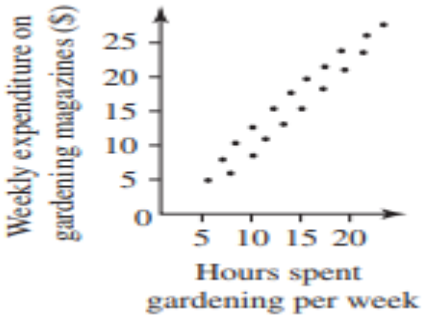
Week 2
Term 1
2021

HAWKER COLLEGE
Engage | Inspire | Achieve

Learning Brief

MA3



Goals

- review the statistical investigation process; for example, identifying a problem and posing a statistical question, collecting, or obtaining data, analysing the data, interpreting and communicating the results.
- construct a scatterplot, parallel dot plots, and divided bar charts to identify patterns in the data suggesting the presence of an association
- describe an association between two numerical variables in terms of direction (positive/negative), form (linear/non-linear) and strength (strong/moderate/weak)
- use a scatter plot to identify the nature of the relationship between variables

Theoretical Components

Resources:
For this week the theory work is in the Week *2* Notes & Exercises – see below

There are links to Mathspace lessons embedded in the Week 2 booklet.

The clip introduces scatterplots

https://www.youtube.com/watch?v=G6Edu_RybxA

A further explanation of scatter plots and correlation is given by

https://www.youtube.com/watch?v=CWnfwZRAuaY&disable_polymer=true

Knowledge Checklist

- Interpret parallel dot plots
- Using an appropriate scale to construct dot plots
- Interpret divided bar charts
- Constructing a divided bar chart
- Determining the relationship between two variables using a scatterplot
- Determining the independent variable
- Constructing a scatterplot

Practical Components

There are questions to be answered in the booklet *Week 2 Notes & Exercises*

Review Week 1 and 2
https://mathspace.co/student/tasks/TopicCustomTask-436801/

Investigation

See the end of the brief ☺

Quiz

https://mathspace.co/student/tasks/TopicCustomTask-436801/

MATHEMATICAL APPLICATIONS 3

WEEK 2 NOTES & EXERCISES

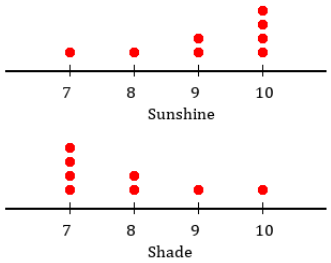
Parallel Dot Plots

Dot plots are a quick way to represent data visually. Dot plots are usually used for small data sets because they can help you to quickly see the spread of data and identify any outliers.

Parallel dot plots help you compare two or more sets of data, which must be plotted against the same scale. This makes the comparison between the data sets easy and ensures it isn't misleading. Parallel dot plots must be in the same unit and same scale.

Exercise 1

1. Elizabeth did an experiment to see how well plants grow in different conditions. She had 8 plants grow in the sunshine, and 8 plants grow in the shade. She measured how tall they grew in centimetres after 2 months and recorded the information as a parallel dot plot.

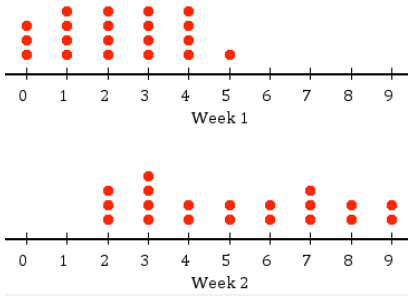


   a. Which group of plants had a higher range of heights?

   b. Which dot plot shows a positive skew?

   c. How much higher is the median height of plants that grew in the sunshine than the median height of plants that grew in the shade?

2. Twenty people joined a group fitness class and over two weeks, they were tested on the number of chin ups they can do. The dot plots show the number of chin ups each person could do.



a. From the first to the second week, what was the increase in the median number of chin ups someone could do?

b. In week 1, the average number of chin ups was 2.25. Did the average increase or decrease in the second week?

3. Mae and Amelia are goal shooters for their netball teams. The table shows the number of goals they score in each game of the season.

