Bivariate investigation for juniors.

(Levels 2 – 6)

Name: _____

Created by Elizabeth Sneddon

Current Level (circle one):

2 / 3 / 4 / 5 / 6

Goal Level (circle one):

2 / 3 / 4 / 5 / 6

Exercise:

Work with your teacher to write a plan to measure a person's height.

Problem

Example:

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

Plan

Example:

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 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 do we record the measurement of the foot length in mm? Explain.

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

5) How long would it take to measure two students? How accurate would this be to estimate heights of other junior students?

6) How long would it take to measure all students at Aorere College? How accurate would this be to estimate heights of other junior students?

7) Circle the words that complete the sentences below.

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

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

8) Why is measuring 30 students a good compromise? Explain

Exercises

Problem 1

I wonder if there is a relationship between a person's height and weight for junior students at Aorere College?

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: _____

Plan:

Measure Variable 2: _____

Plan:

Problem 2

I wonder if there is a relationship between a person's neck circumference and wrist circumference for junior students at Aorere College?

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: _____

Plan:

Measure Variable 2: _____

Plan:

Problem 3

I wonder if there is a relationship between a person's age and weight for junior students at Aorere College?

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: _____

Plan:

Measure Variable 2:_____

Plan:

Data

Measure and record the height and arm spans for students in your class.

Sample	Height	Arm Span	Sample	Height	Arm Span
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

Analysis

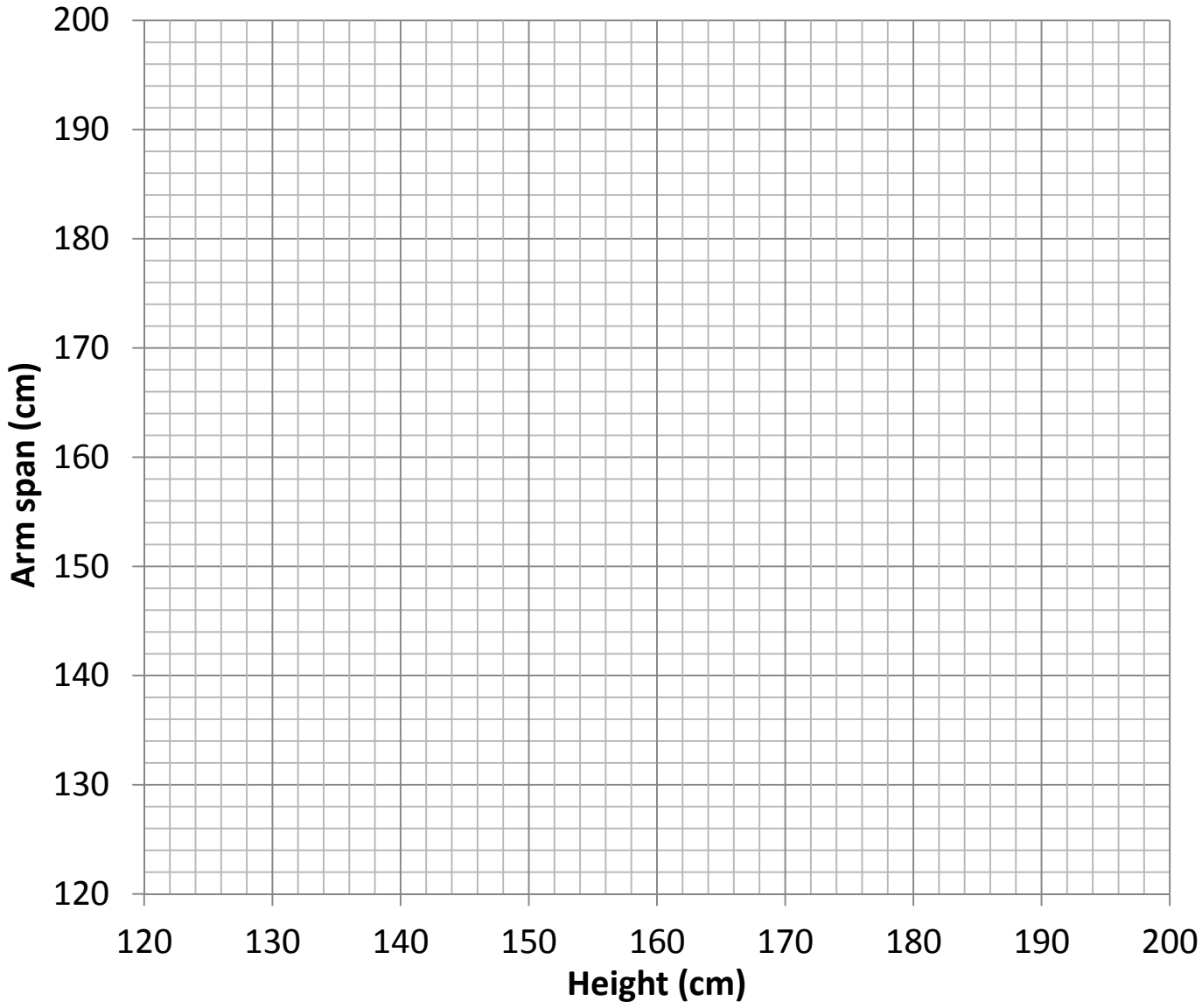
Drawing Scatter Graphs

Step 1: Draw the scatter graph. We make 2 axes, and put one measurement on each axis.

Step 2: Make the graph large so we can have a good look at it.

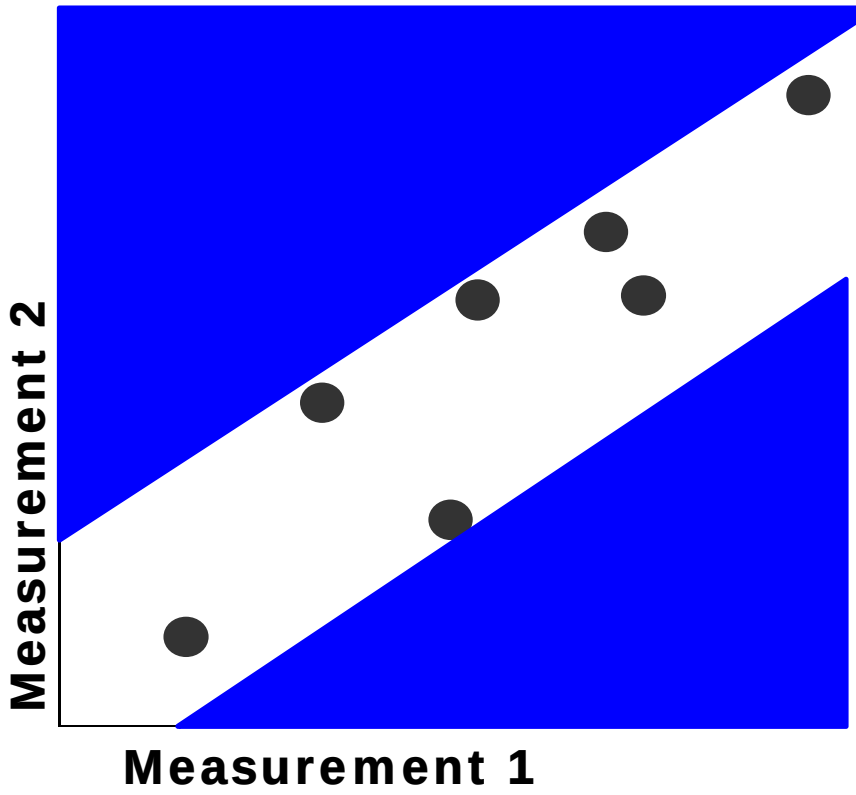
Exercise:

Add your class's measurements to the scatterplot below.

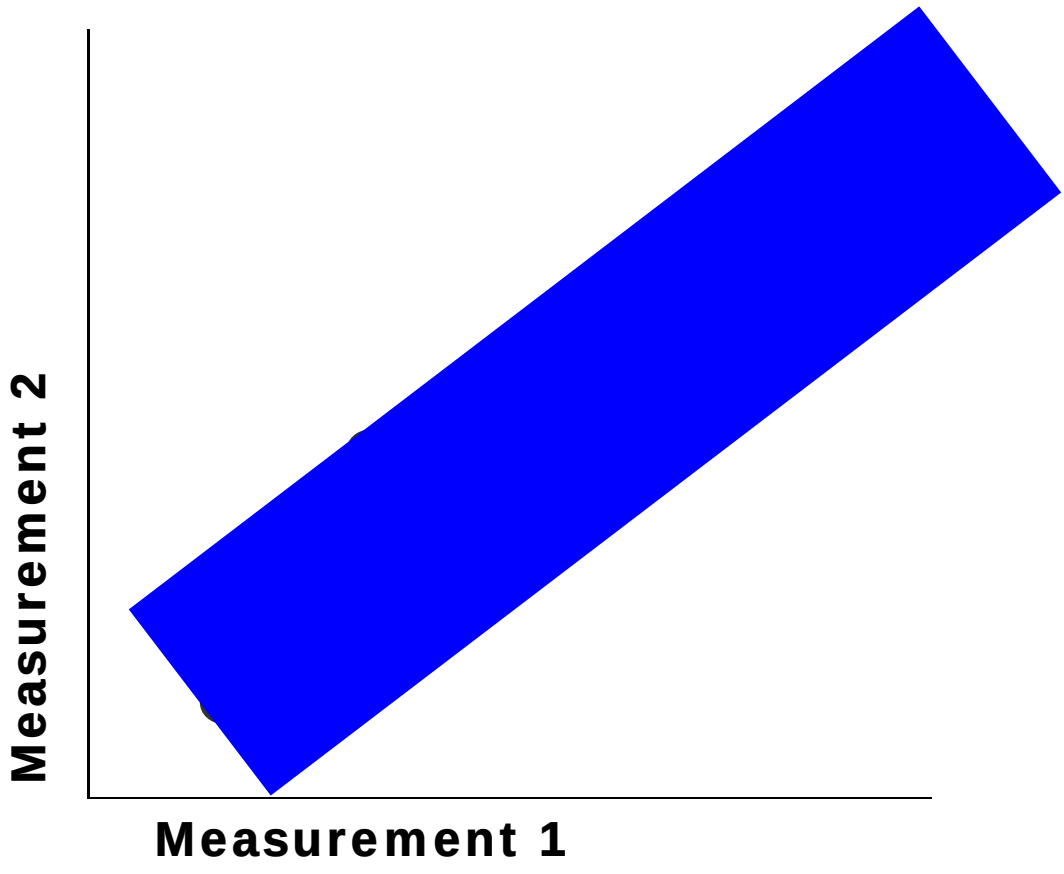


Analysing Scatter Graphs

Step 1: Colour in the area where there is no data.

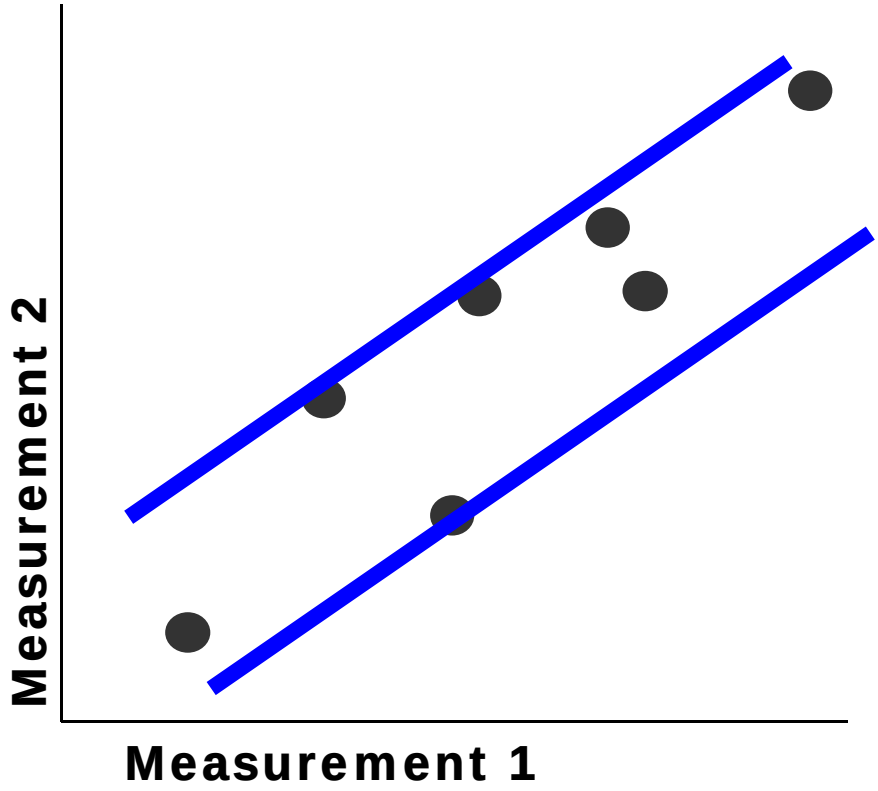


Step 2: Think of the data in the middle as a paintbrush stroke.

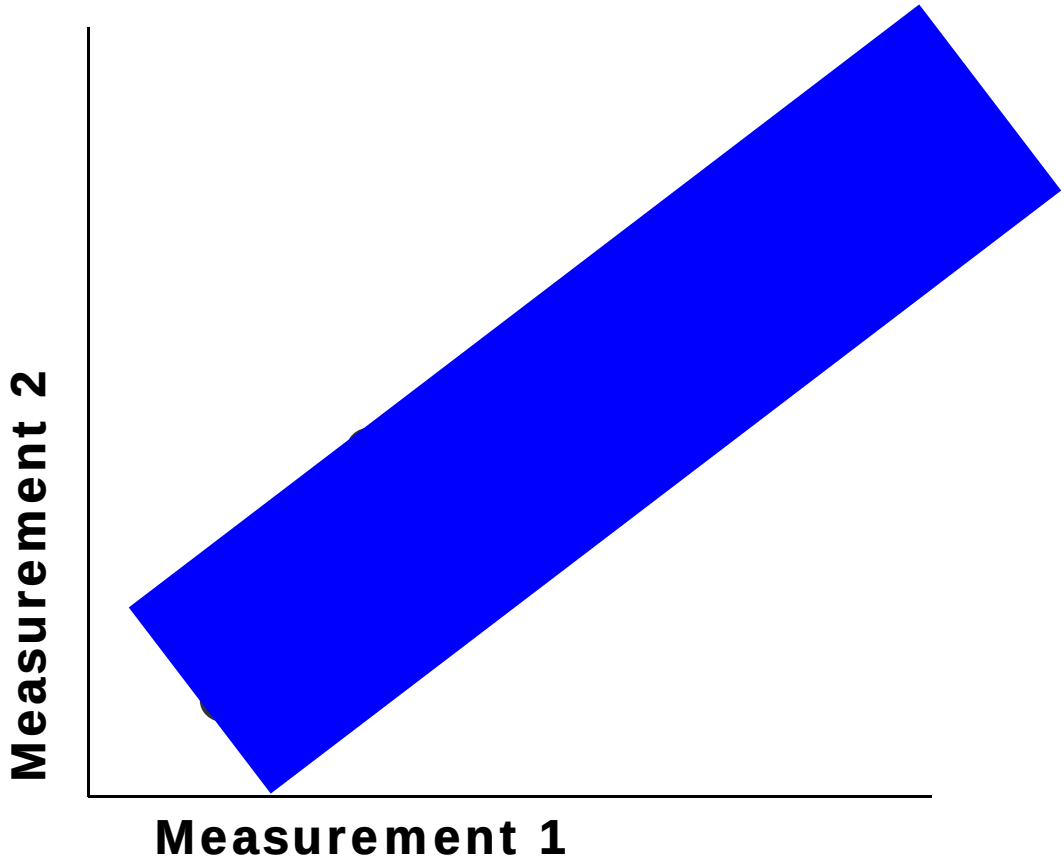


OR Alternative method (suggested for Levels 5 / 6):

Step 1: Draw edges around the data points (like joining the dots).



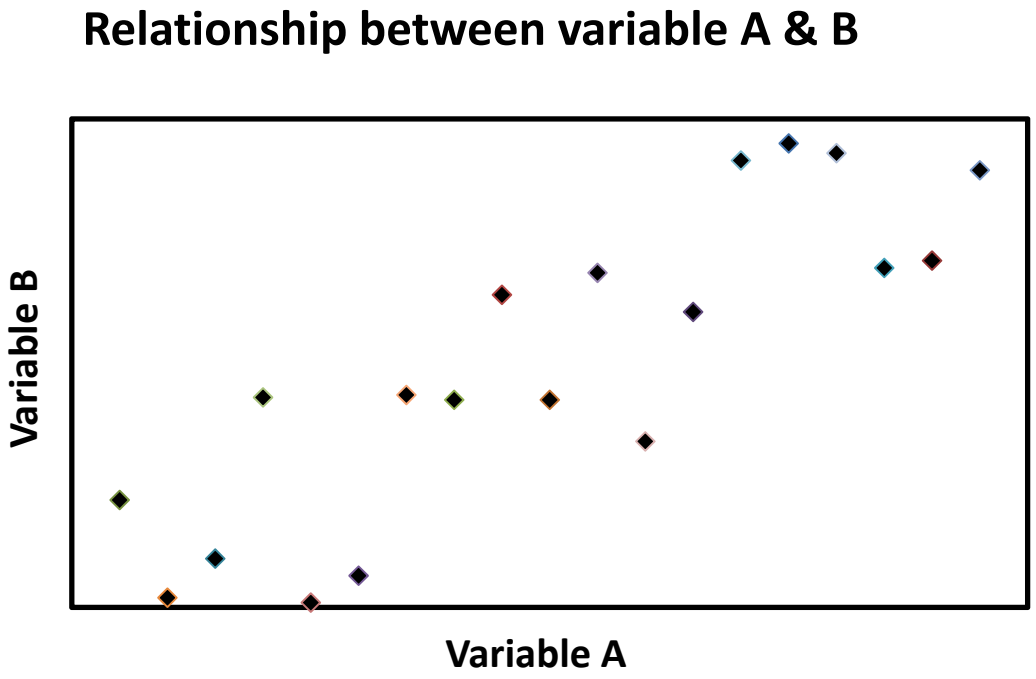
Step 2: Think of the edges you've drawn as a paintbrush stroke.



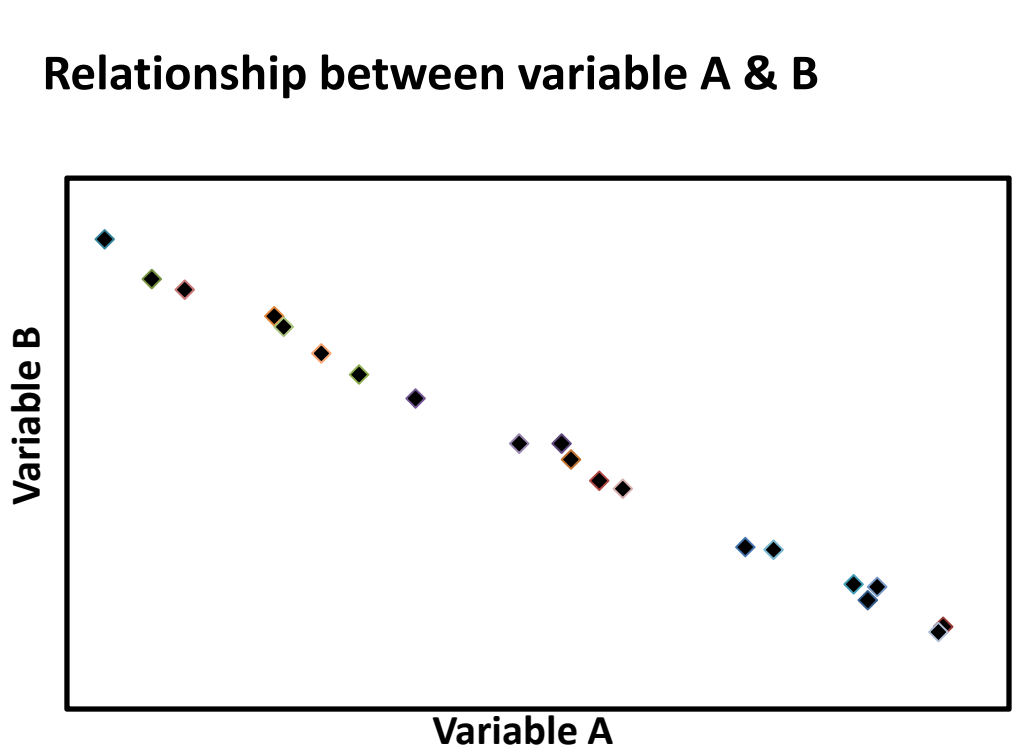
Exercise:

Colour in the areas where there is no data, **OR** draw edges around the data in the graphs below.

