AChor/MPM1D **Name: _____**
Date: _____

Worksheet 6-1: Relationships and Variables

When two quantities are related in some way, they form a relationship.
Examples: The distance Ms. Chor drives and the time she takes
The cost of a pizza and number of toppings on it

Which of the following describes a relationship?

(a)	the distance Rahim swims and the time he takes	Yes	No
(b)	the distance Anna swims and the time Mike spends studying	Yes	No
(c)	the temperature and the amount of clothing people wear	Yes	No
(d)	the number of long distance calls and the amount of telephone bill	Yes	No
(e)	the temperature in Vancouver and the temperature in Toronto	Yes	No

Values that can change in a relationship are represented by variables.

There are two types of variables in a relationship:
The **dependent** variable is the variable that depends on the other variable in a relationship.
The **independent** variable is the variable that does not depend on any other variables.
**** Dependent variable is always graphed on the *y*-axis.**
Independent variable is always graphed on the *x*-axis.

Identity the dependent and independent variables for the following:

(a) The distance a jogger runs depends on the length of time she runs

(b) Ms. Chor wants to know how much flour is needed to make 120 cookies. A recipe for 24 cookies requires 4 cups of flour.

(c) A building must have 6 fire alarms on each floor. How many alarms are needed for our school?

(d) A knitter needs to know how much wool is required to make ten sweaters. Twenty metres of wool are needed to make one sweater.

(e) The printing cost for the school newspaper drops 1 cent for every page over 50. What is the cost for printing a newsletter of 100 pages?

(f) The manager wants to know how many cartons are needed to package cans of orange juice. Each carton holds 24 cans of orange juice.

Assigned Work: WS 6-1

Correlation

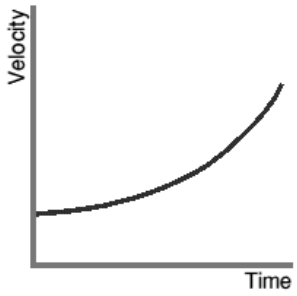
Correlation is often used to express the relationship between two variables. For instance, correlation might be used to express the relationship between:

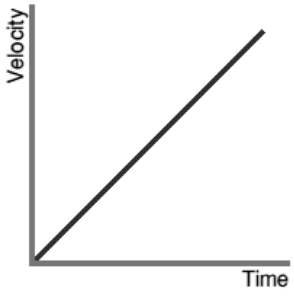
- Age and height of children
- Number of days students are absent and their level of achievement
- Scores on two different student assessments, such as reading and math
- Earlier versus later scores, such as earlier and later performance in writing

When values on two variables tend to go in the same direction, we call this a *direct relationship*.

The correlation between children's ages and heights is a direct relationship. Older children tend to be taller than younger children. This is a direct relationship because children with higher ages tend to have higher heights.

Graph of a direct relationship between velocity and time looks like this:



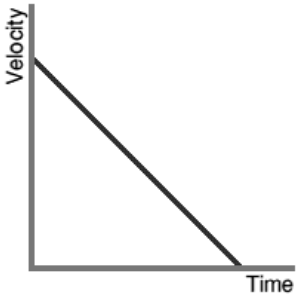


The graphs show that **as time increases, velocity increases** as well.

When values on two variables tend to go in opposite directions, we call this an *inverse relationship*.

The correlation between students' number of absences and level of achievement is an inverse relationship. Students who are absent more often tend to have lower achievement. This is an inverse relationship because children with higher numbers of absences tend to have lower achievement scores.

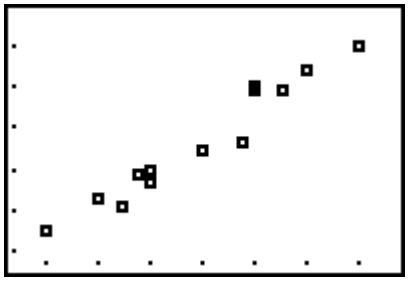
Graph of an inverse relationship between velocity and time looks like this:



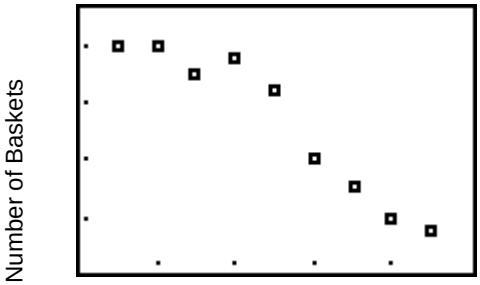
The graphs show that **as time increases, velocity decreases** instead.

