

You are working for a local concert hall. You've determined that the profit the concert hall makes from a performance given by a certain rock band is a function of the price,  $x$ , of a ticket, where the profit function is given by:

$$P(x) = -75x^2 + 1500x - 4800$$

Your boss wants you to explain to her exactly what the equation means, so you rewrite the profit function as:

$$P(x) = x(1500 - 75x) - 4800$$

- a) Why might a quadratic make sense for modeling this situation?
- b) What could the  $-4800$  represent in terms of the concert situation?
- c) The independent variable  $x$  is price per ticket. How do you think the price per ticket is related to the number of tickets sold?
- d) What could the expression  $x(1500 - 75x)$  represent in terms of the concert situation?
- e) What might the expression  $1500 - 75x$  mean in terms of the concert situation?



Your boss decides that she wants to see the profit function with **number of tickets sold** as the independent variable, rather than the **cost per ticket**. Can you fix the function?

### **Part 1:**

- a) Because the price of the tickets impacts the number of tickets sold – as the price of the tickets goes up, the number of tickets sold goes down. Also, it makes sense that there would be an upside down U – there a price you could set where profit would be maximized, and it goes down on either side.
- b) \$4800 could be the fixed costs of holding the concert
- c) As price goes up, ticket sales go down – negative/decreasing relationship
- d) The revenue gained when tickets are priced at \$x
- e) The number of tickets sold when tickets are priced at \$x

Additional questions:

- 1) What is the relationship between revenue and profit?
- 2) Conceptually, how would you figure out the total amount of money brought in by ticket sales?
- 3) What price corresponds the maximum profit?
- 4) What number of tickets corresponds to the maximum profit?
- 5) What price and number of tickets corresponds to the break-even point?
- 6) What does the 1500 mean in terms of the situation? (Max people if tickets free) What does the -75 mean? (number of people lost for each \$1 price is increased)

### **Part 2:**

Number of tickets sold =  $-75(\text{price per ticket}) + 1500$

$$n = -75p + 1500$$

$$n - 1500 = -75p$$

$$p = (-1/75)n + 20$$

$$\text{Revenue} = np = n[(-1/75)n + 20] = (-1/75)n^2 + 20n$$

$$\text{Profit} = \text{Revenue} - 4800 = (-1/75)n^2 + 20n - 4800$$

<b><u>Price per ticket</u></b>	<b><u>Number of tickets sold</u></b>	<b><u>Revenue</u></b>	<b><u>Profit</u></b>
0	1500	0	-4800
2	1350	2700	-2100
4	1200	4800	0
6	1050	6300	1500
8	900	7200	2400
10	750	7500	2700
12	600	7200	2400
14	450	6300	1500
16	300	4800	0
18	150	2700	-2100
20	0	0	-4800