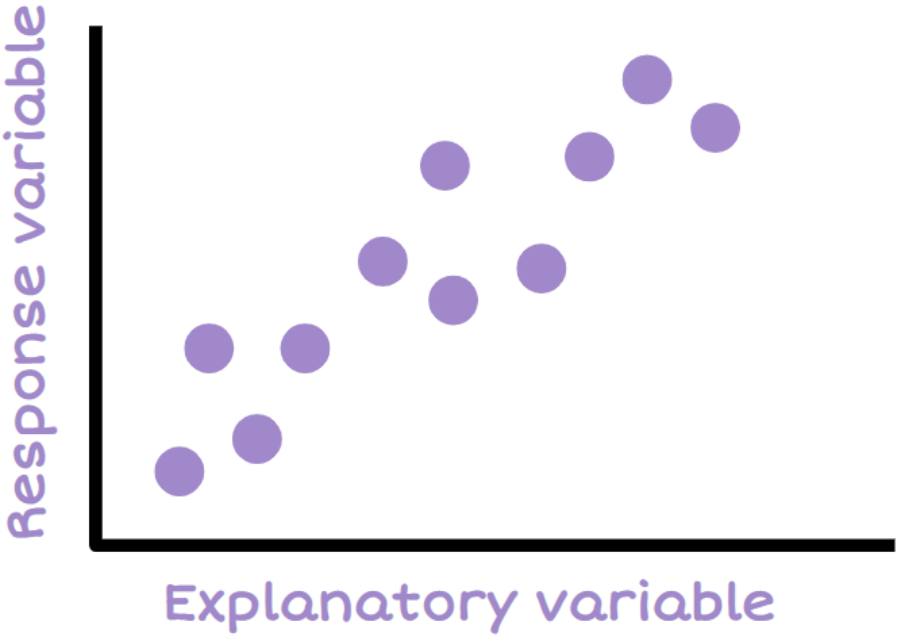
Year 10 Relationships Workbook



Name:

By Liz Sneddon_

Problem / Plan

Example:

Problem

I wonder if there is a relationship between a person's foot length and hand span for students at your school?

Plan

For measuring foot length:

1. Ask the person to remove their right shoe.
2. Ask the person to place their right foot against a wall, facing outwards.
3. Make sure that their heel is touching the wall.
4. Place a book at the end of their toes.
5. Using a tape measure, measure the distance (in mm) from the wall to the bottom of the book.
6. Record this measurement on a data table.
7. Take measurements from 30 students.

For measuring hand span:

1. Ask the person to place their right hand flat on a piece of paper on a desk, palm down.
2. Ask the person to spread their fingers as wide as they can.
3. Using a pen, mark the edge of the persons' smallest finger and thumb.
4. The person can now remove their hand.
5. Using a tape measure, measure the distance (in mm) between the two marks.
6. Record this measurement on a data table.
7. Take measurements from 30 students.

Exercises:

Look at the example plan and answer these questions.

1) Why would you ask the student to remove their shoe? Explain.

2) Does it matter whether you measure a student's left or right foot? Explain why/why not.

3) Why should we take measurements from people with small **and** big feet? (E.g. young and older people).

4) Circle the words that complete the sentences below.

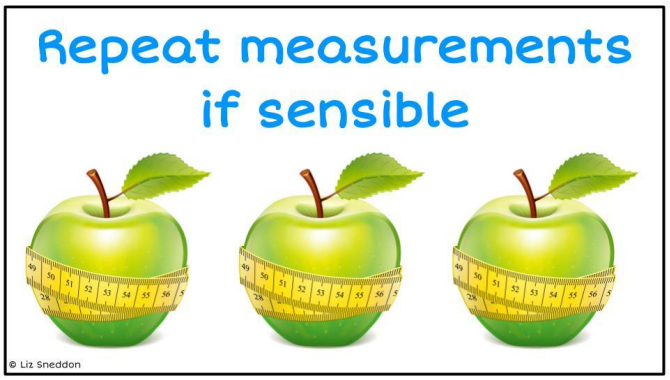
Smaller sample sizes take a shorter / longer time to collect data, but are more / less reliable.

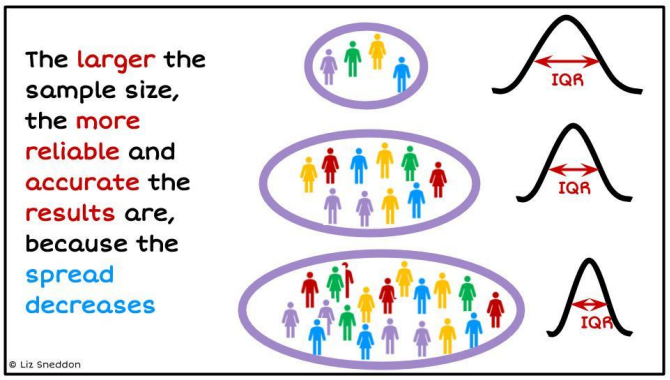
Larger sample sizes take a shorter / longer time to collect data, and are more / less reliable.

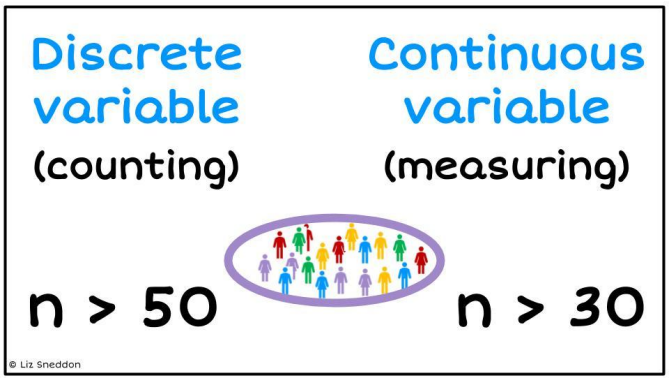
Controlling sources of variation

When coming up with your plan, you need to think about how you can minimise the amount of variation - making sure that all the measurements are done in the same way.

Here are some things to think about:







Example:

When measuring foot length and handspan, some of the factors I will control are:

- Using the same measuring tape, so that all the measurements are consistent.
- Getting students to put their hand down on a piece of paper, so that their hand is as flat as possible. This will make the measurements consistent.
- Get students to take their shoe off when I measure the length of their foot, because the different shoes people wear could have a different end (e.g. pointed, flat, curved) which would change the measurements and not be an accurate measurement of the length of their foot.

Exercises

Problem 1
I wonder if there is a relationship between a person's **height** and **weight** for students at your school?

Plan
State what the two variables you are investigating are.
Then write a detailed plan of how you are going to take these measurements.

Measure Variable 1:_____

Measure Variable 2: _____

Plan:

Problem 2

I wonder if there is a relationship between the **distance** a student walks to school and the **time** it takes to walk from home for students at your school?

Plan

State what the two variables you are investigating are.
Then write a detailed plan of how you are going to take these measurements.

Measure Variable 1:_____

Measure Variable 2: _____

Plan:

Data

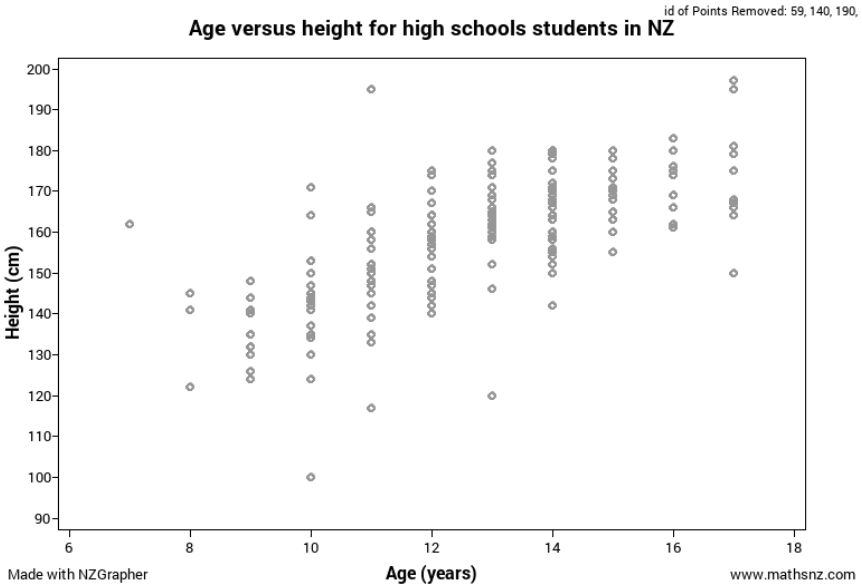
You will need to measure and record the data for your investigation. You will need to set up a table similar to the one below.

Sample	Measurement 1	Measurement 2
1		
2		
3		
…		
30		

Drawing Scatter Graphs

You will be using NZGrapher to draw a graph of your data.

Example:

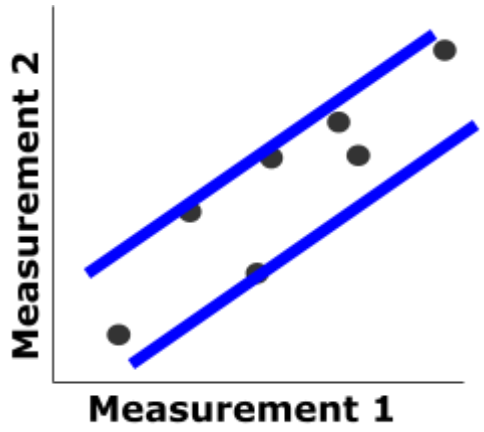
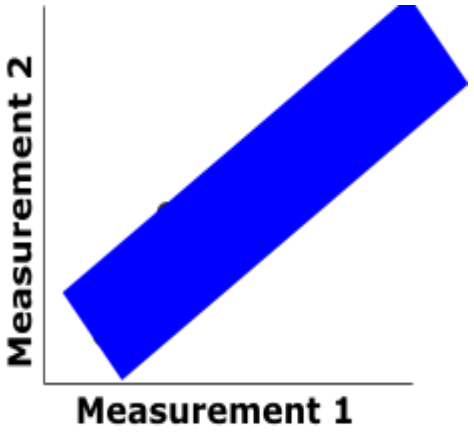


Exercise:

Go to NZGrapher and explore one of the following two datasets. Then choose two quantitative variables and draw a scatter graph.

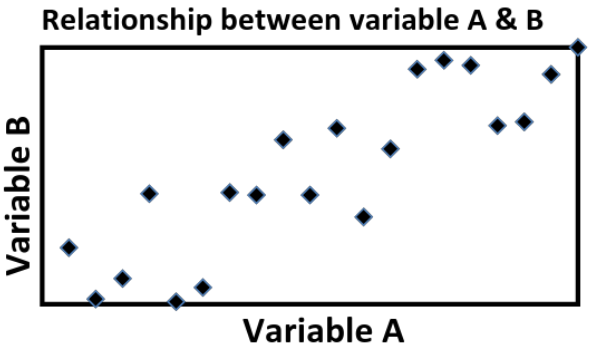
1. Diamonds.csv
2. Rugby.csv

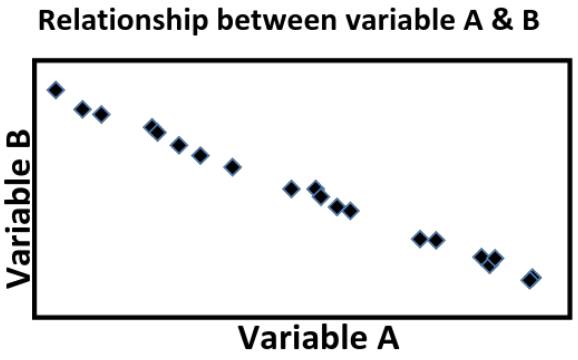
Analysis

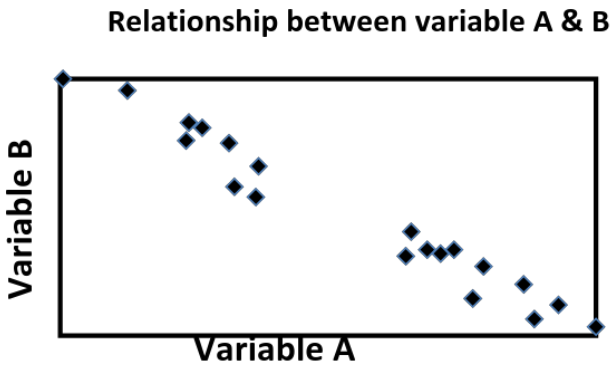
Step 1:	**Step 2:**
Draw edges around the data points (like joining the dots)	Think of the data in the middle as a paint brush stroke.
	

