

# Auditing Course Material

Part 28 of 61 (Chapters 2701-2800)

## 2. Terms of Sale

When cash discounts are offered, it is essential to consider the cost of credit to the buyer.

For instance, with terms like 2/10, net 30, where early payment earns the buyer a 2%, one might question whether this discount provides a significant incentive for early settlement.

Let us assess the cost to the buyer of not paying early. For instance, if an order amounts to Rs 1,000, the buyer faces a choice: paying Rs 980 within 10 days or waiting an additional 20 days to pay the full Rs 1,000.

Clearly, the buyer effectively borrows Rs 980 for 20 days and incurs Rs 20 in interest on this "loan." Calculating this interest rate allows us to understand the true cost of forgoing the early payment discount.

$$\text{INTEREST FOR 20 DAYS} = \frac{20}{980} = 0.0241 \quad (2.41\%)$$
$$\text{EFFECTIVE ANNUAL INTEREST} = \left(1 + 0.0241\right)^{\frac{365}{20}} - 1$$
$$= 0.446 \quad (44.6\%)$$

Given that the interest rate (44.6%) is so high here, it is unlikely that the seller benefits from early payment. Ignoring the possibility of default by the buyer, the decision of a customer to forgo the discount almost surely works to the seller's advantage.

## 2. Terms of Sale

---

The credit instrument is the basic evidence of indebtedness. Some of types of credit instruments are discussed below.

- (i) **Open Account:** This method is straightforward and common in business transactions. The seller ships goods to the buyer along with an invoice. The buyer acknowledges receipt by signing the invoice, creating a record of the transaction. Both parties maintain their respective accounts, with the buyer expected to settle the invoice within the agreed-upon credit period.
  - (ii) **Promissory Note:** In situations where additional assurance is needed, such as for large orders or transactions lacking cash discounts, a promissory note may be used. This legal document acts as an acknowledgment of debt, signed by the buyer, and outlines the terms of repayment, including the amount owed and the repayment schedule.
  - (iii) **Commercial Draft:** This instrument serves as a pre-shipment credit commitment. The seller draws up a commercial draft specifying the payment amount and due date, sending it to the buyer along with shipping invoices. Upon acceptance, the draft becomes a legally binding obligation for the buyer to pay the specified amount at the agreed-upon time.
  - (iv) **Sight Draft:** A sight draft requires immediate payment upon presentation to the buyer. This is often used in situations where the seller requires prompt payment for goods or services rendered.
  - (v) **Time Draft:** In contrast to a sight draft, a time draft allows the buyer a specified period to make payment. This flexibility may be beneficial for buyers with longer cash conversion cycles or cash flow constraints.
  - (vi) **Trade Acceptance:** When the buyer agrees to pay the draft at a future date, it becomes a trade acceptance. This document formalizes the buyer's commitment to pay and can be retained by the seller or sold to a third party for immediate liquidity.
  - (vii) **Banker's Acceptance:** This type of draft is guaranteed by a bank, making it more secure for the seller. The bank's acceptance signifies its commitment to honor the payment, adding credibility to the transaction. Banker's acceptances are commonly used in international trade transactions.
  - (viii) **Conditional Sales Contract:** With a conditional sales contract, ownership of the goods remains with the seller until the buyer completes payment. The contract outlines the terms of sale, including the installment amounts, interest rates, and conditions for transferring ownership to the buyer upon full payment.
-

## 2. Terms of Sale

You place an order for 500 units of inventory at a unit price of Rs 135. The supplier offers terms of 1/10, net 30.

- (i) How long do you have to pay before the account is overdue?
- (ii) If you take the full period, how much should you remit?
- (iii) How quickly must you pay to get the discount?
- (iv) If you do take the discount, how much should you remit?
- (v) If you don't take the discount, how much interest are you paying implicitly?
- (vi) How many days' credit are you receiving?

**Solution:**

- (i) How long do you have to pay before the account is overdue?

**30 DAYS**

- (ii) If you take the full period, how much should you remit?

**$500 \times 135 = \text{Rs } 67500$**

- (iii) How quickly must you pay to get the discount?

**WITHIN 10 DAYS**

- (iv) If you do take the discount, how much should you remit?

**$(1 - 0.01) \times 67500 = 66825$**

- (v) If you don't take the discount, how much interest are you paying implicitly?

**$67500 - 66825 = 675 \quad (1\% \text{ of } 67500)$**

- (vi) How many days' credit are you receiving?

**20 DAYS**

## 2. Terms of Sale

A firm's credit terms are 2/15, net 30. Based on experience, 65 percent of all customers will take the discount.

(a) What is the average collection period for the firm?

(b) If the firm sells 1,300 products every month at a price of Rs 1,700 each, what is its average balance sheet amount in accounts receivable?

Solution:

(a) What is the average collection period for the firm?

$$\text{AVERAGE COLLECTION PERIOD} = 65\% \text{ of } 15 \text{ Days} + 35\% \text{ of } 30 \text{ Days} \\ = 20.25 \text{ DAYS}$$

(b) If the firm sells 1,300 products every month at a price of Rs 1,700 each, what is its average balance sheet amount in accounts receivable?

$$\text{AVERAGE DAILY BALANCE} = \frac{1300 \times 1700 \times 20.25 \times 12}{365} \\ = \text{Rs } 14,71,315.07$$

## 2. Terms of Sale

A firm has weekly credit sales of Rs 27,500, and the average collection period is 27 days. The cost of production is 75 percent of the selling price. What is the average accounts receivable figure?

Solution:

$$\text{DAILY SALES} = \frac{27500}{7} = 3928.57$$

$$\text{AVERAGE ACCOUNTS RECEIVABLE} = 3928.57 \times 27 \\ = 1,06,071.43$$

## 2. Terms of Sale

A company has an average collection period of 36 days. Its average daily investment in receivables is Rs 58,300. What are annual credit sales? What is the receivables turnover?

Solution:

$$\text{RECEIVABLE TURNOVER} = \frac{365}{36} = 10.1389 \text{ times}$$

$$\begin{aligned}\text{ANNUAL CREDIT SALES} &= 10.1389 \times 58300 \\ &= \text{Rs } 5,91,097.22\end{aligned}$$

## 2. Terms of Sale

A firm offers terms of 1/10, net 30. What effective annual interest rate does the firm earn when a customer does not take the discount?

Solution:

$$\text{INTEREST RATE FOR 20 DAYS} = \frac{1}{99} = 1.01\%$$

$$\begin{aligned}\text{EFFECTIVE ANNUAL RATE} &= (1 + 0.0101)^{\frac{365}{20}} - 1 \\ &= 0.2013 \quad (20.13\%)\end{aligned}$$

### 3. Analyzing credit policy,

---

When analyzing credit policy, businesses need to thoroughly consider several essential factors:

- (i) **Revenue Effects:** The decision to offer credit affects revenue streams. By extending credit to customers, a company allows them to defer payment, potentially leading to delayed revenue recognition. However, offering credit may also attract more customers or enable the firm to charge higher prices, ultimately increasing total revenues. Assessing the balance between delayed revenue and potential revenue growth is crucial in determining the impact on the firm's bottom line.
  - (ii) **Cost Effects:** Regardless of the payment method (cash or credit), the company incurs immediate costs associated with sales. These costs include expenses related to acquiring or producing merchandise, such as procurement, production, and distribution costs. Even in credit sales, where payment is delayed, these upfront costs must be covered by the company.
  - (iii) **Cost of Debt:** Extending credit necessitates financing the resulting accounts receivable. To manage cash flow, the firm may need to arrange short-term borrowing to cover operational expenses while awaiting payment from customers. The cost of this financing, such as interest rates on loans or lines of credit, adds to the overall cost of offering credit and impacts the company's profitability.
  - (iv) **Probability of Non-payment:** Granting credit entails the risk of nonpayment by customers, which can adversely affect the company's financial health. While cash sales eliminate this risk, credit sales introduce the possibility of default or late payment. Evaluating the creditworthiness of customers and establishing effective credit assessment processes are crucial to mitigate the risk of nonpayment and minimize bad debt losses.
  - (v) **Cash Discount:** Offering a cash discount within credit terms serves as an incentive for customers to pay earlier than the agreed-upon credit period. This discount encourages prompt payment, thereby improving cash flow and reducing the company's financing needs. However, the cost of providing discounts must be weighed against the benefits of accelerated cash receipts and the potential impact on profit margins.
-

### 3. Analyzing credit policy,

ABC Electronics, a prominent consumer electronics manufacturer, has long adhered to a cash-only sales approach. However, prompted by requests from key clients, the management is now contemplating a shift towards implementing a net 30-day credit policy. To assess the viability of this proposal, several parameters are defined:

Price per unit: Rs 49

Variable cost per unit: Rs 20

Current monthly sales volume: 100 units

Expected sales volume under the new policy: 110 units

Monthly required return: 2% per month

Considering these factors, the management seeks a recommendation regarding the adoption of the net 30-day credit policy.

Solution:

<u>BENEFITS</u>	<u>COST</u>
INCREMENTAL CASH FLOW	INCREMENTAL VARIABLE COST
$= (49-20)(110-100) = \text{Rs } 290$ * FC is ignored	$= 20(110-100) = \text{Rs } 200$
PV OF INCREMENTAL CASH FLOW	SALE OF 30 Days = $49 \times 100 = \text{Rs } 4900$
$= \frac{290}{0.02} = 14500$	TOTAL COST = $4900 + 200 = \text{Rs } 5100$
SINCE $14500 > 5100 \Rightarrow$	SWITCH TO 30 Day CREDIT POLICY

### 3. Analyzing credit policy,

BHEL makes large turbines for Hydel power plants. A new customer has placed an order for 8 turbines. The variable cost is Rs 24 lakh per unit, and the credit price is Rs 26.25 lakh each. Credit is extended for one period, and based on historical experience, payment for about 1 out of every 200 such orders is never collected. The required return is 2.9 percent per period.

(i) Assuming that this is a one-time order, should it be filled? The customer will not buy if credit is not extended.

(ii) Suppose that customers who don't default become repeat customers and place the same order every period forever. Further assume that repeat customers never default. Should the order be filled?

Solution:

(i) Assuming that this is a one-time order, should it be filled? The customer will not buy if credit is not extended.

BENEFITS		COSTS
$PV \text{ of } SALE = \frac{26,25,000}{(1+0.029)} \times (1-0.005)$ <p style="text-align: center;">↑ DEFAULT PROBABILITY</p> $= 25,38,265$		$SALE \text{ OF } 1 \text{ PERIOD} = 94,00,000$
		$NPV = 2538265 - 9400000 = 1,38,265 \text{ (+ve)}$ <p style="text-align: center;"><math>\Rightarrow</math> FILL THE ORDER</p>

(ii) Suppose that customers who don't default become repeat customers and place the same order every period forever. Further assume that repeat customers never default. Should the order be filled?

BENEFITS		COSTS
$PV \text{ of } SALE$ $= \frac{(2625000 - 2400000)}{0.029} \times (1-0.05)$ $= 77,19,897.59$		$SALE \text{ OF } 1 \text{ PERIOD} = 94,00,000$
		$NPV = 7719897.59 - 9400000 = 53,19,897.59 \text{ (+ve)}$ <p style="text-align: center;"><math>\Rightarrow</math> FILL THE ORDER</p>

### 3. Analyzing credit policy,

A firm is considering a change in its cash-only sales policy. The new terms of sale would be net one month. Determine if the firm should proceed or not. The price per unit is Rs 720 and the cost per unit is Rs 495. The monthly sales are expected to rise from 1100 units to 1140 units with the proposed new policy. The required return is 0.95 percent per month.

Solution:

BENEFITS	COSTS
INCREMENTAL CASH flow $= (720 - 495)(1140 - 1100)$ = Rs 9000	INCREMENTAL VARIABLE COST $= 495(1140 - 1100) = 19,800$
PV OF INCREMENTAL CASH flow $= \frac{9000}{0.0095} = 9,47,368$	SALE OF 30 DAYS = $1100 \times 720 = 792,000$
SINCE $947368 > 811800 \Rightarrow$	TOTAL COST = 8,11,800
	PROCEED WITH NEW POLICY

### 3. Analyzing credit policy,

A company currently has an all-cash credit policy. It is considering making a change in the credit policy by going to terms of net 30 days. Based on the following information, what do you recommend? The required return is 0.95 percent per month.

	Current Policy	New Policy
Price per unit	Rs 295	Rs 302
Cost per unit	Rs 230	Rs 234
Monthly sales	1105	1125

Solution:

<u>BENEFITS</u>	<u>COSTS</u>
<p>INCREMENTAL CASH Flows</p> $= (302 - 234) \times 1125 - (295 - 230) \times 1105$ $= 4675$	<p>INCREMENTAL VARIABLE COST</p> $= 1105(234 - 230) + 234(1125 - 1105)$ $= 9100$ <p>PRESENT SALE OF 1 MONTH</p> $= 295 \times 1105 = 3,25,975$ <p>Total Cost = 3,35,075</p>
<p>PV of INCREMENTAL CASH Flows</p> $= \frac{4675}{0.0095} = 4,92,105$	$NPV = 492105 - 335075 = Rs 157030 (+ve)$ <p>YES, CHANGE CREDIT POLICY</p>

### 3. Analyzing credit policy,

A Shop has decided to offer credit to its customers during the spring selling season. Sales are expected to be 600 bicycles. The average cost to the shop of a bicycle is Rs 525. The owner knows that only 96 percent of the customers will be able to make their payments. To identify the remaining 4 percent, the company is considering subscribing to a credit agency. The initial charge for this service is Rs 750, with an additional charge of Rs 10 per individual report. Should the shop subscribe to the agency?

Solution:

#### SAVING FROM NO BAD DEBT

Saving from not selling to  
bad credit risks  
 $= 525 \times 600 \times 0.04 = 12,600$

#### SUBSCRIPTION COSTS

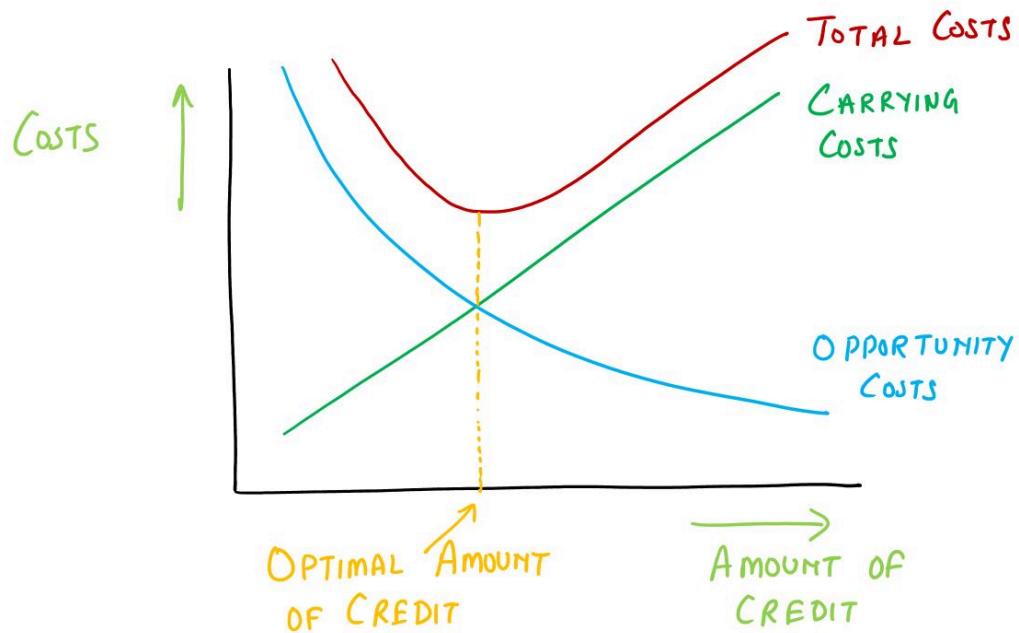
$$\begin{aligned} &\text{Subscription Costs} \\ &= 750 + 10 \times 600 \\ &= 6,750 \end{aligned}$$

$$\text{NET SAVINGS} = 12,600 - 6,750 = \text{Rs } 5,850$$

$\Rightarrow$  SUBSCRIBE TO CREDIT AGENCY

## 4. Optimal Credit Policy

Determining the optimal amount of credit involves a thorough consideration of both the benefits and costs associated with extending credit to customers. Let's delve deeper into the factors influencing this decision.



### Carrying Costs

Carrying costs associated with granting credit primarily consist of 3 components:

- (i) **Required Return on Receivables:** Firms expect a return on the funds tied up in accounts receivable, which represents the cost of financing the credit extended to customers. This is typically calculated based on the firm's cost of capital or desired rate of return.
- (ii) **Losses from Bad Debts:** There is always a risk of customers defaulting on their payments, leading to bad debts. Firms incur losses when customers fail to pay their outstanding balances, which contributes to the overall carrying costs of credit.
- (iii) **Costs of Credit Management:** Managing credit involves expenses related to credit analysis, monitoring customer creditworthiness, and collecting overdue payments. These administrative costs add to the overall cost of carrying credit.

### Opportunity Costs

If a firm adopts a highly restrictive credit policy, it may miss out on potential revenue opportunities. These opportunity costs stem from:

- (i) **Increased Sales Volume:** Offering credit terms can attract new customers and encourage existing ones to make larger purchases, leading to higher sales volumes than would be possible with a cash-only policy.
- (ii) **Potential Price Premium:** Customers may be willing to pay a higher price for the convenience of deferred payment, allowing the firm to command premium prices for its products or services.

### Total Credit Cost Curve

The total credit cost curve represents the combined effect of carrying costs and opportunity costs associated with different levels of credit extension.

At the point where the total credit cost is minimized, the optimal amount of credit is determined. This represents the equilibrium between the benefits of increased sales and the costs of carrying credit.

Deviating from this optimal level may result in suboptimal outcomes.

Granting excessive credit beyond the optimal level may result in higher carrying costs exceeding the benefits of increased sales, while maintaining credit below the optimal level may lead to missed revenue opportunities.

## 5. Credit Scoring

---

Assessing the creditworthiness of customers is crucial for firms to manage credit risk effectively.

Here are several common sources used to evaluate a customer's creditworthiness:

- **Financial Statements:** Reviewing a customer's financial statements provides insights into their financial health, including profitability, liquidity, and solvency. This information helps assess their ability to fulfill credit obligations.
- **Credit Reports:** Credit reports compile data on a customer's payment history with other firms, indicating their reliability in meeting financial commitments. These reports offer valuable information on past credit behavior and help predict future payment behavior.
- **Banks:** Banks often assist their business clients in obtaining credit information about other firms. They may share insights into a customer's creditworthiness based on their banking relationships and transaction history.
- **Payment History with the Firm:** Examining a customer's payment history with the firm itself provides direct insights into their creditworthiness. Timely payments indicate reliability, while late or missed payments raise concerns about future credit risk.
- **Trade References:** Firms may seek credit references from other businesses or suppliers that have previously extended credit to the same customers. These trade references offer firsthand accounts of customers' payment behavior, reliability, and creditworthiness, helping firms make informed credit decisions.

In evaluating creditworthiness, the classic 5 Cs of credit serve as fundamental factors:

- (i) **Character:** This assesses the customer's willingness to meet credit obligations, including their integrity, reliability, and past credit behavior.
- (ii) **Capacity:** Capacity evaluates the customer's ability to fulfill credit obligations based on their operating cash flows, profitability, and financial stability.
- (iii) **Capital:** Capital refers to the customer's financial reserves, including equity, retained earnings, and overall financial strength, which indicate their ability to withstand financial challenges.
- (iv) **Collateral:** Collateral represents assets pledged by the customer to secure credit obligations. It provides a source of repayment for the lender in case of default, reducing credit risk.
- (v) **Conditions:** Conditions consider the broader economic environment and industry-specific factors impacting the customer's business. Understanding market conditions helps assess the customer's ability to honor credit commitments in different economic scenarios.

By evaluating these factors and utilizing information from various sources, firms can make informed decisions about extending credit and manage credit risk effectively.

### Credit Scoring

Credit scoring is the process of calculating a numerical rating for a customer based on information collected; credit is then granted or refused based on the result. For example, a firm might rate a customer on a scale of 1 (very poor) to 10 (very good) on each of the five Cs of credit using all the information available about the customer. A credit score could then be calculated by totaling these ratings. Based on experience, a firm might choose to grant credit only to customers with a score above, say, 30.

---

## 6. Collection Policy

---

Collection policy represents the culmination of a firm's credit management strategy, focusing on the systematic monitoring of accounts receivable and the pursuit of payment for past-due accounts.

**Monitoring Receivables:** Firms closely monitor outstanding accounts to identify any signs of trouble. One essential metric tracked is the average collection period (ACP), which measures the average time it takes customers to pay their invoices. Any unexpected increases in the ACP signal potential issues, such as delayed payments or overdue accounts.

**Aging Schedule:** The aging schedule is another vital tool for monitoring receivables. It categorizes accounts receivable based on the length of time they have been outstanding, typically into buckets such as current, 30 days past due, 60 days past due, and so on. This schedule helps identify overdue accounts and assess the overall health of the receivables portfolio.

When customers fail to make timely payments, firms typically follow a structured sequence of collection procedures:

- (i) *Delinquency Letter:* The firm sends a formal delinquency letter to notify the customer of the past-due status of their account. This serves as an initial reminder and request for payment.
  - (ii) *Contact Customer:* If the delinquency letter does not yield results, the firm may follow up with a telephone call or a meeting with the customer. This allows for direct communication to address any issues and prompt payment.
  - (iii) *Collection Agency:* If the customer remains non-responsive, the firm may enlist the services of a collection agency. Collection agencies specialize in recovering outstanding debts and may employ various tactics to secure payment.
  - (iv) *Legal Action:* As a last resort, the firm may initiate legal proceedings against the customer to compel payment. This involves filing a lawsuit or obtaining a court judgment to enforce payment through legal channels.
-

# 1. Short-term Financing

---

Short-term financing is crucial for businesses to manage their day-to-day operations, cover expenses, and seize opportunities for growth. The optimal combination of alternative sources of short-term financing depends on several key considerations: cost, availability, timing, flexibility, and the degree to which the firm's assets are encumbered by legal claims.

Let's delve into each method of short-term financing and explore its implications:

## Trade Credit from Suppliers

Trade credit from suppliers is a common and significant source of short-term financing. It allows firms to defer payment for goods or services received, effectively extending their cash conversion cycle. However, the availability of trade credit depends on the firm's relationship with its suppliers and its payment history. Strict adherence to prompt payment policies can enhance trust with suppliers and ensure continued access to trade credit.

## Forgoing Cash Discounts

When suppliers offer cash discounts for prompt payment, forgoing these discounts effectively incurs a cost of trade credit. The longer the period between the end of the discount period and payment, the higher the opportunity cost. Firms must weigh the benefits of preserving cash against the cost of forgoing discounts when deciding whether to take advantage of cash discounts.

## Stretching Accounts Payable

Stretching accounts payable involves delaying payment beyond the due date. While this can provide additional short-term financing, it comes with potential costs such as forgone cash discounts, late payment penalties, and possible damage to the firm's credit rating. Firms must carefully assess these costs and their ability to obtain future credit before stretching payables.

## Accrued Expenses

Accrued expenses, such as wages and taxes, represent a spontaneous source of financing. Firms typically incur these expenses on established dates but may delay payment until later dates. This interest-free financing provides ongoing liquidity, but postponing tax and wage payments can have severe consequences, including penalties and damage to the firm's reputation.

## Commercial Paper

Large, creditworthy companies may issue commercial paper, which are unsecured, short-term promissory notes sold in the money market. Commercial paper is often cheaper than short-term loans from commercial banks, making it an attractive source of financing. However, firms must have a strong credit rating to access the commercial paper market.

