Microeconomics

- Utility

How Do Consumers Make Choices?

- How do you make the best choice in conditions of scarcity?
  - In other words, how do you get the “biggest bang for your buck?”
- Consider questions like:
  - Why do people purchase more of something when its price falls?
  - Why do people buy more goods and services when their budget increases?

Learning Objectives

- By the end of this section, you will be able to:
- Explain marginal utility and the significance of diminishing marginal utility
- Calculate marginal and total utility
- Propose decisions that maximize utility

Rationality and Self-Interest

- Assumption of Rationality: also called the theory of rational behavior, it is the assumption that people will make choices in their own self-interest.
- The assumption of rationality—also called the theory of rational behavior—is primarily a simplification that economists make in order to create a useful model of human decision-making.
- The assumption that individuals are purely self-interested doesn't imply that individuals are greedy and selfish. People clearly derive satisfaction from helping others, so "self-interest" can also include pursuing things that benefit other people.

Rationality in Action

Rationality in Action

Rationality suggests that consumers will act to maximize self-interest and businesses will act to maximize profits. Both are taking into account the benefits of a choice, given the costs.

Rationality and Consumers

- When a consumer is thinking about buying a product, what does he or she want? The theory of rational behavior would say that the consumer wants to maximize benefit and minimize cost.
- As the cost of the product increases, it becomes less likely that the consumer will decide that the benefits of the purchase outweigh the costs.

Rationality in Action (cont.)

Rationality and Students Example

- How do students decide on a major?
- A number of things may factor a student's decision on a major, such as what type of career a student is interested in, the reputation of specific departments at the university a student is attending, and the student's preferences for specific fields of study.
- You discover that Business Analytics majors earn significantly higher salaries. This discovery increases the benefits in your mind of the Analytics major, and you decide to choose that major.

Rationality and Businesses

- Businesses also have predictable behavior, but rather than seeking to maximize happiness or pleasure, they seek to maximize profits.
- When economists assume that businesses have a goal of maximizing profits, they can make predictions about how companies will react to changing business conditions.
- For example: If a company stands to earn more profit by moving some jobs overseas, then that's the result that economists would predict.

Consumer Choice and Utility

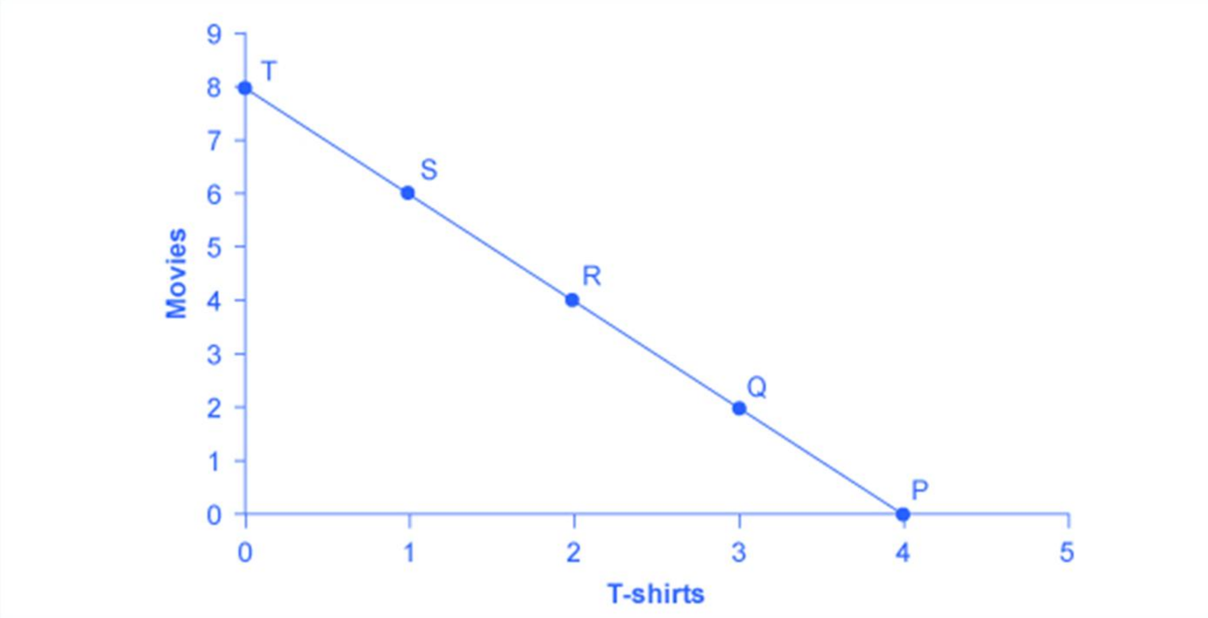
- Consumer choice: the combination of goods and services a consumer purchases
- Economists look at what consumers can afford with a budget constraint (or budget line), and the total utility or satisfaction derived from those choices

