Price Control

Purpose: The purpose of the assignment is to determine the price of the board game that will lead to the maximum profit. There are multiple cases that each need separate conditions in order to achieve the highest income. Each board game needs 7QR to manufacture and distribute, and increasing the price by 7QR reduces demand by 40,000 (arbitrary) units. At 7QR, the initial demand is 320000 units.

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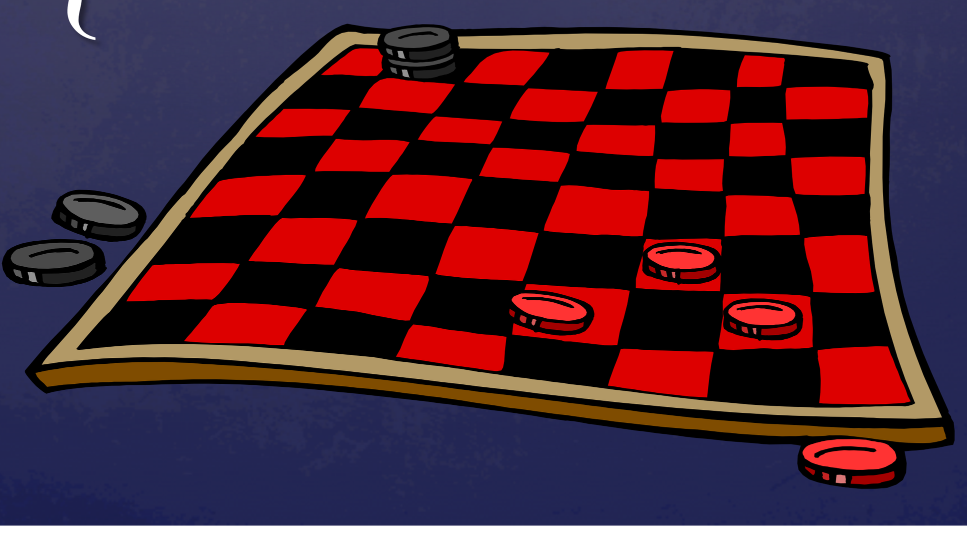


- In our project, we've set y to be the profit made and x to be the "number of 7's" in the price; that is to say, by how many 7's we are increasing the price.

a) Find the maximum profit that can be made.

This is the simplest case. In order to find a formula for the profit, we need to find the number of units sold and the final price. (Profit = (Units sold)*(Price – cost)

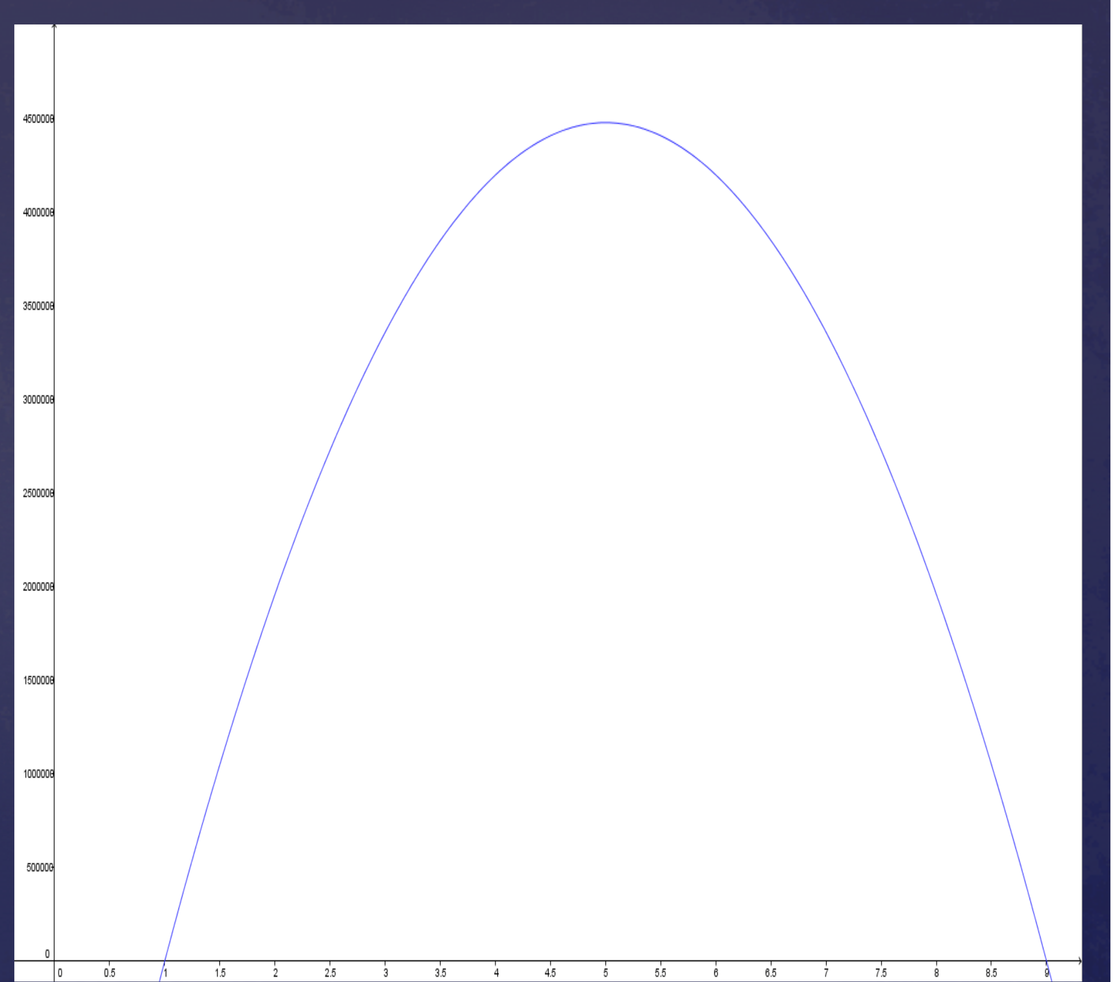
To come up with a formula for our profits, we made a table of values:

	Price-cost	Demand	Profit
X=2	7QR	280,000	1,960,000QR
X=3	14QR	240,000	3,360,000QR

Profit Determination

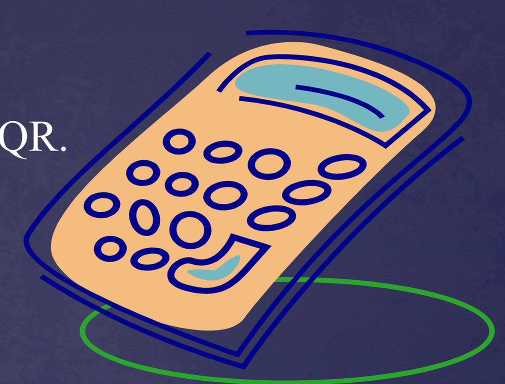
From this, we can generalize that the formula of our profits is:
F(x) = (320000-40000(x-1))*(7x-7)

The graph of F(x) looks like this: ➔



From the graph, it is apparent that the function maximizes at about x=5; however, a more rigorous proof using derivatives is needed.

The derivative of this is:
F'(x) = 2,800,000 - 560,000x
F'(x) = 0 ➔
2,800,000=560,000x = 0 ➔ X=5, making the price 28QR.
X=5 is the only critical number.

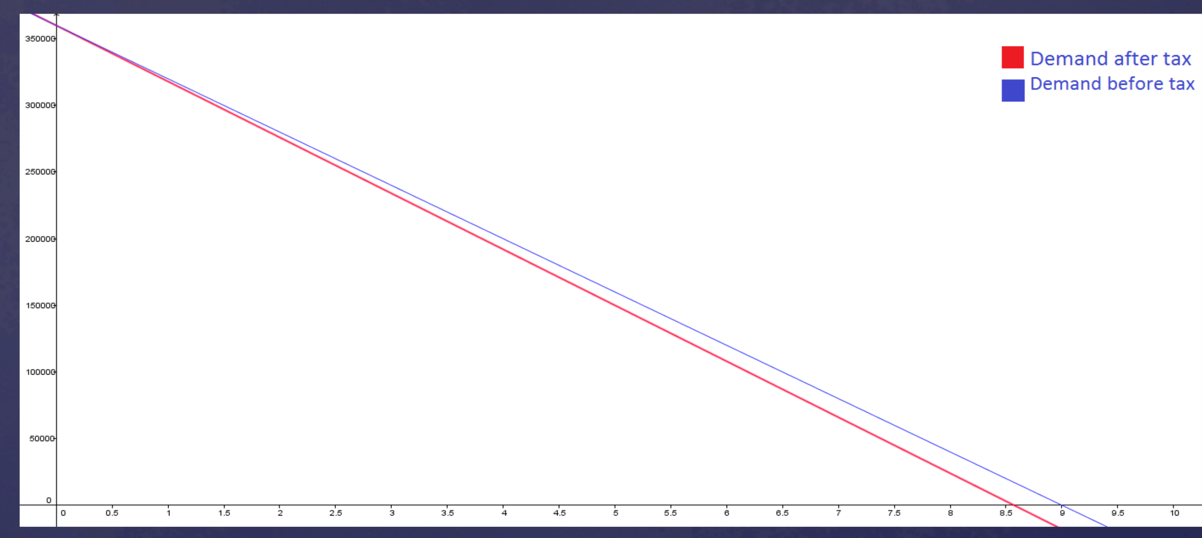


By the first derivative rule:

When x=6, F'(x) = -560000
When x=4, F'(x) = 560000
Because the derivative of x increases and then decreases, it's a local maximum.
That means that the maximum profit is:
F(x): (320000-40000(5-1))*(7(5)-7) = 4,480,000QR
The maximum profit that can be earned under these conditions is 4,480,000QR.
Domain: From this, it can be seen that x>=1 and 9>=x, as anything beyond that will result in negative numbers, which is absurd in this situation.

b) The consumer must now pay a 5% tax when purchasing the board game. Find the new maximum profit.