	Game 1	Game 2	Game 3	Game 4	Game 5	Game 6	Game 7	Game 8
Mae	2	5	5	4	3	2	2	4
Amelia	2	1	1	3	4	2	3	1

a. Construct parallel dot plots for this data.

b. How does the range of each set of scores compare?

Divided Bar Charts

When comparing two categorical variables, it can be useful to represent the results from a two-way table (in percentage form) graphically. We can do this using divided (segmented) bar charts. A segmented bar chart consists of two or more columns, each of which matches one column in the two-way table. Each column is subdivided into segments, corresponding to each cell in that column. The segmented bar chart is a powerful visual aid for comparing and examining the relationship between two categorical variables.

Example

Sixty-seven primary and 47 secondary school students were asked about their attitude to the number of school holidays which should be given. They were asked whether there should be fewer, the same number, or more school holidays. 5 primary school students and 2 secondary students wanted fewer holidays, 29 primary and 9 secondary students thought they had enough holidays (that is, they chose the same number) and the rest thought they needed to be given more holidays. The data in percentage form is shown in two-way frequency tables and a segmented bar chart.

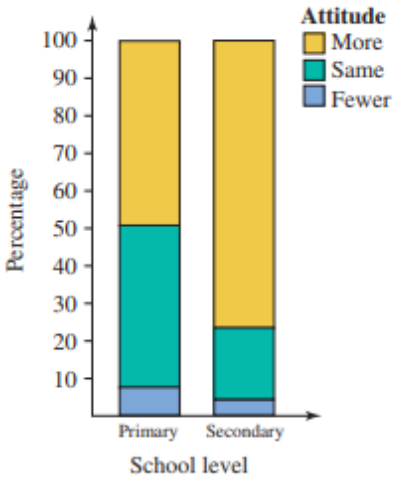
Solution
Raw Data:

Attitude	Primary	Secondary	Total
Fewer	5	2	7
Same	29	9	38
More	33	36	69
Total	67	47	114

Percentages:

Attitude	Primary	Secondary
Fewer	7.5	4.3
Same	43.3	19.1
More	49.2	76.6
Total	100	100

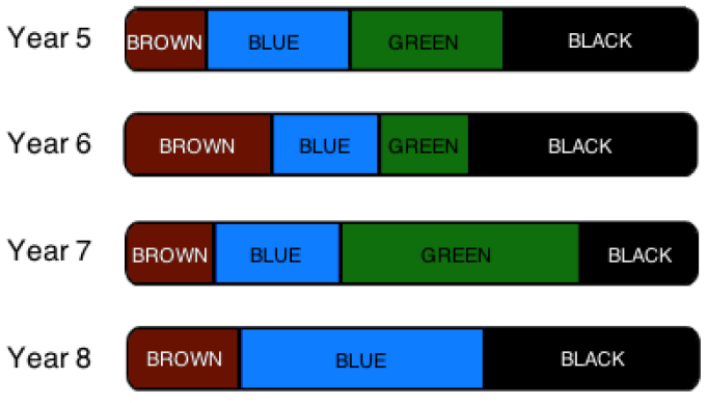
Divided Bar Chart:



Secondary students were much keener on having more holidays than were primary students.

Exercise 2

1. A survey was conducted asking students from Year 5, 6, 7 and 8 what eye colour they have. Study the four divided bar graphs shown here and answer the following questions.



   a. Which grade has the largest percentage of brown-eyed children?

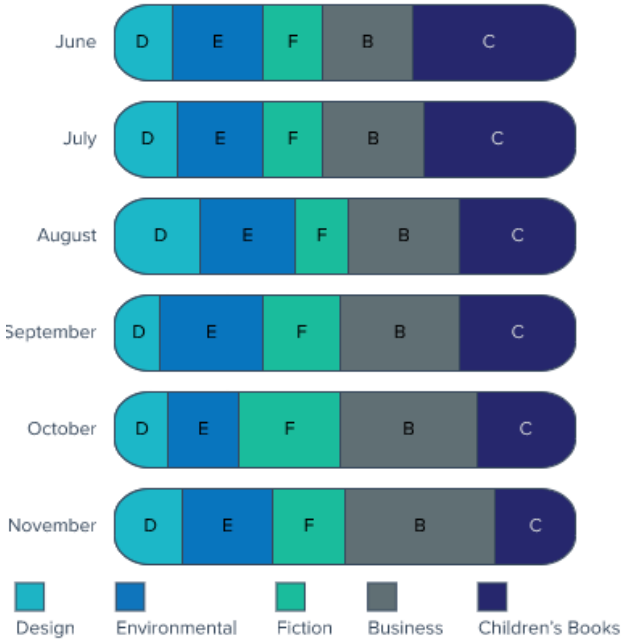
b. Which grade has the largest percentage of blue-eyed children?