Table 1. Algerian. Consumption Choices

Average Household Income before Taxes	65000
Average Annual Expenditures	60000
Food at home	12000
Food away from home	5000
Housing	15000
Apparel and services	3000
Transportation	8000
Healthcare	4000
Entertainment	2500
Education	3500
Personal insurance and pensions	5000
All else: tobacco, reDZDing, personal care, cash contributions, miscellaneous	2000

Consumer Choice and the Budget Constraint

- Imagine that Ahmed likes to collect T-shirts and watch movies
  - the quantity of T-shirts is shown on the horizontal axis
  - the quantity of movies is on the vertical axis
- The specific choices along the budget constraint line show the combinations of affordable T-shirts and movies



Utility

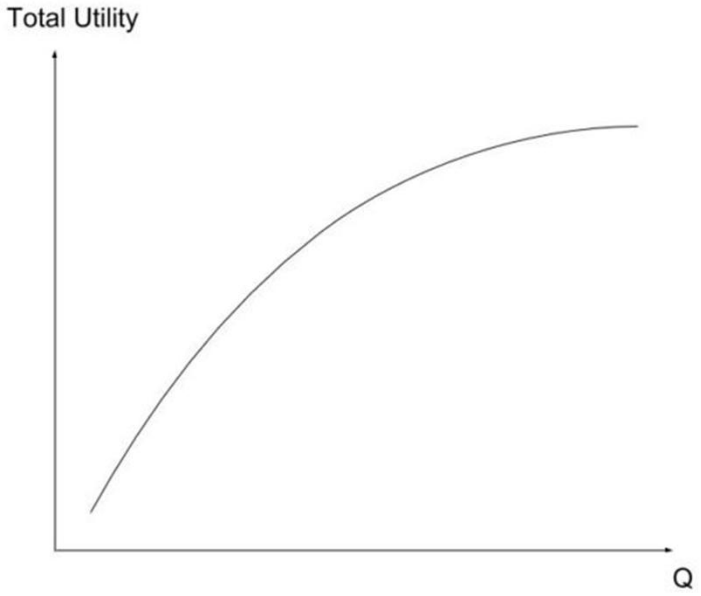
Table 2. Total Utility

T-Shirts (Quantity)	Total Utility	Movies (Quantity)	Total Utility
1	22	1	16
2	43	2	31
3	63	3	45
4	81	4	58
5	97	5	70
6	111	6	81
7	123	7	91
8	133	8	100

- Utility: the satisfaction or happiness a person gets from consuming a good or service
  - Ahmed obtains utility from consuming T-shirts and consuming movies
- The second column shows the total utility, or total amount of satisfaction

Total Utility

- This is a typical total utility curve showing an increase in total utility as consumption of a good increases, though at a decreasing rate
- Total utility follows the expected pattern: it increases as the number of movies that Ahmed watches rises
- Calculate total utility by multiplying the utility of each good by the number of goods, then DZDding that together.
  - Three T-shirts are worth 63 utils. Two movies are worth 31 utils.
  - Total utility of 94 (63 + 31).



