ARBA MINCH UNIVERSITY

INSTITUTE OF TECHNOLOY

FACULTY OF COMPUTING AND SOFTWARE ENGINEERING

Course Name: Introduction to Economics

Group Assignment (20%)

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Part I: Workout the Following Questions and Show Each Steps Clearly!

1) When price of tea in local café rises from Br. 10 to 15 per cup, demand for coffee rises from 3000 cups to 5000 cups a day despite no change in coffee prices.

A) Determine cross price elasticity.

B) Based on the result, what kind of relation exists between the two goods?

Answer:

A) Calculation of Cross-Price Elasticity (CPE):

Cross-price elasticity of demand measures how the quantity demanded of one good responds to a change in the price of another good. It is especially useful when analyzing goods that may be substitutes or complements.

The formula for cross-price elasticity is:

$$E_{xy} = \frac{\%\Delta Q_x}{\%\Delta P_y} = \frac{\frac{Q_{x2}-Q_{x1}}{Q_{x1}}}{\frac{P_{y2}-P_{y1}}{P_{y1}}}$$

Where:

- Q_{x1} = Initial quantity of coffee = 3,000 cups
- Q_{x2} = New quantity of coffee = 5,000 cups
- P_{y1} = Initial price of tea = Br. 10
- P_{y2} = New price of tea = Br. 15

Now plug in the values:

$$\%\Delta Q_x = \frac{5000-3000}{3000} = \frac{2000}{3000} = 0.667\ (or\ 66.7\%)$$

$$\%\Delta P_y = \frac{15-10}{10} = \frac{5}{10} = 0.5\ (or\ 50\%)$$

$$E_{xy} = \frac{0.667}{0.5} = 1.33$$

B) Interpretation of Cross-Price Elasticity:

The calculated cross-price elasticity is **1.33**, which is **positive and greater than one**. This indicates that the two goods—tea and coffee—are **substitute goods**. When the price of tea increases, consumers shift their consumption to coffee, thereby increasing its demand.

A positive CPE always suggests substitution, but the magnitude also tells us the strength:

- **E > 1:** Strong substitutes
- **E < 1:** Weak substitutes
- **E < 0:** Complements
- **E = 0:** Unrelated goods

Since the elasticity is significantly above 1, it implies that **coffee is a strong substitute for tea** in the eyes of consumers. This can happen if both beverages serve similar functions (e.g., morning drinks, caffeine intake) and are similarly priced and available.

2) Suppose a consumer‘s utility function is given by U (X, Y) = 2X^2Y^4. Find marginal rate of substitution (MRSX,Y) and interpret your result.

Answer:

The **Marginal Rate of Substitution (MRS)** measures how much of one good (Y) a consumer is willing to give up to obtain an additional unit of another good (X), keeping utility constant. It reflects the trade-off between two goods in consumption.

Step 1: Compute Marginal Utilities

We start by finding the **marginal utilities** of X and Y. Marginal Utility (MU) is the partial derivative of the utility function with respect to each good.

Given:

$$U(X,Y) = 2X^2Y^4$$

$$MU_X = \frac{\partial U}{\partial X} = 4XY^4$$

$$MU_Y = \frac{\partial U}{\partial Y} = 8X^2Y^3$$

Step 2: Compute MRS_{X,Y}

The formula for MRS is:

$$MRS_{X,Y} = \frac{MU_X}{MU_Y}$$

Substitute:

$$MRS_{X,Y} = \frac{4XY^4}{8X^2Y^3}$$

Simplify:

$$MRS_{X,Y} = \frac{Y}{2X}$$

Step 3: Interpretation

This result tells us that the consumer is willing to give up **Y/2X** units of good Y for one more unit of good X, **without changing their level of satisfaction**.

- If X increases or Y decreases, the MRS decreases—meaning the consumer becomes less willing to give up Y for more X.
- If Y increases or X decreases, MRS increases indicating the consumer is more willing to give up Y for additional X.

This ratio varies depending on the amounts of X and Y consumed, illustrating the **diminishing marginal rate of substitution**. As the consumer consumes more of X and less of Y, each additional unit of X provides less additional utility, and they require more Y to give it up.

