This handout will begin by first giving a short review of material we covered in lecture dealing with the Income Elasticity of Demand (IED) and Cross-Price Elasticity of Demand (C-PED). Then we will take a look at two examples where were taken from old midterms. First will be the questions and after that will be a solution to the problems. I would advise you to first try to work out the examples before you check the answers.

1. Review of IED and C-PED

Income Elasticity of Demand (IED)

**Income Elasticity of Demand** gives information regarding how quantity demanded for a good responds to a change in income (income is the only factor changing in this case, we assume the price of the good does not change).

\[
\text{Income Elasticity of Demand} = \frac{\text{Percentage Change in Quantity Demanded}}{\text{Percentage Change in Income}} = \frac{\%\Delta Q_D}{\%\Delta M}
\]

To calculate IED we need information regarding income and quantity demanded. Specifically, we need two different income levels and the quantity demanded of the good for each income level. In order to calculate IED we need two points, \( (Q_{D_1}, M_1) \) and \( (Q_{D_2}, M_2) \).

In order to calculate the IED we use the midpoint formula

\[
\text{IED} = \frac{Q_{D_2} - Q_{D_1}}{Q_{D_1} + Q_{D_2}} \times \frac{M_2 - M_1}{2} \times \frac{M_1 + M_2}{2}
\]

Once we have calculated the IED between two points, we can then think about the types of goods we have as follows.

- The goods are "Normal Goods" if IED > 0
- The goods are "Inferior Goods" if IED < 0
Cross-Price Elasticity of Demand (C-PED)

Cross-Price Elasticity of Demand gives information regarding how quantity demanded for a good responds to a change in price of another good (price of the other good is the only factor changing in this case).

\[ C\text{-PED} = \frac{\text{Percentage Change in Quantity Demanded of Good A}}{\text{Percentage Change in Price of Good B}} = \frac{\%\Delta Q^A_D}{\%\Delta P^B} \]

To calculate C-PED we need information regarding quantity demanded of a good and the price of another good. Specifically, we need two different prices of a good and the quantity demanded of another good for each price.

In order to calculate C-PED we need two points, \((Q^A_{D1}, P^B_1)\) and \((Q^A_{D2}, P^B_2)\).

In order to calculate the C-PED we use the midpoint formula

\[
C\text{-PED} = \frac{\frac{Q^A_{D2} - Q^A_{D1}}{Q^A_{D1} + Q^A_{D2}}}{\frac{P^B_2 - P^B_1}{P^B_1 + P^B_2}}
\]

Once we have calculated the C-PED between two points, we can then think about the relationship between the goods we have as follows.

- The goods are "Substitutes" if IED > 0
- The goods are "Complements" if IED < 0
2. Examples of IED and C-PED

When calculating different elasticities it is very important to keep in mind, what information you need to calculate a certain elasticity and what information you have available. Also, sometimes there is information that is not relevant to certain elasticities. Be sure you are aware of what information is necessary and what information is not. The following examples emphasize this point. The answers to these example problems are at the end of this handout.

Example #1

You are told that if Coke costs $1 per can, 300 cans of Dr. Rocket are demanded and if Coke costs $0.50 per can, 100 cans of Dr. Rocket are demanded. When Dr. Rocket costs $0.50 per can 250 cans are demanded, and when Dr. Rocket costs $1.00 per can, 100 cans are demanded. When average income is $50,000, 600 cans of coke are demanded (given a certain price) and 275 cans of Dr. Rocket are demanded; when average income is $40,000, 450 cans of coke are demanded and 350 cans of Dr. Rocket are demanded.

- Can the Price-Elasticity of Demand be calculated for either good?
- If so, calculate the PED.
- What is the cross-price elasticity of Coke and Dr. Rocket?
- Given this information, how are Coke and Dr. Rocket related (substitutes or complements)?
- For which goods can we calculate the income elasticity of demand?
- Calculate the income elasticity of demand for this (these) good(s).
- Is this good normal or inferior?

Example #2

When average income is $50,000, 400 containers of peanut butter are sold and 250 jars of jelly are sold; when average income is $60,000, 500 containers of peanut butter are sold and 350 jars of jelly are sold. When jelly costs $3 a jar, 300 jars of jelly are sold and 350 containers of peanut butter are sold; when jelly costs $2 a jar, 400 jars of jelly are sold and 425 containers of peanut butter are sold.