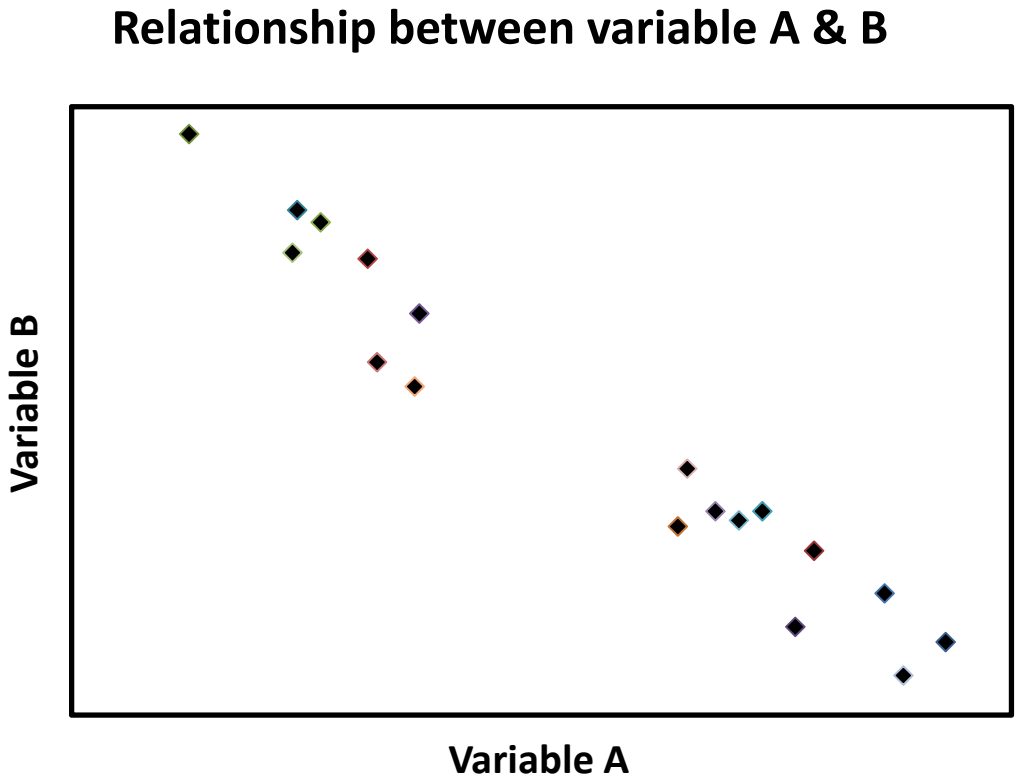
1)



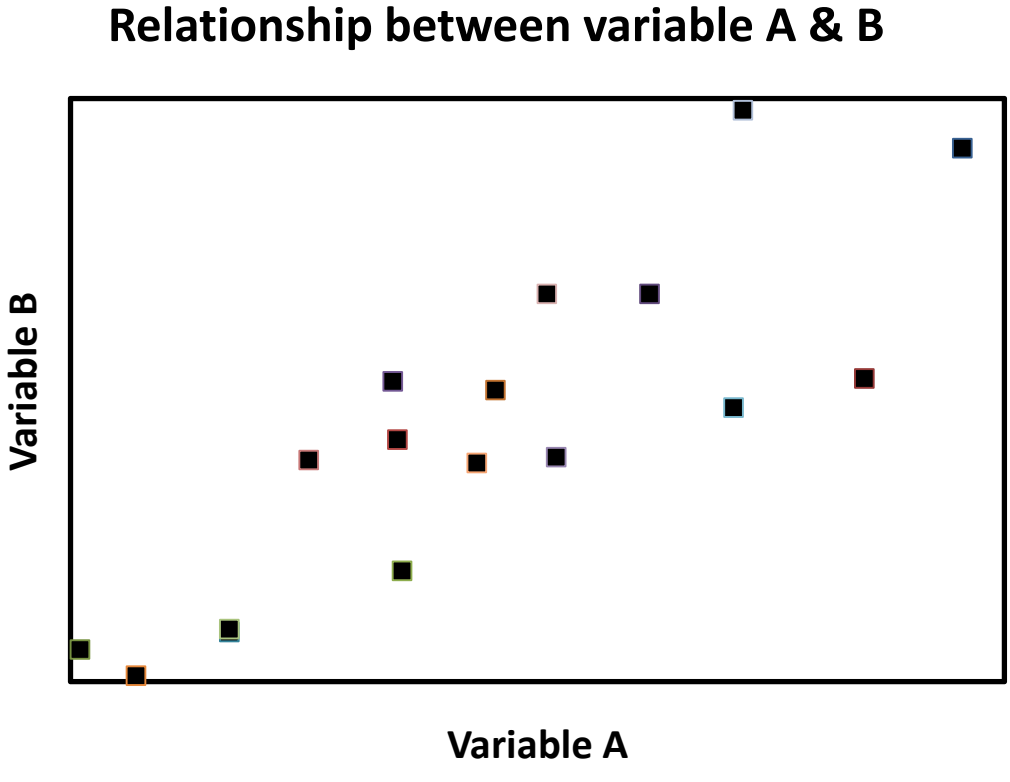
2)



3)


Relationship between variable A & B
Variable B
Variable A

4)


Relationship between variable A & B
Variable B
Variable A

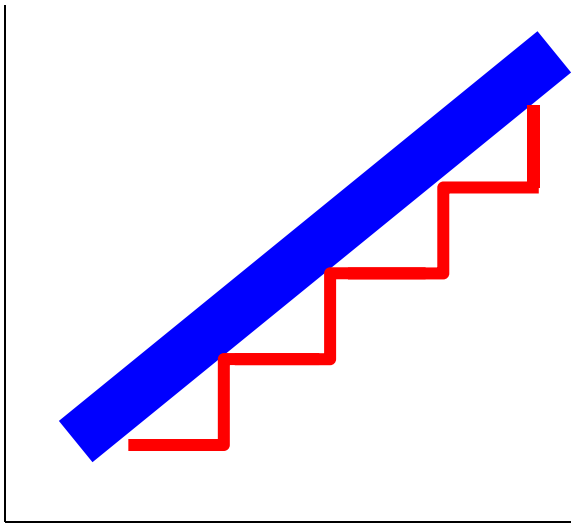
Describe the Trend

Look at the paintbrush stroke that you drew (between the edges).

Do you see:

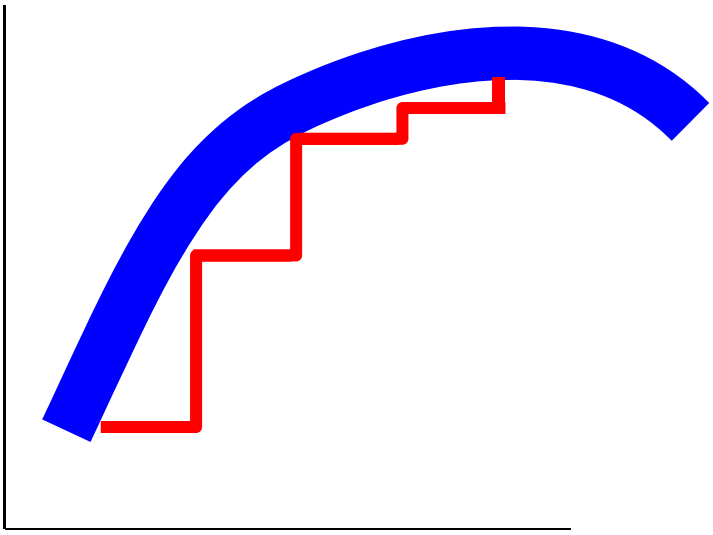
a **linear** trend…

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



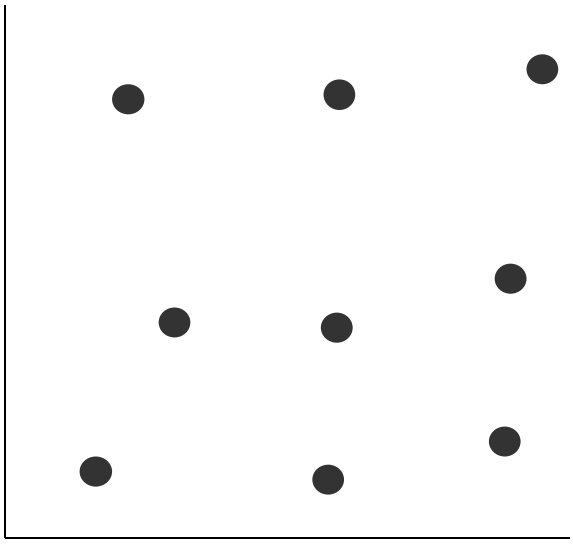
a **non-linear** trend…

(looks like a curve)



or no trend?

(no pattern at all)



Sentence Framework:

Level 2 / 3 / 4:

I notice that the type of relationship between

measurement 1 and **measurement 2** is

linear / curved / no pattern.

This is because the paintbrush stroke we drew is quite

straight / curved / goes nowhere.

Level 5:

This is because the trend is changing at a **constant / non constant rate**.

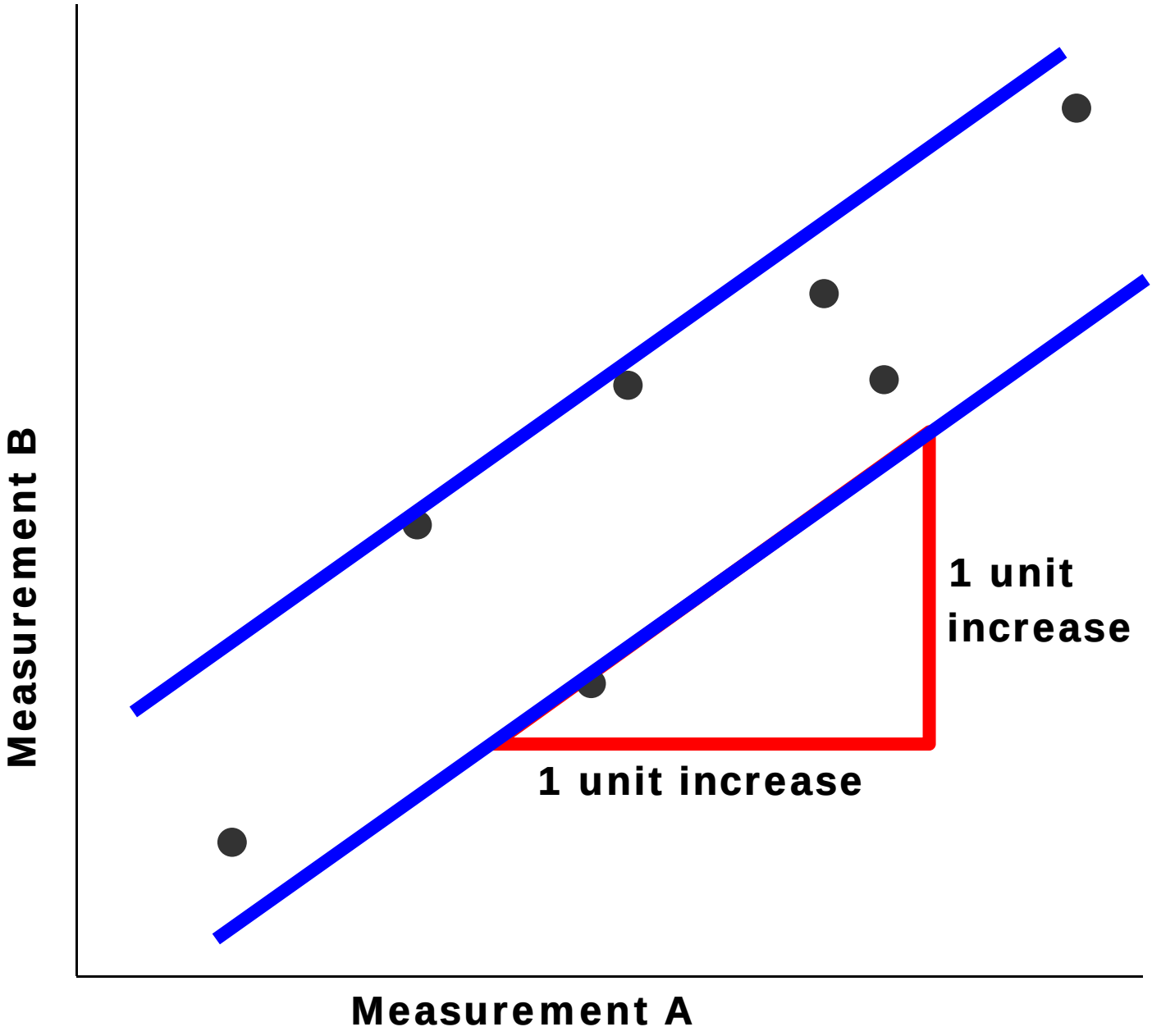
Level 6:

We can see this because for every 1 **unit** increase

in **measurement 1**, **measurement 2**

increases by **# units**.

Example:



I notice that the type of relationship between measurement A and measurement B is linear.

This is because the paintbrush stroke we drew is quite straight .

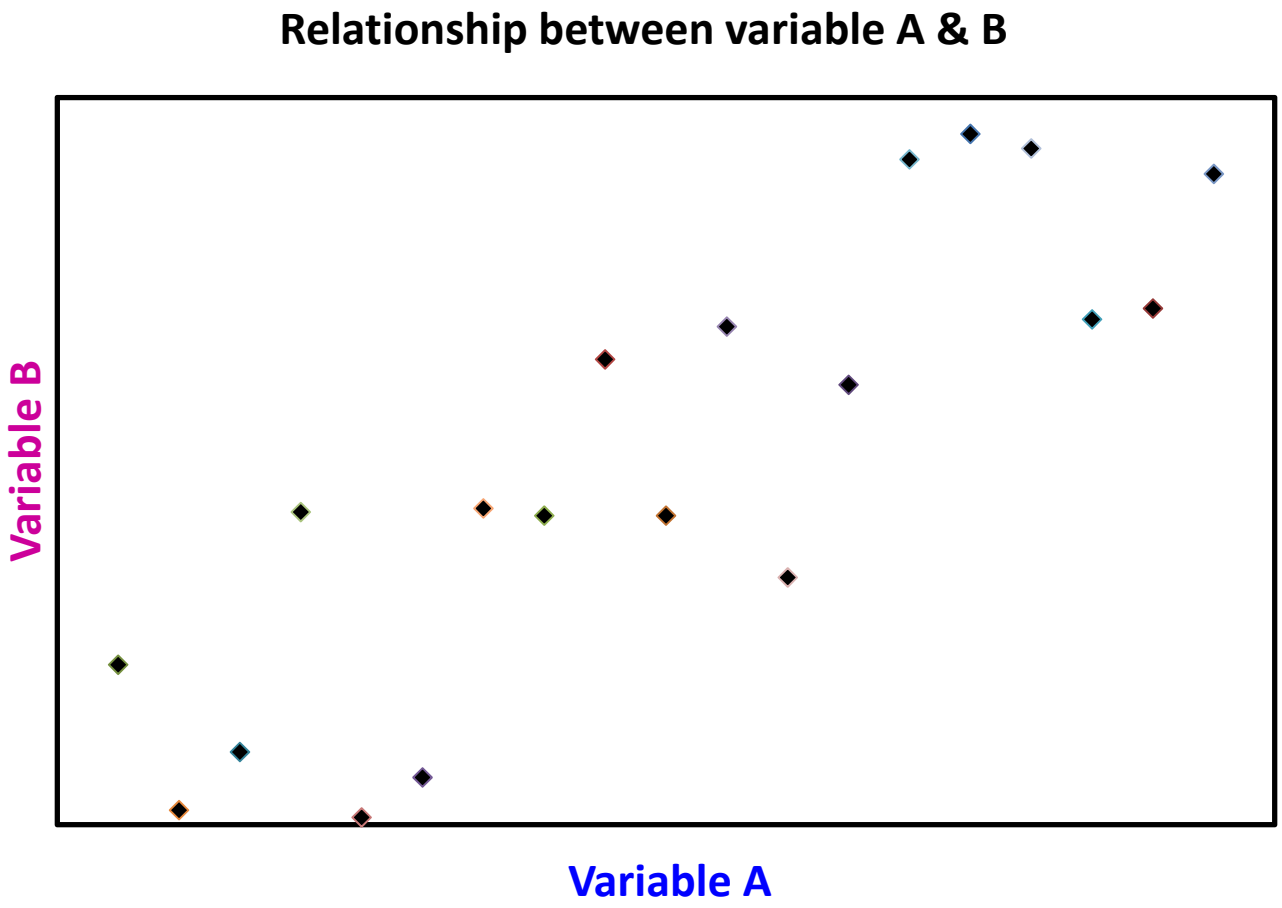
This is because the trend is changing at a constant rate.

We can see this because for every 1 unit increase in measurement A, measurement B increases by 1 unit.

Exercise:

Colour in the areas where there is no data, **OR** draw edges around the data in the graphs below.
Then write a sentence describing the type of relationship.

1)



I notice that the type of relationship between

_____ and _____

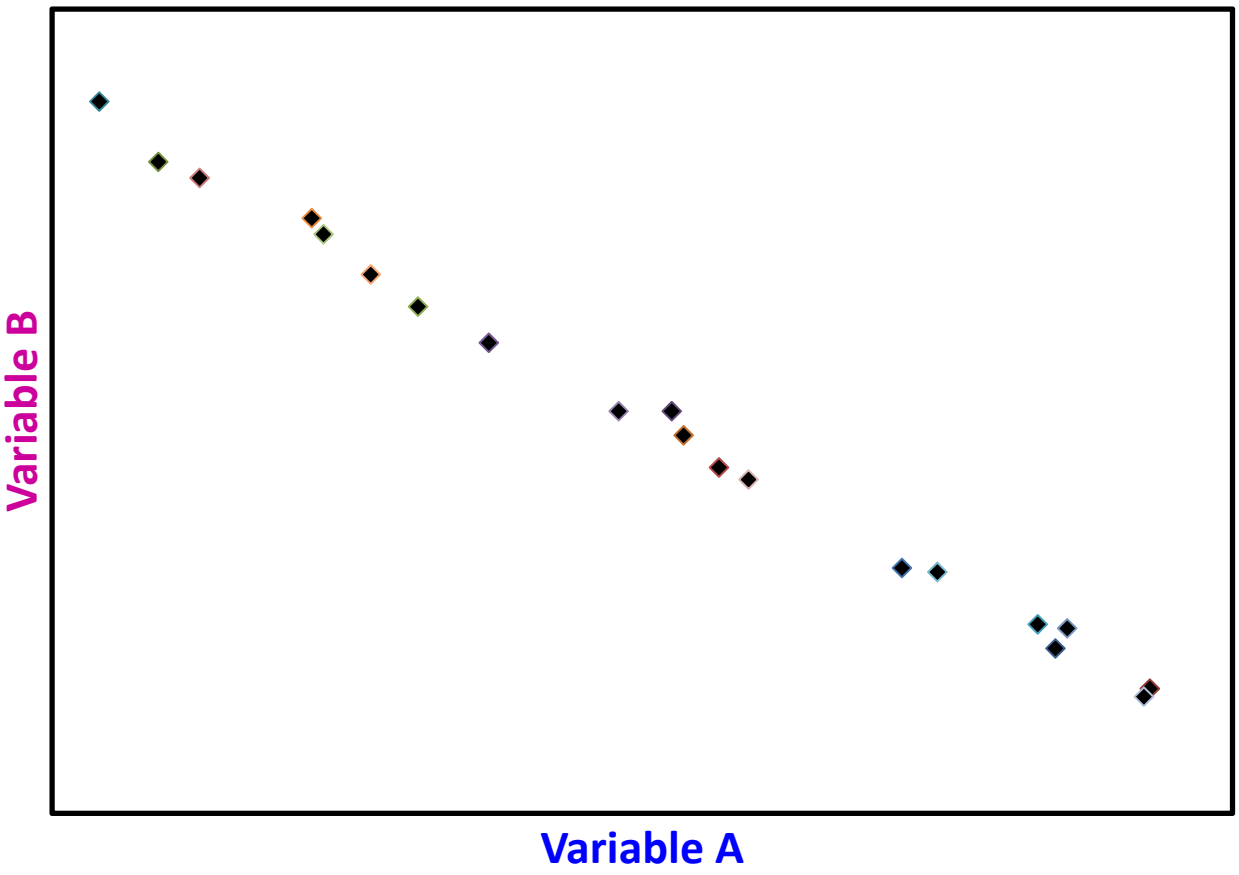
is _____.