c. Which grade has the largest percentage of black-eyed children?

d. Which grade has no green-eyed children?

e. Which grade has the same percentage of green-eyed children as blue-eyed children?

2. The local library constructed divided bar graphs showing the last six months of book loans by category. Assume that the total number of loans was the same for each month.
3.



a. In which month did subscribers borrow the most children's books?

b. In which month did people borrow the same number of design books as environment books?

c. Which book category grew constantly during the 6 months?

Scatter Plots

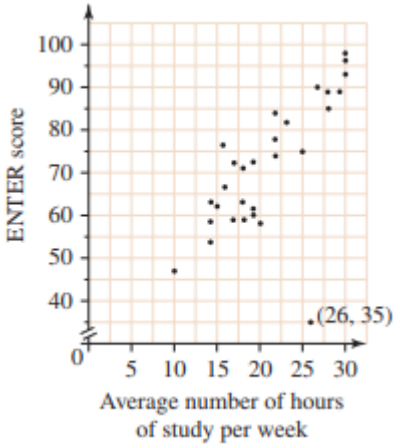
We often want to know if there is a relationship between two numerical variables. A scatter plot, which gives a visual display of the relationship between two variables, provides a good starting point. Consider the data obtained from last year's class at Northbank College. Each student in the class of 29 students was asked to give an estimate of the average number of hours they studied per week during Year 12. They were also asked for the ENTER score they obtained.

Average hours of study	ENTER score
18	59
16	67
22	74
27	90
15	62
28	89
18	71
19	60
22	84
30	98

Average hours of study	ENTER score
14	54
17	72
14	63
19	72
20	58
10	47
28	85
25	75
18	63
19	61

Average hours of study	ENTER score
17	59
16	76
14	59
29	89
30	93
30	96
23	82
26	35
22	78

The figure below shows the data plotted on a scatter plot.



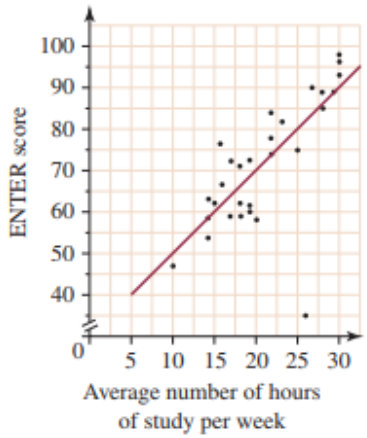
It is reasonable to think that the number of hours of study put in each week by students would affect their ENTER scores and so the number of hours of study per week is the independent variable and appears on the horizontal axis. The ENTER score is the dependent variable and appears on the vertical axis.

In analysing the scatter plot, we look for a pattern in the way the points lie. Certain patterns tell us that certain relationships exist between the two variables. This is referred to as **correlation**. We look at what type of correlation exists and how strong it is.

In the figure above, we see some sort of pattern: the points are spread in a rough corridor from bottom left to top right. We refer to this data following such a direction as having a **positive** relationship. This tells us that as the average number of hours studied per week increases, the ENTER score also increases.

The point (26,35) is an **outlier**. It stands out because it is well away from the other points and clearly is not part of the 'corridor' referred to previously. This outlier may have occurred because a student exaggerated the number of hours he or she worked in a week or perhaps there was a recording error. This needs to be checked.

