**Economy Note**

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**Engineering Economics:** Engineering economics is a branch of economics that specifically applies economic principles to engineering projects and decision-making processes.

Engineering economics helps engineers and decision-makers assess the costs, benefits, risks, and trade-offs associated with different alternatives when designing, developing, and implementing engineering solutions.

**Economics:** Economics is the social science that studies how individuals, businesses, governments, and societies allocate their scarce resources to satisfy their unlimited wants and needs.

**Engineering economics is important for several reasons:**

***Informed Decision-Making:*** It enables engineers and decision-makers to make well-informed choices by quantifying the costs, benefits, and potential risks associated with different engineering projects and alternatives.

***Resource Optimization:*** By considering factors like time value of money and cost analysis, engineering economics helps optimize the allocation of resources, ensuring efficient use of funds, materials, and labor.

***Project Viability:*** It helps assess the economic feasibility of projects, determining whether they are financially viable and will yield positive returns on investment.

***Risk Assessment:*** Engineering economics allows for the evaluation of risks and uncertainties associated with projects, aiding in the identification of potential pitfalls and the development of risk mitigation strategies.

***Project Planning:*** By considering financial factors from the outset, engineering economics assists in creating realistic project plans and budgets.

***Investment Decisions:*** Engineers use engineering economics to evaluate the profitability of investments, aiding in decisions regarding the adoption of new technologies or expansion of existing systems.

1. ***Macroeconomics:*** Macroeconomics is the study of the economy as a whole. It focuses on large-scale economic phenomena, such as national income, inflation, unemployment, and overall economic growth.
2. ***Microeconomics***: Microeconomics is the study of individual economic agents, such as consumers, firms, and markets.

Microeconomics analyzes the behavior of smaller economic units to understand how their choices and interactions influence supply, demand, and prices for specific goods and services.

***Difference Between macro and micro economics:***

|  |  |  |
| --- | --- | --- |
| **Aspect** | **Microeconomics** | **Macroeconomics** |
| Scope | Focuses on individual | Focuses on the economy as a |
|  | economic units, such as | whole, including aggregate |
|  | households, firms, and | variables like GDP, inflation, and |
|  | industries. | unemployment. |
| Analysis | Studies individual behavior, | Analyzes broad economic trends, |
|  | choices, and interactions in | policies, and interactions that |
|  | specific markets. | influence the overall economy. |
| Concerns | Prices, supply and demand, | Aggregate output, national |
|  | consumer behavior, | income, economic growth, |
|  | production, market | inflation, unemployment. |
|  | structures. |  |
| Decision | Helps understand how | Focuses on how government |
| Making | individuals and firms make | policies and economic factors |
|  | economic decisions. | impact overall economic |
|  |  | conditions. |
| Perspective | Narrow perspective on | Broad perspective on the entire |
|  | specific parts of the | economy. |
|  | economy. |  |

**Moral And Ethics**

Ethics in economy refers to **the application of moral principles** and values in economic activities and decision-making processes. Ethical considerations in economic engineering guide decision-making to create socially responsible and sustainable economic systems, ensuring fairness, equity, environmental protection, and long-term planning.

Moral in economy refers to the ethical principles and values that guide economic activities, decisions, and policies, ensuring that they align with notions of fairness, responsibility, and social well-being. It involves considering the broader impact of economic actions on individuals, communities, and the environment while upholding ethical standards in the pursuit of economic goals.

***Production, Service and Products***

**Production** is the process of converting inputs, known as factors of production, into outputs, which are goods and services that satisfy human wants and needs. It is a fundamental concept in economics and business, as it is the foundation of wealth creation and economic growth.

***Factors of Production:*** Factors of production are the resources and inputs required to produce goods and services. There are typically four primary factors of production:

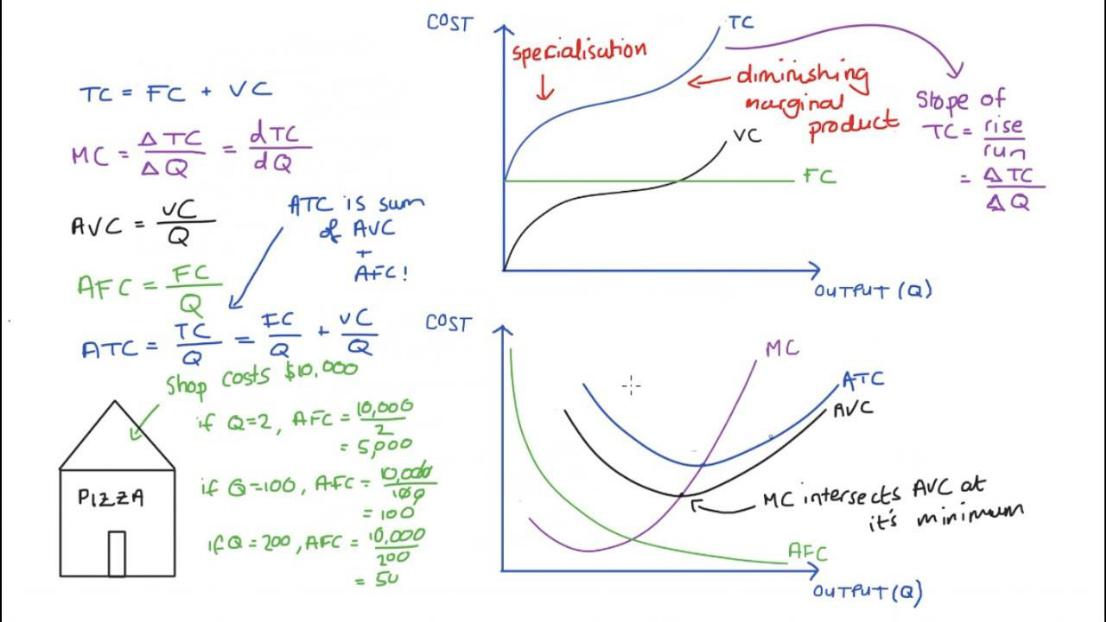
1. **Land:** Land includes all natural resources used in production, such as minerals, water, forests, and agricultural land. Land is considered a fixed factor because its supply is generally fixed in the short run.
2. **Labor:** Labor refers to the physical and mental effort exerted by human beings in the production process. This includes both manual and intellectual work.
3. **Capital:** Capital includes all man-made resources used in production, such as machinery, equipment, tools, buildings, and technology. It is divided into two categories: physical capital (tangible assets) and financial capital (money used to acquire physical capital or invest in a business).
4. **Entrepreneurship:** Entrepreneurship is the ability and willingness of individuals or groups to organize and manage the other factors of production. Entrepreneurs identify opportunities, take risks, make decisions, and coordinate the use of land, labor, and capital to create goods and services.

