Chapter 4

Individual and Market Demand
Topics to be Discussed

- Individual Demand
- Income and Substitution Effects
- Market Demand
- Consumer Surplus
- Network Externalities
- Empirical Estimation of Demand
Effect of a Price Change

Assume:
- $I = $20
- $P_C = $2
- $P_F = $2, $1, $0.50

Each price leads to different amounts of food purchased.
Effect of a Price Change

The Price-Consumption Curve traces out the utility maximizing market basket for each price of food.
Effect of a Price Change

- By changing prices and showing what the consumer will purchase, we can create a demand schedule and demand curve for the individual.

- From the previous example:

<table>
<thead>
<tr>
<th>Demand Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
</tr>
<tr>
<td>$2.00</td>
</tr>
<tr>
<td>$1.00</td>
</tr>
<tr>
<td>$0.50</td>
</tr>
</tbody>
</table>
Effect of a Price Change

<table>
<thead>
<tr>
<th>Price of Food</th>
<th>Demand Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.00</td>
<td>E: $P_f/P_c = 2/2 = 1 = MRS</td>
</tr>
<tr>
<td>$1.00</td>
<td>G: $P_f/P_c = 1/2 = .5 = MRS</td>
</tr>
<tr>
<td>$0.50</td>
<td>H: $P_f/P_c = .5/2 = .25 = MRS</td>
</tr>
</tbody>
</table>

When the price falls, $P_f/P_c$ & MRS also fall.
Substitutes & Complements

- Two goods are considered substitutes if an increase (decrease) in the price of one leads to an increase (decrease) in the quantity demanded of the other.
- Two goods are considered complements if an increase (decrease) in the price of one leads to a decrease (increase) in the quantity demanded of the other.
Substitutes & Complements

- If the price consumption curve is downward-sloping, the two goods are considered substitutes.
- If the price consumption curve is upward-sloping, the two goods are considered complements.
- They could be both.
Individual Demand

- Income Changes
  - Using the figures developed in the previous chapter, the impact of a change in the income can be illustrated using indifference curves
  - Changing income, with prices fixed, causes consumers to change their market baskets
Effects of Income Changes

Assume: $P_f = $1, $P_c = $2
$I = $10, $20, $30

An increase in income, with the prices fixed, causes consumers to alter their choice of market basket.
Effects of Income Changes

The Income Consumption Curve traces out the utility maximizing market basket for each income level

Income Consumption Curve
An increase in income, from $10 to $20 to $30, with the prices fixed, shifts the consumer’s demand curve to the right as well.
An Inferior Good

...but hamburger becomes an inferior good when the income consumption curve bends backward between B and C.

Both hamburger and steak behave as a normal good, between A and B...
Individual Demand

- Engel Curves
  - Engel curves relate the quantity of good consumed to income
  - If the good is a normal good, the Engel curve is upward sloping
  - If the good is an inferior good, the Engel curve is downward sloping
Engel Curves

Engel curves slope upward for normal goods.
Engel curves are backward bending for inferior goods.
### Annual US Household Consumer Expenditures

<table>
<thead>
<tr>
<th>Expenditures (S) on:</th>
<th>Income Group (2000 $)</th>
<th>Less than $10,000</th>
<th>10,000–19,999</th>
<th>20,000–29,999</th>
<th>30,000–39,999</th>
<th>40,000–49,999</th>
<th>50,000–69,999</th>
<th>70,000 and above</th>
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</thead>
<tbody>
<tr>
<td>Entertainment</td>
<td></td>
<td>763</td>
<td>957</td>
<td>1399</td>
<td>1658</td>
<td>1982</td>
<td>2507</td>
<td>3912</td>
</tr>
<tr>
<td>Owned Dwelling</td>
<td></td>
<td>1228</td>
<td>1961</td>
<td>2466</td>
<td>3735</td>
<td>4466</td>
<td>6121</td>
<td>10,619</td>
</tr>
<tr>
<td>Rented Dwelling</td>
<td></td>
<td>1945</td>
<td>2208</td>
<td>2475</td>
<td>2530</td>
<td>2567</td>
<td>1742</td>
<td>1381</td>
</tr>
<tr>
<td>Health Care</td>
<td></td>
<td>1248</td>
<td>1943</td>
<td>2018</td>
<td>1977</td>
<td>2173</td>
<td>2320</td>
<td>2882</td>
</tr>
<tr>
<td>Food</td>
<td></td>
<td>2517</td>
<td>3328</td>
<td>4507</td>
<td>5118</td>
<td>6228</td>
<td>6557</td>
<td>8665</td>
</tr>
<tr>
<td>Clothing</td>
<td></td>
<td>868</td>
<td>978</td>
<td>1391</td>
<td>1686</td>
<td>1986</td>
<td>2359</td>
<td>4004</td>
</tr>
</tbody>
</table>