## Bankers' Acceptance

Bankers' acceptance financing involves a bank guaranteeing payment on behalf of a firm for a future transaction, typically associated with foreign trade. Bankers' acceptances are highly marketable and can provide desirable short-term funds. However, firms must ensure they have the necessary documentation and creditworthiness to obtain bankers' acceptances.

## Unsecured short-term loans

Unsecured short-term loans are a type of borrowing where a firm does not pledge collateral against the loan. These loans are typically obtained from commercial banks and can be structured in several ways:

*Line of Credit:* A line of credit is an informal agreement between a bank and its customer, specifying the maximum amount of credit the bank will allow the firm to borrow at any given time. It provides flexibility as the borrower can access funds as needed, up to the agreed-upon limit. Interest is charged only on the amount borrowed, and the borrower can repay and re-borrow funds within the specified limit.

*Revolving Credit Agreement:* A revolving credit agreement is a formal, legal commitment by a bank to extend credit up to a maximum amount. Under this arrangement, the borrower can access funds whenever necessary, as long as the total borrowings do not exceed the maximum limit. For the privilege of having access to this credit facility, the borrower typically pays a commitment fee on the unused portion of the credit line, in addition to interest on any borrowed amount. This commitment fee compensates the bank for keeping the credit available even if not utilized fully.

*Transaction Loan:* Transaction loans are suitable when a firm needs short-term funds for a specific purpose, such as completing a project or fulfilling an order. Unlike lines of credit or revolving credit agreements, transaction loans are granted for individual transactions, with each loan evaluated separately based on the borrower's ability to repay. Cash flow analysis plays a crucial role in the approval process, ensuring that the borrower can meet its obligations without straining its financial resources.

## Secured Short-term loans

Secured short-term loans are a type of borrowing where a firm pledges collateral to the lender to secure the loan. This type of

financing is often utilized by firms that may have difficulty obtaining unsecured credit due to factors such as creditworthiness or financial stability.

Lenders require borrowers to pledge security against the loan to mitigate the risk of default. By providing collateral, the borrower offers the lender an additional source of repayment, which can include both the firm's cash flow and the value of the pledged assets. The two primary assets used to secure short-term business loans are:

(i) *Accounts Receivable*: These are amounts owed to the company by customers for goods or services provided on credit. Accounts receivable serve as collateral because they represent a future inflow of cash to the company.

(ii) *Inventory*: Inventory consists of goods held by the company for sale or production. It serves as collateral because it has tangible value that can be liquidated to repay the loan in case of default.

Lenders can obtain a secured interest in inventories through various arrangements, including:

- *Floating Lien*: This is a general or blanket lien against a group of assets, such as inventory or receivables, without specifically identifying individual assets. The lender holds a security interest in the entire pool of assets.
  - *Chattel Mortgage*: A chattel mortgage involves placing a lien on specifically identified personal property (assets other than real estate) to secure a loan. The borrower retains possession of the collateral, but the lender has a legal claim to it if the borrower defaults.
  - *Trust Receipt*: A trust receipt acknowledges that the borrower holds specific inventory and proceeds from its sale in trust for the lender. The borrower is entrusted with the inventory but holds it as security for the loan, with the understanding that the proceeds from its sale will be used to repay the lender.
  - *Terminal Warehouse Receipt*: This arrangement involves placing inventory in the possession of an independent third party, such as a warehouse, which issues a receipt to the lender. The inventory serves as collateral for the loan, and the third party holds it until the loan is repaid.
-

## 1. Short-term Financing

---

Instead of pledging receivables, a firm may engage in factoring (selling) receivables to acquire cash. Factoring often relieves the firm of credit checking, the cost of processing receivables, collection expenses, and bad-debt expenses.

Factoring is a financial arrangement where a firm sells its accounts receivable (invoices) to a third-party financial institution, known as a factor, at a discount. Instead of waiting for customers to pay their invoices, the firm receives immediate cash from the factor, which then assumes responsibility for collecting the outstanding receivables from the customers. This process provides the firm with immediate liquidity, freeing up cash flow that would otherwise be tied up in unpaid invoices.

When a firm engages in factoring, it transfers the title of its accounts receivable to the factor. Unlike pledging receivables as security for a loan, where the firm retains ownership, factoring involves the actual sale of receivables to the factor. This means that the factor assumes full ownership and responsibility for collecting the outstanding amounts from customers.

Factoring transactions are typically conducted on a "without recourse" basis. This means that once the receivables are sold to the factor, the firm is not liable for any non-payment by customers. The factor bears the risk of non-collection and cannot seek repayment from the firm if customers default on their payments.

Factors typically maintain credit departments to assess the creditworthiness of the firm's customers. They conduct credit checks and may refuse to purchase receivables deemed too risky. This helps mitigate the risk of non-payment and ensures that factors only acquire receivables with a high likelihood of being collected.

Factoring allows firms to outsource credit and collection responsibilities to the factor. By selling their receivables, firms relieve themselves of the administrative burden and costs associated with maintaining a credit department and pursuing collections. Factors specialize in credit management and have the resources to efficiently collect payments from customers.

Factoring arrangements are governed by contracts between the factor and the client (the firm selling the receivables). These contracts typically outline the terms of the agreement, including the duration, fees, and responsibilities of each party. Contracts are often renewable annually with provisions for cancellation, usually requiring prior notice.

---

## 1. Introduction

---

Inventory Management is the process of overseeing and controlling the flow of goods or products within a business. It involves the efficient handling of stock, ensuring that the right products are available in the right quantities at the right time.

Effective inventory management is crucial for maintaining optimal levels of stock, avoiding stockouts or overstock situations, and maximizing profitability.

Consider a manufacturing company that produces electronic components. The company needs to keep track of raw materials, such as circuit boards and microchips, as well as finished goods. Utilizing historical production data and demand forecasts, the company can optimize its inventory levels, avoiding delays in production due to shortages or excess stock.

The inventory manager must coordinate with suppliers to maintain an efficient supply chain, reordering materials just in time to meet production schedules.

Accurate tracking and categorization of inventory help in identifying slow-moving or obsolete items, allowing for proactive adjustments.

Effective inventory management in the electronics manufacturing industry contributes to streamlined operations, minimized production disruptions, and improved overall cost efficiency.

---

## 2. Need for Inventory

---

Inventory is crucial across various facets of an organization to ensure seamless operations and meet customer demands.

Here are different inventory categories within a business:

1. **Raw Material:** The basic materials required for production. For instance, in a bakery, flour and sugar are raw materials.
2. **Components and Parts (Bought out Parts):** These are elements purchased externally but used in the manufacturing process. In a car assembly line, purchased tires and batteries are examples.
3. **Work in Progress:** Items in the production process but not yet completed. In a furniture factory, this could include partially assembled chairs or tables.
4. **Finished Goods:** Fully manufactured products ready for sale. In a smartphone manufacturing company, the final, packaged smartphones are the finished goods.
5. **Distribution Inventory (Pipeline Inventory):** Inventory stored in warehouses or during transportation. For an online retailer, this includes products stored in fulfillment centers or in transit to customers.
6. **Maintenance, Repair, and Operational Inventory (MRO):** Inventory used for day-to-day operations and maintenance. In an airline, MRO inventory would consist of spare parts for aircraft maintenance.

### Motives for Inventory

Thus, the reasons for maintaining inventory can be categorized into four key motives:

1. **Transactional:** Inventory is necessary for the smooth execution of the production process. Raw materials and components needed in a manufacturing line to ensure continuous production.
  2. **Precautionary:** Inventory acts as a precaution against potential interruptions in the production process or unexpected demand fluctuations. Maintaining safety stock to address unforeseen delays in the supply chain or unexpected spikes in customer demand.
  3. **Speculative:** Inventory is held as a strategic move to hedge against anticipated increases in the prices of raw materials or other market uncertainties. Stockpiling certain goods in anticipation of a predicted rise in commodity prices or potential supply chain disruptions.
  4. **De-coupling:** Inventory is used to de-link or separate various stages of the production and sales processes, providing flexibility. Building up inventory to decouple production from sales, allowing production to continue even if sales are slower, or vice versa.
-

### 3. Types of Inventory

1. Anticipation Inventory or Seasonal Inventory

FUTURE DEMAND

2. Fluctuation Inventory or Safety Stock or Buffer stock or Reserve stock.

UNEXPECTED DEMAND

3. Lot-size Inventory or Cycle Stock

BENEFIT OF LOWER PRICE

4. Distribution Inventory or Transportation or Pipeline or Movement Inventory

TRANSIT, WAREHOUSE

5. Speculative or Hedge Inventory

PROTECT AGAINST PRICE FLUCTUATIONS

6. Maintenance, Repair, and Operating (MRO) Inventory

SPARE PARTS, LUBRICANTS, CLEANING COMPOUNDS

The various categories of Inventories are listed below:

#### 1. Anticipation Inventory or Seasonal Inventory

Stock held in anticipation of future demand fluctuations or seasonal variations.

*Example:* A toy manufacturer stocking up on extra inventory in anticipation of higher demand during the holiday season.

#### 2. Fluctuation Inventory or Safety Stock or Buffer Stock or Reserve Stock

Additional stock maintained as a safety net to counter unexpected variations in demand or supply chain disruptions.

*Example:* A retailer keeping extra units of a popular product to address sudden spikes in customer demand or unexpected delays from suppliers.

#### 3. Lot-size Inventory or Cycle Stock

Inventory ordered in economic lot sizes to benefit from lower costs and quantity discounts.

*Example:* A car manufacturer ordering a specific quantity of tires to take advantage of bulk purchase discounts and minimize production costs.

#### 4. Distribution Inventory or Transportation or Pipeline or Movement Inventory

Inventory in transit or stored in distribution centers, ensuring a continuous flow in the supply chain.

*Example:* An online retailer strategically placing stock in warehouses across the country to reduce delivery times and meet customer expectations.

#### 5. Speculative or Hedge Inventory

Stock held as a precautionary measure to hedge against potential price increases or unforeseen events.

*Example:* An oil company maintaining a reserve inventory to counter fluctuations in oil prices or supply chain disruptions caused by geopolitical events.

#### 6. Maintenance, Repair, and Operating (MRO) Inventory

Inventory comprising spare parts and supplies essential for ongoing operations and maintenance.

*Example:* An airline keeping an inventory of spare aircraft parts, lubricants, and cleaning compounds to ensure prompt maintenance and repairs as needed.

## 4. Inventory

---

The motive for keeping inventory can be **Transactional** (needed for production process), **Precautionary** (interruptions in production process), **Speculative** (if prices of raw materials are expected to rise) or **De-coupling** (de-linking of production from purchase or de-linking of production from sales).

---

## 5. Costs of Inventory

---

The Costs of Inventory can be divided into 3 categories:

### 1. Holding Cost (Carrying Cost)

Holding cost pertains to the expenses associated with maintaining items in inventory. These costs encompass a wide range, including facility rent, power, insurance, labor, security, material handling, record-keeping, theft, leakage, and waste.

It is usually written either in absolute value (Rs 5 per unit of item per year) or as percentage of cost of item (20% of the value of the item per year).

It can be sub-divided into following types:

1.1 **Capital Costs:** This includes the cost of capital tied up in inventory and the opportunity cost of using that capital elsewhere.

1.2 **Storage Costs:** Encompasses expenses related to physical space, labor, equipment, and the general handling of the inventory.

1.3 **Risk Costs:** Encompasses various risks associated with holding inventory, such as theft, damage, insurance, and obsolescence.

### 2. Ordering Cost

Ordering cost is incurred each time an order is placed and includes fixed costs per order, regardless of the number of items ordered. This involves clerical work, purchase order processing, and related administrative expenses.

As the size of orders increases, the frequency of orders decreases. This results in a reduction in the overall ordering cost, as larger orders lead to fewer order placements.

### 3. Shortage Cost (Stockout Costs)

Shortage costs arise when demand surpasses supply, leading to potential outcomes such as backorders or lost sales.

There can be two outcomes of shortage:

(i) **Backorder:** Accepting orders but unable to fulfill them immediately.

(ii) **Lost Sale:** Failing to meet demand, resulting in revenue loss.

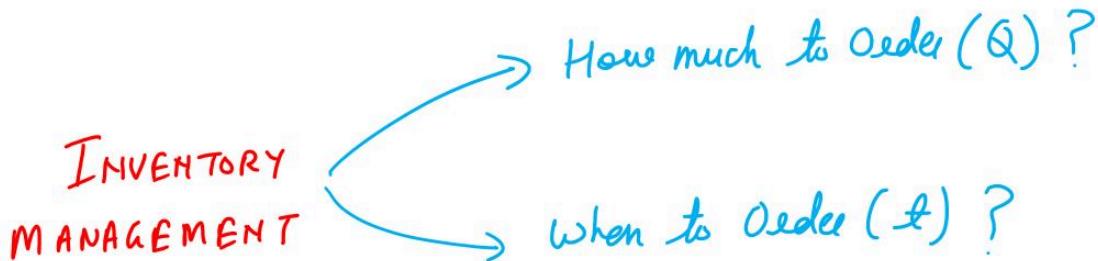
Stockouts can lead to dissatisfied customers and revenue loss, making it crucial to balance inventory levels.

To mitigate shortage costs, businesses might opt to store more inventory, but this approach increases holding costs, creating a delicate balance in inventory management. Striking the right balance is crucial for efficient operations and customer satisfaction.

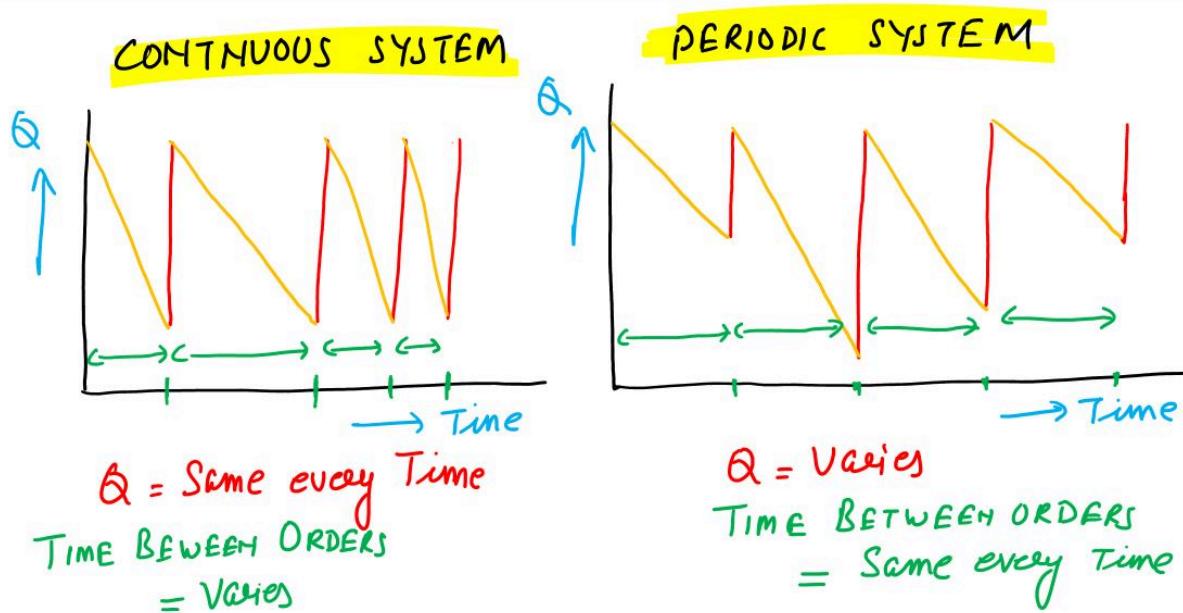
---

## 6. Inventory Control Systems

Inventory control systems focus on two essential questions: determining the optimal quantity to order and deciding the appropriate timing for placing orders.



The **how much to order** question involves selecting the right order quantity to balance between avoiding stockouts and minimizing holding costs. On the other hand, the **when to order** question revolves around identifying the most opportune moment to initiate replenishment, considering factors like reorder points and lead times.



Inventory control systems can broadly be divided into two types:

### 1. Continuous System (Fixed Order Quantity)

It is also called **Perpetual System**. This system demands consistent ordering of a predetermined quantity each time inventory levels hit a specified reorder point. It maintains a perpetual update of stock levels.

It is similar to ordering a new checkbook when the number of remaining checks reaches a specified point, ensuring continuous availability.

Similarly, Retailers employing an electronic inventory system that automatically places an order for a specific quantity of products as soon as the stock falls below a certain threshold.

### 2. Periodic Inventory System (Fixed Time Period)

It is also known as **Periodic Review System**. Orders are placed at regular time intervals, regardless of the current stock level, simplifying the replenishment process but potentially risking stockouts.

For example, a bakery receiving a bulk delivery of flour and sugar every Tuesday morning, ensuring a steady supply for the week and simplifying ordering logistics.

Similarly, an art supply store conducts a monthly review of its inventory and orders art materials every 30 days, providing a systematic approach to managing stock levels.

## 7. SKU

---

SKU stands for Stock Keeping Unit, and it is a unique code or identifier assigned to a specific product to distinguish it from other items in inventory. SKUs are crucial in inventory management as they provide a detailed and standardized way to track and manage individual products. Each SKU is associated with specific attributes of a product, such as size, color, style, and location.

Suppose a clothing retailer sells jeans, and a particular style is named "Classic Fit Jeans." The SKU for this product could be a combination of various attributes:

- **Style Code:** A unique identifier for the product, e.g., CLF01 (Classic Fit Jeans).
- **Size:** Different sizes of the jeans, such as S, M, L, XL.
- **Color:** Various color options, such as Blue, Black, or Grey.
- **Location:** The specific store or warehouse where the product is stocked.

So, a specific SKU for a pair of Classic Fit Jeans in Medium size, Blue color, located in Store A, could be represented as "CLF01-M-BLUE-StoreA." Each combination of these attributes creates a unique SKU, allowing the retailer to precisely identify and manage inventory at a granular level. This level of detail aids in accurate tracking, ordering, and restocking of products to meet customer demand efficiently.

---

## 8. Just-in-Time (JIT)

---

Just-in-Time (JIT) inventory management is a strategy that aims to minimize inventory levels by synchronizing production and delivery with actual customer demand. The goal of JIT is to have the right quantity of raw materials, components, or finished goods in the right place at the right time, eliminating excess inventory and associated carrying costs. JIT is often associated with lean manufacturing principles and is widely used in industries such as manufacturing and retail.

Key principles and characteristics of Just-in-Time inventory management include:

### Demand-Driven Production

JIT operates based on actual customer demand. Instead of producing goods in anticipation of future orders, production is triggered by customer orders, allowing for a more responsive and efficient manufacturing process.

### Reduced Lead Times

The focus is on minimizing the time between placing an order and receiving the finished product. This is achieved by streamlining production processes, reducing setup times, and optimizing workflows.

### Continuous Improvement

JIT emphasizes continuous improvement in all aspects of the production process. This includes identifying and eliminating waste, improving efficiency, and enhancing quality. Techniques such as Kaizen, 5S, and Total Quality Management (TQM) are often associated with JIT.

### Supplier Relationships

Strong relationships with reliable suppliers are crucial in JIT systems. Suppliers deliver components or materials just in time for production, helping to avoid the need for large inventories. These relationships are often built on trust, reliability, and quality assurance.

### Small Batch Sizes

JIT encourages smaller, more frequent production runs to match the actual demand. This approach reduces the need for large inventories of finished goods and allows for flexibility in responding to changing market conditions.

### Quality Control

Ensuring high-quality products is a fundamental aspect of JIT. By identifying and addressing quality issues promptly, the system avoids the production of defective goods and associated waste.

### Cross-Functional Teams

Collaboration among different functional areas within a company is essential in JIT. Cross-functional teams work together to streamline processes, reduce bottlenecks, and improve overall efficiency.

### Pull System

JIT often uses a pull system, where production is triggered by actual customer orders. This is in contrast to a push system, where goods are produced based on forecasts or speculative demand.

While JIT can lead to significant cost savings and improved efficiency, it requires careful planning, effective communication with suppliers, and a commitment to continuous improvement. Additionally, JIT systems may be vulnerable to disruptions in the supply chain, as they rely on a tightly coordinated network of suppliers and manufacturers.

---

# 1. Introduction

---

The prevalent and classic method for deciding the order quantity in a continuous system is the Economic Order Quantity (EOQ) model, also known as the economic lot-size model.

In this approach, when inventory reaches a predetermined level, termed as the **reorder point**, a consistent quantity is ordered. The period it takes for the ordered items to be delivered is known as the **Lead Time**.

Ford W Harris is credited with the earliest published derivation of the fundamental EOQ model formula in 1915.

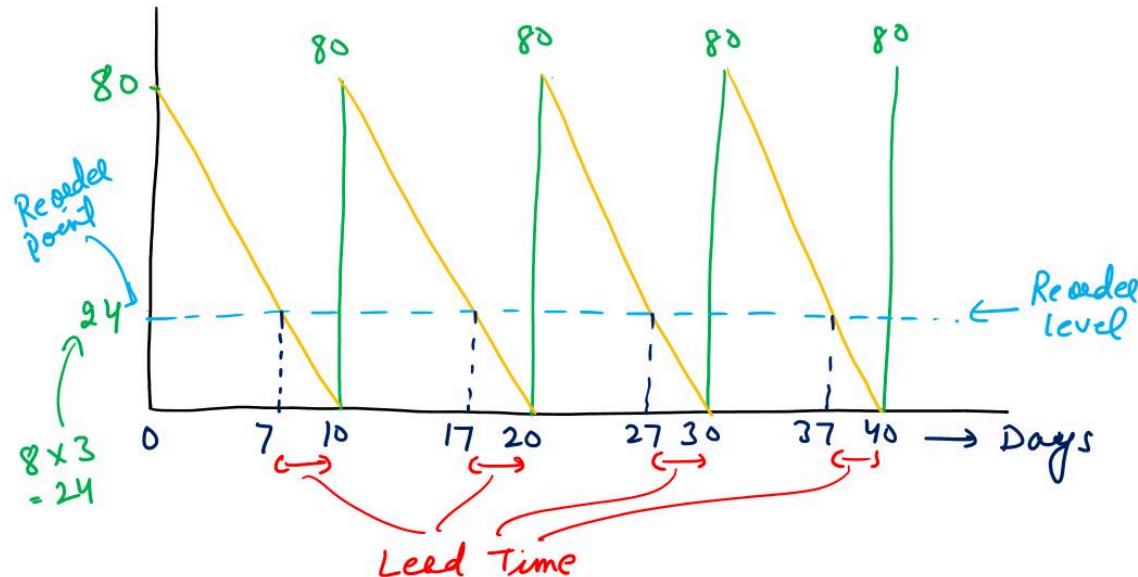
The EOQ, a type of the Continuous Inventory System, involves ordering a fixed quantity each time.

The EOQ model gives us that order size that minimizes the overall inventory costs.

---

## 2. Continuous Inventory System

Before going into EOQ, let us understand, how continuous inventory system works.



We will use the example of a shop selling Maggi packets.

Suppose the daily demand for Maggi packets is 8 units, and the delivery time (**lead time**) is 3 days.

Imagine today is Day 0, and the shop starts with an inventory stock level of 80 Maggi packets.

Since 8 units are sold every day, this inventory will last for 10 days, depleting by the evening of Day 10. To ensure a seamless supply, we want the inventory to be replenished by the morning of Day 11. However, placing an order on the evening of Day 10 won't suffice, as the supplier takes 3 days to deliver.

