Exploring Quadratic Relations | Unit 5 Lesson 1

(A) Lesson Context

BIG PICTURE of this UNIT:	• How do we analyze and then work with a data set that shows both increase and decrease • What is a parabola and what key features do they have that makes them useful in modeling applications • How do I use graphs, data tables and algebra to analyze quadratic equations?		
CONTEXT of this LESSON:	Where we've been In previous units, you looked for number patterns & graphed data from either linear or exponential relations	Where we are Explore a new type of relation through number patterns & scatter plot graph in data from a variety of activities	Where we are heading How can I use graphs of quadratic relations to make predictions from quadratic data sets & quadratic models and quadratic equations

(B) Lesson Objectives:

a. Look for number patterns that arise in data sets
b. Prepare scatter plots of these data sets

(C) Exploration 1 – Number Patterns

EX 1. Given the pattern .....2,4,8,14,22,32,44, ...

(a) How do you know the pattern is NOT linear?

(b) How do you know the pattern is NOT exponential?

(c) What are the next three terms of the sequence?

(d) What are the 3 terms that came before 2?

EX 2. Given the pattern .....16,15,12,7,0,-9,-20 .....

(a) How do you know the pattern is NOT linear?

(b) How do you know the pattern is NOT exponential?

(c) What are the next three terms of the sequence?

(d) What are the 3 terms that came before 16?

EX 3. Data Sets in Context:

Below is a data set that measures the Profit, P(C), in Millions of Euros as a function of Cars, C, that are produced per year.

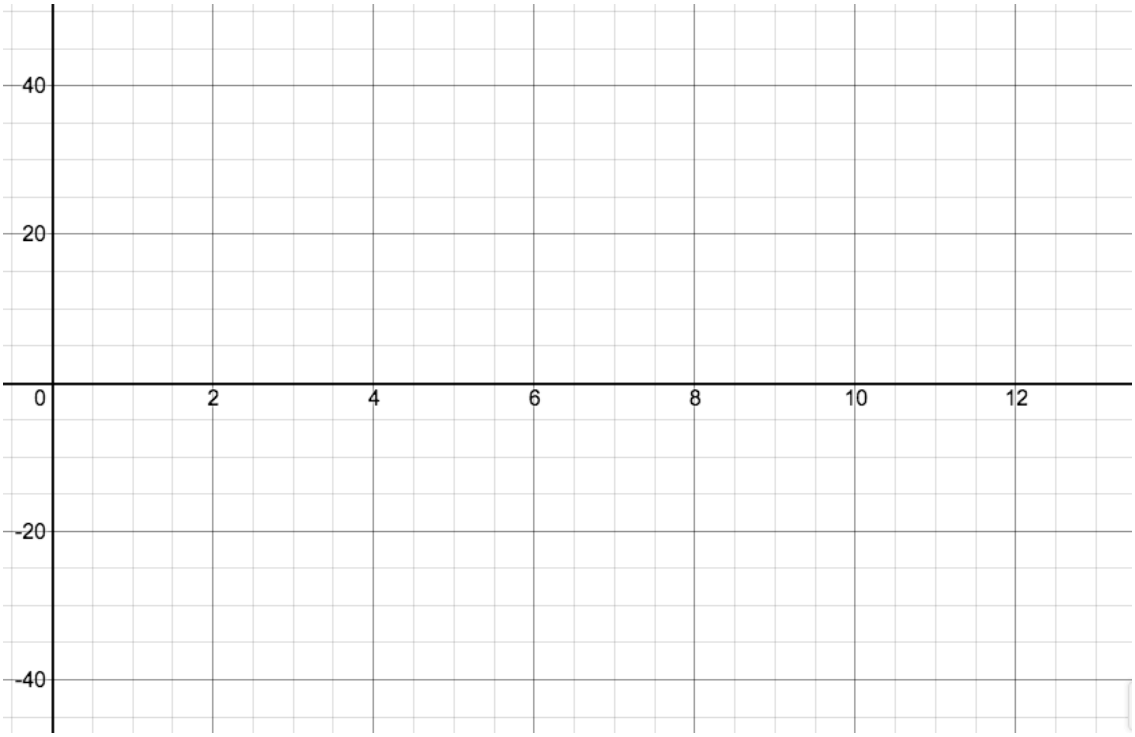
C	0	1	2	3	4	5	6	7	8	9	10	11
P(C)	-40	-18	0	14	24	30	32	30	24	14	0	-18

(a) Describe the pattern in the data set

(b) What are the next three terms of the sequence?