***Services:*** Services encompass a wide range of intangible economic activities that fulfill needs and provide value. They involve expertise, skills, and actions provided by individuals or businesses to others. Some types of services include:

1. ***Healthcare Services****:* Medical treatment, diagnostics, surgeries, and healthcare consultations provided by doctors, nurses, and medical professionals.
2. ***Educational Services****:* Teaching, training, and learning opportunities provided by schools, colleges, universities, and online platforms.
3. ***Financial Services****:* Banking, investment, insurance, and financial advisory services that help individuals manage and grow their wealth.
4. ***Transportation Services****:* Moving people and goods through services like public transportation, taxis, ride-sharing, and logistics.
5. ***Utilities Services****:* Basic services like electricity, water, and sanitation that are essential for daily life.

***Products****:* Products are tangible items produced, manufactured, or extracted to satisfy consumer needs and wants. There are various types of products, each serving a specific purpose:

1. ***Consumer Goods****:* Items purchased by individuals for personal consumption, including necessities (food, clothing) and luxuries (electronics, jewelry).
2. ***Durable Goods****:* Products with a longer lifespan, such as appliances, furniture, and vehicles.
3. ***Non-Durable Goods****:* Short-lived products that are consumed quickly, like food, beverages, and toiletries.
4. ***Intermediate Goods****:* Materials and components used in production processes, not meant for end-consumer use.
5. ***Capital Goods****:* Tools, machinery, equipment, and facilities used by businesses for production and operations.
6. ***Raw Materials****:* Natural resources or primary materials used as inputs in manufacturing and production.
7. ***Commodities****:* Standardized raw materials traded on exchanges, like oil, gold, and agricultural products.



***Definition of Demand and Supply***

* ***Demand:*** The quantity of a good or service that consumers are willing and able to buy at various prices, holding other factors constant.
* ***Supply:*** The quantity of a good or service that producers are willing and able to offer for sale at various prices, again holding other factors constant.

***Law of Demand***

As the price of a good decreases, the quantity demanded increases, all else being equal, and vice versa.

In other words, *“There's an inverse relationship between price and quantity demanded.”*

***Law of Supply***

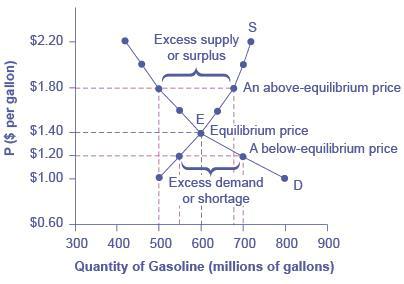
As the price of a good increases, the quantity supplied increases, all else being equal. In other words, *“Price of a product is directly proportionate to its quantity.”*

***Demand Schedule***

A table showing the quantity of a good or service that consumers are willing to buy at various prices, while other factors are constant.

***Supply Schedule***

A table illustrating the quantity of a good or service that producers are willing to offer for sale at different prices, while other factors remain constant.

***Demand and Supply Curves***

* ***Demand Curve:*** A graphical representation of the relationship between the price of a good and the quantity demanded by consumers.
* ***Supply Curve:*** A graphical representation of the relationship between the price of a good and the quantity supplied by producers.

***Demand Curve\****

QD = a – bP

Where,

QD = Quantity Demanded

a = Intercept of the demand curve (quantity demanded when price is 0)

b = Slope of the demand curve (change in quantity demanded per unit change in price)

P = Price

***Supply Curve***

QS = c + dP

Where,

QS = Quantity Supplied

c = Intercept of the supply curve (quantity supplied when price is 0)

d = Slope of the supply curve (change in quantity supplied per unit change in price)

P = Price

***Market Equilibrium***

At equilibrium,

QD = QS.

***Examples:***

1. Draw a demand curve using the demand equation Qd=50-5p.\*\*

Demand schedule for different values of price(p):

|  |  |
| --- | --- |
| Price | Quantity |
| 0 | 50-5\*0=50 |
| 2 | 50-5\*2=40 |
| 5 | 50-5\*5=25 |
| 10 | 50-5\*10=0 |
| 12 | 50-5\*12=-10 |

Putting Price(p) on the x-axis and Quantity demanded(Qd) on the y-axis we get the following graph:

***Shift in Demand and Supply Curves\****

A **shift in the demand and supply curves** in economics refers to a change in the entire relationship between the price of a good and the quantity demanded or supplied at every price level. When a curve shifts, it means that for any given price, buyers or sellers are willing to purchase or supply a different quantity than before the shift.

