

5-1 Modeling Data with Quadratic Functions

Quadratic function

$$f(x) = \boxed{a}x^2 + bx + \boxed{c} \quad \text{y-intercept}$$

slope

Linear function

$$y = \boxed{m}x + \boxed{b}$$

slope      y-intercept

Quadratic

- 1.) Highest degree term is 2.
- 2.) All exponents are whole numbers.

"FOIL"ing

$$(1 + x)(9 + x)$$

$$9 + x + 9x + x^2$$

→  $x^2 + 10x + 9$

quadratic

First  
Outside  
Inside  
Last

$$9 = 9x^0$$

$$x^0 = 1$$

$$1.) (-5x - 4)(-5x - 4) = f(x)$$

$$25x^2 + 20x + 20x + 16$$

$$25x^2 + 40x + 16$$

quadratic

$$2.) \{x^2 + 24 - 11x - x^2 = y\}$$

$$-11x + 24 = y$$

not quadratic

$$3.) f(x) = (3-x)(3-x)$$

$$9 - 3x - 3x + x^2$$

$$9 - 6x + x^2$$

$$x^2 - 6x + 9$$

quadratic

$$4.) f(x) = 3x(x+1) - x$$

$$3x^2 + 3x - x$$

$$3x^2 + 2x$$

quadratic

$$ax^2 + bx + c$$

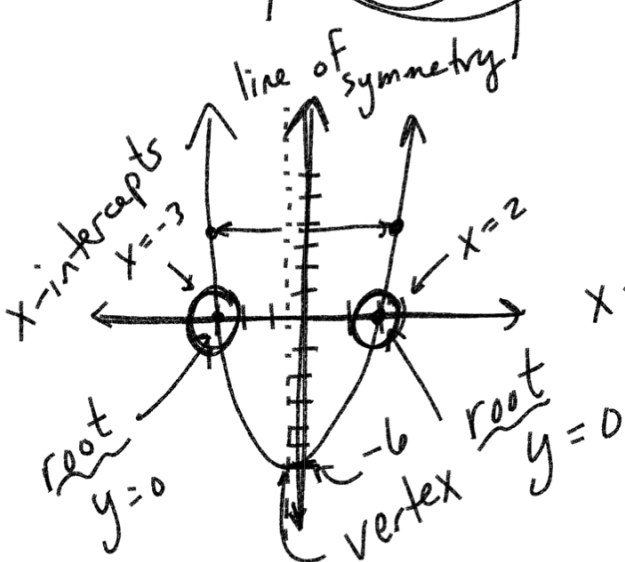
$$b=0$$

$$y = (x - 2)(x + 3)$$

$$x^2 + 3x - 2x - 6$$

$$y = (+)x^2 + x(-6) \leftarrow y\text{-intercept}$$

positive up



x-intercepts

parabola

$$(x - 2) = 0$$

$$+2 \quad +2$$

$$x = 2$$

$$(x + 3) = 0$$

$$-3 \quad -3$$

$$x = -3$$

Find quadratic model

$$f(x) = ax^2 + bx + c$$

1.)  $(-1, 1)$   $(1, 1)$   $(3, 9)$

$(-1, 1)$   
↑  
x  
↑  
f(x)

$$f(x) = ax^2 + bx + c$$
$$\begin{array}{c} \uparrow \qquad \downarrow \qquad \downarrow \\ 1 = a(-1)^2 + b(-1) + c \\ 1 = a - b + c \end{array}$$

system of equations!

$$\begin{array}{l} a - b + c = 1 \\ a + b + c = 1 \\ 9a + 3b + c = 9 \end{array}$$

$(1, 1)$

$$f(x) = ax^2 + bx + c$$
$$\begin{array}{c} \downarrow \qquad \downarrow \\ 1 = a(1)^2 + b(1) + c \\ 1 = a + b + c \end{array}$$

$(3, 9)$

$$f(x) = ax^2 + bx + c$$
$$\begin{array}{c} \downarrow \qquad \downarrow \qquad \downarrow \\ 9 = a(3)^2 + b(3) + c \\ 9 = 9a + 3b + c \end{array}$$

