The relationship between the milk and cookies consumption in the US

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ABSTRACT

For doing this research, it is collected relevant data to estimate milk consumption in the United States. Our goal and objective were to prove whether there is a relationship between the amount of milk and cookies consumption in the USA. Analytical and empirical frameworks were outlined along with the datasets explained. As we analyzed and processed the data we were able to develop a hypothesis. In this hypothesis, we assumed milk and cookies were complementary goods. We used regression analysis in order to formulate a demand estimation equation for U.S. milk and cookie consumption. After analyzing and verifying the statistical significance of the data, the results show our hypothesis was correct. We further analyzed the data using the elasticity of demand in order to determine the degree more accurately to which our independent variables affected our dependent variable. Using the elasticity of demand, we were able to show the effects a change on one independent variable had on the dependent variable, demand for milk in the U.S. We then made recommendations in regard to the elasticity of demand is used; if the price of cookies goes up 10%, and then the demand for milk will decrease 2.8%. Lastly, in regard to income, since there is a negative coefficient of (-0.29), it means Milk is classified as an inferior good and therefore less will be purchased when income increases.

Keyword: Milk, Cookies, Regression analysis, USA.

1. INTRODUCTION

In this study, we researched historical data regarding consumption of the primary good X (milk), pricing of good X (Px), complementary good Y (cookies), pricing of a complementary good (Py), and average household income (M). This was done in an attempt to derive a demand equation sufficient to forecast the demand of the primary good in the U.S. Our intention was to find the data relevant to the demand for milk and derive a demand equation. It was crucial to find data that proved to be statistically significant in influencing the demand for the primary good. This, in turn, would allow us to accurately forecast quantities demanded of milk. Some of our other goals were the following:

- Determine if good Y was a compliment or substitute for our primary good.
- Study the price elasticity of demand, the income elasticity of demand, and cross-price elasticity of demand. This was done in order to determine the effects of the price of primary good, income, and the price of complementary good had on quantities demanded on our primary good.

2. RESEARCH DESIGN AND EMPIRICAL FRAMEWORKS

The analysis was primarily derived and based on using a regression analysis model. It is the belief that this model will successfully prove that the price of good X, good Y, and household income have an effect on demand for good X.

We hypothesize our coefficients will be the following

The price of good X (Px) we expect have a negative (inverse) coefficient.

For the price of good Y (Py) we expect that this will be a complementary good and therefore have a higher value than the absolute value of 1.

For average household income (M) we expect that good X is a normal good which indicates the coefficient of M should be positive.

The demand elasticity of milk was also taken into account in order to determine the effect a change an independent variable had on milk consumption in the U.S. We were then able to demonstrate how this elasticity could be applied in order to counteract a change in quantity demanded of milk resulting from a change in one of the independent variables. [1]

For the purpose of this study, we only evaluated the consumption of milk in the U.S, milk pricing, cookie pricing, and average household income for the selected time periods. We awarded that there were many other factors that could have been considered, however, for the sake of simplicity.

2.1. DEMAND FUNCTION

The demand function:

$Qd = a + b (Px) + c (Py) + d (M)$

In this case the values are as follows:

a= intercept (in thousands) Qd= US per capita consumption of milk and cookies

b= Coefficient of Milk, Px= Average price of Milk

c= Coefficient of Cookies, Py= Average price of Cookies

d= Coefficient of household income, M= Average income (in thousands)

3. REGRESSION MODEL

OUTPUT

Regression Statistics	
Multiple R	0.93107791
R Square	0.866906075
Adjusted R Square	0.840287289
Standard Error	5.254613663
Observations	19

ANOVA

	df	SS	MS	F	Significance F
Regression	3	2697.656522	899.2188405	32.56745459	8.21917E-07
Residual	15	414.1644712	27.61096475		
Total	18	3111.820993			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	306.6765384	27.96343939	10.96705359	1.46409E-08	247.0738782	366.2791986	247.0738782	366.2791986
Milk ($ per pound)	-125.3237758	39.21742467	-3.195614625	0.006017634	-208.9137378	-41.73381384	-208.9137378	-41.73381384
Cookies	20.62916598	4.531941262	4.551949107	0.000381715	30.28877012	10.96956184	30.28877012	10.96956184
Income (thousands)	-0.296362211	0.392176149	-0.755686472	0.461540088	-1.132265886	0.539541465	-1.132265886	0.539541465

Table 1: Regression analysis

4. RESULT AND DISCUSSIONS

Based on the regression result, it is found that following demand function

$Qdx = 306.67 - 125Px - 20Py - 0.29M$

To understand the data, it is needed to address the meaning behind the coefficients found while using the regression analysis.