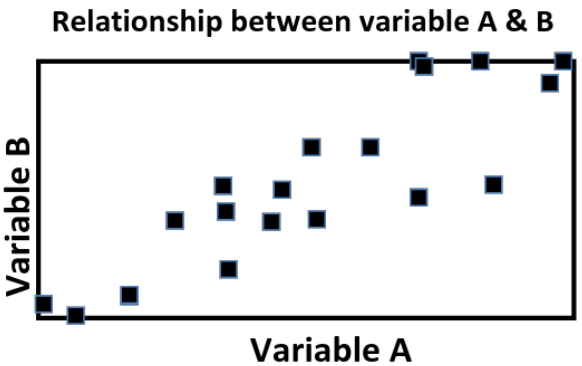
Exercise:

Shade in the following graphs.





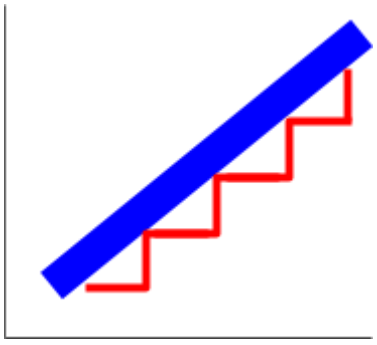




Trend

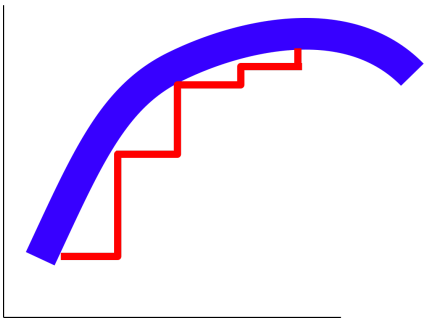
a **linear** trend…

(looks like a straight line, and has a constant step size)



a **non-linear** trend…

(looks like a curve and has a **non-constant** step size)



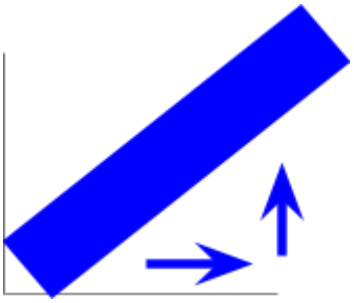
or **no** trend?

(no pattern at all)

Direction

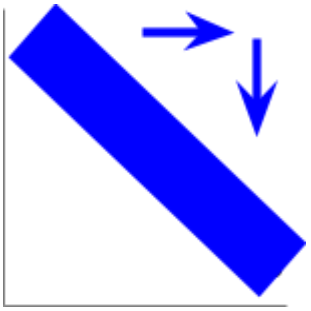
a **positive** direction…

(as one measurement gets bigger, so does the other)



or a **negative** direction?

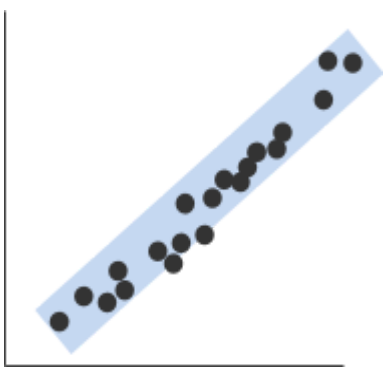
(as one measurement gets bigger, the other gets smaller)



Strength

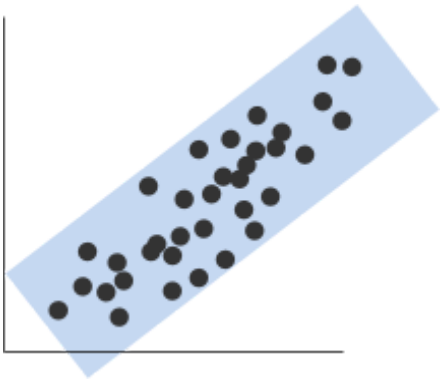
a **strong** relationship?

(small amount of scatter)



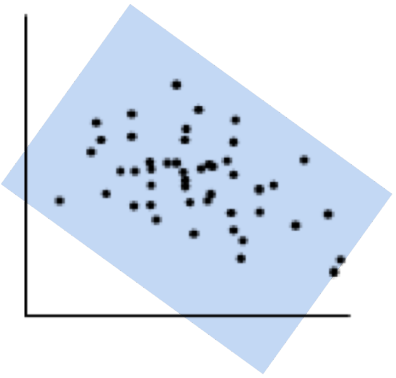
a **moderate** relationship?

(moderate amount of scatter)



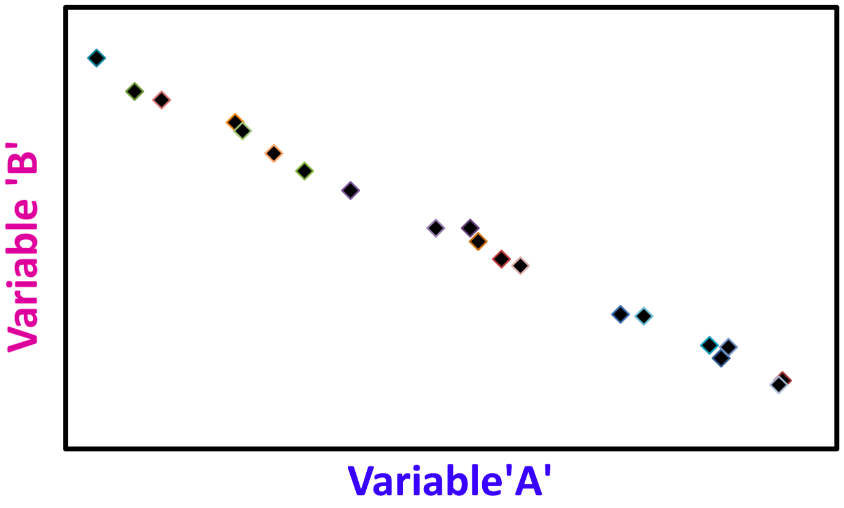
or a **weak** relationship?

(a lot of scatter)



Exercise:

1) Shade the data. Then decide whether there is a relationship between variable A and B. If there is a relationship, decide the trend, direction and strength.