Income and Substitution Effects

- A change in the price of a good has two effects:
  - Substitution Effect
  - Income Effect
Income and Substitution Effects

- Substitution Effect
  - Consumers will tend to buy more of the good that has become relatively cheaper, and less of the good that is relatively more expensive.
  - The substitution effect is the change in an item’s consumption associated with a change in the price of the item, with the level of utility held constant.
  - When the price of an item declines, the substitution effect always leads to an increase in the quantity demanded of the good.
Income and Substitution Effects

- Income Effect
  - Consumers experience an increase in real purchasing power when the price of one good falls.
  - The income effect is the change in an item’s consumption brought about by the increase in purchasing power, with the price of the item held constant.
  - When a person’s income increases, the quantity demanded for the product may increase or decrease.
Income and Substitution Effects: Normal Good

When the price of food falls, consumption increases by $F_1F_2$ as the consumer moves from A to B.

The substitution effect, $F_1E$, (from point A to D), changes the relative prices but keeps real income (satisfaction) constant.

The income effect, $EF_2$, (from D to B) keeps relative prices constant but increases purchasing power.

The income effect, $EF_2$, (from point A to D), changes the relative prices but keeps real income (satisfaction) constant.
Since food is an inferior good, the income effect is negative. However, the substitution effect is larger than the income effect.
Income and Substitution Effects

- A Special Case: The Giffen Good
  - The income effect may theoretically be large enough to cause the demand curve for a good to slope upward
  - This rarely occurs and is of little practical interest
Market Demand

Market Demand Curves

- A curve that relates the quantity of a good that all consumers in a market buy to the price of that good
- The sum of all the individual demand curves in the market
Determining the Market Demand Curve

<table>
<thead>
<tr>
<th>Price</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Market Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>10</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>8</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>6</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>
The market demand curve is obtained by summing the consumer’s demand curves.
Market Demand

- Aggregation is important to be able to discuss regarding demand for different groups
  - Households with children
  - Consumers aged 20 – 30, etc.
**Market Demand**

- **Price Elasticity of Demand**
  - Measures the percentage change in the quantity demanded resulting from a percent change in price

\[
E_P = \frac{\%\Delta Q}{\%\Delta P} = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}
\]
Price Elasticity of Demand

- Inelastic Demand
  - $E_p$ is less than 1 in absolute value
  - Quantity demanded is relatively unresponsive to a change in price
  - $|\% \Delta Q| < |\% \Delta P|$
  - Total expenditure ($P \times Q$) increases when price increases
Price Elasticity of Demand

- Elastic Demand
  - $E_p$ is greater than 1 in absolute value
  - Quantity demanded is relatively responsive to a change in price
  - $|\%\Delta Q| > |\%\Delta P|$
  - Total expenditure ($P \times Q$) decreases when price increases
Price Elasticity of Demand

- Isoelastic Demand
  - When price elasticity of demand is constant along the entire demand curve
  - Demand curve is bowed inward (not linear)
The Aggregate Demand for Wheat

- The demand for US wheat is comprised of two components: domestic demand and export demand.

- The domestic demand for wheat is given by the equation:
  \[ Q_{DD} = 1465 - 88P \]

- The export demand for wheat is given by the equation:
  \[ Q_{DE} = 1344 - 138P \]
The Aggregate Demand for Wheat

- Domestic demand is relatively price inelastic ($E_d = -0.2$)
- Export demand is more price elastic ($E_d = -0.4$)
  - Poorer countries that import US wheat turn to other grains and food if wheat prices increase
The Aggregate Demand for Wheat

Total world demand is the horizontal sum of the domestic demand AB and export demand CD.

Above C, export demand is zero, so domestic demand = total demand = AE segment.
Consumer Surplus

- Consumers buy goods because it makes them better off
- Consumer Surplus measures how much better off they are
Consumer Surplus

- **Consumer Surplus**
  - Consumers buy goods because it makes them better off
  - The difference between the maximum amount a consumer is willing to pay for a good and the amount actually paid
  - Can calculate consumer surplus from the demand curve
Consumer Surplus - Example

- Student wants to buy concert tickets
- Demand curve tells us willingness to pay for each concert ticket
  - 1\textsuperscript{st} ticket worth $20 but price is $14 so student generates $6 worth of surplus
  - Can measure this for each ticket
  - Total surplus is addition of surplus for each ticket purchased
Consumer Surplus