To ensure the new order arrives on the day the inventory is depleted, we need to place the order 3 days in advance, on Day 7. Extending this logic, future orders would be placed on Day 17, Day 27, Day 37, and so forth, ensuring replenishment on Day 20, Day 30, and Day 40, respectively. This cycle of ordering in advance and maintaining a reorder point repeats.

The specific days, such as Day 7, 17, 27, 37, are termed **Reorder Points**.

The inventory level on Day 7 equals the inventory needed for the next 3 days and is referred to as the **Reorder Level**. Thus, orders are placed when the inventory reaches this Reorder Level, ensuring a continuous and timely supply to meet customer demand.

## 3. Assumptions of EOQ

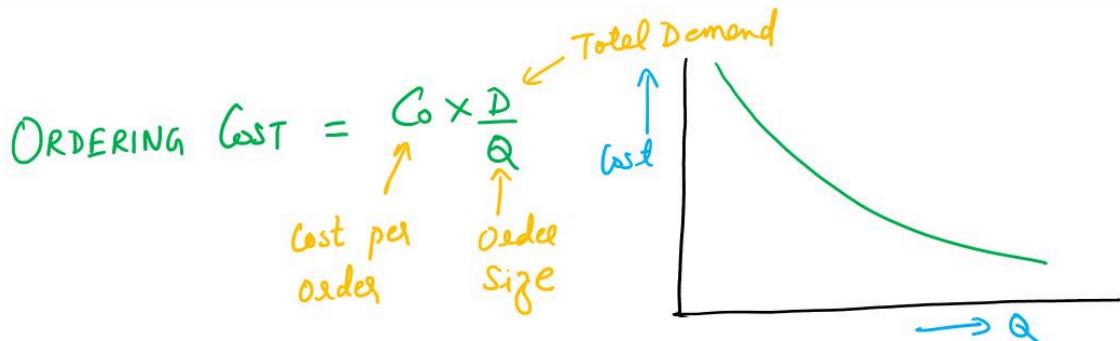
The Economic Order Quantity (EOQ) model relies on the following underlying **assumptions**:

1. Ordering costs remain constant.
2. The demand rate is known and uniformly distributed over the entire year.
3. Lead time remains fixed.
4. The purchase price of the item remains constant, without any discounts or quantity discounts considered.
5. Replenishment is instantaneous, with the entire order batch delivered at once.
6. The model considers only one product in its calculations.

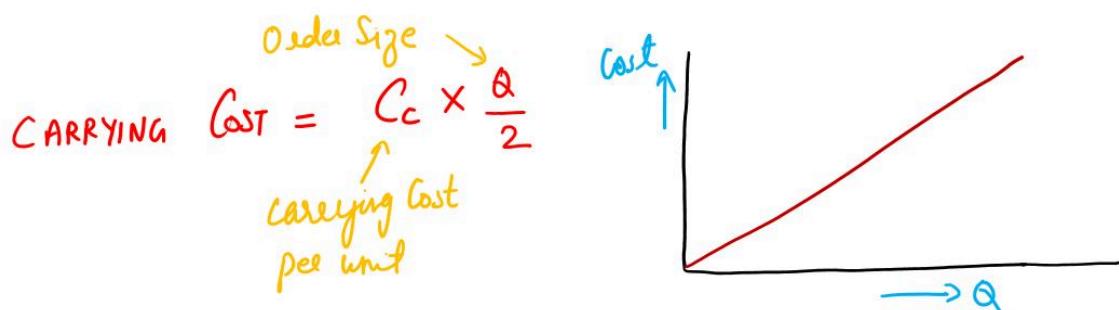
## 4. Economic Order Quantity

The Economic Order Quantity (EOQ) represents the optimal order quantity that minimizes the Total Cost (TC), which is the sum of Ordering Cost and Carrying Cost.

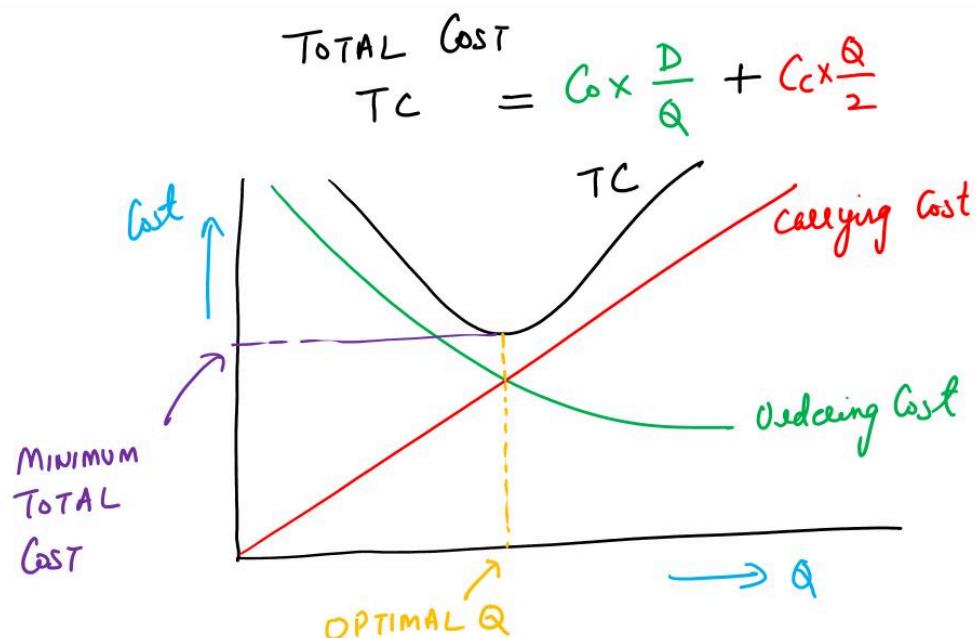
The Ordering Cost is given by following formula:



The Carrying Cost is given by following formula:



Total Cost (TC) is the sum of Ordering Cost and Carrying Cost.



Our objective is to find that  $Q$ , where the TC is minimum.

$$C_o \times \frac{D}{Q} = C_c \times \frac{Q}{2}$$

$$Q = \sqrt{\frac{2 C_o D}{C_c}}$$

OPTIMAL QUANTITY OR EOQ

This optimal order quantity occurs at the point in the Figure, where the TC curve is at a minimum, which coincides exactly with the point where the carrying cost curve intersects the ordering cost curve. This enables us to determine the optimal value of Q by equating the two cost functions and solving for Q.

$$\begin{aligned} TC &= C_o \times \frac{D}{Q} + C_c \times \frac{Q}{2} \\ \frac{\partial TC}{\partial Q} &= -C_o \frac{D}{Q^2} + \frac{C_c}{2} \\ \hookrightarrow \text{Equating to zero} \\ -C_o \frac{D}{Q^2} + \frac{C_c}{2} &= 0 \\ \Rightarrow Q &= \sqrt{\frac{2 C_o D}{C_c}} \end{aligned}$$

Alternatively, the optimal value of Q can also be determined by differentiating the total cost (TC) with respect to Q, setting the resulting function equal to zero (the slope at the minimum point on the total cost curve), and solving for Q.

## 4. Economic Order Quantity

### Illustration 1

The Asian Paints wants to determine the optimal order size and total inventory cost for Tractor Emulsion paint given an estimated annual demand of 10,000 litres of paint, an annual carrying cost of Rs 0.75 per litre, and an ordering cost of Rs 150 per order. They would also like to know the number of orders that will be made annually and the time between orders (i.e., the order cycle). The company processes orders for 311 days in a year.

Solution:

$$D = 10,000 \text{ litres annually}$$

$$C_c = \text{Rs } 0.75 \text{ per litre per annum} \rightarrow EOQ = \sqrt{\frac{2 C_o D}{C_c}}$$

$$C_o = \text{Rs } 150 \text{ per order}$$

$$= \sqrt{\frac{2 \times 150 \times 10,000}{0.75}} = 2000$$

$$T.C. = C_c \times \frac{Q}{2} + C_o \times \frac{D}{Q} = 0.75 \times \frac{2000}{2} + 150 \times \frac{10,000}{2000} = 1500$$

$$\text{Number of Orders} = \frac{10,000}{2000} = 5$$

$$\text{Order Cycle} = \frac{311}{5} = 62.2 \text{ days}$$

### Illustration 2

A building materials supplier obtains its bagged cement from a single supplier. Demand is reasonably constant throughout the year, and last year the company sold 2,000 tonnes of this product. It estimates the costs of placing an order at around Rs 25 each time an order is placed, and calculates that the annual cost of holding inventory is 20 per cent of purchase cost. The company purchases the cement at Rs 60 per tonne. How much should the company order at a time?

Solution:

$$D = 2000$$

$$C_o = \text{Rs } 25 \text{ per order}$$

$$C_c = 20\% \text{ of Rs } 60 = \text{Rs } 12$$

$$\rightarrow EOQ = \sqrt{\frac{2 C_o D}{C_c}} = \sqrt{\frac{2 \times 25 \times 2000}{12}} = 91.287 \text{ Tonnes}$$

### Illustration 3

Dell Computers stocks and sells a particular brand of personal computer. It costs the store ₹ 450 each time it places an order with the manufacturer for the personal computers. The annual cost of carrying the PCs in inventory is ₹ 170. The store manager estimates that annual demand for the PCs will be 1200 units. Determine the optimal order quantity and the total minimum inventory cost.

Solution:

$$D = 1200$$

$C_c$  = Rs 170 per annum

$C_o$  = Rs 450

$$\rightarrow EOQ = \sqrt{\frac{2 C_o D}{C_c}} = \sqrt{\frac{2 \times 450 \times 1200}{170}}$$

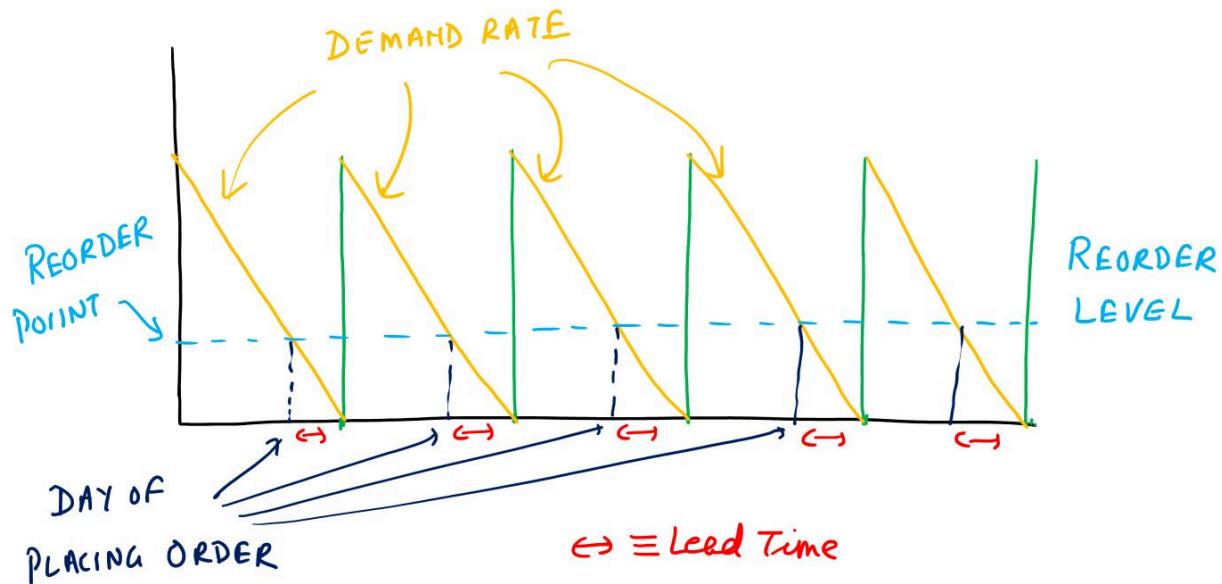
= 79.7 (approx 80 computers)

$$TC = C_o \frac{D}{Q} + C_c \frac{Q}{2} = 450 \times \frac{1200}{79.7} + 170 \times \frac{79.7}{2}$$

$$= \text{Rs } 13549.9$$

## 5. Reorder Level

In the case of the shop selling Maggi packets, as explored in our discussion of the continuous inventory system, we discovered the importance of placing orders well in advance to ensure that new stock arrives on the day the existing inventory is depleted.



This proactive approach is necessary due to the time it takes for the supplier to deliver the order, known as lead time.

The calculation for the appropriate inventory level at the time of order placement is expressed as:

$$\text{REORDER LEVEL} = \text{DEMAND RATE} \times \text{LEAD TIME}$$

In our example on the shop selling Maggi packets, the Reorder level will be:

$$\begin{aligned}\text{Reorder Level} &= 8 \text{ per day} \times 3 \text{ days} \\ &= 24 \text{ units}\end{aligned}$$

## 5. Reorder Level

### Illustration 1

The Asian Paints, in the previous example, is open 311 days per year. If annual demand is 10,000 litres of Tractor Emulsion paint and the lead time to receive an order is 10 days, determine the reorder point for paint.

Solution:

$$D = 10,000 \text{ litres} \quad L = 10 \text{ days}$$
$$\text{DEMAND RATE}(d) = \frac{10,000}{311} = 32.154 \text{ litres per day}$$
$$\text{REORDER LEVEL} = d \times L = 32.154 \times 10$$
$$= 321.54 \text{ litres}$$

### Illustration 2

The following information is given:

Expected usage of 100,000 units in a period of 250 days

Cost of processing an order Rs 20 per order

Carrying cost per unit Rs 0.50 for the period lead time on order: 5 days

The company wants to keep a reserve supply of 3 day's usage.

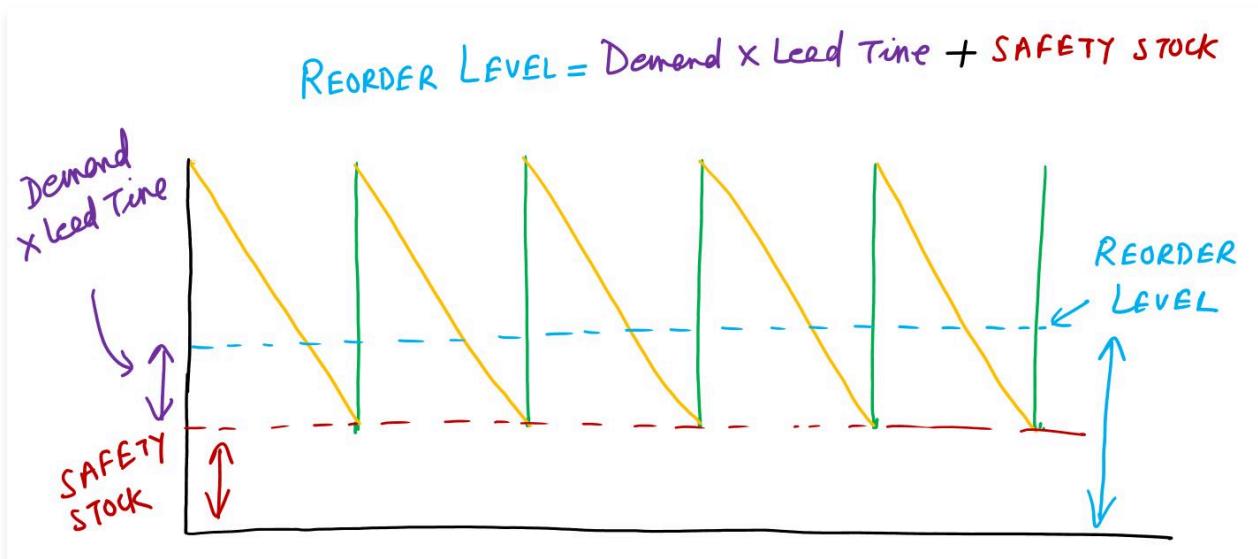
How many units will be included in the reorder point?

Solution:

$$D = 1,00,000 \quad C_c = 0.50 \quad C_o = 20 \quad L = 5 \text{ days}$$
$$\text{DEMAND RATE}(d) = \frac{1,00,000}{250} = 400 \text{ per day}$$
$$\text{SAFETY STOCK (for 3 days)} = 400 \times 3 = 1200$$
$$\text{REORDER LEVEL} = d \times L + \text{Safety stock}$$
$$= 400 \times 5 + 1200 = 3200 \text{ units}$$

## 6. Safety Stock

In what we have studied till now, the current calculation of Reorder Level assumes a scenario where the inventory reaches zero precisely on the day the new stock arrives. This assumption relies on the daily demand rate being constant and the supplier consistently taking the same lead time for delivery.



In reality, unforeseen variations may occur. What if the demand rate unexpectedly increases on certain days? Or what if the supplier encounters delays in transportation, extending the lead time?

To address such uncertainties, we introduce the concept of "Safety Stock," also known as "Buffer Stock" or "Reserve Stock."

Safety Stock serves as a protective buffer against unexpected variations in demand or delivery delays. It acts as a cushion, ensuring that even if demand surpasses expectations or if the supplier encounters delays, the store still has a reserve of inventory to meet customer needs. Its primary objective is to maintain a reliable and consistent level of product availability, safeguarding against unforeseen disruptions.

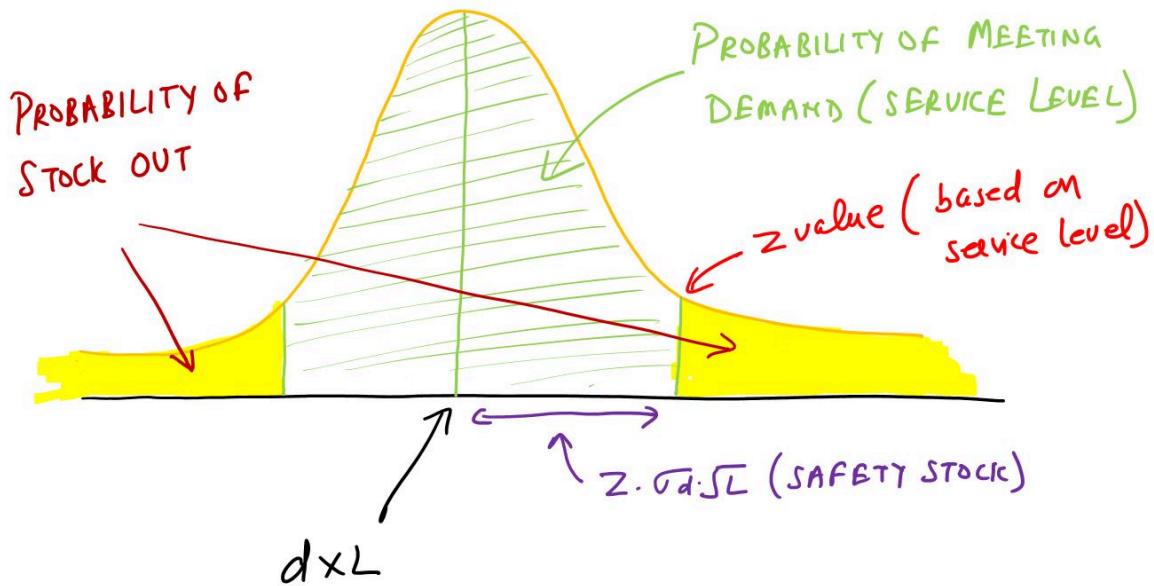
Thus, we can now rewrite the formula for Reorder Level, by making a provision for Safety Stock in it.

$$\begin{aligned}\text{REORDER LEVEL} &= \text{DEMAND RATE} \times \text{LEAD TIME} + \text{SAFETY STOCK} \\ &= d \times L + \text{Safety Stock}\end{aligned}$$

### Finding Safety Stock

One method to determine safety stock is to establish a safety stock that will meet a specified service level.

The service level is the probability that the amount of inventory on hand during the lead time is sufficient to meet expected demand, that is, the probability that a stockout will not occur. The term service is used, since higher the probability that inventory will be on hand, the more likely that customer demand will be met—that is, that the customer can be served.



A service level of 90% means that there is a 0.90 probability that demand will be met during the lead time, and the probability that a stockout will occur is 10%.

To compute the reorder point with a safety stock that will meet a specific service level, we will assume that:

- demand during each day of lead time is uncertain (variable),
- and can be described by a normal distribution.

With above assumptions, the Safety Stock is given by below formula:

$$\text{SAFETY STOCK} = z \cdot \sigma_d \cdot \sqrt{L}$$

Number of standard deviations corresponding to service level  
 Standard deviation of daily demand  
 Lead Time

Thus, we can revise our formula for Reorder Level as:

$$\begin{aligned}
 \text{REORDER LEVEL} &= d \times L + \text{SAFETY STOCK} \\
 &= d \times L + z \cdot \sigma_d \cdot \sqrt{L}
 \end{aligned}$$

## 6. Safety Stock

### Illustration 1

For the previous example on Asian Paints, we will assume that daily demand for Tractor Emulsion paint is normally distributed with an average daily demand of 30 litres and a standard deviation of 5 litres of paint per day. The lead time for receiving a new order of paint is 10 days. Determine the reorder point and safety stock if the store wants a service level of 95% — that is, the probability of a stockout is 5%. (the corresponding value of  $z$  is 1.65).

Solution:

$$\text{DEMAND RATE } (d) = 30 \quad \sigma_d = 5 \quad L = 10$$

FOR 95% SERVICE LEVEL  $\Rightarrow z = 1.65$

$$\begin{aligned} \text{SAFETY STOCK} &= z \cdot \sigma_d \sqrt{L} = 1.65 \times 5 \times \sqrt{10} \\ &= 26.1 \text{ litres} \end{aligned}$$

$$\begin{aligned} \text{REORDER LEVEL} &= d \times L + z \cdot \sigma_d \sqrt{L} \\ &= 30 \times 10 + 26.1 \\ &= 326.1 \text{ litres} \end{aligned}$$

## 1. Introduction

The ABC system of inventory classification is used to categorize and prioritize items in a company's inventory based on their importance.

The ABC system helps organizations allocate resources more efficiently by focusing attention on the most critical items. The classification is done by considering the economic value of each item in relation to the overall inventory.

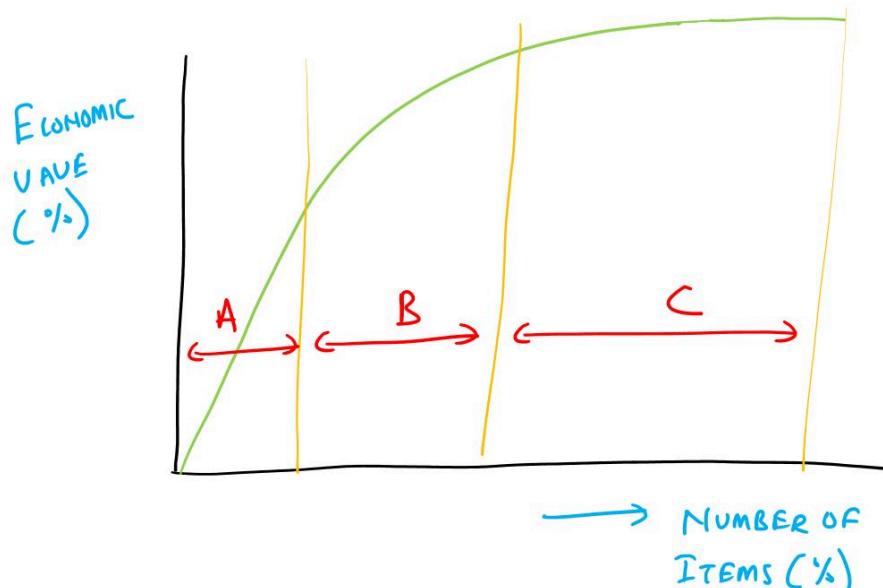
$$\begin{aligned} & \text{ANNUAL ECONOMIC VALUE} \\ & = \text{ANNUAL DEMAND} \times \text{UNIT COST} \end{aligned}$$

Then the items are classified into 3 categories:

**A Category** (Top 20%): High-value items contributing to approximately 80% of the total economic value.

**B Category** (Next 30%): Moderate-value items contributing to the next 15% of the total economic value.

**C Category** (Bottom 50%): Low-value items contributing to the remaining 5% of the total economic value.



The ABC classification allows organizations to prioritize their attention and tighter control (stringent monitoring, lower inventory levels, minimum safety stock) on managing the high-value items, while adopting more relaxed controls (less monitoring, higher inventory levels, higher safety stock) for lower-value items.