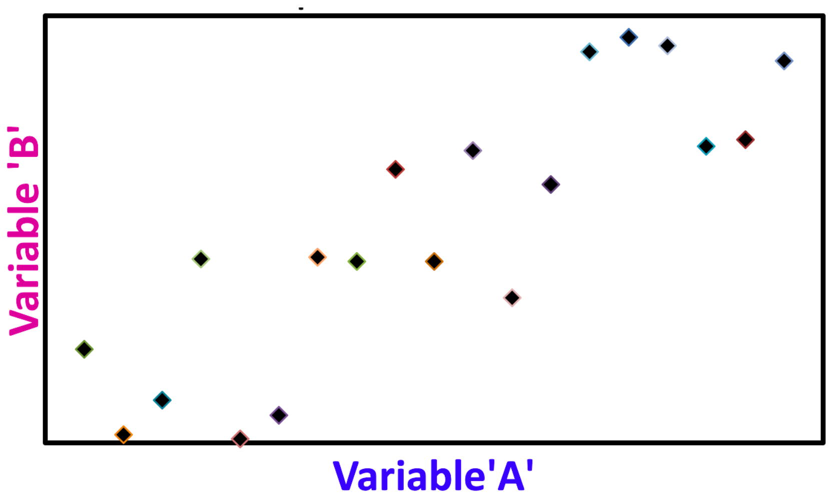


Relationship:
Yes / No

Trend:
Linear / Non-linear

Direction:
Positive / Negative

Strength:
Strong / Moderate / Weak

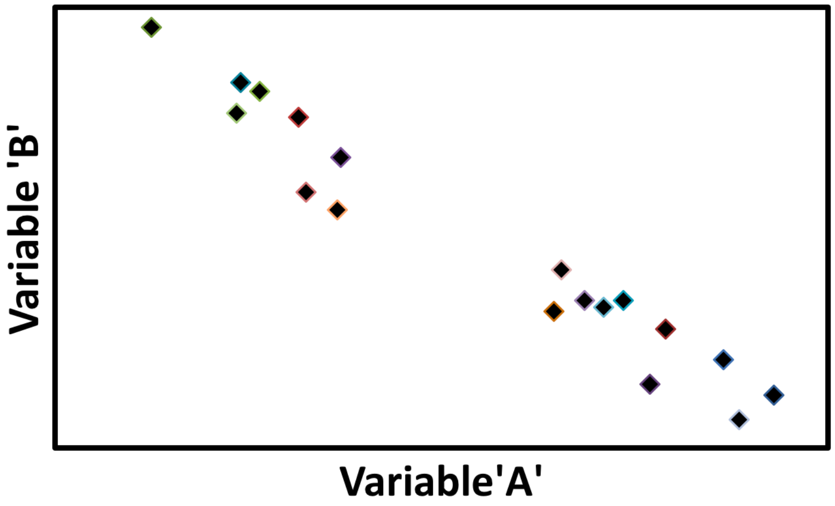


Relationship:
Yes / No

Trend:
Linear / Non-linear

Direction:
Positive / Negative

Strength:
Strong / Moderate / Weak

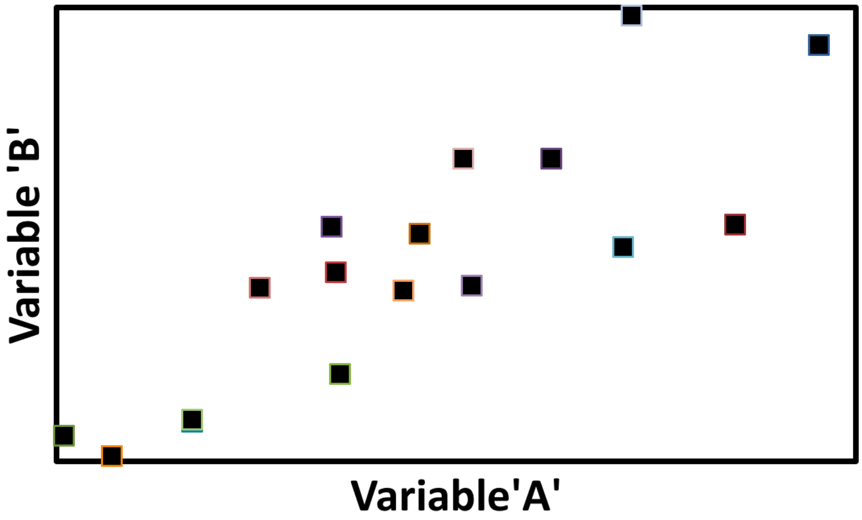


Relationship:
Yes / No

Trend:
Linear / Non-linear

Direction:
Positive / Negative

Strength:
Strong / Moderate / Weak

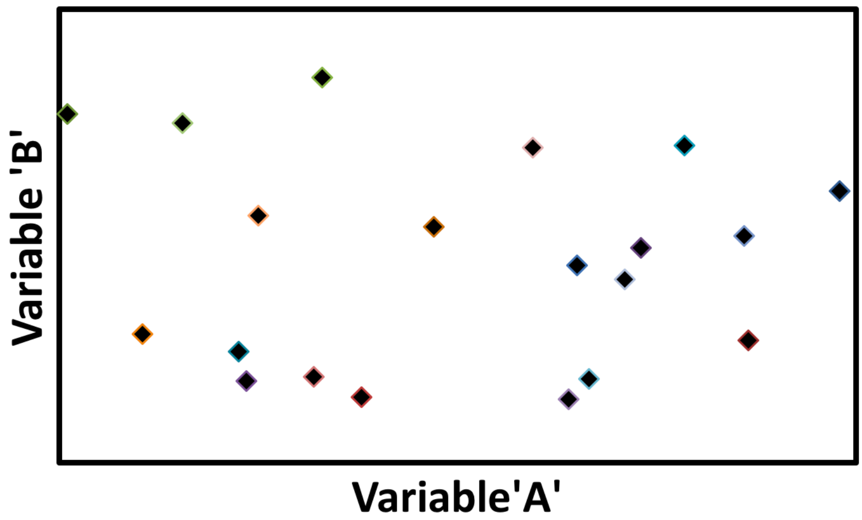


Relationship:
Yes / No

Trend:
Linear / Non-linear

Direction:
Positive / Negative

Strength:
Strong / Moderate / Weak

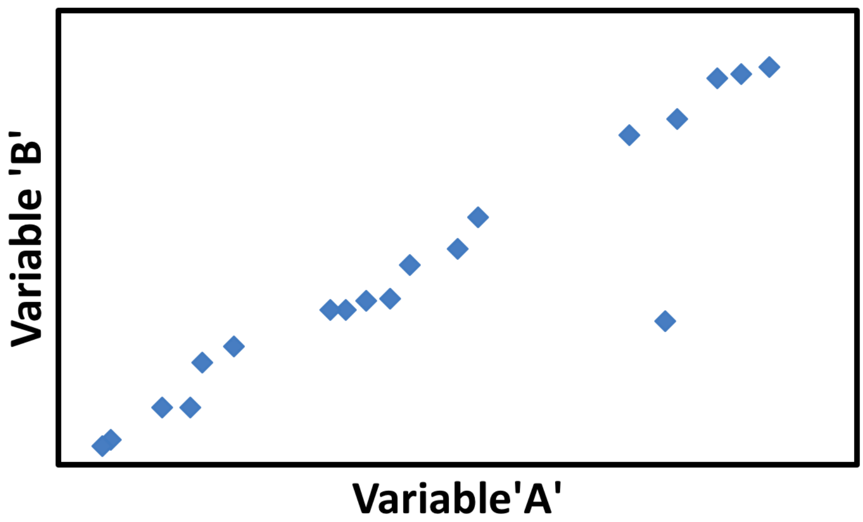


Relationship:
Yes / No

Trend:
Linear / Non-linear

Direction:
Positive / Negative

Strength:
Strong / Moderate / Weak



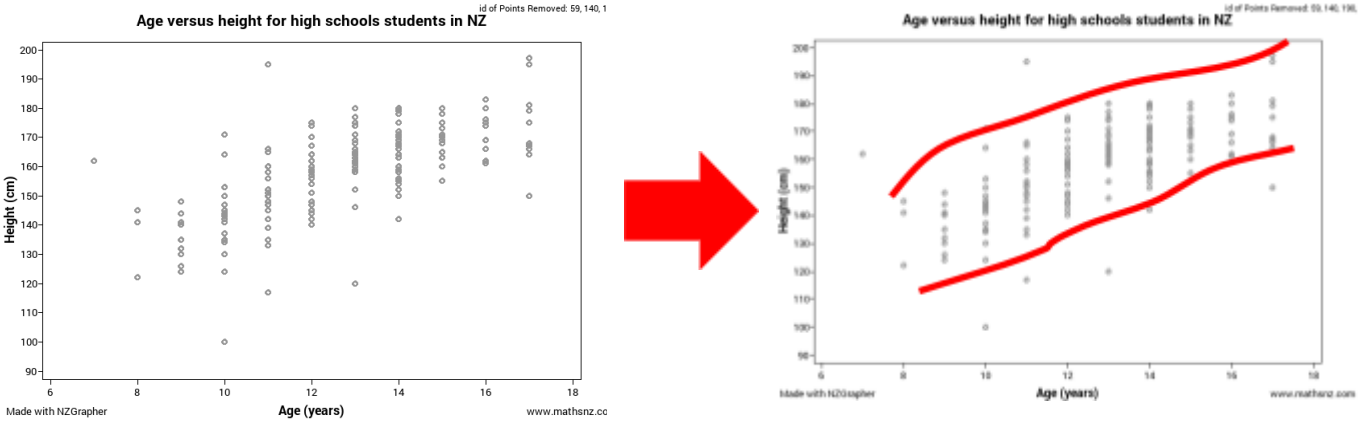
Relationship:
Yes / No

Trend:
Linear / Non-linear

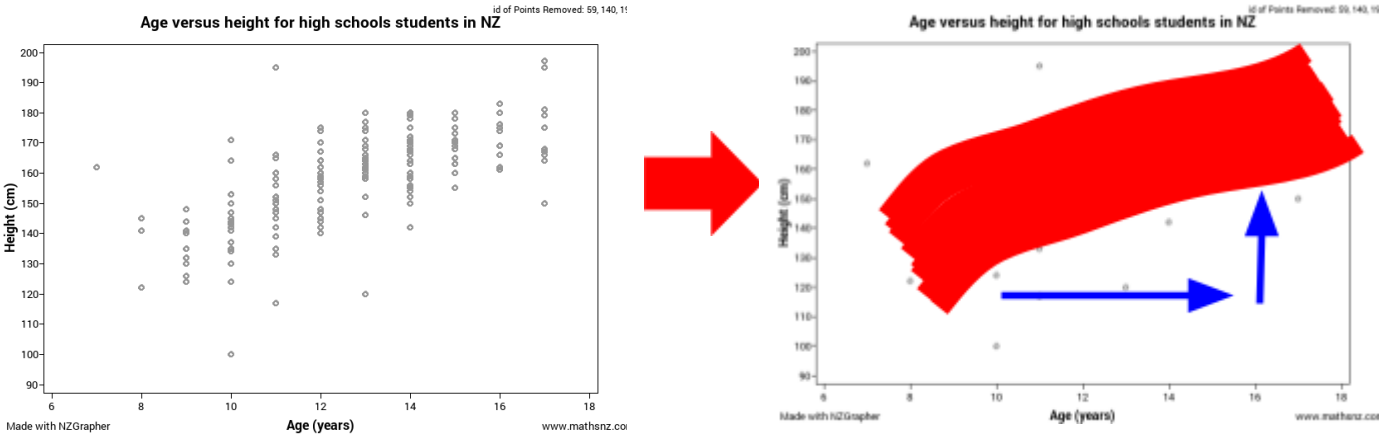
Direction:
Positive / Negative

Strength:
Strong / Moderate / Weak

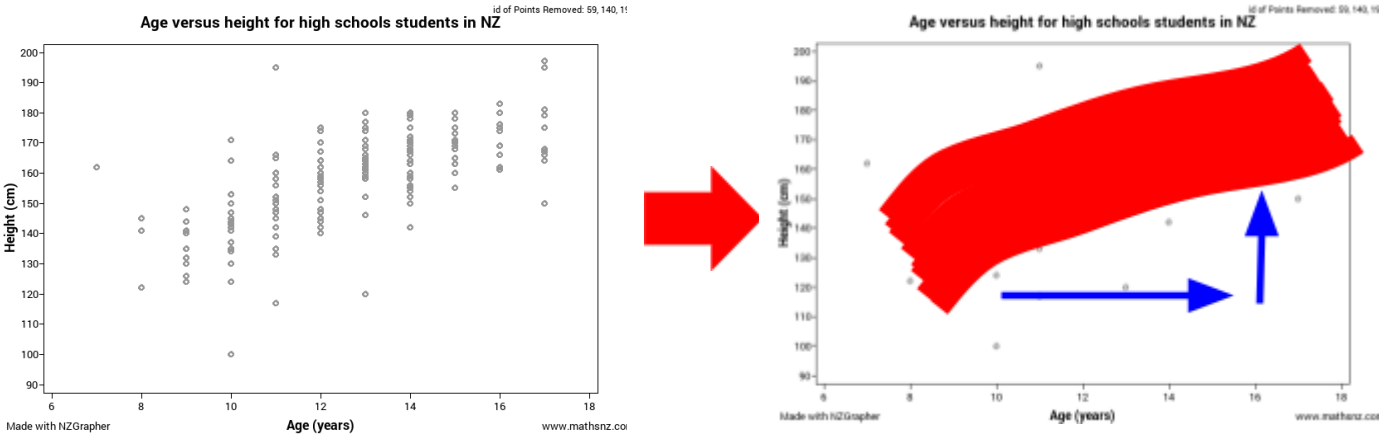
Example:



I notice that the **trend** of relationship between the age of a student and their height appears to be **linear**. This is because the trend is **changing at a constant rate**.



I notice that the **direction** of relationship between a students age and height is **positive**. This is because as age **increases**, height **increases**.



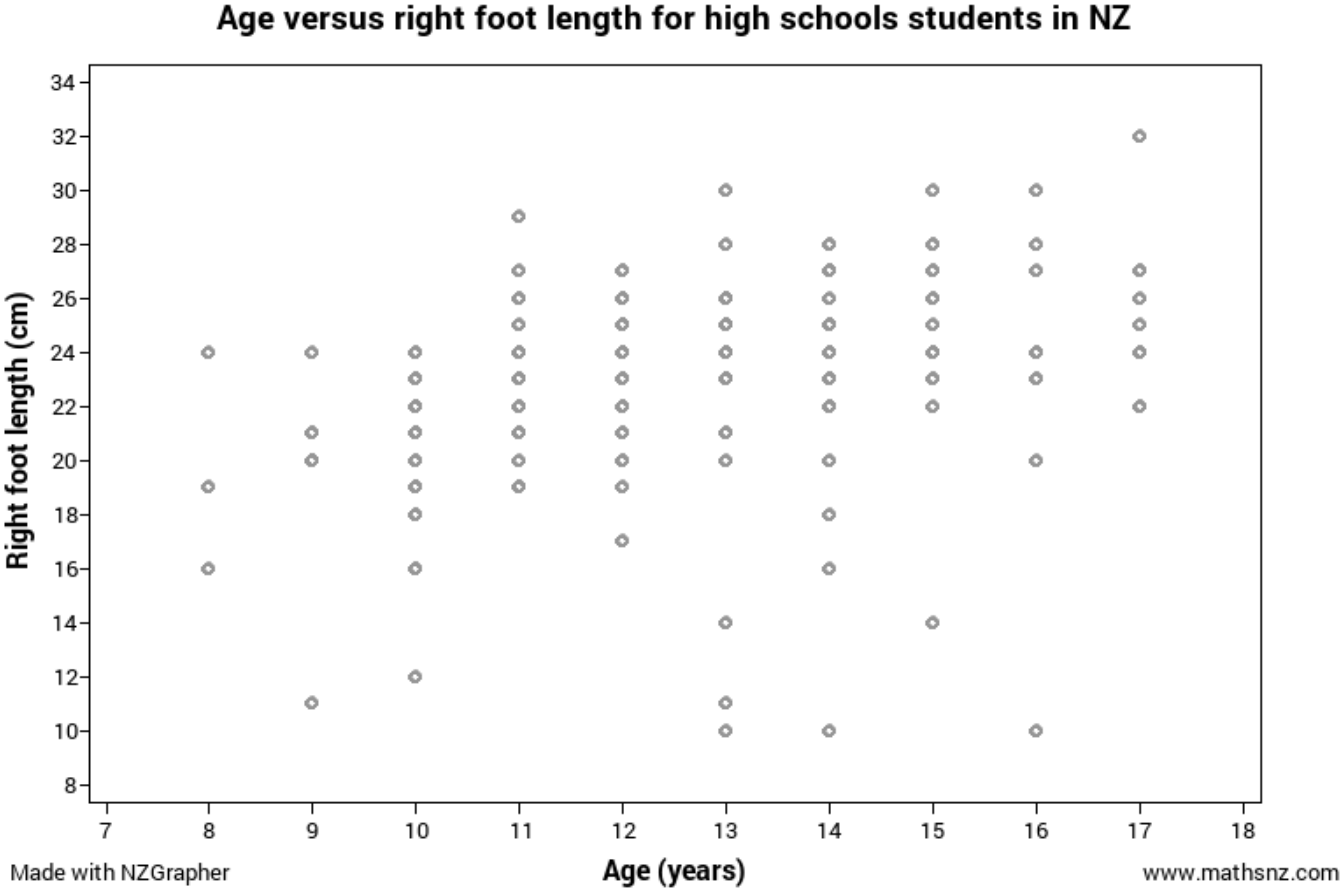
I notice that the **strength** of relationship between a student's age and height is **weak**. This is because there is **a lot of scatter** around the trend line.

Exercise:

For the following graphs, shade the data, then describe the **features** (trend, direction and strength) in **context**.