(c) What are the 3 terms that came before 0?

SUMMARY: KEY TO DATA ANALYSIS:



(D) Investigating Quadratic Relations – Modelling a Business' Revenue

The Paymore Shoe company introduced a new line of neon green high heel running shoes. The table below shows the number of pairs of shoes sold at one store over an 11 month period.

Month	1	2	3	4	5	6	7	8	9	10	11
Shoes sold	56	60	62	62	60	56	50	42	32	20	6

(a) Show that the data is quadratic

(b) State the domain and range for this model, given the context for the data.

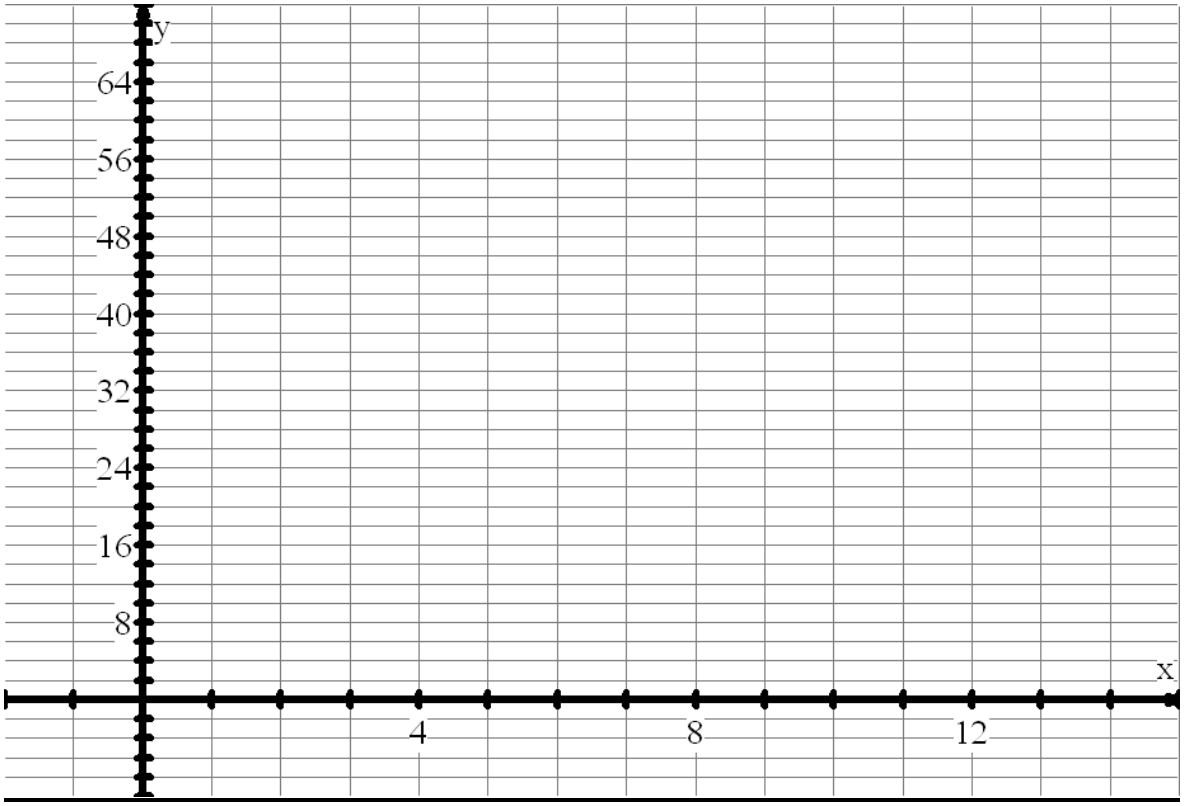
(c) At what rate are shoe sales changing between months 1 & 2? What does this mean?

(d) At what rate are shoe sales changing between months 6 & 7? What does this mean?

(e) Explain why a quadratic model would be suitable for the fashion business.

(f) Explain why a quadratic model would NOT be suitable for the fashion business.

(g) Draw a scatter-plot of the data.



