KEY

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Demand for Chips & Salsa

Source of original data

In order to determine the Cost functions, I used information from the following web pages:
http://cookinfood.com/2012/05/03/homemade-tortilla-chips-happy-cinco-de-mayo/
http://www.walmart.com/ip/Great-Value-Vegetable-Oil-48-Oz/10451002
http://www.thesimpledollar.com/saving-pennies-or-dollars-making-your-own-salsa/
http://www.worldmarket.com/product/stainless-steel-lidded-spice-jars-set-of-6.do?&from=fn
http://www.walmart.com/cp/Tortillas-Pitas-Wraps/1001458

I generated a survey to determine the demand function for Salsa. The results appear in the following link
https://qtrial.qualtrics.com/CP/Report.php?RP=RP_4SXlsi2iXW7cXrv

Finally, for the demand function for Chips, Dr. Heavilin's broadcasted my survey in class and helped me gather data
(USU-Math-1100)
https://www.dropbox.com/s/gnk0kn4mb2ccj1r/Dr.%20Heavilin-Math%201100%20-%20USU-%20Survey.png

Description

As an economics and finance major, I decided to compare the behavior of two complementary goods and analyze the monetary effect one has over the other. This type of investigation is very useful for the **financial well-being of an enterprise**. Two goods are called complementary goods when a larger consumption of one also incentivizes a larger consumption of the other. Through calculus, I have enough tools to determine possible future values of some products, and relying on the **Price Elasticity of Demand (PED) concept, advise companies on the price they should set for their products.**