This is because _____

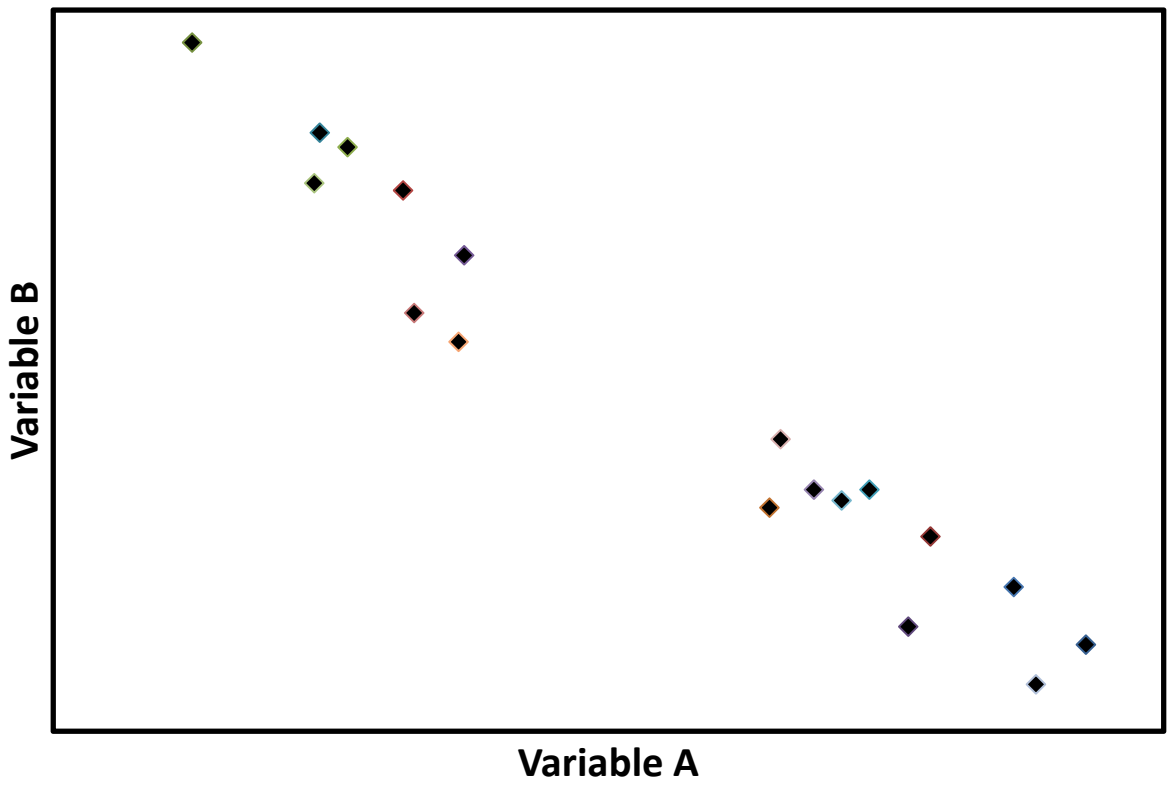
_____

_____

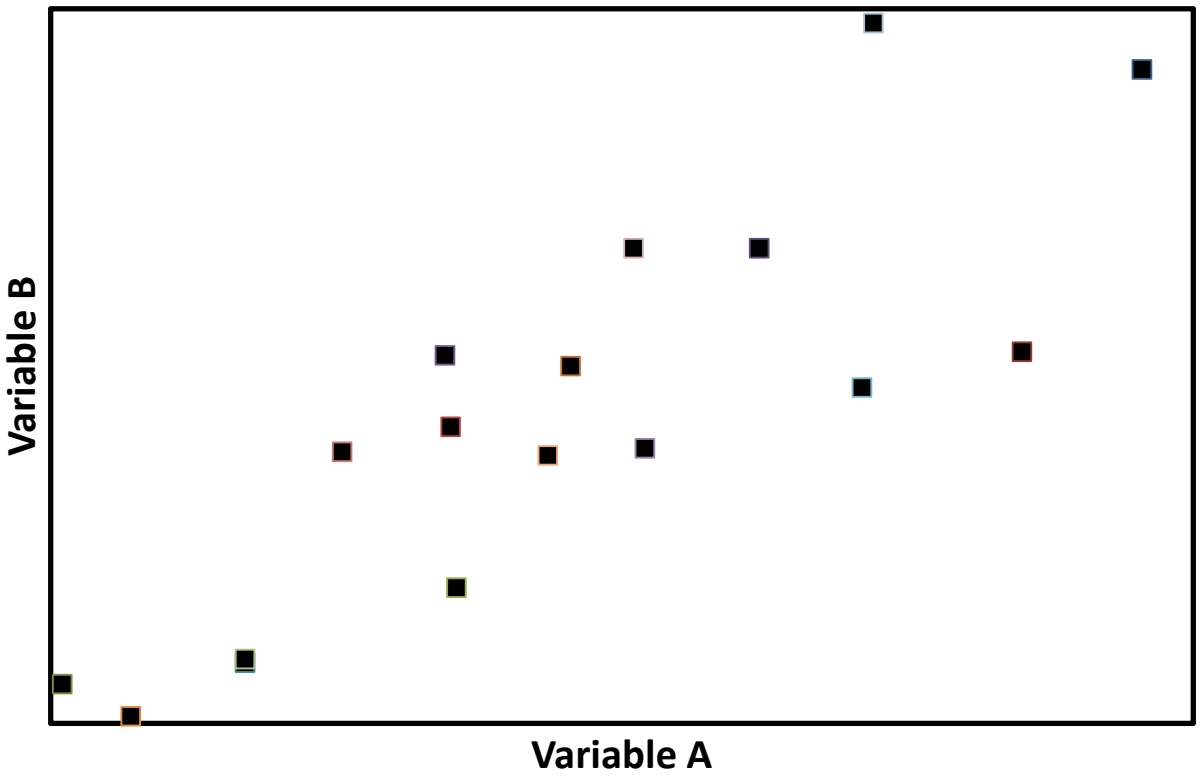
2)



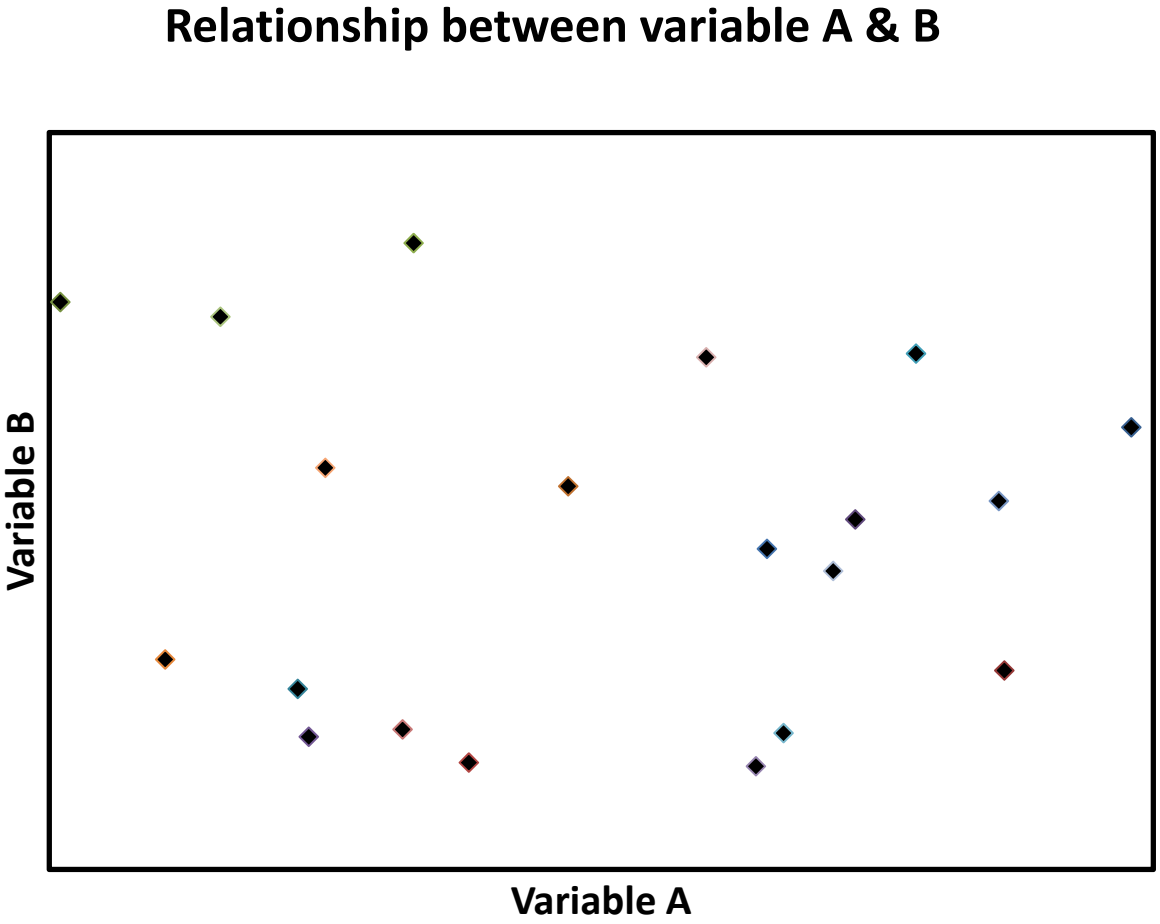
3)



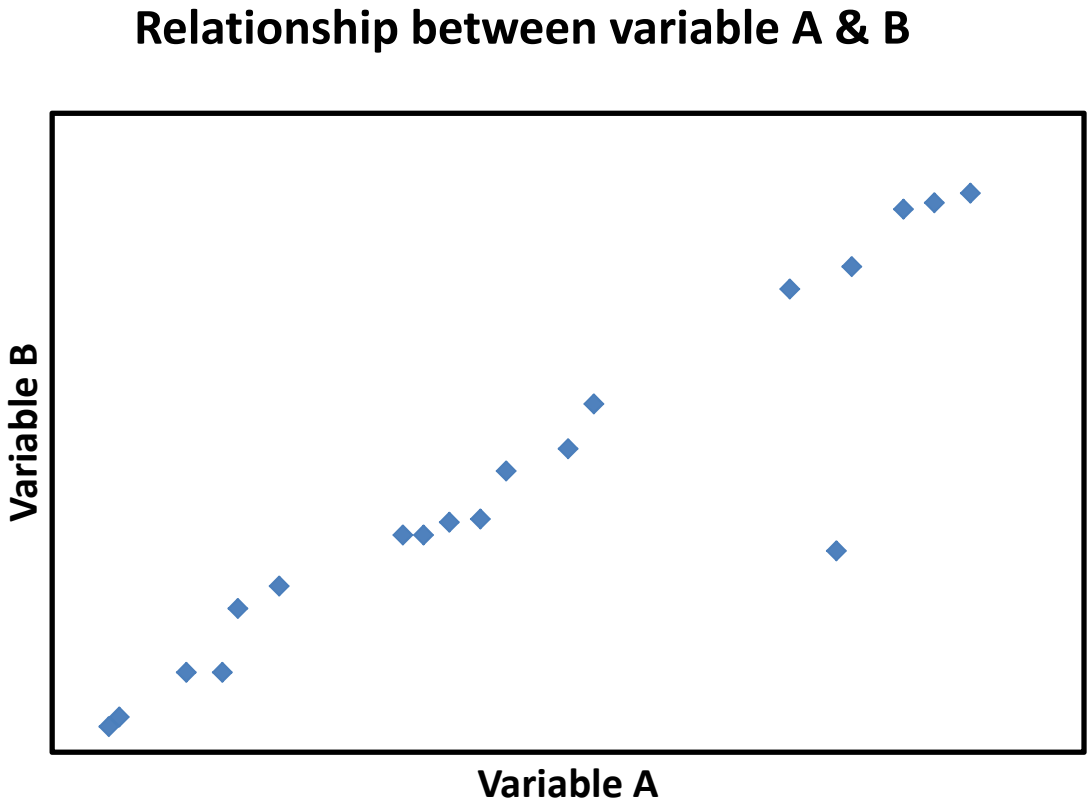
4)



5)



6)

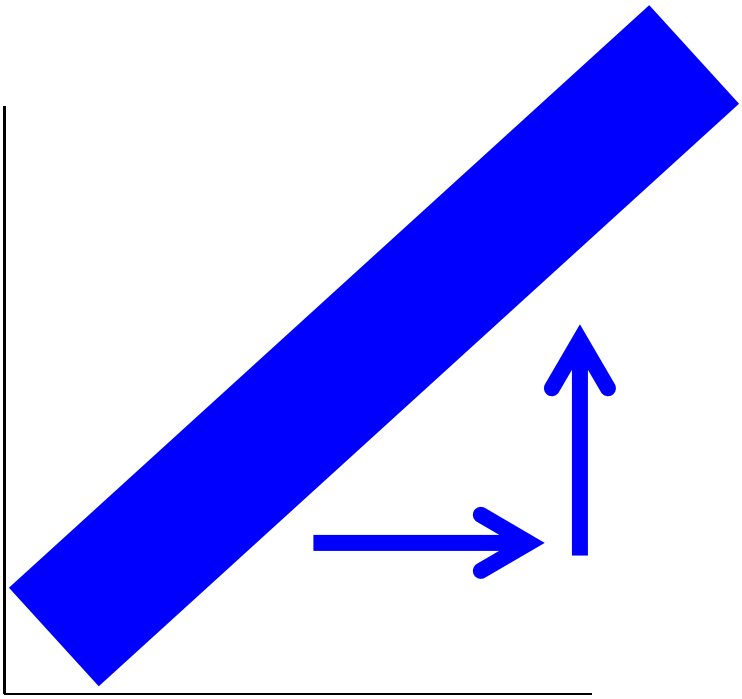


Describe the Direction of the Trend

Do you see:

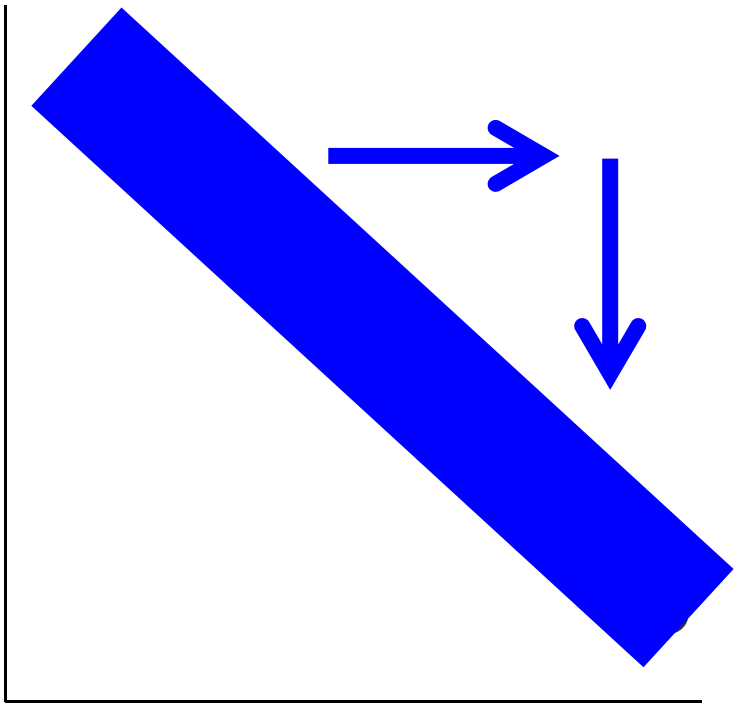
a **positive** direction…

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



or a **negative** direction?

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



Sentence Framework:

Level 2 / 3 / 4:

I notice that the direction of the relationship between

measurement 1 and **measurement 2** is

positive / negative.

Level 5:

This is because the paintbrush stroke we drew goes

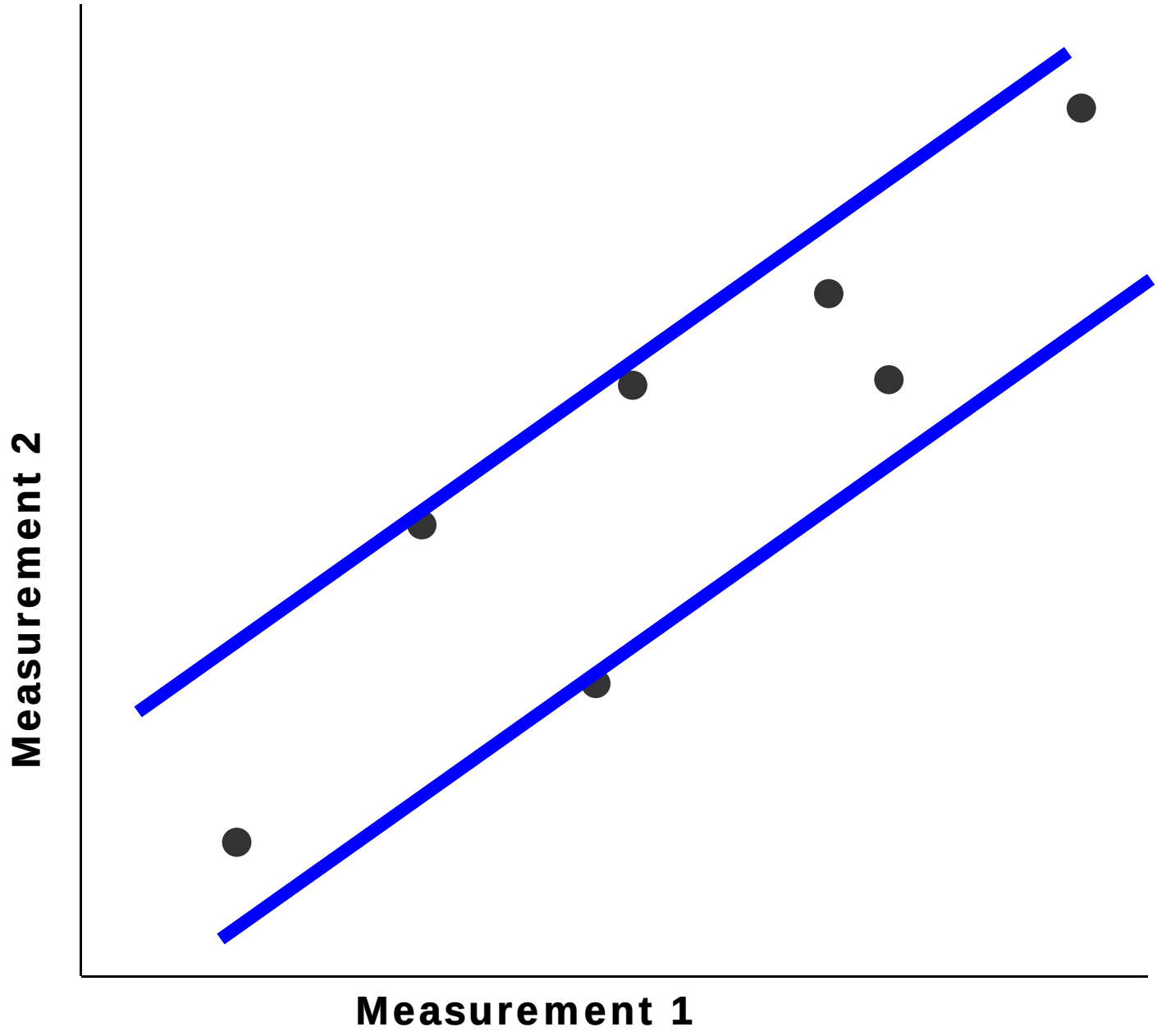
up / down.

Level 6:

This is because as **measurement 1** increases

measurement 2 **increases / decreases**.

Example:



I notice that the direction of relationship between measurement 1 and measurement 2 is positive.