3) A consumer has $200 to spend on two goods X and Y with prices $5 and $8 respectively. Derive the equation of the budget line and sketch the graph.

Answer:

1. **Budget Constraint Concept**

The budget line shows all possible combinations of two goods that a consumer can afford, given their income and the prices of the goods. Mathematically, it is defined as:

$$P_X \cdot X + P_Y \cdot Y = I$$

Where:

- $P_X = 5$ (price of good X),
- $P_Y = 8$ (price of good Y),
- $I = 200$ (total income).

2. **Deriving the Budget Line Equation**

Using the formula: $5X + 8Y = 200$

To express the budget line in slope-intercept form (i.e., solve for Y):

$$8Y = 200 - 5X$$

$$Y = 25 - 0.625X$$

This equation tells us how many units of Y can be bought for every level of X within the budget.

3. **Intercepts and Slope**

- **Y-intercept**: Set $X=0$, then $Y = 200/8 = 25$.
- **X-intercept**: Set $Y=0$, then $X = 200/5 = 40$.
- **Slope**: $-P_X/P_Y = -5/8 = -0.625$

  The slope is negative, showing the trade-off: for every additional unit of X, the consumer must give up 0.625 units of Y.

4. **Graphical Representation**

The budget line is a straight downward-sloping line from:

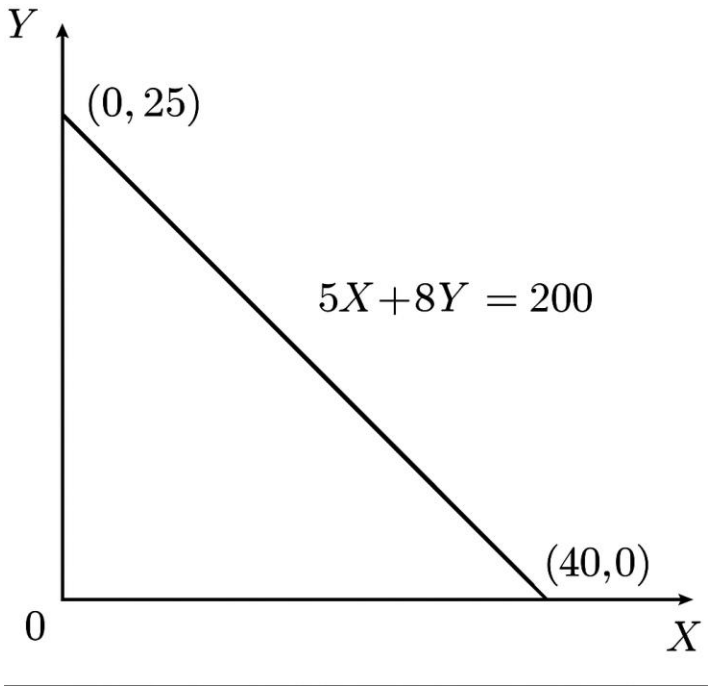
- **Point (X=0,Y=25) to**
- **point (X=40,Y=0)**

All points **on the line** represent combinations of X and Y that **use the full $200**. Points **below the line** are affordable (under budget), and points **above the line** are unaffordable (beyond the budget).

5. **Economic Interpretation**

The budget line illustrates a consumer's purchasing power and opportunity cost. The slope tells us how much Y must be sacrificed for more X. This helps in choosing the best combination of goods that maximizes utility, subject to financial limits.

If the consumer's income increases or prices change, the **budget line will shift or rotate**, respectively, reflecting the new constraints.



4) Consider the following short run production function: Q = 4L^2 - 0.4L^3

a) Find the value of L that maximizes output
b) Find the value of L that maximizes marginal product
c) Find the value of L that maximizes average product

Answer:

This is a classic example of a cubic short-run production function with increasing, then diminishing, returns to the variable input, labor (L). The goal is to analyze output maximization, marginal product, and average product.

a) Maximizing Total Output

To find the level of labor (L) that maximizes total output (Q), we set the **first derivative of Q** with respect to L equal to zero:

$$Q = 4L^2 - 0.4L^3$$

$$\frac{dQ}{dL} = 8L - 1.2L^2$$

Set the derivative equal to zero:

$$8L - 1.2L^2 = 0 \Rightarrow L(8 - 1.2L) = 0$$

Solutions:

- $L = 0$
- $L = \frac{8}{1.2} = 6.67$

We discard $L = 0$ because it results in no output. So, **maximum output occurs at** $L = 6.67$.

b) Maximizing Marginal Product (MP)

Marginal Product is the first derivative of Q, which we already found:

$$MP = 8L - 1.2L^2$$

To find the value of L that maximizes MP, take the second derivative of Q (i.e., the first derivative of MP):

$$\frac{d^2Q}{dL^2} = \frac{d(MP)}{dL} = 8 - 2.4L$$

Set it to zero:

$$8 - 2.4L = 0 \Rightarrow L = \frac{8}{2.4} = 3.33$$

Thus, **MP is maximized at $L = 3.33$.**

c) Maximizing Average Product (AP)

Average Product is defined as:

$$AP = \frac{Q}{L} = \frac{4L^2 - 0.4L^3}{L} = 4L - 0.4L^2$$

Take the derivative of AP with respect to L:

$$\frac{d(AP)}{dL} = 4 - 0.8L$$

Set to zero:

$$4 - 0.8L = 0 \Rightarrow L = \frac{4}{0.8} = 5$$

So, **Average Product is maximized at $L = 5$.**

Summary Table:

Criterion	Optimal Labor (L)
Maximum Total Output	6.67
Maximum Marginal Product	3.33
Maximum Average Product	5

5) If the total cost function of a firm under perfectly competitive market is given by: TC = $3Q^2 + Q + 90$. Then,

a) Find the optimum level of output and the corresponding profit when the price of the product is Birr 25?

b) If you are the advisor of the firm, what do you suggest? And why?

Answer:

This problem involves a firm operating under **perfect competition**, meaning it is a price taker. The firm maximizes profit where **Marginal Cost (MC) = Price (P)**.

a) Optimum Output and Profit

Given:

- Price (P) = 25
- Cost function: $TC = 4Q + 90$
- Revenue: $TR = P \times Q = 25Q$

Step 1: Find Marginal Cost (MC)

MC is the derivative of TC:

$$MC = \frac{d(TC)}{dQ} = \frac{d(4Q + 90)}{dQ} = 4$$

Step 2: Set MC = P

$$MC = 4 \Rightarrow P = 25$$

Since P > MC, the firm can **increase output to earn more profit**. But here, MC is constant (4), and does not rise with Q. That means the firm **should produce as much as it can** within its capacity.

Step 3: Calculate Profit for a given Q

Profit:

$$\pi(Q) = TR - TC = 25Q - (4Q + 90) = 21Q - 90$$

This profit function is increasing with Q, so higher Q yields higher profit.

b) Advice to the Firm

Since **MC is constant and lower than P**, the firm should produce **as much output as possible**, assuming no capacity constraints. Every unit produced adds 21 Birr to profit.

Economic justification:

- The firm is operating **under increasing returns to scale** or constant cost.
- As long as **P > MC**, it is profitable to expand output.
- No other cost constraint (e.g., rising input prices, capacity limit) is mentioned.

Recommendation:

- **Produce at full capacity** to maximize profit.
- Monitor input costs and market price to ensure P > MC remains true.
- Re-evaluate the cost function if capacity limits or rising variable costs appear in the long run.

6) Suppose Arba Minch textile factory is facing the following production function of fixed supply of machineries (capital) and variable input (labor).

Given a fixed number of machineries (10), and labor hours ranging from 0 to 9, with corresponding total product (TP) values provided, calculate:

a) Average Product of Labor (APL) and Marginal Product of Labor (MPL)

b) Graph TP, AP, and MP

c) Identify and explain the three stages of production

Answer:

a) Calculate APL and MPL

Let's define:

- **APL (Average Product of Labor)** = TP / L
- **MPL (Marginal Product of Labor)** = Change in TP / Change in Labor

Labor (L)	TP	APL = TP/L	MPL = ΔTP/ΔL
0	0	-	-
1	2	2.00	2
2	5	2.50	3
3	9	3.00	4
4	12	3.00	3
5	14	2.80	2
6	15	2.50	1
7	15	2.14	0
8	14	1.75	-1
9	12	1.33	-2

b) **Graphical Explanation**

TP Curve:

- Increases rapidly at first, then slowly, then declines—illustrating law of diminishing returns.

