General Maths Unit 3

Topic: Data and Statistics
Chapter 1 Part 2

Univariate Data
Investigating Data Distributions

Topics

- Dot plots and stem plots
- Log Scales
- Median, Range, IQR, Mean and Standard Deviation
- Five number summary and box plots

Dot Plots and Stem Plots – Ex 1d

Numerical data can be displayed in a number of ways:

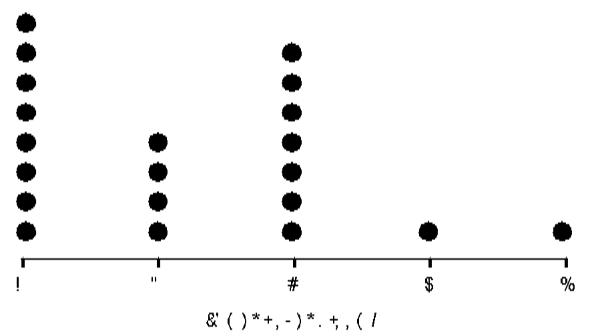
- Stem plots
- Frequency tables
- Histograms
- Dotplots
- Boxplots

Dot plots

- In dot plots, a single dot represents each data value.
- Dot plots are used to display discrete data where values are not spread out very much.
- They are also used to display categorical data.

Dot plots have a scaled horizontal axis and each data value is indicated by a dot above this scale. The end result is a set of vertical lines of evenly spaced dots.

Example



Stem Plots

- A stem plot or a stem-and-leaf plot is another quick and easy way to display numerical data
- Stem plots work well for both discrete and continuous data.
- They are particularly useful for displaying small to medium sized sets of data (up to about 50 data values)
- Like the dot plot, they are designed to be a pen and paper technique. original data in ascending order.

Key features of the stem plot

- Each data is considered to have 2 parts: stem and leaf.
- When asked to represent data using a stem and Leaf plot, the stem and leaf should be in numerical ascending order.
- It is important to include a key in a stem-plot so it is clear what the data values represent.

Example

rate (%) Key: 1|2 = 12

0	1 1 3 3 7 8 9
1	2 3 5 7
2	0 1 2 5 6 6 6 7
3	0 6 7
4	
5	5

Split Stem-and-leaf plots

Sometimes if the data is "bunched up" due to only a few values for the stem, we can split the stems.

Example

The marks of 17 VCE students on a statistics test is shown below

2 12 13 9 18 17 7 16 12 10 16 14 11 15 16 15 17

Shown in a stem plot

0	2 7 9
1	0 1 2 2 3 4 5 5 6 6 6 7 7 8

We can split the stem into either halves or fifths as shown below to gain a greater understanding of the spread

Stem split into halves

Key: 1|6 = 16

0	2
0	7 9
1	0 1 2 2 3 4
1	5 5 6 6 6 7 7 8

Stem split into fifths

Key: 1|6 = 16

0	
0	2
0	
0	7
0	9
1	0 1
1	2 2 3
1	4 5 5
1	6 6 6 7 7
1	8

Exam Question - 2013

The following ordered stem plot shows the percentage of homes connected to broadband internet for 24 countries in 2007.

key $1|6 = 16\%$

1	
1	6 7
2	0 1 1 3 4 4
2	5 7 8 9
3	0 0 1 1 1 2 2 3
3	5 7 8 8
4	

Question 1

The number of these countries with more than 22% of homes connected to broadband internet in 2007 is

A. 4
B. 5
C. 19
D. 20
E. 22

Complete Ex 1d

Using a log scale to display data – Ex 1e

- Many numerical variables we deal with have values that range over several orders of magnitude. E.g. the population of countries can range from a few thousand to millions.
- This would be impossible to show on a histogram.
- To solve this problem we convert the values using a logarithm scale, which spreads out the countries with small populations and "pulls in" the countries with large populations so that we can make sense of the histogram
- Log scales can be used to transform a skewed histogram to symmetry

Important points….

1. Always check the horizontal axis on your histogram to look for "log"
2. If log is there convert the log values to actual values by using the log value as a power of 10.

► A brief introduction to logarithms to the base 10 and their interpretation

Consider the numbers:

0.01, 0.1, 1, 10, 100, 1000, 10 000, 100 000, 1 000 000

Such numbers can be written more compactly as:

10^{-2}, 10^{-1}, 10^{0}, 10^{1}, 10^{2}, 10^{3}, 10^{4}, 10^{5}, 10^{6}

In fact, if we make it clear we are only talking about powers of 10, we can merely write down the powers:

−2, −1, 0, 1, 2, 3, 4, 5, 6

These powers are called the **logarithms** of the numbers or 'logs' for short.

When we use logarithms to write numbers as powers of 10, we say we are working with logarithms to the *base 10*. We can indicate this by writing $\log_{10}$.