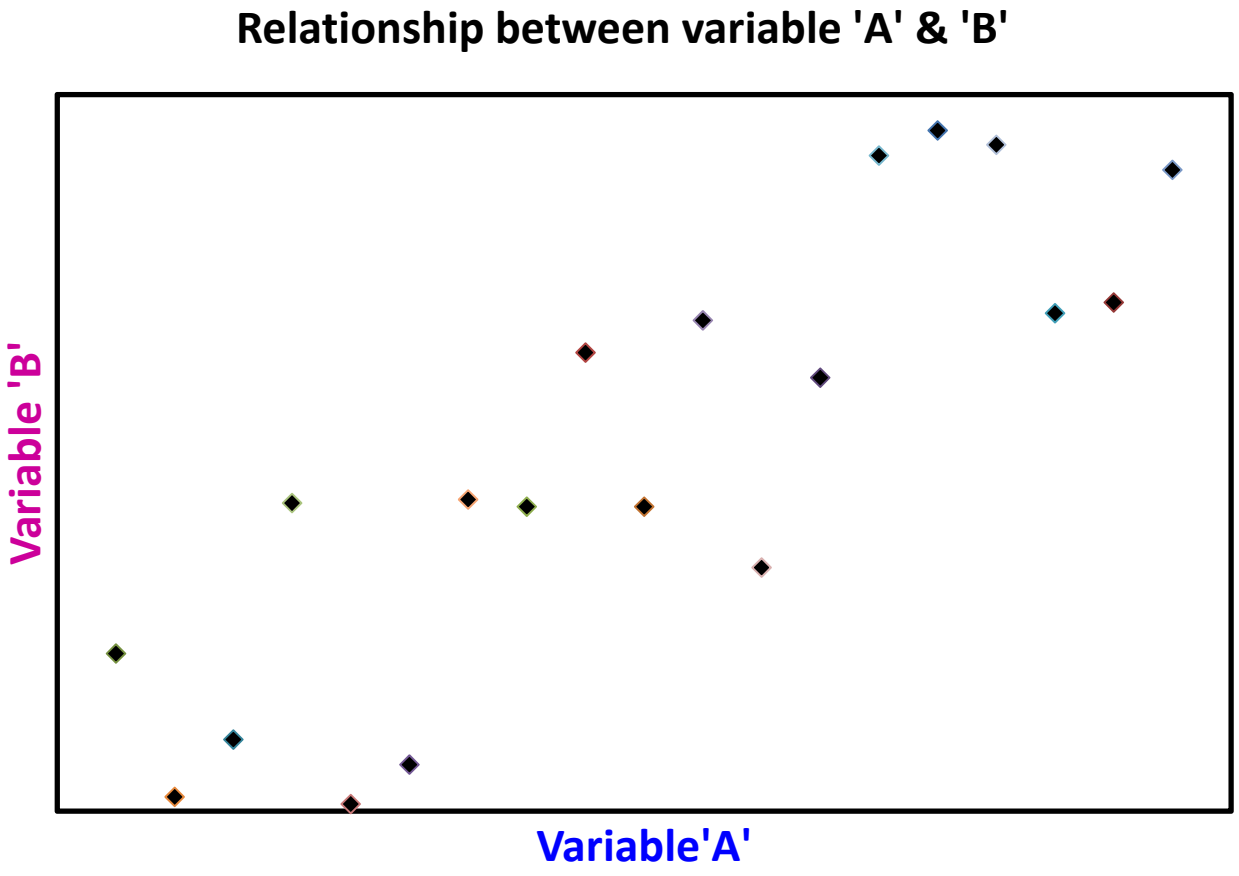
This is because the paintbrush stroke we drew is goes up.

This is because as measurement 1 increases, measurement 2 increases.

Exercise:

Colour in the areas where there is no data, **OR** draw edges around the data in the graphs below.
Then write a sentence describing the direction of the relationship.

1)

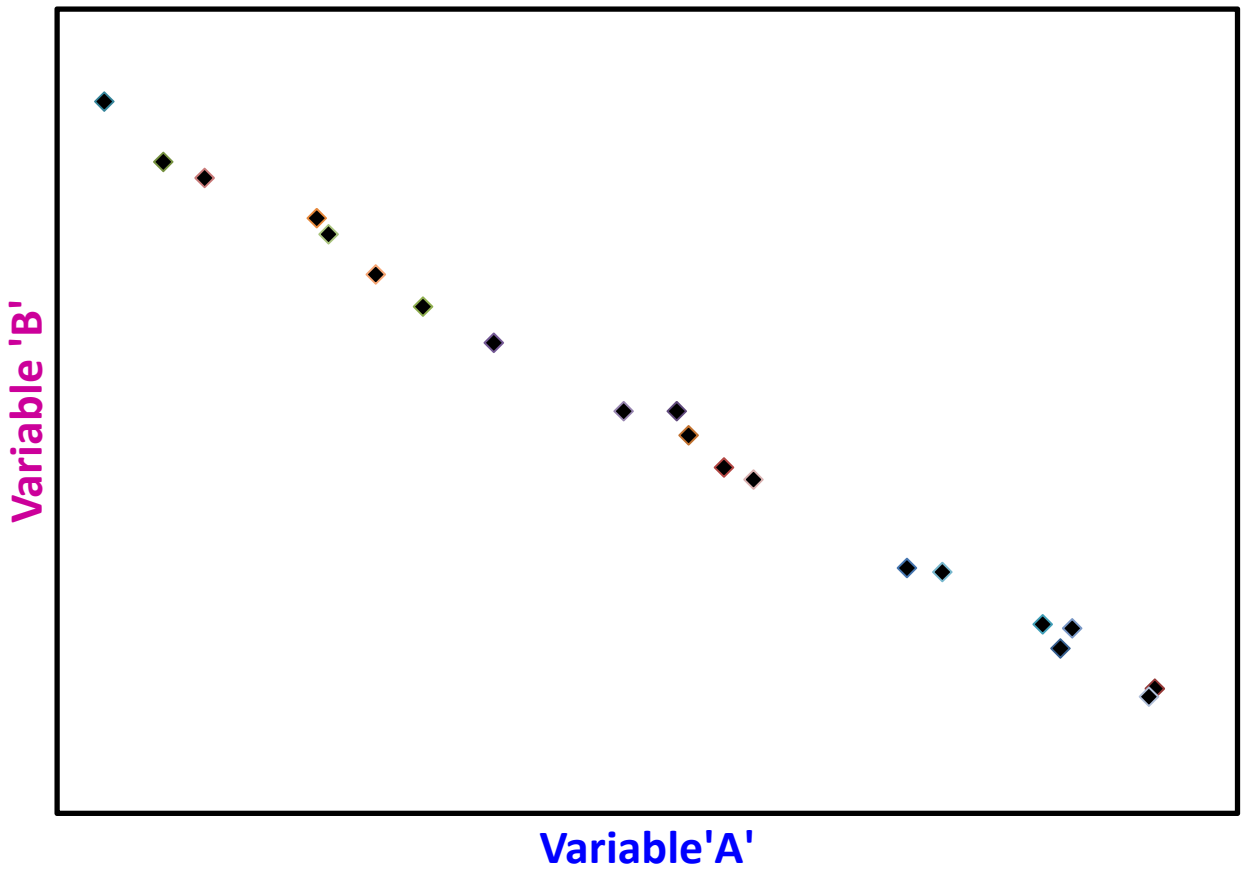


I notice that the direction of the relationship between between _____ and _____ is _____.

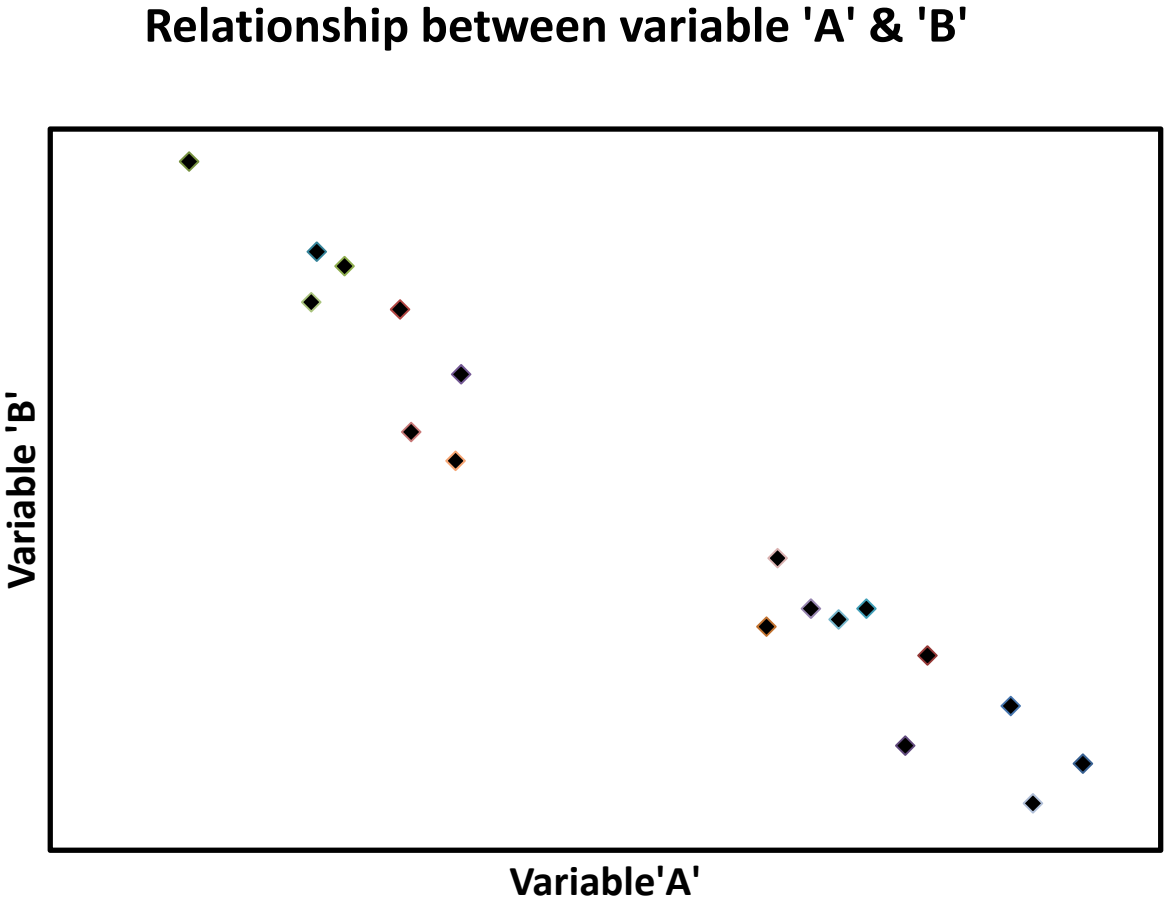
This is because _____

_____.

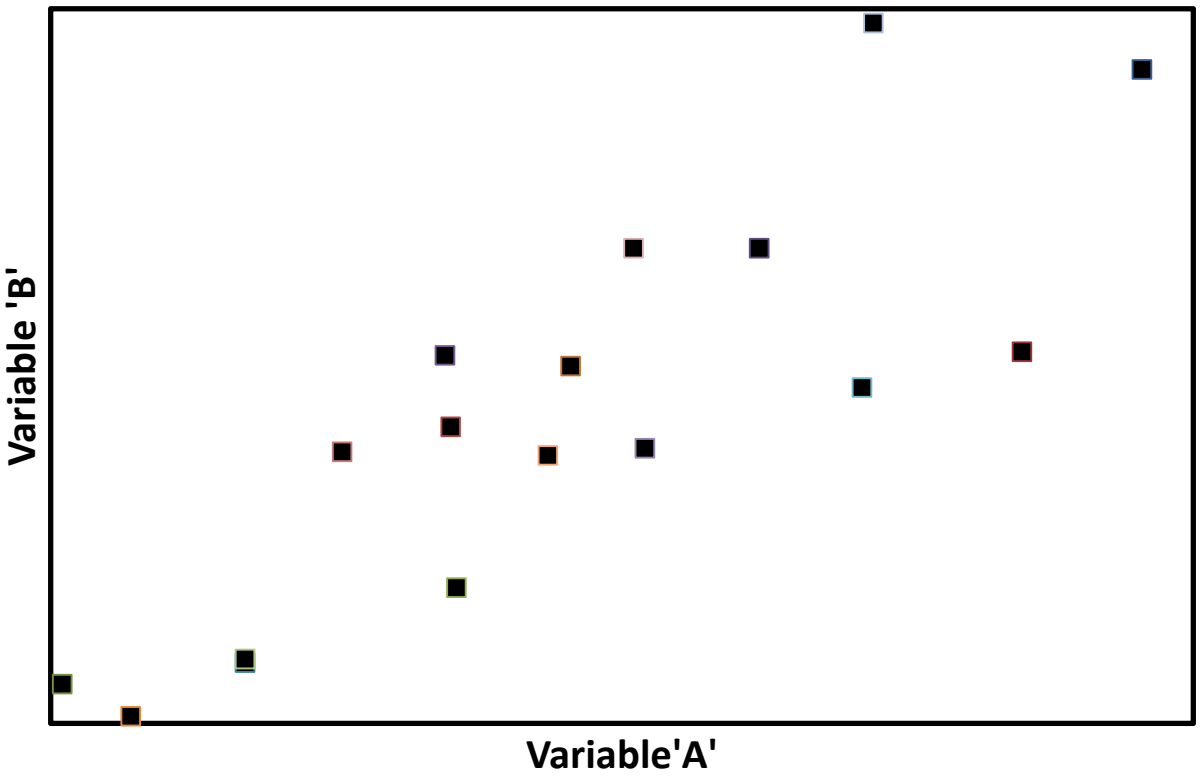
2)



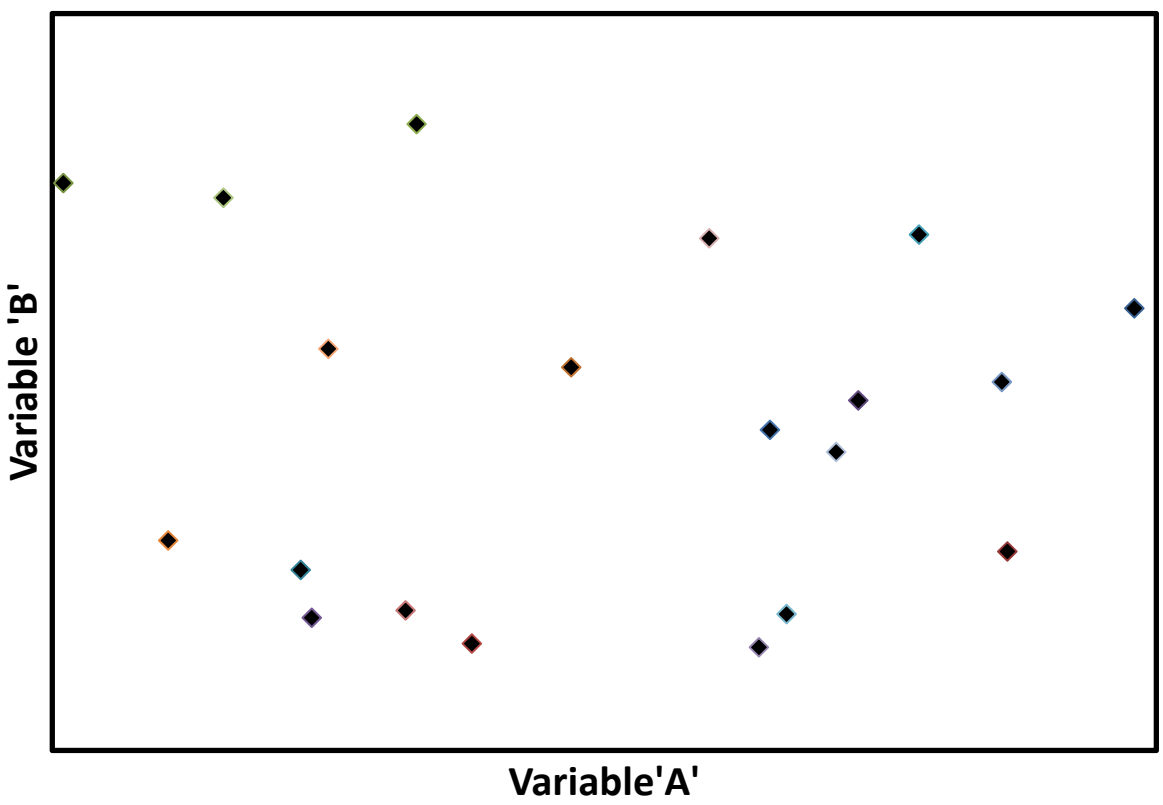
3)



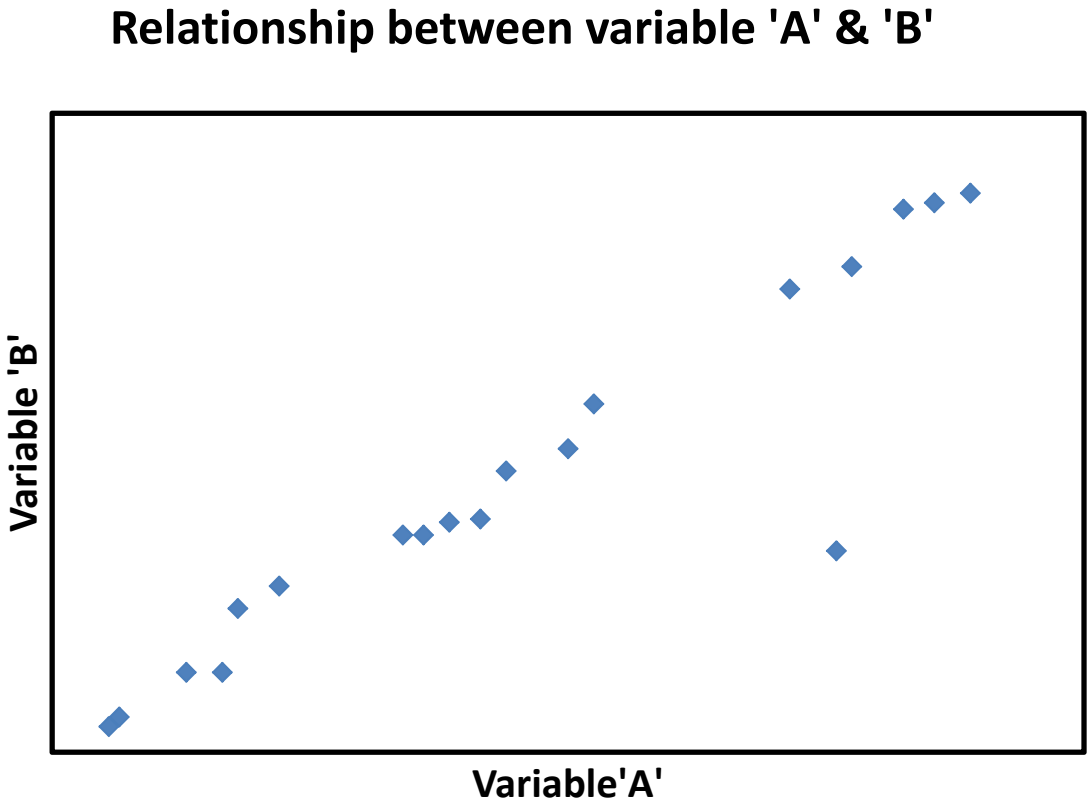
4)



5)



6)

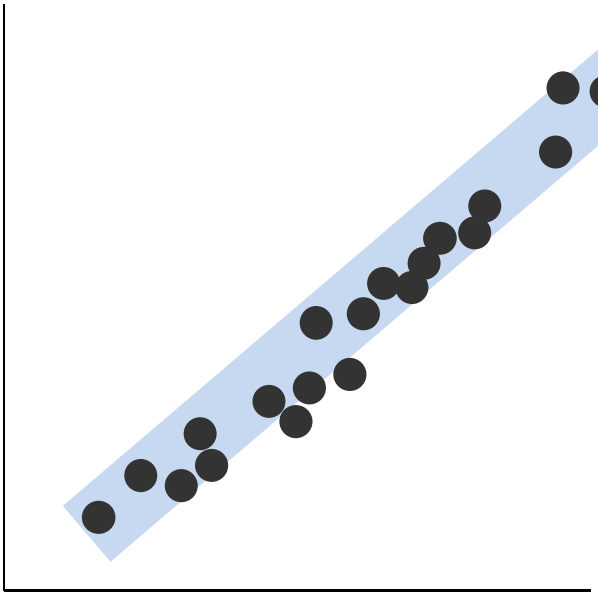


Scatter

Do you see:

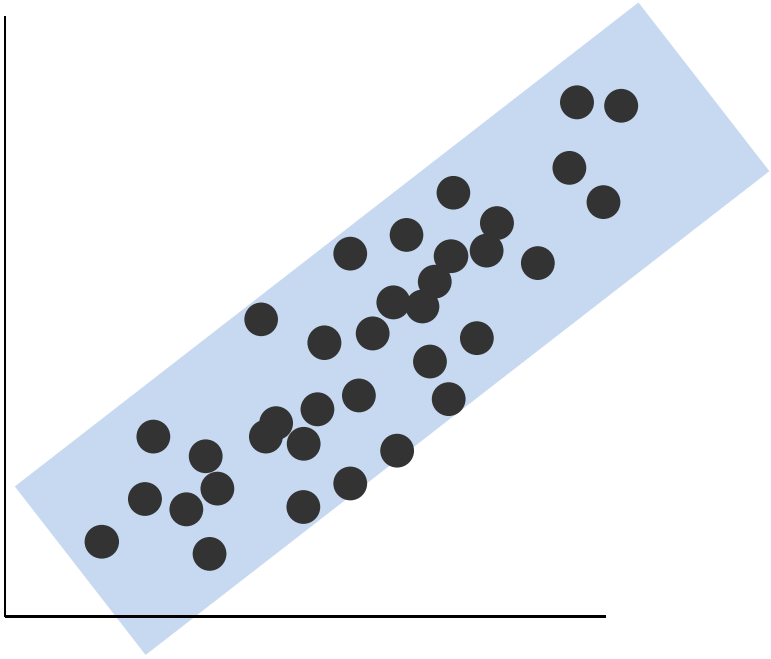
a **strong** relationship?