Marginal Utility versus Total Utility

- A choice at the margin is a decision to do a little more or a little less of something
- Marginal utility is based on the notion that individuals rarely face all-or-nothing decisions
  - The change in total utility from consuming one more or one less of an item
  - The marginal utility of a third slice of pizza is the change in satisfaction one gets when eating the third slice instead of stopping with two
- Marginal thinking: “How much better will I do on an exam if I study for one more hour?”

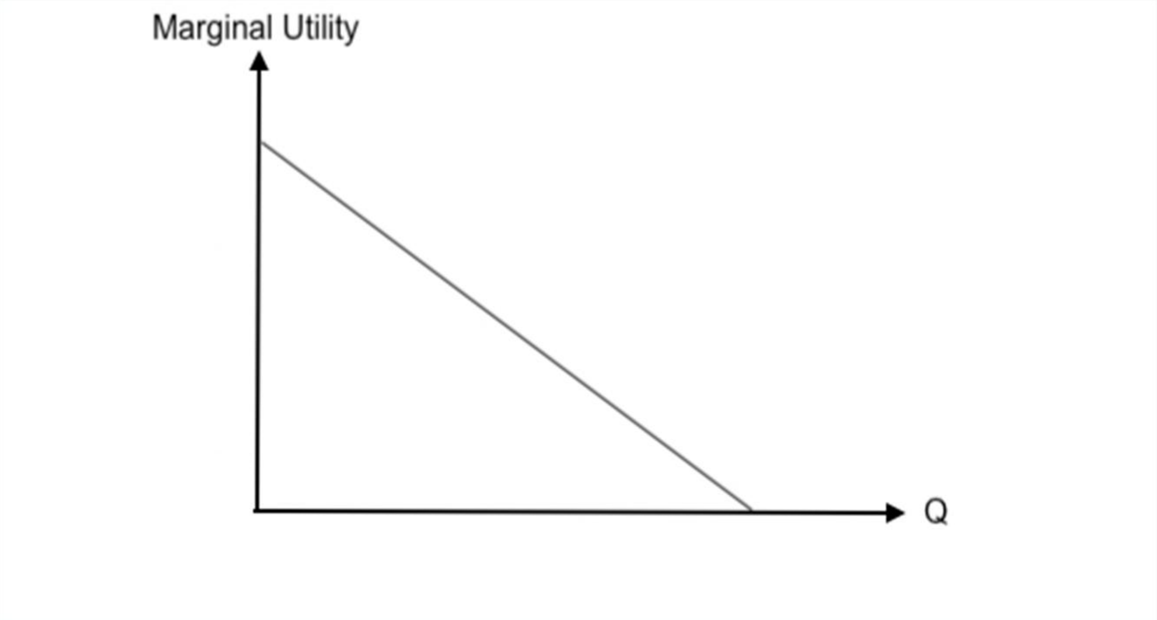
Calculating Marginal Utility

- Marginal Utility is equal to the change in total utility divided by the change in quantity

$$MU = \frac{\text{change in total utility}}{\text{change in quantity}}$$

Marginal Utility vs. Total Utility

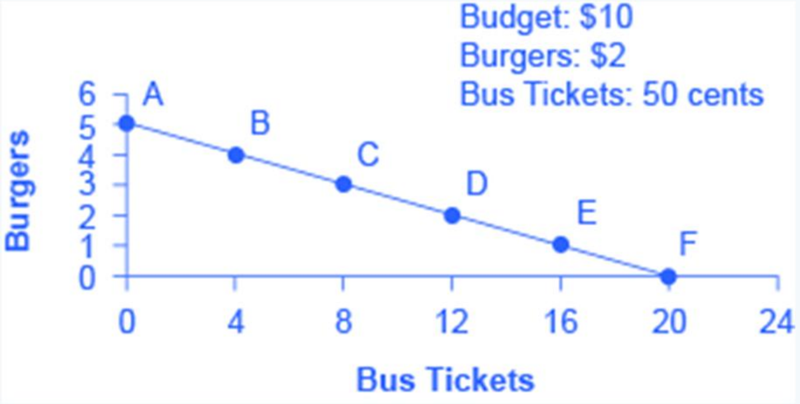
- Marginal utility decreases as consumption of a good increases
- This is an example of the law of diminishing marginal utility, which holds that the additional utility decreases with each unit added
- Diminishing marginal utility is another example of the more general law of diminishing returns



Budget Constraints and Choices

- Budget Constraint: refers to all possible combinations of goods that someone can afford, given the prices of goods and the income (or time) we have to spend.
- Sunk Costs: costs incurred in the past that can't be recovered.
- Opportunity Cost: measures cost by what is given up in exchange; opportunity cost measures the value of the forgone alternative.

