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A PROGRAMMED EXERCISE IN ELASTICITY OF DEMAND

For the Bogor Workshop on Nutrition and Agriculture, Revised July, 1981

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Objectives ·

- 1 To understand the meaning of data on elasticity of demand with respect to income and price
- 2 To understand how elasticity figures can be used to help in the formulation of public policy relative to agriculture and nutrition

Note In these exercises we will assume we are working with deflated price data -- that is -- data with inflation removed. Thus income is assumed to be real income (not inflated from one year to the next because the general price level is rising)

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A INCOME ELASTICITY OF DEMAND

Definition

Income elasticity of demand, also called elasticity of demand with respect to income

$$E = \frac{\% \text{ change in consumption}}{\% \text{ change in income}} = \frac{\frac{Q_{D_2} - Q_{D_1}}{Q_{D_1}}}{\frac{\text{Income}_2 - \text{Income}_1}{\text{Income}_1}}$$

Calculation 1 Assume

Income in 1981 is 200

Income in 1982 is 220

Amount of rice purchased in 1981 ( $Q_{D_1}$ ) is 110 kg

Amount of rice purchased in 1982 ( $Q_{D_2}$ ) is 113 kg

What is the elasticity of demand for rice with respect to income?  
(Fill in the boxes and run the calculation on your calculator)

$$E = \frac{\frac{113 - 110}{110}}{\frac{220 - \boxed{\phantom{000}}}{200}} = \frac{\boxed{\phantom{000}}}{1} = 27$$

Calculation 2 Assume

Income in 1981 is 200

Income in 1982 is 220

Consumption (amount purchased) of beef in 1981 is 5 lbs

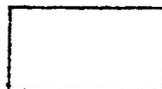
Consumption of beef in 1982 is 6 lbs

$$E = \frac{\frac{\boxed{\phantom{000}} - \boxed{\phantom{000}}}{\boxed{\phantom{000}}}}{\frac{\boxed{\phantom{000}} - \boxed{\phantom{000}}}{\boxed{\phantom{000}}}} = \frac{-\boxed{\phantom{000}}}{\boxed{\phantom{000}}} = \boxed{\phantom{000}}$$

Explanation

Note that in calculation 1 income increased by 10 percent and rice consumption increased by 27 percent. This is like saying that if income is increased by 1 percent then rice consumption will increase by 27 percent. This latter is the way income elasticity is commonly explained.

In calculation 2 you found a different elasticity. Given the assumptions of calculation 2, what percent would you expect beef consumption to increase when income increases by 1 percent?



B PRICE ELASTICITY OF DEMAND

Definition

Price elasticity of demand, also called elasticity of demand with respect to price, or own price elasticity of demand

$$E = \frac{\% \text{ change in consumption}}{\% \text{ change in price}} = \frac{\frac{Q_{D2} - Q_{D1}}{Q_{D1}}}{\frac{\text{Price}_2 - \text{Price}_1}{\text{Price}_1}}$$

Calculation 3 Assume

Price of flour in 1981 is 1000  
Price of flour in 1982 is 950  
Amount purchased in 1981 is 200 kg  
Amount purchased in 1982 is 205 kg

$$L = \frac{205 - \boxed{\phantom{000}}}{200} = \frac{\boxed{\phantom{000}}}{- .05} = \boxed{\phantom{000}}$$

950 - 1000

1000

Note that your resulting elasticity is negative. Price elasticity figures are normally negative. Some writers therefore ignore the sign and write elasticities as positive assuming that you realize they are, in fact, negative.

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Calculation 4      Assume

Price of pork in 1981 is 500  
Price of pork in 1982 is 525  
Quantity demanded (amount purchased) in 1981 is 150 g  
Quantity demanded in 1982 is 138 g

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$$E = \frac{\frac{\text{Quantity demanded in 1982} - \text{Quantity demanded in 1981}}{\text{Quantity demanded in 1981}}}{\frac{\text{Price of pork in 1982} - \text{Price of pork in 1981}}{\text{Price of pork in 1981}}} = \frac{\frac{138 - 150}{150}}{\frac{525 - 500}{500}} =$$

Did you remember to include the minus sign ?