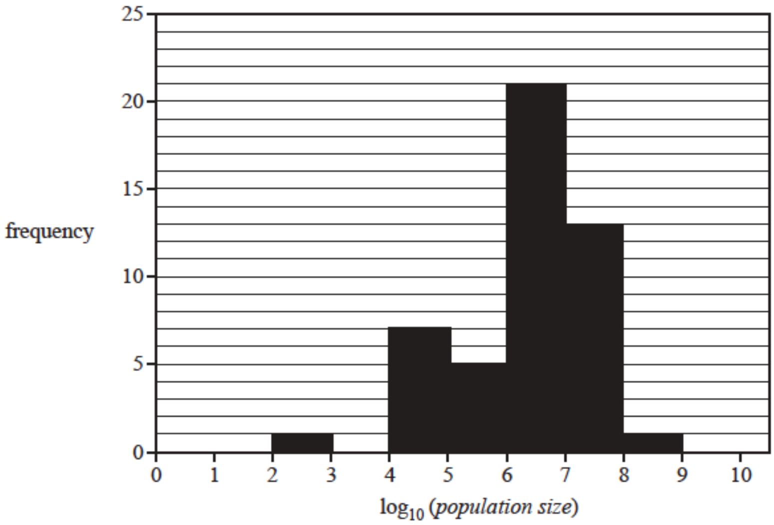
Note: We could also use logarithms to write numbers as powers of two, for example, $8 = 2^3$, or powers of 5 – for example, $625 = 5^4$. In these cases we would be working with logarithms to the base 2 and 5 respectively. Only base 10 logarithms are required for this course.

Examples

2019

Question 3

The histogram below shows the *population size* for these 48 countries plotted on a $\log_{10}$ scale.



Data: Worldometers, <www.worldometers.info/>

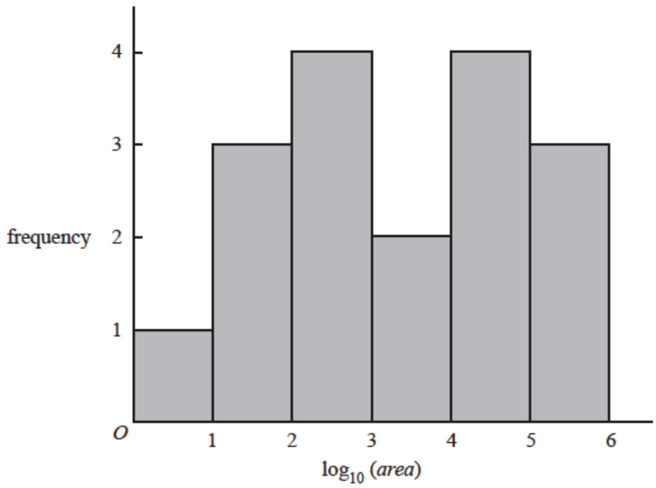
Based on this histogram, the number of countries with a *population size* that is less than 100 000 people is

A. 1
B. 5
C. 7
D. 8
E. 48

2017

Question 4

The histogram below shows the distribution of the $\log_{10}$ (*area*), with *area* in square kilometres, of 17 islands.



The median area of these islands, in square kilometres, is between

A. 2 and 3

B. 3 and 4

C. 10 and 100

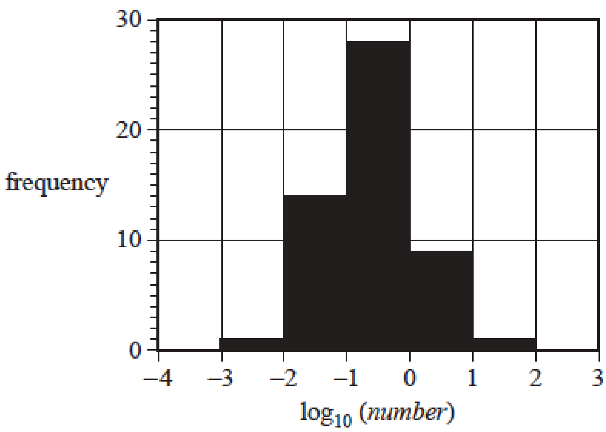
D. 1000 and 10 000

E. 10 000 and 100 000

2016

Question 7

The histogram below shows the distribution of the *number* of billionaires per million people for the same 53 countries as in Question 6, but this time plotted on a $\mathbf{log_{10}}$ scale.



Data: Gapminder

Based on this histogram, the number of countries with one or more billionaires per million people is

A. 1

B. 3

C. 8

D. 9

E. 10

▶ Constructing a histogram with a log scale

The task of constructing a histogram is also a CAS calculator task.

Using a TI-Nspire CAS to construct a histogram with a log scale

The weights of 27 animal species (in kg) are recorded below.

1.4	470	36	28	1.0	12 000	2600	190	520
10	3.3	530	210	62	6700	9400	6.8	35
0.12	0.023	2.5	56	100	52	87 000	0.12	190

Construct a histogram to display the distribution:

a of the body weights of these 27 animals and describe its shape

b of the log body weights of these animals and describe its shape.

Steps

1 a Start a new document by pressing ctrl + N.

b Select **Add Lists & Spreadsheet**.

Enter the data into a column named 'weight'.

2 a Press ctrl + I and select **Add Data & Statistics**.

Click on the **Click to add variable** on the x-axis and select the variable 'weight'. A dot plot is displayed.

b Plot a histogram using menu>**Plot Type**>**Histogram**.

c Describe the shape of the distribution.

Shape: positively skewed with outliers

3 a Return to the **Lists & Spreadsheet** screen.

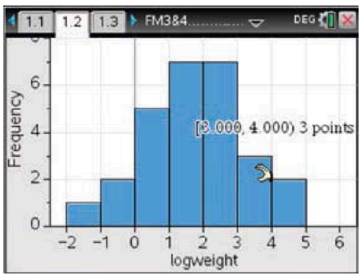
b Name another column 'logweight'.

c Move the cursor to the grey cell below the 'logweight' heading. Type in = **log(weight)**.