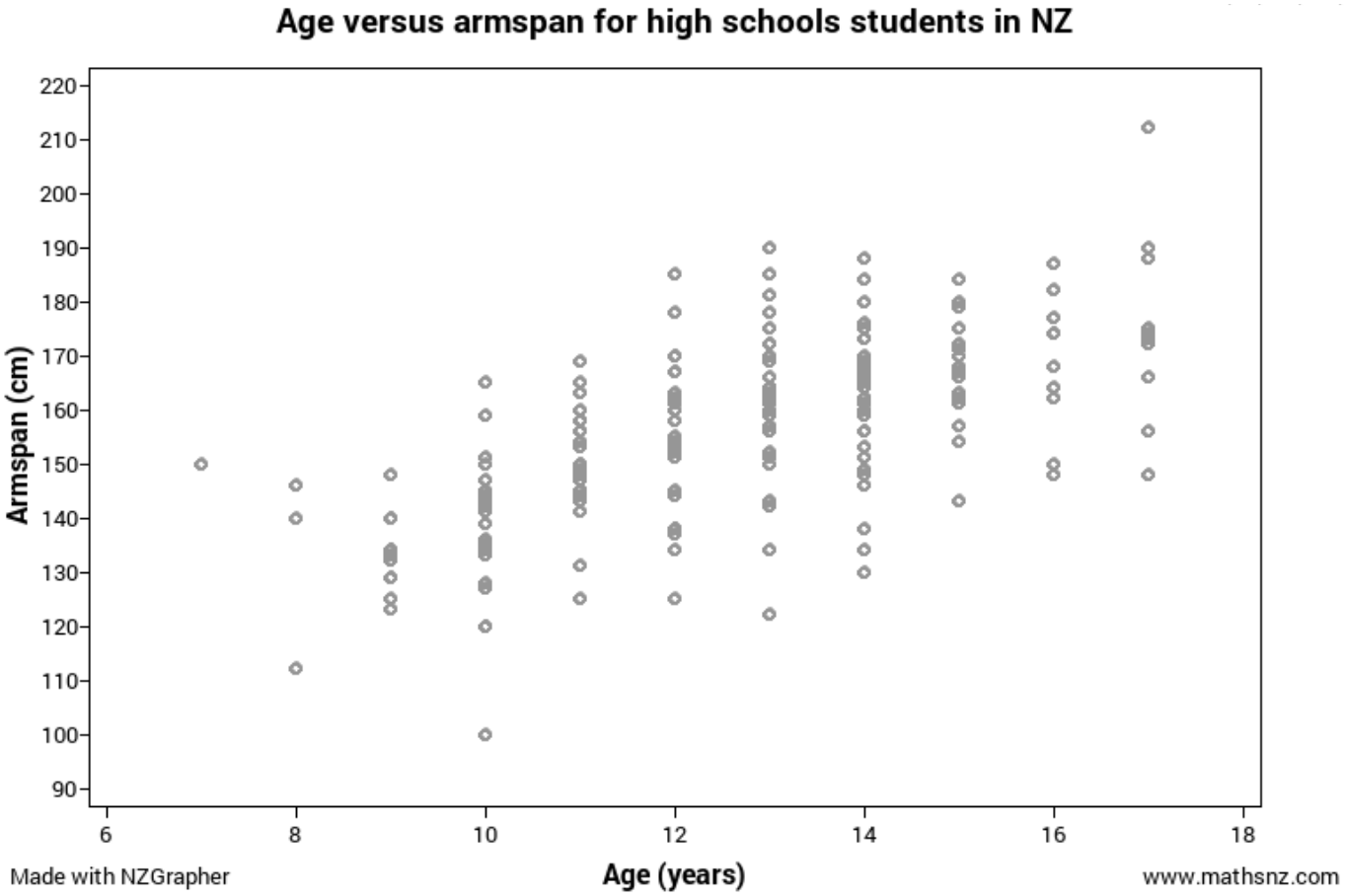
1) Problem:

I wonder if there is a relationship between the age (years) of school students and the length of their right foot, from students who participated at your school.



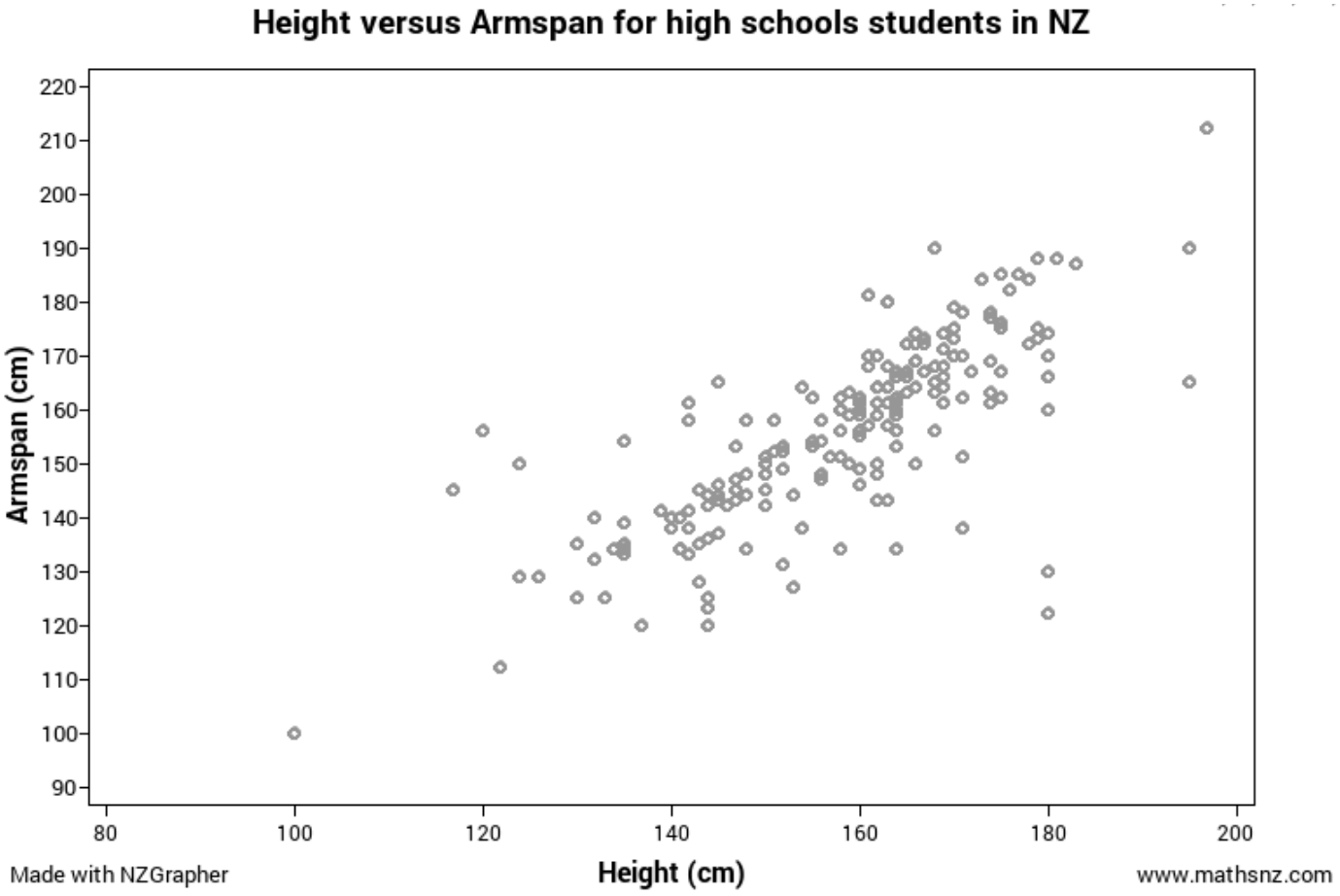
2) Problem:

I wonder if there is a relationship between the age (years) of school students and the armspan (cm), for Year 11 students who participated from your school.



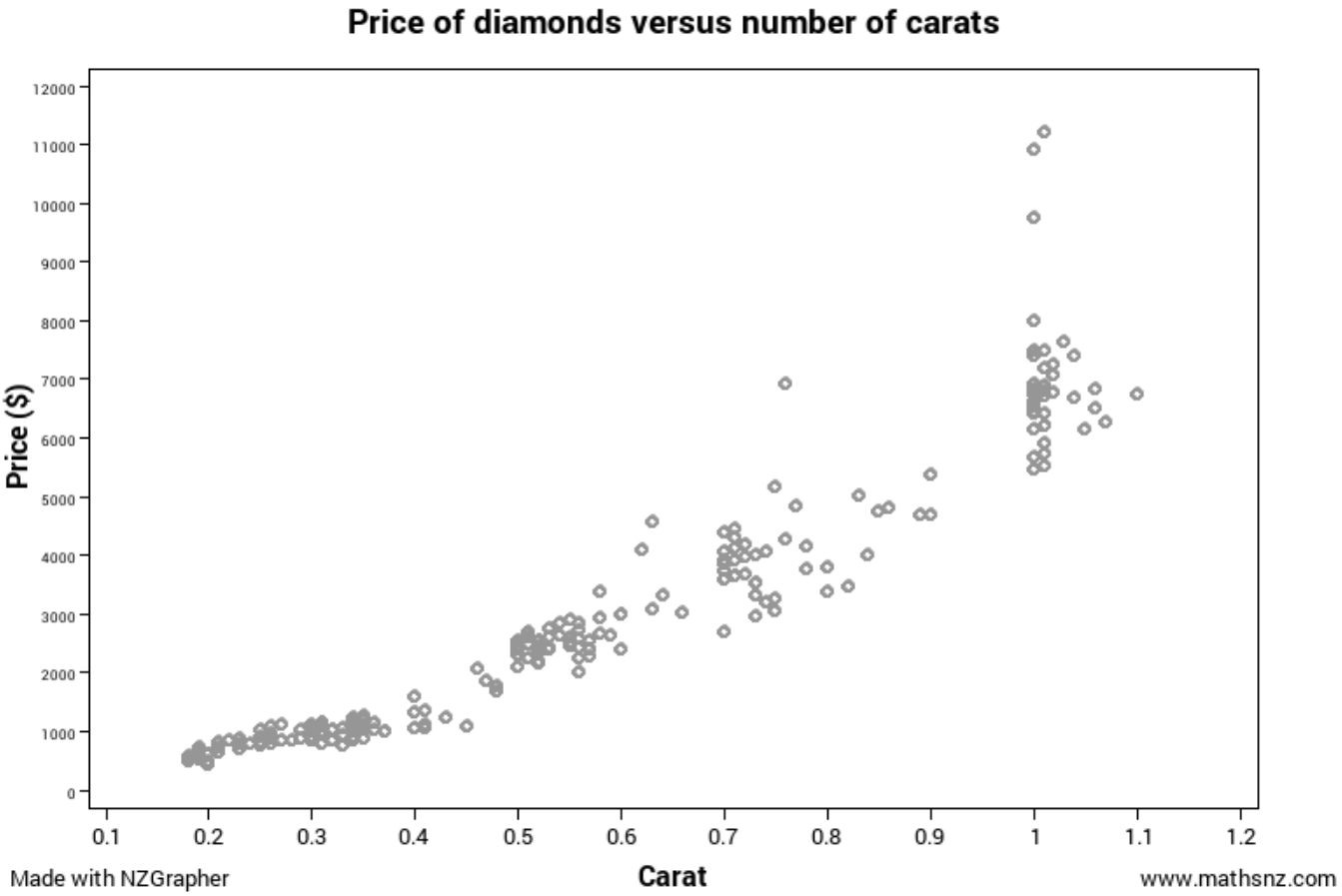
3) Problem:

I wonder if there is a relationship between the height (cm) and armspan (cm), for Year 11 students at your school



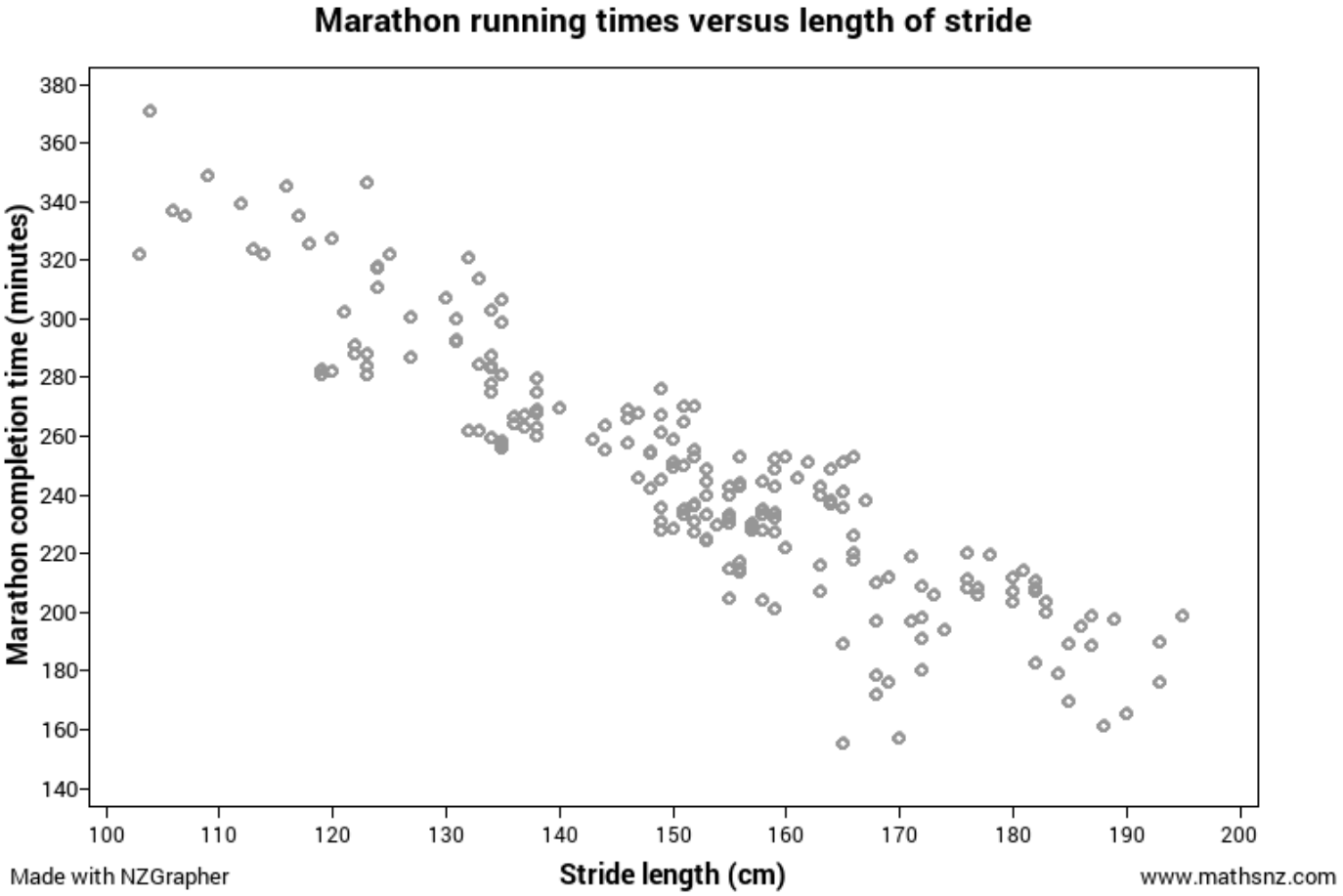
4) Problem:

I wonder if there is a relationship between the price ($) and the number of carats, from a selection of diamonds from a retail store in Singapore.



