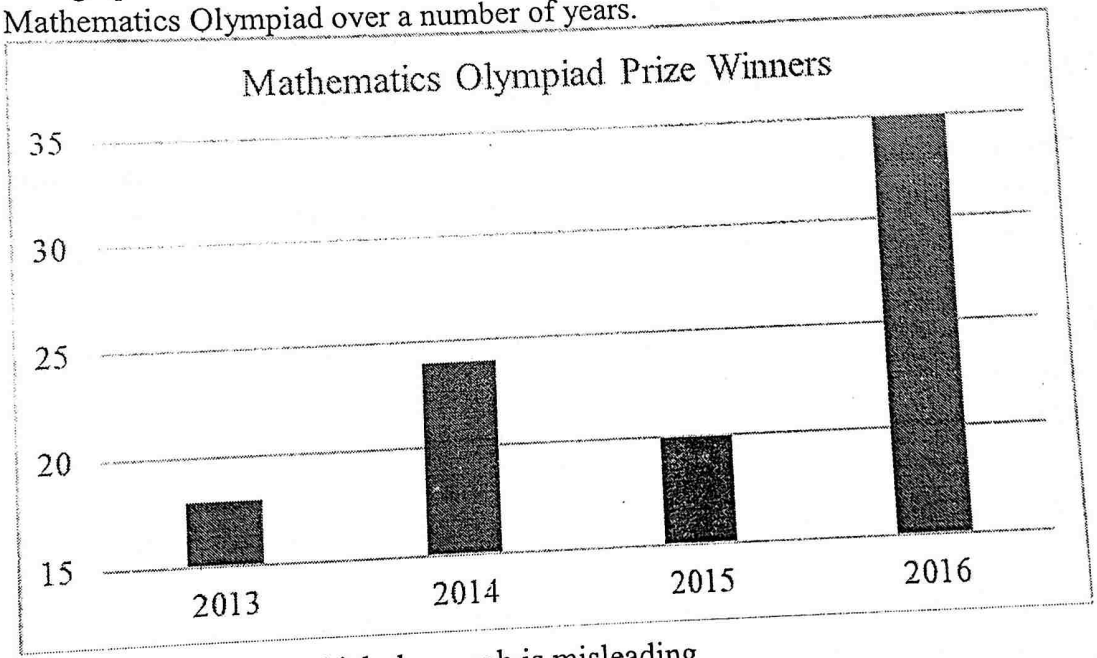
Although company A has 32% of the market share, its portion in the pie chart is smaller than that of company B, which has 24% share and 8% share than company A.

Explain one way in which the pie chart is misleading. [1]

[2016 Bedok North Sec Sch]

The values do not add up to 100%.

8 The graph shows the number of prize winners from Chung Cheng High School (Main) at the Mathematics Olympiad over a number of years.



Explain one way in which the graph is misleading. [1]

[2016 CCHMS]

The vertical axis of the graph does not start from zero. It starts at 15, hence the number of prize winners might be misleading.

Answers :

1(a) The icons represent different quantities of food. The icons are of different sizes.

(b) Tedd was correct about the mode, but he misled his parents by not telling them that other students except for 3 (including him) all scored above 70%. So he has done poorly compared to his classmates.

2 The height of the bar for 2015 is twice that of 2016. But the figure in 2016 is clearly not twice that of 2015. Other acceptable answers – the differences between the height of the bars and the figures are not proportional.

3 Acceptable answers:
- Unequal spacing of years on the horizontal axis may lead to misinterpreting the trend.
- The vertical axis does not start from 0. It exaggerates the differences between the population in each year.

4 The units on both axes are not the same (aspect) thus we cannot compare both sales numbers directly. It is misleading because it gives the readers a wrong sense that the online ad sales is less than the newspaper ad sales from 2003 to 2008. [accept other possible answers]

5 Vertical axis did not start from zero. Because of that, the percent of Democrats looked like it was more than double the percent of Republicans and Independents.

6
- The vertical scale is not defined. The exchange rate for other years cannot be read properly.
- The increase in the number of years is not constant/uniform or some years are missing. There is a possibility that the rate in 2013 could be a decrease.

7
- The sizes of the sectors are distorted. It gives the impression that Company *B* has the largest market share, but the figures show that Company *A* has the largest percentage of the global smartphone market.

- The percentages do not add up to 100%. It exaggerates the market shares of Company *A*, *B* and *C*.

8 The vertical axis (does not start at 0) starts at 15 OR the scale of the vertical axis is not uniform so the length of each bar is not representative of the number of prize winners.