(a thin paintbrush stroke, or a small amount of scatter)



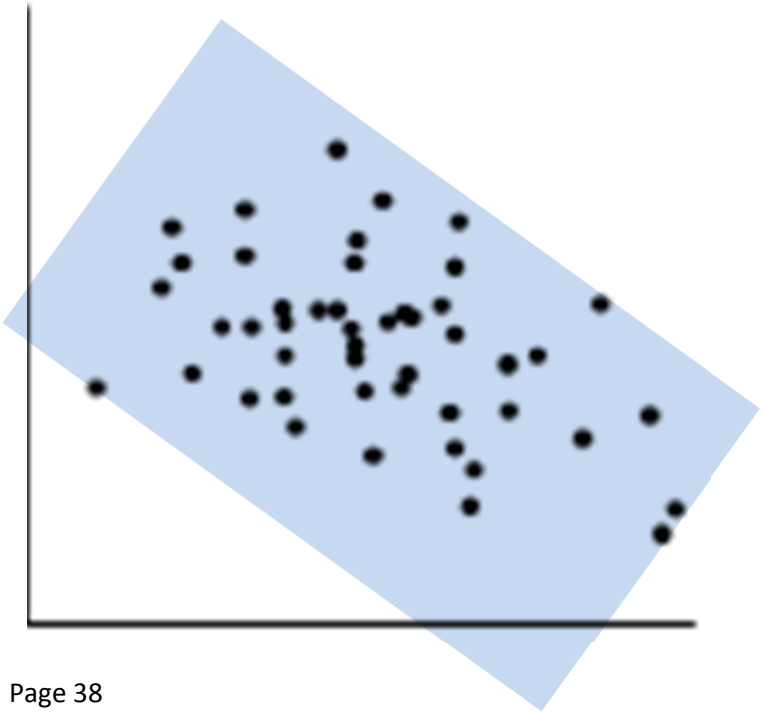
a **moderate** relationship?

(a medium sized paintbrush stroke, or a moderate amount of scatter)



or a **weak** relationship?

(a wide paintbrush, or a lot of scatter)



Sentence Framework:

Level 2 / 3 / 4:

I notice that the strength of the relationship between

measurement 1 and **measurement 2**

is **strong / moderate / weak / none**.

Level 5:

This is because the width of the paintbrush stroke we

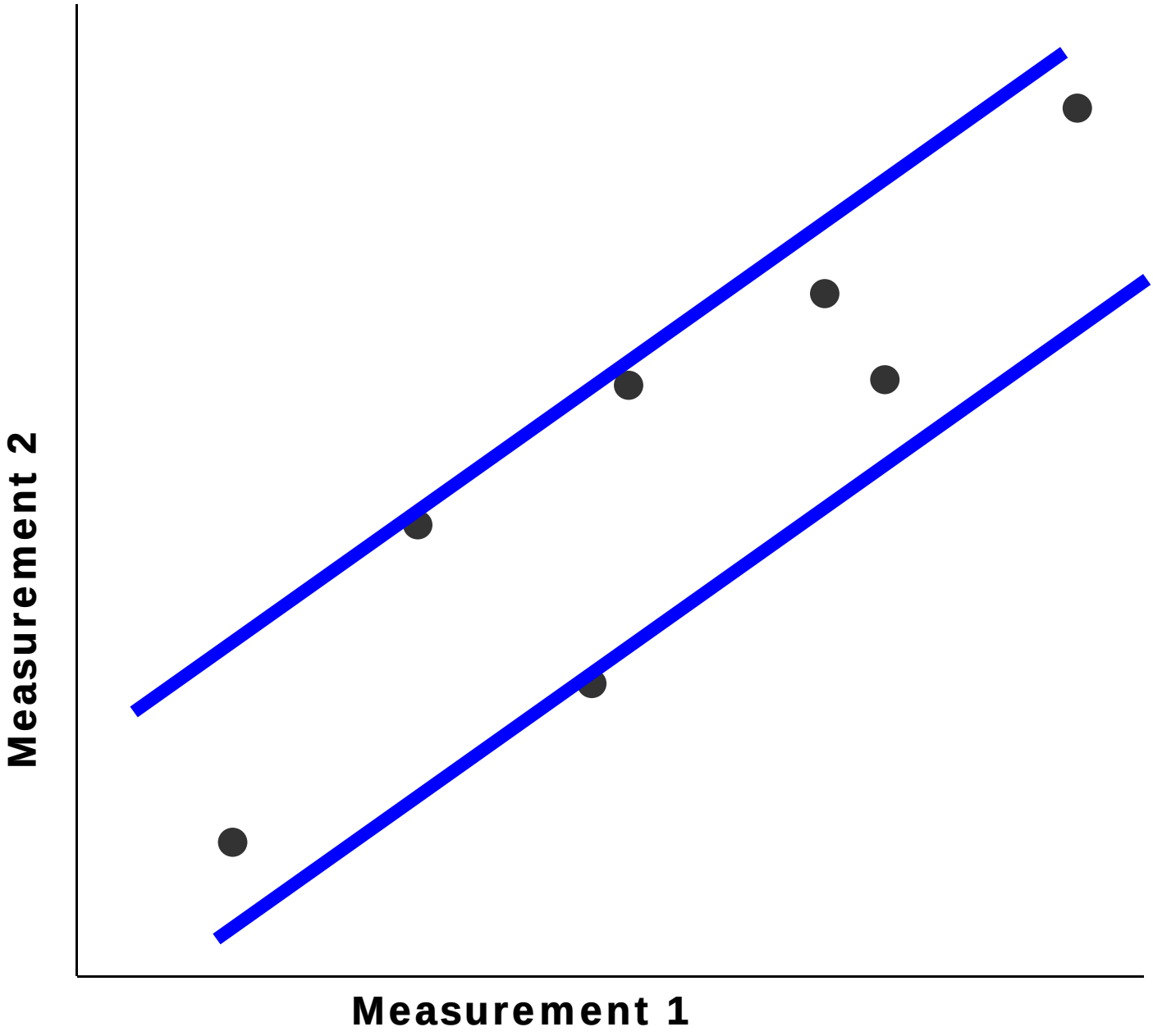
drew is quite **thin / moderate / wide**.

Level 6:

This is because there is a **small / moderate / large**

amount of scatter around the trend line.

Example:



I notice that the strength of relationship between measurement 1 and measurement 2 is moderate.

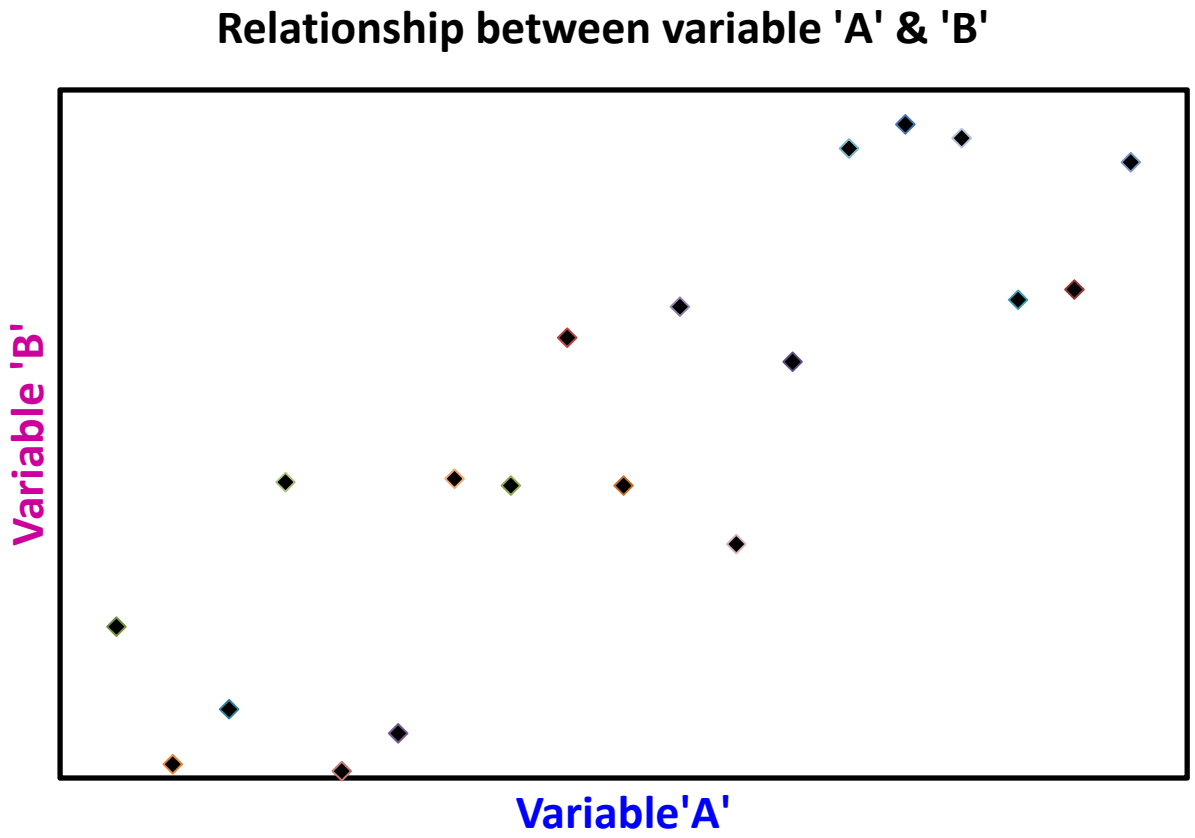
This is because the width of the paintbrush stroke we drew is quite moderate.

This is because there is a moderate amount of scatter around the trend line.

Exercise:

Colour in the areas where there is no data, **OR** draw edges around the data in the graphs below.
Then write a sentence describing the strength of the relationship.

1)

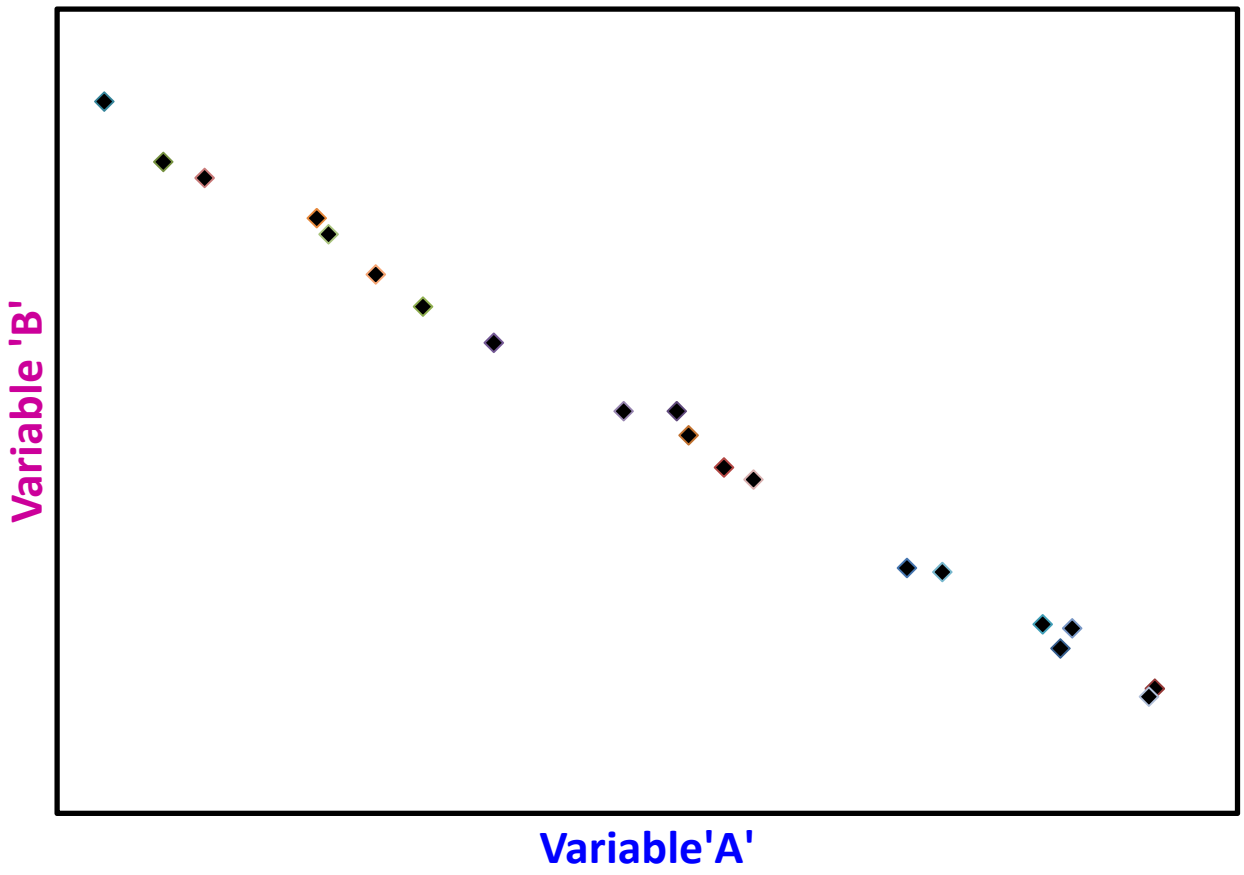


I notice that the strength of the relationship between between _____ and _____ is _____.

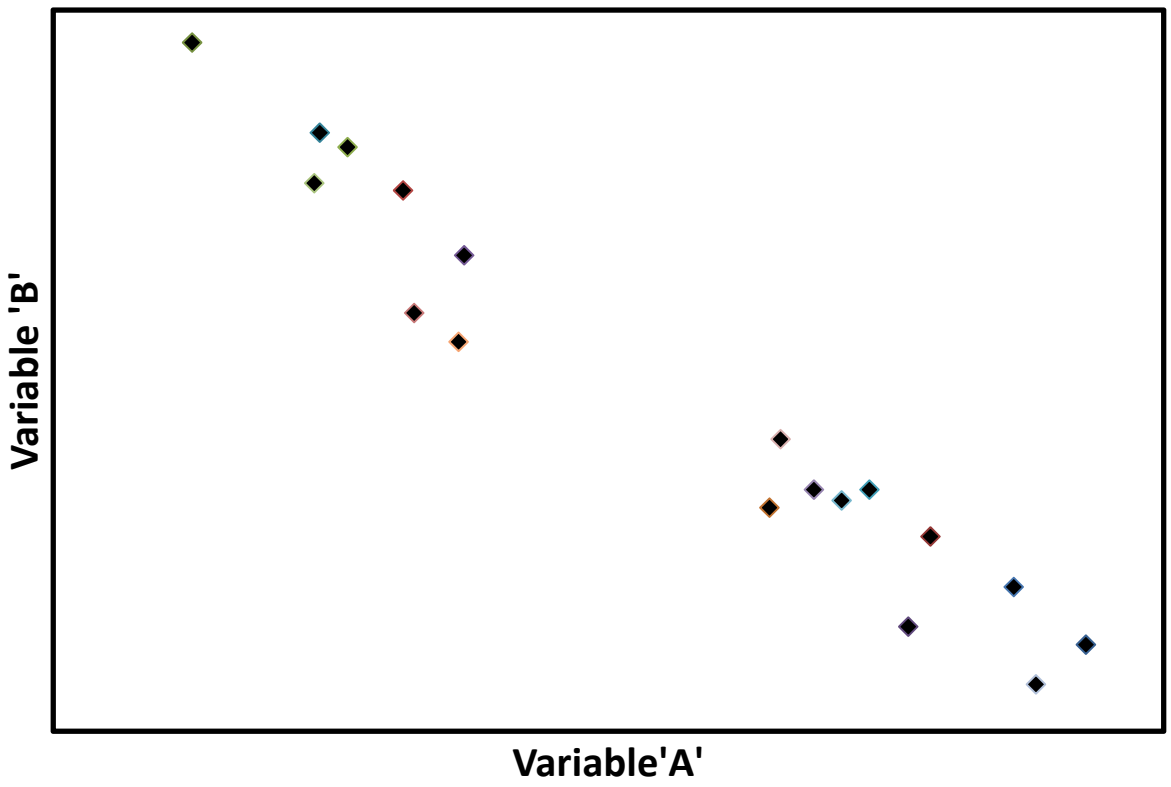
This is because _____

_____.

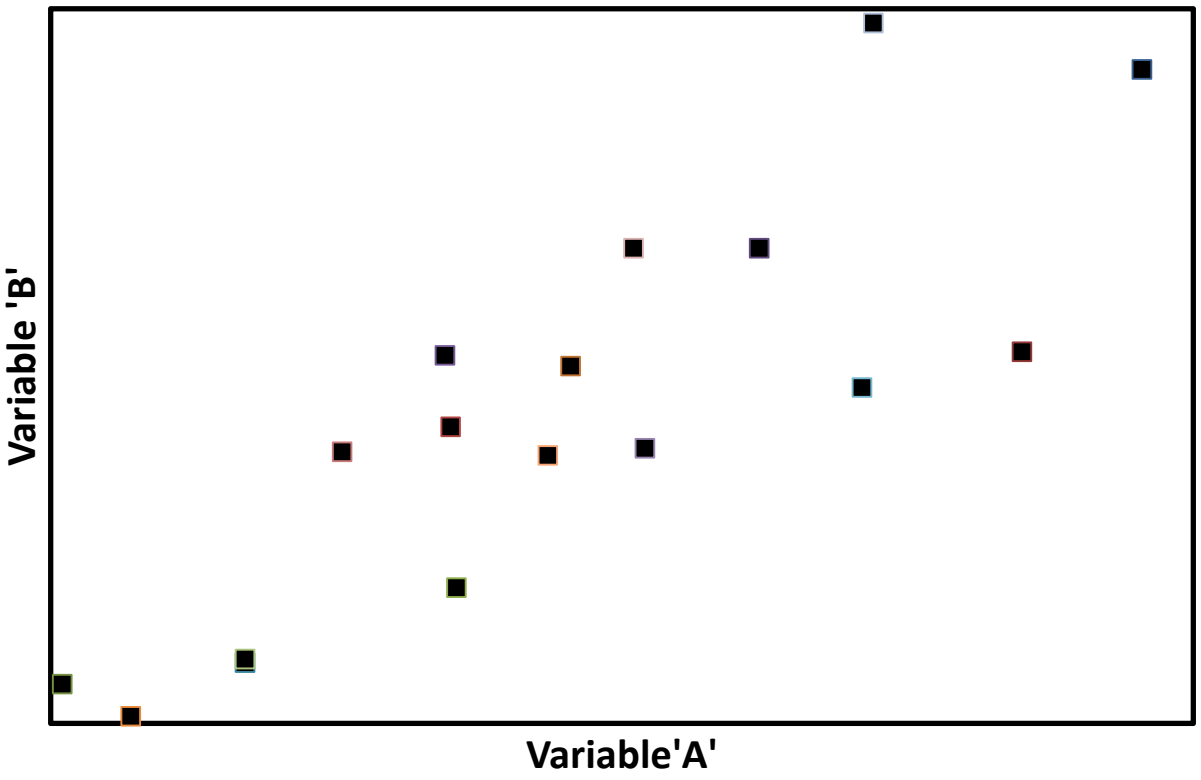
2)