Correlation of a relationship can be described as *positive* (+) or *negative* (–). Positive correlation is used to indicate a direct relationship and negative correlation is used to indicate an inverse relationship.

Plotted Points



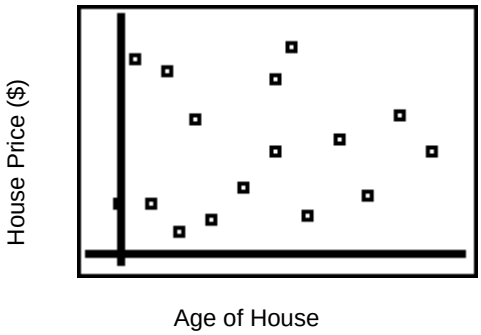
1. The graph shows the plotted points rising upwards to the right.
   - Agree
   - Disagree
   - Pass
2. As the length of the tibia increases the length of the leg increases.
   - Agree
   - Disagree
   - Pass
3. The graph can be used to determine the length of a person's leg if you know the length of the tibia bone.
   - Agree
   - Disagree
   - Pass



1. The graph shows the plotted points falling to the right.
   - Agree
   - Disagree
   - Pass
2. As the distance from the net increases the number of baskets made decreases.
   - Agree
   - Disagree
   - Pass
3. The graph can be used to determine the number of baskets you will make if you know the distance from the basket.
   - Agree
   - Disagree
   - Pass

---

1. The graph shows the plotted points scattered.
   - Agree
   - Disagree
   - Pass
2. As the age of the house increases the price of the house is either large or small.
   - Agree
   - Disagree
   - Pass
3. The graph can't be used to determine the price of the house if you know how old it is.
   - Agree
   - Disagree
   - Pass



AChor/MPM1D

Name: _____ WS 6-1
Date: _____

Relationships

Complete the following statements.
Explain the reasons for your choice.
Indicate if you and your partner agree or disagree.

Is There a Relationship?
As a person gets taller their armspan _____. (*gets wider, gets smaller, stays the same*)
The longer a person's legs are _____ they run. (*the faster, the slower, will make no difference to how fast*)
As a person's foot size increases, their walking stride _____. (*gets longer, gets shorter, stays the same*)
As a person's forearm gets longer, their armspan _____. (*gets longer, gets shorter, stays the same length*)
The longer a person's thumb is _____ their index finger. (*the longer, the shorter, will make no difference to the length of*)
As a person gets taller, their foot size _____. (*gets longer, gets shorter, is not affected*)

Relationships Summary

A ***scatter plot*** is a graph that shows the _____ between **two** variables.

The points in a scatter plot often show a pattern, or _____.

From the pattern or trend you can describe the _____.

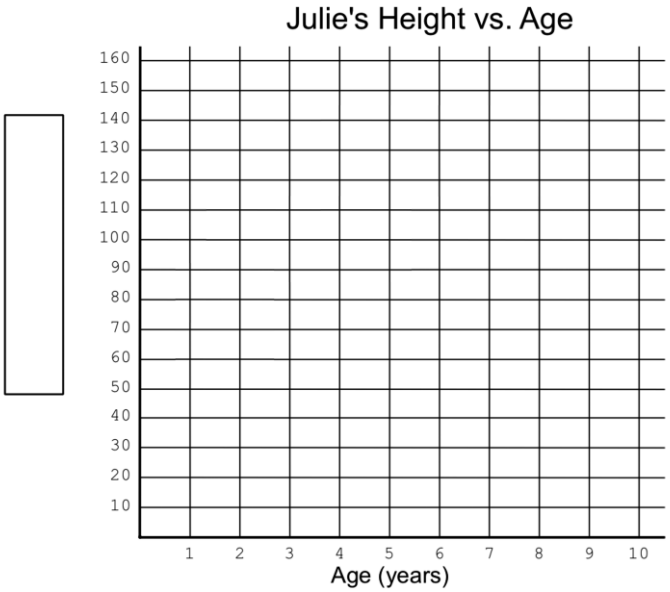
Example:
Julie gathered information about her age and height from the markings on the wall in her house.