The coefficient of Px is -125 means that for every 10 unit increase in price, quantity demanded will go down 1250 units. Law of demand holds.

The coefficient of Py is -20 means when there is a 10 unit increase in price, quantity demanded will go down 200 units. Law of demand holds.

With regard to income, there is a negative coefficient of (-0.29) which means Milk can be classified as an inferior good and less will be purchased when income increases.

In the following regression result, we see the P value of milk price; Cookies price and income are 0.006017634, 0.000381715 and 0.461540088 respectively. So, in case of milk price and cookies price we can reject the null hypothesis, because both values (P value of milk price=

0.006017634, P value of Cookies price= 0.000381715) are less than the common level of alpha value =0.05. So, we can say that there are significant relationship between quantity demand and price of milk and cookies. [2]

In case of the coefficient of income we can't reject the null hypothesis, because P value of income is 0.461540088 or 46% which is much higher than the common level of alpha value of 5%. So, we can say that there is no significant relationship between quantity demand and income. [3]

The value of R^2 shows how closely data are fitted to the regression result. If the value of R^2 becomes zero percent then it indicates that none of the variation of the response data around its mean value. And when the value of r square become 1 or 100 percent then it indicates the all the variability of the response data around its mean value. In our following regression statistics, it has been shown that the value of R^2 is 0.866906075. This is indicating that 86.67% of the variation of dependent variable (quantity demand) has been explained by the independent variables of milk price, cookies and income and as the adjusted r square is also less than the original r square value so it indicates a good model too. [4]

4.1 RELATIONSHIP BETWEEN QUANTITY DEMAND AND PRICE OF MILK

In the below figure we found that the there are inverse relationship between price of milk and quantity demand. That indicates that if the price of milk increase by $0.87 then the quantity demand decrease by one unity. And the intercept term is 0.002 and coefficient is 0.87. The value of R square is 0.68 indicates that 68% dependent variable is explained by independent variable. As it is above 50% so, we can say that the data has been fitted goodly. [5]
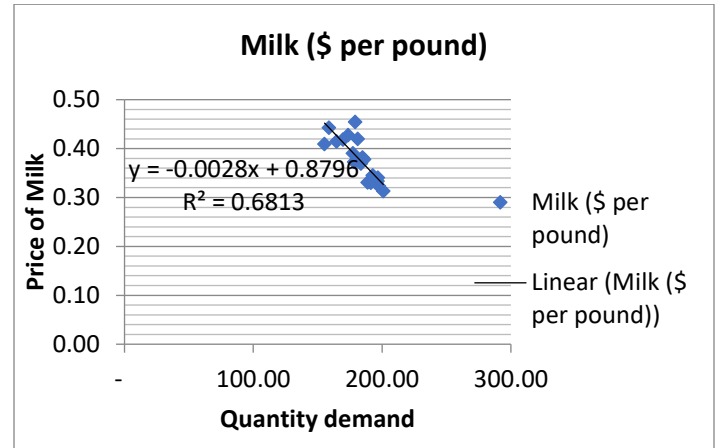

Figure 2: Relationship between quantity demand and price of milk per pound

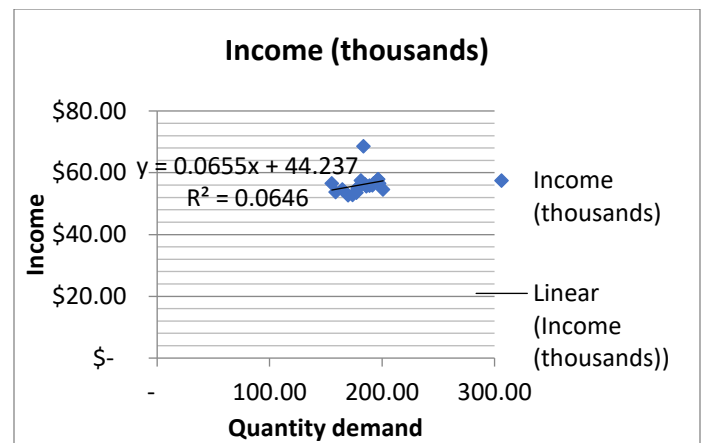### 4.2 RELATIONSHIP BETWEEN QUANTITY DEMAND AND INCOME

Figure 3: Relationship between quantity demand and Income of the people

In the figure 2, it is found that there is an upward trending linear relationship between quantity demand and income. As the regression coefficient is 44.23 so, it indicates that the quantity demand is increased by one unit by increasing $44 of the people. The value of r square is 0.064 indicates that the goodness of fit between income and quantity demand data is very week. There is not any strong evidence here to prove that there are close relationship between these two variables. [6]