MP Curve:

- Rises initially, peaks, then declines—MP falls to zero and becomes negative.

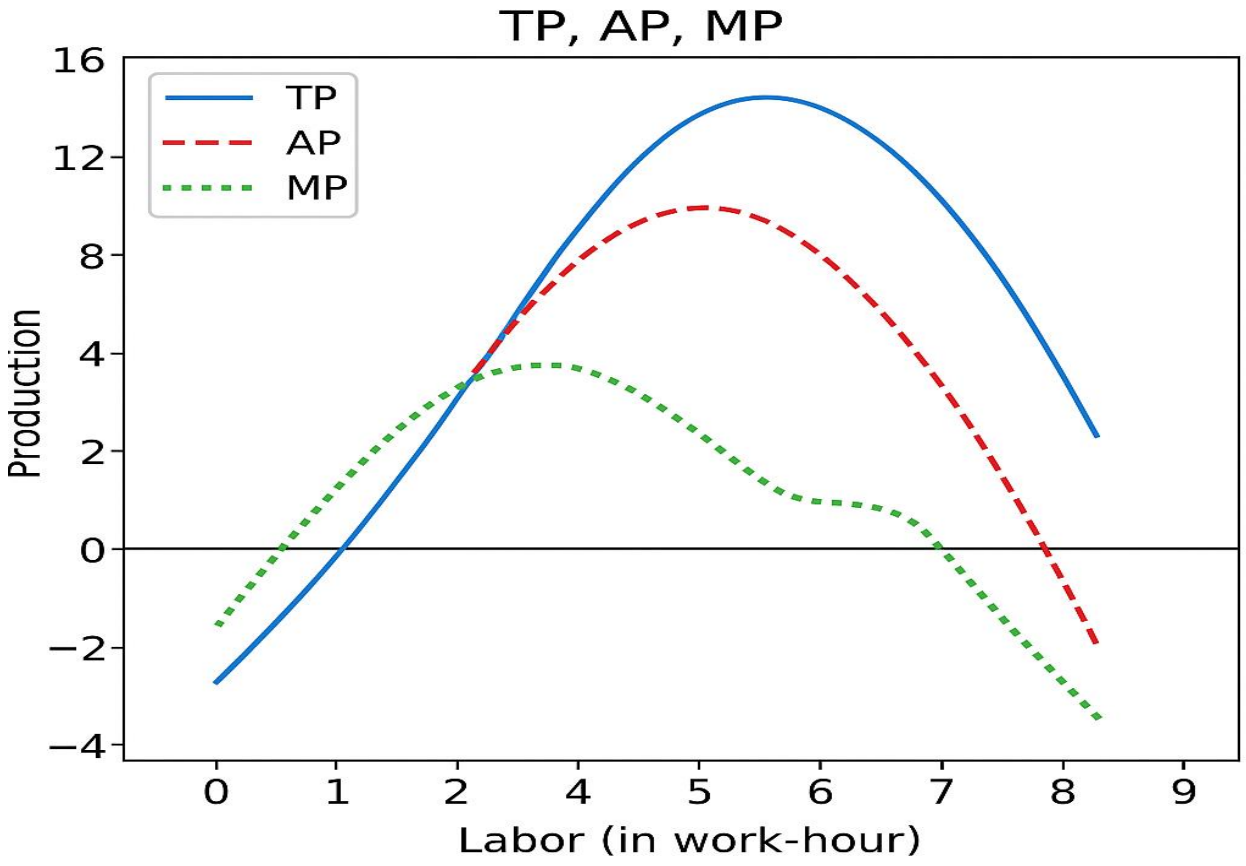
AP Curve:

- Increases, peaks, then declines more gradually.

c) Stages of Production

The **Three Stages of Production** based on the behavior of TP, MP, and AP:

1. **Stage I (0–3 workers):**
    - TP increases at increasing rate.
    - MP and AP both rise.
    - Rational for firms to hire more labor as productivity increases.
2. **Stage II (3–7 workers):**
    - TP increases at decreasing rate.
    - MP decreases but remains positive.
    - AP peaks and then declines.
    - This is the **rational stage** for production (efficient zone).
3. **Stage III (7+ workers):**
    - TP decreases.
    - MP is negative.
    - Adding more labor reduces output—irrational to operate here.