***Factors that causes shift in Demand:***

* *Income*
* *Consumer preferences*
* *Population*
* *Price of goods*

***Factors that causes shift in Supply:***

* *Input prices*
* *Government regulations and taxes*
* *Number of suppliers*
* *Producers choice*

**Surplus and Shortage Analysis**:

**demand Curve Analysis**:

The demand curve is typically represented as:

Qd = f(P)

Where:

* Qd is the quantity demanded.
* P is the price of the product.

1. **Downward Sloping Demand Curve**: The negative slope of the demand curve reflects the law of demand. Mathematically, it shows that as the price
2. decreases, the quantity demanded (Qd ) increases, and vice versa.

**Supply Curve Analysis**:

The supply curve is typically represented as:

Qs = g(P)

Where:

* Qs is the quantity supplied.
* P is the price of the product.

1. **Upward Sloping Supply Curve**: The positive slope of the supply curve reflects the law of supply. As the price (P) of a product increases, the quantity supplied (Qs) by producers also increases.

**Equilibrium Analysis**:

Equilibrium occurs when the quantity demanded equals the quantity supplied.

Mathematically, this can be represented as:

Qd = Qs

1. **Equilibrium Price (P∗P∗)**: The equilibrium price is where the demand and supply curves intersect. It is the price at which buyers are willing to buy exactly the amount that sellers are willing to sell. In equation form:

Qd(P∗) = Qs(P∗)

**Impact of Shifts**: Any change in factors affecting demand or supply shifts their respective curves. For example, if there's an increase in demand due to factors like rising income, the new demand curve (Qd′Qd′) will be to the right of the initial demand curve (QdQd). This shift will lead to a new equilibrium with a higher price and quantity.

Qd′(P′) = Qs(P′)

Conversely, if there's a change in supply, the supply curve (Qs′) shifts. This can be due to changes in production technology or input costs, for instance.

**Surplus and Shortage Analysis**:

1. **Surplus**: A surplus occurs when the quantity supplied (Qs) exceeds the quantity demanded (Qd) at a given price (P). In equations:

Qs > Qd at P

1. **Shortage**: A shortage occurs when the quantity demanded (Qd) exceeds the quantity supplied (Qs) at a given price (P). In equations:

Qd > Qs at P

|  |  |  |
| --- | --- | --- |
| **Price Change** | **Effect on Quantity Demanded** | **Effect on Quantity Supplied** |
| Price Increases | Decreases | Increases |
| Price Decreases | Increases | Decreases |

**Supply Schedule**: A supply schedule lists different prices and the corresponding quantities of a product that producers are willing to supply at those prices, assuming other factors remain constant.

**Demand Schedule**: A demand schedule lists different prices and the corresponding quantities of a product that consumers are willing to buy at those prices, assuming other factors remain constant.

***Market Equilibrium\*\****

The point at which the quantity demanded equals the quantity supplied, (Qd=Qs) resulting in no excess demand or excess supply.

Equilibrium in a market can be disrupted by various factors, such as changes in consumer preferences, shifts in supply, or government interventions. When equilibrium is disturbed, market forces work to restore it:

* Price Adjustment
* Market Signals
* Market Forces
* Government Intervention

***Examples:***

1. Consider a commodity Qd =17-3p and Qs = 3+4p, where Qd, Qs and p denotes quantity demanded, quantity supply and price respectively. Find the equilibrium price and quantity for that commodity.

At, Market equilibrium,

Qd = Qs

=> 17-3p=3+4p

=> 7p = 14

p = 2.

So, price is 2.

Equilibrium quantity, Qe = Qd = 17-3\*2 = 11.

2. Using the following demand and supply equations, find the equilibrium quantity and market price: Qd = 20-2p, Qs = 10+3p.

At, Market equilibrium,

Qd = Qs

=> 20-2p=10+3p

=> 5p = 10

p = 2.

So, price is 2.

Equilibrium quantity, Qe = Qd = 20-2\*2 = 16.

***Determination of Equilibrium***

Equilibrium is established when the demand and supply curves intersect. At this point, the market clears and there's no pressure for prices to change.

***Market Price and Quantity***

The price and quantity at which the demand and supply curves intersect, establishing equilibrium in the market.

**Elasticity of Demand**

***(skip this)***

***Elasticity of demand***

**Elasticity of Demand** is a concept in economics that measures how responsive the quantity demanded of a good is to changes in its price.

**Arc Elasticity:**

* Arc elasticity calculates elasticity over a range or interval of prices and quantities.
* It considers the initial and final points on the demand curve to calculate the percentage change in price and quantity.
* **Arc elasticity is useful when you have discrete data points or when you want to measure elasticity over a range.**
* The formula for arc elasticity is: PED = ((Q2 - Q1) / ((Q1 + Q2) / 2)) / ((P2 - P1) / ((P1 + P2) / 2))

**Example of Arc Elasticity:** Suppose the quantity demanded for a good decreases from 10 units to 8 units when the price increases from $5 to $7. Using arc elasticity, we would use both sets of initial and final points to calculate the elasticity over the entire range.

**Point Elasticity:**

* Point elasticity calculates elasticity at a specific point on the demand curve.
* It considers the elasticity at a single point without considering a range.
* Point elasticity is used when you need to know the elasticity at a specific price-quantity combination.
* The formula for point elasticity is: PED = (dQ/dP) \* (P/Q)

**Example of Point Elasticity:** Suppose you want to know the elasticity of demand at a price of $5 and a quantity of 10 units. You would use point elasticity to calculate the elasticity at this specific point.

***Price Elasticity of Demand (PED)\*\****

A measure of how much the quantity demanded of a good responds to a change in its price.

PED = (% Change in Quantity Demanded) / (% Change in Price)

PED = ((Q2 - Q1) / Q1) / ((P2 - P1) / P1)

* If PED = 0 (or very small), demand is perfectly inelastic. Quantity demanded does not change in response to price changes.
* If 0<PED< 1, demand is inelastic.