Press enter to calculate the values of logweight.

4 a Plot a histogram using a log scale. That is, plot the variable 'logweight'.

Note: Use menu>**Plot Properties**>**Histogram Properties**>**Bin Settings**>**Equal Bin Width** and set the column width (bin) to 1 and alignment (start point) to −2 and use menu>**Window/Zoom**>**Zoom-Data** to rescale.



b Describe the shape of the distribution.

Shape: approximately symmetric

Complete Ex 1e

Measures of Centre and Spread – Ex 1f

After displaying data using a histogram, stem plot, frequency table or dotplot we can make even more of sense of the data by calculating what are called **summary statistics.**

Summary statistics are used because they give us an idea about:

1. where the center of the distribution is
2. how the distribution is spread out.

Median – Measure of Centre

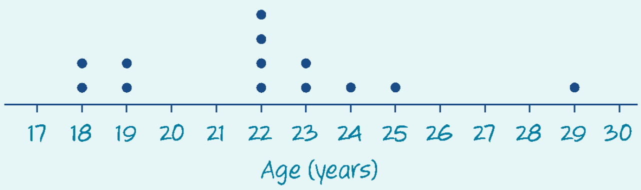
- When the data set is arranged in ascending order, the **median** is the middle value.

Rule to calculate Median

Median Score = $\dfrac{n+1}{2}$ th

Finding the median value from a dot plot

The dot plot opposite displays the age distribution (in years) of the 13 members of a local cricket team.



Determine the median age of these cricketers and mark its location on the dot plot.

Finding the median value from a stem and leaf plot

The stem plot opposite displays the maximum temperature (in °C) for 12 days in January.

Determine the median maximum temperature for these 12 days.

Key: 0|8 = 8°C

1	8 9 9
2	0 2 5 7 8 9 9
3	1 3

Range

The range is the difference between the highest and lowest value.

Range = Highest Score – Lowest Score

Finding the range from a stem plot

The stem plot opposite displays the maximum temperature (in °C) for 12 days in January.

Determine the temperature range over these 12 days.

Key: 0|8 = 8°C

1	8 9 9
2	0 2 5 7 8 9 9
3	1 3

Quartiles

The median divides a set of data in half. Quartiles divide a set of data into quarters.
The symbols used are **Q1 (Lower Quartile), Q2 (Median), Q3 (Upper Quartile)**

- The middle quartile **Q2 is the median.** This means that 50% of the data lie below this value and 50% of the data lie above this value.

- The Lower Quartile (Q1) means that the first 25% of the data lies below this value and 75% of the data lies above this value.

- The Upper Quartile (Q3) means that 75% of the data lies below this value and 25% of the data lies above this value.

There are 4 steps to locating the quartiles:

1. Write down the data in ascending order,
2. Locate the median Q2.
1. Now consider just the lower half of the set of data. Find the middle score. This is Q1.
2. Consider just the upper half of the set of data. Find the middle score. This is Q3.

Or, put all the values into your calculator and have the calculator find them for you

Interquartile Range

The interquartile range gives the range of the middle 50% of values.

IQR = Q3 – Q1

Example

Consider the stem plot below and find the median, quartiles, range, interquartile range and mode.

Stem	Leaf
2	3 3
2	5 7 9
3	1 3 3 4 4
3	5 8 9 9
4	0 2 2
4	6 8 8 8 9

Example

Use the stem plot to determine the quartiles Q_1 and Q_3, the IQR and the range, R, for life expectancies.

The median life expectancy is $M = 73$.

Stem: 5|2 = 52 years

5	2
5	5 6
6	4
6	6 6 7 9
7	1 2 2 3 3 4 4 4 4
7	5 5 6 6 7 7

Using CAS

CAS Calculator: Finding mean, mode, median, quartiles and standard deviation.

1. Enter 'Lists and Spreadsheets' mode.
2. Enter data into List A.
3. Label the column (optional)
4. Press 'Menu'.
5. Press '4: Statistics'.
6. Press '1:Stat Calculations'
7. Press 'One Variable'.
8. Number of lists: 1. Press OK.
9. Use arrow keys to find all needed information.

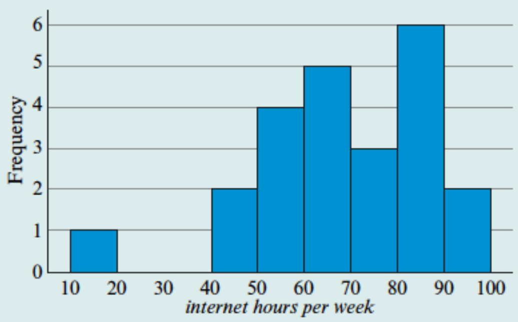
Why is the *IQR* a more useful measure of spread than the range?

The *IQR* is a measure of spread of a distribution that includes the middle 50% of observations. Since the upper 25% and lower 25% of observations are discarded, the interquartile range is generally not affected by the presence of outliers.

Finding the median and quartiles from a histogram

Example 20 Finding the median and quartiles from a histogram

The histogram shows the average number of hours per week a group of 23 people spent on the internet. Find possible values for the median and quartiles of this distribution.



Exam Question
2004

The following information relates to Questions 1 and 2.