7. Given a short run cost function as TC = 1/3Q^3 – 2Q^2 + 60Q + 100, find the minimum value of AVC and MC.

Answer:

To solve this, we must first understand the relationships between cost concepts:

- **Total Cost (TC)** = Total Fixed Cost (TFC) + Total Variable Cost (TVC)
- **Average Variable Cost (AVC)** = TVC / Q
- **Marginal Cost (MC)** = d(TC) / dQ

From the cost function:

$$TC = \frac{1}{3}Q^3 - 2Q^2 + 60Q + 100$$

- Here, TFC = 100, so:

$$TVC = TC - TFC = \frac{1}{3}Q^3 - 2Q^2 + 60Q$$

Step 1: Find AVC

$$AVC = \frac{TVC}{Q} = \frac{\frac{1}{3}Q^3 - 2Q^2 + 60Q}{Q} = \frac{1}{3}Q^2 - 2Q + 60$$

Step 2: Minimize AVC

To minimize AVC, take the derivative and set it to zero:

$$\frac{d(AVC)}{dQ} = \frac{2}{3}Q - 2 \Rightarrow \frac{2}{3}Q - 2 = 0 \Rightarrow Q = 3$$

Substitute back:

$$AVC_{min} = \frac{1}{3}(3)^2 - 2(3) + 60 = 3 - 6 + 60 = 57$$

So, **minimum AVC = 57 at Q = 3.**

Step 3: Find MC

$$MC = \frac{d(TC)}{dQ} = Q^2 - 4Q + 60$$

To find the minimum MC, differentiate MC again:

$$\frac{d(MC)}{dQ} = 2Q - 4 = 0 \Rightarrow Q = 2$$

$$MC_{min} = (2)^2 - 4(2) + 60 = 4 - 8 + 60 = 56$$

So, **minimum MC = 56 at Q = 2**.

Part II: Short answer and discussion type questions

1. **Explain the relationship between product and cost curves and show the relationship diagrammatically**

Answer:

Understanding the **relationship between product and cost curves** is central to microeconomic theory. These curves are two sides of the same coin: **product curves** describe how inputs (like labor) produce output, while **cost curves** show the monetary cost of that production. The connection between them lies in how efficiently inputs are used.

Key Product Curves

1. **Total Product (TP)**: Total output from all units of labor.
2. **Marginal Product (MP)**: Additional output from one more unit of labor.
3. **Average Product (AP)**: Output per unit of labor.

Key Cost Curves

1. **Total Cost (TC)**: Total of fixed and variable costs.
2. **Marginal Cost (MC)**: Cost of producing one more unit of output.
3. **Average Variable Cost (AVC)**: Variable cost per unit of output.
4. **Average Total Cost (ATC)**: Total cost per unit of output.

The Relationship

- **MP and MC** are **inversely related**.
  When **MP rises**, output increases efficiently, so **MC falls**.
  When **MP falls**, efficiency drops, so **MC rises**.
- **AP and AVC** also have an **inverse relationship**.
  As AP increases, more output is produced per unit of labor, so AVC declines. When AP falls, AVC rises.

These relationships stem from the **Law of Diminishing Marginal Returns**—as more units of a variable input are added to a fixed input, the additional output eventually decreases.