In general, A items frequently require a continuous control system, where the inventory level is continuously monitored; a periodic review system with less monitoring will suffice for C items.

This strategic approach helps in optimizing inventory management and improving overall efficiency.

## 2. Steps of ABC analysis

Let us understand the steps involved in the ABC system of inventory classification, using an example.

The maintenance department for a small manufacturing firm has responsibility for maintaining an inventory of spare parts for the machinery it services. The parts inventory, unit cost, and annual usage are as follows:

Part	Unit Cost (in Rs)	Annual Usage
1	60	90
2	350	40
3	30	130
4	80	60
5	30	100
6	20	180
7	10	170
8	320	50
9	510	60
10	20	120

As an operations manager, classify the inventory parts according to the ABC system to determine which stocks of parts should most closely be monitored.

### 1. Calculate Total Economic Value

Multiply the annual demand or usage quantity of each item by its unit cost to calculate the annual economic value. This represents the monetary value of each item in the inventory. Then represent total economic value of each item in percentages, in comparison to gran total economic value (Green). Also calculate the percentage of quantity for each item, in comparison to total quantities (Blue).

Part	Unit Cost (in Rs)	Annual Usage	ECONOMIC VALUE	% of TOTAL VALUE	% of TOTAL QUANTITY
1	60	90	5400	6.3	9
2	350	40	14000	16.4	4
3	30	130	3900	4.6	13
4	80	60	4800	5.6	6
5	30	100	3000	3.5	10
6	20	180	3600	4.2	18
7	10	170	1700	2.0	17
8	320	50	16000	18.7	5
9	510	60	30600	35.9	6
10	20	120	2400	2.8	12
				<u>100</u>	<u>100</u>

### 2. Rank Items by Total Economic Value

Sort the items in descending order based on their annual economic value. This ranking helps identify the items that contribute the most to the overall inventory value.

Part	Unit Cost (in Rs)	Annual Usage	ECONOMIC VALUE	% of TOTAL VALUE
1	60	90	5400	6.3 (4)
2	350	40	14000	16.4 (3)
3	30	130	3900	4.6 (6)
4	80	60	4800	5.6 (5)
5	30	100	3000	3.5 (8)
6	20	180	3600	4.2 (7)
7	10	170	1700	2.0 (10)
8	320	50	16000	18.7 (2)
9	510	60	30600	35.9 (1)
10	20	120	2400	2.8 (9)
			<u>100</u>	

### 3. Determine Cumulative Percentage

Calculate the cumulative percentage of the total annual economic value as you move down the ranked list.

PART No	% of TOTAL QUANTITY	Cumulative %
9	6	6
8	5	11
2	4	15
1	9	24
4	6	30
3	13	43
6	18	61
5	10	71
10	12	83
7	17	100

### 4. ABC Classification

Based on the cumulative percentage, classify the items into three categories:

A Category (Approx top 20% of quantities)

B Category (Next 30% of quantities):

C Category (Bottom 50% of quantities)

PART NO	TOTAL QUANTITY	Cumulative %	VALUE
9	6	6	$\frac{35.9 + 18.7 + 16.4}{3} = 71.0\%$
8	5	11	$\frac{35.9 + 18.7 + 16.4}{3} = 71.0\%$
2	4	15	$\frac{35.9 + 18.7 + 16.4}{3} = 71.0\%$
1	9	24	$\frac{6.3 + 5.6 + 4.6}{3} = 16.5\%$
4	6	30	$\frac{6.3 + 5.6 + 4.6}{3} = 16.5\%$
3	13	43	$\frac{6.3 + 5.6 + 4.6}{3} = 16.5\%$
6	18	61	$\frac{4.2 + 3.5 + 2.8 + 2.0}{4} = 12.5\%$
5	10	71	$\frac{4.2 + 3.5 + 2.8 + 2.0}{4} = 12.5\%$
10	12	83	$\frac{4.2 + 3.5 + 2.8 + 2.0}{4} = 12.5\%$
7	17	100	$\frac{4.2 + 3.5 + 2.8 + 2.0}{4} = 12.5\%$

A  $(9, 8, 2) \rightarrow 15\% \text{ items have } 71.0\% \text{ value}$

B  $(1, 4, 3) \rightarrow 28\% \text{ items have } 16.5\% \text{ value}$

C  $(6, 5, 10, 7) \rightarrow 57\% \text{ items have } 12.5\% \text{ value}$

### **3. Other classification models**

---

Some other classification models, similar to ABC, are:

#### **HML**

In this analysis, the classification of existing inventory is based on unit price of the items. They are classified as high, medium and low price items.

#### **VED**

In this analysis, the classification of existing inventory is based on criticality of the items. They are classified as vital, essential and desirable items. It is mainly used in spare parts inventory. Another version is VEIN (vital, essential, important and normal)

#### **FSN**

In this analysis, the classification of existing inventory is based consumption of the items. They are classified as fast moving, slow moving and non-moving items.

#### **SDE**

In this analysis, the classification of existing inventory is based on the items. They are classified as scarce, difficult and easily available items.

#### **GOLF**

In this analysis, the classification of existing inventory is based sources of the items. They are classified as Government supply, ordinarily available, local availability and foreign source of supply items.

#### **SOS**

In this analysis, the classification of existing inventory is based nature of supply of items. They are classified as seasonal and off-seasonal items.

#### **MUSIC-3D analysis**

It stands for Multi-Unit Selective Inventory Control—Three Dimensional approach, the three dimensions being finance, operations and materials.

---

# 1. Derivatives

---

A derivative is a financial contract whose **value depends on** (or is derived from) the price of an **underlying asset**.

You don't directly buy or sell the asset itself. Instead, you make a deal **based on how that asset's price will move in the future**.

---

## Underlying Assets Can Be:

- Stocks (e.g., Reliance shares)
- Commodities (e.g., gold, oil)
- Currencies (e.g., USD/INR)
- Interest rates
- Market indices (e.g., Nifty 50)

You are a jeweller in India and need to **buy 1 kg of gold** after 2 months to make jewellery for Diwali sales. You're worried that **gold prices might rise**.

### 💡 Current Situation:

- Today's gold price: ₹60,000 per 10 grams
- 1 kg = 1000 grams → ₹6,00,00,000 (₹60 lakh)

You want to **lock this price now** to avoid future risk.

---

### ➡ What You Do:

You buy a **gold futures contract** on the MCX (Multi Commodity Exchange) for 1 kg gold at ₹60,000/10g, with **delivery after 2 months**.

---

### ✓ What Happens Next:

After 2 Months Spot Price	Outcome
₹62,000	Price rose You still pay ₹60,000 → you saved ₹2,000 per 10g
₹58,000	Price fell You still pay ₹60,000 → you overpaid (but had price certainty)

---

## 2. Uses of Derivatives

---

Derivatives serve several important purposes in financial markets, offering various benefits to investors, corporations, and financial institutions.

Some key uses of derivatives include:

### Hedging

Derivatives allow investors and businesses to hedge against price fluctuations in assets, currencies, or interest rates. By entering into a contract, they can offset potential losses caused by adverse market movements.

A wheat farmer may enter into a contract to lock in a price for selling wheat in the future. This protects the farmer from a possible fall in wheat prices before the harvest, ensuring stable income.

### Speculation

Derivatives provide opportunities to speculate on the future direction of prices. Speculators use these contracts to profit from anticipated price changes, often using leverage to amplify potential returns.

An investor who expects the price of gold to rise may enter into a contract that increases in value if gold prices go up, allowing the investor to profit without holding physical gold.

### Risk Management

Corporations and financial institutions use derivatives to manage financial risks such as currency movements, interest rate changes, or commodity price volatility. These contracts help ensure predictable cash flows and stable financial performance.

A multinational company operating in different countries may enter into contracts to fix exchange rates, protecting itself from losses caused by unfavorable currency fluctuations.

### Arbitrage

Derivatives can also be used to take advantage of price differences between related markets. Arbitrageurs use contracts to buy in one market and sell in another, profiting from price mismatches without bearing significant risk.

An arbitrageur spots a price difference between a stock and its related contract. By buying in the cheaper market and selling in the more expensive one, they lock in a risk-free profit as prices move toward alignment.

---

## 3. Hedging

---

**Hedging** is a strategy used to **protect against potential financial losses** caused by unexpected changes in prices, interest rates, or currency exchange rates. It involves entering into a separate contract that moves in the **opposite direction** of the risk you are trying to manage.

The goal of hedging is **not to make a profit**, but to **reduce uncertainty** and ensure stability in income, costs, or asset values.

---

### Example:

A company that exports goods to the United States earns revenue in US dollars. If the US dollar weakens against the Indian rupee, the company will receive fewer rupees for the same amount of dollars. To protect itself from this risk, the company enters into a contract that ensures a fixed exchange rate. This way, even if the dollar weakens, the company's income in rupees remains stable.

---

## 3. Hedging

---

**Hedging** can be applied in two directions, depending on whether a person or business is expecting to **buy** or **sell** something in the future. Based on this, there are two types of hedging strategies:

---

### Long Hedge

A **long hedge** is used when a person or business plans to **buy** a product, commodity, or asset in the future and is worried that its **price may increase**.

-  **Objective:** To lock in current prices and protect against a **future price rise**.
-  **Example:** A biscuit manufacturing company needs to buy wheat after 2 months. It enters into a contract today to secure the price. If wheat prices rise later, the company is protected.

---

### Short Hedge

A **short hedge** is used when a person or business expects to **sell** a product or asset in the future and is worried that its **price may fall**.

-  **Objective:** To lock in current prices and protect against a **future price fall**.
  -  **Example:** A wheat farmer expects to harvest and sell wheat after 3 months. He enters into a contract today to lock in the selling price. If prices fall later, the farmer still receives the agreed price.
-

## 3. Hedging

---

A **natural hedge** is a risk-reduction strategy that arises automatically through a company's regular business operations, without the need for entering into any financial contract.

In simple terms, a natural hedge exists when a company's **expenses and revenues are in the same currency or move in the same direction**, so that gains in one area naturally offset losses in another.

---

### 💡 Example:

An Indian company **exports software to the U.S.** (earning in US dollars) and also **imports hardware from the U.S.** (paying in US dollars).

Even if the **exchange rate changes**, the impact on earnings is naturally balanced by the impact on costs.

Thus, the company is **naturally protected** against currency fluctuations without needing a separate financial contract.

---

## 3. Hedging

---

A **perfect hedge** is a situation where the risk of loss from price fluctuations is **completely eliminated** through a well-matched contract.

In a perfect hedge:

- The **quantity, timing, and nature** of the contract exactly match the exposure.
- Any gain or loss in the actual business is **fully offset** by the opposite movement in the contract.

---

### 💡 Example:

An Indian company knows it must pay **\$1 million** to a U.S. supplier exactly **3 months from now**.

To protect itself, the company enters into a contract today that guarantees it can buy \$1 million at a fixed exchange rate after 3 months.

Even if the currency rate changes during this time, the company's **payment in rupees remains the same**.

➡ This is a **perfect hedge**, because the amount, date, and terms of the contract **exactly match the underlying exposure**.

---

## 3. Hedging

---

A **financial hedge** is a strategy that involves using **financial contracts** to protect against potential losses caused by changes in prices, interest rates, exchange rates, or other market variables.

Unlike a **natural hedge**, which arises from normal business operations, a **financial hedge** is deliberately created using contracts to manage risk.

---

### Example:

A company has to pay **\$1 million** to a foreign supplier in 3 months.

To avoid the risk of the **foreign currency becoming more expensive**, the company enters into a **contract** today to fix the exchange rate.

Even if the currency rate rises, the company still pays at the agreed rate — its **cost is protected**.

---

## 4. Speculation

---

**Speculation** is the use of financial contracts to **profit from expected price movements** in the market. Unlike hedging, which focuses on reducing risk, **speculation involves deliberately taking risk** in the hope of earning higher returns.

Speculators do **not own the underlying asset** — they enter into contracts based on their **prediction** of future prices, interest rates, or currency movements.

---

### Example:

An investor believes that the price of gold will **rise** in the next two months.

Instead of buying physical gold, the investor enters into a **contract** that will gain value if the price of gold increases.

If the prediction is correct, the investor earns a **profit from the price rise**. If the price falls, the investor incurs a **loss**.

---

## 5. Arbitrage

---

**Arbitrage** is the practice of **buying and selling the same or related assets in different markets at the same time** to profit from price differences, with **no or very low risk**.

In arbitrage, the trader takes advantage of temporary **mispicing** — buying where the price is low and selling where the price is high — and earns a **risk-free profit** as the prices converge.

---

### Example:

A stock is trading at **₹500** on Exchange A and **₹505** on Exchange B.

An arbitrageur **buys the stock at ₹500 on A and sells it at ₹505 on B at the same time**.

The **₹5 difference per share** is a **risk-free profit** — assuming no transaction costs or delay.

---

## 6. Forward Contracts

---

A **forward contract** is a **customized agreement** between two parties to **buy or sell an asset at a specific price on a future date**.

It is a **private contract**, not traded on an exchange, and is tailored to meet the needs of both parties regarding **price, quantity, and delivery date**.

---

### Key Features:

- **Over-the-counter (OTC)**: Traded privately between two parties
- **Customized**: Flexible terms like amount, date, and price
- **No daily settlement**: Profits or losses are settled only at the end
- **Used for hedging or speculation**
- May carry **counterparty risk** (risk that one party defaults)

---

### Example:

An Indian importer expects to pay **\$1 million** to a U.S. supplier in 3 months.

To avoid the risk of the **rupee weakening**, he enters into a **forward contract** with a bank to buy \$1 million at a fixed rate of ₹83 per dollar.

No matter the actual rate after 3 months, he will pay ₹83 per dollar — protecting himself from currency risk.

---

## 7. Futures Contracts

---

A **futures contract** is a **standardized agreement** to buy or sell an asset at a predetermined price on a specified future date, traded on a **regulated exchange**.

Unlike forward contracts (which are private), **futures are public, transparent, and highly liquid**, and are settled **daily** through an exchange system.

---

### Key Features:

- **Standardized**: Terms like quantity, quality, and expiry date are fixed by the exchange
- **Exchange-traded**: Traded on platforms like NSE, BSE, MCX
- **Daily settlement (Mark-to-Market)**: Gains and losses are adjusted every day
- **Margin requirement**: Both parties must deposit an initial margin
- **Lower counterparty risk**: Clearing houses guarantee the transaction

---

### Example:

An investor expects the price of **Tata Motors stock** (currently ₹700) to rise.

They **buy a futures contract** today for delivery at ₹710 after 1 month.

If the stock price rises to ₹740, the investor gains ₹30 per share.

If it falls to ₹680, the investor loses ₹30 per share.

---

## 8. Mark-to-Market

---

Mark-to-Market (M2M) is the daily process of adjusting a trader's profit or loss based on the closing market price of a futures contract.

This means profits or losses are settled every day — not just at the end of the contract.

### Simple Example: Tata Motors Futures

- You buy 1 futures contract of Tata Motors at ₹700
- Lot size = 100 shares
- The contract has a 3-day life

Now let's see how M2M is calculated each day based on closing prices.

### Day-wise M2M Table

Day	Closing Price (₹)	Daily Change (₹)	M2M Profit/Loss (₹)	Cumulative P&L
Buy Day	₹700	-	-	₹0
Day 1	₹710	+₹10	₹10 × 100 = ₹1,000 profit	₹1,000
Day 2	₹695	-₹15	-₹15 × 100 = ₹1,500 loss	-₹500
Day 3	₹705	+₹10	₹10 × 100 = ₹1,000 profit	₹500 net gain

### What Happens Each Day:

-  Day 1: Price rose by ₹10 → Exchange credits ₹1,000 to your margin account.
-  Day 2: Price dropped by ₹15 → Exchange debits ₹1,500 from your account.
-  Day 3: Price rose again by ₹10 → ₹1,000 credited.

You receive or pay money daily, based on that day's market price.

At expiry, your final gain or loss is already realized through daily M2M adjustments.

### Key Points:

- Ensures daily profit/loss is settled — no surprises at expiry
- Helps maintain transparency and liquidity
- Requires traders to maintain sufficient margin daily
- Reduces default risk since losses are settled every day

## 8. Mark-to-Market

For a commodity, you are long futures contracts, established at an initial settle price of Rs 1,580. Over the subsequent four trading days, the commodity settles at Rs 1,587, Rs 1,582, Rs 1,573, and Rs 1,584, respectively. Compute the cash flows at the end of each trading day, and compute your total profit or loss at the end of the trading period.

Solution:

	DAY 0	DAY 1	DAY 2	DAY 3	DAY 4
VALUE	1580	1587	1582	1573	1584
CASH FLOW		7	-5	-9	11
TOTAL PROFIT = 1584 - 1580					7 - 5 - 9 + 11 = 4
					= 4

## 8. Mark-to-Market

You are short 25 gasoline futures contracts, established at an initial settle price of \$2.46 per gallon, where each contract represents 42,000 gallons. Over the subsequent four trading days, gasoline settles at \$2.42, \$2.47, \$2.50, and \$2.56, respectively. Compute the cash flows at the end of each trading day, and compute your total profit or loss at the end of the trading period.

Solution:

	DAY 0	DAY 1	DAY 2	DAY 3	DAY 4
VALUE	25,83,000	25,41,000	25,93,500	26,25,000	26,88,000
CASH FLOW		42,000	-52,500	-31,500	-63,000
TOTAL PROFIT = 25,83,000 - 26,88,000					= -1,05,000

## 9. Comparing Forward and Future contracts

---

Here's a comparison between Futures Contracts and Forward Contracts:

### Futures vs Forward Contracts

Feature	Futures Contract	Forward Contract
Trading Platform	Traded on organized exchanges (e.g., NSE, BSE)	Traded over-the-counter (OTC) — private agreement
Standardization	Standardized terms (lot size, expiry, quality, etc.)	Fully customized (flexible terms)
Settlement	Daily settlement via Mark-to-Market (M2M)	Settlement happens only at maturity
Counterparty Risk	Very low, guaranteed by the clearing house	Higher risk — depends on the reliability of counterparty
Liquidity	High — easy to enter or exit positions	Low — difficult to cancel or transfer
Margin Requirement	Yes — initial and maintenance margins required	Usually no margin, but full payment at end
Regulation	Regulated by exchanges and market regulators (e.g., SEBI)	Not formally regulated; based on mutual agreement
Usage	Common among traders, speculators, institutions	Mostly used by businesses and banks for hedging

### In Simple Terms:

- **Futures** = Public, standardized, safe, and liquid
- **Forwards** = Private, flexible, and customizable, but riskier

---

## 10. Swaps

---

A **swap** is a financial agreement between two parties to **exchange cash flows** or financial obligations over a period of time, based on **different financial terms** such as interest rates or currencies.

Swaps are typically used by **corporations, banks, and financial institutions** to manage **interest rate risk, currency risk, or credit exposure**.

---

In a swap, the parties **do not exchange the actual principal amount** — they only exchange **the interest or other cash flows** based on a notional value.

While swaps offer significant flexibility in their structure, they typically fall into 3 main categories: interest rate swaps, currency swaps, and credit default swaps.

---

## 10. Swaps

---

An **Interest Rate Swap** is a financial contract between two parties to **exchange interest payments** on a fixed notional amount — typically one pays a **fixed rate**, and the other pays a **floating rate**.

- The **principal amount is not exchanged**
- Only the **interest payments** are swapped
- These contracts are **customized** and traded over-the-counter (OTC)

---

### 🎯 Why Use an Interest Rate Swap?

To **manage interest rate risk** or to **convert** a loan from:

- **Fixed rate to floating rate**, or
- **Floating rate to fixed rate**

---

### 📌 Example:

**Scenario:**

- Company A has a ₹10 crore loan at **floating interest** (e.g., MCLR + 1%)
- Company B has a ₹10 crore loan at **fixed interest** (e.g., 7%)

**Objective:**

- A wants **fixed payments** for predictability
- B wants **floating payments** to benefit if rates fall

---

### 📋 Swap Agreement:

- A agrees to **pay 7% fixed interest** to B
- B agrees to **pay MCLR + 1% floating interest** to A

Now:

- A still pays floating to its bank, but receives the same amount from B → effectively pays **7% fixed**
- B still pays fixed to its bank, but receives fixed from A → effectively pays **floating**

➡ Both companies **swap their interest exposure** without refinancing their loans

---

## 10. Swaps

---

A **Currency Swap** is a financial agreement between two parties to exchange principal and interest payments in different currencies, typically over a long period.

It helps companies and institutions manage currency and interest rate risks when they operate or borrow in multiple countries.

### Key Characteristics:

- Involves exchange of principal amounts at the beginning and end
- Also involves regular exchange of interest payments
- Can involve fixed vs fixed, fixed vs floating, or floating vs floating interest payments
- Typically used in international borrowing or foreign investments

### Example:

#### Scenario:

- Indian company (A) needs to borrow \$1 million for 5 years
- U.S. company (B) needs to borrow ₹8.3 crore for 5 years
- Each company can borrow cheaply in its home country but needs funds in the other currency

### Currency Swap Agreement:

#### 1. Initial Exchange:

- A gives ₹8.3 crore to B
- B gives \$1 million to A

#### 2. Interest Payments (for 5 years):

- A pays interest on ₹8.3 crore to B (e.g., 8% annually)
- B pays interest on \$1 million to A (e.g., 4% annually)

#### 3. Final Exchange:

- At the end of 5 years, they return the principal amounts to each other

### Why Use a Currency Swap?

- Access cheaper foreign loans
- Match loan currency with revenue currency
- Hedge against exchange rate fluctuations
- Fix interest costs in both currencies

### Key Points:

Feature	Description
Principal Exchanged	Yes — at start and end of contract
Interest Payments	Paid regularly in each party's local currency
Purpose	Manage currency & interest rate risks
Typical Users	Multinational companies, governments, banks

## 10. Swaps

---

A Credit Default Swap (CDS) is a financial contract where one party **buys protection against the default of a borrower**, and the other party **sells that protection** in exchange for regular payments.

Think of it like **insurance** on a bond or loan — if the borrower defaults, the protection seller pays the loss.

### **Parties Involved:**

1. **CDS Buyer:** Pays regular premiums; receives compensation if default happens
2. **CDS Seller:** Receives premiums; pays out if default occurs
3. **Reference Entity:** The borrower (e.g., a company or government) whose default triggers the payment

### **Example:**

- A bank owns ₹100 crore worth of bonds issued by Company X.
- To protect itself from **credit risk**, the bank enters into a **CDS contract** with another institution.
- It agrees to pay 2% annual premium (₹2 crore) for 5 years.

### **Two outcomes:**

Event	What Happens
Company X does not default	Bank pays ₹2 crore/year; no payout from CDS seller
Company X defaults	CDS seller pays the bank ₹100 crore (or agreed loss value)

### **Why Use a CDS?**

- Hedge against **credit/default risk** on bonds and loans
- Transfer risk from one party to another
- Speculate on a company's **creditworthiness**
- Improve risk-based capital requirements

## 10. Swaps

ABC Company and XYZ Company need to raise funds to pay for capital improvements at their manufacturing plants.