- Can the Price-Elasticity of Demand be calculated for either good?
- If so, calculate the PED.
- What is the cross-price elasticity of peanut butter and jelly?
- Given this information, how are peanut butter and jelly related (substitutes or complements)?
- For which goods can we calculate the income elasticity of demand?
- Calculate the income elasticity of demand for this (these) good(s).
- Is this good normal or inferior?
Solution to Example #1

Can the Price-Elasticity of Demand be calculated for either good?

In order to calculate PED we need two (quantity, price) pairs for one good (two points along a certain goods demand curve). We are given this information for Dr. Rocket (the second sentence). We are never given this information for Coke.

We have two (quantity, price) pairs for Dr. Rocket. Specifically, \((Q_{D1}, P_1) = (250, $0.50)\) and \((Q_{D2}, P_2) = (100, $1)\). Then, plugging these numbers into the above formula, we obtain:

\[
PED = \frac{\frac{Q_{D2} - Q_{D1}}{Q_{D1} + Q_{D2}}}{\frac{P_2 - P_1}{P_1 + P_2}} = \frac{\frac{100 - 250}{250 + 100}}{\frac{1 - 0.50}{0.50 + 1}} = \frac{-150}{350} \cdot \frac{2}{2} = \frac{-150}{175} = -\frac{150}{175} \cdot \frac{0.75}{0.50} = -\frac{9}{7}
\]

Given this data, the PED is \(-\frac{9}{7}\).

**NOTE:** This tells us that given these two points, this demand curve for Dr. Rocket is *elastic*. We know this because the PED is less than -1.

What is the cross-price elasticity of Coke and Dr. Rocket?

To determine this we need two different prices for one good and the corresponding quantity demanded for the other good, given these prices. We have two different prices for Coke, and the quantity demanded for Dr. Rocket given these prices (the first sentence).

We have, \((Q_{D1}^A, P_1^B) = (300, $1)\), with Dr. Rocket being good A and Coke being good B, and \((Q_{D2}^A, P_2^B) = (100, $0.50)\). With this information we can fill out the formula:

\[
C-PED = \frac{\frac{Q_{D2}^A - Q_{D1}^A}{Q_{D1}^A + Q_{D2}^A}}{\frac{P_2^B - P_1^B}{P_1^B + P_2^B}} = \frac{\frac{100 - 300}{300 + 100}}{\frac{0.50 - 0.50}{0.50 + 1}} = \frac{-200}{-400} \cdot \frac{2}{2} = \frac{-200}{200} \cdot \frac{0.75}{0.50} = \frac{3}{2}
\]

Given this data, the C-PED is \(\frac{3}{2}\).
Given this information, how are Coke and Dr. Rocket related (substitutes or complements)?

We know that Coke and Dr. Rocket are substitute goods. Since the C-PED is positive, this tells us that as the price of one good increases, the quantity demanded of the other good increases. This is consistent with substitutes (if a good becomes more expensive, a consumer will substitute with the other good (purchase more of the other good)).

For which goods can we calculate the income elasticity of demand?

For IED we need two different income levels and the quantity demanded of the good for each income level. We have this information for both Coke and Dr. Rocket (the last two sentences).

Calculate the income elasticity of demand for this (these) good(s).

Lets first do Coke, thus we have \((Q_{D1}, M_1) = (600, $50,000)\) and \((Q_{D2}, M_2) = (450, $40,000)\). Plugging these figures into the IED formula:

\[
IED = \frac{\frac{Q_{D2} - Q_{D1}}{Q_{D1} + Q_{D2}}}{\frac{M_2 - M_1}{M_1 + M_2}} = \frac{\frac{450 - 600}{600 + 450}}{\frac{40,000 - 50,000}{50,000 + 40,000}} = \frac{\frac{-150}{1050}}{\frac{-10,000}{90,000}} = \frac{-150}{-525} = \frac{525}{9} \times \frac{45}{10} = \frac{9}{7}
\]

Thus, the IED of Coke is \(\frac{9}{7}\).

Now lets do Dr. Rocket. For Dr. Rocket, we have \((Q_{D1}, M_1) = (275, $50,000)\) and \((Q_{D2}, M_1) = (350, $40,000)\). Plugging these figures into the IED formula:

\[
IED = \frac{\frac{Q_{D2} - Q_{D1}}{Q_{D1} + Q_{D2}}}{\frac{M_2 - M_1}{M_1 + M_2}} = \frac{\frac{350 - 275}{275 + 350}}{\frac{40,000 - 50,000}{50,000 + 40,000}} = \frac{\frac{75}{625}}{\frac{-10,000}{90,000}} = \frac{75}{312.5} \times \frac{45}{10} = \frac{27}{25}
\]

Thus, the IED of Dr. Rocket is \(-\frac{27}{25}\).
Is this good normal or inferior?