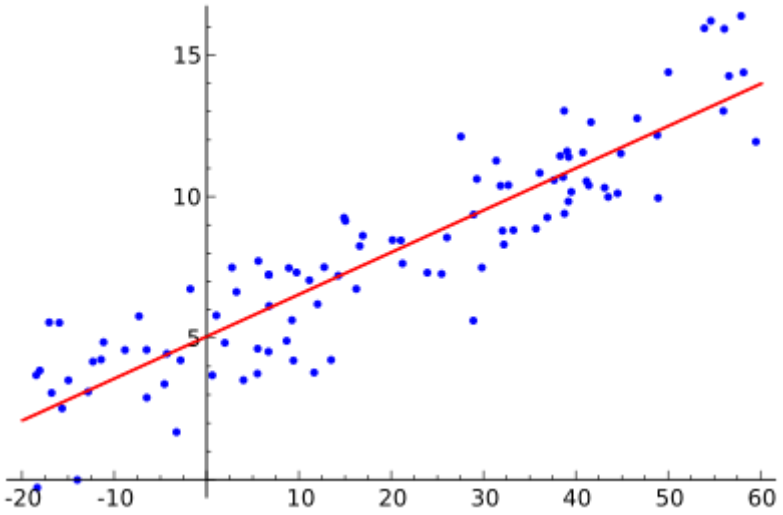
5) Problem:

I wonder if there is a relationship between the stride length (cm) and marathon completion times (minutes) for marathon races in NZ.



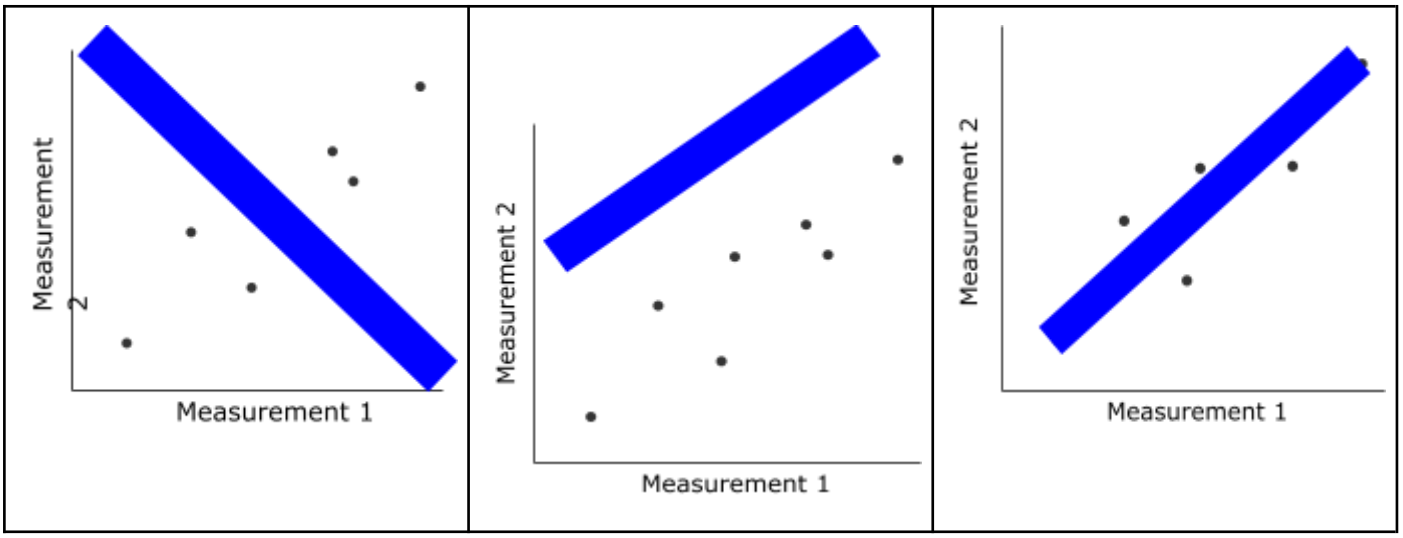
Adding a line of best fit

We want to draw a line that represents the data well. This means a line going through the middle of the data.

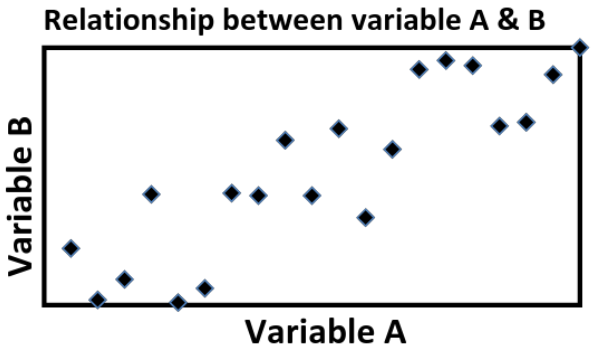


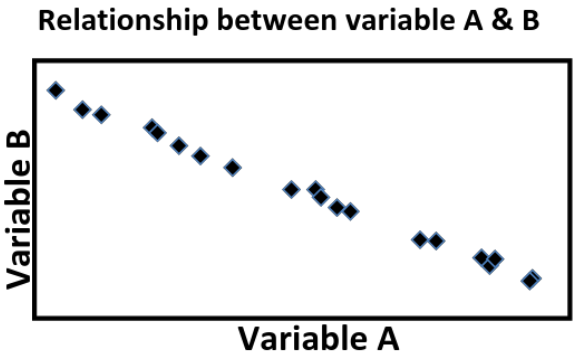
Exercise:

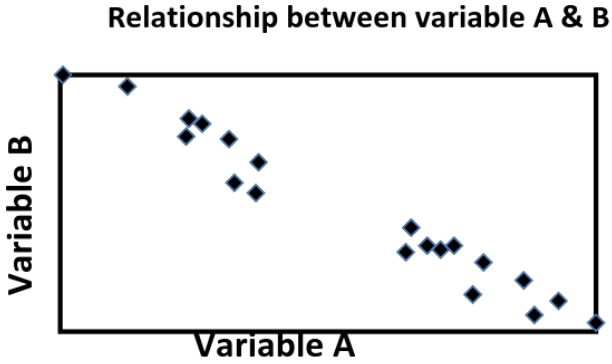
1) Which of the following lines best fits the data? Explain.

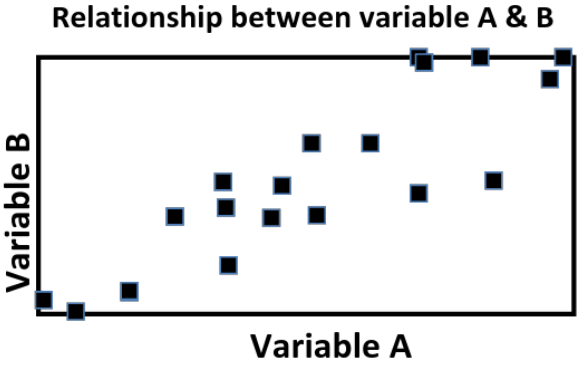


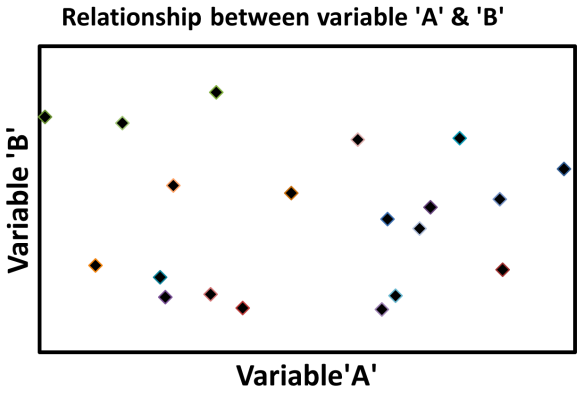
2) Add a line of best fit to the following graphs.

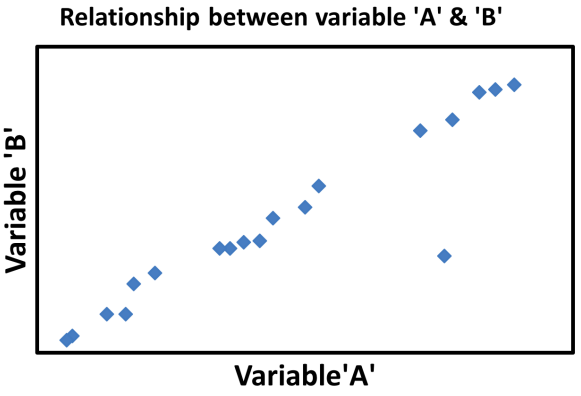












Conclusion

In your conclusion you need the following:

- To answer your original question (I wonder …).
- Describe the decision in context, stating specifically who these results can be applied to.
- Discuss improvements or other investigations that this might lead into.

Answering the investigation problem

When making a conclusion, we need to decide if there is a relationship or not between the 2 variables.

Participants

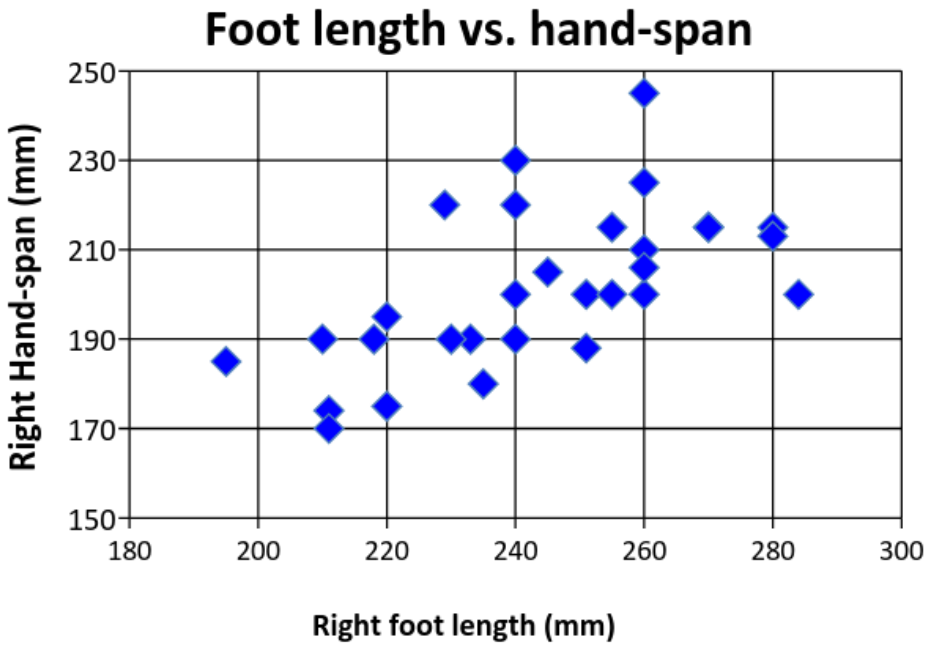
The conclusion is valid for the specific participants or objects who you collected data from.