ABC Company is a well-established firm with an excellent credit rating in the debt market; it can borrow funds either at 11 percent fixed rate or at LIBOR + 1 percent floating rate.

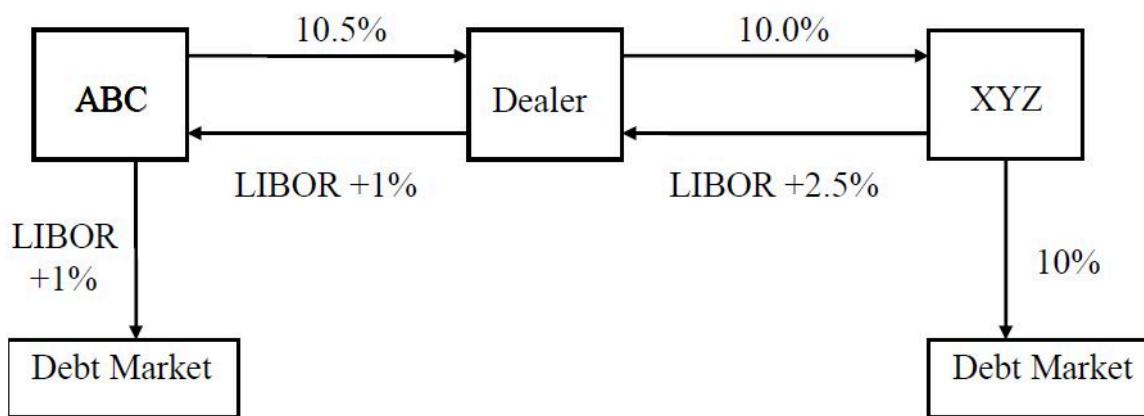
XYZ Company is a fledgling start-up firm without a strong credit history. It can borrow funds either at 10 percent fixed rate or at LIBOR + 3 percent floating rate.

- (i) Is there an opportunity here for ABC and XYZ to benefit by means of an interest rate swap?
- (ii) Suppose you've just been hired at a bank that acts as a dealer in the swaps market, and your boss has shown you the borrowing rate information for your clients, ABC and XYZ. Describe how you could bring these two companies together in an interest rate swap that would make both firms better off while netting your bank a 2 percent profit.

**Solution:**

(i) XYZ has a comparative advantage relative to ABC in borrowing at fixed interest rates, while ABC has a comparative advantage relative to XYZ in borrowing at floating interest rates. Since the spread between ABC and XYZ's fixed rate costs is only 1%, while their differential is 2% in floating rate markets, there is an opportunity for a 3% total gain by entering into a fixed for floating rate swap agreement.

(ii) If the swap dealer must capture 2% of the available gain, there is 1% left for ABC and XYZ. Any division of that gain is feasible; in an actual swap deal, the divisions would probably be negotiated by the dealer. One possible combination is 0.5% for ABC and 0.5% for XYZ.



# 11. Exotics

---

Exotics refer to a category of derivative contracts that possess more complex features compared to standard or "vanilla" derivatives (Swaps, options, forwards, and futures). These features can include non-standard expiration dates, unusual underlying assets, or complex payoff structures.

Exotic derivatives are often tailored to meet specific risk management or investment objectives of market participants. They can be designed to provide exposure to unique market factors or to hedge against specific risks that may not be adequately addressed by standard derivatives.

Let us discuss some of them:

## 1. Inverse Floaters

Inverse floaters are derivative securities whose interest payments move inversely with changes in an underlying benchmark rate, such as LIBOR. As the benchmark rate decreases, the interest payments on inverse floaters increase, and vice versa.

An inverse floater might pay an interest rate of 20 percent minus LIBOR. For instance, if LIBOR is 9 percent, the inverse floater pays  $20\% - 9\% = 11\%$ . If LIBOR rises to 12 percent, the payments on the inverse would fall to  $20\% - 12\% = 8\%$ .

## 2. Superinverse Floaters

Superinverse floaters are similar to inverse floaters but exhibit even more pronounced sensitivity to changes in the underlying benchmark rate. The interest payments on superinverse floaters move more than one-to-one with changes in the benchmark rate.

A superinverse floater might pay an interest rate of 30 percent minus twice LIBOR. If LIBOR is 10 percent, the superinverse floater pays  $30\% - (2 \times 10\%) = 10\%$ . If LIBOR falls by 3 percent to 7 percent, the return on the superinverse rises by 6 percent from 10% to 16%.

## 3. Caps

Caps are derivative instruments that provide protection against an increase in interest rates by setting a maximum or "capped" interest rate on a floating rate obligation.

A firm might purchase a 7 percent cap on its borrowing, meaning it would pay LIBOR plus any additional interest up to a maximum of 7 percent. If LIBOR rises above 7 percent, the cap pays the firm the difference between LIBOR and 7 percent.

## 4. Floors

Floors are derivative contracts that protect against a decrease in interest rates by setting a minimum or "floored" interest rate on a floating rate obligation.

A firm could purchase a floor with a limit of 7 percent, meaning it would receive payments from the floor if LIBOR falls below 7 percent. For instance, if LIBOR falls to 5 percent, the floor pays the firm the difference between 7 percent and 5 percent, effectively providing a minimum interest rate of 7 percent.

---

# 1. Options



An option is a contract between two parties: the buyer (who holds a long position), and the seller (who holds a short position). It is one of types of Derivatives.

It grants the owner the power to either buy (in the case of a call option) or sell (in the case of a put option) an asset (which could be a bond, stock, etc.) at a predetermined price known as the strike price or exercise price. This right can be exercised on or before a specified date. In return for this privilege, the owner pays a price called the premium to the seller. Importantly, the owner has the right to exercise the option but is not obligated to do so.

Let us break down this long definition with an example.

Consider you are interested in purchasing shares of ITC company, but you are not certain about its future performance. You decide to buy an option contract to give yourself flexibility.

## 1. Option is a Contract

You enter into an option contract. You're the buyer (holding a long position), and another party is the seller (holding a short position).

## 2. Right to Buy (Call option) or Sell (Put option)

You have two choices: a call option or a put option.

- (i) With a *call option*, you have the right (but not the obligation) to buy ITC shares at a predetermined price.
- (ii) With a *put option*, you have the right (but not the obligation) to sell ITC shares at a predetermined price.

## 3. Underlying Asset

The underlying asset is the shares of ITC. You're not buying or selling the shares yet; you're just securing the right to do so. The assets can be based on stocks, indexes, ETFs, futures contracts, currencies, bonds, commodities, and cryptocurrencies etc.

## 3. Predetermined Fixed Price (Strike Price)

Let's say the predetermined price for the call option is Rs 280 per share. This is called Strike Price or Exercise Price. This means you have the right to buy ITC shares at Rs 280 per share if you choose to exercise the option. Exercising the option means the act of buying or selling the underlying asset via the option contract.

## 4. Given Date (Expiration Date)

The option contract has an expiration date. The expiration date of an option, for instance, August 24, 2025, can be categorized into 3 types:

- (i) *American Options*: These options provide the holder with the right to exercise at any time between the purchase date and the expiration date.
- (ii) *European Options*: In contrast to American options, European options only allow exercise at the expiration date itself. This means the holder cannot exercise the option before the expiration date.
- (iii) *Bermudan Options*: Bermudan options fall between American and European options regarding exercise flexibility. They allow the holder to exercise the option on specific dates before the expiration date. These dates are predetermined and specified in the option contract.

### **5. Price for this right (Premium)**

In exchange for the option contract, you pay a premium to the option seller. Let us say the premium is Rs 10 per share.

### **6. No Obligation**

Importantly, as a buyer of option, you're not obligated to exercise your option. If the stock price doesn't move as expected or if you change your mind, you can let the option expire without taking any action.

Remember that the seller of option (writer) must honour the contract, if required to do so by the buyer of the option (holder/owner). Notice that the seller of option is obligated to do so.

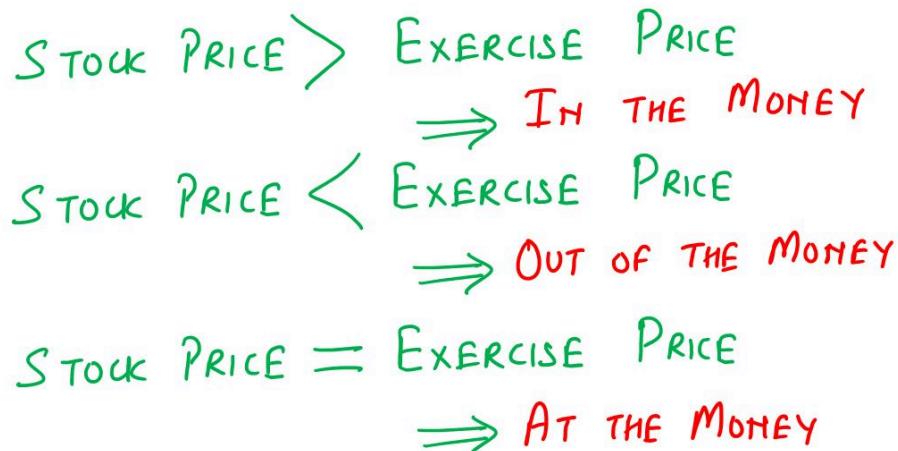
So, in summary, by buying an option contract, you're paying a premium for the right (but not the obligation) to buy or sell a specific asset at a predetermined price on or before a specified date. This gives you flexibility and potential profit opportunities without requiring you to commit to buying or selling the asset outright.

---

## 2. Call Option

A call option grants the holder (also called owner of option or buyer of option) the right to purchase an asset at a predetermined price within a specified timeframe.

For instance, let us consider your intention to acquire 100 shares of ITC, on or before August 24, 2025, at Rs 280 per share under an American option. You anticipate the market price to exceed Rs 280 per share on any day leading up to August 25, 2025. To secure this purchasing right at the fixed price of Rs 280, you pay a premium of Rs 10 per share to seller of the option.



There can be 3 potential scenarios at the time of exercising the option:

### In the Money

If the market price of ITC stock rises to above Rs 280, say Rs 300, you would want exercise your option, realizing a profit of Rs 20 per share (ignoring premium paid). This is termed as being in the money. If the stock price is greater than the exercise price, we say that the call is in the money.

The value of this call option will be Rs 20, when market price of the share is Rs 300. The value will be Rs 30, when market price of the share is Rs 310. The value will be Rs 40, when market price of the share is Rs 320. Thus, the value will keep increasing with increase in the market price of the share.

### Out of the Money

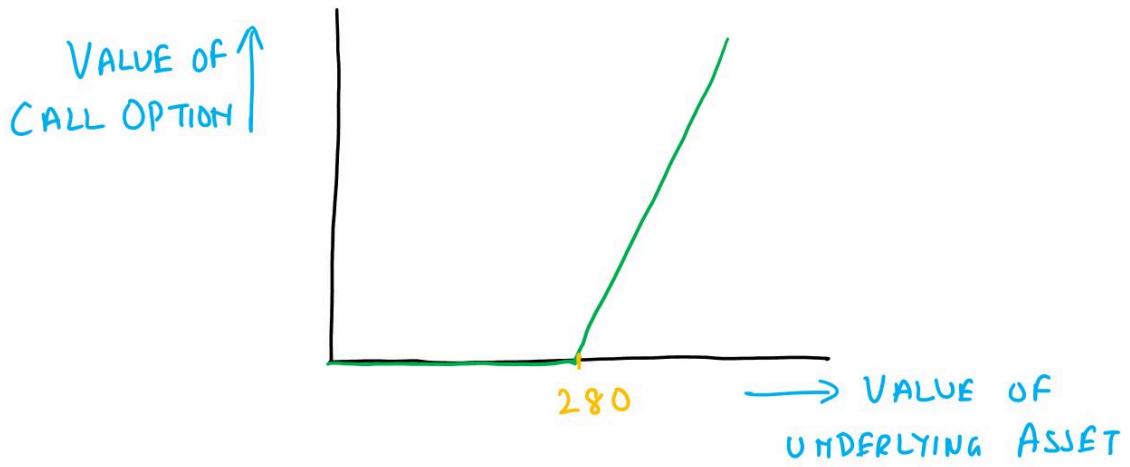
Conversely, if the market price drops below Rs 280, say Rs 240, you would opt not to exercise your option, as there's no obligation to do so. You will simply walk away. This situation is termed as being out of the money. If the stock price is lesser than the exercise price, we say that the call is out of the money.

The value of this call option will be Zero, when market price of the share below Rs 280.

### At the Money

Should the market price remain at Rs 280, matching the exercise price, it's termed as being at the money. In such a case, you may or may not exercise the option.

The value of this call option will be Zero, when market price of the share is equal to Rs 280.



### Summary

The figure plots the value of the call option at expiration against the value of ITC's stock. This is referred to as the *hockey stick diagram* of call option values. If the stock price is less than Rs 280, the call is out of the money and worthless. If the stock price is greater than Rs 280, the call is in the money and its value rises one-for-one with increases in the stock price. Notice that the call can never have a negative value (the lowest value can be zero only). It is a limited liability instrument, which means that all the holder can lose is the initial amount she paid for it.

---

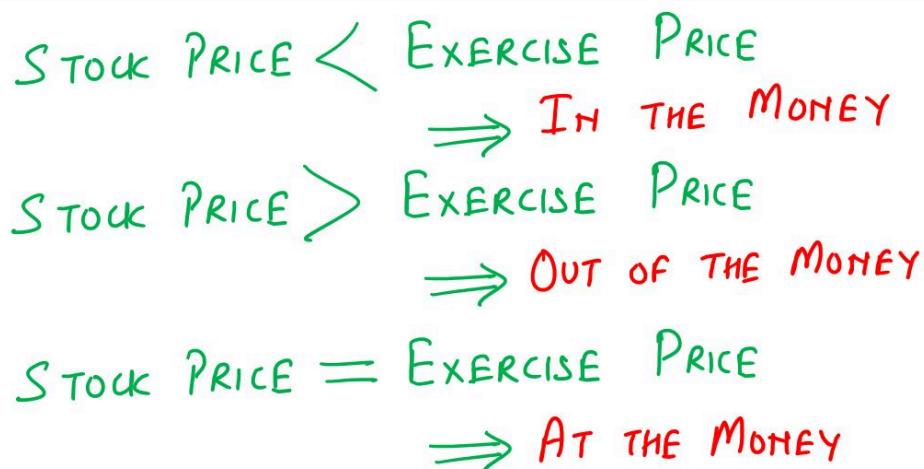
### 3. Put Option

A put option can be viewed as the opposite of a call option. Just as a call gives the holder the right to buy the stock at a fixed price, a put gives the holder the right to sell the stock for a fixed exercise price.

A put option grants the holder (also known as the owner or buyer of the option) the right to sell an asset at a predetermined price within a specified timeframe.

Remember, you (say Abhinav) are buyer of the put option and you get "right to sell" from the seller of the option (say Ayushi).

For example, suppose you intend to SELL shares of Infosys on March 10, 2025, at Rs 1800 per share. You will do so, only when you anticipate the market price to fall below Rs 1800 per share. To secure this selling right at the fixed price of Rs 1800, you pay a premium of Rs 50 per share to the seller of the option (Ayushi).



There can be 3 potential scenarios at the time of exercising the option:

#### In the Money

If the market price of Infosys stock drops below Rs 1800, say Rs 1500, you would be happy to exercise your option. On March 10, 2025, you will buy Infosys shares from the market for a price of Rs 1500, and sell them to Ayushi for a price of Rs 1800, on the same day, realizing a profit of Rs 300 per share (ignoring premium paid). This is termed as being in the money. If the stock price is less than the exercise price, we say that the put is in the money.

The value of this put option will be Rs 300 when the market price of the share is Rs 1500. The value will be Rs 1700 when the market price of the share is Rs 100. The value will keep increasing with decreases in the market price of the share.

#### Out of the Money

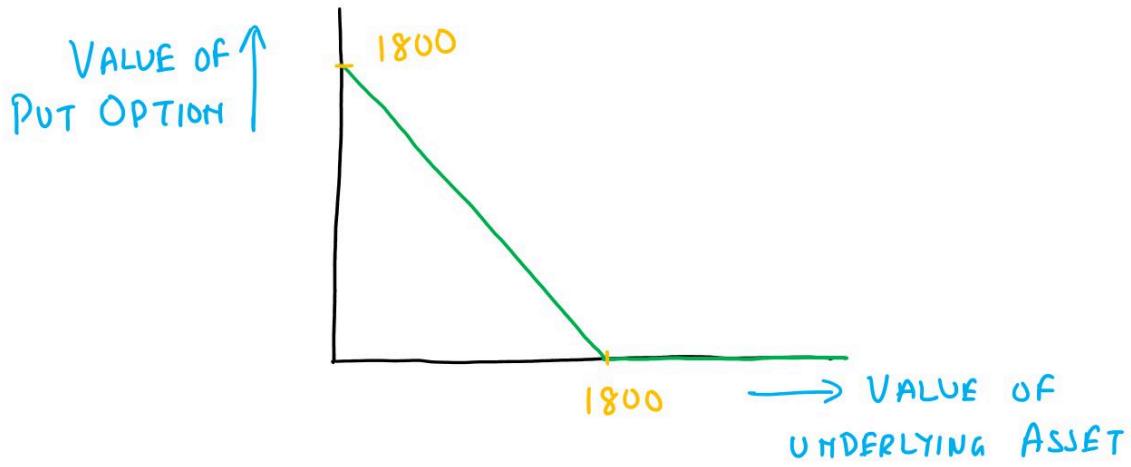
Conversely, if the market price rises above Rs 1800, say Rs 1900, you would not like to exercise your option, as there's no obligation to do so. This situation is termed as being out of the money. If the stock price is greater than the exercise price, we say that the put is out of the money.

The value of this put option will be zero when the market price of the share is above Rs 1800.

#### At the Money

Should the market price remain at Rs 1800, matching the exercise price, it's termed as being at the money. In such a case, you may or may not exercise the option.

The value of this put option will be zero when the market price of the share is equal to Rs 1800.



### Summary

The figure illustrates the value of the put option at expiration against the value of Infosys's stock.

If the stock price is higher than Rs 1800, the put is out of the money and worthless. Its value is zero. If the stock price is less than Rs 1800, the put is in the money, and its value rises one-for-one with decreases in the stock price.

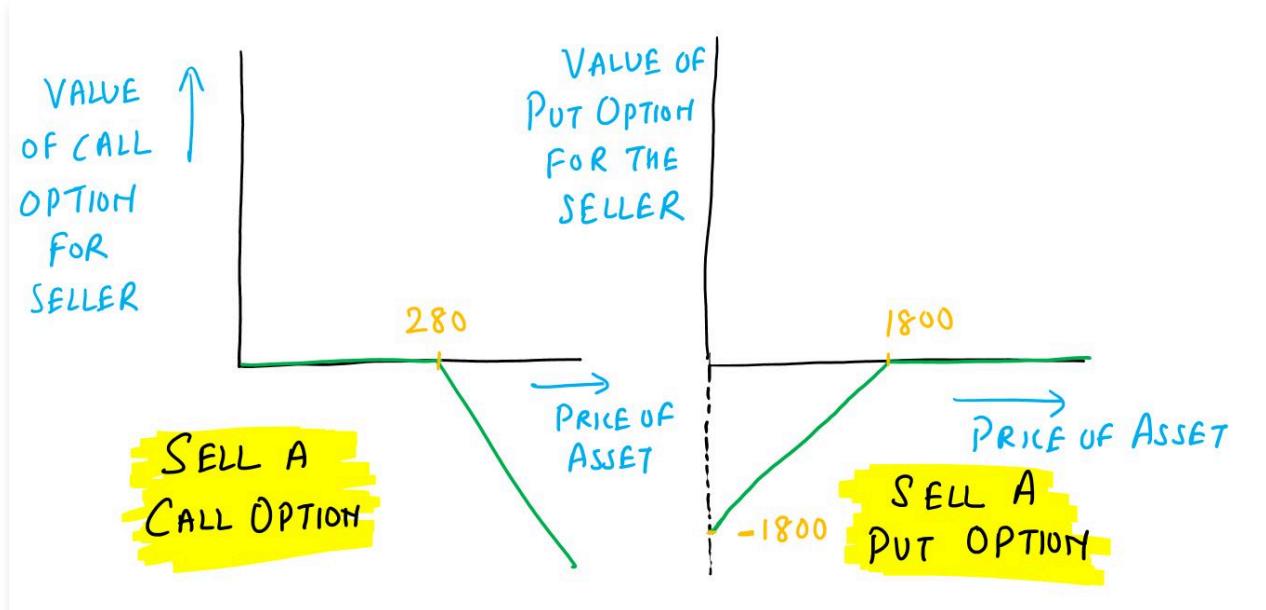
The put option can never have a negative value; its lowest value can only be zero. It is a limited liability instrument, meaning that the maximum loss for the holder is the initial premium paid.

---

## 4. Seller of Options

Till now, we have discussed everything from the perspective of the *buyer of the option*. Let us now look at *seller of option*.

When an investor sells an option, whether it's a call or put, *they are obligated* to fulfill the terms of the contract if the buyer chooses to exercise it. This means that the seller must honor their commitment as required by the option holder, without exception.



### Seller of Call Option

Suppose the Seller of Call Option is Sumita and Buyer of Call Option is Babita.

At the expiration date, if the stock price surpasses the exercise price, the call option holder (Babita) will execute the call. It will be must for Sumita (seller of the call option) to provide shares at the exercise price. Consequently, Sumita incurs a loss equal to the difference between the stock price and the exercise price.

For instance, suppose the ITC stock price reaches Rs 320 while the exercise price stands at Rs 280. Anticipating exercise, the Sumita purchases stock at Rs 320, ultimately losing Rs 40 as she's obligated to sell at Rs 280 to Babita. Conversely, if the stock price falls below the exercise price by expiration, Sumita bears no liability.

Despite the apparent risk, why would a call option seller (Sumita) assume such a position? The answer lies in the premium received for taking on this risk. This premium compensates for potential losses incurred by Sumita if the stock price exceeds the exercise price.

The position of 'Seller of Call Option- Sumita' is illustrated in the accompanying figure. It indicates that while the Sumita doesn't incur losses if the stock price remains below Rs 280, for each dollar increase above Rs 280, she seller loses a corresponding dollar.

