Using First Differences

Suggested time: 75 min

What's important in this lesson:
Interpret the meaning of a point on a scatterplot.
Describe trends and relationships observed in data.

Complete these steps:

1. Complete the "Using First Differences" handout. Check your answers.
2. Complete the "First Differences ".
3. Check your work with your teacher.
4. Do the assignment.

Hand-in the following to your teacher:

1. Unit 3, Lesson 3 First Differences Assignment.

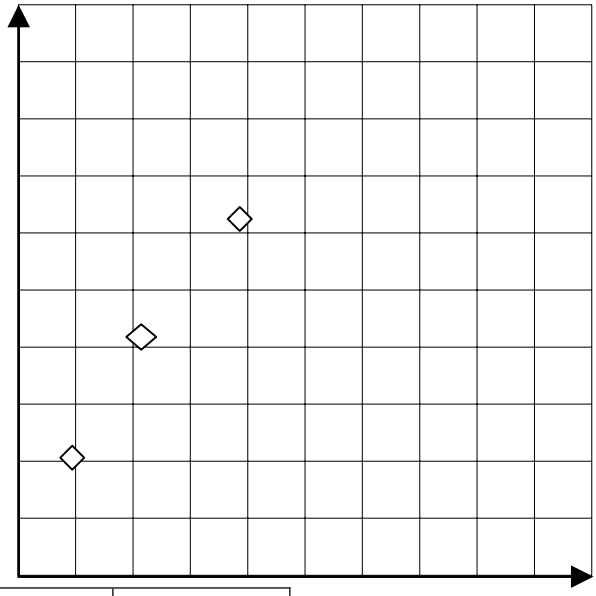
Questions for the teacher:

Interpreting Graphs and Using First Differences

Let's revisit the examples from Lesson 2…

Jody works at a factory that produces square tiles for bathrooms and kitchens. She helps determine shipping costs by calculating the perimeter of each tile.

Calculate the perimeter and record your observations in column 2.



Side Length (cm)	***Perimeter (cm)***
1	***4***
2	***8***
3	***12***
4	***16***
5	***20***

Describe what happens to the perimeter of each tile when the side length increases by one centimetre.

Construct a graph of the perimeter of a tile vs. the side length of the tile.

a) Which variable is the independent variable?

The independent variable is the side length of the tile.

b) Which variable is the dependent variable?
The dependent variable is the perimeter of the tile since the perimeter depends on the side length.

c) Use the graph to describe the relationship between the perimeter and side length of a tile.
The relationship can be represented by a straight line. We call this a linear relationship.

d) Describe the shape of the graph.
The graph moves upward and to the right. It is a straight line.

Let's review the Table of Values…

Side Length (cm)	***Perimeter (cm)***	***First Differences*** Calculate the first differences by subtracting consecutive perimeter values.
1	***4***	***8 – 4 = 4***
2	***8***	
3	***12***	***12 – 8 = 4***
4	***16***	***16 – 12 = _____***
5	***20***	***20 - 12 = _____***

In the following exercises, underline the correct choice in each set of brackets.

1. Calculate the first differences in column 3 of the table.

2. What do you notice about the first difference?
The first differences are (constant/changing).

3. When the side length increases by one centimetre, the perimeter increases by a (constant/different) amount.

4. The plotted points suggest a (linear/non-linear) relationship.

Jody is paid $8/hour to calculate perimeters.

Number of Hours	***Pay ($)***	***First Differences***
0	***0***	
1	***8***	***8 – 0 = 8***
2	***16***	***16 – 8 = _____***
3	***24***	***24 – 16 = _____***
4	***32***	***32 – 24 = _____***
5	***40***	***40 – 32 = _____***

1. Describe what happens to her pay when the number of hours she works increases by one hour.

2. When the number of hours worked increases by one, the pay increases by _____.

3. The plotted points suggest a (linear/non-linear) relationship.

4. Calculate the first differences. What do you notice about the first differences? The first differences are (constant/changing)

Conclusion:

To find a pattern in first differences, the values of the independent variable must change by a constant amount.

First differences of a linear relation are constant.

First differences of a non-linear relation are not constant.

Calculate the first differences. Decide whether the relation is linear or non-linear.

x	y	diff
-2	5	
-1	2	
0	-1	
1	-4	
2	-7	
3	-10	
4	-13	

x	y	diff
-2	5	
-1	9	
0	12	
1	14	
2	15	
3	15	
4	14	

x	y	diff
-2	5	
-1	5	
0	5	
1	5	
2	5	
3	5	
4	5	

Complete each table. Is each relation linear or non-linear? Explain.

$Y = x^2+2$

x	y	diff
-2		
-1		
0		
1		
2		
3		
4		

$Y = 2-x$

x	y	diff
-2		
-1		
0		
1		
2		
3		
4		

$Y = 4x+3$

x	y	diff
-2		
-1		
0		
1		
2		
3		
4		

Application

A baseball falls from rest. The approximate distance it falls, d metres, and the time, t seconds, are related by the equation $d=5t^2$.

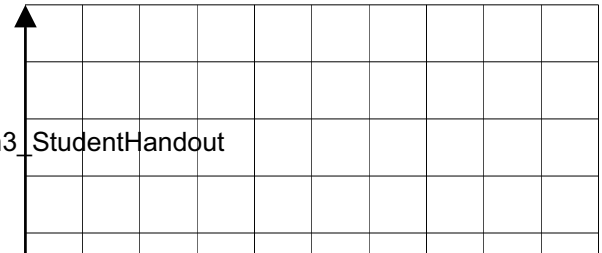
x	y	diff
-2		
-1		
0		
1		
2		
3		
4		

(a) Complete the table.