Age (years)	1	2	3	4	5	6	7	8
Height (cm)	70	82	93	98	106	118	127	135

a) Label the vertical axis.

b) Describe the trend in the data.

c) Describe the relationship.
(Is it direct or inverse? Explain.)



Variables

The *independent variable* is located on the _____ axis.

This variable does not depend on the other variable.

The *dependent variable* is located on the _____ axis.

This variable depends on the other variable.

Independent variable is _____

Dependent variable is _____

Note:
The independent variable comes *first* in the table of values.

Line of Best Fit

To be able to make predictions, we need to model the data with a line or a curve of best fit.
Rules for drawing a line of best fit:

1. The line must follow the _____.
2. The line should _____ through as many points as possible.
3. There should be _____ number of points above and below the line.
4. The line should pass through points all along the line, not just at the ends.
5. The line should pass through at least _____ points (not necessarily the end points)

Making Predictions

Use your line of best fit to estimate the following:

Question	Answer	Method of Prediction
How tall was Julie when she was 5 years old?		
How tall will Julie be when she is 9 years old?		
How old was Julie at 100 cm tall?		
How tall was Julie when she was born?		

Interpolate

When you interpolate, you are making a prediction _____ the data.

These predictions are usually _____.

Hint:
You are interpolating when the value you are finding is somewhere between the first point and the last point.

Extrapolate

When you extrapolate, you are making a prediction _____ the data.

It often requires you to _____the line.

These predictions are less reliable.

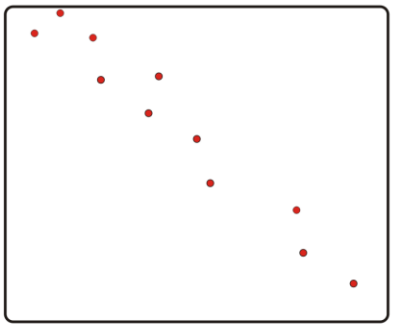
You are extrapolating when the value you are finding is before the first point or after the last point. This means you may need to extend the line.

AChor/MPM1D

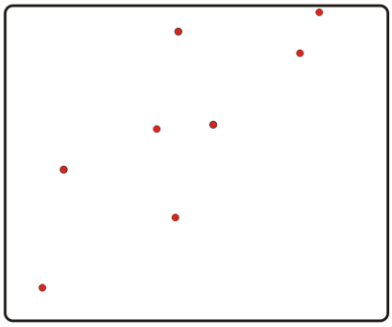
Name: _____ WS 6-1
Date: _____

Describing Scatter Plots and Lines of Best Fit

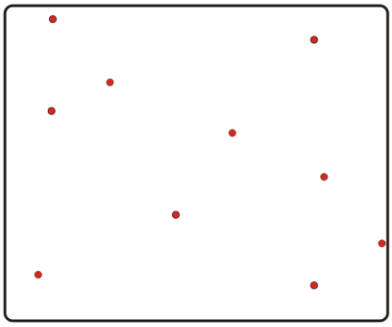
Draw a line of best fit for each of the scatter plots that show a linear relationship below. Write two or three key words to describe each relation on the line below the scatter plot. (*rises upward to the right, falls downward to the right, no relationship, strong, weak, linear, non-linear*)