Explanation

In calculation 3, price decreased by 5 percent and consumption increased by 2.5 percent. The resulting elasticity figure was thus - 5. What that

What that means is that if price changes by 1 percent we can expect consumption to change by half a percent. That is like saying that if price decreased by 10 percent, consumption would increase by 5 percent. Similarly it means if price decreases by 1 percent consumption increases by .5 percent. The elasticity of demand with respect to price for flour in this calculation is - .5.

Given the assumptions of calculation 4, what percent would you expect pork consumption to decrease if the price of pork rises by 1 percent?

What percent would you expect pork consumption to increase if the price of pork falls by 1 percent?

(That's right, it's the same )

C. DEVELOPMENT OF THE CONCEPT

Now suppose you are told that the price elasticity of demand for rice among high income consumers is - 2. You also know that high income households consume 130 kg of rice per capita per year. How much more rice will the high income household buy per person if the price of rice falls by 1 percent next year?

$$0.02 \times 130 = \text{_____} \text{ kg}$$

How much more if the price of rice falls by 10 percent instead of by 1 percent?

$$0.2 \times 130 = \text{_____} \text{ kg}$$

Suppose the price elasticity of demand among low income consumers is found to be - 4. And suppose low income consumers buy about 90 kg of rice per capita per year. How much more rice will the low income household buy per person if the price of rice falls by 1 percent next year?

\_\_\_\_\_ x 90 = \_\_\_\_\_ kg

How much more rice will the low income household buy per person if the price of rice falls by 10 percent next year?

\_\_\_\_\_ x \_\_\_\_\_ = \_\_\_\_\_ kg

Under the above assumptions, which household increased consumption more when the price of rice was reduced?

\_\_\_\_\_ The high income household \_\_\_\_\_ The low income household

Let's take oranges for our next example

<u>Assume</u>	<u>High Income Household</u>	<u>Low Income Household</u>
Present annual per capita consumption	50 kg	2 kg
Price elasticity of demand	3	1.5

Assume a 1 percent decline in the price of oranges. How much will per capita consumption of oranges increase?

High Income H H. \_\_\_\_\_ kg      Low Income H H \_\_\_\_\_ kg

Now assume a 10 percent decline in the price of oranges. How much will per capita consumption of oranges increase?

High Income H H \_\_\_\_\_ kg.      Low Income H H \_\_\_\_\_ kg

Under the above assumptions, which household increased consumption of oranges more when the price was reduced?

High Income H H \_\_\_\_\_ kg      Low Income H H \_\_\_\_\_ kg

Since in low income households the price elasticity of demand is higher for both rice and for oranges than it is in high income households, is it reasonable that low income households might increase consumption of rice more than high income households yet increase consumption of oranges less than high income households when the price of both products falls 10 percent?

\_\_\_\_\_ Yes      \_\_\_\_\_ No

Explain \_\_\_\_\_

D ELASTICITY CALCULATIONS FROM THE REAL WORLD

Oleh Boediono calculated income and price elasticity of demand figures for Indonesia. His calculations for food are shown in Table 1. Notice that if you disregard the sign, income and price elasticity figures for a particular commodity tend to be close. Using the Boediono calculations and ignoring the signs, which food commodities have relatively inelastic demands (say between 0 and 75) ?

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A one percent change in the price of these commodities will result in considerably less than a one percent change in consumption of these commodities. Similarly, a one percent change in income will result in considerably less than a one percent change in consumption of these commodities.

Which commodities on the list have elasticities close to one, (say between 75 and 125) ?

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For these commodities, a one percent change in price or income yields approximately a one percent change in consumption.