A percentage change in price leads to a smaller percentage change in quantity demanded.

* If PED = 1, demand is unit elastic.

A percentage change in price leads to an equal percentage change in quantity demanded.

* If PED > 1, demand is elastic.

A percentage change in price leads to a larger percentage change in quantity demanded.

* If PED = ∞ (or very large), demand is perfectly elastic.

Quantity demanded is highly responsive to price changes.

***Example:***

If the price of a product increases by 10%, and as a result, the quantity demanded decreases by 20%, the price elasticity of demand would be:

Now,

PED = (-20% / 10%)

= -2

***This indicates that the good has a relatively inelastic demand since the value of PED is less than 1.***

***Cross-Price Elasticity of Demand (XED)***

Cross-price elasticity of demand (XED) measures how sensitive the quantity demanded of one good is to changes in the price of another related good. It helps us understand whether two goods are substitutes or complements.

The formula for calculating XED is:

XED = (% Change in Quantity Demanded of Good A) / (% Change in Price of Good B)

* If XED > 0, the goods are substitutes: An increase in the price of one good leads to an increase in the quantity demanded of the other (and vice versa).
* If XED < 0, the goods are complements: An increase in the price of one good leads to a decrease in the quantity demanded of the other (and vice versa).
* If XED = 0, the goods are unrelated: Changes in the price of one good have no effect on the quantity demanded of the other.

***Income Elasticity of Demand (YED)***

Income elasticity of demand (YED) measures how sensitive the quantity demanded of a good is to changes in consumer income. It helps us understand whether a good is a normal or inferior good and how it relates to changes in consumer incomes.

The formula for calculating YED is:

YED = (% Change in Quantity Demanded) / (% Change in Income)

* If YED > 1, the good is a luxury: An increase in income leads to a proportionally larger increase in the quantity demanded.
* If YED < 1 but still positive, the good is a necessity: An increase in income leads to an increase in the quantity demanded, but it is proportionally smaller.
* If YED < 0 (negative), the good is an inferior good: An increase in income leads to a decrease in the quantity demanded.

***Examples***

1. If the demand for the commodity y increases from 5 units to 8 units as a result of increase in income of a consumer from Tk. 50,000.00 to Tk. 65,000.00, find the income elasticity of demand and comment on the nature of the commodity.

Percentage Change in Quantity Demanded:

- Initial Quantity Demanded (Q1) = 5 units

- New Quantity Demanded (Q2) = 8 units

% Change in Quantity Demanded = [(Q2 - Q1) / Q1] × 100

= [(8 - 5) / 5] × 100

= (3 / 5) × 100 = 60%

Percentage Change in Income:

- Initial Income (I1) = Tk. 50,000.00

- New Income (I2) = Tk. 65,000.00

% Change in Income = [(I2 - I1) / I1] × 100

= [(65,000 - 50,000) / 50,000] × 100

= (15,000 / 50,000) × 100 = 30%

YED = (% Change in Quantity Demanded) / (% Change in Income)

= 60/30

= 2

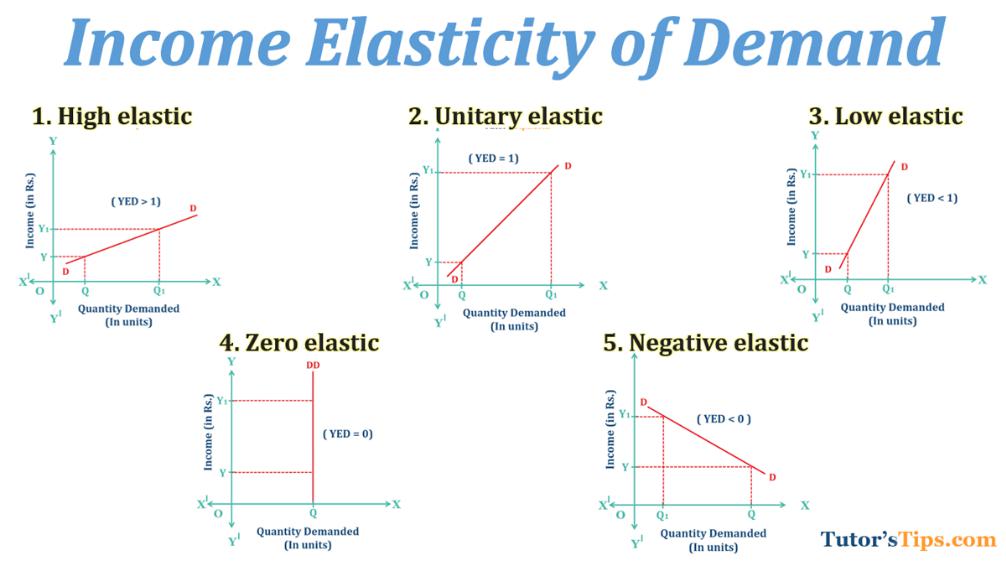
The income elasticity of demand (YED) is 2.

***Interpretation:***

With a YED of 2, this suggests that the commodity Y is a \*\*luxury good\*\*. Luxury goods have income elasticities greater than 1. In this case, a 1% increase in income leads to a 2% increase in the quantity demanded of the commodity Y. Consumers consider it a non-essential or luxury item, and they are relatively more responsive to income changes by purchasing more of it when their income increases.

**Elasticity of Supply**: Elasticity of supply measures the percentage change in quantity supplied in response to a percentage change in price. It indicates how responsive producers are to changes in price. The formula for the price elasticity of supply (PES) is:

* PES =  ℎ ∈ ℎ ∈
* If PES > 1: Supply is elastic. A small change in price leads to a proportionally larger change in quantity supplied.
* If PES < 1: Supply is inelastic. A change in price leads to a proportionally smaller change in quantity supplied.
* If PES = 1: Supply is unit elastic. The percentage change in quantity supplied is exactly equal to the percentage change in price.