Ahmed's Burgers & Bus Ticket Budget



Budget Constraints and Choices (cont.)

Types of Budget Constraints

- Limited amount of money to spend on the things we need and want.
- Limited amount of time.

Budget Constraints and Choices (cont. II)

Budget Constraint Results

- You have to make choices.
- Every choice involves trade-offs.
- No matter how many goods a consumer has to choose from, every choice has an opportunity cost, i.e. the value of the other goods that aren’t chosen.
- The budget constraint framework assumes that sunk costs—costs incurred in the past that can’t be recovered—should not affect the current decision.

Calculating Opportunity Cost Steps

Steps to Calculate Opportunity Cost

- Step 1. Use this equation where P and Q are the price and respective quantity of any number, n, of items purchased and Budget is the amount of income one has to spend.

  Budget = P1×Q1+P2×Q2+⋯+Pn×Qn

- Step 2. Apply the budget constraint equation to the scenario.

10=2×Q1+0.50×Q2

- Step 3. Simplify the equation.

We are going solve for Q_1.

$$
\begin{aligned}
10 &= 2Q_1 + 0.50Q_2 \\
10 - 2Q_1 &= 0.50Q_2 \\
-2Q_1 &= -10 + 0.50Q_2 \\
(2)(-2Q_1) &= (2) - 10 + (2)\,0.50Q_2 \\
-4Q_1 &= -20 + Q_2 \\
Q_1 &= 5 - \tfrac{1}{4}Q_2
\end{aligned}
$$

- Step 4. Use the equation.

$$
\begin{aligned}
Q_1 &= 5 - \left(\tfrac{1}{4}\right)8 \\
Q_1 &= 5 - 2 \\
Q_1 &= 3
\end{aligned}
$$

- Step 5. the results.