Now list the commodities which have relatively elastic demand (say above 125)

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For these commodities, a one percent change in price or income results in a significantly greater than one percent change in consumption.

Table 1 Income and price elasticities for selected foods, Indonesia

<u>Commodity</u>	<u>Income Elasticity</u>	<u>Direct Price Elasticity</u>
Corn and Cassava	3	- 26
Vegetables and fruits	1 2	- 97
Coconut	1 1	- 88
Tea and coffee	1 1	- 90
Spices	3	- 25
Livestock and L S Products	2 2	-1 73
Fish	1 3	-1 04
Rice	7	- 63
Sugar	1 4	-1 15
Prepared food	1 2	-1 01
Drinks	2 1	-1 71

Source Oleh Boediono, "Elastisitas Permintaan untuk Berbagai Barang di Indonesia, Penerapan Metode Frisch," Ekonomi dan Keuangan Indonesia, Vol XXVI, No 3, September, 1978, p 362



Table 2 Price Elasticity of Demand by Income Strata, Cali, Colombia, 1969-70

<u>Commodity</u>	<u>Low Income</u>			<u>High Income</u>		<u>Average</u>
	I	II	III	IV	V	
Rice	- 43	- 40	- 40	- 26	- 18	- 35
Milk	- 1 79	- 1 62	- 1 12	- 64	- 20	- 77
Peas	- 1 13	- 1 13	- 76	- 59	- 52	- 70
Oranges	- 1 39	- 96	- 79	- 64	- 29	- 69
Bread and Pastery	- 65	- 56	- 32	- 24	- 00	- 31

Source Pinstrup-Anderson, Per, et al , "The Impact of Increasing Food Supply on Human Nutrition Implications for Commodity Priorities in Agricultural Research and Policy," American Journal of Agricultural Economics, May, 1976, p 137

Table 3 --Percent of a 10 Percent Expansion in Quantity Supplied  
Expected to be Consumed by Poorest Fifth of the  
Population (the calorie deficient strata) Cali,  
Colombia, 1969-70

<u>Commodity</u>	<u>Percent of increase consumed by</u>	
	Poorest fifth of the population (the calorie deficient strata)	The top four fifths of the population (This consumption increase is wasted)
<u>Starchy root crops</u>		
Cassava	30.4	<u>69.6</u>
Potatoes	27.5	<u>72.5</u>
<u>Cereals</u>		
Rice	20.2	_____
Maize	27.8	_____
Bread and Pastry	25.0	_____
<u>Livestock Products</u>		
Beef	12.1	_____
Pork	11.1	_____
Eggs	12.5	_____
Milk	12.0	_____
<u>Fresh Fruits and Vegetables</u>		
Oranges	12.4	_____
Peas	8.0	_____

Source Pinstруп-Anderson, et al, op cit, p 138



F POLICY IMPLICATIONS OF THE EXERCISES ON  
NUTRITION ECONOMICS AND  
DEMAND ELASTICITY

On the basis of the calculations you made in the nutrition economics exercise (cost of calories, protein in various foods) and taking into account what you have learned about demand elasticity (including the percent of an increase in production likely to be consumed by a particular income group)

1 What commodities should you push if you are trying to increase calorie consumption among your lowest income group?

\_\_\_\_\_

Why? \_\_\_\_\_

2 What commodities should you push if you are trying to increase consumption of protein among your lowest income group?

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Why? \_\_\_\_\_

3 What commodities should you push if you are trying to increase both calorie and protein consumption among your lowest income group?

\_\_\_\_\_

Why? \_\_\_\_\_

Assuming that it costs no more to increase livestock production by 10 percent than it does to increase rice production by 10 percent, which should you push if your goal is to increase farm income?

\_\_\_\_\_ Livestock

\_\_\_\_\_ Rice

Why? \_\_\_\_\_

What sorts of policy conflicts can you now tie to differential elasticities of demand?

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