### Seller of Put Option

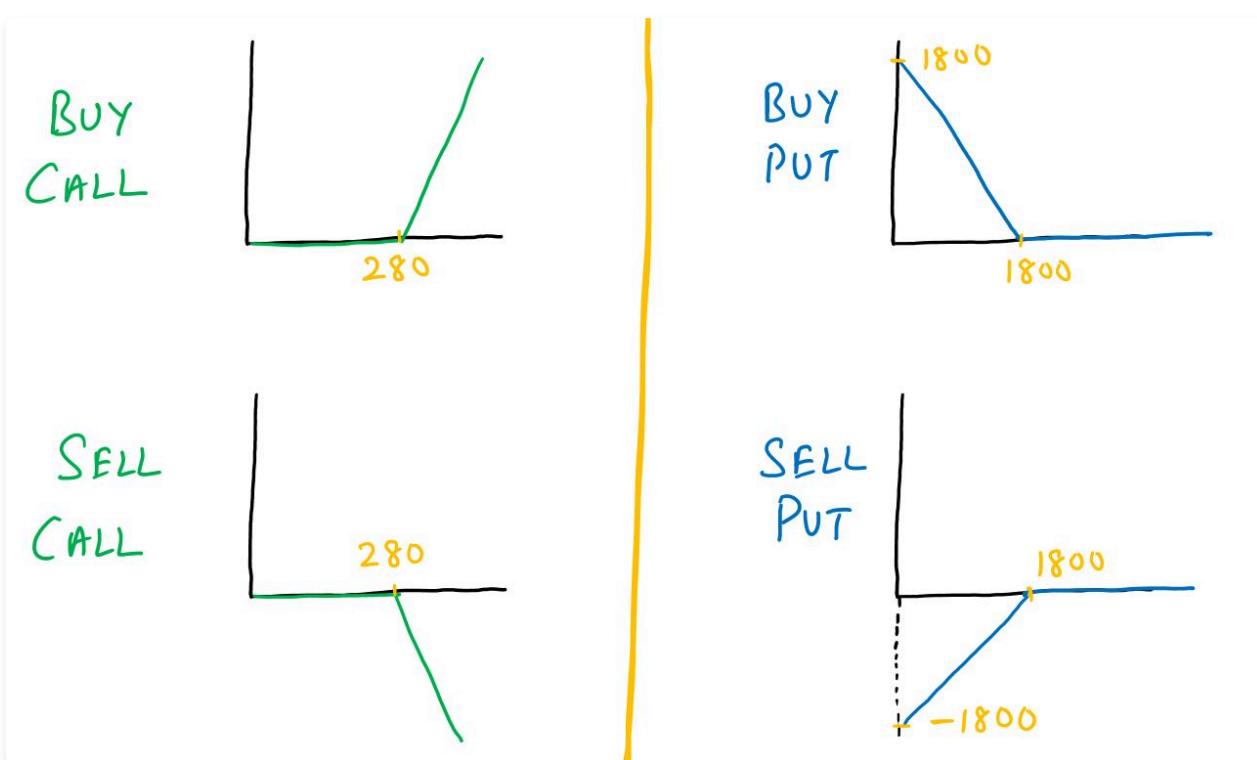
In contrast, let's examine the seller of a put option. Suppose the Seller of Call Option is Somesh and Buyer of Call Option is Bikram.

When an investor sells a put, they commit to purchasing shares if the put holder exercises their right. The seller experiences a loss if the stock price declines below the exercise price.

For example, consider Infosys stock priced at Rs 1200 with an exercise price of Rs 1800. If the put holder (Bikram) exercises, selling the stock at Rs 1800, Somesh must buy it at the same price. With the stock valued at Rs 1200, Somesh incurs a Rs 600 loss.

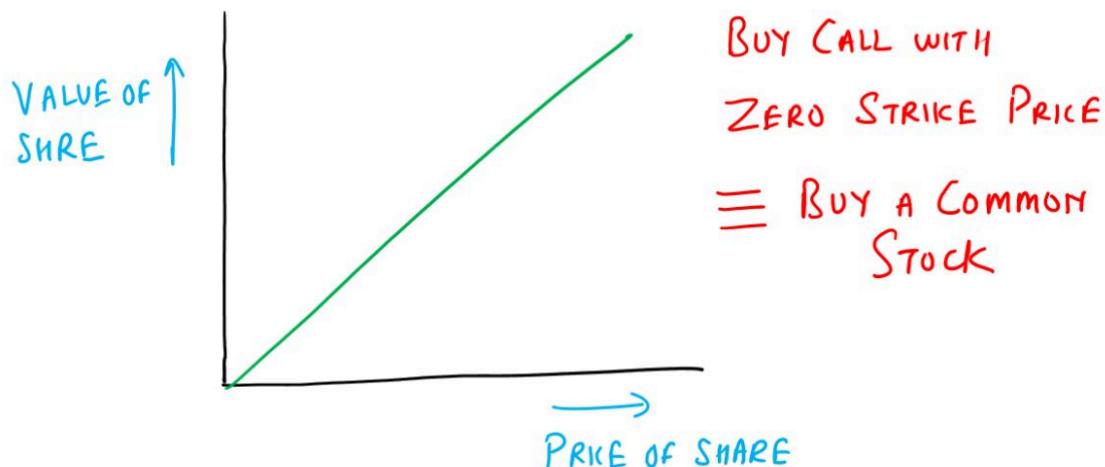
The figure depicting the "sell-a-put" position illustrates that while Somesh faces no losses if the stock price exceeds Rs 1800 at expiration, for each dollar decrease below Rs 1800, the Somesh suffers a corresponding dollar loss.

## 5. Zero Sum Game



It may be noted that the graph of selling a call is the mirror image of the graph of buying a call. This occurs because options are a *zero-sum game*. The seller of a call loses what the buyer makes.

Similarly, the graph of selling a put is the mirror image of the graph of buying a put. Again, the seller of a put loses what the buyer makes.



Consider a call option with an exercise price of zero. In this scenario, the call holder has the right to buy the stock at no additional cost. Effectively, if the exercise price is zero, the call holder can acquire the stock for nothing, as they can exercise the option to buy shares at no extra expense. Thus, owning a call option with an exercise price of zero essentially replicates owning the stock itself. Therefore, buying the stock is equivalent to buying a call option with an exercise price of zero, as both grant you ownership rights in the underlying asset.

## 6. Summary- Call and Put

---

The (buyer/seller) of a (put/call) option (pays/receives) money for the (right/obligation) to (buy/sell) a specified asset at a fixed price for a fixed length of time.

### Buyer of Call Option

- A call option confers the right, without the obligation, to buy an asset at a given price on or before a given date.
- The buyer of a call option pays money for the right to buy.
- You would buy a call option if you expect the price of the asset to increase.
- A call option has unlimited potential profit.
- Buy Call option is also called Long Call

### Buyer of Put Option

- A put option confers the right, without the obligation, to sell an asset at a given price on or before a given date.
- The buyer of a put option pays money for the right to sell.
- You would buy a put option if you expect the price of the asset to decrease.
- A put option has limited potential profit; the underlying asset's price cannot be less than zero.
- Buy Put option is also called Long Put.

### Seller of Call and Put Options

- The seller of a call option receives money for the obligation to sell.
  - The seller of a put option receives money for the obligation to buy.
  - Sell Call option is also called Short Call. Sell Put option is also called Short Put.
- 

## 6. Summary- Call and Put

---

Suppose a financial manager buys call options on 50,000 barrels of oil with an exercise price of \$95 per barrel. She simultaneously sells a put option on 50,000 barrels of oil with the same exercise price of \$95 per barrel. Consider her gains and losses if oil prices are \$90, \$92, \$95, \$98, and \$100. What do you notice about the payoff profile?

Solution:

PRICE	CALL OPTION	PUT OPTION	NET PAYOFF
90	0	-5	-5
92	0	-3	-3
95	0	0	0
98	3	0	3
100	5	0	5

---

## 7. Naked and Covered Options

---

### Naked Options

Naked options, also known as uncovered options, refer to options positions where the trader sells options contracts without holding an offsetting position in the underlying asset.

For call options, selling a naked call means the trader sells call options on an asset they don't own. They profit if the price of the underlying asset remains below the strike price at expiration but face unlimited potential losses if the price rises substantially.

For put options, selling a naked put means the trader sells put options without holding the underlying asset. They profit if the price of the underlying asset remains above the strike price at expiration but face potential losses if the price falls below the strike price.

### Covered Options

Covered options, on the other hand, refer to options positions where the trader holds an offsetting position in the underlying asset.

For covered calls, the trader sells call options on an asset they already own. This position is considered covered because the trader can deliver the underlying asset if assigned.

For covered puts, the trader writes put options on an asset they are willing to purchase if assigned. This position is covered because the trader has the cash or margin to buy the underlying asset if necessary.

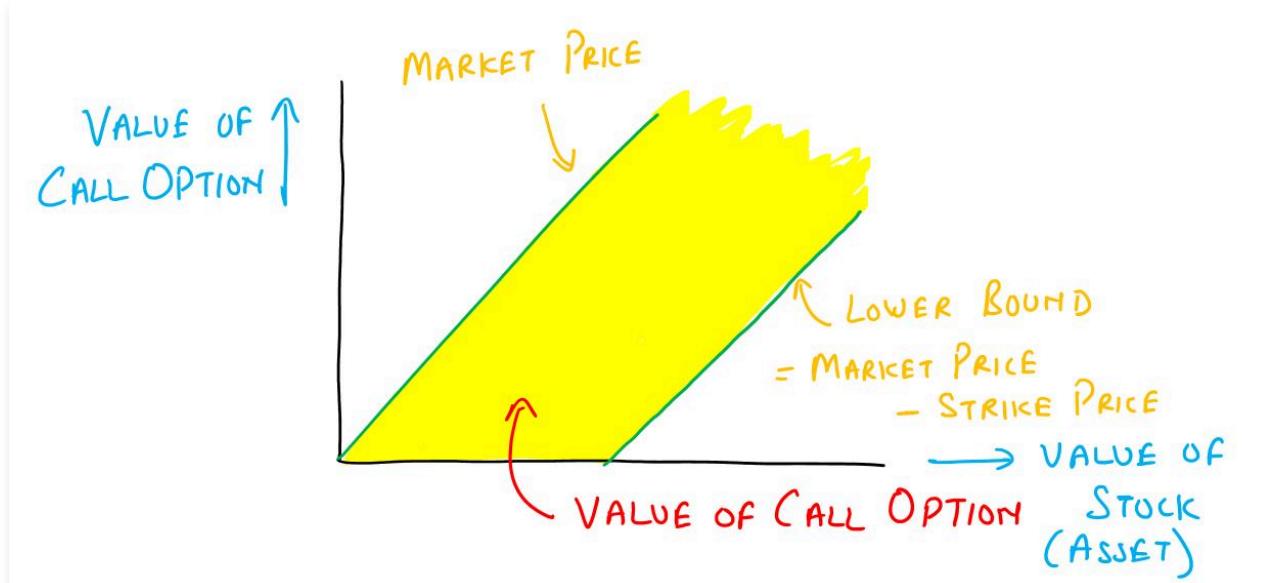
Covered options strategies are generally less risky than naked options strategies because the trader holds an offsetting position in the underlying asset, reducing the potential for unlimited losses.

---

## 8. Value of an Option

Determining the value of an option is a crucial aspect of options trading.

Let us consider a scenario where we aim to ascertain the **value of a call option**, specifically one that is "in the money" before its expiration. In this scenario, let us assume we're dealing with an American call option, where the current stock price is Rs 60, and the exercise price of the call option is Rs 50.



### Minimum Value

First thing, it is important to recognize that the value of the call option cannot fall below a certain threshold, which is the difference between the current stock price and the exercise price. In this case, that threshold is Rs 10. If the option were priced lower than Rs 10, it would create **arbitrage** opportunities.

For instance, if the option were priced at Rs 8, an investor could exploit this arbitrage opportunity by purchasing the call option for Rs 8, acquiring the underlying stock for Rs 50, and selling it in the market for Rs 60. This would result in an instant profit of Rs 2, as the total cash outflow would be Rs 58 (Rs 50 for the stock purchase + Rs 8 for the call option), yielding a profit of Rs 2 (60-58).

Therefore, the value can not dip below the difference between the current market price and the exercise price. However, in practice, the actual price of the call option is likely to exceed this minimum value of Rs 10. Investors may be willing to pay more than Rs 10 because if they anticipate the possibility of the stock price rising further before the option's expiration.

For example, if the call option were priced at Rs 12, its intrinsic value would still be Rs 10 (the difference between the market price and the exercise price). The additional Rs 2 represents the **time premium**, reflecting the extra amount investors are willing to pay due to the potential for further stock price appreciation before the option expires.

In summary, the value of a call option comprises its intrinsic value and a time premium (also called extrinsic value).

## VALUE OF CALL / PUT OPTION

= INTRINSIC VALUE + TIME PREMIUM

FOR CALL

$$\text{Max.} \{ \text{Stock Price} - \text{Strike Price}, 0 \}$$

FOR PUT

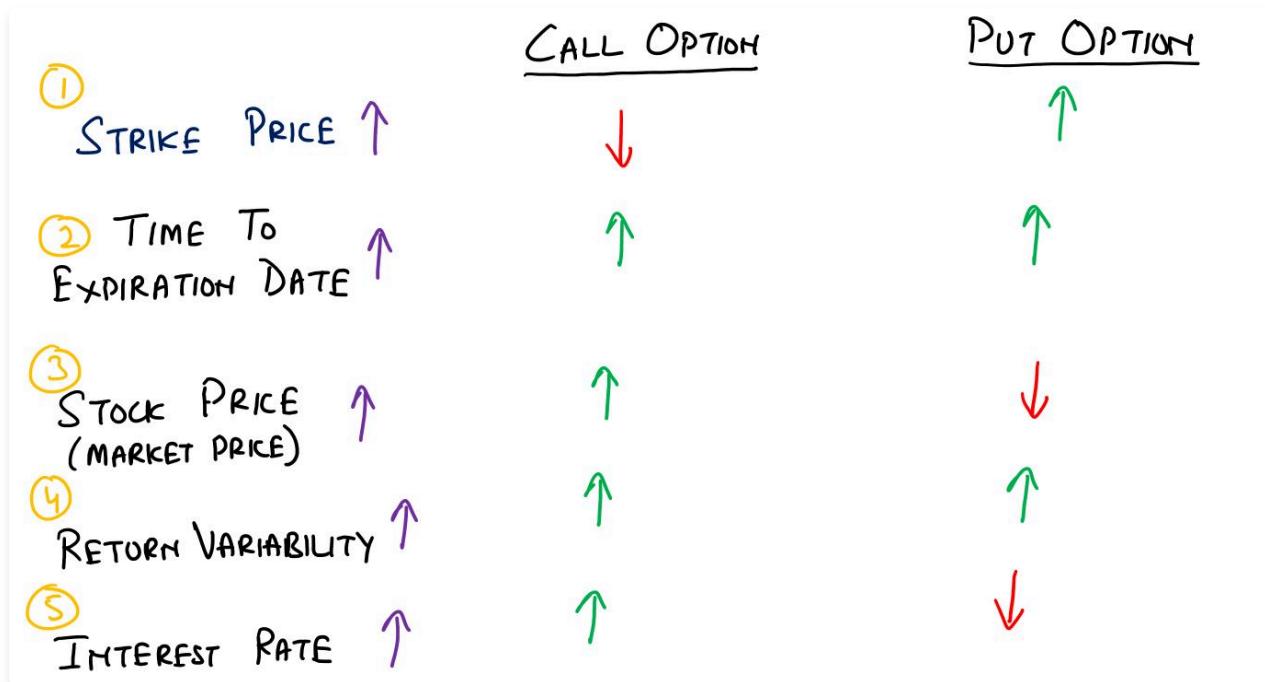
$$\text{Max.} \{ \text{Strike Price} - \text{Stock Price}, 0 \}$$

### Maximum Value

The upper limit of a call option's value is determined by the price of the underlying stock. The value of an option to buy common stock cannot exceed the value of the stock itself. This is because a call option grants the holder the right to purchase common stock at a predetermined exercise price. Opting to exercise the call option to buy stock would be imprudent if the same stock could be bought directly from the market at a lower price.

	CALL	PUT
IN THE MONEY	$S > E$ +ve	$S < E$ +ve
AT THE MONEY	$S = E$ 0	$S = E$ 0
OUT OF THE MONEY	$S < E$ 0	$S > E$ 0
	$S = \text{STOCK PRICE}$	$E = \text{EXERCISE PRICE}$
		INTRINSIC VALUE

## 8. Value of an Option



Let us delve deeper into 5 factors that determines the value of options:

### 1. Exercise Price

Also known as the strike price, the exercise price is the price at which the underlying asset can be bought (for call options) or sold (for put options) upon exercise of the option contract.

For call options, an increase in the exercise price reduces the option's value, as it becomes less favorable to buy the underlying asset at a higher price.

Conversely, for put options, an increase in the exercise price increases the option's value, as it becomes more attractive to sell the underlying asset at a higher price.

### 2. Expiration Date

The expiration date represents the end of the option contract period.

Generally, the longer the time until expiration, the greater the probability that the option will be profitable, especially if the underlying asset's price moves favorably. Therefore, options with longer expiration periods have higher values. This is true for both call options and put options.

Obviously, the 9-month call has the same rights as the 6-month call, and it also has an additional 3 months within which these rights can be exercised. This is applicable to american options only and not european options, which can be exercised on the expiration date only.

### 3. Stock Price

The price of the underlying stock or asset plays a significant role in determining the value of options.

For call options, a higher stock price increases the likelihood of the option being "in the money," thus increasing its value.

Conversely, for put options, a higher stock price decreases the probability of the option being "in the money," resulting in a lower option value.

### 4. Variability in Price of Underlying Asset

Volatility refers to the degree of fluctuation in the price of the underlying asset. Higher volatility implies greater uncertainty and potential for price swings in the underlying asset's value. Options on highly volatile assets tend to have higher values compared to options on less volatile assets. This is because higher volatility increases the likelihood of the option being profitable, as there is a greater chance of significant price movements in the underlying asset. This is true for both call options and put options.

## 5. Interest Rate

Interest rates influence the value of options.

Higher interest rates increase the present value of future cash flows, making it more valuable to delay payment of the exercise price for call options. Therefore, call options tend to have higher values when interest rates are higher.

On the other hand, higher interest rates may decrease the value of put options, as they reduce the present value of future cash flows from selling the underlying asset at a future date.

---

## 8. Value of an Option

---

You notice that shares of stock in the Nirma Corporation are going for Rs 48 per share. Call options with an exercise price of Rs 35 per share are selling for Rs 8. What will you do, if the option expires today?

Solution:

The call is selling for less than its intrinsic value; an arbitrage opportunity exists.

Buy Call Option for Rs 8  
Exercise Call by Paying Rs 35  
Sell the Stock for Rs 48  
Riskless Profit =  $48 - (35 + 8) = Rs 5$

## 8. Value of an Option

T-bills currently yield 4.8 percent. Stock in a manufacturing company is currently selling for Rs 63 per share. There is no possibility that the stock will be worth less than Rs 61 per share in one year.

- (i) What is the value of a call option with a Rs 60 exercise price? What is the intrinsic value?
- (ii) What is the value of a put option with a Rs 60 exercise price? What is the intrinsic value?

Solution:

Call Option

$$\text{VALUE OF CALL OPTION} = 63 - \frac{60}{1+0.048} = \text{Rs } 5.75$$
$$\text{INTRINSIC VALUE} = \text{Max}(63-60, 0) = \text{Rs } 3$$

Put Option

The value of the put option is Rs 0 since there is no possibility that the put will finish in the money. The intrinsic value is also Rs 0.

## 8. Value of an Option

Use the following information to answer the question that follows. The stock is currently selling for Rs 83.

Expiration date- 26 March 2025

Expiration Price - Rs 80

Price of Call option - Rs 2.80

Price of Put option - Rs 0.80

Expiration date- 26 April 2025

Expiration Price - Rs 80

Price of Call option - Rs 6

Price of Put option - Rs 1.40

Expiration date- 26 July 2025

Expiration Price - Rs 80

Price of Call option - Rs 8.05

Price of Put option - Rs 3.90

Expiration date- 26 October 2025

Expiration Price - Rs 80

Price of Call option - Rs 10.20

Price of Put option - Rs 3.65

Which options have arbitrage opportunities?

Solution:

CALL OPTION FOR MARCH

PRICE < INTRINSIC VALUE  $\Rightarrow$  ARBITRAGE OPPORTUNITY

↑  
2.80                   ↑  
                          8

$$\text{PROFIT} = 83 - (80 + 2.80) = \text{Rs } 0.20$$

## 8. Value of an Option

Use the following information to answer the questions that follow. The stock is currently selling for Rs 114 per share.

Expiration date- August 2025

Expiration Price - Rs 110

Price of Call option - Rs 13.05

Price of Put option - Rs 4.70

Suppose you BUY 1000 shares of put option contracts.

- (i) What is your maximum gain?
- (ii) On the expiration date, the share is selling for Rs 104 per share, what is your net gain?

Suppose you SELL 1000 shares of put option contracts.

- (iii) What is your net gain or loss if the share is selling for Rs 103 at expiration?
- (iv) What is your net gain or loss if the share is selling for Rs 132 at expiration?
- (v) What is the break-even price—that is, the terminal stock price that results in a zero profit?

Solution:

$$\text{PRICE OF 1000 PUT OPTIONS} = 4.7 \times 1000 = \text{Rs } 4700$$

### BUY PUT

$$\begin{aligned} \text{(i) Max. Gain (when stock price=0)} &= 110 \times 1000 - 4700 \\ &= 1,05,300 \end{aligned}$$

$$\begin{aligned} \text{(ii) Gain when stock price is Rs 104} &= 1000(110-104) - 4700 \\ &= 1,300 \end{aligned}$$

### SELL PUT

$$\text{(iii) Net loss} = 4700 - 1000 \times (110-103) = -2300$$

$$\text{(iv) Net Gain} = 4700 \text{ (PUT IS OUT OF MONEY)}$$

$$\begin{aligned} \text{(v) At BreakEven} \\ 4700 &= 1000(110-x) \\ \Rightarrow x &= 105.30 \end{aligned}$$

## 9. Black-Scholes Model

The Black-Scholes model, named after its creators Fischer Black and Myron Scholes, is a groundbreaking mathematical formula used to calculate the theoretical price of options. It revolutionized the field of finance by providing a quantitative framework for valuing options contracts.

The model is based on the concept that the value of an option depends on 5 key factors:

- (i) *Current Price of the Underlying Asset*: This refers to the current market price of the asset underlying the option, such as a stock or a commodity.
- (ii) *Exercise Price*: Also known as the strike price, this is the price at which the underlying asset can be bought or sold upon exercise of the option.
- (iii) *Time to Expiration Date*: The duration until the option contract expires. The longer the time to expiration, the higher the probability that the option will be profitable, and thus the higher its value.
- (iv) *Variance of the Prices of the Underlying Asset*: Variance represents the measure of how much the prices of the underlying asset fluctuate over time. Higher variance implies greater volatility, which generally increases the value of options.
- (v) *Risk-free Interest Rate*: This is the rate of return on an investment with zero risk of financial loss. It serves as the opportunity cost of holding the option instead of investing in a risk-free asset.

The Black-Scholes model uses these parameters to calculate the theoretical value of an option. The formula is given by:

$$\text{VALUE OF CALL, } C = S \cdot N(d_1) - E \cdot e^{-Rt} \cdot N(d_2)$$

$$d_1 = \frac{\ln\left(\frac{S}{E}\right) + \left(R + \frac{\sigma^2}{2}\right) \cdot t}{\sqrt{\sigma^2 \cdot t}}$$

$$d_2 = d_1 - \sqrt{\sigma^2 \cdot t}$$

$S$  = CURRENT STOCK PRICE

$E$  = EXERCISE PRICE OF OPTION

$R$  = RISK FREE RATE OF RETURN

$\sigma^2$  = VARIANCE OF STOCK RETURNS

$t$  = TIME TO EXPIRATION DATE

$N(d)$  = PROBABILITY THAT RANDOM VARIABLE WILL BE  $\leq d$   
(NORMAL DISTRIBUTION)

Importantly, the model assumes certain conditions:

- *European-style Option*: The Black-Scholes model assumes that the option being valued is of European style, meaning it can only be exercised at expiration.
- *No Transaction Costs*: The model assumes that there are no transaction costs associated with buying or selling the option.
- *No Dividends*: The model assumes that the underlying asset does not pay dividends during the life of the option.

- *Random Market Movements:* The model assumes that market movements are random and unpredictable. This is consistent with the efficient market hypothesis, which posits that all available information is already reflected in market prices.
- *Constant Risk-free Rate:* The model assumes that there exists a risk-free interest rate that is known and remains constant over the life of the option.
- *Constant Volatility:* The model assumes that the volatility of the underlying asset's returns is constant and known. Volatility measures the degree of variation of the asset's price over time.
- *Normal Distribution of Returns:* The model assumes that the returns of the underlying asset follow a normal distribution.