The marks obtained by students who sat for a test are displayed as an ordered stemplot as shown

0	9
1	
2	0 1 2 5 6
3	0 1 1 1 3 5 5 7 8 9 9
4	1 2 3 4 4 6 7 7
5	0

Question 1

The number of students who sat the test is

A. 25

B. 26

C. 27

D. 32

E. 50

Question 2

The interquartile range of these test marks is closest to

A. 9

B. 13

C. 30

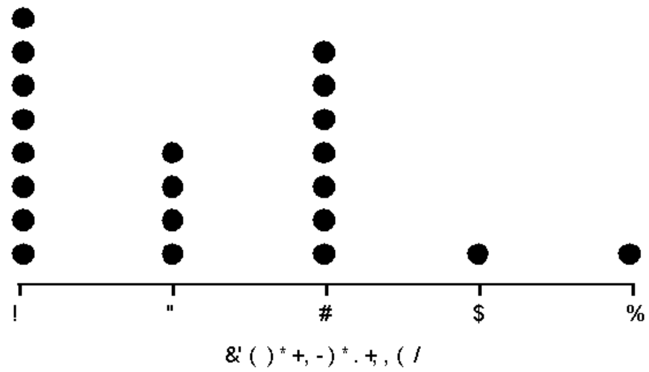
D. 36

E. 41

2007

! "#$%&' '&( )*+$)%&;- . /)&*$ #'. /#0$ &$1 2#0/)&*0$3$ *4$56*

*?7$824$=>24$1 7>2: $9?2: 9$4!?7$85 94; 5164523$2E$4!?7$36C I 7; $2E$1 78; 22C 9$53$7@1?$2E$1 . $@4@4C 7349$@8A7; 4597
9@7$53$@8 7: $?5K?D;597$@4@4C 734$1 >21HE



9 . 3+, 01 * (:

*?7$C 287$2E$4!?7 59$85 94; 5164523$59

) ;$.

<;$!

;$ M

7 ;$ #

" ;$ N

9 . 3+, 01 * (=

*?7$C 785@8$2E$4!?7 59$85 94; 5164523$59

) ;$.

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The mean and standard deviation

Alternative measures of centre and spread are:

- The mean (centre)
- The standard deviation (spread)

**These two values describe the centre and spread of a symmetric distribution with only two numbers.

Mean – Measure of Centre

- The mean of a set of data is what is referred to as the average.
- One value to represent the data set.
- It is found by the sum of data values divided by the number of data values.
- The symbol for the mean is **$\bar{x}$ or x bar**
- Is affected by outliers and skewed data.
- Useful for comparing sets of data that are symmetrical.

Rule

$$\text{mean} = \frac{\text{sum of data values}}{\text{total number of data values}}$$

Example

Calculate the mean value of: 10, 12,15, 16,18, 19, 22, 25, 27, 29

Notation

- the Greek capital letter sigma, $\sum$, as a shorthand way of writing 'sum of'
- a lower case x to represent a data value
- a lower case x with a bar, $\bar{x}$ (pronounced '*x bar*'), to represent the mean of the data values
- an n to represent the total number of data values.

The rule for calculating the mean then becomes: $\bar{x} = \dfrac{\sum x}{n}$

Example

The following is a set of reaction times (in milliseconds): 38 36 35 43 46 64 48 25

Write down the values of the following, correct to one decimal place.

a n **b** $\sum x$ **c** $\bar{x}$

Mean or Median??

Choosing between the mean and the median

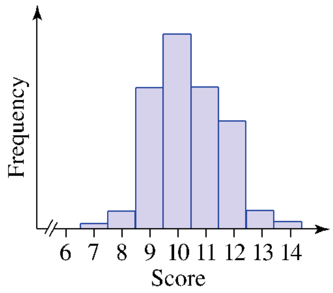
The *mean* and the *median* are both measures of the *centre* of a distribution. If the distribution is:

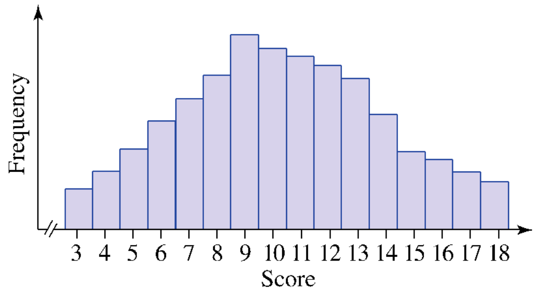
- *symmetric* and there are no outliers, either the *mean* or the *median* can be used to indicate the centre of the distribution
- clearly *skewed* and/or there are *outliers*, it is more appropriate to use the *median* to indicate the *centre* of the distribution.

Standard Deviation

- The standard deviation gives a measure of how data is spread around the mean.
- If a set of data has a small standard deviation it means the data is closely spread and the scores are consistent with each other.
- If the standard deviation is large it means the original data scores are well spread and are inconsistent.

Eg.





Each set of data has a mean of 10. The set of data above left has a standard deviation of 1 and the set of data above right has a standard deviation of 3.

As we can see, the larger the standard deviation, the more spread are the data from the mean.

Using CAS

CAS 3: How to calculate the mean and standard deviation using the TI-Nspire CAS

The following are the heights (in cm) of a group of women.