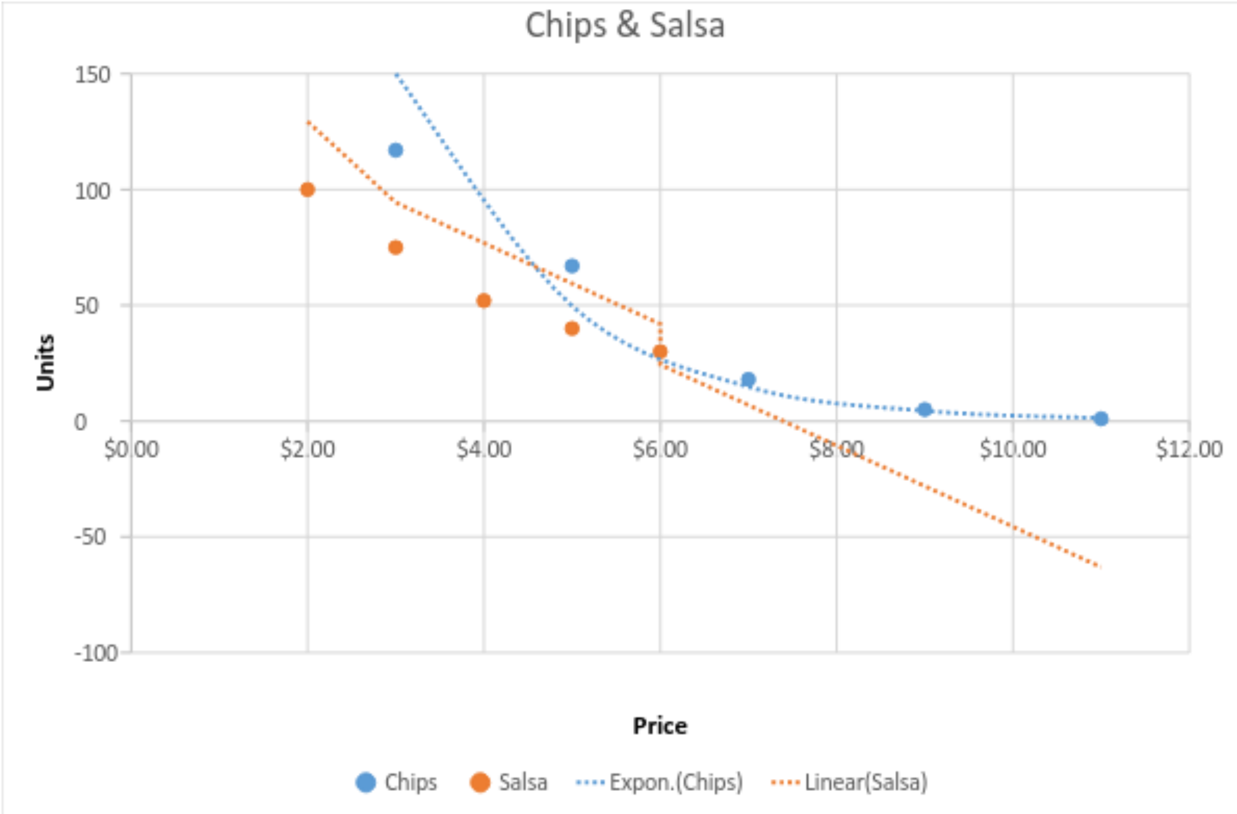

Figure 1: Amount demanded of chips and salsa depending on their price.
The interval for c (p) is (0, ∞); and the interval for s (p) is (0, 6).

1. **What is the unit price elasticity for chips, and for salsa? Find the total revenue for the sale of chips and the sale of salsa at each unit elasticity price**

   First, calculate the price elasticity of the demand curve for chips using $Ep = -\frac{p \cdot f'(p)}{f(p)}$. Since you have the original function, find the first derivative of *C (p)* and plug it into the equation. Noting that revenue is maximized when price is set so that the PED is exactly one, equal the result to one. Find the price at which the revenue for chips is maximized.

c' (p) = $(-\ 0.606)(1027.8e^{-0.606p})$

$$-\frac{p \cdot f'(p)}{f(p)} = 1$$

$$-\frac{p \cdot (-0.606)(1027.8e^{-0.606p})}{(1027.8e^{-0.606p})} = 1$$

$$p_1 = \frac{1}{0.606}$$

To find the total Revenue for Chips and Salsa at $p = \frac{1}{0.606}$, use the equation

$$R(x) = p \cdot f(p)$$

Plug the price found above into R(x) and evaluate it with the equation for chips, and then do the same thing with the equation for salsa.

$Rc_1 = (1.65) \cdot (1027.8e^{-0.606(1.65)})$

= 623.9381017 dollars.

$Rs_1 = (1.65) \cdot (2.9286(1.65)^2 - 40.929(1.65) + 170.4)$

= 182.8962119 dollars.

$$R_1 = 806.8343136\ dollars.$$

-Round to the nearest cent-

-The price unit elasticity for chips it's US$1.65. Therefore, at the price where revenue for chips c (p) is maximized, the total revenue for chips and salsa will be $806.83 dollars.

Now, in order to find unit price elasticity for salsa, use the same price elasticity formula with the salsa equation s (p). Equal the result to one to see what is the price at which the revenue for salsa is maximized.

s' (p) = 5.8572p – 40.929

$$-\frac{p \cdot f'(p)}{f(p)} = 1$$

$$-\frac{p \cdot (5.8572p - 40.929)}{2.9286p^2 - 40.929p + 170.4} = 1$$

We found two prices that maximize revenue for salsa, try both points to see which one is the greatest.

$$p_2 = 6.17744 \qquad = 3.13964$$

Evaluate how much revenue the producer will get for salsa, and for chips, at the price unit elasticity found for salsa. We found two prices that maximize revenue for salsa. Evaluate for the one that is inside the interval of the salsa function; c (p) = (0, 6). The first price value ($p_2 = 6.17744$) is not located in the function, so just plug in $p_2 = 3.13964$, and find the total revenue.

$Rc_2(3.13964)$ = (3.13964) $\cdot(1027.8e^{-0.606(3.13964)})$
= 481.383 dollars.

$Rs_2(3.13964)$ = (3.13964) $\cdot(2.9286(3.13964)^2 - 40.929(3.13964) + 170.4)$
= 222.179 dollars.

Take the two greater values found, and add them to get the total revenue.

$$R_2 = 703.562$$

-Round to the nearest cent-

<u>The price unit elasticity for salsa is \$6.18 and \$3.14 dollars, but the one that maximizes revenue in this function is \$3.14. With the optimal price for salsa, total revenue equals \$703.56.</u>

2. **What is the price at which the same amount of Chips and Salsa are sold? How many units were sold at this point?**
   Look for the intersection between C(x) and S(x).