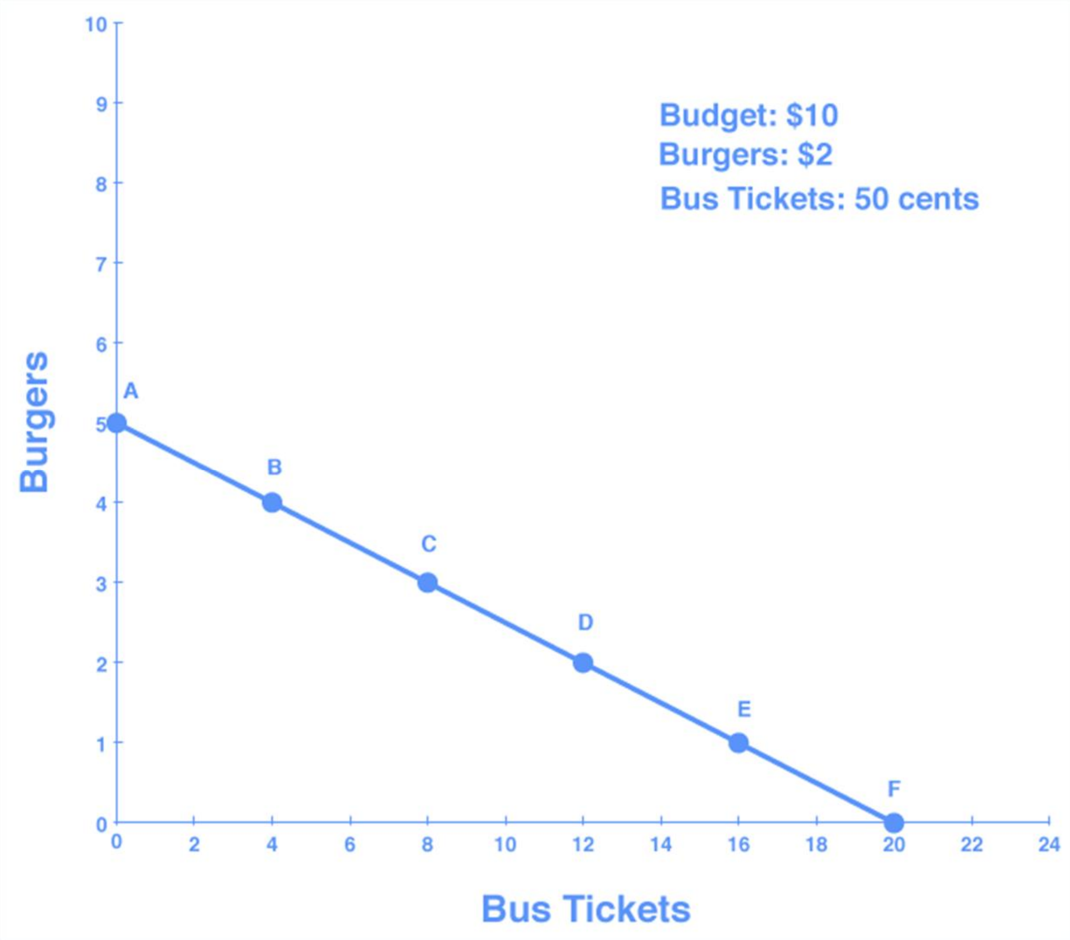
Calculating Opportunity Cost - Graph

How many burgers and bus tickets can Ahmed buy?

- Ahmed’s budged equation:

  $10=2\times Q1+0.50\times Q2$

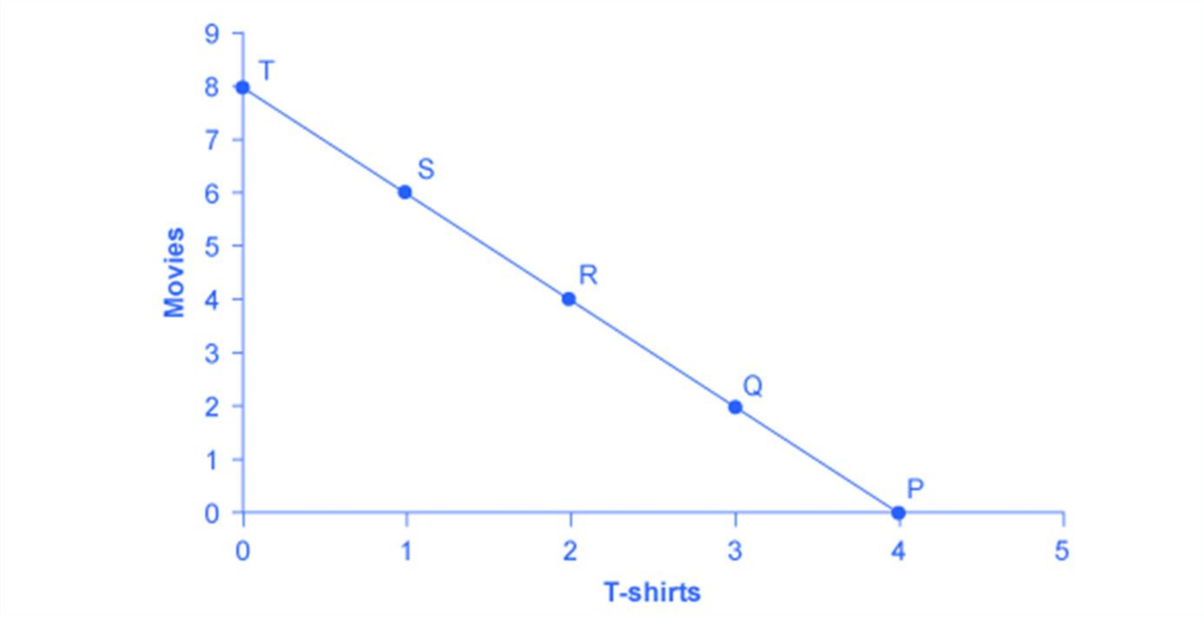
Point	Quantity of Burgers (at $2)	Quantity of Bus Tickets (at 50 cents)
A	5	0
B	4	4
C	3	8
D	2	12
E	1	16
F	0	20