(E) Investigating Quadratic Relations – Modelling a Business' Revenue

A hockey arena seats 1600 people. The cost of a ticket is $10. At this price, every ticket is sold. To increase revenue, the arena management plans to increase ticket prices. They conduct a survey and determine that for a 50 cent increase in price, 50 less people will attend

i. What is the initial cost of a ticket?
ii. What is the initial number of people attending the game?
iii. What revenue/income does the hockey arena make?

iv. One price increment of $0.50 is made. What is the new ticket price?
v. How many people attend the game now?
vi. What revenue/income does the hockey arena make?

vii. Two price increments of $0.50 are made. What is the new ticket price?
viii. How many people attend the game now?
ix. What revenue/income does the hockey arena make?

x. Three price increments of $0.50 are made. What is the new ticket price?
xi. How many people attend the game now?
xii. What revenue/income does the hockey arena make?

Continue this pattern to complete a data table

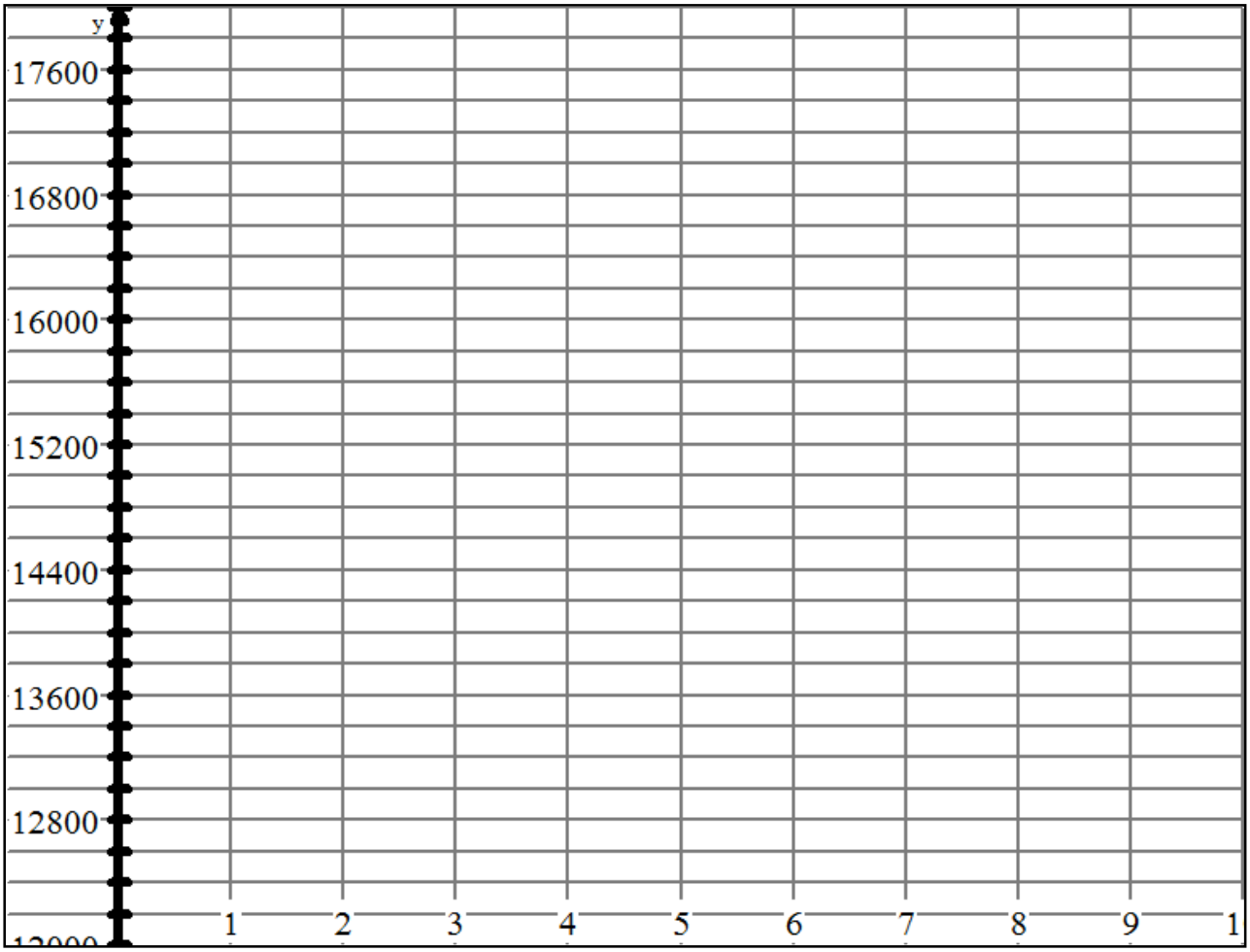
# of price increments	Ticket price	Number of people attending	Revenue/income
0	10	1,600	16,000
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

b. What type of a relation is “ticket price”? Write an equation for determining the ticket price.