Equal the two original equations to each other in order to determine what is the price that should be set if the producer wants to sell the same quantity of chips and of salsa.

$$1027.8e^{-0.606p} = 2.9286p^2 - 40.929p + 170.4$$

Solve for p,

$$p_3 = 5.71957$$

Plug the price value found into both of the equations to determine the number of units demanded.

c $(5.71957) = 1027.8e^{-0.606(5.71957)}$
$= 32.1084$ ***-Round to the nearest integer-***
$= 32$ units.

s $(5.71957) = 2.9286(5.71957)^2 - 40.929(5.71957) + 170.4$
$= 32.1084$ ***-Round to the nearest integer-***
$= 32$ units.

-For the answer, round the price to the nearest cent-

-<u>The price at which the same amount of Chips and Salsa are sold is \$5.72 dollars. At this price, 32 units of salsa and 32 units of chips are demanded.</u>

3. **In order to get more revenue, what is the ideal price to sell both the chips and the salsa? Compare R_1, R_2, and R_3 and choose the greatest value obtained.**

We already have R_1 and R_2 from the first question.

$$R_1(1.65) = 806.83\ dollars.$$

$$R_2(3.14) = 703.56\ dollars.$$

To find the total revenue at the intersection points, R_3, you have to plug into both equations the price value obtained ($p_3 = 5.71957$), and add up the results of the functions.

$Rc_3(5.71957) = (5.71957)\cdot(1027.8e^{-0.606(5.71957)}) \quad = 183.646$

$Rs_3(5.71957) = (5.71957)\cdot(2.9286(5.71957)^2 - 40.929(5.71957) + 170.4)$
$= 183.646$

$$R_3(5.72) = 367.292$$

<u>Setting the price at \$1.65 dollars will give you \$103.27 dollars more than setting it at \$3.14 and \$439.54 more than at \$5.72. Therefore, the ideal price to get more revenue for both chips and salsa is \$1.65 dollars.</u>

4. **What price for chips and what price for salsa will produce more profit?**
The equation for profit is: $P(x) = R(x) - C(x)$**.**

Chips Cost function Cc(x) = 3.42x + 0.70
First, analyze the different prices obtained for the revenue of chips with the given Cost function for chips.
Plug into the original Chips demand equation the different prices set, in order to get the amount of units sold at that price

$$p_1 = 1.65$$

$$c_1(1.65) = 1027.8e^{-0.606(1.65)}$$

= 378.144 ***-Round to the nearest integer-***
= 378 units

Take the units found, and plug them into the profit equation. After having set the cost function, take the respective revenue found for each price and built the equation.

P_1 (x) = 624 - ((3.42·378) + 0.70)
= -669.46 dollars

-Repeat the steps with p_2.

$$p_2 = 3.14$$

$$c_2(3.14) = (2.9286(3.14)^2 - 40.929(3.14) + 170.4)$$

= 153.291
= 154 units

P_2 (x) = 481 – ((3.14 · 154) + 0.7)
= -3.26 dollars

-At price for the same amount of chips and salsa;

$$p_3 = 5.72$$

$c_3(5.72)$= 32 (You already had this one from question #3)

P(x) = 367 – ((5.72 · 32) + 0.7)
= 183.26 dollars.

The price for chips that will produce more profit is \$5.72 dollars.

Salsa Cost function Cs(x) = 2.79x + 1.2
First, plug into the original Salsa demand equation the different prices set.

$$p_1 = 1.65$$

$$s(1.65) = (2.9286(1.65)^2 - 40.929(1.65) + 170.4)$$
= 110.54
= 111 units

Take the units found, and plug them into the profit equation. After having set the cost function, take the respective revenue found for each price and built the equation.

P_1(x) = 183 – ((2.79·111) + 1.2)
= -127.89 dollars.

-Repeat the steps with p_2.

$$p_2 = 3.14$$

$$s(3.14) = (2.9286(3.14)^2 - 40.929(3.14) + 170.4)$$
= 70.7578
= 71 units

P_2(x) = 222 - ((2.79·71) + 1.2)
= 22.71 dollars.

-At price for the same amount of chips and salsa

$$p_3 = 5.72$$

$s(5.72) = 32$ (You already had this one from question #3)

$P_3(x) = 184 - ((2.79 \cdot 32) + 1.2)$
$= 93.52$ dollars.

<u>The price for salsa that will produce more profit is $5.72 dollars.</u>

Relying on the previous analysis made, it is better to aim for the price found at the intersection point of the two functions. Although revenue for chips or salsa was the highest at each optimization point, an economic examination should always take into account the cost of creating a product. The price found ($5.72), will generate more profit for both chips and salsa, setting aside any harmful losses.