UTILITY MAXIMIZATION
P
L
M
AltGr
Ctrl

Rules for Maximizing Utility

- Consumer equilibrium: comparing the trade-offs between one affordable combination with all the other affordable combinations
  - that is, the combination of goods and services that will maximize an individual's total utility
- Ahmed has income of 56 DZD. Movies cost 7 DZD and T-shirts cost 14 DZD. The points on the budget constraint line show the combinations of movies and T-shirts that are affordable



Applying the Rule

- To maximize total utility, spend each dollar on the item which yields the greatest marginal utility per dollar of expenditure
- Ahmed’s first purchase will be a movie. Why?
  - Ahmed’s choices are to purchase either a T-shirt or a movie
  - The first movie gives Ahmed more marginal utility per dollar than the first T-shirt, and because the movie is within his budget, he will purchase a movie first
- Ahmed will continue to purchase the good which gives him the highest marginal utility per dollar until he exhausts the budget

Rules for Maximizing Utility cont.

Table 1. A Step-by-Step Approach to Maximizing Utility

Try	Which Has	Total Utility	Marginal Gain and Loss of Utility, Compared with Previous Choice	Conclusion
Choice 1: P	4 T-shirts and 0 movies	81 from 4 T-shirts + 0 from 0 movies = 81	–	–
Choice 2: Q	3 T-shirts and 2 movies	63 from 3 T-shirts + 31 from 0 movies = 94	Loss of 18 from 1 less T-shirt, but gain of 31 from 2 more movies, for a net utility gain of 13	Q is preferred over P
Choice 3: R	2 T-shirts and 4 movies	43 from 2 T-shirts + 58 from 4 movies = 101	Loss of 20 from 1 less T-shirt, but gain of 27 from two more movies for a net utility gain of 7	R is preferred over Q
Choice 4: S	1 T-shirt and 6 movies	22 from 1 T-shirt + 81 from 6 movies = 103	Loss of 21 from 1 less T-shirt, but gain of 23 from two more movies, for a net utility gain of 2	S is preferred over R
Choice 5: T	0 T-shirts and 8 movies	0 from 0 T-shirts + 100 from 8 movies = 100	Loss of 22 from 1 less T-shirt, but gain of 19 from two more movies, for a net utility loss of 3	S is preferred over T

Decision Making by Comparing Marginal Utility

- How Ahmed could use the following thought process (if he thought in utils) to make his decision regarding how many T-shirts and movies to purchase:
- Step 1: From Table 1, Ahmed can see that the marginal utility of the fourth T-shirt is 18. If Ahmed gives up the fourth T-shirt, then he loses 18 utils
- Step 2: Giving up the fourth T-shirt, however, frees up14 DZD (the price of a T-shirt), allowing Ahmed to buy the first two movies (at 7 DZD each)
- Step 3: Ahmed knows that the marginal utility of the first movie is 16 and the marginal utility of the second movie is 15. Thus, if Ahmed moves from point P to point Q, he gives up 18 utils (from the T-shirt), but gains 31 utils (from the movies)
- Step 4: Gaining 31 utils and losing 18 utils is a net gain of 13. This is just another way of saying that the total utility at Q (94 according to the last column in Table 1) is 13 more than the total utility at P (81)
- Step 5: So, for Ahmed, it makes sense to give up the fourth T-shirt in order to buy two movies

A Rule for Maximizing Utility

- This process of decision making described previously suggests a rule to follow when maximizing utility
- Since the price of T-shirts is not the same as the price of movies, it’s not enough to just compare the marginal utility of T-shirts with the marginal utility of movies
- We need to control for the prices of each product
- We can do this by computing and comparing marginal utility per dollar of expenditure for each product
- Marginal utility per dinar is the amount of additional utility Ahmed receives given the price of the product