c. What type of a relation is “number of people attending”? Write an equation for determining the number of people attending.

d. What type of relation is “revenue”? Write an equation for determining the revenue for the arena.

e. Graph the data on the partial grid provided.



(F) Investigating Quadratic Relations – Geometry Problems – Maximum Area

A farmer has 400 m of fencing. He wants to enclose 2 rectangular garden plots that border on a river and that are separated by a fence. If the farmer does NOT fence the side along the river, what is the largest area he can enclose? What are the dimensions (length and width) of this enclosure?

Data

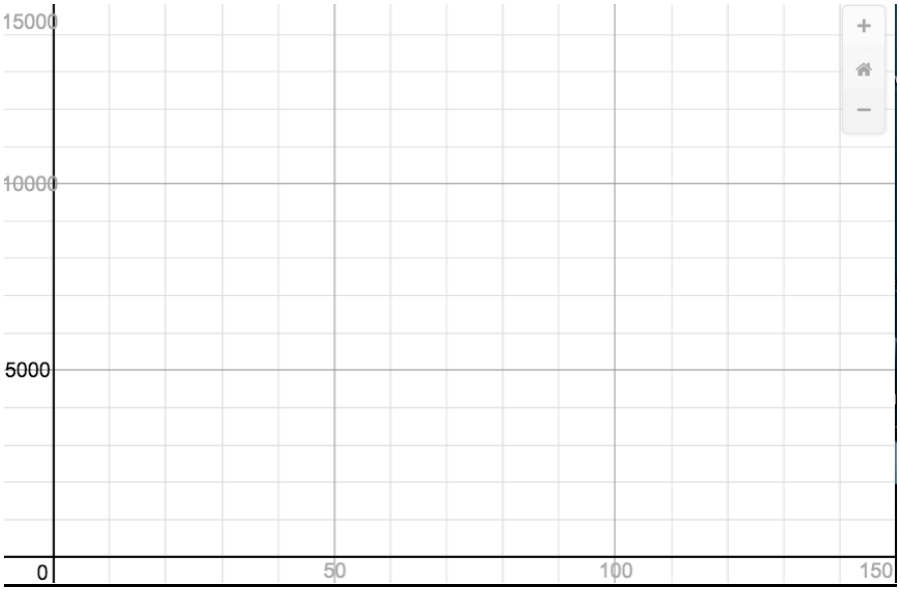
Explore the different combinations of widths & lengths he could have for his garden. Calculate the area for each (2 starting examples for W are given)

W	20	40					
L							
A							

Problem: If the farmer wanted to *maximize* the area of his gardens, what would he choose for the dimensions of EACH garden? Explain your choice.

What does the solution look like on your graph?

Graph:



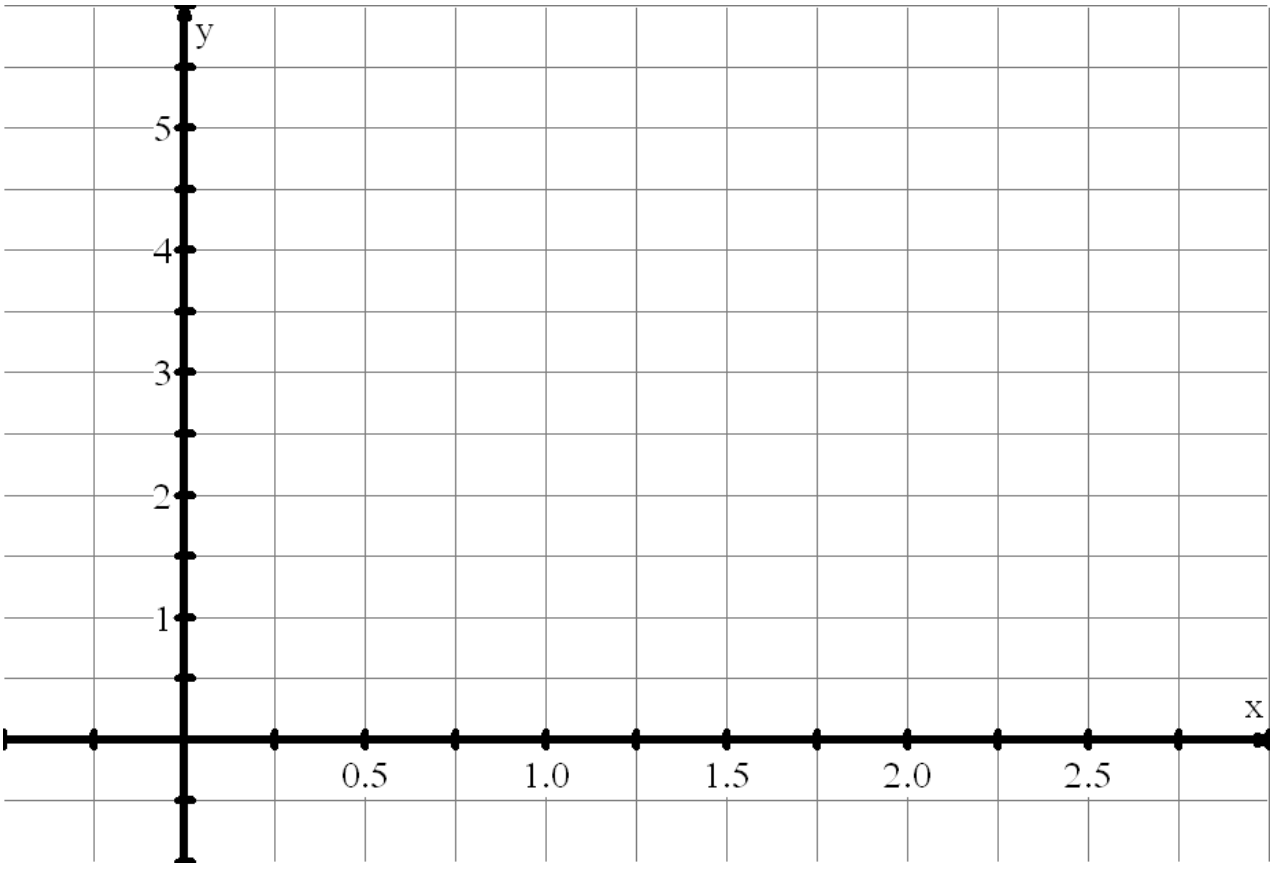
Algebra - Could we write an equation for the area ***A*** in terms of the width, ***w***?

(G)Investigating Quadratic Relations – Projectiles

12. A ball is tossed straight up in the air. Its height is recorded every quarter second.

Time (s)	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Height (m)	1.5	3.5	4.9	5.7	5.7	5.2	4.1	2.4	0.1

(a) Draw a scatter plot.
(b) What type of model is a reasonable representation of the relationship between the height of the ball and the time in the air? Explain
(c) Draw the graph that best fits the data.
(d) When does the ball reach its highest point above the ground? What is the ball's height at this point? Be as precise as you can, using your graphical model.
(e) About how long is the ball in the air? Explain.



(H) Investigating Quadratic Relations – Projectiles

Mr Santowski & Mr Smith are on the roof of an apartment building and Mr S kicks a soccer ball. The height of the soccer ball is, H, measured in meters above the ground and the time of flight of the ball is measured in seconds and the flight of the ball can be modeled by the equation $H = -5t^2 + 30t + 80$. You will analyze the trajectory of the ball by answering the following questions.

(A) Graph the relation on the calculator and use the data table on the GDC to complete the data table on this sheet and then graph the data points to make a diagram here.

(B) How high was the building from which we kicked the ball?

(C) How long did it take for the ball to reach its maximum height? What was its maximum height?

(D) When did the ball hit the ground?

(E) For how long was the ball in flight?

(F) What is the domain for this relation, given the context of the equation?

(G) What is the range?

(H) What is the height of the ball at t = 5.5 seconds?

(I) At what time(s) is the height of the ball 100 m?