Graphical Representation

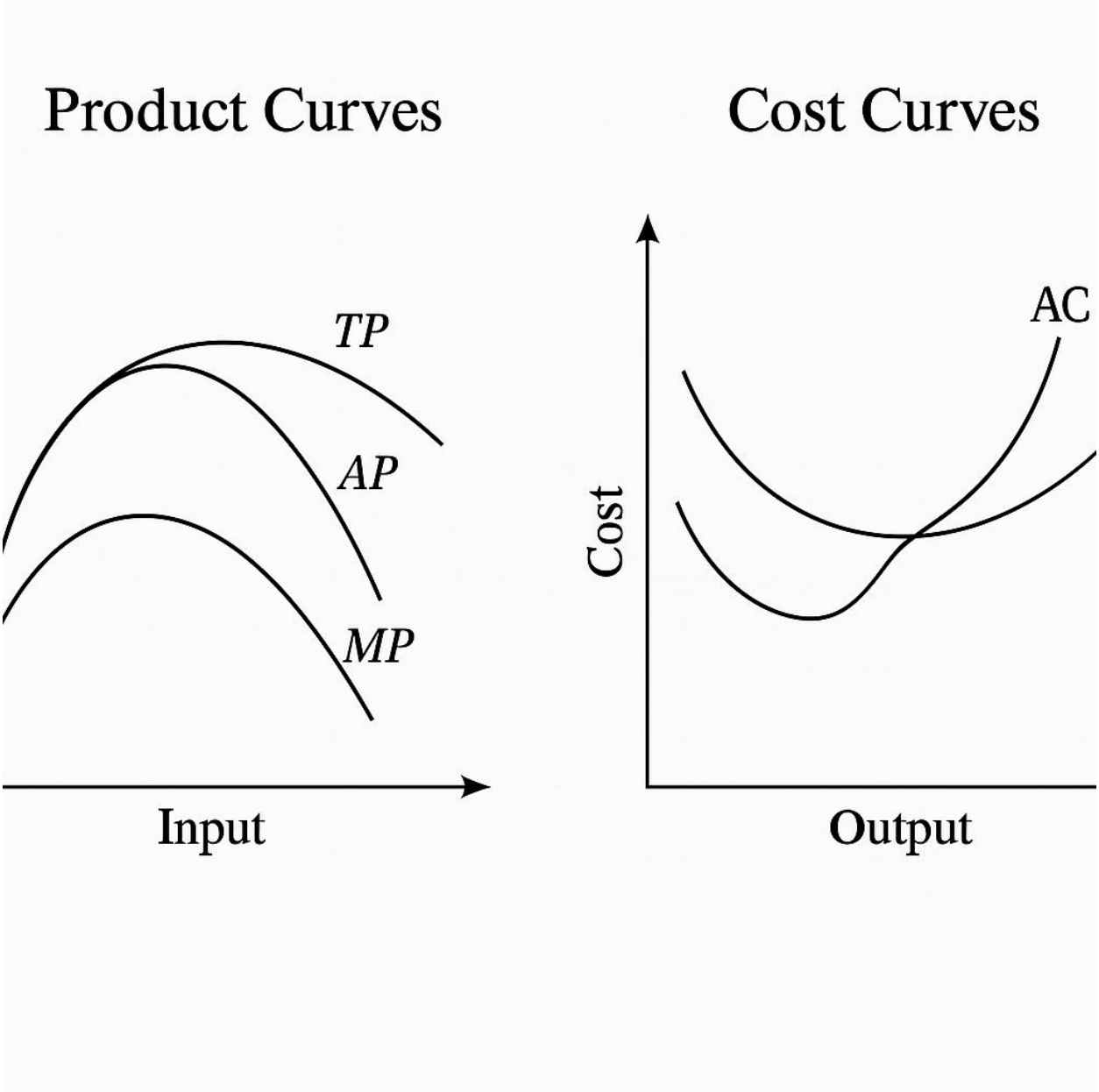
Here are the two diagrams:

1. Product Curves

- TP increases then flattens.
- MP rises, peaks, then falls.
- AP also peaks and declines after.

2. Cost Curves

- MC is U-shaped and intersects AVC and ATC at their minimum points.
- AVC and ATC fall, then rise, creating the classic U-shape.



2. Outline and discuss types of unemployment

Answer:

Unemployment refers to the condition where individuals who are capable of working and actively seeking work are unable to find employment. It is a key indicator of economic health. Economists identify several types of unemployment based on different causes and labor market behaviors.

1. Frictional Unemployment

- **Definition:** Temporary unemployment occurring when people are between jobs or entering the labor market for the first time.
- **Example:** A recent college graduate searching for their first job, or someone who voluntarily quits to find a better job.
- **Cause:** Normal labor market turnover.
- **Policy Response:** Job placement services, career counseling, and improving labor market information.

2. Structural Unemployment

- **Definition:** Unemployment caused by a mismatch between workers' skills and the skills needed for available jobs.
- **Example:** A factory worker loses a job due to automation and lacks the skills for high-tech roles.
- **Cause:** Technological changes, globalization, long-term industry decline.
- **Policy Response:** Education and retraining programs, geographic mobility support.