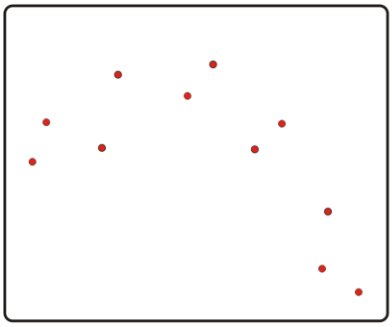
a)_____



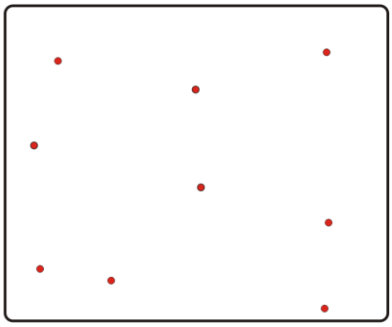
b)_____



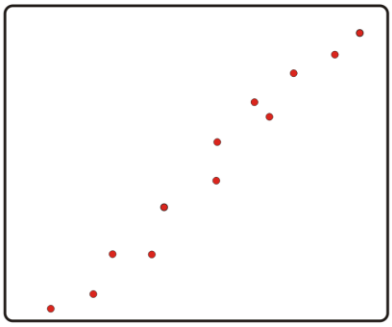
c)_____



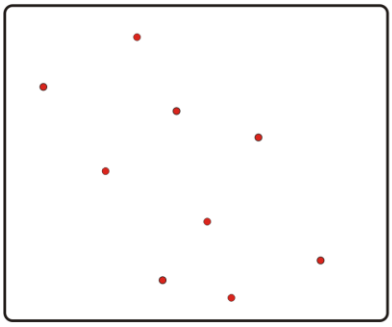
d)_____



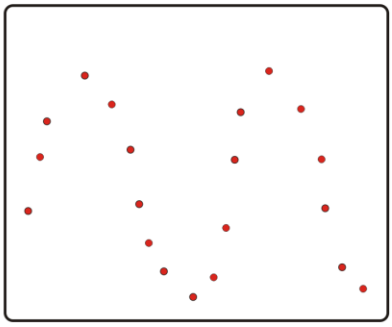
e)_____



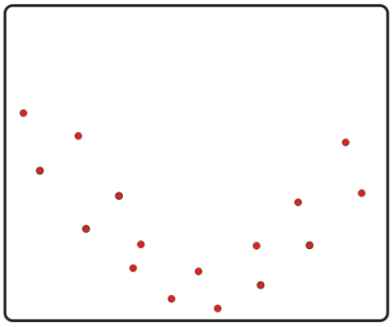
f)_____



g)_____

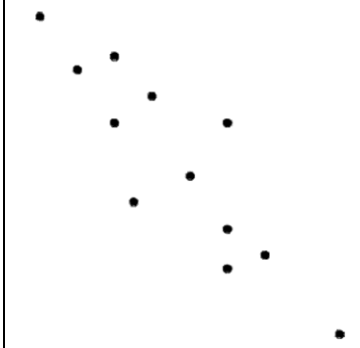
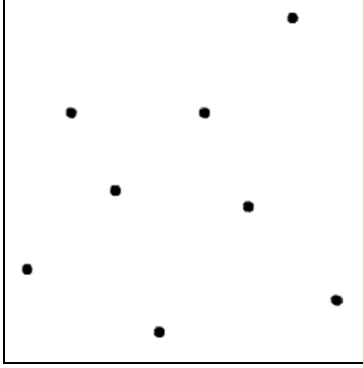


h)_____



i)_____

Correlation

	A scatter plot shows a _____ correlation when the pattern rises up to the right. *This means that the two quantities increase together.*
	A scatter plot shows a _____ correlation when the pattern falls down to the right. *This means that as one quantity increases the other decreases.*
	A scatter plot shows _____ correlation when no pattern appears. *Hint:* *If the points are roughly enclosed by a circle, then there is no correlation.*

Strong or Weak?

If the points nearly form a line, then the correlation is _____.

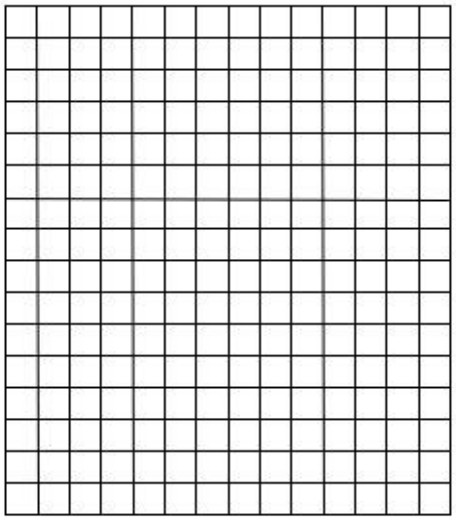
If the points are dispersed more widely, but still form a rough line, then the correlation is _____.