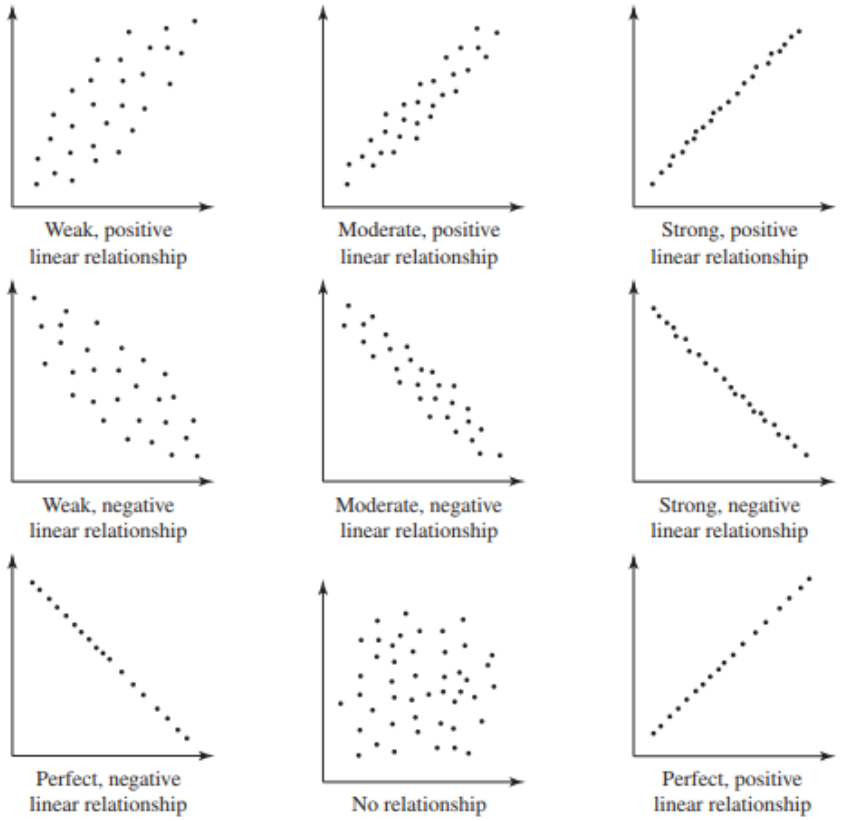
We could describe the rest of the data as having a linear form as the straight line in the diagram below indicates.



When describing the relationship between two variables displayed on a scatter plot, we need to comment on:

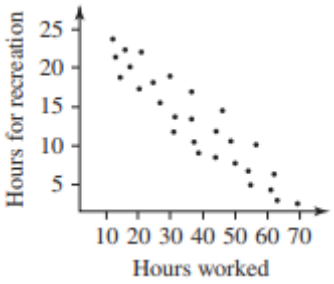
a. The direction – whether it is positive or negative
b. The form – whether it is linear or non-linear
c. The strength – whether it is strong, moderate, or weak
d. Possible outliers.

Below is a gallery of scatter plots showing the various patterns we look for:



Example

Th scatter plot on the right shows the number of hours people spend at work each week and the number of hours people get to spend on recreational activities during the week.



Decide whether a relationship exists between the variables and comment on whether it is positive or negative; weak, moderate or strong; and whether it has a linear form.

Solution

- The points on the scatter plot are spread in a certain pattern, namely in a rough corridor from the top left to the bottom right corner. This tells us that as the work hours increase, the recreation hours decrease.
- The corridor is straight (that is, it would be reasonable to fit a straight line into it).
- The points are neither too tight nor too dispersed.
- The pattern resembles the central diagram in the gallery of scatter plots show previously.

There is a moderate, negative relationship between the two variables.

Exercise 3

1. For each of the following pairs of variables, write down whether you would reasonably expect a relationship to exist between the pair and, if so, comment on whether it would be a positive or negative association.

    a. Time spent in a supermarket and money spent

b. Income and value of car driven

c. Number of children living in a house and time spent cleaning the house

d. Age and number of hours of competitive sports played per week

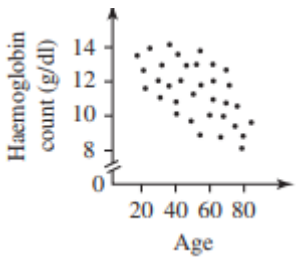
e. Amount spent on petrol each week and distance travelled by car each week