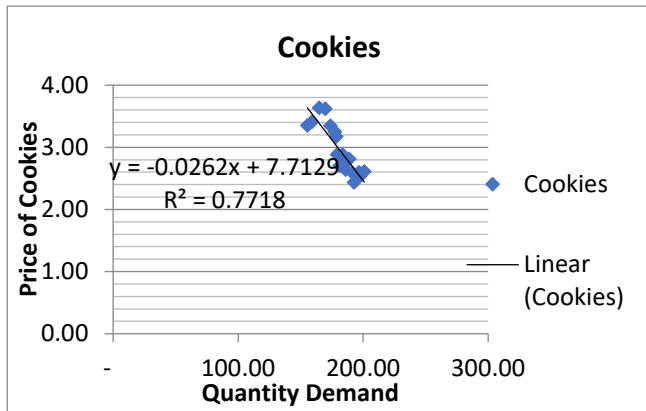## 4.3 RELATIONSHIP BETWEEN QUANTITY DEMAND AND PRICE OF COOKIES

Figure 4: Relationship between quantity demand and Cookies

In figure 3, we have shown the relationship between the price and quantity demand of cookies. We have found the downward slopping liner line of cookies which indicates that there is an inverse relationship between the price and the quantity demand of cookies. The coefficient of determination is 7.7 indicates that if the price of cookies decreases by 7.71 unit then the quantity demand increase by one unit. As the value of r square is 0.77 or 77% indicates that the above model is goodly fitted. [7]

4.4 ELASTICITY OF DEMAND

4.4.1 PRICE ELASTICITY

From the main quantity demand formula we were able to extrapolate necessary information to forecast a couple of quantities demanded based on pricing fluctuations of Good X (Milk).

306.67-(125*(px))-(20*(py))-(0.29*(m))

We chose 10 cents per pound of milk for the first forecast and 25 cents per pound of milk for the second one. Price of good Y held constant at $3 and income at $50,000. The quantities demanded resulted in 219 pounds of Milk per capita for 10 cents and 200 pounds of Milk per capita if price of milk was 25 cents per pound

of milk. From these results we can see that law of demand holds and arc elasticity of price in good X is -125. [8]

We deduce the price elasticity formula to be

-125* .10+.25/219.67+200.92

The result for price elasticity is absolute value 1.78. Since this is more than 1, we can assume the good to be price elastic as raising 10% price in Milk would result reduction of quantity demanded by 17%, greatly outweighing the benefit of the price increase.

4.4.2 CROSS-PRICE ELASTICITY

From the main quantity demanded formula we were able to extrapolate necessary information to forecast a couple of quantities demanded based on pricing fluctuations of Good Y (Cookies). [9]

306.67-{125*(px))-(20*(py))-(0.29*(m)}

We chose $2 per pound of cookies for the first forecast and $3 per pound of cookies for the second one. Price of good X becomes constant at 25cents and income at $50,000. The quantities demanded resulted in 220 pounds of Milk per capita for $2 and 200 pounds of Milk per capita if price of cookies per pound was $3 cents per pound of milk. From these results we can see that law of demand holds and arc elasticity of price in good Y is -20. [10]

We deduce the price elasticity formula to be

-20* 5/220.92+200.92

The result for price elasticity is -0.28. Since this is a negative number, we can assume the goods to be complements of each other as raising 10% price of Cookies per pound would result reduction of quantity demanded of Milk by 2.8%. In other words, they are considered to be complements because if prices of cookies are raised, customers will buy fewer cookies. In turn, they will buy less milk they usually used to consume along with said cookies. [11]

5. CONCLUSIONS

It is observed that the coefficient of Px is -125 means that for every 10 unit increase in price, quantity demanded will go down 1250 units. Law of demand holds. And the coefficient of Py is -20 means when there is a 10 unit increase in price, quantity demanded will go down 200 units. Law of demand holds. It is found in the above discussion that the P value of milk price, Cookies price and income is 0.006017634, 0.000381715 and 0.461540088 respectively. So, in case of milk price and cookies price we can reject the null hypothesis. We can say that there are significant relationship between quantity demand and price of milk and cookies. In case of the coefficient of income we can't reject the null hypothesis, because P value of income is 0.461540088. It has been shown that the value of R^2 is 0.866906075. This is indicating that 86.67% of the variation of dependent variable i.e. quantity demand has been explained by the independent variables. The result for price elasticity is absolute value 1.78. Since this is more than 1, we can assume the good to be price elastic as raising 10% price in Milk would result reduction of quantity demanded by 17%, greatly outweighing the benefit of the price increase.

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