The behaviour of economic actors is often constrained by the economic resources they have at their disposal

- Examples:
- –Individuals maximising utility will be subject to a budget constraint
- –Firms maximising output will be subject to a cost constraint
- The function we want to maximise is called the objective function
- The restriction is called the constraint

Max $U = f(X_1\ X_2) = X_1^2 X_2$

$[X_1^*\ X_2^*]$

Subject to

$g(X_1\ X_2) = P_1X_1 + P_2X_2 = M$

<u>Two ways to do this:</u>

- By Substitution
- Lagrange Multiplier

Method 1: By Substitution

<u>Step 1:</u> Use the constraint to express X_2 in terms of X_1 (or vice-versa)

$$X_2 = \frac{M}{P_2} - \frac{P_1}{P_2} X_1$$

<u>Step 2:</u> Substitute expression for X_2 into the objective function

$$U = X_1^2 X_2 = X_1^2 \left[\frac{M}{P_2} - \frac{P_1}{P_2} X_1 \right]$$

$$\underset{X^*_1}{Max} \quad U = X_1^2 X_2 = X_1^2 \frac{M}{P_2} - X_1^3 \frac{P_1}{P_2}$$

Step 3:

$$\underset{X^*_1}{Max} \quad U = X_1^2 X_2 = X_1^2 \frac{M}{P_2} - X_1^3 \frac{P_1}{P_2}$$

F.O. Condition

$$dU = f_1 . dX_1 = 0$$

$$f_1 = 2 X_1 \frac{M}{P_2} - 3 X_1^2 \frac{P_1}{P_2} = 0$$

$$2 \frac{M}{P_2} = 3 X_1 \frac{P_1}{P_2}$$

$$X^*_1 = \frac{2}{3} \frac{M}{P_1}$$

($P_1X_1 = 2/3M$, expenditure on good 1 is 2/3 of income)

S. O. Condition

For a Max,

$$d^2U = f_{11}.dX_1^2 < 0$$

$$f_{11} = 2\frac{M}{P_2} - 6X_1\frac{P_1}{P_2}$$

X_1 needs to be large enough to sign N.D.

How Large? First find the X_1 that sets,

$$f_{11} = 2\frac{M}{P_2} - 6X_1\frac{P_1}{P_2} = 0$$

Answer: $X_1 = \frac{1}{3}\frac{M}{P_1}$

The optimal $X_1^* = \frac{2}{3}\frac{M}{P_1} \Rightarrow f_{11} < 0$

Step 4: Substitute this value into constraint to find corresponding value of X_2 that maximises objective function

Since $P_1X_1 + P_2X_2 = M$

$$X^*{}_2 = \frac{M}{P_2} - \frac{P_1}{P_2}X_1 = \frac{M}{P_2} - \frac{P_1}{P_2}\left[\frac{2}{3}\frac{M}{P_1}\right] = \frac{1}{3}\frac{M}{P_2}$$

(note, rearranging, $P_2X_2 = 1/3\ M$. expenditure on good 2 is 1/3 of M)

Method 2: By The Lagrange Multiplier

Max the Objective function:

Max $U = f(X_1 X_2) = X_1^2 X_2$

$[X_1^* X_2^*]$

Subject to the constraint:

$g(X_1 X_2) = P_1X_1 + P_2X_2 – M = 0$

Step 1: Define the Lagrangean Function L

(L= objective function + λ constraint)

Max $L = f(X_1 X_2) + \lambda g(X_1 X_2)$

$[X_1^* X_2^* \lambda*]$

Max $L = X_1^2 X_2 + \lambda(M - P_1X_1 - P_2X_2)$

$[X_1^* X_2^* \lambda*]$

OR $L = X^2{}_1 X_2 - \lambda(P_1X_1 + P_2X_2 - M)$

Step 2: Find all first order partial derivatives, set dL = 0

1. $L_{X1} = 2X_1X_2 - \lambda P_1 = 0$ eq1
2. $L_{X2} = X_1^2 - \lambda P_2 = 0$ eq2
3. $L_{\lambda} = M - P_1X_1 - P_2X_2 = 0$ eq3