In this case, the only person affected is the consumer (the cost of manufacturing is not changed). This will result in lower demand, as the price of the good for the buyer has gone up by 5%. Because of this, it is necessary to revise the "demand" part of the formula. After taking points and plotting them on the graph below:



We end up with this,
F(x) = (320000-40000(1.05x-1))*(7x-7)
Making the derivative:
F'(x) = 2,814,000 – 588,000x.
F'(x) = 0 ➔
2,814,000 – 588,000x = 0➔ X=67/14, making the price 26.5QR.
X=67/14 is the only critical number.

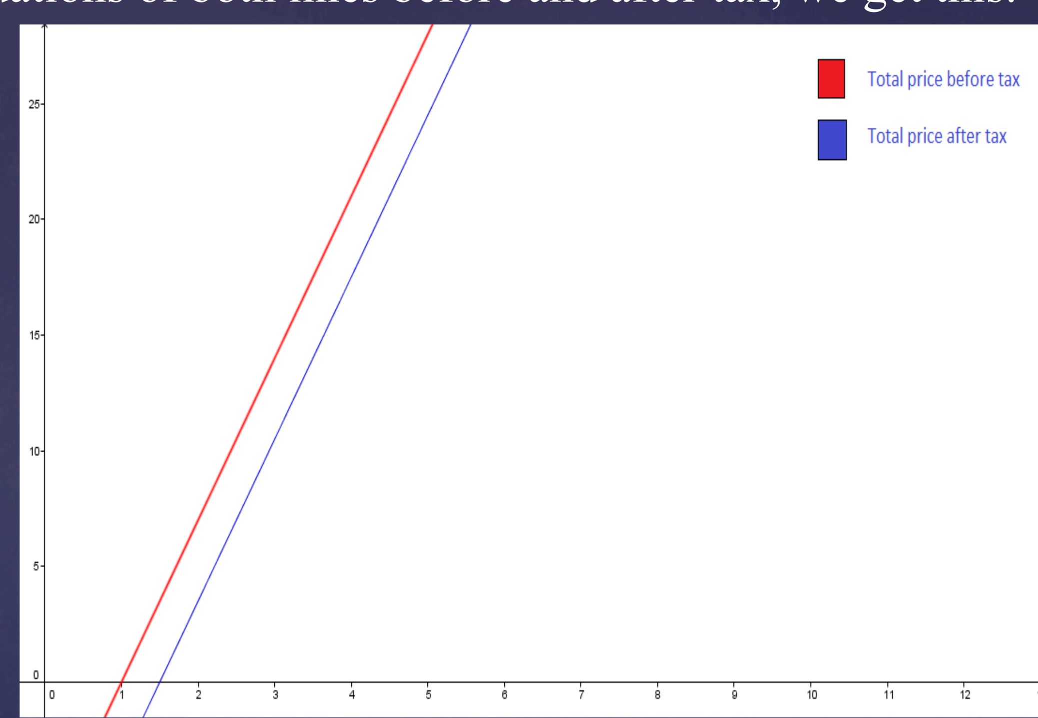
By the first derivative rule:
When x=5, F'(x) = -126000
When x=4, F'(x) = 462000
Because the derivative of x increases and then decreases, it's a local maximum.
That means that the maximum profit is:
F(x): (320000-40000((1.05)(67/14)-1))*(7(67/14)-7) = 4,213,500QR
The maximum profit that can be earned under these conditions is 4,213,500QR

This time, the domain is: x>=1 and x<=(9/1.05)

c) An excise tax has been imposed on our company, forcing us to pay 3.5QR to the government. Find the new maximum profit.

Because the tax increases the cost of making the board game, we can assume that it increases the total costs, and increases the price of manufacturing from 7QR to 10.5QR.

Therefore, the only change needed in the original formula is in the "price" section. If we graph the equations of both lines before and after tax, we get this: ➔



F(x) = (320000-40000(x-1))*(7x-10.5)
F'(x) = 2,940,000 – 560,000x
F'(x) = 0 ➔
2,940,000 – 560,000x = 0 ➔
X=21/4 making the price 26.25QR.
X=21/4 is the only critical number.

By the first derivative rule:
When x=6, F'(x) = -420000
When x=5, F'(x) = 140000
Because the derivative of x increases and then decreases, it's a local maximum.
That means that the maximum profit is:
F(x): (320000-40000((21/4)-1))*(7(21/4)-10.5) = 3,937,500QR
The maximum profit that can be earned under these conditions is 3,937,500QR

In this case, the domain is x>=1.5 and x<=9

- All of these examples demonstrate the challenges that must be overcome in choosing the correct price in order to maximize the revenue made in any business. It is of critical importance to solve this problems so that the business can run successfully.

Conclusion