3. Cyclical Unemployment

- **Definition:** Unemployment linked to the business cycle, especially during economic downturns or recessions.
- **Example:** Construction workers laid off during a housing market crash.
- **Cause:** Decline in overall demand for goods and services.
- **Policy Response:** Expansionary fiscal and monetary policies to boost demand (e.g., stimulus spending, interest rate cuts).

4. Seasonal Unemployment

- **Definition:** Unemployment due to seasonal patterns in certain industries.
- **Example:** Agricultural workers during off-harvest months, or tourism jobs in low season.
- **Cause:** Fluctuations in demand based on time of year.

3. Discuss the relationship between GDP and GNP.

Answer:

Gross Domestic Product (GDP) and **Gross National Product (GNP)** are two important measures used to assess the size and health of a country's economy. Although they are closely related, they differ in **how they define the ownership of economic activity**.

Gross Domestic Product (GDP)

- **Definition:** GDP measures the total market value of all **final goods and services produced within a country's borders** in a given period, usually a year.
- **Includes:** All production inside the country—by both domestic and foreign entities.
- **Excludes:** Income earned by citizens abroad.

Example: If a German-owned car company produces cars in Ethiopia, the value of that production is counted in Ethiopia's GDP.

Gross National Product (GNP)

- **Definition:** GNP measures the total market value of all **final goods and services produced by a country's citizens** (nationals), regardless of where they are located.
- **Includes:** Income earned by nationals abroad.
- **Excludes:** Income earned by foreigners within the country.

Example: If an Ethiopian engineer works in Dubai and sends income home, that income is part of Ethiopia's GNP, not GDP.

The Relationship between GDP and GNP

The relationship is summarized by the formula:

GNP=GDP + Net Factor Income from Abroad (NFIA)

Where:

- **NFIA = Income earned by nationals abroad − Income earned by foreigners domestically**

If NFIA is **positive**, GNP > GDP
If NFIA is **negative**, GDP > GNP

4. **Outline and discuss the causes and effects of inflation.**

Answer:

Inflation is the sustained increase in the general price level of goods and services over time. While moderate inflation is normal in growing economies, high or unpredictable inflation can disrupt economic stability and harm living standards. Understanding the **causes** and **effects** of inflation is essential for sound economic policymaking.

Causes of Inflation

1. **Demand-Pull Inflation**
   - Occurs when aggregate demand exceeds aggregate supply.
   - **Example:** Economic boom → higher consumer spending → prices rise.
   - Driven by: government spending, credit expansion, rising exports, or tax cuts.
2. **Cost-Push Inflation**
   - Caused by rising production costs (e.g., wages, raw materials).
   - Producers pass higher costs to consumers via price increases.
   - **Example:** Oil price hike → increased transport costs → broader price rises.
3. **Built-In (Wage-Price Spiral) Inflation**
   - Higher wages → more consumer spending → rising demand → higher prices.
   - Workers then demand even higher wages to keep up with cost of living, perpetuating the cycle.
4. **Monetary Inflation**
   - Caused by excessive growth in the money supply.

- More money chasing the same amount of goods increases price levels.
- Often linked to central bank policies or government deficit financing.

5. **Imported Inflation**
   - Arises from rising prices of imported goods.
   - Exchange rate depreciation makes foreign goods more expensive.
   - Common in countries heavily reliant on imports.

Effects of Inflation

1. **Reduced Purchasing Power**
   - The same amount of money buys fewer goods and services.
   - Especially harmful to fixed-income earners and savers.
2. **Uncertainty in Business and Investment**
   - Inflation makes it hard to predict future costs and revenues.
   - This can discourage long-term investment and slow economic growth.
3. **Distorted Spending and Saving**
   - People may spend quickly to avoid future price increases, reducing savings rates.
4. **Income Redistribution**
   - Inflation can unfairly benefit debtors (they repay in cheaper money) and harm creditors.
   - Widening inequality if wages don't keep pace with prices.
5. **Balance of Payments Problems**
   - Domestic goods become less competitive abroad, worsening trade deficits.