Example:

If the data is from students at the local primary school, then the results apply to those students only.

Example:

Data was collected from a sample of Year 11 students at your school. These 30 students measurements are shown on the graph below. An analysis and conclusion are given below.



Conclusion:

Students who participated in my investigation, show that as their right foot length increases, their right hand span tends to increase. So I would suggest that there is a relationship between the students foot length and hand span, for the Year 11 participants from your school

Improvements:

I could improve my investigation by getting students to remove not just their shoe, but also their sock. This is because I noticed that some students had quite thick socks, while some girls had very thin panty hose. So it is possible that the measurements for foot length are not as accurate as they could be.

Other investigations:

These results may not be applied to younger children, as they may have different ratios of hand span and foot length as they have many different growth spurts. This could be another interesting investigation to do using students at the local primary school.

Exercise:

Write a conclusion for each of the problems below.

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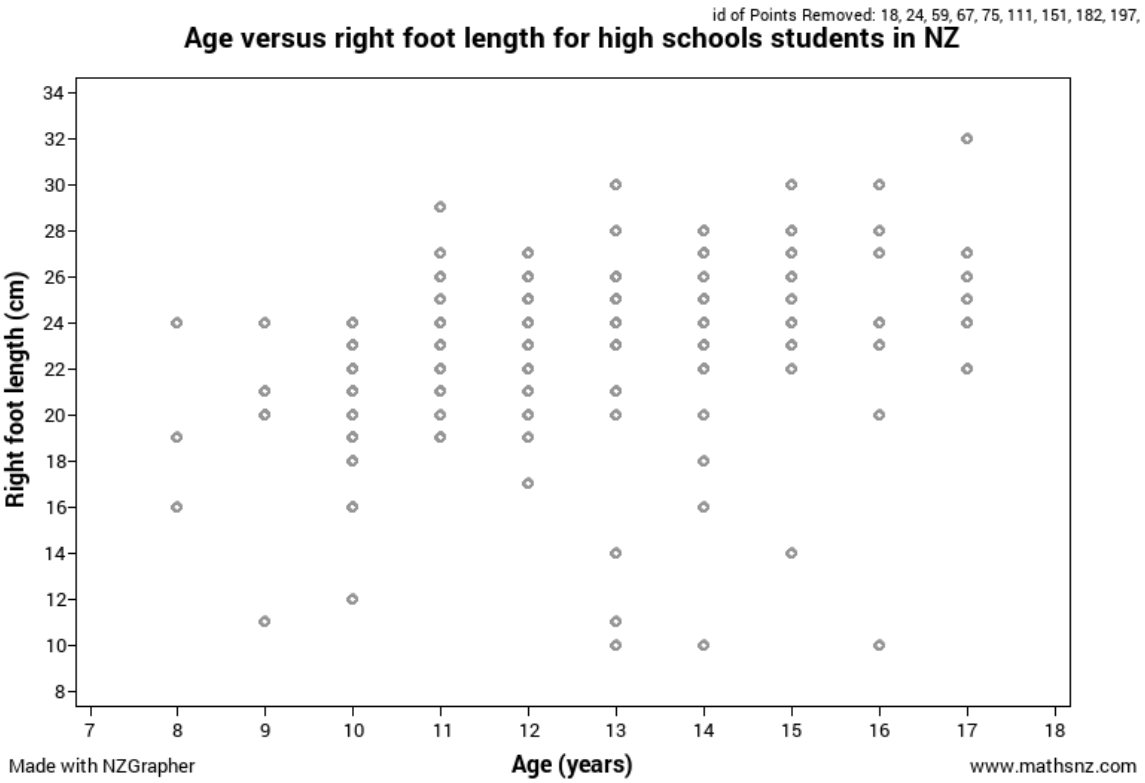

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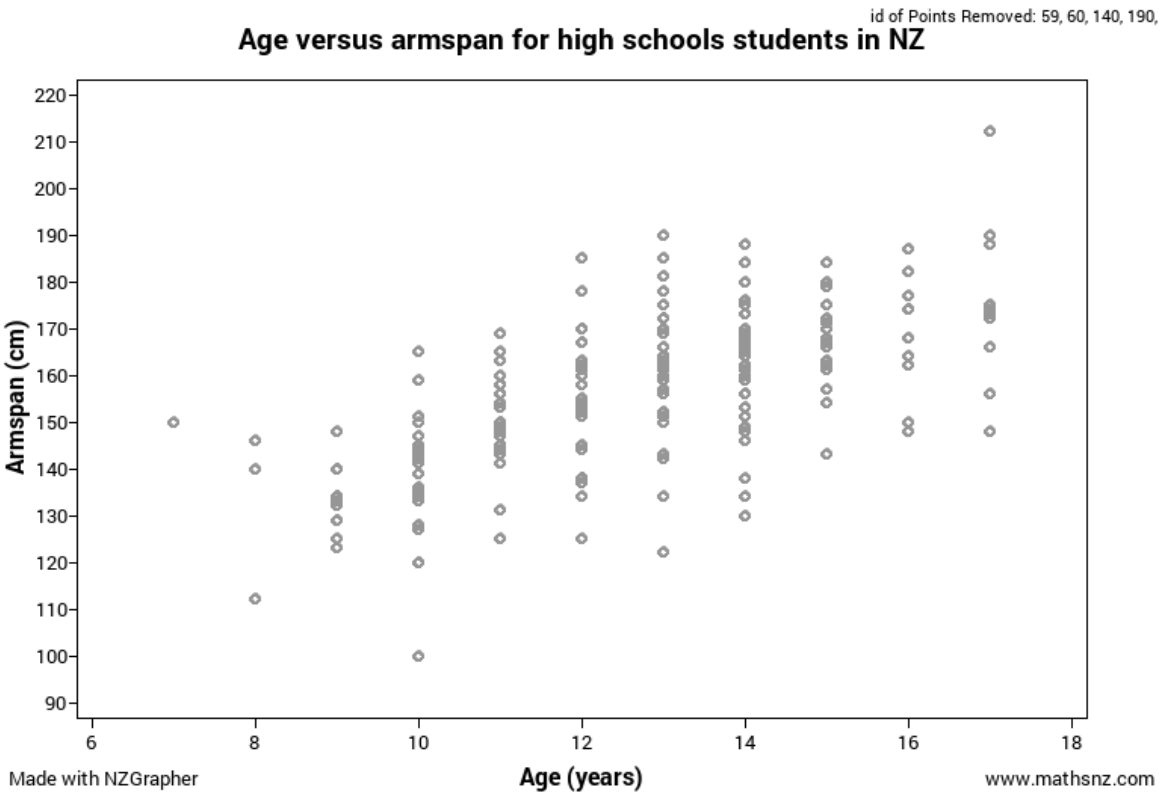

3) Problem:

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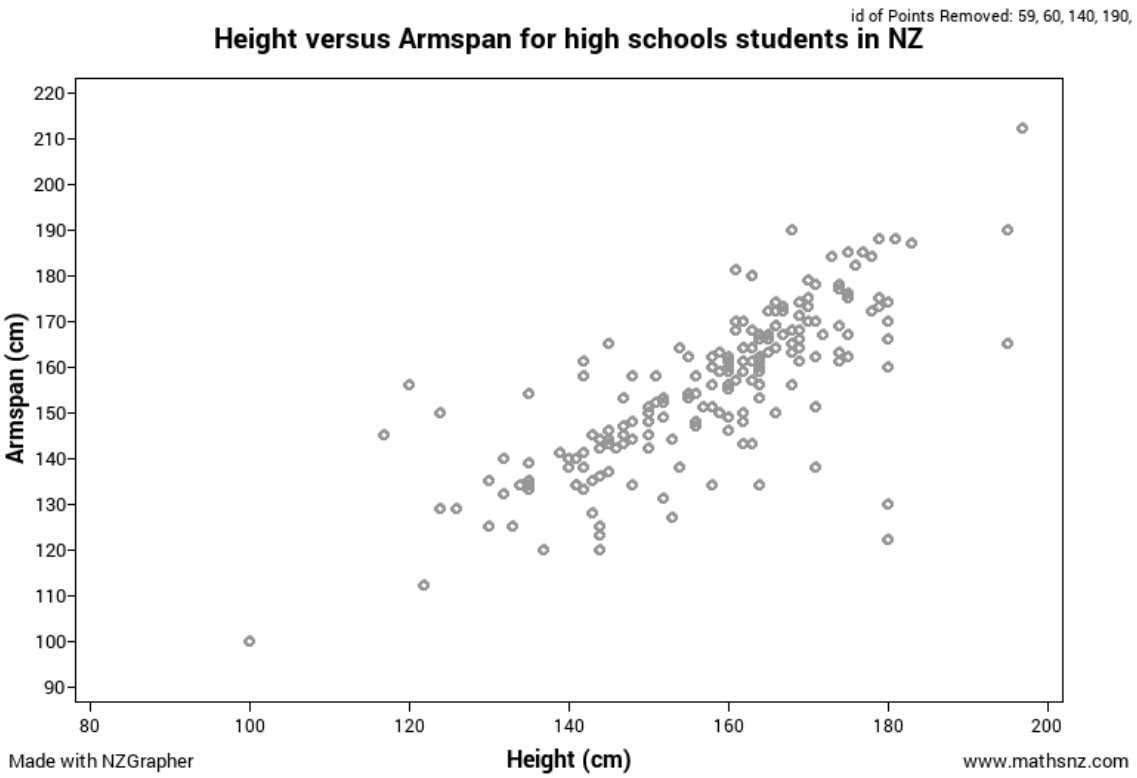

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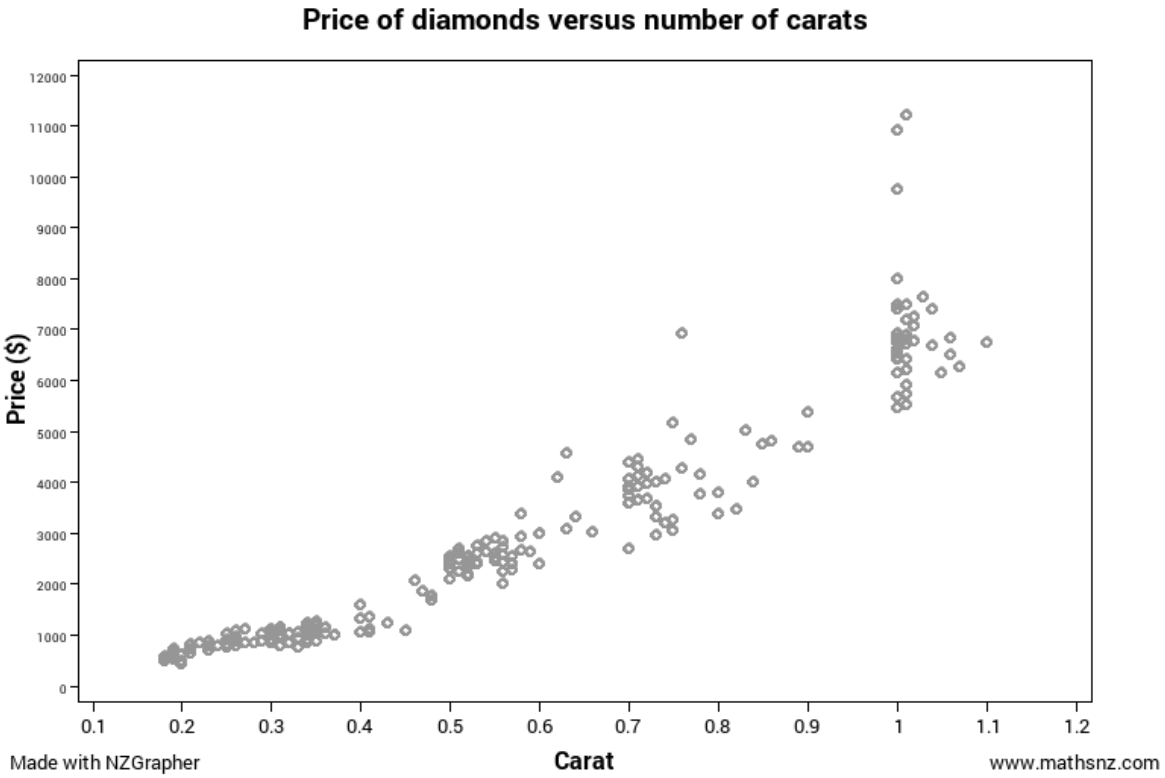
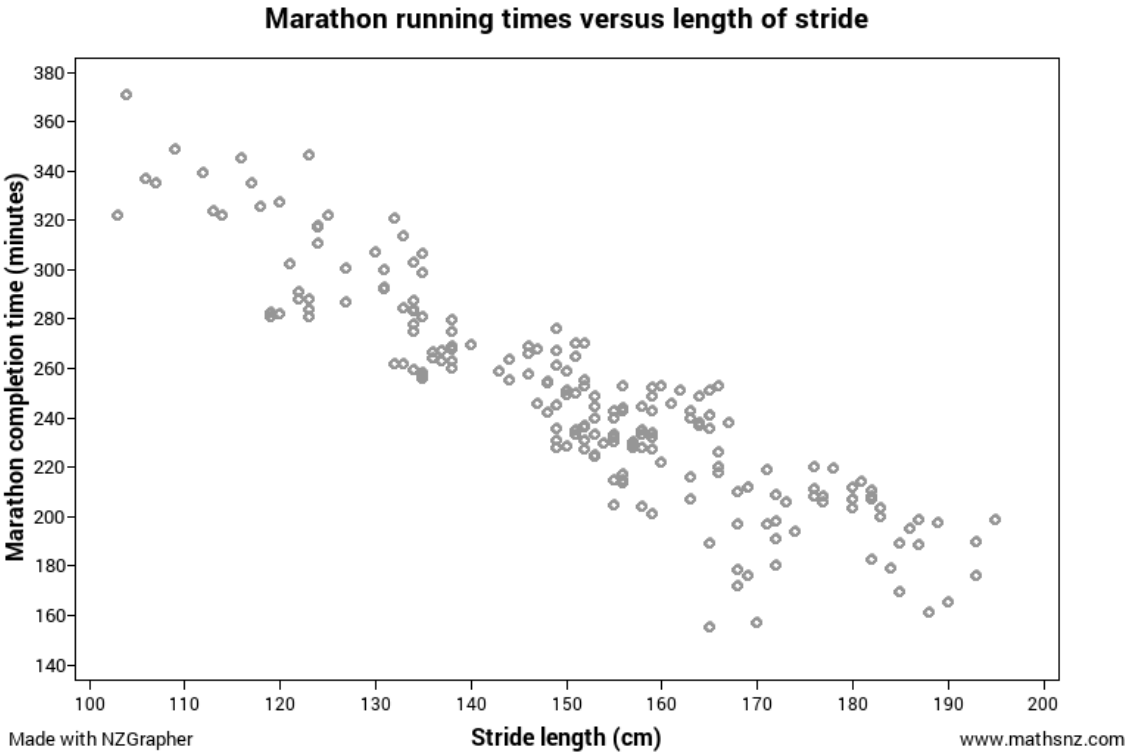