Hint:
To visualize this, enclose the plotted points in an oval.
If the oval is *thin*, then the correlation is *strong*.
If the oval is *fat*, then the correlation is *weak*.

Creating Scatter Plots and Lines of Best Fit

Anthropologists and forensic scientists use data to determine information about people. Scientists can make predictions about the height, age, and sex of the person they are examining by looking for relationships in large amounts of data.

1. Construct a graph of the length of the humerus bone vs. the length of the radius.



Length of Radius (cm)	Length of Humerus (cm)
25	29.7
22	26.5
23.5	27.1
22.5	26
23	28
22.6	25.2
21.4	24
21.9	23.8
23.5	26.7
24.3	29
24	27

2. Circle the point on the graph that represents the data for a radius that is 21.9 cm long.
   How long is the humerus? _____.

3. Put a box around the point on the graph that represents the data for a humerus that is 27.1 cm long. How long is the radius? _____.

4. Describe the trend.

5. Describe the relationship.
   The relationship between the two variables is _____.
   As the length of the radius gets longer, the humerus _____.

6. a) Draw a line of best fit.
   b) Use the line of best fit to predict the length of the humerus, if the radius is 24.5 cm long. Did you interpolate or extrapolate?
   c) Use the line of best fit to predict the length of the radius, if the humerus is 25 cm long. Did you interpolate or extrapolate?

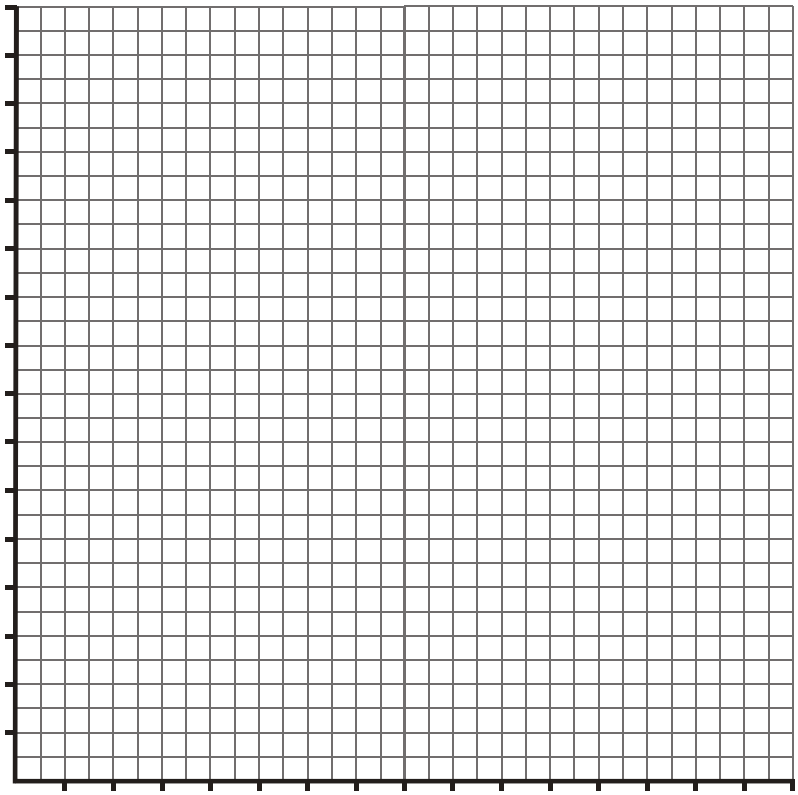
AChor/MPM1D

Name: _____ WS 6-1
Date: _____

Test the hypothesis: The older you are, the more money you earn.

Plot the data on the scatter plot below, choosing appropriate scales and labels.

Age	Earnings ($)
25	22000
30	26500
35	29500
37	29000
38	30000
40	32000
41	35000
45	36000
55	41000
60	41000
62	42500
65	43000
70	37000
75	37500



Note: The symbol _____ is used to signal a "break" in the axis when the scale does not start at zero to avoid a large empty space in one corner of the graph.

1) Draw a line of best fit. Describe the trend in the data.

2) Does the data support the hypothesis? Give reasons to support your answer. (Refer to the scatter plot.)

3) Explain why the data for ages over 65 do not correspond with the hypothesis.

4) Explain what the point (41, 35000) represents.