**Arc Elasticity**: Arc elasticity is a method used to calculate elasticity over a range of values, rather than at a single point. It's the average of the elasticity at the starting and ending points of the range. The formula for arc elasticity is:

|  |  |  |
| --- | --- | --- |
| Arc Elasticity = | ℎ ∈ |  |
|  |  |
| ℎ ∈ |  |

This method is useful when dealing with large changes in price or quantity, as it provides a more accurate representation of elasticity over a range.

**Example of Arc Elasticity**: Let's say the price of a product increases from $10 to $15, and the corresponding quantity demanded decreases from 100 units to 80 units. Using the arc elasticity formul

|  |  |  |
| --- | --- | --- |
| Arc Elasticity = | ℎ ∈ |  |
|  |  |
| ℎ ∈ |  |

Percentage Change in Quantity = 80−100100×100 = −20% .

Average Percentage Change in Price = (15−10)+(10−15)×100 = −33.33%

10+15

Arc Elasticity = −33.33%−20%− ≈ 0.6.

The arc elasticity in this example is 0.6. Since it's less than 1, the demand is inelastic in this price range, meaning that a 1% change in price would result in less than a 0.6% change in quantity demanded.

**Point Elasticity**: Point elasticity measures elasticity at a specific point on a demand or supply curve. It's the ratio of the percentage change in quantity to the percentage change in price at that specific point. The formula for point elasticity is:

Point Elasticity = ℎ ∈  ℎ ∈  .

**Example of Point Elasticity**: Consider the demand curve for a product with the equation Qd = 200−2P. At a price of $30, the quantity demanded is:

Qd = 200−2×30 = 140 units

Now, let's calculate the point elasticity at this specific point:

Percentage Change in Quantity = 140−200200×100=−30%.

Percentage Change in Price = 3030−31×100=−3.33%

Point Elasticity = −30%− ≈ 9 .

**National Income**

***Gross Domestic Product (GDP)\*\****

GDP is the total value of all goods and services produced within a country's borders in a given time period (usually a year). It's a comprehensive measure of a country's economic activity and is often used to gauge the overall health and size of an economy.

GDP can be calculated using ***three*** approaches: **production, income,** and **expenditure.** These should yield the same value when calculated correctly.

For example,

if a country produces $500 billion worth of goods and services in a year, then its GDP for that year is $500 billion.

***Formulas:***

Real GDP Growth Rate = [(Real GDP in Current Year - Real GDP in Previous Year) / Real GDP in Previous Year] × 100

Per Capita GDP = GDP / Total Population

Suppose Country A's GDP was $500 billion in 2020 and increased to $550 billion in 2021. The population in both years was 100 million.

- Real GDP Growth Rate = [(550 - 500) / 500] × 100 = 10%

- Per Capita GDP in 2020 = 500 / 100 = $5,000

- Per Capita GDP in 2021 = 550 / 100 = $5,500

This growth indicates a positive economic trend in Country A, with an increase in both GDP and per capita GDP.

***Gross National Product (GNP)\*\****

GNP is the total value of all goods and services produced by a country's residents, both domestically and internationally, within a specific time frame. It takes into account the income earned by a country's residents from abroad and subtracts the income earned by foreigners within the country.

*GNP takes into account the earnings of a country's residents, whether they are within the country or abroad.*

For example,

If a country's residents earn $50 billion from foreign investments and foreigners earn $30 billion from investments within the country, the GNP will be the sum of these: $50 billion + $30 billion = $80 billion.

***Economic Growth***

Economic growth refers to the increase in an economy's output of goods and services over time. It's typically measured by the percentage change in GDP from one period to another.

Economic growth signifies an increase in an economy's capacity to produce goods and services, leading to a higher standard of living for its citizens.

For example,

If a country's GDP grows from $1 trillion in one year to $1.1 trillion the following year, its economic growth rate is 10% ($100 billion increase / $1 trillion initial GDP).

**Inflation**

Inflation: Inflation means that cost and revenue cash flow estimates increase over time. This increase is due to the changing value of money that is forced upon a country’s currency by inflation, thus making a unit of currency (such as the dollar) worth less relative to its value at a previous time.

Inflation contributes to

• A reduction in purchasing power of the currency

• An increase in the CPI (consumer price index)

• An increase in the cost of equipment and its maintenance

•An increase in the cost of salaried professionals and hourly employees

• A reduction in the real rate of return on personal savings and certain corporate investments.

P = value or amount of money at a time designated as the present or time 0. Also P is

referred to as present worth (PW), present value (PV), net present value (NPV), dis

counted cash flow (DCF), and capitalized cost (CC); monetary units, such as dollars .

F = value or amount of money at some future time. Also F is called future worth (FW)

and future value (FV); dollars.

A = series of consecutive, equal, end-of-period amounts of money. Also A is called the

annual worth (AW) and equivalent uniform annual worth (EUAW); dollars per

year, euros per month.

n = number of interest periods; years, months, days.

i = interest rate per time period; percent per year, percent per month.

t = time, stated in periods; years, months, days.

Cash inflows are the receipts, revenues, incomes, and savings generated by project and business activity. A plus sign indicates a cash inflow.

Cash outflows are costs, disbursements, expenses, and taxes caused by projects and business activity. A negative or minus sign indicates a cash outflow. When a project involves only costs, the minus sign may be omitted for some techniques, such as benefit/cost analysis.