$(-1, 1)$   $(1, 1)$   $(3, 9)$

$$f(x) = x^2$$

$$f(x) = x^2$$

$$f(-1) = (-1)^2 = 1$$

$$f(1) = (1)^2 = 1$$

$$f(3) = (3)^2 = 9$$

$$\begin{aligned} \textcircled{1} & a - b + c = 1 \\ \textcircled{2} & a + b + c = 1 \\ \textcircled{3} & 9a + 3b + c = 9 \end{aligned}$$

$$\begin{aligned} \textcircled{2} & a + \overset{0}{\cancel{b}} + c = 1 \\ \textcircled{3} & 9a + \overset{0}{\cancel{3b}} + c = 9 \end{aligned}$$

$$\begin{aligned} & -(a + c = 1) \\ & 9a + c = 9 \end{aligned}$$

$$\begin{array}{r} -a \quad \cancel{c} = -1 \\ 9a \quad \cancel{c} = 9 \\ \hline \frac{8a}{8} = \frac{8}{8} \end{array}$$

$$a = 1$$

$$\begin{aligned} \textcircled{1} & a - b + c = 1 \\ \textcircled{2} & -(a + b + c = 1) \quad b = 0 \end{aligned}$$

$$\begin{array}{r} \cancel{a} - b + \cancel{c} = 1 \\ + \quad \cancel{-a} - b - \cancel{c} = -1 \\ \hline -2b = 0 \\ \quad \quad \quad \frac{0}{-2} \quad \frac{-1}{-2} \end{array}$$

$$a - b + c = 1$$

$$1 - 0 + c = 1$$

$$1 + c = 1$$

$$-1 \quad -1$$

$$c = 0$$

$$a = 1 \quad b = 0 \quad c = 0$$

$$f(x) = ax^2 + \overset{0}{\cancel{b}}x + \overset{0}{\cancel{c}}$$

$$f(x) = x^2$$

$(-4, 8), (-1, 10), (2, 4)$   
 $x \quad f(x)$

$$f(x) = ax^2 + bx + c$$

$$f(x) = ax^2 + bx + c$$

$$(-4, 8) \quad 8 = a(-4)^2 + b(-4) + c$$

$$8 = 16a - 4b + c$$

- ①  $16a - 4b + c = 8$
- ②  $a - b + c = 10$
- ③  $4a + 2b + c = 4$

$$(-1, 10) \quad f(x) = ax^2 + bx + c$$

$$10 = a(-1)^2 + b(-1) + c$$

$$10 = a - b + c$$

$$\begin{array}{r} 16a - 4b + c = 8 \\ - \quad a + b + c = 10 \\ \hline 15a - 3b = -2 \end{array}$$

$$(2, 4) \quad f(x) = ax^2 + bx + c$$

$$4 = a(2)^2 + b(2) + c$$

$$4 = 4a + 2b + c$$

$$\begin{array}{r} 4a + 2b + c = 4 \\ - \quad a + b + c = 10 \\ \hline 3a + 3b = -6 \end{array}$$

$$\begin{array}{r} 15a - 3b = -2 \\ 3a + 3b = -6 \\ \hline 18a = -8 \quad a = -\frac{4}{9} \end{array}$$

$$3a + 3b = -6$$

$$3(-\frac{4}{9}) + 3b = -6$$

$$3b = -6 + \frac{12}{9}$$

$$3b = -\frac{54}{9} + \frac{12}{9}$$

$$10 = a - b + c$$

$$10 = -\frac{4}{9} - \frac{14}{9} + c$$

$$10 = -\frac{18}{9} + c$$

$$-\frac{12}{9} + 3b = -6 + \frac{12}{9}$$

$$+\frac{12}{9}$$

$$3b = \frac{-42 \div 3}{9 \div 3} = \frac{-14}{3}$$

$$10 = -2 + c$$

$$+2 \quad +2$$

$$12 = c$$

$$f(x) = ax^2 + bx + c$$

$$f(x) = -\frac{4}{9}x^2 - \frac{14}{9}x + 12$$

$$\frac{1}{3}(3b) = \left(\frac{-14}{3}\right)\frac{1}{3}$$

$$b = \frac{-14}{9}$$

HW  
Ch 5.1 events  
Supplemental WS  
Online HW 18  
Quiz 19 } Feb 11<sup>th</sup>  
HW/Quiz 16 due tomorrow  
Actual Test due Feb 4<sup>th</sup>