Since the IED for Coke is positive, we know Coke is a \textbf{normal good} (income and quantity demanded are positively related).

Since IED for Dr. Rocket is negative, we know that Dr. Rocket is an \textbf{inferior good} (income and quantity demanded are negatively related).
Solution to Example #2

Can the Price-Elasticity of Demand be calculated for either good?

In order to calculate PED we need two (quantity, price) pairs for one good (two points along a certain goods demand curve). We are given this information for jelly (the last sentence). We are never given this information for peanut butter.

We have two (quantity, price) pairs for Jelly. Specifically, \((Q_{D_1}, P_1) = (300, \$3)\) and \((Q_{D_2}, P_2) = (400, \$2)\). Then, plugging these numbers into the above formula, we obtain:

\[
PED = \frac{Q_{D_2} - Q_{D_1}}{Q_{D_1} + Q_{D_2}} \cdot \frac{P_2 - P_1}{P_1 + P_2} = \frac{400 - 300}{300 + 400} \cdot \frac{\$2 - \$3}{\$3 + \$2} = \frac{100}{700} \cdot \frac{-\$1}{\$5} = \frac{100 \times -2.5}{350} = -\frac{5}{7}.
\]

Given this data, the PED is \(-\frac{5}{7}\).

**NOTE:** This tells us that given these two points, this demand curve for Jelly is *inelastic*. We know this because the PED is between 0 and -1.

What is the cross-price elasticity of Peanut Butter and Jelly?

To determine this we need two different prices for one good and the corresponding quantity demanded for the other good, given these prices. We have two different prices for jelly, and the quantity demanded for peanut butter given these prices (the last sentence).

We have, \((Q^A_{D_1}, P^B_1) = (350, \$3)\), with peanut butter being good A and jelly being good B, and \((Q^A_{D_1}, P^B_1) = (425, \$2)\). With this information we can fill out the formula:

\[
C-PED = \frac{Q^A_{D_2} - Q^A_{D_1}}{Q^A_{D_1} + Q^A_{D_2}} \cdot \frac{P^B_2 - P^B_1}{P^B_1 + P^B_2} = \frac{425 - 350}{350 + 425} \cdot \frac{\$2 - \$3}{\$3 + \$2} = \frac{75}{775} \cdot \frac{-\$1}{\$5} = \frac{75 \times -2.5}{387.5} = -\frac{15}{31}.
\]

Given this data, the C-PED is \(-\frac{15}{31}\).
Given this information, how are peanut butter and jelly related (substitutes or complements)?

We know that peanut butter and jelly are complement goods. Since the C-PED is negative, this tells us that as the price of one good increases, the quantity demanded of the other good decreases. This is consistent with complements (if a good becomes more expensive, a consumer will consume less of that good and the complement good).

For which goods can we calculate the income elasticity of demand?

For IED we need two different income levels and the quantity demanded of the good for each income level. We have this information for both peanut butter and jelly (the first sentence).

Calculate the income elasticity of demand for this (these) good(s).

Let's first do peanut butter. For peanut butter, we have \((Q_{D_1}, M_1) = (400, $50,000)\) and \((Q_{D_2}, M_2) = (500, $60,000)\). Plugging these figures into the IED formula:

\[
IED = \frac{Q_{D_2} - Q_{D_1}}{Q_{D_1} + Q_{D_2}} \cdot \frac{M_2 - M_1}{M_1 + M_2} = \frac{100}{900} \cdot \frac{100}{450} = \frac{100 \times 55}{450 \times 10} = \frac{11}{9}
\]

Thus, the IED of Peanut Butter is \(\frac{11}{9}\).

Now let's do jelly. For jelly, we have \((Q_{D_1}, M_1) = (250, $50,000)\) and \((Q_{D_2}, M_2) = (350, $60,000)\). Plugging these figures into the IED formula:

\[
IED = \frac{Q_{D_2} - Q_{D_1}}{Q_{D_1} + Q_{D_2}} \cdot \frac{M_2 - M_1}{M_1 + M_2} = \frac{100}{600} \cdot \frac{100}{300} = \frac{100 \times 55}{300 \times 10} = \frac{11}{6}
\]

Thus, the IED of Jelly is \(\frac{11}{6}\).
Is this good normal or inferior?

Since the IEDs for both peanut butter and jelly are positive, we know that peanut butter and jelly are both normal goods (income and quantity demanded are positively related).