5) Problem:

I wonder if there is a relationship between the stride length (cm) and marathon completion times (minutes) for marathon races in NZ.

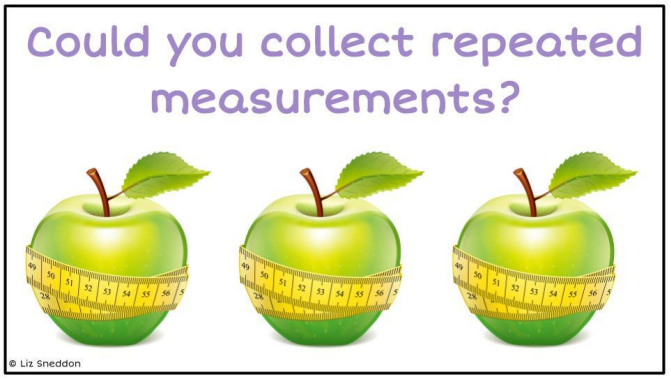


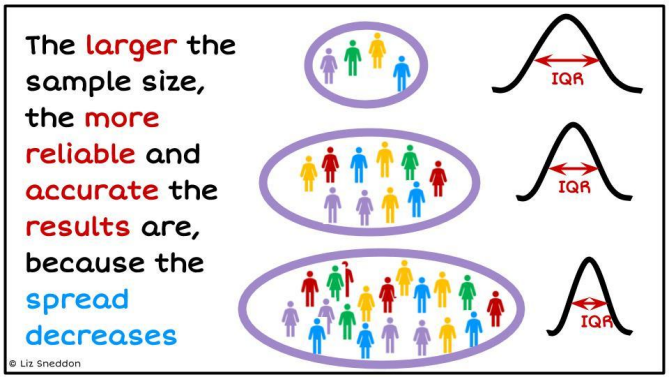
Insight for Excellence

There are a number of ways that you can show statistical and contextual insight. You will need to show some of these:

- Plan: Reflecting on your plan and suggesting improvements,
- Analysis: Discussing scatter and outliers (if appropriate),
- Conclusion: Discussing sampling variability and other variables/factors.

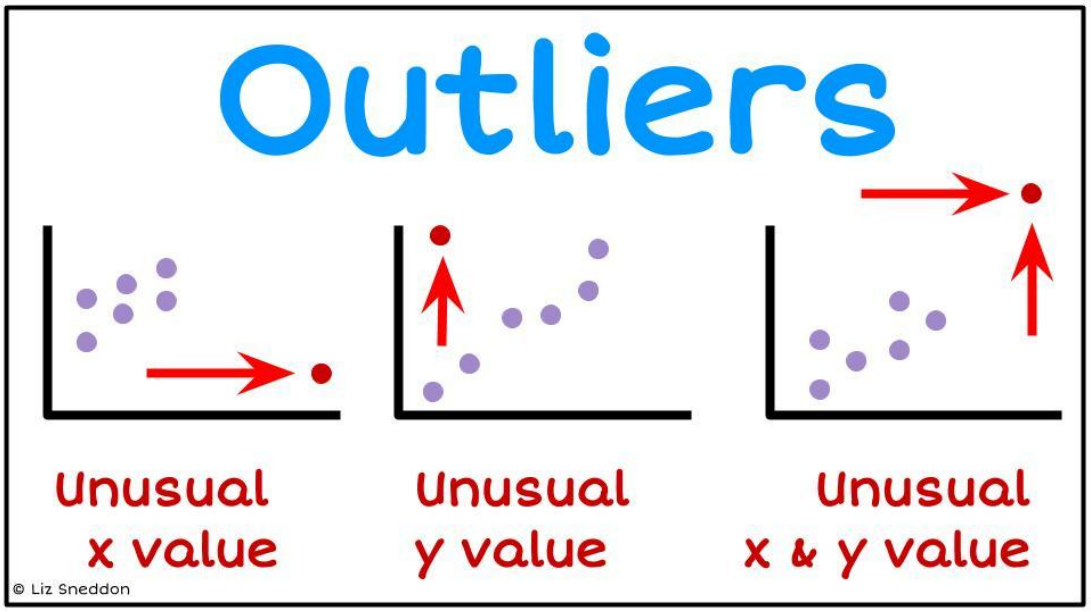
Plan: Reflection & Improvements



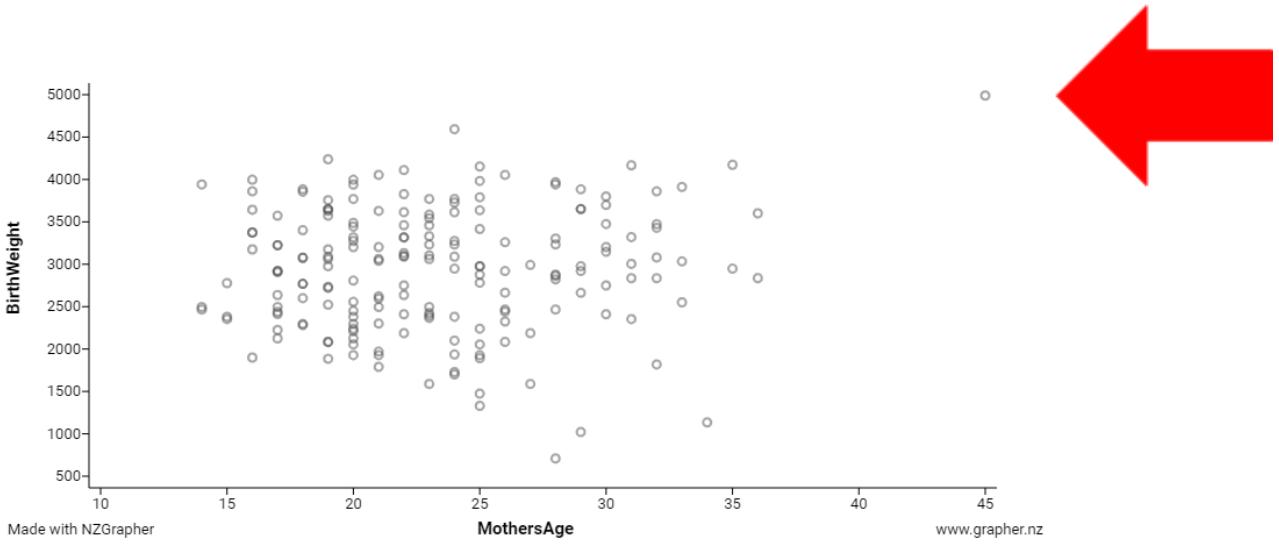


Analysis: Outliers

An outlier is a point that is **A LONG WAY AWAY** from the trend pattern. Be careful when identifying these points, and make sure you state the coordinates.



Example:

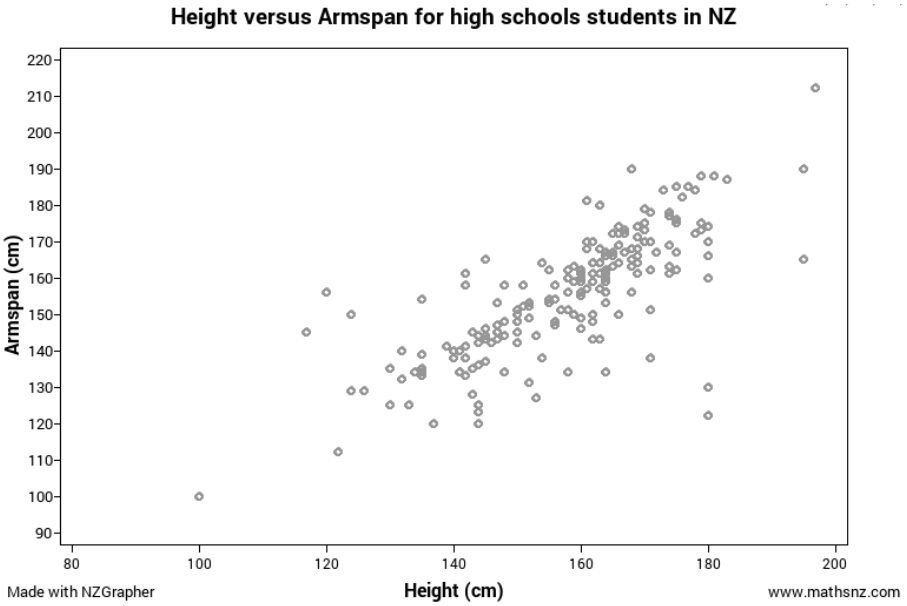


Looking at the graph above of the mothers age and birthweight of her baby, we can see that there is an outlier - this is a mother who is 45 years of age and the baby weighs around 5000grams. The mother's age and the baby's weight are both unusually large.

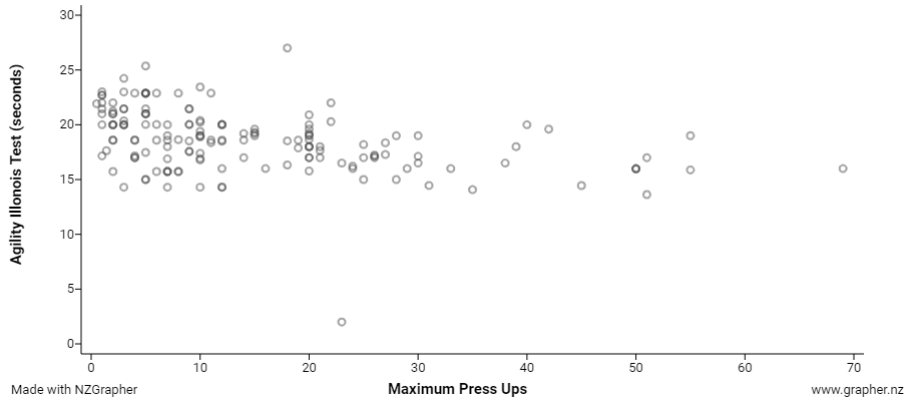
Exercise:

Identify any outliers in the following graphs. Highlight them on the graph, and then write a sentence estimating their coordinate points.