One of the key attractions of the Black–Scholes formula is its simplicity and ease of use. It allows anyone to estimate the value of an option with just a few observable parameters. Notably, four of the five parameters required by the model—current stock price, exercise price, interest rate, and time to expiration—are readily available from market data.

The only parameter that needs to be estimated is the variance of return, often derived from historical price data or implied volatility from option prices.

---

## 9. Black–Scholes Model

---

The Binomial Model of option pricing is used to value options by simulating the possible future price movements of the underlying asset over discrete time intervals. It is one of the fundamental models in options pricing theory, alongside the Black–Scholes Model.

The Binomial Model operates under certain assumptions, including:

- The price of the underlying asset follows a binomial distribution, meaning it can only move up or down by certain proportions over each time interval.
- There are no transaction costs, taxes, or dividends during the option's lifespan.
- The risk-free interest rate is constant over the option's life.
- The options are European-style, meaning they can only be exercised at expiration.

The model constructs a binomial tree, representing the possible price paths of the underlying asset over time. Each node in the tree corresponds to a possible price level of the asset at a particular point in time. The tree starts at the current price of the underlying asset and branches out at each time step, representing upward and downward price movements.

Starting from the terminal nodes (the final time period), the option values are calculated recursively backward through the tree. At each node, the option value is determined by considering the potential payoff of exercising the option at that node, discounted back to the present value using the risk-free interest rate.

To calculate the option values, the model uses risk-neutral probabilities, which are probabilities adjusted to reflect the risk-free rate. These probabilities ensure that the expected return from holding the option is equal to the risk-free rate, facilitating arbitrage-free pricing.

As the time intervals become smaller and the number of steps in the tree increases, the binomial model *converges to the Black–Scholes Model*, providing increasingly accurate estimates of option prices.

---

## 9. Black-Scholes Model

You are given the following information concerning options on a particular stock:

Stock price = Rs 83

Exercise price = Rs 80

Risk-free rate = 6% per year, compounded continuously

Maturity = 6 months

Standard deviation = 53% per year

(i) What is the intrinsic value of the call option and of the put option?

(ii) What is the time value of the call option and of the put option?

(iii) Does the call or the put have the larger time value component? Why?

Solution:

USING BLACK SCHOLES MODEL

$$d_1 = \frac{\ln\left(\frac{83}{80}\right) + \left(0.06 + \frac{0.53^2}{2}\right) \times \frac{6}{12}}{0.53 \times \sqrt{\frac{6}{12}}} = 0.3657 \quad N(d_1) = 0.6427$$
$$N(d_2) = 0.4964$$
$$d_2 = 0.3657 - \left(0.53 \times \sqrt{\frac{6}{12}}\right) = -0.0091$$
$$C = 83 \times 0.6427 - 80 \times e^{-0.06 \times 0.5} \times 0.4964 = 14.81$$

PUT-CALL PARITY EQUATION

$$\text{PRICE OF PUT} = 80 \times e^{-0.06 \times 0.5} + 14.81 - 83 = 9.44$$

(i) What is the intrinsic value of the call option and of the put option?

INTRINSIC VALUE OF CALL

$$= \max\{83 - 80, 0\} = 3$$

INTRINSIC VALUE OF PUT

$$= \max\{80 - 83, 0\} = 0$$

(ii) What is the time value of the call option and of the put option?

TIME  
 VALUE OF CALL =  $14.81 - 3 = 11.81$   
 TIME  
 VALUE OF PUT =  $9.44 - 0 = 9.44$   
 ALSO CALLED TIME PREMIUM

(iii) Does the call or the put have the larger time value component? Why?

The time premium, also known as extrinsic value, is the portion of an option's premium that reflects the amount of time remaining until the option expires. It represents the expectation of future price movements and the potential for the option to become profitable before expiration.

Call options typically benefit from upward price movements in the underlying asset. Investors often purchase call options when they anticipate the price of the underlying asset to rise. Since there's an expectation of potential future gains, the time premium for call options tends to be higher to account for the possibility of those gains occurring before expiration.

In general, call options with lower strike prices tend to have higher time premiums because they are closer to being "in the money" (i.e., the strike price is closer to or lower than the current market price of the underlying asset). Conversely, put options with higher strike prices tend to have higher time premiums because they are closer to being "in the money" (i.e., the strike price is closer to or higher than the current market price of the underlying asset). This difference in strike price dynamics contributes to the generally larger time premium for call options.

---

## 10. Options Greeks

Options Greeks are a set of risk measures that help traders understand the sensitivity of options prices to changes in various factors. These factors include the underlying asset price, time to expiration, volatility, interest rates etc.

$$\text{DELTA} (\Delta) = \frac{\Delta \text{ PRICE OF OPTION}}{\Delta \text{ PRICE OF ASSET}}$$

$$\text{GAMMA} (\Gamma) = \frac{\Delta \text{ DELTA}}{\Delta \text{ PRICE OF ASSET}}$$

$$\text{THETA} (\Theta) = \frac{\Delta \text{ PRICE OF OPTION}}{\Delta \text{ TIME}}$$

The most commonly used options Greeks are:

### Delta

Delta measures the rate of change of the option's price in relation to changes in the price of the underlying asset. It ranges from -1 to 0 for put options and 0 to 1 for call options, indicating the probability of the option expiring in the money.

A delta of 0.5 means the option's price will increase by Rs 0.50 for every Rs 1 increase in the underlying asset's price.

### Gamma

Gamma measures the rate of change of delta in response to changes in the price of the underlying asset. It shows how delta will change as the underlying price moves.

Gamma is highest for at-the-money options and decreases as the option moves further into or out of the money.

### Theta

Theta measures the rate of change of the option's price in relation to the passage of time. It indicates how much the option's value will decrease as time passes, reflecting time decay.

Theta is negative for both call and put options, as options lose value over time due to the diminishing time to expiration.

$$\text{VEGA} (\nu) = \frac{\Delta \text{ PRICE OF OPTION}}{\Delta \text{ VOLATILITY}}$$

$$\text{RHO} (\rho) = \frac{\Delta \text{ PRICE OF OPTION}}{\Delta \text{ INTEREST RATE}}$$

### Vega

Vega measures the rate of change of the option's price in relation to changes in implied volatility. It shows how sensitive the option's price is to changes in volatility.

It indicates how much the option's price will change for a 1% change in implied volatility. Vega is highest for at-the-money options and decreases as the option moves into or out of the money.

### Rho

Rho measures the rate of change of the option's price in relation to changes in interest rates. It reflects how much the option's value will change for a change in the risk-free interest rate.

It indicates how much the option's price will change for a 1% change in the risk-free interest rate. Rho is higher for longer-dated options and is more significant for options on interest-rate-sensitive assets like bonds.

$$\text{CHARM} = \frac{\Delta \text{ DELTA}}{\Delta \text{ TIME}}$$

$$\text{VANNA} = \frac{\Delta \text{ DELTA}}{\Delta \text{ VOLATILITY}}$$

$$\text{VOLGA} = \frac{\Delta \text{ VEGA}}{\Delta \text{ VOLATILITY}}$$

#### **Charm**

Charm measures the rate of change of delta in relation to changes in time to expiration. It quantifies how delta will change as time passes, considering the impact of time decay.

It quantifies how delta will change as time passes, considering the impact of time decay. Charm is highest for at-the-money options and decreases as the option moves into or out of the money.

#### **Vanna**

Vanna measures the rate of change of delta in relation to changes in implied volatility. It shows how delta will change as volatility changes.

It shows how delta will change as volatility changes, indicating the option's sensitivity to both price and volatility movements. Vanna is highest for options that are at the money and decreases as the option moves into or out of the money.

#### **Vomma (Volga)**

Vomma, also known as Volga, measures the rate of change of vega in relation to changes in implied volatility.

It quantifies the sensitivity of vega to changes in volatility, indicating how much vega will change for a 1% change in implied volatility. Vomma is highest for at-the-money options and decreases as the option moves into or out of the money.

## 11. Warrant

---

A warrant is an option to purchase common stock at a specified exercise price (usually higher than the market price at the time of warrant issuance) for a specified period (often lasting for years and, in some cases, in perpetuity).

In contrast, a right is also an option to buy common stock, but normally it has a subscription price lower than the market value of the common stock and a very short life (often two to four weeks).

Warrants often are employed as "sweeteners" to a public issue of bonds or debt that is privately placed. As a result, the corporation should be able to obtain a lower interest rate than it would otherwise. For companies that are marginal credit risks, the use of warrants may spell the difference between being able and not being able to raise funds through a debt issue.

Occasionally, warrants are sold directly to investors for cash. In addition, warrants are sometimes used in the founding of a company as compensation to underwriters and venture capitalists. Still, the origin of most warrants is in connection with a debt issue, often a private placement.

The warrant itself contains the provisions of the option. It states the number of shares the holder can buy for each warrant. Frequently, a warrant will provide the option to purchase 1 share of common stock for each warrant held, but it might be 2 shares, 3 shares, or 2.54 shares.

Another important provision is the price at which the warrant is exercisable, such as Rs 12 a share. This means that in order to buy 1 share, the warrant holder must put up Rs 12 a share. This exercise price may either be fixed or "stepped up" over time. For example, the exercise price might increase from Rs 12 to Rs 13 after three years and to Rs 14 after another three years.

The warrant must specify the date that the option expires unless it is perpetual, having no expiration date. Because a warrant is only an option to purchase stock, warrant holders are not entitled to any cash dividends paid on the common stock, nor do they have voting power.

If the common stock is split or a stock dividend is declared, the option price of the warrant is usually adjusted to take this change into account. Some warrants are callable after a period of time – provided that share price exceeds some minimum price.

---

## 1. Combination of Options

---

Let us understand, how puts and calls can be used as building blocks for more complex option contracts.

We will discuss Protective Put, Covered call and Synthetic Stocks.

We will also discuss put-call parity equation.

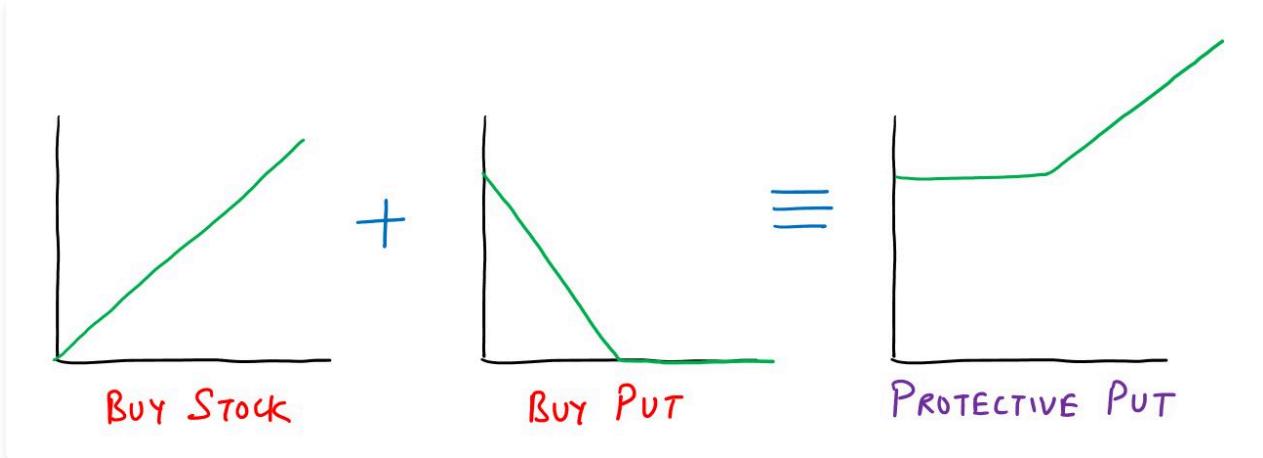
---

# 1. Combination of Options

## First Option

Let us understand the payoff from combination of:

- (i) buy a put option
- (ii) buy the asset (stock)



If the share price is greater than the exercise price, the put option is worthless, and the value of the combined position is equal to the value of the common stock.

If, instead, the exercise price is greater than the share price, the decline in the value of the shares will be exactly offset by the rise in the value of the put.

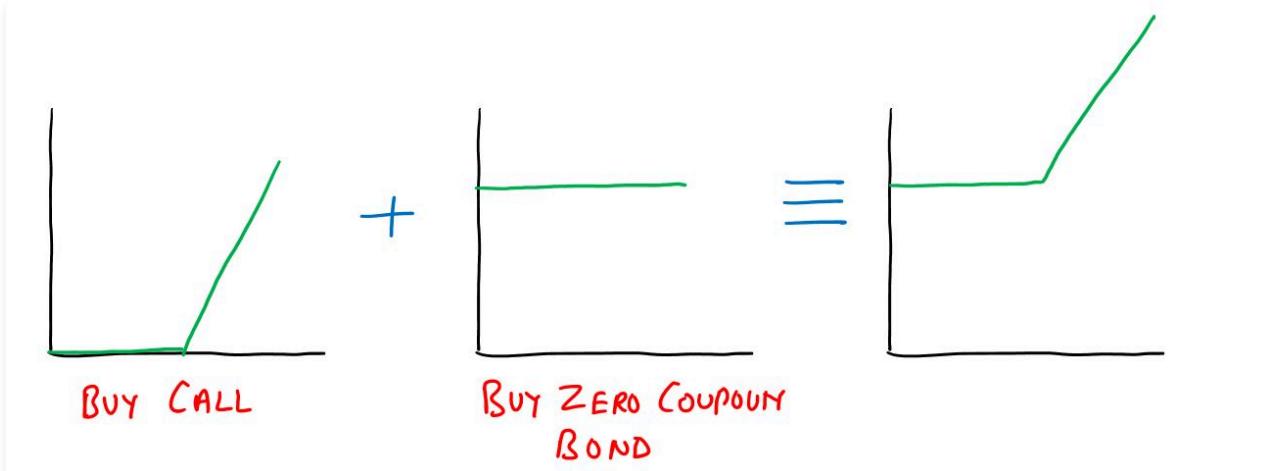
This is shown in the figure.

The strategy of buying a put and buying the underlying stock is called a **protective put**. It is as if we are buying insurance for the stock. The stock can always be sold at the exercise price, regardless of how far the market price of the stock falls.

## Second Option

Now consider the payoff from combination of:

- (i) Buy a call option
- (ii) Buy a risk-free, zero coupon bond that matures on the same day that the call option expires



The investor receives a guaranteed fixed sum from the bond, regardless of what happens to the stock. In addition, the investor receives a payoff from the call of Rs 1 for every Rs 1 that the price of the stock rises above the exercise price.

## Summary

The graph of second option looks exactly like the graph of a protective put (first option).

$$\begin{matrix} \text{Buy PUT} \\ + \\ \text{Buy STOCK} \end{matrix} = \begin{matrix} \text{Buy CALL} \\ + \\ \text{Buy ZERO COUPON BOND} \end{matrix}$$

In other words, the investor gets the same payoff from:

1. Buying a put and buying the underlying stock.
2. Buying a call and buying a risk-free, zero coupon bond.

## 1. Combination of Options

In case of protective put, we have seen that, the investor gets the same payoff from:

1. Buying a put + buying the underlying stock.
2. Buying a call + buying a risk-free, zero coupon bond.

If investors have the same payoffs from the two strategies, the two strategies must have the same cost.

$$\begin{matrix} \text{PRICE OF} \\ \text{PUT} \end{matrix} + \begin{matrix} \text{PRICE OF} \\ \text{STOCK} \end{matrix} = \begin{matrix} \text{PRICE OF} \\ \text{CALL} \end{matrix} + \begin{matrix} \text{PRESENT VALUE OF} \\ \text{STRIKE PRICE} \end{matrix}$$

This relationship is known as **put-call parity** and is one of the most fundamental relationships concerning options.

It says that there are two ways of buying a protective put. You can buy a put and buy the underlying stock simultaneously. Here, your total cost is the price of the underlying stock plus the price of the put. Or you can buy the call and buy a zero coupon bond. Here, your total cost is the price of the call plus the price of the zero coupon bond. The price of the zero coupon bond is equal to the present value of the exercise price.

It may be noted that put-call parity equation holds only if the put and the call have both the same exercise price and the same expiration date. In addition, the maturity date of the zero coupon bond must be the same as the expiration date of the options.

Put-call parity is a fundamental concept in options trading that establishes a relationship between the prices of put and call options with the same strike price and expiration date. It essentially states that the total cost of establishing a particular options position through one method should equal the total cost through another method.

In other words, the total cost of the protective put position created by buying the stock and put option should equal the total cost of the protective put position created by buying the call option and the zero coupon bond.

This relationship is crucial because it helps ensure that options markets are efficient and prevents arbitrage opportunities. If put-call parity did not hold, traders could exploit price differences between puts and calls to make risk-free profits, undermining the integrity of the options market.

## 1. Combination of Options

Put-call parity is a fundamental concept in options trading that establishes an equilibrium relationship between the prices of put and call options with the same strike price and expiration date.

It essentially states that the cost of setting up a certain options position through different combinations of puts and calls must be equal.

$$\text{PRICE OF PUT} + \text{PRICE OF STOCK} = \text{PRICE OF CALL} + \text{PRESENT VALUE OF STRIKE PRICE}$$

Rearranging the above equation, we get:

$$\text{PRICE OF STOCK} = \text{PRICE OF CALL} - \text{PRICE OF PUT} + \text{PRESENT VALUE OF STRIKE PRICE}$$

This new equation states that you can replicate the purchase of a share of stock by buying a call, selling a put, and buying a zero coupon bond. (Note that because a minus sign comes before "Price of put," the put is sold, not bought.) Investors in this three-legged strategy are said to have purchased a **synthetic stock**.

By combining these three components, the investor effectively creates a position that behaves similarly to owning shares of stock.

If the stock price rises above the strike price of the call option, the investor profits from the call option.

If the stock price falls below the strike price of the put option, the investor can buy the stock at the strike price using the funds from the zero coupon bond.

Overall, a synthetic stock allows investors to gain exposure to the price movements of a stock without actually owning the shares outright. It can be used for various purposes, including hedging, speculation, or arbitrage opportunities.

# 1. Combination of Options

Many investors may adopt a conservative strategy known as selling a **covered call**. The investor gets the payoff from combination of:

- (i) buy a stock
- (ii) sell (write) a call on the stock



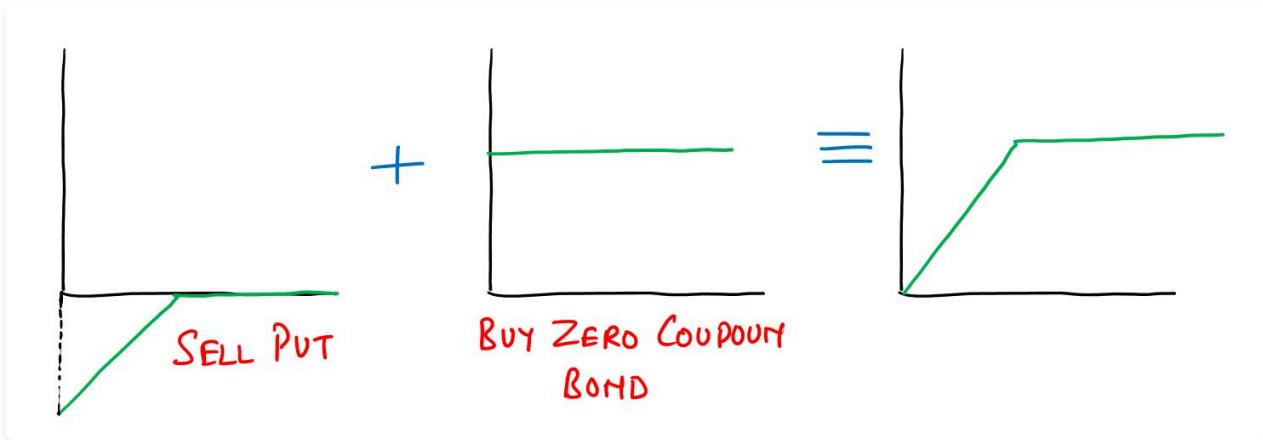
If the stock price remains below the strike price of the call option until expiration, the call option expires worthless.

If the stock price rises above the strike price of the call option, the investor may have to sell the shares at the strike price, limiting potential gains from stock price.

$$\text{PRICE OF STOCK} - \text{PRICE OF CALL} = -\text{PRICE OF PUT} + \text{PRESENT VALUE OF STRIKE PRICE}$$

The put-call parity relationship tells us that this strategy is equivalent:

- (i) sell a put
- (ii) buy a zero coupon bond.



Selling a put option obligates the investor to buy the stock at the strike price if the option is exercised. Buying a zero coupon bond ensures that the investor has the funds to buy the stock at the strike price if the put option is exercised.

The graphs show us that both strategies will give us same payoff. They both provide a limited upside potential (capped at the strike price) and downside protection.

These strategies are called **Covered Call**.

## 1. Combination of Options

$$\text{PRICE OF PUT} + \text{PRICE OF STOCK} = \text{PRICE OF CALL} + \text{PRESENT VALUE OF STRIKE PRICE}$$

↑ F.V. of Bond

PUT-CALL PARITY

$$\begin{aligned} &\text{BUY PUT} + \text{BUY STOCK} \\ &\equiv \\ &\text{BUY CALL} + \text{BUY ZERO COUPON BOND} \end{aligned}$$

PROTECTIVE  
PUT

$$\begin{aligned} &\text{SELL CALL} + \text{BUY STOCK} \\ &\equiv \\ &\text{SELL PUT} + \text{BUY ZERO COUPON BOND} \end{aligned}$$

COVERED  
CALL

# 1. Combination of Options

Answer following questions, with your understanding of Put–Call Parity equation.

- (i) A stock is currently selling for Rs 38 per share. A call option with an exercise price of Rs 40 sells for Rs 3.80 and expires in 3 months. If the risk-free rate of interest is 2.6% per year, compounded continuously, what is the price of a put option with the same exercise price?

Solution:

$$38 + P = 40 \times e^{-0.026 \times \frac{3}{12}} + 3.80$$
$$\Rightarrow P = 5.54$$

- (ii) A put option that expires in 6 months with an exercise price of Rs 65 sells for Rs 4.89. The stock is currently priced at Rs 61, and the risk-free rate is 3.6 percent per year, compounded continuously. What is the price of a call option with the same exercise price?

Solution:

$$61 + 4.89 = 65 \times e^{-0.036 \times 0.5} + C$$
$$\Rightarrow C = 2.05$$

- (iii) A put option and a call option with an exercise price of Rs 85 and three months to expiration sell for Rs 2.40 and Rs 5.09, respectively. If the risk-free rate is 4.8 percent per year, compounded continuously, what is the current stock price?

Solution:

$$S + 2.40 = 85 \times e^{-0.048 \times \frac{3}{12}} + 5.09$$
$$\Rightarrow S = 86.68$$

- (iv) A put option and a call option with an exercise price of Rs 55 expire in two months and sell for Rs 2.65 and Rs 5.32, respectively. If the stock is currently priced at Rs 57.30, what is the annual continuously compounded rate of interest?

Solution:

$$57.30 + 2.65 = 55 \times e^{-x \times \frac{2}{12}} + 5.32$$
$$e^{-x \times \frac{2}{12}} = 0.9932$$
$$x = 0.0405 \quad 4.05\%$$

---

## 2. Insurance is a Put Option

---

A put option gives the holder the right (but not obligation), to sell a specific asset at a predetermined price (the strike price) within a specified period of time. This is typically used as a form of insurance against the downside risk of owning that asset. If the asset's value falls below the strike price, the holder of the put option can still sell it for the predetermined price, thereby limiting their losses.