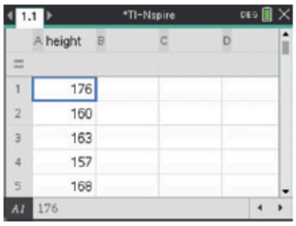
176 160 163 157 168 172 173 169

Determine the mean and standard deviation of the women's heights. Give your answers correct to two decimal places.

Steps

1 Start a new document by pressing [ctrl] + [N].

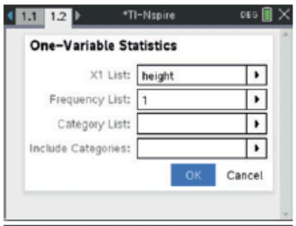
2 Select **Add Lists & Spreadsheet**.
Enter the data into a list named *height*, as shown.



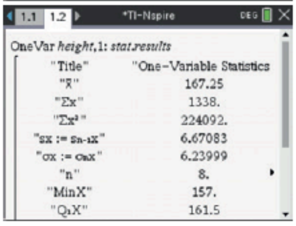
3 Statistical calculations can be done in either the **Lists & Spreadsheet** application or the **Calculator** application (used here).
Press [ctrl] + [I] and select **Add Calculator**.

a Press [menu]>**Statistics>Stat Calculations>One-Variable Statistics**. Press [enter] to accept the **Num of Lists** as 1.

b **i** To complete this screen, use the ▸ arrow and [enter] to paste in the list name *height*.



ii Pressing [enter] exits this screen and generates the results screen shown opposite.



4 Write down the answers to the required degree of accuracy (i.e. two decimal places).

The mean height of the women is $\bar{x}$ = 167.25 cm and the standard deviation is s = 6.67 cm.

Notes: **a** The sample standard deviation is **sx**.

b Use the ▲ ▼ arrows to scroll through the results screen to obtain values for additional statistical values.

Example

A group of year 12 students received the following percentage results for their Further Maths SAC. Use CAS to fill out the summary statistics below:

Scores:

12	87	55	67	89	44	9	23	24	12	89	77
98	34	67	54	51	73	65	54	44	30	99	87
56	43	89	56	33	89	75	70	43	29	97	92
12	69	76	54	43	22	90	78	88	91	27	19

Lowest Score:

Q1:

Median:

Q3:

Highest Score:

Range:

IQR:

Mean:

Standard Deviation:

Using CAS

When the data values have a frequency of more than one, then it is easiest to calculate the mean by using the Lists and Spreadsheet mode on CAS Calculator.

CAS Calculator: Finding mean, mode, median, quartiles and standard deviation.

1. Enter 'Lists and Spreadsheets' mode.
2. Enter data into List A.
3. Enter frequency into List 2 (only if frequencies are more than 1).
4. Label the columns
5. Press 'Menu'.
6. Press '4: Statistics'.
7. Press '1:Stat Calculations'
8. Press 'One Variable'.
9. Number of lists: 1. Press OK.
10. X List: List A, Freq: 1 or List B.
11. Press 'OK'.
12. Use arrow keys to find all needed information.

Eg 2. Calculate the weekly income of the following 30 families:

Income	Number of Families
\$350	3
\$480	2
\$550	2
\$600	4
\$680	6
\$700	6
\$720	7

Exam Question
2014

Use the following information to answer Questions 3–5.

The following table shows the data collected from a sample of seven drivers who entered a supermarket car park. The variables in the table are:

- *distance* – the distance that each driver travelled to the supermarket from their home
- *sex* – the sex of the driver (female, male)
- *number of children* – the number of children in the car
- *type of car* – the type of car (sedan, wagon, other)
- *postcode* – the postcode of the driver's home.

***Distance* (km)**	***Sex* (F = female, M = male)**	***Number of children***	***Type of car* (1 = sedan, 2 = wagon, 3 = other)**	***Postcode***
4.2	F	2	1	8148
0.8	M	3	2	8147
3.9	F	3	2	8146
5.6	F	1	3	8245
0.9	M	1	3	8148
1.7	F	2	2	8147
2.5	M	2	2	8145

Question 3

The mean, $\bar{x}$, and the standard deviation, s_x, of the variable, *distance*, are closest to

A. $\bar{x} = 2.5$ $\quad s_x = 3.3$
B. $\bar{x} = 2.8$ $\quad s_x = 1.7$
C. $\bar{x} = 2.8$ $\quad s_x = 1.8$
D. $\bar{x} = 2.9$ $\quad s_x = 1.7$
E. $\bar{x} = 3.3$ $\quad s_x = 2.5$

Question 4

The number of categorical variables in this data set is

A. 0
B. 1
C. 2
D. 3
E. 4

Question 5

The number of female drivers with three children in the car is

A. 0
B. 1
C. 2
D. 3
E. 4

2012

Question 3

The total weight of nine oranges is 1.53 kg.

Using this information, the mean weight of an orange would be calculated to be closest to

A. 115 g
B. 138 g
C. 153 g
D. 162 g
E. 170 g

1. 2003

The following information relates to Questions 4 and 5.

The mean weight of twelve people is 72 kg; the standard deviation of the weights of these twelve people is 5 kg.

Question 4

The total weight of the twelve people is

A. 77 kg
B. 360 kg
C. 864 kg
D. 924 kg
E. 4320 kg

Question 5

These twelve people are about to go on a rafting adventure. Before boarding the raft, they are all required to put on a life-saving vest that weighs 2 kg. The effective weight of each person is now their weight plus the weight of the life-saving vest.