Net cash flow = Cash inflows - Cash Out Flows

NCF = R - D

The cash flow diagram is a very important tool in an economic analysis, especially when the cash flow series is complex. It is a graphical representation of cash flows drawn on the y axis with a time scale on the x axis. The diagram includes what is known, what is estimated, and what is needed. That is, once the cash flow diagram is complete, another person should be able to work the problem by looking at the diagram.

Economic equivalence is a combination of interest rate and time value of money to determine the different amounts of money at different points in time that are equal in economic value.

If the interest rate is 6% per year, $100 today (present time) is equivalent to $106 one year from today.

Amount accrued = 100 + 100(0.06) = 106

***Inflation***

Inflation refers to the sustained increase in the general price level of goods and services in an economy over a period of time. It erodes the purchasing power of money, as each unit of currency buys fewer goods and services.

***Measures of Inflation***

* ***Consumer Price Index (CPI):***

The CPI measures changes in the average prices paid by urban consumers for a fixed basket of goods and services. It's widely used to gauge inflation's impact on households.

* ***Producer Price Index (PPI):***

The PPI measures average changes in the selling prices received by domestic producers for their output. It reflects price changes at the production level before goods reach consumers.

* ***GDP Deflator:***

The GDP deflator measures changes in the overall price level for all goods and services included in the GDP. It's a broader indicator than the CPI, covering both consumption and investment goods.

* ***Personal Consumption Expenditures (PCE) Price Index:***

Similar to the CPI, the PCE Price Index measures the average change in prices paid by consumers for goods and services. It's often considered the Federal Reserve's preferred inflation gauge.

***Formula for Inflation Rate:***

Inflation Rate = [(Index in Current Period - Index in Previous Period) / Index in Previous Period] × 100

***Example:***

Let's say the CPI for a certain year is 180 and for the previous year, it was 170. To calculate the inflation rate:

Inflation Rate = [(180 - 170) / 170] × 100 = 5.88%

This indicates a 5.88% increase in the average price level over the specified time period.

**Previous year questions on inflation and solutions**

**1. (a) Define Inflation. What are the causes of inflation.**

**Inflation:** Inflation is the sustained increase in the general price level of goods and services within an economy over a period of time. It signifies a decrease in the purchasing power of money, as each unit of currency buys fewer goods and services than before.

**Causes of Inflation:**

1. **Demand-Pull Inflation:** This occurs when aggregate demand in the economy surpasses aggregate supply, leading to an increase in prices.
2. **Cost-Push Inflation:** This arises when the costs of production for businesses increase, leading them to raise prices to maintain their profit margins.
3. **Built-In Inflation:** This cycle begins with wage increases demanded by workers to keep up with rising prices. Higher wages for workers can lead to higher costs for businesses, prompting them to raise prices, and thus perpetuating inflation.
4. **Monetary Factors:** When a central bank increases the money supply excessively, it can lead to too much money chasing too few goods, resulting in demand-pull inflation. Printing more money without a corresponding increase in production can erode the currency's value.
5. **Supply Shocks:** Sudden disruptions in supply, such as natural disasters, geopolitical events, or production issues, can lead to shortages and higher prices for specific goods.
6. **Imported Inflation:** If a country heavily relies on imports and its currency depreciates, the cost of imported goods can rise, contributing to overall inflation.

**(b) Explain the impact of inflation on the economy of a nation.**

Inflation can have various effects on an economy:

1. **Purchasing Power Erosion:** Inflation reduces the value of money over time, diminishing consumers' purchasing power. This can lead to a decrease in real income and a lower standard of living, especially for fixed-income individuals.
2. **Uncertainty:** High and unpredictable inflation rates make it challenging for businesses and individuals to plan for the future. Long-term contracts become uncertain, and individuals may hesitate to save or invest.
3. **Distorted Price Signals:** Inflation can distort relative prices, making it harder for consumers and producers to make informed decisions. This can lead to misallocation of resources in the economy.
4. **Savers and Lenders' Loss:** Inflation erodes the real value of savings and investments. Lenders receive back less real value than they lent, while borrowers benefit as they repay loans with less valuable currency.
5. **Interest Rates:** Central banks often raise interest rates to combat high inflation. Higher interest rates can deter borrowing and spending, potentially slowing down economic growth.
6. **International Competitiveness:** High inflation can reduce a country's international competitiveness by raising domestic costs and prices, making exports less attractive.
7. **Income Redistribution:** Inflation can redistribute wealth from creditors to debtors, and from those on fixed incomes to others with more flexible sources of income.
8. **Government Finance:** While moderate inflation can reduce the real burden of government debt, hyperinflation can disrupt government finances and undermine economic stability.

**Future Value**

***Present Value (PV) and Future Value (FV)***

* ***Present Value (PV):***

PV is the value of a sum of money today, considering its worth at a future point in time, discounted at a specified rate. It's used to determine what a future cash flow is worth in terms of today's dollars.

* ***Future Value (FV):***

FV is the value that a current sum of money will have at a future date, taking into account the compounding effect over time.

The relationship between PV and FV is governed by the time value of money, which accounts for the fact that money available today is worth more than the same amount in the future due to earning potential (opportunity cost) and inflation.

***One-Time Capital***

When dealing with a single lump-sum cash flow, like an investment or loan, you can calculate its future value or present value based on a given interest rate and time period.

***Future Value Formula:***

FV = PV × (1 + r)^n

Where,

FV = future value

PV = present value

r = interest rate per period

n = number of periods.

***Present Value Formula:***

PV = FV / (1 + r)^n

***Series of Uniform Cash Flows***

When you have a series of uniform cash flows (like an annuity), where the same amount is received or paid at regular intervals, you can calculate their future value or present value as well.