**Consumer Surplus for the Market Demand**

\[ CS = \frac{1}{2} (\$20 - \$14) \times (1600) = \$19,500 \]

**Graphical Representation**

- **Price ($ per ticket)**: 20, 19, 18, 17, 16, 15, 14
- **Market Price**: 14
- **Demand Curve**
- **Actual Expenditure**
- **Consumer Surplus**

**Equation**

\[ \text{CS} = \frac{1}{2} (\$20 - \$14) \times (1600) \]

\[ \text{CS} = \$19,500 \]
Applying Consumer Surplus

- Combining consumer surplus with the aggregate profits that producers obtain, we can evaluate:
  1. Costs and benefits of different market structures
  2. Public policies that alter the behavior of consumers and firms
- Total benefits would be compared to total costs to determine if the clean up was worthwhile
Applying Consumer Surplus – An Example

The Value of Clean Air

- Air is free in the sense that we don’t pay to breathe it
- The Clean Air Act was amended in 1970
- Question: Were the benefits of cleaning up the air worth the costs?
The Value of Clean Air

- Empirical data determined estimates for the demand for clean air
- No market exists for clean air, but can see people are willing to pay for it
  - Ex: People pay more to buy houses where the air is clean
The shaded area represents the consumer surplus generated when air pollution is reduced by 5 parts per 100 million of nitrous oxide at a cost of $1000 per part reduced.
Network Externalities

- Up to this point we have assumed that people’s demands for a good are independent of one another.
- For some goods, one person’s demand also depends on the demands of other people.
- If this is the case, a network externality exists.
Network Externalities

- A *positive network externality* exists if the quantity of a good demanded by a consumer increases in response to an increase in purchases by other consumers.

- *Negative network externalities* are just the opposite.
Network Externalities

- The Bandwagon Effect
  - This is the desire to be in style, to have a good because almost everyone else has it, or to indulge in a fad
  - This is the major objective of marketing and advertising campaigns (e.g. toys, clothing)
  - Positive network externality in which a consumer wishes to possess a good in part because others do
Positive Network Externality: Bandwagon Effect

When consumers believe more people have purchased the product, the demand curve shifts further to the right.
Positive Network Externality: Bandwagon Effect

But as more people buy the good, it becomes stylish to own it and the quantity demanded increases further.

<table>
<thead>
<tr>
<th>Price ($ per unit)</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>$30</td>
<td>$20</td>
</tr>
</tbody>
</table>

- Pure Price Effect
- Bandwagon Effect

Quantity (thousands per month)
Network Externalities

- The Snob Effect
  - If the network externality is negative, a snob effect exists
- The snob effect refers to the desire to own exclusive or unique goods
- The quantity demanded of a “snob” good is higher the fewer the people who own it
Network Externality: Snob Effect

The demand is less elastic and as a snob good its value is greatly reduced if more people own it. Sales decrease as a result. Examples: Rolex watches and long lines at the ski lift.
Empirical Estimation of Demand

- The most direct way to obtain information about demand is through interviews where consumers are asked how much of a product they would be willing to buy at a given price.

- Problem
  - Consumers may lack information or interest, or be misled by the interviewer.
Empirical Estimation of Demand

The Statistical Approach to Demand Estimation

- Properly applied, the statistical approach to demand estimation can enable one to sort out the effects of variables on the quantity demanded of a product
- “Least-squares” regression is one approach
# Demand Data for Raspberries

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity (Q)</th>
<th>Price (P)</th>
<th>Income (I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>4</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>1996</td>
<td>7</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>1997</td>
<td>8</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>1998</td>
<td>13</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>1999</td>
<td>16</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>2000</td>
<td>15</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>2001</td>
<td>19</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>2002</td>
<td>20</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>2003</td>
<td>22</td>
<td>5</td>
<td>20</td>
</tr>
</tbody>
</table>
Estimating Demand

\[ D \text{ represents demand if only } P \text{ determines demand and then from the data: } Q = 28.2 - 1.00P \]
Empirical Estimation of Demand

Complements and Substitutes

$$\log(Q) = a - b \log(P) + b_2 \log(P_2) + c \log(I)$$

- Substitutes: $b_2$ is positive
- Complements: $b_2$ is negative
The Demand for Ready-to-Eat Cereal

Are Grape Nuts and Spoon Size Shredded Wheat good substitutes?

Estimated demand for Grape Nuts (GN):

\[ \log(Q_{GN}) = 1.998 - 2.085 \log(P_{GN}) + 0.62 \log(I) + 0.14 \log(P_{SW}) \]

Price elasticity = -2.0
Income elasticity = 0.62
Cross elasticity = 0.14