The effective weights of the twelve people have

A. a mean of 72 kg with a standard deviation of 5 kg.
B. a mean of 72 kg with a standard deviation of 7 kg.
C. a mean of 74 kg with a standard deviation of 5 kg.
D. a mean of 74 kg with a standard deviation of 7 kg.
E. a mean of 74 kg with a standard deviation of 10 kg.

Complete Ex 1f

The five-number summary and box plots – Ex 1g

A boxplot is a graphical display of the summary statistics of a set of data.
It shows 5 important values: lowest score, Q1, median, Q3, highest score and any outliers if they exist.

Five number summary

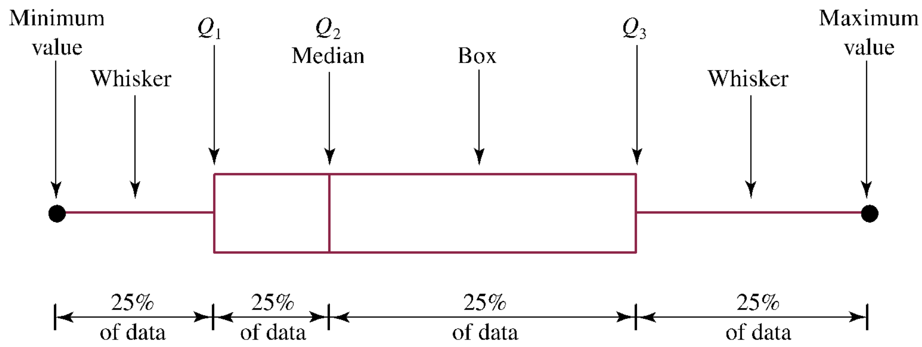
A listing of the median, M, the quartiles Q_1 and Q_3, and the smallest and largest data values of a distribution, written in the order

$$\text{minimum},\ Q_1,\ M,\ Q_3,\ \text{maximum}$$

is known as a *five-number summary*.

Constructing a boxplot:

1. Draw a scale to represent the values. Eg. If values range from 1-100, draw a 10cm horizontal line.
2. Mark the highest and the lowest score with a dot.
3. Mark the median Q1, median and Q3 with a vertical line.
4. Join the lines to form a box
5. Draw in whiskers.



Example
The results out of 20 in a Year 12 Maths Test are:

15	12	17	8	13	19	18	14	16	17	13
11	15	18	12							

display this data in a boxplot and comment on the skewness and outliers.

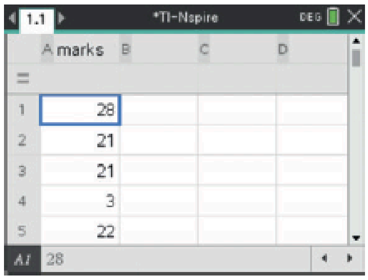
Using CAS

CAS 4: How to construct a boxplot with outliers using the TI-Nspire CAS

Display the following set of 19 marks in the form of a boxplot with outliers.

28 21 21 3 22 31 35 26 27 33
43 31 30 34 48 36 35 23 24

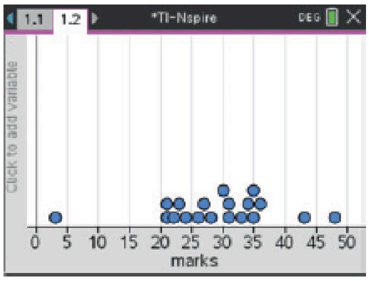
Steps



1 Start a new document by pressing [ctrl]+[N].

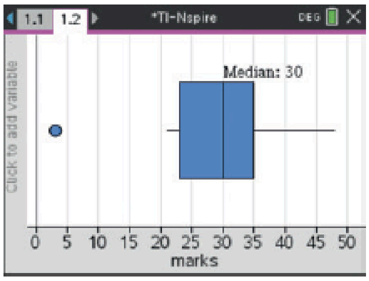
2 Select **Add Lists & Spreadsheet**. Enter the data into a list called ***marks*** as shown.

3 Statistical graphing is done through the **Data & Statistics** application.
Press [ctrl] + [I] and select **Add Data & Statistics**.



Note: A random display of dots will appear – this indicates that list data are available for plotting. Such a dot is not a statistical plot.

a Click on the **Click to add variable** on the x-axis and select the variable ***marks***. A dot plot is displayed by default as shown opposite.



b To change the plot to a boxplot press [menu]>**Plot Type**>**boxplot**. Your screen should now look like that shown opposite.

4 Data analysis
Key values can be read from the boxplot by moving the cursor over the plot or using [menu]>**Analyze>Graph Trace**.
Starting at the far left of the plot, we see that the:

- minimum value is 3 (an outlier)
- first quartile is 23 (**Q_1 = 23**)
- median is 30 (**Median = 30**)
- third quartile is 35 (**Q_3 = 35**)
- maximum value is 48.

Outliers

An outlier is an extreme score. If there are outliers in the data then the whiskers can be very long and this can misrepresent the data. This problem is overcome by using the rule that each whisker must be no longer than 1.5 times the IQR.

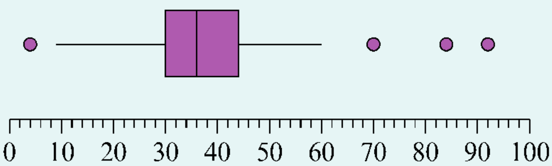
Lower Fence Outlier = Q1 – (1.5 x IQR)
Upper Fence Outlier = Q3 + (1.5 x IQR)

Any values that lie outside these limits are considered outliers.
They are marked on the boxplot with an open circle.