***Future Value of Annuity Formula:***

FV = Pmt × [(1 + r)^n - 1] / r

Where,

Pmt = periodic payment

r = interest rate per period

n = number of periods.

***Present Value of Annuity Formula:***

PV = Pmt × [1 - (1 + r)^(-n)] / r

***Example:***

Imagine you invest $1,000 at an annual interest rate of 5% compounded annually. How much will it be worth in 5 years?

FV = 1000 × (1 + 0.05)^5 = $1,276.28

Conversely, if you want to determine how much you need to invest today to have $2,000 in 3 years:

PV = 2000 / (1 + 0.05)^3 = $1,732.40

If you have a series of annual payments of $500 for 10 years at an interest rate of 6%, the future value of this annuity would be:

FV = 500 × [(1 + 0.06)^10 - 1] / 0.06 = $6,729.17

**\**

**Interest Rates**

**An interest rate** is the cost or price of borrowing money or the return on investment for lending money. It represents the percentage of the principal amount (the initial sum of money) that a borrower pays to a lender for the privilege of using the borrowed funds or the compensation a lender receives for deferring the use of their money.

There are two main types of interest rates:

1. Simple Interest Rate
2. Compound Interest Rate.

Interest is the manifestation of the time value of money. Computationally, interest is the difference between an ending amount of money and the beginning amount.

Interest rate: When interest paid over a specific time unit is expressed as a percentage of the principal, the result is called the interest rate.

Interest rate (%) 100%

Interest period: The time unit of the Interest rate is called the interest period.

ROR: Interest earned over a specific period of time is expressed as a percentage of the original amount and is called rate of return (ROR).

Rate of return (%) 100%

The term return on investment (ROI) is used equivalently with ROR.

In simple terms, interest rates reflect two things: a so-called real rate of return plus the expected inflation rate. The real rate of return allows the investor to purchase more than he or she could have purchased before the investment, while inflation raises the real rate to the market rate that we use on a daily basis.

***Simple Interest***

Simple interest is calculated only on the principal amount (the initial sum of money), and it remains constant over time. It doesn't consider the interest that accumulates on previously earned interest.

***Simple Interest Formula:***

Simple Interest (SI) = Principal (P) × Rate (r) × Time (t)

***Example:***

Let's say you invest $1,000 at a simple interest rate of 8% per year for 3 years. The simple interest earned would be:

SI = 1000 × 0.08 × 3 = $240

***Compound Interest***

Compound interest takes into account not only the principal amount but also the interest that has been earned on previous periods. This results in interest on interest, leading to exponential growth over time.

***Compound Interest Formula:***

Future Value (FV) = Principal (P) × (1 + Rate (r) / n)^(n × Time (t))

Where,

FV = Future Value

P = Principal

r = Annual interest rate (expressed as a decimal)

n = Number of compounding periods per year

t = Number of years

***Example:***

Suppose you invest $1,000 at an annual compound interest rate of 6%, compounded annually for 5 years.

FV = 1000 × (1 + 0.06)^5

= $1,338.23

***Comparing Simple and Compound Interest***

* Compound interest typically yields higher returns over time compared to simple interest, especially for longer investment horizons.
* Compound interest allows your money to grow at a faster rate due to the effect of compounding.

**Previous year questions on interest rates and solutions**

**1. a) Distinguish between nominal interest rate and effective interest rate:**

***Nominal Interest Rate:*** The nominal interest rate, also known as the stated or advertised interest rate, is the rate quoted by a financial institution or lender before accounting for inflation or compounding. It is the rate used to calculate the interest payments on a loan or the interest earned on an investment. The nominal interest rate does not account for the effects of inflation or the frequency of compounding.

***Effective Interest Rate (Annual Percentage Yield - APY or Annual Equivalent Rate - AER):***

The effective interest rate, also known as the real interest rate, is the actual rate that takes into account the effects of compounding and, if applicable, inflation. It reflects the true cost of borrowing or the true return on an investment. The effective interest rate considers both the nominal rate and how often interest is compounded.

**Difference between Simple and Compound Interest:**

|  |  |  |
| --- | --- | --- |
| **Aspect** | **Simple Interest** | **Compound Interest** |
| Calculation | Interest is calculated only | Interest is calculated on the initial |
|  | on the initial principal | principal and accumulated interest |
|  | amount. | from previous periods. |
| Formula | I=P×r×t | A=P×(1+r/n)nt |
|  |  |  |
| Components | Principal (P), rate (r), time | Principal (P), rate (r), time (t), and |
|  | (t), and interest (I). | future amount (A). |
| Interest Earned | Earns the same interest | Earns interest on interest, leading to |
|  | each period. | increasing interest over time. |
| Growth Pattern | Linear growth in interest | Exponential growth in interest |
|  | accumulation. | accumulation. |
| Impact of | Frequency of | Frequency of compounding affects |
| Frequency | compounding doesn't | final amount. |
|  | apply. |  |
| Common | Simple loans, basic | Bank accounts, investments, loans, |
| Applications | savings accounts. | mortgages. |

**(b) Three different bank loan rates for electric generation equipment are listed below. Determine the effective rate on the basis of the compounding period for each rate.**

**i. 9% per year, compounded quarterly.**

**ii. 9% per year, compounded monthly.**

**iii. 4.5% per 6 months, compounded weekly.**

i. 9% per year, compounded quarterly:

- Nominal Rate (R): 9%

- Compounding Frequency (n): 4 (quarterly)

- Effective Interest Rate (APY):

APY = (1 + R/n)^n - 1

= (1 + 0.09/4)^4 - 1

≈ 0.0924 or 9.24%

ii. 9% per year, compounded monthly:

- Nominal Rate (R): 9%

- Compounding Frequency (n): 12 (monthly)

- Effective Interest Rate (APY):

APY = (1 + R/n)^n - 1

= (1 + 0.09/12)^12 - 1

≈ 0.0931 or 9.31%

iii. 4.5% per 6 months, compounded weekly:

- Nominal Rate (R): 4.5% per 6 months, which is equivalent to 9% per year.