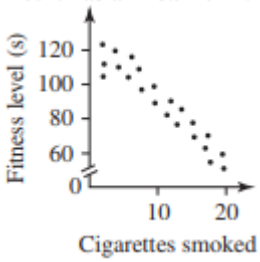
f. Number of hours spent in front of a computer each week and time spent playing the piano each week

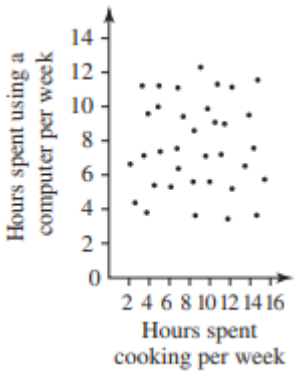
g. Amount spent on weekly groceries and time spent gardening each week

h. Amount of time spent studying and grade on the test

2. Use the wording in the gallery above to describe the correlation between the variables shown in the graphs below:







Devise and sketch your own scatter plot, labelling the axes with appropriate variables, that describes a strong, positive correlation. Remember the independent variable should be on the horizontal axis.

3. The population of a municipality (to the nearest ten thousand) together with the number of primary schools in that municipality is given below for 11 municipalities.

Population (x1000)	110	130	130	140	150	160	170	170	180	180	190
Number of primary schools	4	4	6	5	6	8	6	7	8	9	8

Construct a scatter plot (use a ruler) for the data and use it to comment on the direction, form, and strength of any relationship between the population and the number of primary students. **Note:** The population is the independent variable and thus becomes the x axis.

4. The table below contains data for the time taken to do a paying job and the cost of the job. Determine the independent variable. Construct a scatter plot for the data. Comment on whether a relationship exists between the time taken and the cost. If there is a relationship, describe it.

Time taken (hours)	Cost of job ($)
5	1000
7	1000
5	1500
8	1200
10	2000
13	2500
15	2800
20	3200
18	2800
25	4000
33	3000

2021 MA3

Investigation Week 2

Hypothesis: The length of a person's foot is approximately 15% of their height.

You are going to investigate to see whether it is true.

1. Complete the table below to collect data from nine other school mates. Yours will be the tenth. Make sure you keep both pieces of information together, as you will need to compare each person's foot length with their height.

	Foot length (cm)	Height (m)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

2. Draw a scatter plot using your data on a separate piece of paper. Make sure you identify the independent variable correctly as this determines the x axis. Call this scatter plot 'our school'. Make sure you attach this to the investigation on the next page. **Note:** You may use Excel to draw a scatter plot and print it.

3. Complete this table to show what people's foot length would be if they were 15% of their height:

Foot length (cm)	Height (m)
	1.0
	1.2
	1.4
	1.6
	1.8

4. Plot these points on your scatter graph (in a different colour).

5. Use your scatter graph to evaluate whether the hypothesis was true for your school. Consider the following
   - How close in shape were the two scatter plots?
   - Did any of your school results fall within/near the hypothesis scatter plot "corridor"?
   - Was the hypothesis reasonable or do you think you would need more information?

Marking Rubric

CRITERIA	EXPECTATIONS	POSS	MULT	GIVEN	TOTAL
Practical	Student completes practical work, including exercises and Mathspace task, of the brief to an acceptable standard set by the teacher.	**2**	**3**		**/6**
Investigation Task	Student completes the investigation task of the week to an acceptable standard set by the teacher.	**2**	**2**		**/4**
Reasoning and Communications	Student responses are accurate and appropriate in presentation of mathematical ideas, with clear and logical working out shown.	**4**	**-**		**/4**
Concepts and Techniques	Student submitted work selects and applies appropriate mathematical techniques to solve practical problems and demonstrates proficiency in the use of mathematical facts, techniques, and formulae.	**4**	**-**		**/4**
	Submission Guidelines				
Timeliness	Student submits the exercises, Mathspace/online task and investigation by the set deadline. See scoring guidelines for specific details.	**2**	**-**		**/2**
				FINAL	**/20**

Student Reflection: How did you go with this week's work?
What did you learn?

What did you find easy?

What do you need to work on?