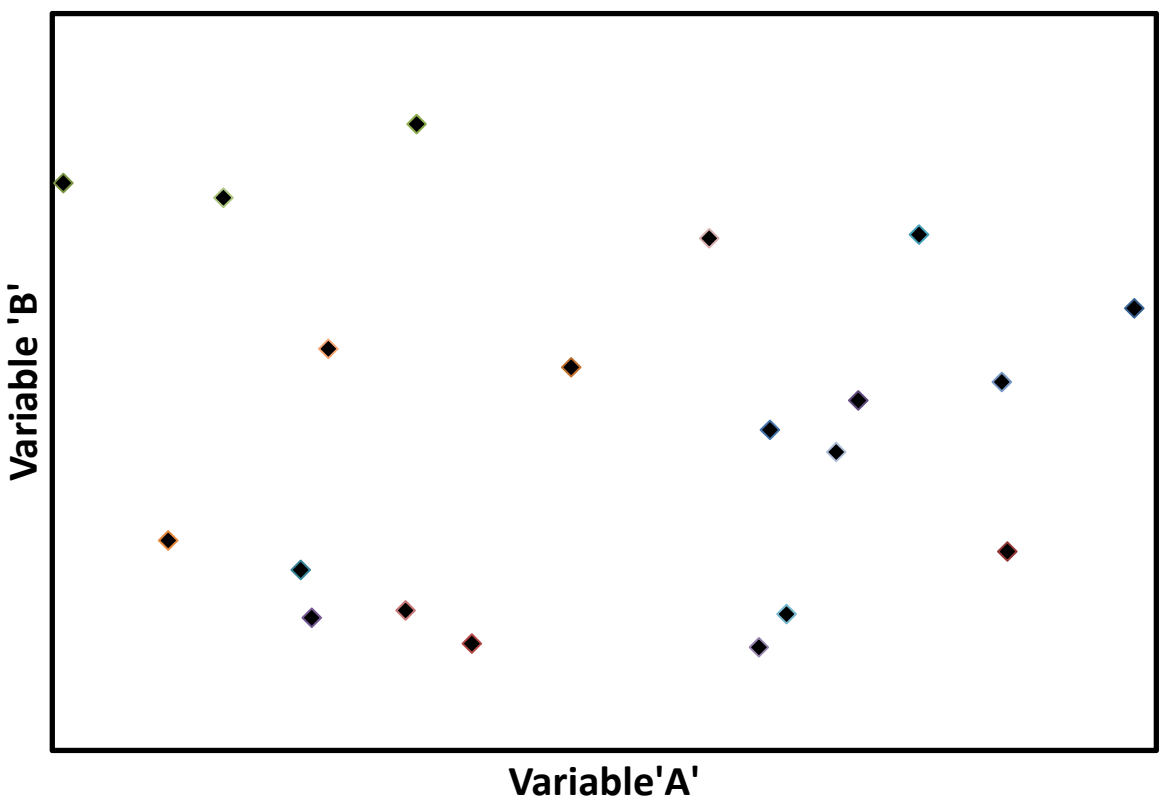
3)



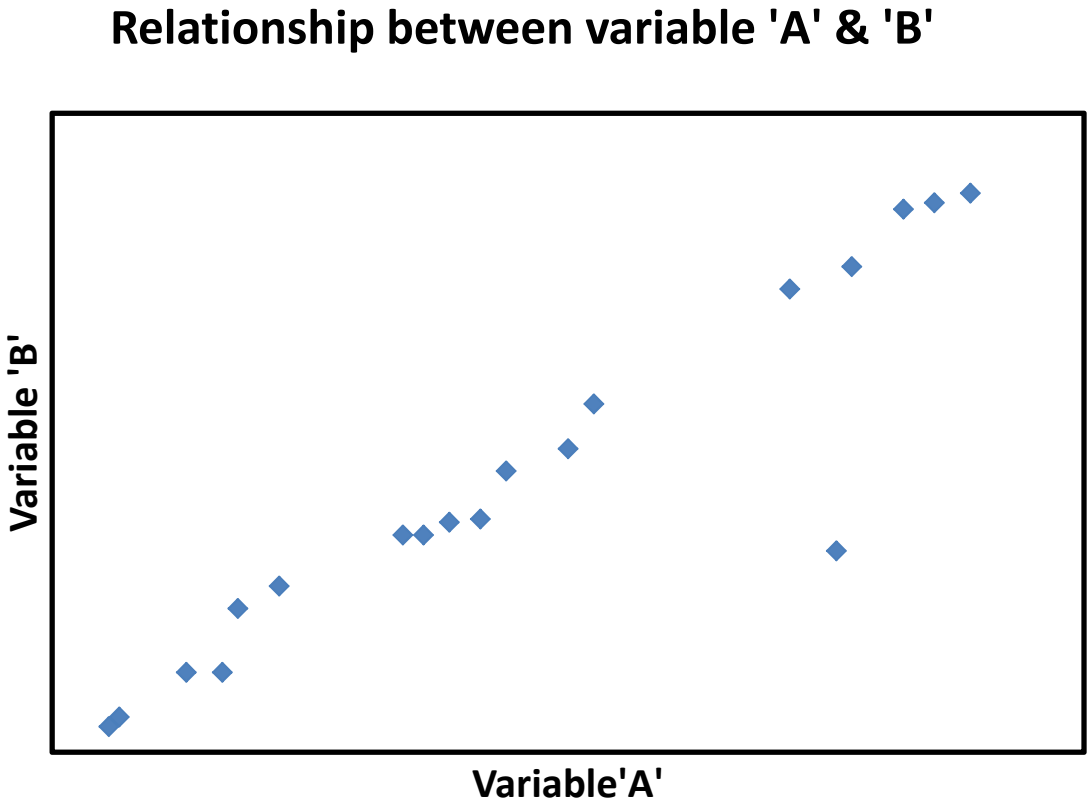
4)



5)



6)

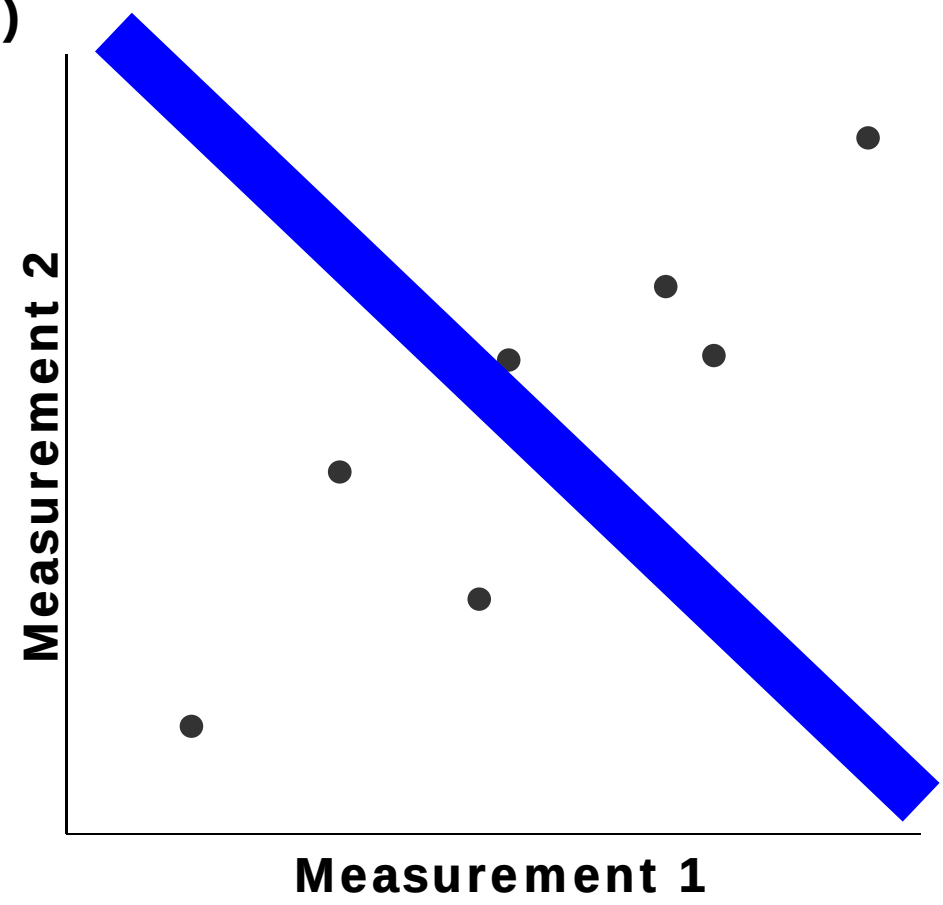


Adding a line of best fit

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

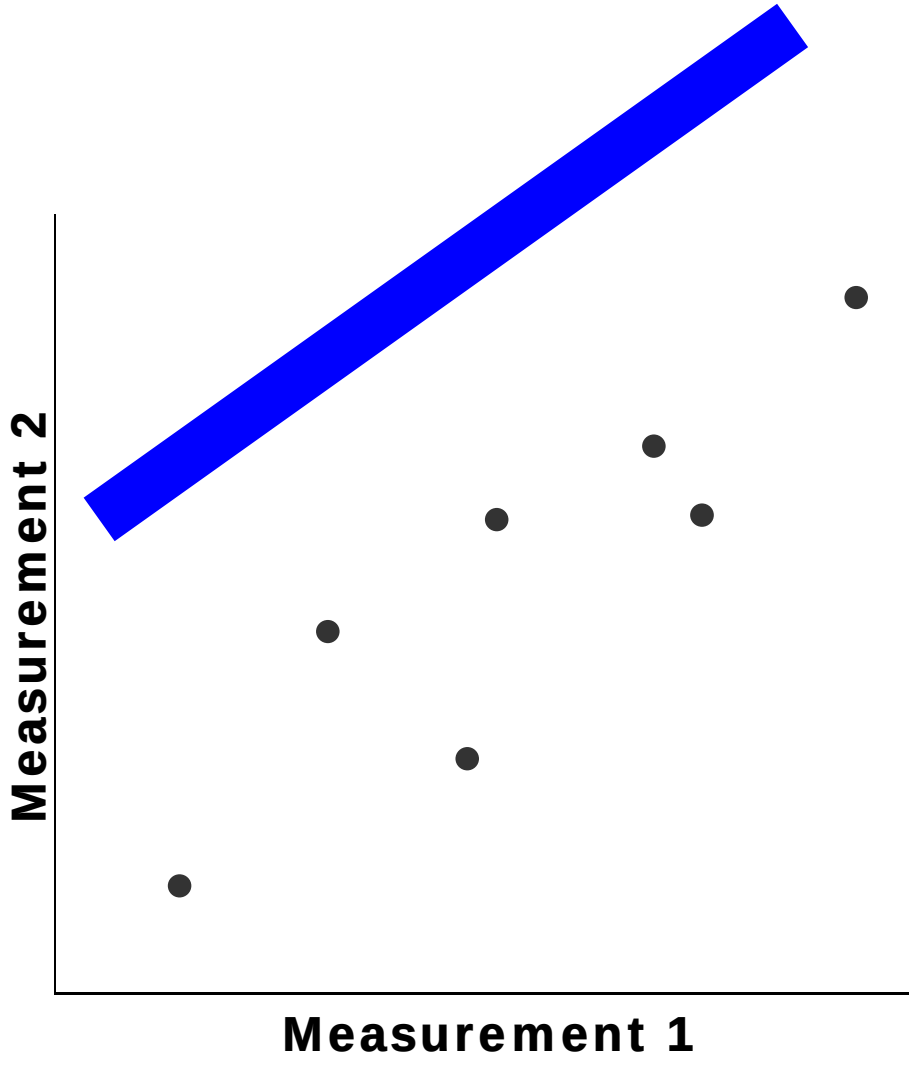
Exercise:

1)



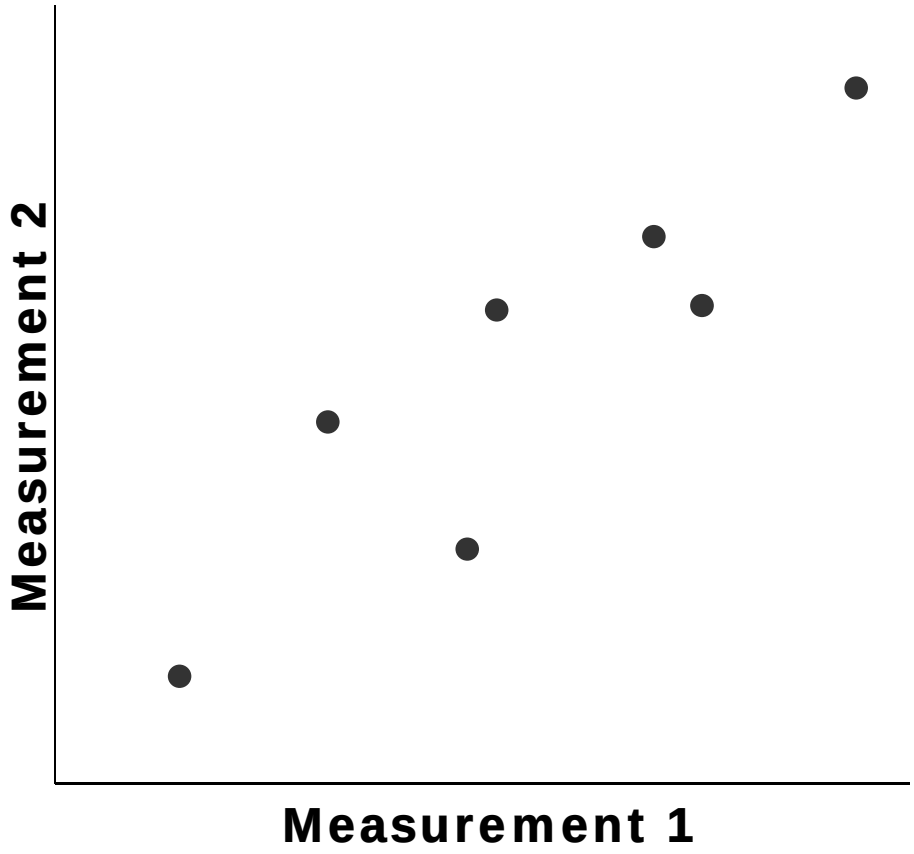
Does the line drawn here represent the data well? Explain why/why not.

2)



Does the line drawn here represent the data well? Explain why/why not.

3)

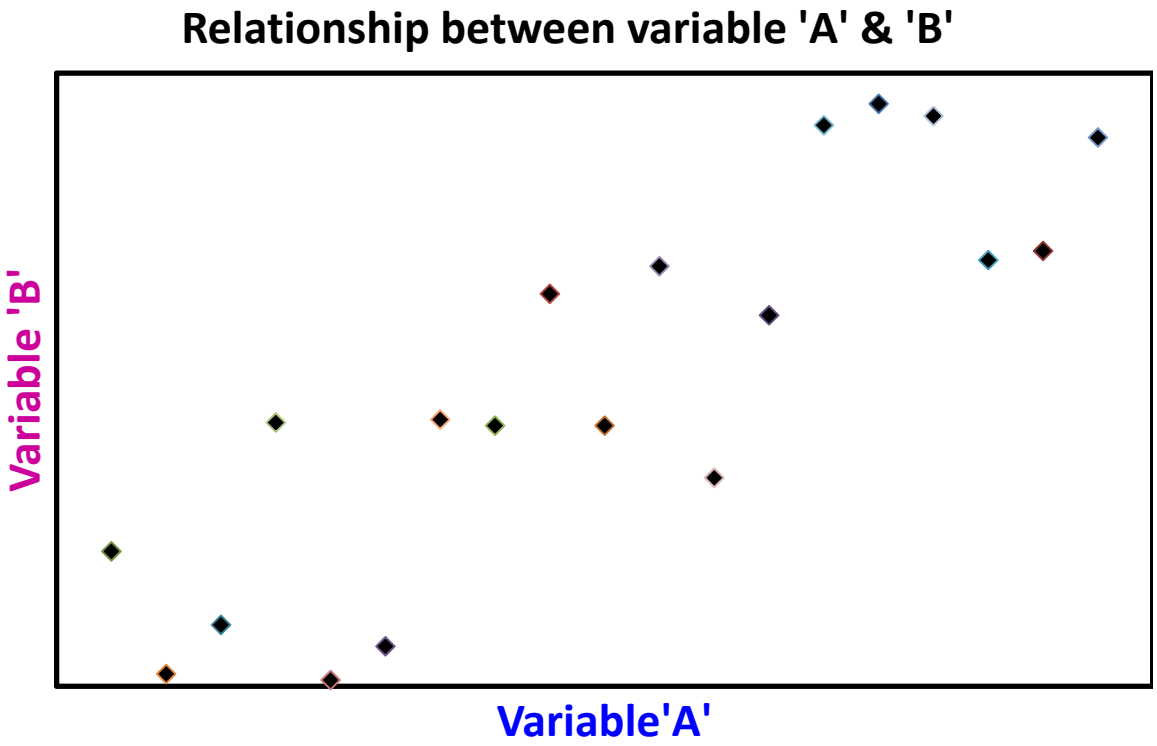


Draw a line that you think represents the data. Explain why you chose this line.

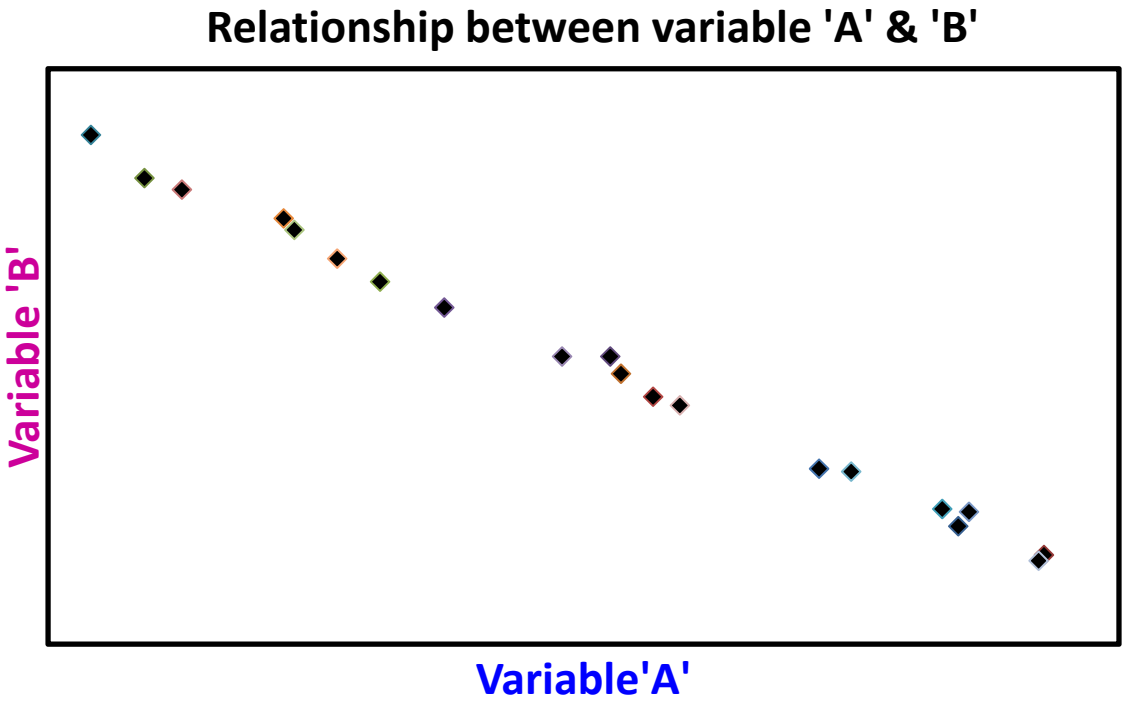
Exercise:

Add a line of best fit to the graphs below

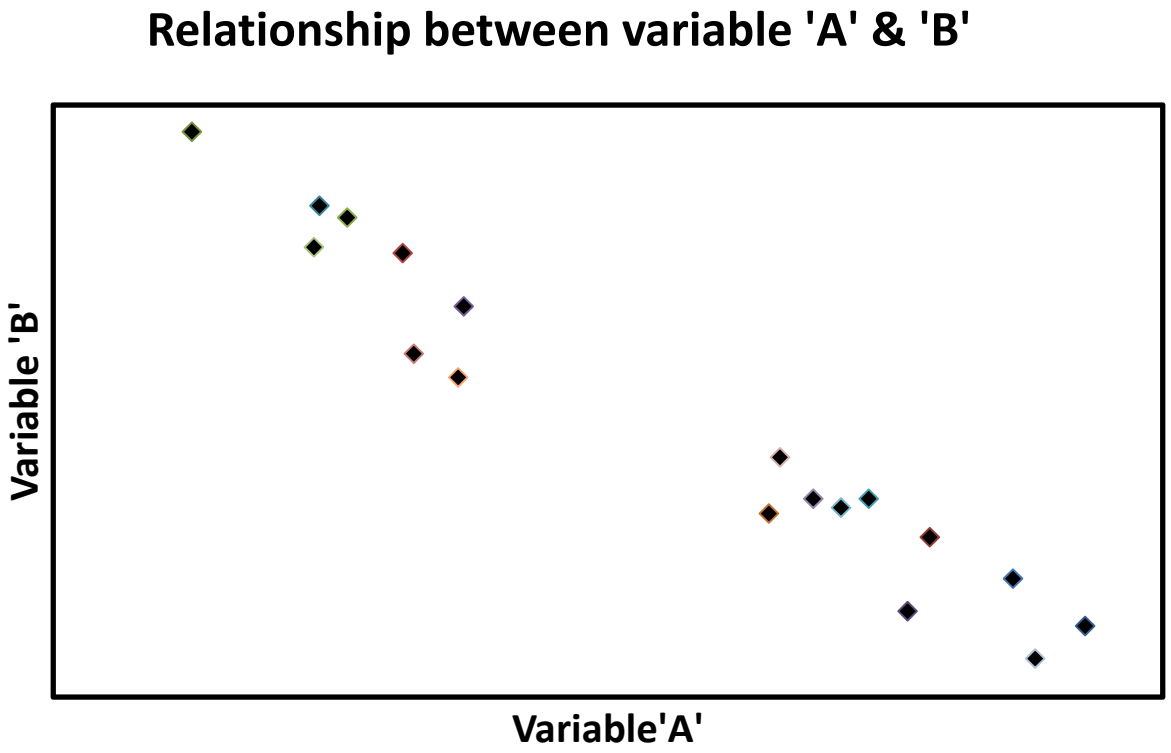
1)