Interpreting Box plots

Example 1

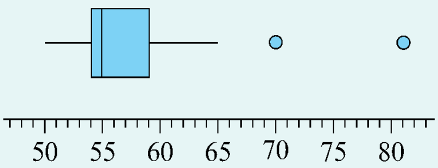
For the box plot shown, write down the values of:



a the median
b the quartiles Q_1 and Q_3
c the interquartile range (IQR)
d the minimum and maximum values
e the values of any possible outliers
f the smallest value in the upper end of the dataset that will be classified as an outlier
g the largest value in the lower end of the dataset that will be classified as an outlier.

Example 2

For the box plot shown, estimate the percentage of values:



a less than 54 **b** less than 55

c less than 59 **d** greater than 59

e between 54 and 59 **f** between 54 and 86.

2022 Exam 2 Example

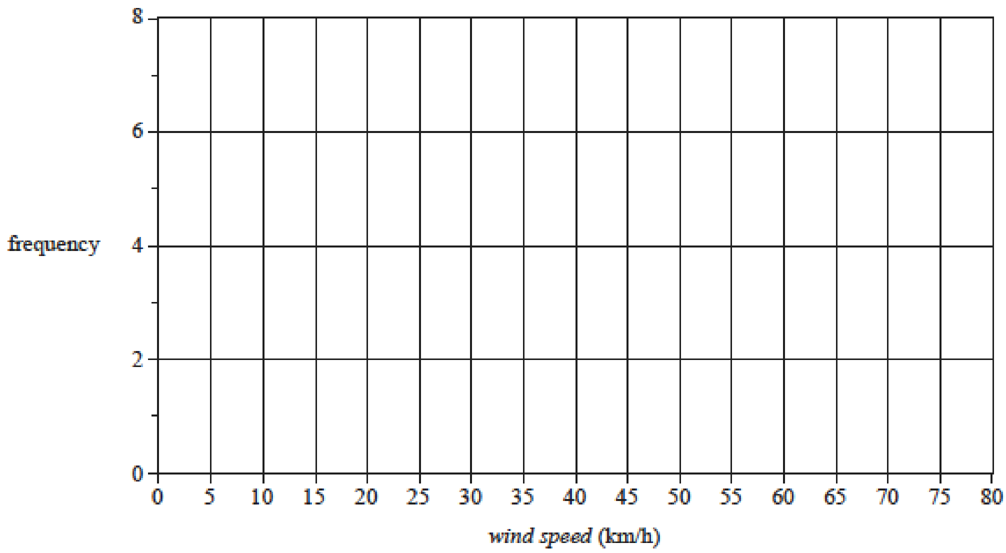
b. The five-number summary for *wind speed* in November 2021 is given below.

Minimum	First quartile (Q_1)	Median	Third quartile (Q_3)	Maximum
15	22	28	35	70

The *wind speeds* for November are to be used to construct a boxplot.

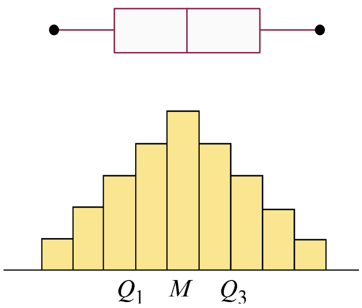
Show that the *wind speeds* of 59 km/h and 70 km/h would appear as outliers in this boxplot. 2 marks

c. On the grid below, use the data from the stem plot on page 2 to construct a histogram that displays the distribution of *wind speed* for November 2021. Use class intervals of widths of five, starting at 15 km/h. 2 marks

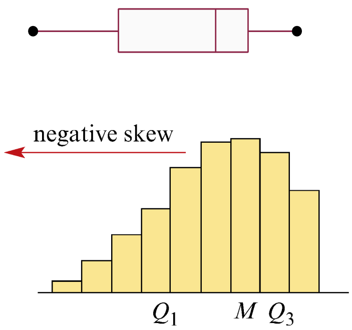


Relating a box plot to shape
As well as stemplots and histograms, the shape of boxplots can be described as symmetrical, positively skewed or negatively skewed.

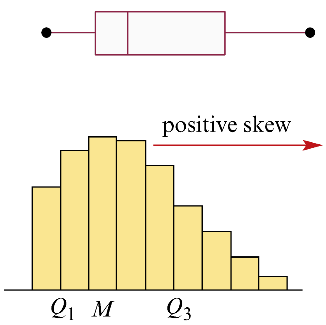
- **Symmetric:** whiskers are about the same length and the median is located about halfway along the box.



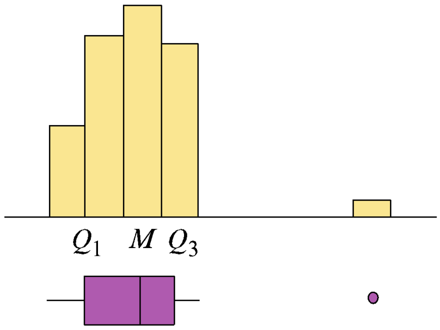
- **Negative:** left hand whisker is longer and the right hand whisker is shorter. The median occurs further towards the right.