(b) Is the relation linear or non-linear? How do you know?

(c) Graph the relation. Plot t horizontally and d vertically.

(d) How does the graph show whether the relation is linear or non-linear?



Using First Differences

Drop Zone at Canada's Wonderland

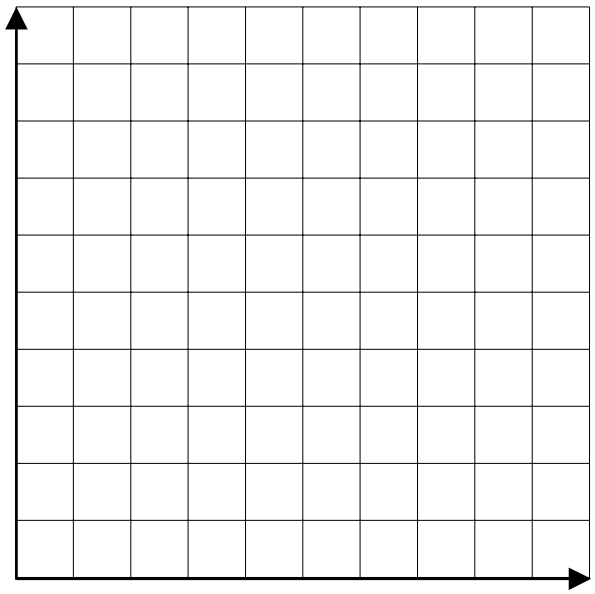
If you ride the "Drop Zone" at Paramount Canada's Wonderland, you will free-fall toward the ground at speeds in excess of 100km/h, or 28m/s. The table gives the riders' speed, before the brakes are applied.

Time(s)	Speed (m/s)	First Differences
0	0	
0.5	4.9	
1.0	9.8	
1.5	14.7	
2.0	19.6	
2.5	24.5	

(a) Calculate the first differences for speed.

(b) Classify the relation as linear or non-linear.

(c) Create a scatter plot of speed versus time.

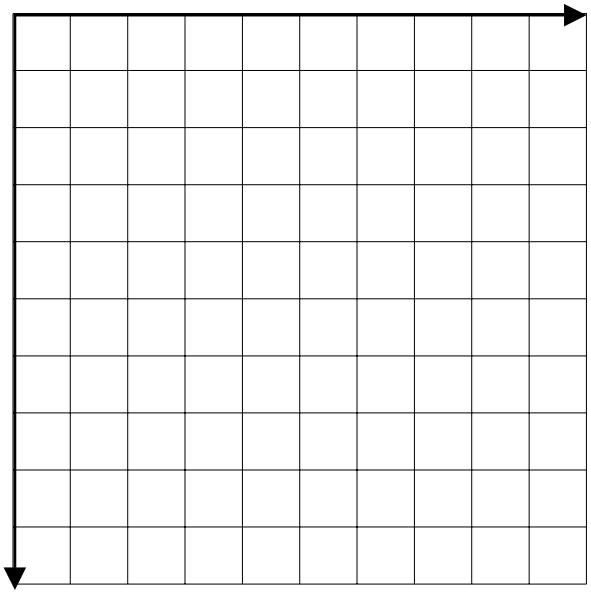


Assessment and Evaluation:
Unit 3 Lesson 3

Deep Sea Divers

The table shows data collected as divers descend below sea level. Calculate the first differences. Use the first differences to determine if the relationship is linear or non-linear. Check your solution by graphing.

Time (min)	Depth (m)	First differences
0	−2	
1	−4	
2	−6	
3	−8	
4	−10	

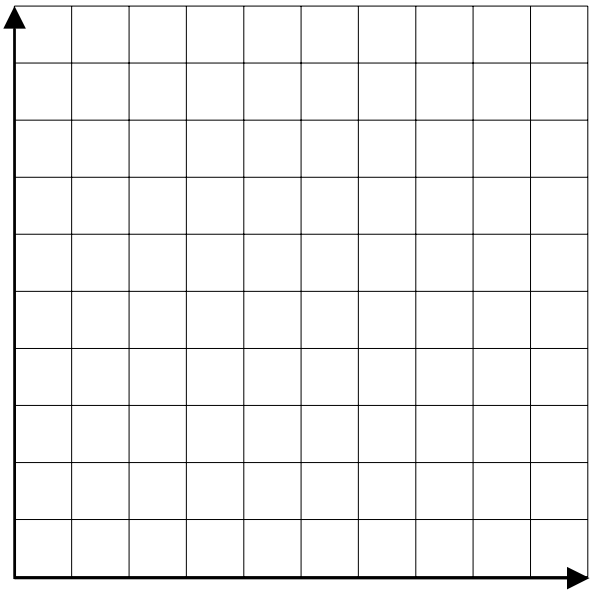


The relationship is:

Hot Air Ballooning

The table shows data collected as a hot air balloon leaves the ground. Calculate the first differences. Use the first differences to determine if the relationship is linear or non-linear. Check your solution by graphing.

Time (sec)	Height (m)	First differences
0	0	
1	2	
2	6	
3	12	
4	20	



The relationship is