Now, let us apply this to the concept of insurance.

Consider a homeowner who purchases insurance for their house. In this scenario, the house serves as the asset. If a catastrophic event such as a fire occurs, it could significantly damage or destroy the house, causing its value to plummet. The homeowner, however, has insurance coverage, which is essentially like holding a put option on the house.

Just like with a put option, if the worst-case scenario happens (e.g., the house burns down), the homeowner can "exercise" their insurance policy. This means they can sell the damaged or destroyed house to the insurance company for the amount of coverage specified in the policy, regardless of the current market value of the house.

By having homeowners insurance, the homeowner is protected against the financial loss resulting from the destruction of their home. Even if the house becomes worthless due to the damage, the insurance company will still compensate the homeowner based on the terms of the policy.

---

## 3. Equity is a Call Option

---

The equityholders (shareholders) of a firm can be compared to holders of a call option. A call option gives the holder the right, but not the obligation, to buy an asset (in this case, the firm's assets) at a predetermined price (the strike price) within a specified period of time (the time to expiration).

The strike price in this scenario is equal to the face value of the debt. The face value of the debt represents the amount the firm must repay to its debtholders upon maturity. The time to expiration of the call option is equivalent to the time to maturity of the debt.

*Scenario 1 - Firm Value Exceeds Debt:* If, at the time of debt maturity, the value of the firm's assets exceeds the face value of the debt, the firm can repay the debtholders in full. In this case, the equityholders retain the remaining value of the firm's assets after satisfying the debt obligations. They benefit from the appreciation in the firm's value beyond the debt amount.

*Scenario 2 - Firm Value is Less Than Debt:* Conversely, if the firm's value is less than the face value of the debt at maturity, the firm must liquidate all its assets to repay the debtholders. In this situation, the equityholders receive nothing, as the entire value of the firm's assets is used to fulfill the debt obligations.

By viewing equity ownership as holding a call option, investors can better understand the risk-reward tradeoff. Equityholders stand to benefit if the firm's asset value appreciates sufficiently to cover the debt obligations, but they also face the risk of losing their entire investment if the firm's assets fall short.

---

## 4. Spread

*SPREAD*  $\Rightarrow$  *PUT + PUT*  
*OR*  
*CALL + CALL*

*Long + Short*

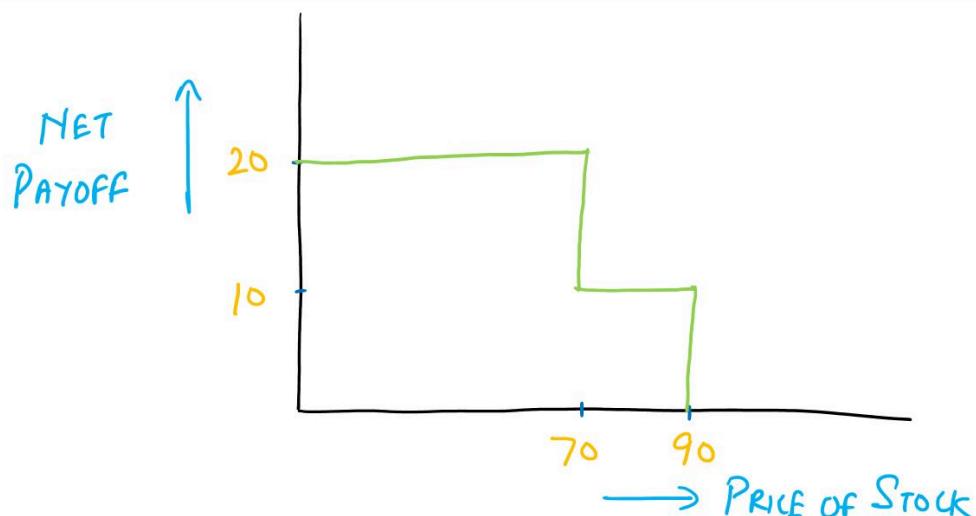
A spread refers to a trading strategy that involves the simultaneous purchase and sale of two or more options contracts. These contracts are of the same type, meaning they are either all call options or all put options, and they are based on the same underlying asset. However, there are differences in either strike prices, expiration dates, or both.

Option spreads offer traders a versatile set of strategies to manage risk, generate income, and speculate on market movements. By simultaneously buying and selling options with different characteristics, traders can tailor their positions to suit their objectives and market conditions.

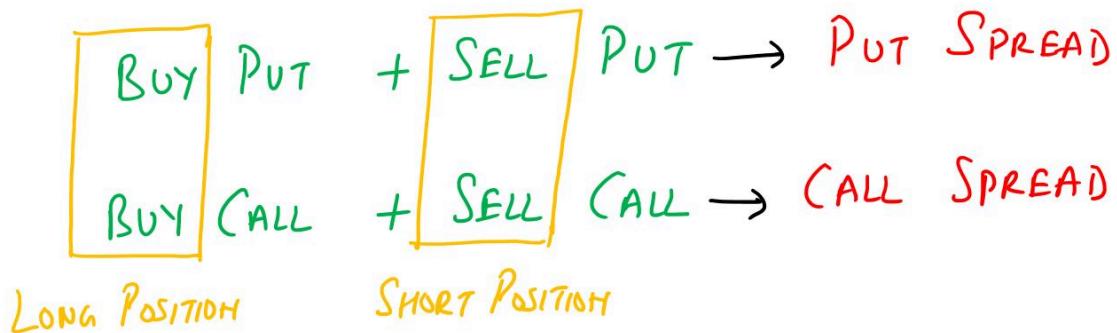
Let us consider a spread strategy using options contracts for stock XYZ:

- (i) *Buy Put Option*: We purchase a put option with a strike price of Rs 90.
- (ii) *Sell Put Option*: Simultaneously, we sell a put option with a strike price of Rs 70.

Stock Price	Long Put	Short Put	Net Payoff
50	+40	-20	20
60	+30	-10	20
70	+20	0	20
80	+10	0	10
90	0	0	0
100	0	0	0



## 4. Spread



### Put Spread

In a put spread, traders execute two transactions:

- Buy Put Option:** This involves purchasing a put option, which gives the buyer the right, but not the obligation, to sell the underlying asset at a specified price (strike price) within a predetermined period (until expiration).
- Sell Put Option:** Simultaneously, the trader sells a put option with a different strike price or expiration date. By selling this put option, the trader receives a premium, but also takes on the obligation to buy the underlying asset at the specified strike price if the option is exercised.

### Call Spread

In a call spread, traders perform two transactions:

- Buy Call Option:** Traders buy a call option, granting them the right to buy the underlying asset at a predetermined price (strike price) within a specified timeframe (until expiration).
- Sell Call Option:** Concurrently, traders sell a call option with a different strike price or expiration date. By selling this call option, they receive a premium but are obligated to sell the underlying asset at the specified strike price if the option is exercised.

## 4. Spread

Vertical spreads, also known as **price spreads**, involve using options contracts with different strike prices but the same expiration date. Typically, the strike prices are either higher or lower than the current market price of the underlying asset.

SAME EXPIRATION DATE  
+  
DIFFERENT STRIKE PRICES

VERTICAL SPREAD  
PRICE SPREAD

There are two main types of vertical spreads:

### Bull Spreads

Buy Call (Lower Strike Price) + Sell Call (Higher Strike Price)

OR

Buy Put (Lower Strike Price) + Sell Put (Higher Strike Price)

### Bear Spreads

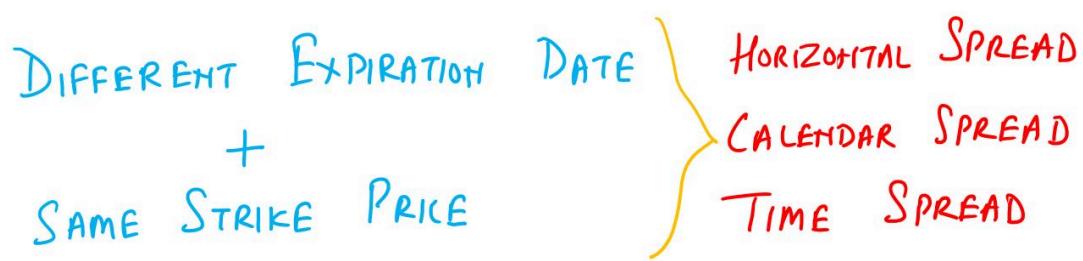
Buy Call (Higher Strike Price) + Sell Call (Lower Strike Price)

OR

Buy Put (Higher Strike Price) + Sell Put (Lower Strike Price)

Bull spreads are utilized when the trader anticipates a bullish market outlook, aiming to profit from an increase in the underlying asset's price. Conversely, bear spreads are employed when the trader expects a bearish market, seeking to capitalize on a potential decline in the underlying asset's price.

## 4. Spread

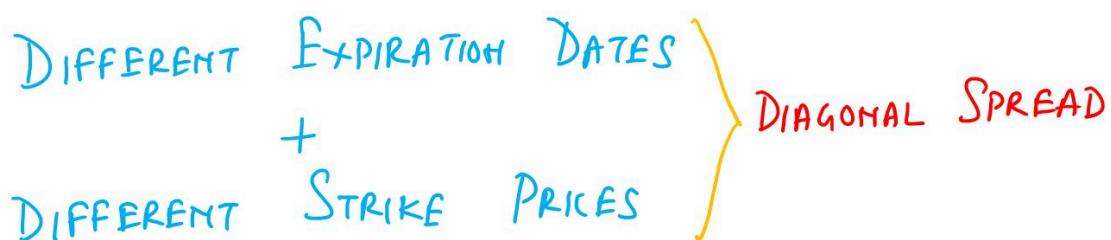


Horizontal spreads, often referred to as **calendar spreads** or **time spreads**, involve options with the same strike price but different expiration dates. These spreads enable traders to leverage differences in implied volatility between short-term and long-term options.

By purchasing options with longer expiration dates and simultaneously selling options with shorter expiration dates, traders can potentially profit from changes in the volatility term structure. Calendar spreads are commonly used to hedge against short-term fluctuations while maintaining exposure to longer-term market movements.

Additionally, they offer a strategy for generating income through the collection of premiums from selling near-term options. Overall, calendar spreads provide traders with a versatile approach to managing risk and capturing potential opportunities in the options market.

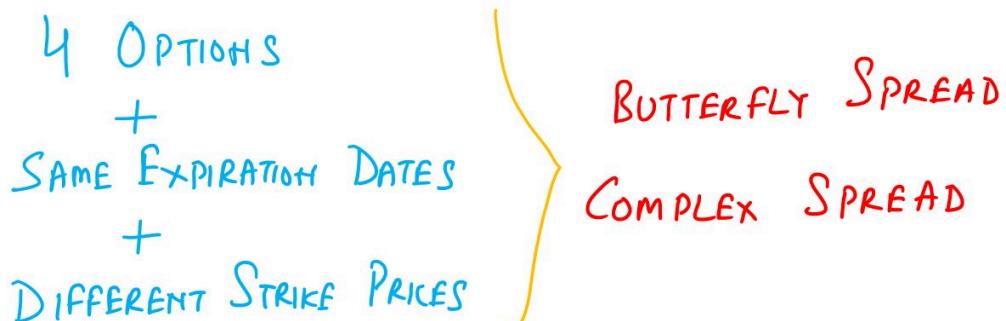
## 4. Spread



Diagonal spreads, also known as **variable spreads**, encompass options contracts with differing strike prices and expiration dates. This strategy blends features of vertical and horizontal spreads, offering flexibility for diverse trading approaches.

Traders utilize diagonal spreads for a range of strategies, including speculating on price movements and volatility changes. By incorporating elements of both vertical and horizontal spreads, diagonal spreads enable traders to capitalize on directional forecasts while also leveraging disparities in implied volatility over time. This versatile approach enhances opportunities for profit and risk management in the options market.

## 4. Spread



A butterfly spread, also called **complex spread**, is an options trading strategy that involves using four option contracts with the same expiration date but three different strike prices spread evenly apart using a 1:2:1 ratio.

This strategy can be implemented using either call options or put options. In a call butterfly spread, the trader buys one call option at a specific strike price, sells two call options at a higher strike price, and buys one more call option at an even higher strike price. Conversely, in a put butterfly spread, the trader buys one put option at a particular strike price, sells two put options at a lower strike price, and buys one more put option at an even lower strike price.

To construct a butterfly spread, a trader initiates the strategy by:

- (i) Buying: Purchasing one in-the-money (ITM) call or put option at a middle strike price.
- (ii) Selling: Simultaneously selling two out-of-the-money (OTM) call or put options, one with a lower strike price and another with a higher strike price than the initial bought option.
- (iii) Buying: Acquiring one more ITM call or put option, positioned further away from the two sold options.

## 5. Straddle



A Straddle is an options trading strategy that involves simultaneously purchasing both a call option and a put option with the same strike price and expiration date for the same underlying asset. This strategy is used when the trader believes that the price of the underlying asset will experience significant volatility but is uncertain about the direction of the movement.

By implementing a straddle, the trader is positioned to profit regardless of whether the underlying asset's price moves up or down. If the price moves significantly in either direction, one of the options will be in the money, offsetting the loss on the other option and potentially resulting in a net profit. The maximum loss for a straddle is limited to the total premium paid to purchase both options.

There are primarily two types of straddles: long straddles and short straddles.

### Long Straddle

In a long straddle, the trader purchases both a call option and a put option with the same strike price and expiration date.

This strategy is used when the trader expects significant price volatility in the underlying asset but is unsure about the direction of the movement. The goal of a long straddle is to profit from a substantial price movement in either direction. If the price moves up significantly, the call option will be profitable, and if it moves down significantly, the put option will be profitable.

### Short Straddle

In a short straddle, the trader sells both a call option and a put option with the same strike price and expiration date.

This strategy is employed when the trader believes that the underlying asset's price will remain relatively stable within a certain range until expiration. The goal of a short straddle is to profit from time decay and a decrease in implied volatility. If the price of the underlying asset remains within the range of the strike prices, both options will expire worthless, and the trader keeps the premiums collected from selling the options.

## 6. Strangle

ONE PUT + ONE CALL  
DIFFERENT STRIKE PRICE  
SAME EXPIRATION PRICE } STRANGLE

A strangle is an options trading strategy that involves the purchase or sale of both a call option and a put option with different strike prices but the same expiration date. Unlike a straddle, which involves options with the same strike price, a strangle uses options with different strike prices.

There are two types of strangles.

### Long Strangle

In a long strangle, the trader buys both a call option and a put option with different strike prices but the same expiration date.

The call option is typically purchased with a higher strike price than the put option. This strategy is used when the trader expects significant price volatility in the underlying asset but is unsure about the direction of the movement.

The goal of a long strangle is to profit from a substantial price movement in either direction. If the price moves up significantly, the call option will be profitable, and if it moves down significantly, the put option will be profitable.

### Short Strangle

In a short strangle, the trader sells both a call option and a put option with different strike prices but the same expiration date.

The call option is typically sold with a higher strike price than the put option. This strategy is employed when the trader believes that the underlying asset's price will remain within a certain range until expiration.

The goal of a short strangle is to profit from time decay and a decrease in implied volatility. If the price of the underlying asset remains within the range of the strike prices, both options will expire worthless, and the trader keeps the premiums collected from selling the options.

## 7. Strip

2 PUTS + 1 CALL  
SAME EXPIRATION DATE  
DIFFERENT STRIKE PRICES } STRIP

A strip is a strategy that involves purchasing two put options and one call option, all with the same expiration date and underlying asset, but with different strike prices. Specifically, the strike price of the call option is typically higher than that of the put options.

The trader buys two put options with the same expiration date and underlying asset but different strike prices. These put options provide the trader with the right to sell the underlying asset at the specified strike prices.

Additionally, the trader purchases one call option with the same expiration date and underlying asset but with a higher strike price compared to the put options. This call option grants the trader the right to buy the underlying asset at the specified strike price.

The strip strategy is typically used by traders who anticipate a significant downward price movement in the underlying asset. By purchasing two put options, they profit from the potential decline in the asset's price. However, by also buying one call option with a higher strike price, they retain the possibility of benefiting from any unexpected upward price movements.

## 8. Strap

1 PUT + 2 CALLS  
SAME EXPIRATION DATE  
DIFFERENT STRIKE PRICES } STRAP

A strap is a trading strategy that involves purchasing two call options and one put option on the same underlying asset, with the same expiration date but different strike prices. Specifically, the strike price of the put option is typically lower than that of the call options.

The trader buys two call options with the same expiration date and underlying asset but different strike prices. These call options give the trader the right to buy the underlying asset at the specified strike prices.

Additionally, the trader purchases one put option with the same expiration date and underlying asset but with a lower strike price compared to the call options. This put option grants the trader the right to sell the underlying asset at the specified strike price.

The strap strategy is typically used by traders who anticipate a significant upward price movement in the underlying asset. By purchasing two call options, they profit from the potential increase in the asset's price. However, by also buying one put option with a lower strike price, they retain the possibility of benefiting from any unexpected downward price movements.

# 1. Securitization

---

Asset Securitization is the process of turning illiquid assets, such as loans or receivables, into tradable securities. This process involves pooling together similar assets, creating a new entity (often called a special-purpose vehicle or SPV) to buy these assets, and then issuing securities backed by the asset pool to investors. The goal is to generate liquidity for the seller while offering investment opportunities for buyers.

Let's consider a bank that has a collection of auto loans issued to customers. These loans are generating regular monthly payments. The bank wants to raise cash immediately but doesn't want to wait for all the payments to come in over time.

Step-by-Step Process is given below:

1. *Identify the Cash-Flow-Producing Assets:* The bank has a set of auto loans where customers make monthly payments. These loans will produce steady cash flows for the next few years.
2. *Pooling the Assets:* The bank pools these auto loans together. These loans are similar because they all involve car purchases and have consistent monthly payments.
3. *Creating the Special-Purpose Vehicle (SPV):* The bank sets up a special-purpose vehicle (SPV), which is a separate legal entity designed to hold the pool of loans. This SPV is created specifically to facilitate the securitization process, and it isolates the loans from the bank's other liabilities.
4. *Selling the Assets to the SPV:* The bank sells the pool of auto loans to the SPV. The SPV now owns the loans, and the bank receives an immediate lump sum payment (the proceeds from selling the loans). This provides the bank with the cash it needs immediately.
5. *Issuing Asset-Backed Securities (ABS):* The SPV now creates asset-backed securities (ABS), which are essentially bonds backed by the future cash flows from the auto loans. The SPV sells these ABS to investors. These investors are essentially buying the right to receive future payments from the auto loans.
6. *Investors Receive the Payments:* As customers make their monthly auto loan payments, those payments flow to the SPV. The SPV then distributes the payments to the investors who bought the ABS.

**Outcome:**

- *For the bank:* The bank receives immediate cash from the sale of the loans to the SPV, which it can use for other purposes (e.g., issuing more loans or expanding operations).
  - *For the investors:* The investors who bought the ABS receive a stream of payments over time, which may offer attractive returns. These investors are exposed to the risk that the auto loan borrowers may not make their payments, but in exchange, they are compensated with a share of the payments.
-

# 1. Securitization

The parties involved in the securitization process and their respective roles are as follows:

## Originator

The initial lender and seller of receivables. In India, this is usually a bank, non-banking financial company (NBFC), or housing finance company.

## Seller

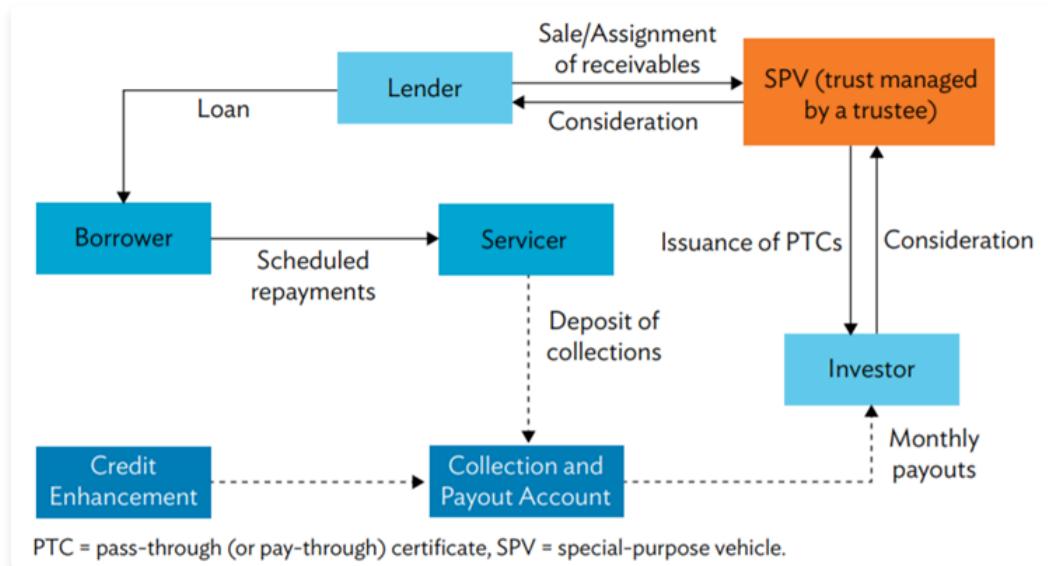
The entity that pools the assets for securitization. In India, the seller and originator are often the same entity.

## Borrower

The individual or entity to whom the originator provides a loan. Payments from the borrowers (typically through equated monthly installments (EMIs)) contribute to the funds used for investor payouts.

## Issuer (SPV)

The special-purpose vehicle (SPV) that issues the marketable securities to investors. The SPV ensures that transactions are carried out according to the agreed terms. In India, the SPV is typically structured as a trust.



## Arranger

The investment banks responsible for structuring the securities. They coordinate with other parties such as investors, rating agencies, and legal counsel to successfully complete the transaction.

## Investor

The purchaser of the securities. In India, investors are generally banks, insurance companies, and mutual funds.

## Rating Agency

Agencies that assess the risks of each transaction, determine the credit enhancements required based on the ratings of the pass-through certificates (PTCs), monitor the transaction's performance until maturity, and take appropriate rating actions.

## Credit Enhancement Provider

Often the originator, who provides a facility to cover any shortfall in pool collections compared to investor payouts. This enhancement may also come from a third party for a fee.

## Servicer

The entity responsible for collecting payments from individual borrowers, making payouts to investors, handling delinquent borrowers, and providing periodic information about the pool's performance to the rating agency. In India, the originator typically acts as the servicer.

# 1. Securitization

---

In the Indian market, there are three main types of securitized instruments commonly used, each backed by different types of receivables or debt, providing opportunities for investors to earn returns based on underlying assets.

The first type is **Asset-Backed Securities (ABSs)**, which are backed by receivables from various financial assets like vehicle loans, personal loans, credit card receivables, and other consumer loans, excluding housing loans. For example, a bank can pool its personal loans or car loans and issue ABSs, which are then sold to investors who receive periodic payments based on the loan repayments made by the borrowers.

The second type is **Mortgage-Backed Securities (MBSs)**, which are backed specifically by receivables from housing loans. In this case, a housing finance company might pool its home loans and create MBSs, allowing investors to earn from the payments made by homeowners on their mortgages.

The third type is **Collateralized Debt Securities (CDSs)**, which are backed by various forms of debt such as corporate loans, bonds, or other debt instruments. For example, a corporation could pool its bonds or loans and issue CDSs, with investors receiving payouts based on the repayments from these corporate debts.

These securitized instruments allow financial institutions to convert their illiquid assets into tradable securities, providing immediate liquidity. At the same time, they offer investors a way to invest in pools of debt or loans, earning returns from the cash flows generated by the underlying assets.