- **Positive:** left hand whisker is shorter and the right hand whisker is longer. The median occurs further towards the left end of the box.



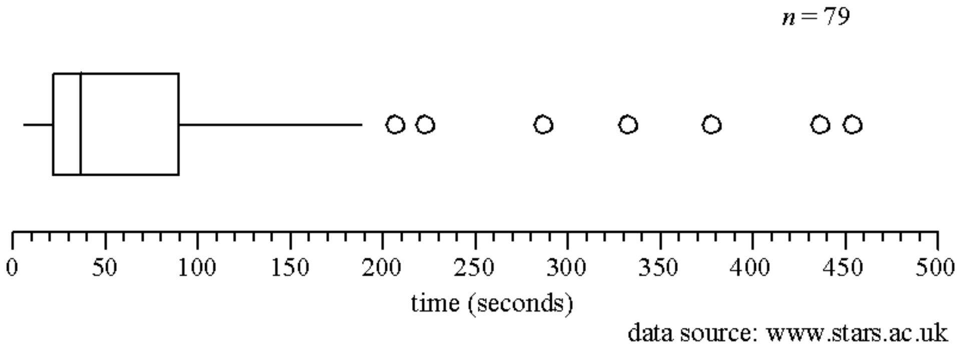
- **Distributions with outliers:**



Exam Question
2008

The following information relates to Questions 1, 2, 3 and 4.

The box plot below shows the distribution of the time, in seconds, that 79 customers spent moving : particular aisle in a large supermarket.



Question 1

The longest time, in seconds, spent moving along this aisle is closest to

A. 40

B. 60

C. 190

D. 450

E. 500

Question 2

The shape of the distribution is best described as

A. symmetric.

B. negatively skewed.

C. negatively skewed with outliers.

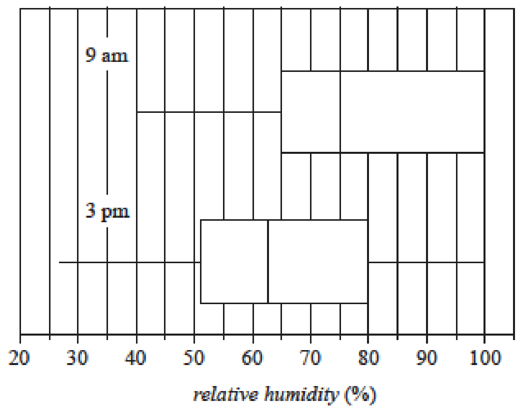
D. positively skewed.

E. positively skewed with outliers.

2022 Exam 2

Question 2 (5 marks)

The boxplots below show the distribution of *relative humidity* (%) at 9 am and 3 pm at a weather station for the 30 days of November 2021.



a. **i.** Determine whether the *relative humidity* in November is more variable at 9 am or 3 pm. Give the approximate values of both the interquartile ranges in your answer. 1 mark

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ii. Write down the percentage of days in November for which the *relative humidity* at 3 pm was less than 80%. 1 mark

___

iii. Complete the five-number summaries for the distributions of *relative humidity* at 9 am and 3 pm by writing the missing values in the table below. 1 mark

Time	Minimum	First quartile (Q_1)	Median	Third quartile (Q_3)	Maximum
9 am		65	75		
3 pm	27	51	63		

b. Do the boxplots support the contention that there is an association between *relative humidity* and time of day? Refer to the values of an appropriate statistic in your answer. 2 marks

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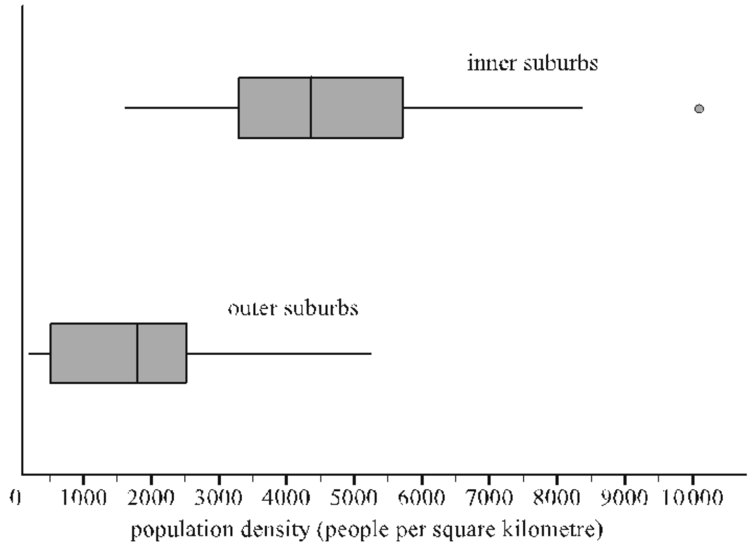
Exam Questions - 2014

Question 7

The parallel boxplots below summarise the distribution of population density, in people per square kilometre, for 27 inner suburbs and 23 outer suburbs of a large city.



Which one of the following statements is **not** true?

A. More than 50% of the outer suburbs have population densities below 2000 people per square kilometre.

B. More than 75% of the inner suburbs have population densities below 6000 people per square kilometre.

C. Population densities are more variable in the outer suburbs than in the inner suburbs.

D. The median population density of the inner suburbs is approximately 4400 people per square kilometre.

E. Population densities are, on average, higher in the inner suburbs than in the outer suburbs.

Complete Ex 1G