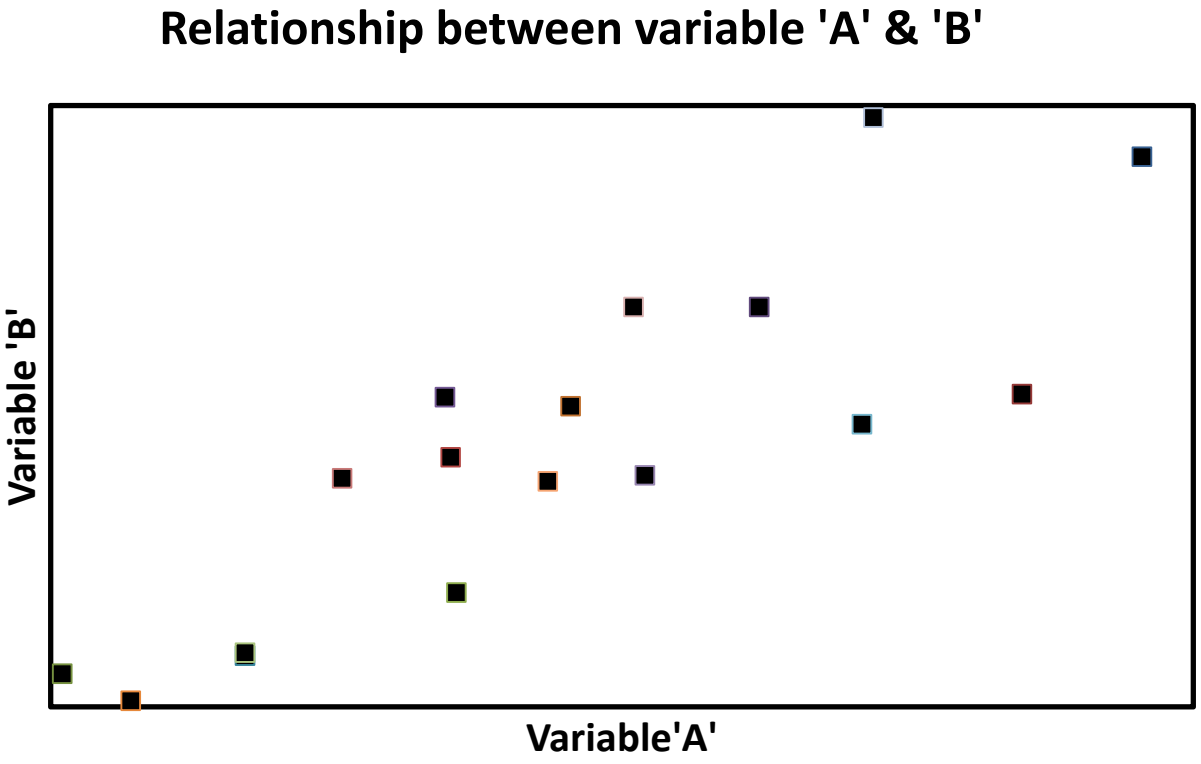
2)



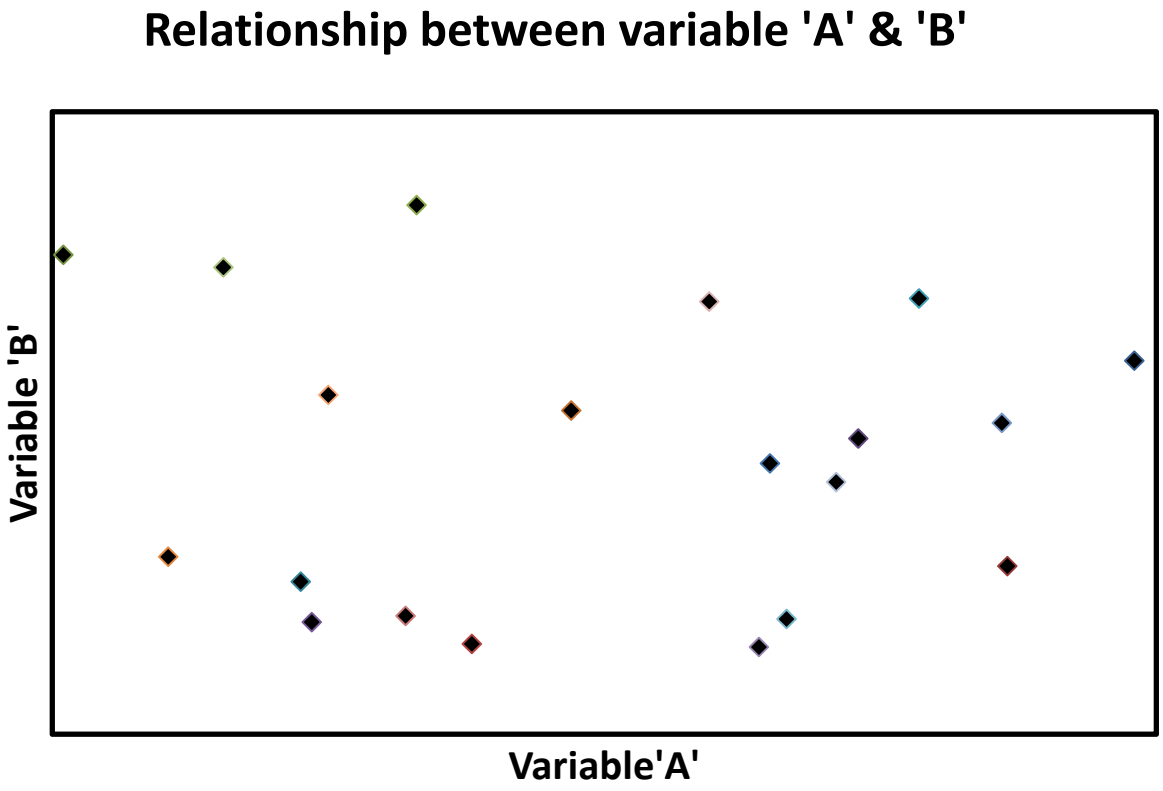
3)


Relationship between variable 'A' & 'B'
Variable 'B'
Variable'A'

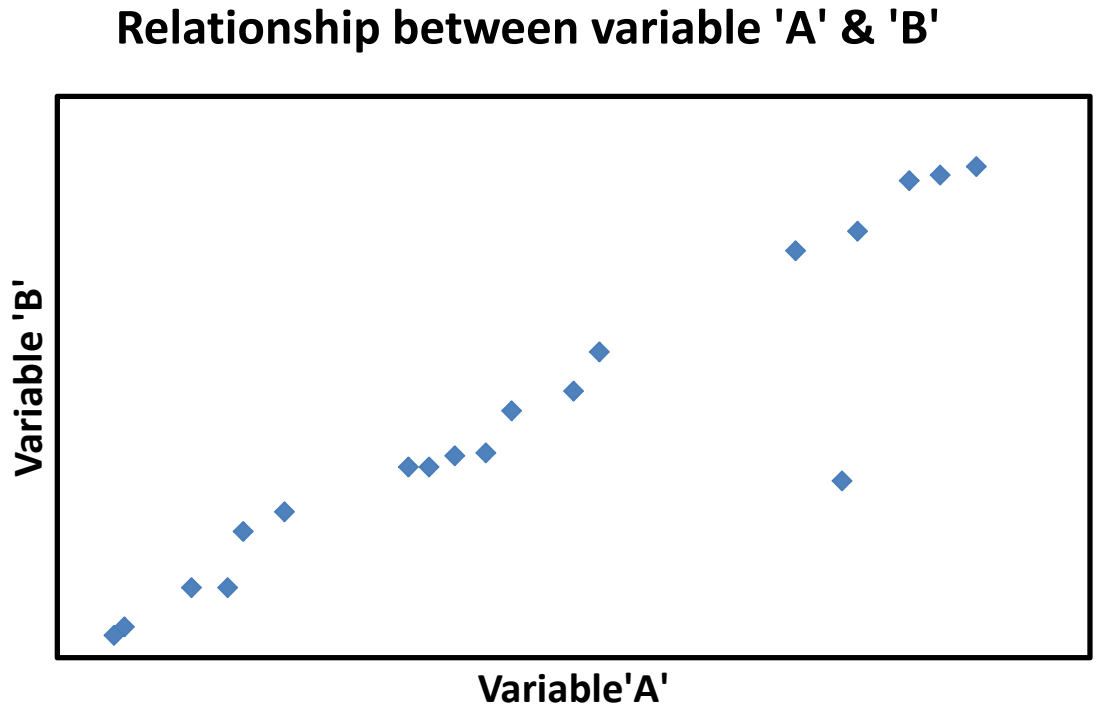
4)


Relationship between variable 'A' & 'B'
Variable 'B'
Variable'A'

5)


Relationship between variable 'A' & 'B'
Variable 'B'
Variable'A'

6)


Relationship between variable 'A' & 'B'
Variable 'B'
Variable'A'

Conclusion

In your conclusion you need to:

Level 2 / 3 / 4:

- Answer the investigation problem

Level 5:

- Discuss which population the results apply to

Level 6:

- Discuss Sampling Variability

Answering the investigation problem

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

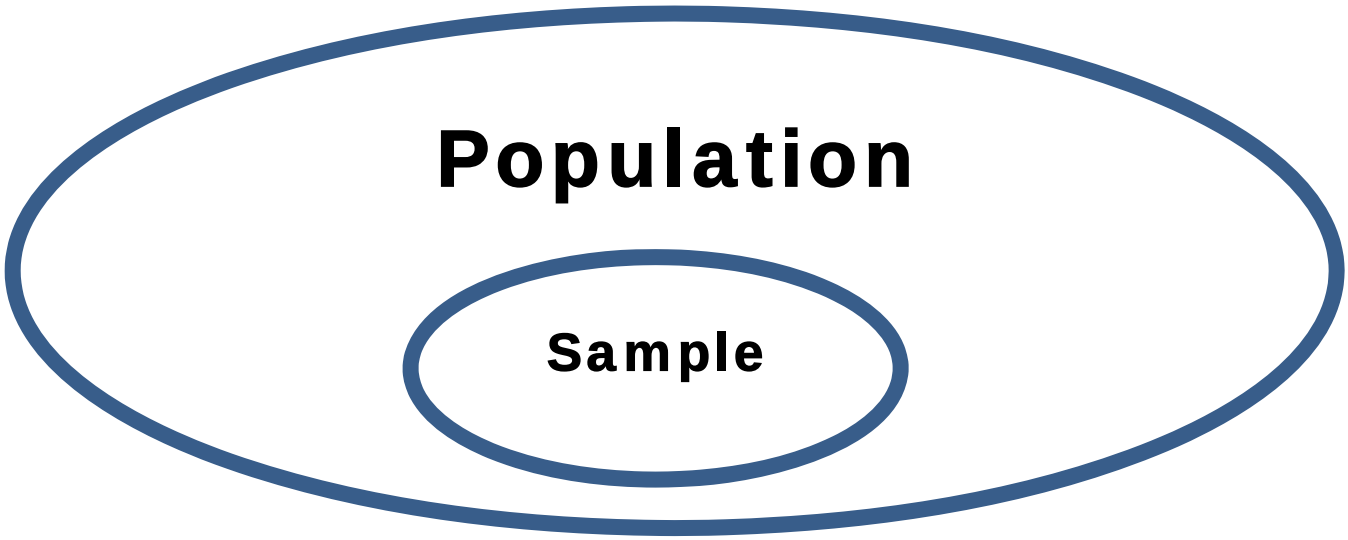
Sentence Framework:

I can conclude that there **is / is not** a relationship

between **measurement 1** and **measurement 2**

for **our sample**.

Population



The conclusion is valid for the specific population that has been sampled.

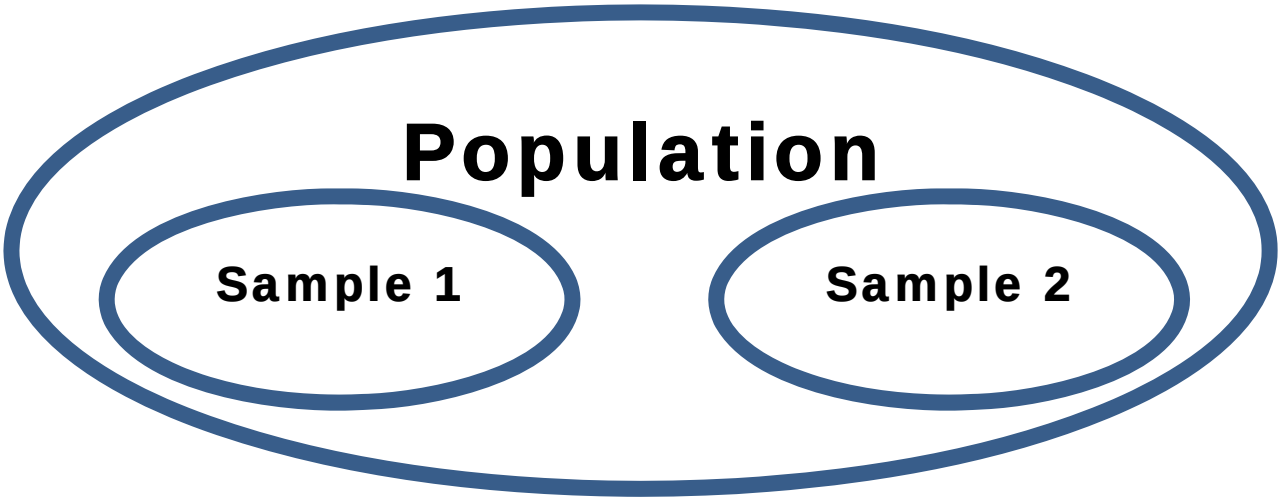
The conclusion can only be applied to an identical population of the one for which the data was collected.

Example

If the data is of Americans, then the conclusions can only be applied to other Americans.

It may be that there are sufficient similarities in the population of America and NZ for the data to be useful to help offer guidance.

Sampling variability



If I took another sample …

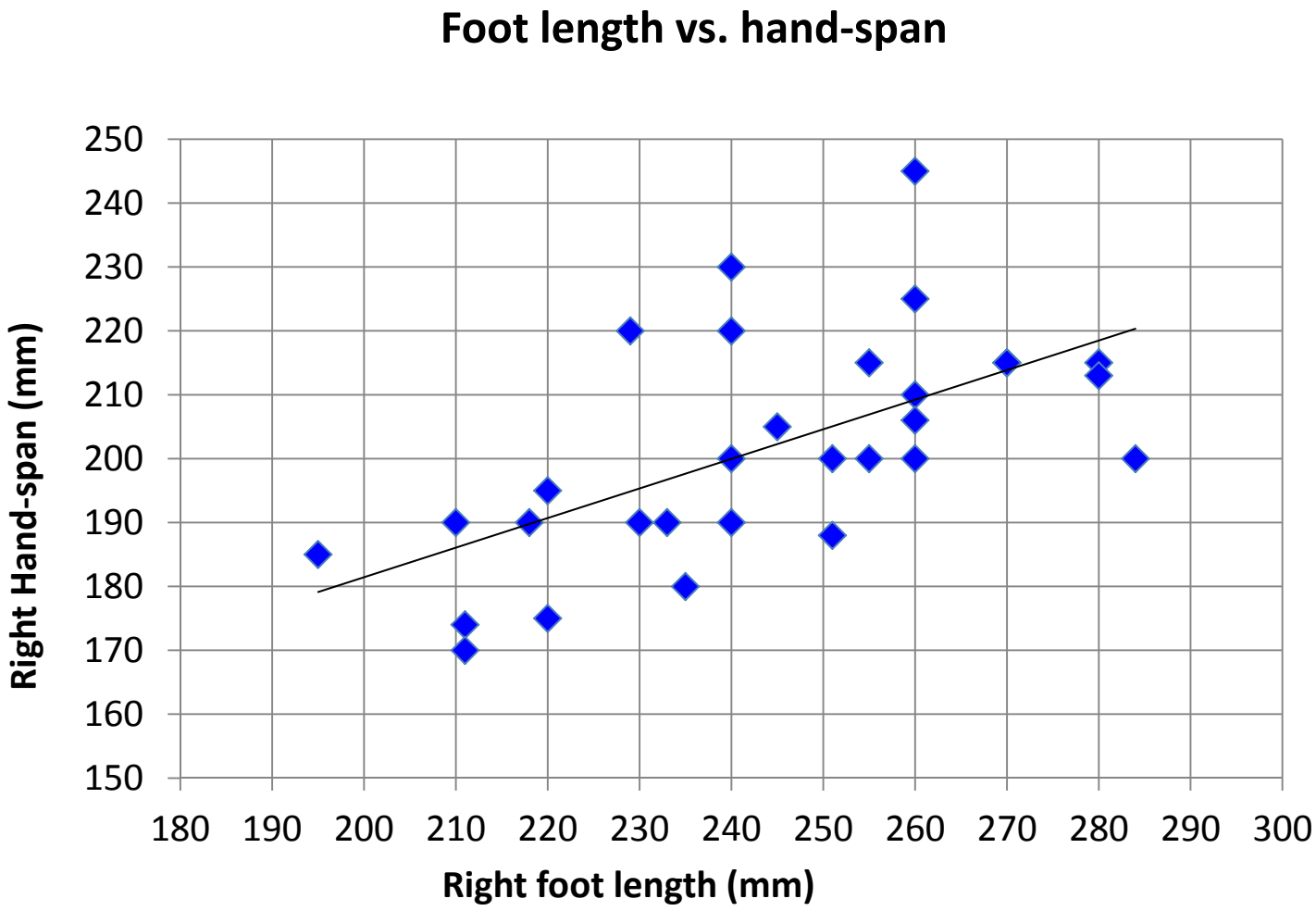
- When another sample is taken, you will select different people, therefore your data will differ from sample to sample.
- However, if a difference is present (or not) in the population, then each sample should represent this
- This means that the analysis and conclusion are likely to remain the same.

If I took a bigger sample …

- The data will be more representative of the population.
- The results will be more accurate.
- The conclusion will be more accurate, and therefore the relationship (if one exists) is stronger.
- Also weaker relationships are more able to be detected with a large sample than a small sample.

Example:

Data was collected from a sample of Junior students at Aorere College. These 30 students measurements are shown on the graph below. An analysis and conclusion are given below.



Level 2 / 3 / 4:

Therefore I can conclude that there is a relationship between the right foot length and right hand span for junior students at Aorere College.

Level 5:

I notice that there is a linear, positive, weak relationship between the right foot length and right hand span.

The relationship between right foot length and right hand span is linear because the right foot length is increasing at a constant rate. For every 1 mm increase in right foot length, the right hand-span is increasing by approximately 0.5 mm.

Level 6:

The analysis and conclusion can be applied to all the junior students at Aorere College. These results may also be applied to other junior and senior students across New Zealand, as I would expect the foot length and hand-span to be similar across most students in New Zealand.

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.

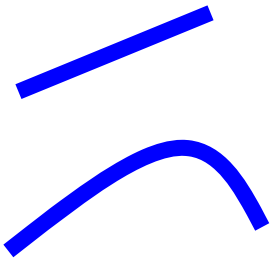
If I took another sample, I would expect different data (as I would be measuring different students), but I would expect the analysis and conclusion to be similar. I would still expect to see a positive, weak, linear relationship between right foot length and right hand span.

If I took a bigger sample, I would expect data that was more representative of the population, and therefore more accurate. This means that the foot lengths and hand spans that we measured of junior students at Aorere College, and the line of best fit is more accurate as we are better at estimating where the line should go. Hence the relationship between foot length and hand span would be stronger.

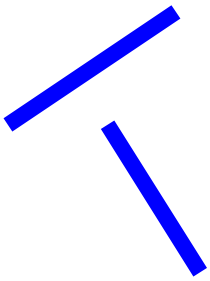
Summary of the Analysis section

We now need to put this altogether in a paragraph with:

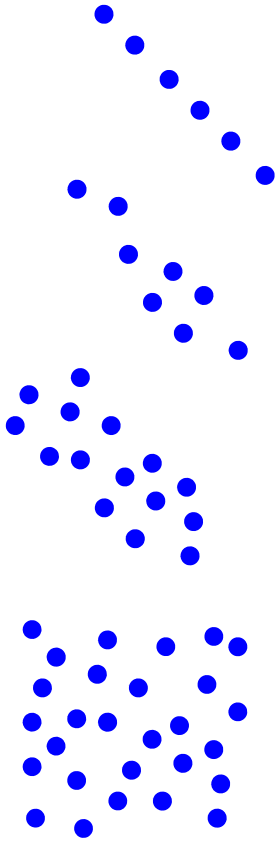
- The type of relationship
  - o Linear
  - o Curved
  - o None



- The direction of the relationship
  - o Positive
  - o Negative



- The strength of the relationship
  - o Strong
  - o Moderate
  - o Weak
  - o None



Summary of the Conclusion section

We now need to put this altogether in a paragraph with:

- Answer the question
    - Is there a relationship? Yes or No?