- Compounding Frequency (n): 52 (weekly)

- Effective Interest Rate (APY):

APY = (1 + R/n)^n - 1

= (1 + 0.09/52)^52 - 1

≈ 0.0937 or 9.37%

**c) What is effective annual interest rate?**

AER is simply the effective interest rate for a one-year period, considering compounding and inflation if applicable. It's used to compare different investment or loan offers on an annual basis.

**d) Relationship between Market Interest Rate, Real Interest Rate, and Inflation Rate:**

* ***Market Interest Rate:*** This is the nominal interest rate that banks and financial institutions advertise.
* ***Real Interest Rate:*** This is the effective interest rate adjusted for inflation. It represents the purchasing power of your money after considering inflation. It is calculated as: Real Interest Rate = Nominal Interest Rate - Inflation Rate.
* ***Inflation Rate:*** This represents the rate at which the general price level of goods and services in an economy is rising. When inflation is considered, the real interest rate gives a more accurate picture of the return on an investment or the cost of borrowing because it accounts for the reduction in purchasing power due to rising prices.

The ***relationship*** can be summarized as follows:

- Market Interest Rate = Real Interest Rate + Inflation Rate.

- If the real interest rate is positive, it means that the investment is growing in purchasing power after accounting for inflation. If negative, it means the investment is not keeping pace with inflation.

**Theory of cost:**

**Fixed Costs (FC)**: Fixed costs are expenses that do not change with changes in the level of production. These costs remain constant regardless of the quantity produced. Examples include rent, salaries of permanent staff, and depreciation of equipment.

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**Variable Costs (VC)**: Variable costs are expenses that change with changes in the level of production. As production increases, variable costs increase, and vice versa. Examples include raw materials, direct labor, and electricity for machinery.

**Total Cost (TC)**: Total cost is the sum of fixed costs and variable costs. It represents the entire cost incurred in producing a given quantity of output. Mathematically: TC=FC+VC.

**Marginal Cost (MC)**: Marginal cost is the additional cost incurred when producing one more unit of output. It's calculated as the change in total cost divided by the change in quantity produced. Mathematically: MC =

**Average Cost (AC)**: Average cost is the cost per unit of output produced. It's

calculated as total cost divided by the quantity produced. Mathematically: AC= **.**

**Long-Run and Short-Run Costs**: In the short run, some costs are fixed (like capital) and cannot be changed easily. In the long run, all costs become variable, and firms have more flexibility to adjust their inputs.

The Minimum Attractive Rate of Return (MARR) is a reasonable rate of return established for the evaluation and selection of alternatives. A project is not economically viable unless it is expected to return at least the MARR. MARR is also referred to as the hurdle rate, cutoff rate, benchmark rate, and minimum acceptable rate of return. it is expected to return at least the MARR. MARR is also referred to as the hurdle rate,

cutoff rate, benchmark rate, and minimum acceptable rate of return.

**CPI (Consumer Price Index)**: The CPI measures the average change in prices paid by consumers for a range of goods and services. It's used to track inflation and gauge changes in the cost of living. The index reflects how prices are changing over time for items like food, housing, and transportation. It helps adjust wages and benefits for inflation and is a key economic indicator.

**GDP (Gross Domestic Product)**: GDP is the total value of all goods and services produced within a country's borders in a specific time period, typically a year. It measures the economic output of a country and includes the value of consumption, investment, government spending, and net exports (exports minus imports).

**GNP (Gross National Product)**: GNP is the total value of all goods and services produced by a country's residents, both domestically and abroad, in a specific time period. It takes into account the income earned by a country's residents from abroad and subtracts the income earned by foreign residents within the country.

**National Income**: National income is the total earnings generated by the production of goods and services within a country's economy. It includes wages, profits, rents, and interest earned by individuals and businesses. National income is a key measure of the economic well-being of a country's residents and provides insights into income distribution and economic growth.

**Tax**: Tax is a mandatory financial obligation imposed by a government on individuals, businesses, or other entities. Its primary purpose is to generate revenue to support various government activities and public services, such as healthcare, education, infrastructure, defense, and social welfare programs.

Taxes are categorized into two main types: **direct taxes** and **indirect taxes**.

* **Direct Taxes**: Direct taxes are levied directly on individuals' or businesses' income, profits, or assets. Examples include income tax, corporate tax, and property tax. These taxes are borne by the entity on which they are imposed.

They can be progressive, where the tax rate increases with higher income, or proportional, where the rate remains constant.

* **Indirect Taxes**: Indirect taxes are imposed on the consumption or use of goods and services. These taxes are collected by businesses or intermediaries from consumers and then passed on to the government. Examples include sales tax, value-added tax (VAT), and excise tax. Indirect taxes can impact the price of goods and services and tend to affect individuals regardless of their income level.

Taxes come in diverse forms, including:

* **Income Tax**: Applied to individuals' earnings and profits.
* **Corporate Tax**: Levied on businesses' profits.
* **Sales Tax**: Imposed on the sale of goods and services.
* **Property Tax**: Applied to real estate ownership.
* **Excise Tax**: Imposed on specific goods like alcohol and tobacco.

**VAT (Value-Added Tax)**: VAT is an indirect tax applied to goods and services at each production or distribution stage. It's collected from consumers by businesses and remitted to the government. VAT taxes the value added at each step, and the end consumer ultimately bears the tax burden. It's a common revenue source worldwide and helps reduce tax evasion. Different countries have varying rates and exemptions for VAT.