Step 3: Solve the system of equations

Solving equations 1 & 2:

$\lambda = 2X_1X_2 / P_1 = X_1^2/P_2$

so $2X_1P_2X_2 = P_1X_1^2$

so $2P_2X_2 = P_1X_1$

expenditure on good 2 is twice that of good 1

And substituting into eq 3

$P_1X_1 + P_2X_2 – M = 0$

$2P_2X_2 + P_2X_2 – M = 0$

$X_2^* = {}^1/_3\ {}^M/p_2$

and from eq 3:

$X_1 = {}^M/_{P1} - {}^{P2X2}/_{P1}$

Substituting in for X_2: $X1^* = {}^2/_3\ {}^M/_{P1}$

$$X^*_2 = \left[\frac{1}{3}\frac{M}{P_2}\right] \quad \& \ X^*_1 = \left[\frac{2}{3}\frac{M}{P_1}\right]$$

(again, note that rearranging reveals that $P_1X_!$ *= 2/3 M and* P_2X_2 *= 1/3 M .*
2/3 of income spent on good 1, and 1/3 on good2)

Step 4: Second Order Condition

$d^2L = L_{11}.dX^2_1 + L_{12}.dX_1dX_2 + L_{21}.dX_2dX_1 + L_{22}\, dX^2_2$

s.t. $g_1.dX_1 + g_2.dX_2 = 0$

or $dX_2 = -(g_1/g_2).dX_1$

N. D. for a Max

$d^2L = [L_{11}.\, g^2_2 - 2L_{12}.g_1.g_2 + L_{22}\, g^2_1]dX^2_1/g^2_2$

$d^2L = \Phi\, dX^2_1/g^2_2$, if $\Phi < 0$, N. D.

$$BD = \begin{vmatrix} 0 & g_1 & g_2 \\ g_1 & L_{11} & L_{12} \\ g_2 & L_{21} & L_{22} \end{vmatrix} = -\Phi > 0 \Rightarrow N.D.$$

$$BD = \begin{vmatrix} 0 & -P_1 & -P_2 \\ -P_1 & 2X_2 & 2X_1 \\ -P_2 & 2X_1 & 0 \end{vmatrix} = -\Phi = 2P_2M > 0 \Rightarrow N.D.$$

$d^2L < 0$, N. D. (Max)

Example 1

- Question
- A consumers preferences can be represented by the Utility Function, U(x,y)=x.y.
- How much will the utility maximising consumer demand of goods x and y if they have an income of DZD100, the price of good x is 5 DZD and the price of good y is 1 DZD?

Lagrangean Method:

$L = x.y + \lambda[100 - 5x - y]$

Eq. 1. $L_X = y - 5\lambda = 0$

Eq. 2. $L_y = x - \lambda = 0$

Eq. 3. $L_\lambda = 100 - 5x - y = 0$

Eq 1&2: $\lambda = {}^{y}/_{5} = x \Rightarrow y^* = 5x$

Substitute into eq.3:

$100 = 5x + y = 10x$

So $x^* = 10$ & $y^* = 5x = 50$ & $U^* = 500$

(note that $P_1X_1 = ½ M$ and $P_2X_2 = ½ M$.
½ of income spent on good 1, and ½ on good2)

Second Order Condition:

$$BD = \begin{vmatrix} 0 & -5 & -1 \\ -5 & 0 & 1 \\ -1 & 1 & 0 \end{vmatrix} = 10 > 0 \Rightarrow Max$$

Quick Review

- What is utility and its connection to consumer behavior?
- How do you calculate the total utility of a collection of goods and services?
- What is the difference between total and marginal utility?
- Contrast and compute marginal utility and total utility
- Why does maximizing utility require that the last unit of each item purchased must have the same marginal utility per dollar?
- How do you calculate the utility-maximizing choice?