Adding a Constant	2. Study the tables and graphs produced by such functions for several combinations of positive and negative numbers

Set 1	**Set 2**	**Set 3**
$y = x^2$	$y = -x^2$	$y = 2x^2$
$y = x^2 + 3$	$y = -x^2 + 5$	$y = 2x^2 + 1$
$y = x^2 - 4$	$y = -x^2 - 1$	$y = 2x^2 - 3$

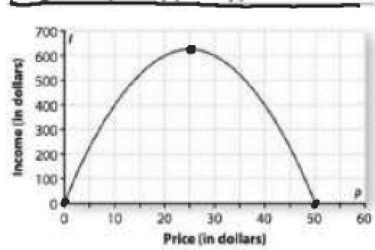
a. How is the graph of $y = ax^2 + c$ related to the graph of $y = ax^2$?

b. How is the relationship between $y = ax^2 + c$ and $y = ax^2$ shown in the tables (x, y) values for the functions?

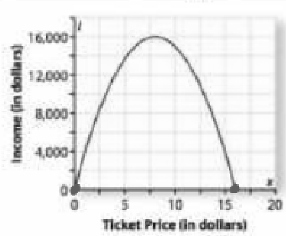
Factored and Expanded Forms

When you studied problems about income from an amusement park bungee jump and promotion of a concert, you looked at functions relating income to ticket price. The resulting income rules has similar forms:

Bungee Jump: $I = p(50 - p)$



Concert Promotion: $I = x(4{,}000 - 250x)$



Just as you did in early courses you can apply properties of numbers and operations to rewrite these rules in equivalent expanded form.

Standard Form

start with highest power and work down.

$I = p(50-p)$

$0 = p(50-p)$

$p = 0 \quad 50 - p = 0$

$50 = p$

$I = x(4000-250x)$

$0 = x(4000-250x)$

$x = 0 \quad 4000 - 250x = 0$

$4000 = 250x$

$x = 16$

$y = ax^2 + bx$

$y = x(ax+b)$

3. a. Using the distributive property rewrite the rule $I = p(50 - p)$ in expanded form. *Write your answer in standard form.*

$I = 50p - p^2$

$I = -p^2 + 50p$

b. Use similar ideas to rewrite ideas $I =$ $x(4{,}000 - 250x)$ in an equivalent expanded form. *Write you answer in standard form.*

$I = 4000x - 250x^2$

$I = -250x^2 + 4000x$

c. Study the graphs of the two income functions: $I = p(50 - p)$ and $I = x(4{,}000 - 250x)$. In each case, find the coordinates of:

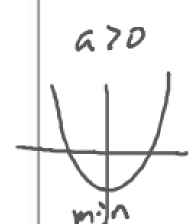
	Bungee	Concert
i. the y-intercepts	$(0,0)$	$(0,0)$
ii. the x-intercepts	$(0,0)$ $(50,0)$	$(0,0)$ $(16,0)$
iii. the maximum point	$I = 25(50-25)$ $25(25)$ $(25, 625)$	$I = 8(4000 - 250(8))$ $(8, 16{,}000)$

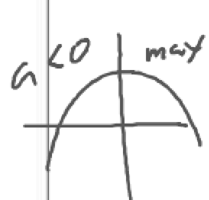
d. How could you find these special points in part b by analyzing the symbolic function rules in factored and/or expanded forms?

y-intercept is c value in standard form.

x-intercepts: $x = 0 \quad x = \frac{-b}{a}$

max/min $x = \left(\frac{-b}{a}\right)\left(\frac{1}{2}\right) = \frac{-b}{2a}$ Find y plug x into equation.





e. The Sauk Prairie High School students made the following observations. How do you think the students arrived at those ideas? Do you agree with them? If not explain way not.

i. It is easiest to find the y-intercept from the expanded form $-p^2 + 50p$.

ii. It is easiest to find x-intercepts of the income function graph from the factored form $p(50 - p)$.

$0 = p(50 - p)$

iii. It is easiest to find the maximum point on the income graph from the x-intercepts.

$I = p(-75p + 950)$

4. The planning committee for Lake Aid, an annual benefit talent show at Wilde Lake High School, surveyed students to see how much they would we willing to pay for tickets. Suppose the committee developed the function $I = -75p^2 + 950p$ to estimate income *I* in dollars for various ticket prices *p* in dollars. Use the patterns you observed in Problem 3 to help answer the following questions.

a. Write the function for the income using an equivalent factored form of the expression given. What information is shown well in the factored form that is not shown in the expanded form?

X-intercepts

$I = 0$
x-intercepts

b. For what ticket price does the committee expect an income of zero?

$I = p(-75p + 950)$ $\quad p = 0 \quad -75p + 950 = 0$

$0 = p(-75p + 950)$ $\quad \frac{-75p}{-75} = \frac{-950}{-75}$

$p = 12.67$

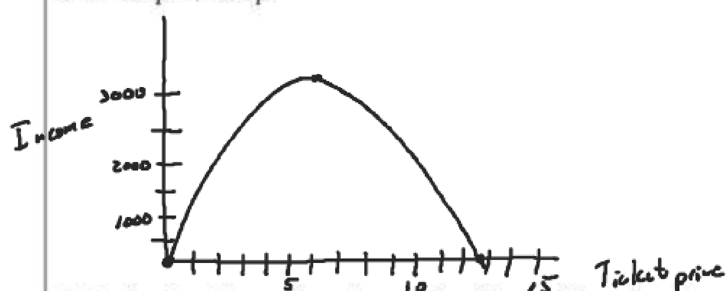
c. What ticket price will generate the greatest income? How much income is expected at that ticket price?

\$6.33 $\quad I = -75p^2 + 950p$

$-75(6.33)^2 + 950(6.33)$

\$3008.33

d. Use your answers to Parts b and c to sketch a graph of $I = -75p^2 + 950p$.



Adding a Linear Term

5. Study the tables and graphs produced by such functions for several combinations of positive and negative numbers.

Set 1	**Set 2**	**Set 3**
$y = x^2$	$y = -x^2$	$y = 2x^2$
$y = x^2 + 4x$	$y = -x^2 + 5x$	$y = 2x^2 + 6x$
$y = x^2 - 4x$	$y = -x^2 - 5x$	$y = 2x^2 - 6x$

Look at the graphs of the functions given above to see if you can find patterns that relate the values of a and b in the rules $y = ax^2 + bx$ to locate the features below. It may help to think about the functions using the equivalent factored form, $x(ax + b)$.