- Population
    - Describe the population who the results apply to.

    - Suggest other populations that the results **may** apply to

- Sampling variability

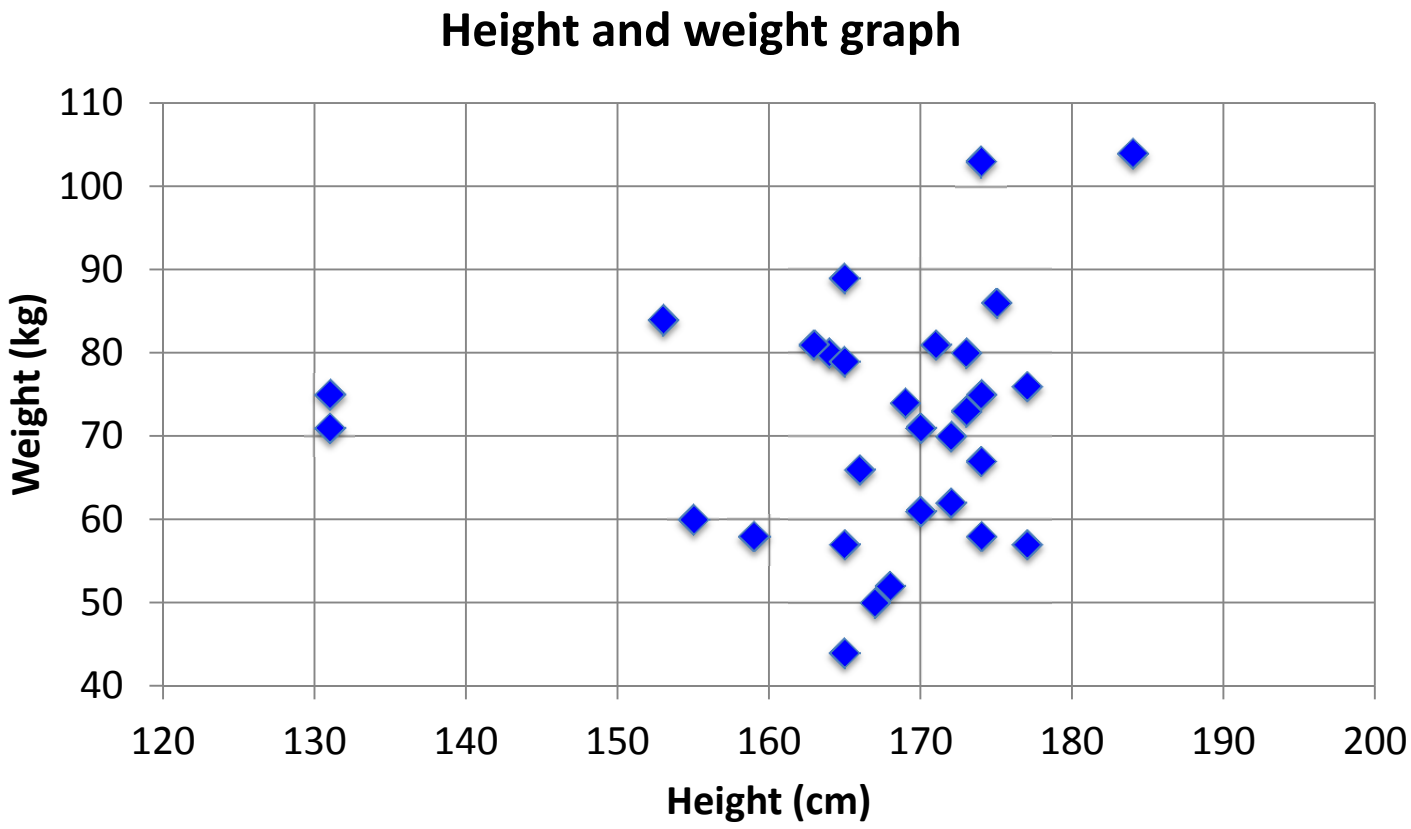
    - If I took another sample …

If I took a bigger sample …

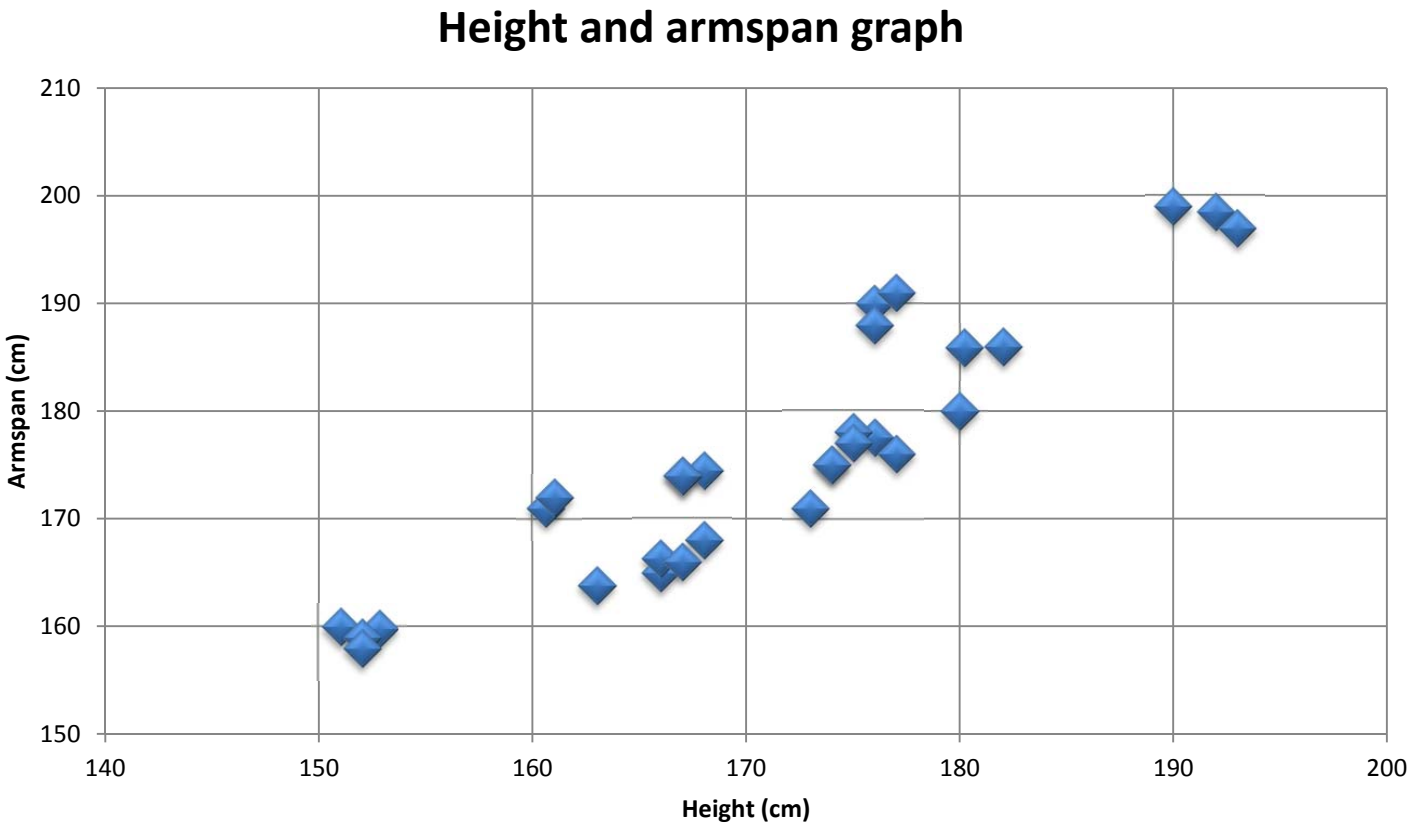
Exercise:

Write an analysis and conclusion for each of the problems below.

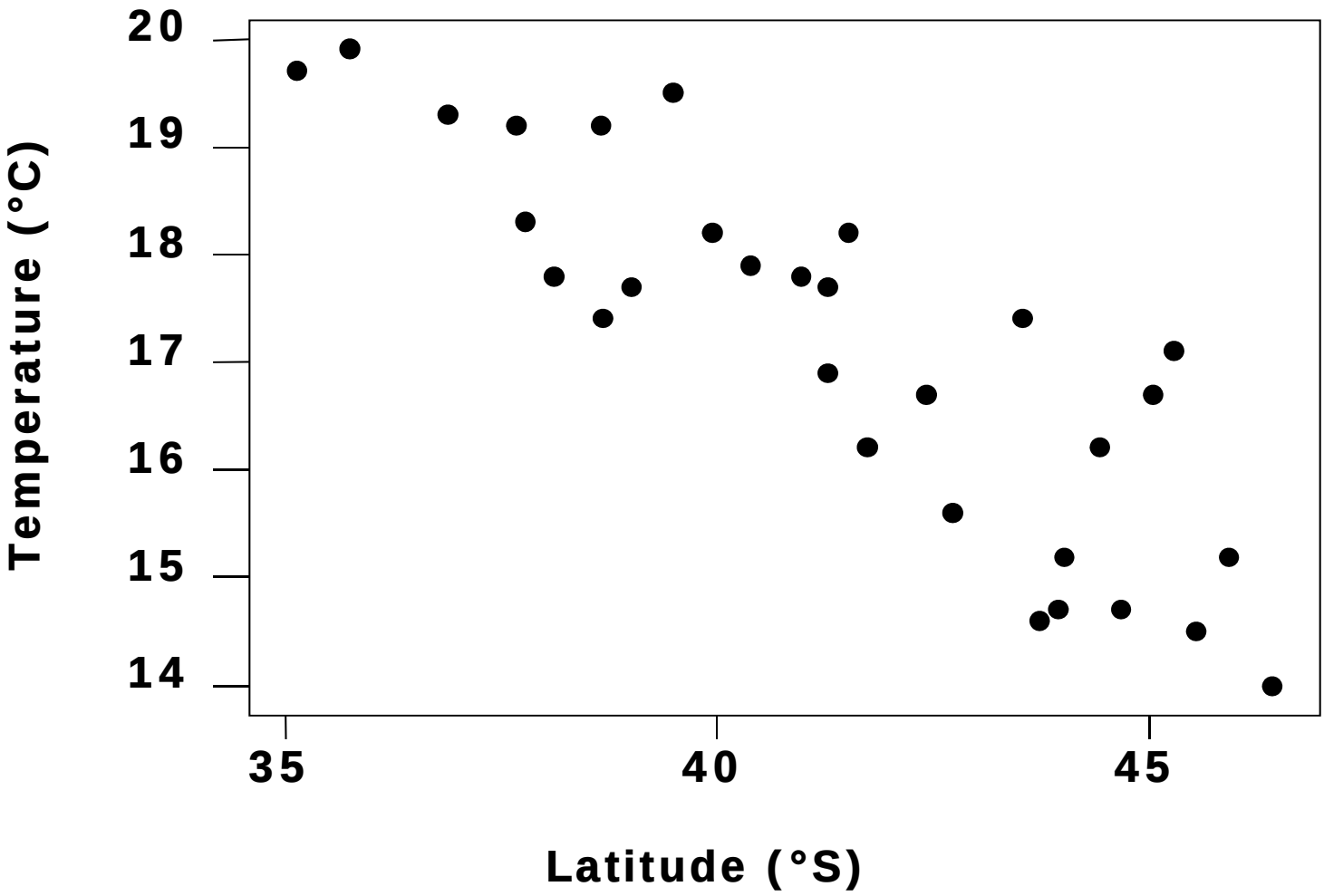
1) **Problem**: I wonder if there is a relationship between height and weight of Junior students at Aorere College.



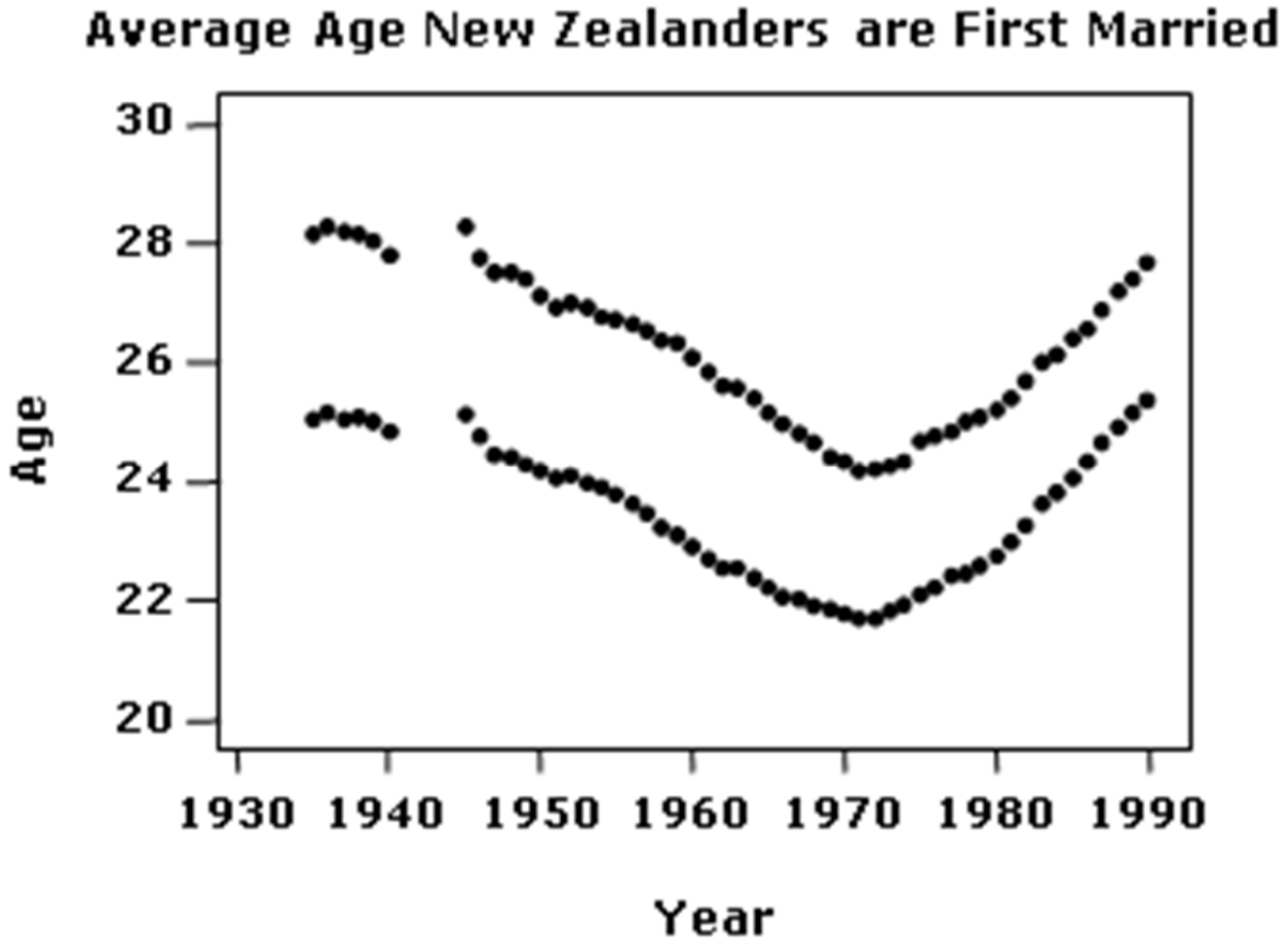
2) **Problem**: I wonder if there is a relationship between height and armspan of Junior students at Aorere College.



3)


Mean January Air Temperatures
for 30 New Zealand Locations
Temperature (°C)
20
19
18
17
16
15
14
35
40
45
Latitude (°S)

4)


Average Age New Zealanders are First Married
Age
30
28
26
24
22
20
1930
1940
1950
1960
1970
1980
1990
Year

Investigation Exercise

Problem

I wonder if there is a relationship between a person's index length and ring finger length for students at Aorere College?

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:_____

Plan:

Measure Variable 2:_____

Plan:

Information such as sample size, justification of measures, description of sample or population:

Data

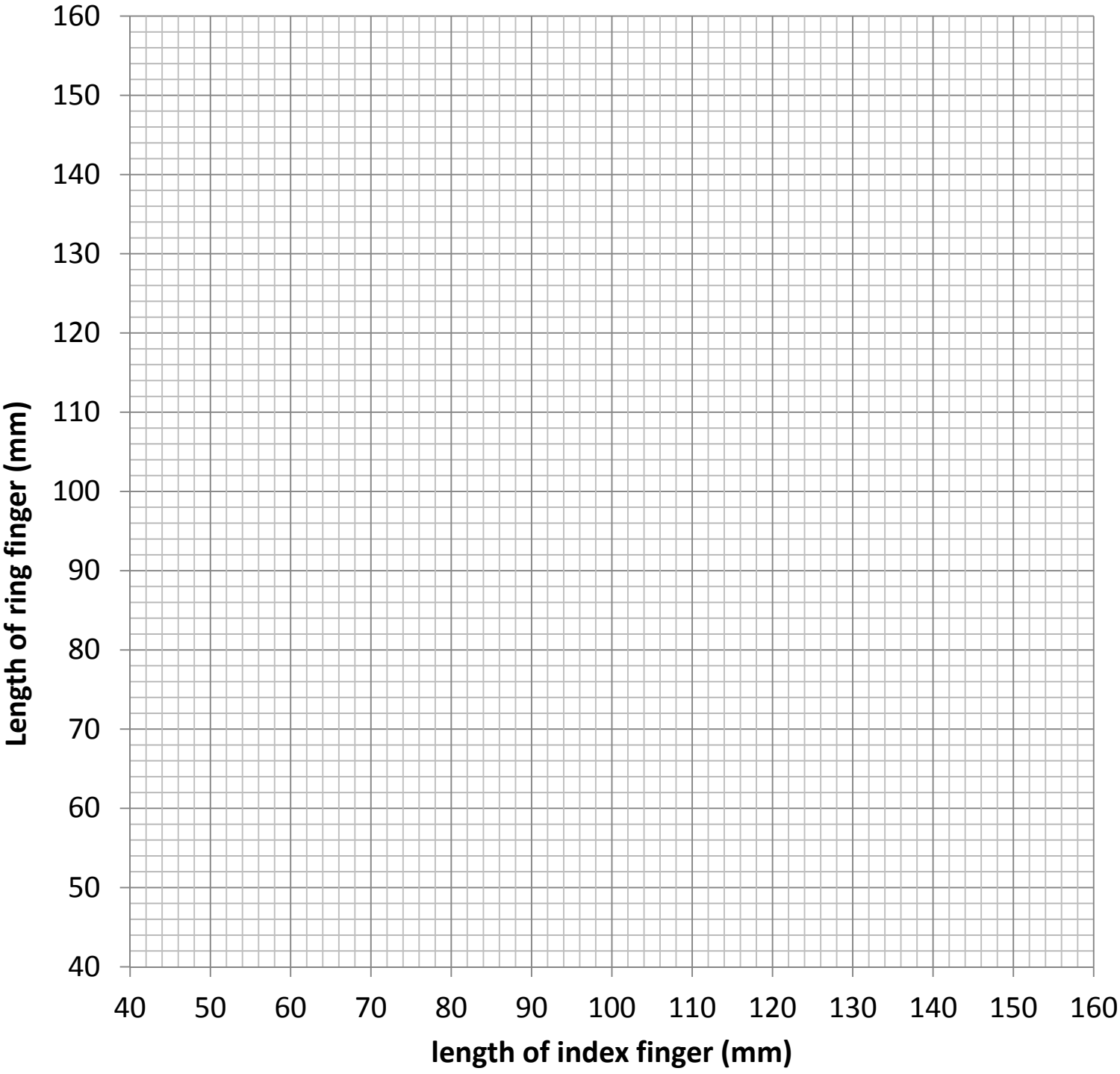
Record the measurements.

Sample			Sample		
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

Analysis

Draw a scatterplot of your data.

Add a line of best fit.



Analysis

Describe the relationship. This may include the strength, direction and type of relationship. Justify your description.

Conclusion

Answer the investigation question.

Discussion of sampling variability (taking another sample, changing sample size, etc.)