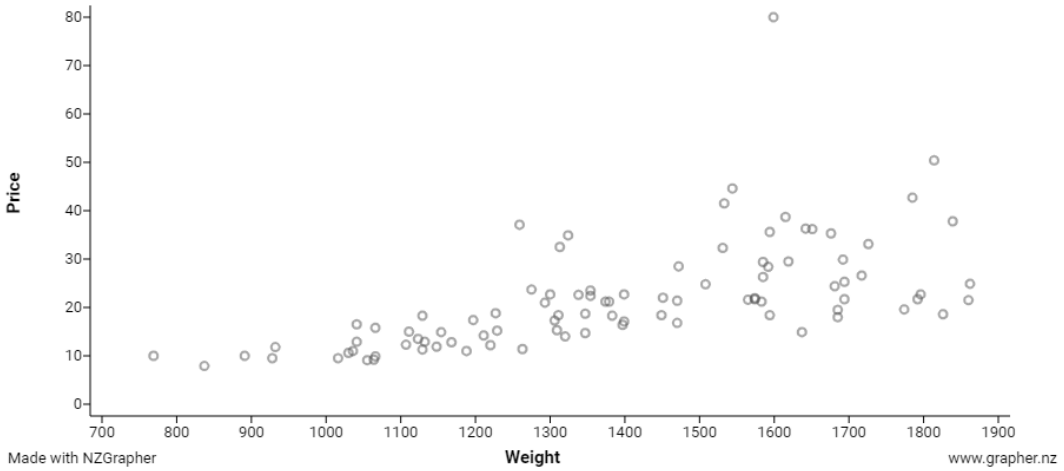
1)



2)



3)


Price
80
70
60
50
40
30
20
10
0
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
Weight
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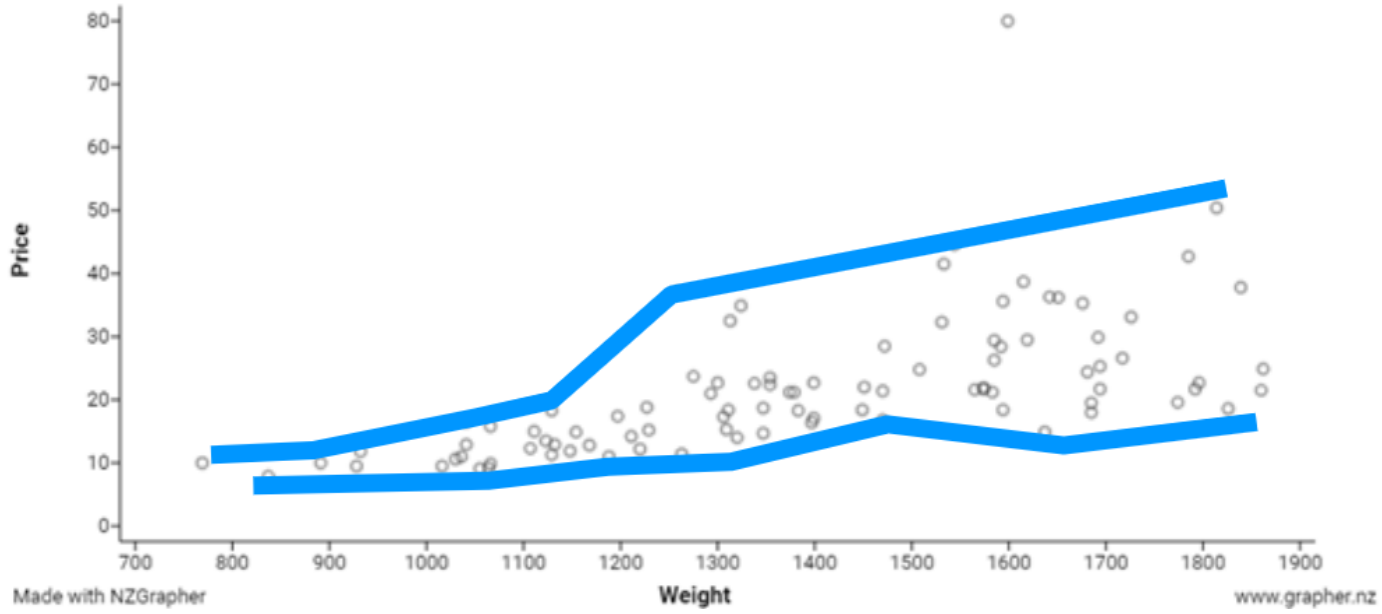
Analysis: Variation / Scatter

We are looking to see if the width of our trend pattern is consistent, or whether it is changing - either increasing in a fan effect, or decreasing in a funnel effect.

When we describe this, we talk about "when the x variable increases, the spread of y variable ___".

The best way to identify what the variation is doing, is to add the lines above and below and see if they are roughly parallel or not.

Example:



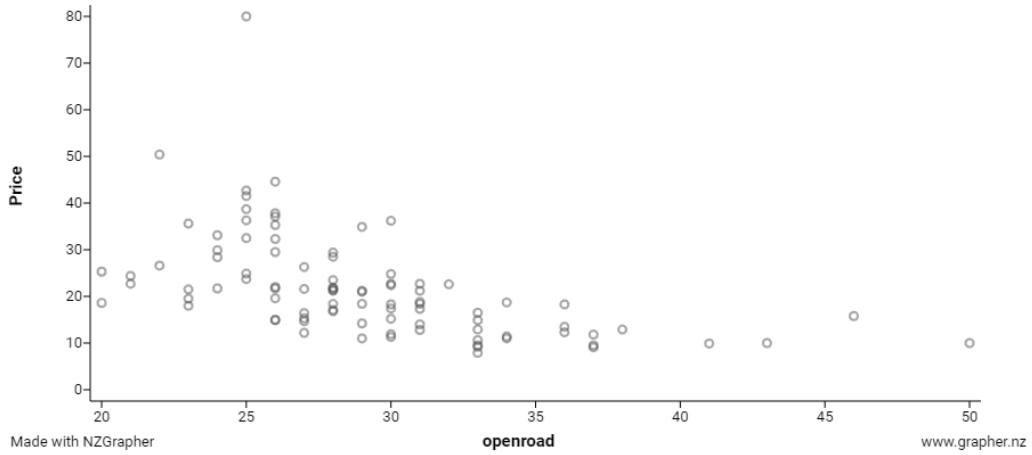
Notice that I have ignored the outlier when I drew the lines.

As the weight of cars increases, the variation in the price of cars is increasing in a fan effect.

Exercise:

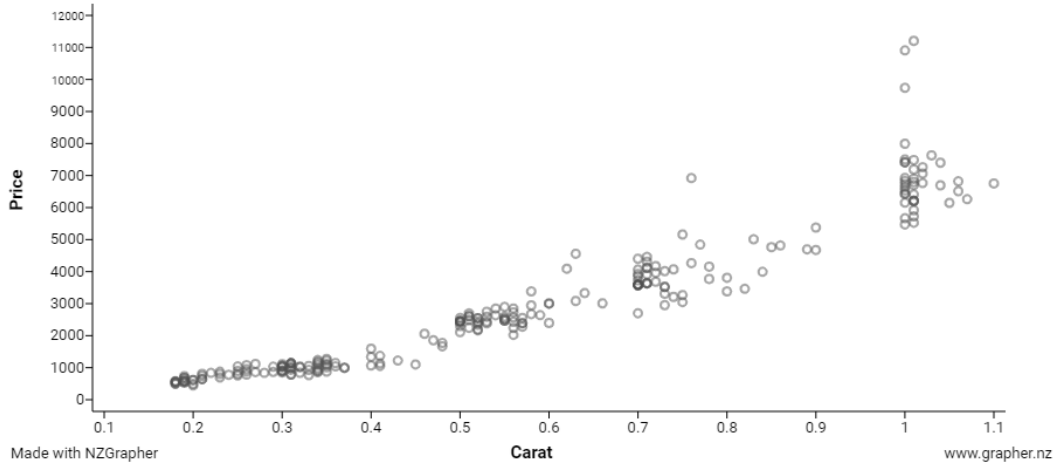
For the following graphs identify if the variation is constant or not, and describe it.

1) Investigation into the Fuel efficiency on open roads versus the Price of a car.



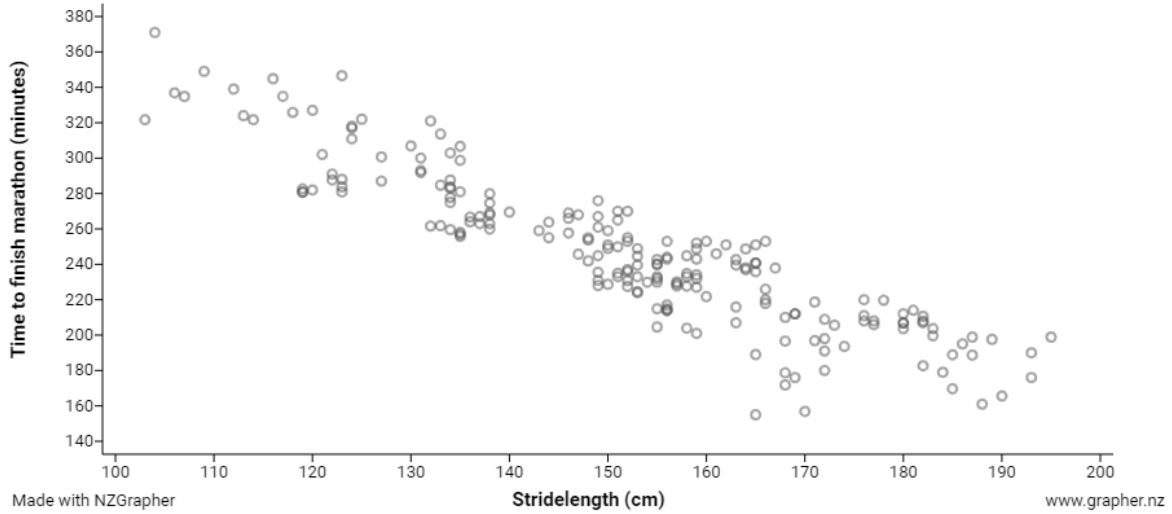
Variation is: Constant / Increasing / Decreasing

2) Investigation into the Size of diamonds (carats) versys the Price.



Variation is: Constant / Increasing / Decreasing

3) Investigation into the Time it takes runners to finish a marathon and the length of their stride.



Variation is: Constant / Increasing / Decreasing

Conclusion: Sampling variability

What if you were to do this investigation again, collecting a whole new sample of data? What do you think would happen?

- Would the data be the same or different?
- Would the trend be likely to stay the same or change?
- Would the line of best fit stay the same, change a little, or change a lot?
- What would happen if you collected more data?

Exercise:

Watch the animations: http://tiny.cc/BivariateVariation

Describe what happens to the data, the trend and the line of best fit.

Conclusion: Other factors

Think about making a puzzle. If you have one piece of the puzzle, you can learn a lot - the colours, the shapes, and guess where it might go in the big picture. But you know that this is only one piece of the puzzle, and that there are lots of other pieces that when put together make a whole different picture.

Data is like a puzzle. You might investigate one particular piece, one particular comparison, but we always need to be aware that there are many other pieces in this puzzle. Before we can paint the whole picture, we need to think about what the other pieces might be.

This is the idea of other factors. You need to consider what other factors might also affect the numerical variables that you are investigating, and explain **WHY** this factor might be affecting either of the variables (response or explanatory).

Example:

Problem:
I wonder if there is a relationship between the length of a persons right foot and their hand span, for students in Mrs Sneddon's Year 9 maths class.

Other variables or factors:
There are a number of different factors that might affect the length of a person's feet. For example, their genetics may influence this. If their parents have small feet, then that would make the child more likely to have small feet too. Equally with hand span - if either of the parents had large or small hand spans, their children are more likely to have the same as the parents.

Another factor that could affect both the hand span and foot length is how tall a person is. If a person is taller, it is likely that both their hand span and foot length are longer than a shorter child (e.g. a 5 year old).

Exercise:

Explain some other factors that may affect either or both variables.

1) **Problem:**
I wonder if there is a relationship between a person's age and the amount of time that they spend on their cell phone each day, for teenagers at Saint Kentigern College.

Other factors:
What other factors do you think would affect the time that teenagers in NZ spend on cell phones each day or the age of a teenager?

2) **Problem:**
I wonder if there is a relationship between the number of hours someone works and the amount of money they get paid, for adults in NZ.

Other factors:
What other factors do you think would affect the amount of money that adults in NZ earn per year, or the number of hours someone works?

3) **Problem:**

I wonder if there is a relationship between the amount of time teenagers study for each week and the number of NCEA credits they get, for all teenagers in NZ.

Other factors: