

# **Auditing Course Material**

Part 13 of 61 (Chapters 1201-1300)

## 7. Sales Mix Decisions - Change in Selling Price

Assume that TechSlice Appliances manufactures a food processor that sells for ₹10,000 per unit. The company is considering a price reduction to ₹9,000 to boost sales and market share. TechSlice also produces a lower-end kitchen appliance, a hand blender, which sells for ₹4,000. Management wants to analyze how changing the price of the food processor would affect the sales mix and overall profitability.

The following information is available about both products.

| Product        | Current Selling Price per Unit (₹) | New Selling Price per Unit (₹) | Variable Cost per Unit (₹) | Contribution Margin at Current Price (₹) | Contribution Margin at New Price (₹) |
|----------------|------------------------------------|--------------------------------|----------------------------|--|--------------------------------------|
| Food Processor | ₹10,000                            | ₹9,000                         | ₹6,000                     | ₹4,000                                   | ₹3,000                               |
| Hand Blender   | ₹4,000                             | No change                      | ₹2,800                     | ₹1,200                                   | ₹1,200                               |

Currently, TechSlice sells 1,000 units of food processors and 3,000 units of hand blenders per year. The company's market analysis suggests that reducing the price of the food processor from ₹10,000 to ₹9,000 could increase sales by 30%, but the hand blender's sales may decrease by 10% due to the shift in customer preference.

Management needs to determine whether reducing the price of the food processor will increase overall contribution margin and profitability, given the anticipated shift in the sales mix.

Contribution Margin Analysis is given below, before and after price reduction.

### 1. Current Contribution Margin:

| Product        | Units Sold | Contribution Margin per Unit (₹) | Total Contribution Margin (₹) |
|----------------|------------|----------------------------------|-------------------------------|
| Food Processor | 1,000      | ₹4,000                           | ₹4,000 × 1,000 = ₹40,00,000   |
| Hand Blender   | 3,000      | ₹1,200                           | ₹1,200 × 3,000 = ₹36,00,000   |
| <b>Total</b>   | -          | -                                | <b>₹76,00,000</b>             |

### 2. Contribution Margin After Price Reduction (with adjusted sales):

| Product        | Units Sold           | Contribution Margin per Unit (₹) | Total Contribution Margin (₹) |
|----------------|----------------------|----------------------------------|-------------------------------|
| Food Processor | 1,000 × 1.30 = 1,300 | ₹3,000                           | ₹3,000 × 1,300 = ₹39,00,000   |
| Hand Blender   | 3,000 × 0.90 = 2,700 | ₹1,200                           | ₹1,200 × 2,700 = ₹32,40,000   |
| <b>Total</b>   | -                    | -                                | <b>₹71,40,000</b>             |

Current Contribution Margin (without price change) = ₹76,00,000

Total Contribution Margin after Price Reduction = ₹71,40,000

Reducing the price of the food processor from ₹10,000 to ₹9,000 would result in a decrease in total contribution margin from ₹76,00,000 to ₹71,40,000, even though the number of food processors sold would increase. The lower contribution margin per unit on the food processor, combined with the decreased sales of hand blenders, leads to an overall loss in profitability.

Based on this analysis, TechSlice Appliances should reconsider its decision to reduce the price of the food processor. Even though sales would increase, the reduced contribution margin and the shift in sales mix would ultimately decrease the

company's total profitability.

This type of analysis highlights the importance of considering both the change in sales volume and the contribution margin when making pricing decisions in a multiproduct environment. Maximizing total contribution margin, not just individual product sales, is key to increasing overall profitability.

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## 8. Sales Compensation Changes

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Many companies compensate salespeople by paying a fixed commission based on gross sales revenue. This method encourages salespeople to focus on selling the highest-priced products rather than those with the highest contribution margin, which may not align with the company's profit-maximization goals. If the objective is to maximize profit, this approach can be ineffective.

Let's consider a company called Indus Hardware, which sells three types of slicers with the following price structure:

- Standard slicer: ₹10,000
- Deluxe slicer: ₹45,000
- Professional slicer: ₹90,000

The company's current policy is to pay sales commissions equal to 10% of the selling price. This system encourages salespeople to prioritize the professional slicers (priced at ₹90,000), even though it may not generate the highest profit for the company.

To better align the salesforce's goals with the company's profit objectives, Indus Hardware is considering a new sales compensation structure. Under this proposed plan:

- Base salaries will be introduced for all salespeople, totaling ₹92.5 lakh per period.
- Salespeople will also earn a commission equal to 15% of the product's contribution margin, which is calculated as the selling price minus the total variable production cost.

Contribution Margins:

- Standard slicer: Contribution margin = ₹4,000
- Deluxe slicer: Contribution margin = ₹14,500
- Professional slicer: Contribution margin = ₹14,000

Under the new structure, salespeople would now be motivated to sell slicers based on their contribution margins rather than their selling prices. In this case, the deluxe slicer, with a contribution margin of ₹14,500, would yield the highest commission. This aligns with the company's goal of maximizing profits by selling more of its most profitable products.

By focusing on products with **higher contribution margins**, Indus Hardware can shift its sales mix from lower-margin products (like the professional slicers) to higher-margin products (like the deluxe slicers). This will boost the company's overall profitability.

In designing compensation structures, fixed expenses are typically not considered unless they are incremental, as in the case of the base salaries of ₹92.5 lakh introduced by Indus Hardware. These base salaries are an incremental cost added under the new plan. However, they are justified by the expected increase in sales of higher-margin products, which will improve overall profitability.

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## 9. Changing Advertising Budgets

Many companies adjust their advertising budgets to influence the sales mix of specific products. Advertising can be a powerful tool for shifting customer focus to more profitable products or increasing overall sales.

For example, consider TechPro Industries, which produces and sells three types of smartphones: Standard, Advanced, and Pro Max. The price and contribution margins of these smartphones are as follows:

| Product  | Price per unit (₹) | Contribution Margin per unit (₹) |
|----------|--------------------|----------------------------------|
| Standard | 15,000             | 5,000                            |
| Advanced | 30,000             | 10,000                           |
| Pro Max  | 45,000             | 15,000                           |

The company's advertising manager proposes increasing the advertising budget for the Pro Max model to boost sales. Currently, the advertising budget is ₹10,00,000 per year, but the manager suggests increasing it to ₹15,00,000. This increase is expected to generate additional sales as follows:

- Standard: 500 more units
- Advanced: 300 more units
- Pro Max: 200 more units

The decision to increase the advertising budget requires an evaluation of the incremental costs and benefits. The key question is whether the additional ₹5,00,000 in advertising will result in enough additional contribution margin to justify the expense.

The contribution margin per unit remains the same for each product, so the additional contribution margin from the extra units sold can be calculated as follows:

| Product      | Additional Units Sold | Contribution Margin per Unit (₹) | Total Incremental Contribution Margin (₹) |
|--------------|-----------------------|----------------------------------|---|
| Standard     | 500                   | 5,000                            | 25,00,000                                 |
| Advanced     | 300                   | 10,000                           | 30,00,000                                 |
| Pro Max      | 200                   | 15,000                           | 30,00,000                                 |
| <b>Total</b> |                       |                                  | <b>85,00,000</b>                          |

By increasing the advertising budget by ₹5,00,000, TechPro Industries would generate an additional contribution margin of ₹85,00,000. After subtracting the incremental advertising cost, the company would see an incremental benefit of ₹80,00,000.

| Total Incremental Contribution Margin (₹) | Incremental Advertising Cost (₹) | Net Incremental Benefit (₹) |
|---|----------------------------------|-----------------------------|
| 85,00,000                                 | 5,00,000                         | 80,00,000                   |

Thus, the increase in advertising is expected to provide significant additional profits for TechPro Industries.

## 10. Special Order Pricing

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In special order decisions, companies determine sales prices for production or service jobs that fall outside their usual operations.

Special order scenarios typically include:

- Jobs that require a competitive bid,
- Orders accepted during periods of low business activity, or
- Products customized to a specific buyer's requirements.

Generally, the sales price for a special order should be set high enough to cover the variable costs and any incremental fixed costs associated with the job, while still generating a profit.

However, companies sometimes deviate from their regular pricing approach and offer **low-ball prices**. A low-ball price might only cover costs, with no profit, or in some cases, be set below cost. The rationale behind this strategy is to win the job and potentially gain access to a new market segment. While this approach might temporarily keep operations running, it is not sustainable in the long term. To remain profitable, a company must eventually set prices that cover total costs and provide a reasonable profit margin.

**Private-label orders** are another instance where special pricing is used. In these cases, the product is branded under the buyer's name rather than the producer's. Companies may accept these orders during slow periods to utilize idle production capacity. Fixed costs are usually not allocated to private-label products, and some variable costs (like sales commissions) may be reduced or eliminated. Prices for private-label orders are typically set to ensure a positive contribution margin.

Special pricing can also be justified in cases where:

- The order involves unusual circumstances, such as high quantities, special delivery requirements, or unique packaging,
- Products are tailor-made to customer specifications, or
- Goods are produced for one-time jobs, like export orders, which don't affect domestic sales.

When setting prices for special orders, management must consider both qualitative and quantitative factors, such as:

- Will offering a low price set a precedent for future pricing?
- Will the contribution margin on a low-bid job be sufficient to justify the added effort and resource use?
- Will the additional production create bottlenecks that reduce overall company efficiency?
- How will fulfilling the special order impact the company's regular sales?
- If the order is placed during an off-season or economic slowdown, is management willing to accept a lower contribution margin to keep the workforce employed?

Special order pricing can be an effective strategy to maintain operations, but the long-term sustainability of pricing below cost or at low margins should always be carefully evaluated.

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## 10. Special Order Pricing

Assume that IndusTech Manufacturing has the opportunity to bid on a special order for 50,000 custom smartphone cases for a large retailer.

The management wants to take this order if it contributes to the company's profit. IndusTech has unused production capacity and can procure the required components from suppliers without additional costs. There are no alternative opportunities to use the currently idle capacity, meaning there is no opportunity cost associated with this decision.

To decide the bid price, IndusTech gathers the following cost details:

| Cost Category                           | Normal Costs (₹) | Relevant Costs for Special Order (₹) |
|---|------------------|--------------------------------------|
| Direct material and components          | ₹60              | ₹60                                  |
| Direct labor                            | ₹15              | ₹15                                  |
| Variable factory overhead               | ₹25              | ₹25                                  |
| Variable selling expenses (commissions) | ₹12              | ₹0 (no commission for special order) |
| <b>Total Variable Costs</b>             | <b>₹112</b>      | <b>₹100</b>                          |
| Fixed factory overhead (allocated)      | ₹30              | Not Relevant                         |
| Fixed selling & administrative costs    | ₹20              | Not Relevant                         |
| <b>Total Full Cost per Unit</b>         | <b>₹162</b>      | <b>₹100</b>                          |

In this special pricing decision, the relevant cost to consider is ₹100 per unit (which includes direct material, direct labor, and variable factory overhead). The fixed overhead costs and selling expenses are not relevant because they will not change as a result of accepting this special order. Therefore, any price above ₹100 will generate a profit.

Assume that IndusTech is currently facing a ₹2,500,000 net loss on its smartphone case line. If management wants to not only cover this loss but also achieve a ₹500,000 before-tax profit, they need to spread the required contribution of ₹3,000,000 across the 50,000 units in the special order. This results in an additional contribution margin of ₹60 per case, leading to a suggested bid price of ₹160 (₹100 variable cost + ₹60 contribution margin).

| Requirement   | Amount (₹)  |
|---|-------------|
| Variable cost per unit                                | ₹100        |
| Additional contribution margin to cover loss & profit | ₹60         |
| <b>Bid price per unit</b>                             | <b>₹160</b> |

If IndusTech decides to set the price at ₹160 per unit, it will cover both the variable production costs and contribute towards reducing its losses while achieving some profit.

When determining the special order price, IndusTech should also take into account the broader market dynamics, competition, and customer demand. Additionally, the company must assess any potential impact on its regular business operations. If the special order creates additional costs, such as increased wear on machinery or overtime pay for workers, those costs must also be factored into the pricing decision.

In conclusion, while special pricing can help fill idle capacity and generate positive cash flow, IndusTech needs to ensure that the price set covers all relevant costs and contributes to long-term profitability.

## 10. Special Order Pricing

The Chumbak store has received a special order from IBM to purchase 50,000 cups, for its employees on Women's day. The sales manager at Chumbak asked the factory accountant to develop an estimate of the cost to fill this order. The production manager advises that there is plenty of idle capacity to fill this order. The factory accountant replied by submitting the information in table below.

| Item  | Cost (Rs.)    |
|---|---------------|
| Direct materials (50,000 @ Rs. 0.66 each)                 | 33,000        |
| Direct labour (50,000 @ Rs. 0.23 each)                    | 11,500        |
| Variable manufacturing overheads (50,000 @ Rs. 0.15 each) | 7,500         |
| Fixed manufacturing overheads (50,000 @ Rs. 0.10 each)    | 5,000         |
| Design costs  | 1,800         |
| Shipping costs  | 3,600         |
| Other administrative costs                                | 1,500         |
| <b>Total order cost</b>                                   | <b>63,900</b> |

The following additional information was provided.

All variable costs are incremental costs relating to this order. The charge for fixed manufacturing overhead is the standard fixed overhead amount that Chumbak allocates to all cups it produces. The fixed manufacturing overhead relates to factory equipment that is used to make the various products. It will not change in the short run. Design costs are the estimated costs of designing the product for this customer. They reflect a cost of Rs. 900 to which is added the standard 100% markup to cover fixed overhead in the design department. The shipping costs are the estimated costs of shipping the completed product to the customer.

The other administrative costs represent the cost that is added to each order to reflect fixed administrative costs at Chumbak that will not change in the short run. What Minimum Price per Cup Should Chumbak quoting on this order to IBM?

Solution:

| Item  | Cost (Rs.)    | Incremental (Rs.) |
|---|---------------|-------------------|
| Direct materials (50,000 @ Rs. 0.66 each)                 | 33,000        | 33,000            |
| Direct labour (50,000 @ Rs. 0.23 each)                    | 11,500        | 11,500            |
| Variable manufacturing overheads (50,000 @ Rs. 0.15 each) | 7,500         | 7,500             |
| Fixed manufacturing overheads (50,000 @ Rs. 0.10 each)    | 5,000         | 0                 |
| Design costs  | 1,800         | 900               |
| Shipping costs  | 3,600         | 3,600             |
| Other administrative costs                                | 1,500         | 0                 |
| <b>Total order cost</b>                                   | <b>63,900</b> | <b>56,500</b>     |
| <b>Cost per cup</b>                                       |               | <b>1.13</b>       |

As shown in table above, the relevant (incremental) costs to fill this order total Rs. 56,500 or Rs. 1.13 per cup. This is the minimum, or floor, price that Chumbak should consider when quoting on this order.

The actual price charged will reflect strategic factors such as the amount of competition (the more unique the organization, the higher the price it likely can charge), the amount of idle capacity, how eager the organization is for new business, the possibility

of the price quoted for this business affecting relationships with current customers, and the possibility of future orders. The opportunity to develop a long-term relationship with the customer will affect the price charged for this order; however, in the long run the organization will need to cover the estimated full costs of filling orders like this.

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## 11. Dropping a Product

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Dropping a product is a critical decision for companies operating in multi-product environments. It involves analyzing whether a particular product line is contributing positively to the business's overall financial health or if it is draining resources. This decision requires managers to carefully assess the product's revenues, variable costs, and avoidable fixed costs while ensuring that irrelevant costs, like common overhead or unavoidable fixed expenses, do not influence the outcome.

In multi-product environments, companies break down their operating results by product lines to assess individual performance. When reviewing these segmented statements, managers must carefully distinguish between relevant and irrelevant costs. If both variable and fixed costs are allocated incorrectly, a product line may appear unprofitable when it's not.

Fixed expenses can be classified into 3 main categories:

1. Avoidable Costs: These are costs that can be eliminated if the product line is discontinued, often referred to as attributable expenses.
2. Unavoidable Direct Costs: These costs are tied directly to the product line but cannot be avoided even if the product line is dropped.
3. Common Expenses: These are costs incurred for the benefit of the entire company, shared across product lines. They will continue regardless of which product lines are discontinued.

Only avoidable costs are relevant when deciding whether to drop a product line. Unavoidable direct costs will remain even if the product is eliminated, and common expenses, like a factory's insurance premium, will continue to be incurred no matter which product lines are retained or dropped.

The **segment margin** is the difference between a product line's revenue and its direct variable and avoidable fixed costs. It provides a measure of the product line's contribution to covering the company's indirect and unavoidable expenses.

A positive segment margin suggests the product line is contributing to the company's overall profit and should be retained. A negative segment margin indicates the product line is a drain on resources and may be a candidate for elimination.

In classifying product line costs, managers must ensure they correctly identify which costs are truly avoidable. For example, the salary of a supervisor assigned to a specific product line may seem avoidable, but if the supervisor will simply be reassigned to another area when the product line is dropped, their salary becomes an unavoidable cost. Accurate classification of these costs is critical for making informed decisions.

Depreciation on equipment used to manufacture a product is typically an irrelevant cost when deciding whether to drop a product line, as it is a sunk cost. However, if the equipment can be sold, the potential selling price becomes relevant because it represents an additional benefit of discontinuing the product line. If the equipment will remain in use for producing other products, the depreciation expense remains unavoidable and irrelevant to the decision.

By understanding and properly classifying relevant costs—focusing only on avoidable expenses—managers can make better decisions about whether to drop or retain a product line, improving the company's overall profitability.

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## 11. Dropping a Product

Assume that MetroTech Hardware has the opportunity to bid on a special order for customized steel doors for a new building project. The order includes three different product lines: Economy, Standard, and Deluxe steel doors.

| Product Line | Sales (₹)          | Direct Variable Expenses (₹) | Contribution Margin (₹) | Total Fixed Expenses (₹) | Net Income (₹)  |
|--------------|--------------------|------------------------------|-------------------------|--------------------------|-----------------|
| Economy      | 80,00,000          | (54,00,000)                  | 26,00,000               | (21,00,000)              | 5,00,000        |
| Standard     | 98,00,000          | (57,00,000)                  | 41,00,000               | (37,00,000)              | 4,00,000        |
| Deluxe       | 30,00,000          | (22,00,000)                  | 8,00,000                | (9,65,000)               | (1,65,000)      |
| <b>Total</b> | <b>2,08,00,000</b> | <b>(1,33,00,000)</b>         | <b>75,00,000</b>        | <b>(67,65,000)</b>       | <b>7,35,000</b> |

Upon initial review of the product line income statements, it appears that the Deluxe line is operating at a net loss of ₹1,65,000. Based on this, some managers might conclude that eliminating the Deluxe product line would improve the company's overall profitability by this amount. However, this conclusion might be premature as it does not consider the relevant and irrelevant costs involved in making this decision.

The income statement shows that the Deluxe product line is generating a loss. However, this statement includes fixed expenses that may not be relevant for making the elimination decision.

To make an informed decision, the company must categorize fixed expenses into three groups:

- (i) *Avoidable Fixed Expenses*: Expenses that can be eliminated if the product line is discontinued (referred to as attributable expenses).
- (ii) *Unavoidable Fixed Expenses*: Expenses that are directly tied to the product line but will persist even if the product line is dropped.
- (iii) *Common Fixed Expenses*: Expenses incurred for the benefit of the entire company and allocated to all product lines.

| Product Line | Avoidable Fixed Expenses (₹) | Unavoidable Fixed Expenses (₹) | Allocated Common Expenses (₹) | Total Fixed Expenses (₹) |
|--------------|------------------------------|--------------------------------|-------------------------------|--------------------------|
| Economy      | 12,00,000                    | 6,00,000                       | 3,00,000                      | 21,00,000                |
| Standard     | 30,00,000                    | 4,20,000                       | 2,80,000                      | 37,00,000                |
| Deluxe       | 4,50,000                     | 3,00,000                       | 2,15,000                      | 9,65,000                 |
| <b>Total</b> | <b>46,50,000</b>             | <b>13,20,000</b>               | <b>7,95,000</b>               | <b>67,65,000</b>         |

By examining the avoidable fixed expenses and the contribution margin, we can determine whether the Deluxe product line should be dropped:

| Product Line | Contribution Margin (₹) | Avoidable Fixed Expenses (₹) | Segment Margin (₹) |
|--------------|-------------------------|------------------------------|--------------------|
| Economy      | 26,00,000               | 12,00,000                    | 14,00,000          |
| Standard     | 41,00,000               | 30,00,000                    | 11,00,000          |
| Deluxe       | 8,00,000                | 4,50,000                     | 3,50,000           |
| <b>Total</b> | <b>75,00,000</b>        | <b>46,50,000</b>             | <b>28,50,000</b>   |

The segment margin represents the excess of revenues over direct variable expenses and avoidable fixed expenses. In this case, the Deluxe line is contributing a positive segment margin of ₹3,50,000, which means it is covering its relevant costs and contributing to the company's overall profitability.

Based on this analysis, MetroTech Hardware should not eliminate the Deluxe product line, as it is generating a positive segment margin and covering its relevant expenses. Removing this product line would reduce the company's overall profitability by ₹3,50,000, the segment margin of the Deluxe line. Additionally, management should consider any indirect impacts on normal company activities and potential unforeseen costs before making the final decision.

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## 11. Dropping a Product

Ashoka hotel is organized into three operating units: a restaurant, a bar, and a spa. The table below summarizes the results for the most recent year. Ashoka hotel is concerned about the continuing losses being reported by the spa and is considering closing it and reallocating the floor space occupied by the spa to the restaurant and bar.

|                | Restaurant (Rs.) | Bar (Rs.) | Spa (Rs.)  | Total (Rs.) |
|----------------|------------------|-----------|------------|-------------|
| Sales          | 12,00,000        | 8,00,000  | 1,00,000   | 21,00,000   |
| Variable costs | 7,00,000         | 3,75,000  | 50,000     | 11,25,000   |
| Fixed costs    | 3,20,000         | 1,18,000  | 2,02,000   | 6,40,000    |
| Profit         | 1,80,000         | 3,07,000  | (1,52,000) | 3,35,000    |

A study of operations yielded the following results:

1. The fixed costs have two components:
  - a. The first component is an allocation of the organization's general business costs of Rs. 3,40,000. These costs are allocated in proportion to the floor space occupied by each unit. The floor space occupied by the restaurant, bar, and spa is 1,000, 400, and 600 square meters, respectively.
  - b. The second component of fixed costs for each unit is the attributable fixed cost relating to rented equipment that can be avoided in full if the unit is closed.
2. If the spa is closed, 400 square meters of the freed up space will be allocated to the restaurant and 200 square meters will be allocated to the bar. Attributable fixed costs in the restaurant and in the bar will not increase if the area is expanded.
3. If the spa is closed and the restaurant is expanded, sales in the restaurant will increase by 10%. Variable costs will increase in the same proportion.
4. A study of the bar customers suggests that the patrons of the spa account for about 50% of the bar sales and that half of these sales will be lost if the spa is closed. Variable costs will decrease in the same proportion. Should the Spa be Closed?

**Solution:**

We can approach this question in two steps. First, eliminate the allocated costs from the contribution of each of the business units. For example, the allocated cost to the restaurant will be Rs. 1,70,000 computed as follows:

$$\text{Rs } 340000 \times \frac{1000}{1000 + 400 + 600}$$

This means that Rs. 1,50,000 (Rs. 3,20,000 – Rs. 1,70,000) is the amount of attributable and avoidable costs associated with the restaurant. We can use the same approach to identify the effect of removing the allocated costs from the bar and spa. The result is shown in the table below.

|                          | Restaurant (Rs.) | Bar (Rs.) | Spa (Rs.) | Total (Rs.) |
|--------------------------|------------------|-----------|-----------|-------------|
| Sales                    | 12,00,000        | 8,00,000  | 1,00,000  | 21,00,000   |
| Variable costs           | 7,00,000         | 3,75,000  | 50,000    | 11,25,000   |
| Attributable Fixed costs | 1,50,000         | 50,000    | 1,00,000  | 3,00,000    |
| Profit                   | 3,50,000         | 3,75,000  | (50,000)  | 6,75,000    |
| Corporate fixed costs    |                  |           |           | 3,40,000    |
| Profit                   |                  |           |           | 3,35,000    |

With the spa closed, restaurant sales will increase to Rs. 13,20,000 [Rs. 12,00,000 × (1 + 10%)] and variable costs will increase to Rs. 7,70,000 [Rs. 7,00,000 × (1 + 10%)].

In addition, sales in the bar will decrease to Rs. 6,00,000 [Rs. 8,00,000 × (1 - 25%)] and variable costs will decrease to Rs. 2,81,250 [Rs. 3,75,000 × (1 - 25%)].

The table below summarizes the result. The result of closing the spa has decreased the corporate profit by Rs. 6,250 (Rs. 3,35,000 – Rs. 3,28,750). Although this difference is not significant, the analysis does illustrate a situation in which the sales by one organizational unit can affect sales in another organizational unit and that these relationships need to be evaluated when consideration is given to dropping an apparently unprofitable product or line of business.

**Restaurant (Rs.) Bar (Rs.) Total (Rs.)**

|                          | Restaurant (Rs.) | Bar (Rs.) | Total (Rs.)     |
|--------------------------|------------------|-----------|-----------------|
| Sales                    | 13,20,000        | 6,00,000  | 19,20,000       |
| Variable costs           | 7,70,000         | 2,81,250  | 10,51,250       |
| Attributable Fixed costs | 1,50,000         | 50,000    | 2,00,000        |
| Profit                   | 4,00,000         | 2,68,750  | 6,68,750        |
| Corporate fixed costs    |                  |           | 3,40,000        |
| <b>Profit</b>            |                  |           | <b>3,28,750</b> |

## 12. Replacement Decisions

Machine replacement decisions are essential for firms seeking to improve operational efficiency, reduce costs, or maintain a competitive edge. To determine whether a machine should be replaced or retained, companies use relevant costing analysis, focusing only on future costs and revenues that will change as a result of the decision.

Here's a structured approach to analyzing machine replacement decisions.

### 1. Identify Relevant Costs

The first step in a replacement analysis is to identify all relevant costs and revenues. Relevant costs are future costs that will differ between retaining the old machine and replacing it. These typically include:

- *Operating Costs*: Ongoing expenses required to operate the machine. Newer machines often have lower operating costs due to improved efficiency and reduced maintenance needs.
- *Purchase Cost of the New Machine*: The initial investment required to acquire the new machine.
- *Disposal Value of the Old Machine*: If the old machine can be sold, its disposal or salvage value represents a relevant cash inflow if replacement is chosen.
- *Sunk Costs (Irrelevant)*: Costs such as the original purchase price or book value of the old machine are past expenditures that do not affect future decisions. These are irrelevant in a replacement decision as they remain unchanged regardless of the outcome.

### 2. Calculate Total Relevant Costs for Each Option

To make an informed choice, calculate and compare the total costs of each option (keeping the existing machine vs. replacing it) over the same time horizon, typically the remaining useful life of the current machine.

#### Example Calculation Structure

| Cost Components                       | Keep Old Machine | Replace with New Machine |
|---------------------------------------|------------------|--------------------------|
| Operating Costs (over remaining life) | Rs. X,XX,XXX     | Rs. Y,YY,YYY             |
| Cost of New Machine                   | -                | Rs. Z,ZZ,ZZZ             |
| Disposal Value of Old Machine         | -                | (Rs. A,AA,AAA)           |
| <b>Total Relevant Costs</b>           | Rs. Total 1      | Rs. Total 2              |

For each option:

- *If Retaining the Old Machine*: Sum the operating costs over its remaining useful life.
- *If Replacing with the New Machine*: Include the purchase cost of the new machine, lower operating costs, and any cash inflow from the disposal of the old machine.

### 3. Compare the Relevant Costs

Once the calculations are complete, compare the total relevant costs of each option. If the replacement option has a lower total cost, it indicates a cost-saving advantage. This comparison is a critical part of the decision-making process, as it provides a clear picture of the financial impact of each choice.

### 4. Consider Qualitative and Strategic Factors

Beyond the quantitative analysis, several qualitative and strategic factors can impact the replacement decision:

- *Increased Production Efficiency*: New machines can improve production speed and consistency, potentially leading to higher output and customer satisfaction.
- *Reduced Downtime and Maintenance*: A newer machine may require fewer repairs, reducing downtime and improving production reliability.
- *Technological Advancements*: Upgraded machines may offer advanced features, aligning with the firm's future goals and competitive strategies.

##### **5. Make the Decision and Recommendation**

Based on the relevant cost comparison and qualitative considerations, a recommendation is made:

If the replacement option has lower relevant costs and aligns with strategic goals, the firm should proceed with the replacement. If retaining the old machine is more cost-effective and the qualitative factors do not favor replacement, the firm should keep the old machine.

---

## 12. Replacement Decisions

Omega Aerospace, an aerospace manufacturer, is considering replacing an outdated metal-cutting machine with a new, more efficient model. The decision to replace the machine depends on a cost comparison over the next two years, which is the remaining useful life of the old machine.

Here is the relevant financial information for both the current machine (old machine) and the potential replacement (new machine):

| Details                                      | Old Machine   | New Machine  |
|--|---------------|--------------|
| Original Cost                                | Rs. 10,00,000 | Rs. 6,00,000 |
| Useful Life                                  | 5 years       | 2 years      |
| Age  | 3 years       | 0 years      |
| Remaining Useful Life                        | 2 years       | 2 years      |
| Accumulated Depreciation                     | Rs. 6,00,000  | -            |
| Book Value                                   | Rs. 4,00,000  | -            |
| Current Disposal Value                       | Rs. 40,000    | -            |
| Terminal Disposal Value (end of useful life) | Rs. 0         | Rs. 0        |
| Annual Cash Operating Costs                  | Rs. 8,00,000  | Rs. 4,60,000 |

Using relevant costing analysis, determine if Omega Aerospace should replace the old machine with the new machine.

### SOLUTION:

To make the replacement decision, we will use relevant costing principles. We will only consider costs that differ between the two options (keeping the old machine versus replacing it with the new machine). This includes operating costs over the remaining two years and any disposal value or purchase cost associated with the new machine.

Step 1: Calculate Relevant Costs if the Old Machine is Kept

Operating Costs for the Old Machine (over 2 years):

$$\text{Operating Cost} = 8,00,000 \times 2 = 16,00,000$$

Total Relevant Cost if Old Machine is Kept:

$$\text{Total Cost (Old Machine)} = 16,00,000$$

Step 2: Calculate Relevant Costs if the Machine is Replaced with the New Machine

Cost of New Machine: Rs. 6,00,000

Operating Costs for the New Machine (over 2 years):

$$\text{Operating Cost} = 4,60,000 \times 2 = 9,20,000$$

Disposal Value of Old Machine: Rs. 40,000 (cash inflow from selling the old machine)

Total Relevant Cost for New Machine:

$$\text{Total Cost (New Machine)} = 6,00,000 + 9,20,000 - 40,000 = 14,80,000$$

Step 3: Comparison of Relevant Costs

| Costs                         | Keep Old Machine     | Replace with New Machine |
|-------------------------------|----------------------|--------------------------|
| Operating Costs (2 years)     | Rs. 16,00,000        | Rs. 9,20,000             |
| Disposal Value of Old Machine | -                    | (Rs. 40,000)             |
| Cost of New Machine           | -                    | Rs. 6,00,000             |
| <b>Total Relevant Costs</b>   | <b>Rs. 16,00,000</b> | <b>Rs. 14,80,000</b>     |

The total relevant cost for replacing the old machine is Rs. 14,80,000, whereas keeping the old machine results in a higher relevant cost of Rs. 16,00,000. By replacing the old machine, Omega Aerospace will save Rs. 1,20,000 over the two-year period.

Therefore, Omega Aerospace should replace the old machine to achieve these cost savings.

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## 12. Replacement Decisions

XYZ Manufacturing Co. is considering replacing its old lathe machine. The old machine has a current book value of Rs. 1,50,000 and is expected to last another five years with annual operating costs of Rs. 90,000. The company has found a new, more efficient machine available for Rs. 3,00,000, which would also have a five-year life and reduce annual operating costs to Rs. 45,000. The current market resale value of the old machine is Rs. 40,000. The company's tax rate on the sale of equipment is 20%.

| Criteria               | Old Machine               | New Machine  |
|------------------------|---------------------------|--------------|
| Purchase Cost          | Rs. 1,50,000 (book value) | Rs. 3,00,000 |
| Remaining Life         | 5 years                   | 5 years      |
| Resale Value (Current) | Rs. 40,000                | N/A          |
| Annual Operating Cost  | Rs. 90,000                | Rs. 45,000   |

XYZ Manufacturing Co. wants to know if they should replace the old machine.

**SOLUTION:**

*Step 1: Calculate the Net Cash Outlay for the New Machine*

Cost of New Machine: Rs. 3,00,000

Less Current Resale Value of Old Machine: Rs. 40,000

Net Cash Outlay for Replacement:  $\text{Rs. } 3,00,000 - \text{Rs. } 40,000 = \text{Rs. } 2,60,000$

*Step 2: Calculate Annual Operating Savings*

Operating Cost of Old Machine: Rs. 90,000 per year

Operating Cost of New Machine: Rs. 45,000 per year

Annual Savings in Operating Costs:  $\text{Rs. } 90,000 - \text{Rs. } 45,000 = \text{Rs. } 45,000$

*Step 3: Calculate Total Relevant Cost Over the Life of Machines*

### Old Machine (if retained)

| Item                        | Calculation                   | Amount      |
|-----------------------------|-------------------------------|-------------|
| Operating Costs for 5 Years | $\text{Rs. } 90,000 \times 5$ | Rs. 450,000 |

### New Machine (if purchased)

| Item                             | Calculation                   | Amount              |
|----------------------------------|-------------------------------|---------------------|
| Net Cash Outlay                  |                               | Rs. 2,60,000        |
| Operating Costs for 5 Years      | $\text{Rs. } 45,000 \times 5$ | Rs. 2,25,000        |
| <b>Total Cost of New Machine</b> |                               | <b>Rs. 4,85,000</b> |

*Step 4: Compare Relevant Costs*

The relevant cost analysis shows that the total cost of replacing the old machine with the new one is Rs. 4,85,000, while keeping the old machine results in a lower total cost of Rs. 450,000 over the next five years. Thus, XYZ Manufacturing Co. should retain the old machine as it incurs a lower relevant cost compared to replacing it with the new machine.

## 1. Introduction

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Cost accounting includes two systems of accounting, i.e., Non-Integral Accounting system and Integral Accounting system. When the cost accounting records and financial accounting records are integrated, the system is called **Integrated or Integral accounting system**. However, when the cost and financial accounting records are kept separately, the system is called **Non-Integrated Accounting system or Cost Control System**. While non-integrated system of accounting necessitates reconciliation between financial and cost accounts but no reconciliation is required under integrated accounting system.

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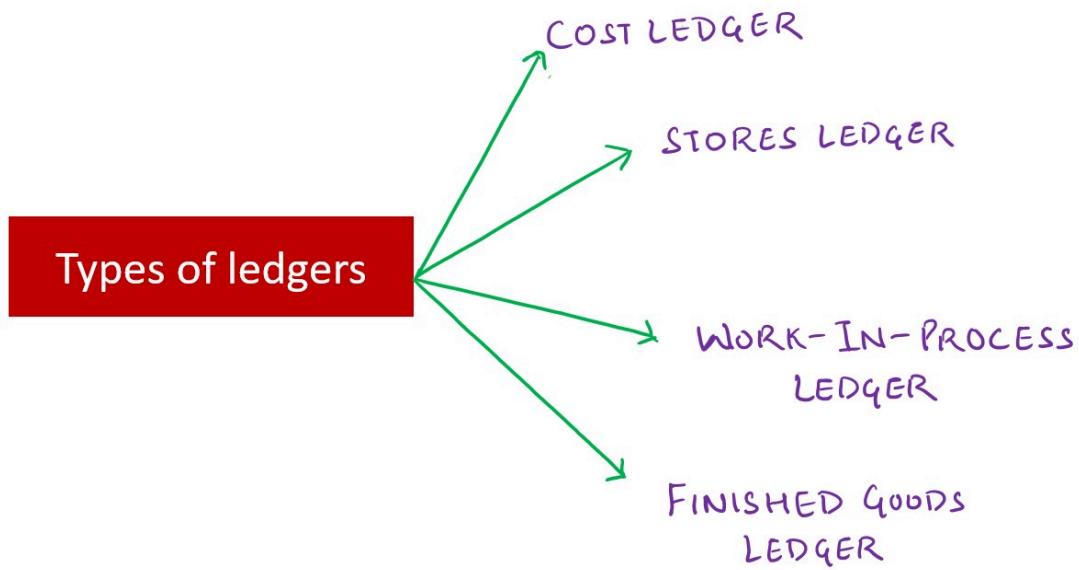
## 2. Non-Integrated Accounting system

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Under Non-Integrated Accounting System, separate ledgers are maintained for cost accounts and financial accounts. The system is also known as **cost ledger accounting system**. In this system, only those transactions which relate to the product or service being supplied, are recorded in the cost accounts. The items of expenses in relation to sales, production or other matters of factory management are also considered in the accounts. Thus, expenses like interest, bad debts and revenue/income from 'other than the sale of product or service' are excluded. Non-Integrated Accounting Systems contain fewer accounts as compared to financial accounting system due to the exclusion of purchases, expenses and also Balance Sheet items like fixed assets, debtors and creditors. The items which are excluded are represented by an account called 'Cost ledger control account'.

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## 2. Non-Integrated Accounting system



The ledgers maintained under non-integrated accounting system under Cost Accounting are as follows:

### Cost Ledger

This is the principle ledger of the cost department in which impersonal accounts are recorded. This ledger is made self-balancing by maintaining therein a Control Account for each subsidiary ledger.

### Stores Ledger

It contains an account for each item of stores. The entries in each account maintained in this ledger are made from the invoice, goods received note, material requisitions, material received note etc. Accounts in respect of each item of stores show receipt, issue and balance in physical as well as in monetary terms.

### Work-in-Process Ledger

This ledger is also known as *job ledger*, it contains accounts of unfinished jobs and processes. All material costs, wages and overheads for each job in process are posted to the respective job accounts in this ledger. The balance in a job account represents total balance of job/work-in-process, as shown by the job account.

### Finished Goods Ledger

It contains an account for each item of finished product manufactured or the completed job. If the finished product is transferred to stock, a credit entry is made in the work-in-process ledger and a corresponding debit entry is made in this ledger.

## 2. Non-Integrated Accounting system



The various cost control accounts can be described as given below.

### Cost Ledger Control Account

This account is also known as *General Ledger Adjustment Account*. This account is made to complete double entry. All items of expenditure are credited to this account. Sales are debited to this account and net profit/loss from Costing Profit & Loss Account is transferred to this account. The balance in this account at the end of the particular period represents the net total of all the balances of the impersonal accounts.

### Stores Ledger Control Account

This account is debited for the purchase of material and credited for issue of materials from the stores. The balance in this account indicates the total balance of all the individual stores accounts. Abnormal losses or gains, if any, in this account are transferred to Costing Profit & Loss Account. Entries are made on the basis of goods received notes and stores requisitions etc.

### Wages Control Account

This account is debited with total wages paid (direct and indirect). Direct wages are further transferred to Work-in-Process Control Account and indirect wages to Production Overhead; Administration Overhead or Selling & Distribution Overhead Control Accounts, as the case may be. Wages paid for abnormal idle time are transferred to Costing Profit & Loss Account either directly or through Abnormal Loss Account.

### Manufacturing/Production/Works/ Factory Overhead Control Account

This account is debited with indirect costs of production such as indirect material, indirect employee, indirect expenses (carriage inward etc.). Overhead recovered (absorbed) is credited to this Account. The difference between overhead incurred and overhead recovered (i.e. Under Absorption or Over Absorption of Overheads) is transferred to Overheads Adjustment Account.

### Work-in-Process Control Account

This account is debited with the total cost of production, which includes—direct materials, direct employee, direct expenses, production overhead recovered, and is credited with the amount of finished goods completed and transferred. The balance in this account represents total balances of jobs/works-in-process, as shown by several job accounts.

### Administrative Overhead Control Account

This account is debited with overheads incurred and credited with overhead recovered. The overhead recovered are debited to Finished Goods Control Account, if administrative overhead is related with production activities otherwise to Cost of Sales Account. The difference between administrative overheads incurred and recovered is transferred to Overhead Adjustment Account.

### Finished Goods Control Accounts

This account is debited with the value of goods transferred from Work-in-process Control Account and administration costs

recovered (if relates to production activities). This account is credited with Cost of Sales Account. The balance of this account represents the value of goods unsold at the end of the period.

#### **Selling and Distribution Overhead Control Account**

This account is debited with selling and distribution overheads incurred and credited with the selling and distribution overheads recovered. The difference between overheads incurred and recovered is transferred usually to Overhead Adjustment Account.

#### **Cost of Sales Account**

This account is debited with the cost of finished goods transferred from Finished Goods Control Account for sale, General Administrative overhead recovered, Selling and distribution overhead recovered. The balance of this account is ultimately transferred to Sales Account or Costing Profit & Loss Account.

#### **Costing Profit & Loss Account**

This account is debited with cost of sales, under-absorbed overheads and abnormal losses and is credited with sales value, over-absorbed overhead and abnormal gains. The net profit or loss in this account is transferred to Cost Ledger Control Account.

#### **Overhead Adjustment Account**

This account is to be debited for under-recovery of overhead and credited with over-recovery of overhead amount. The net balance in this account is transferred to Costing Profit & Loss Account. Sometimes, Overhead Adjustment Account is dispensed with and under/over absorbed overheads is directly transferred to Costing Profit & Loss Account from the respective overhead accounts.

---

## 2. Non-Integrated Accounting system

The double entry system of maintaining Cost Ledger can be illustrated with the help of various accounting entries as below.

### Journal Entries related to Materials

Purchase – Rs. 5,000 (credit or cash)

|                          |                            |      |
|--------------------------|----------------------------|------|
| (i) Material Control A/c | — Dr.                      | 5000 |
|                          | to Cost Ledger Control A/c | 5000 |
| (ii) Stores Ledger A/c   | — Dr.                      | 5000 |
|                          | to Material Control A/c    | 5000 |

Note: Sometimes Material Control Account is dispensed with and entries are directly made into Stores Ledger Control A/c, giving a credit to Cost Ledger Control A/c.

Material returned to vendor – Rs. 500

|                         |                             |     |
|-------------------------|-----------------------------|-----|
| Cost ledger Control A/c | — Dr.                       | 500 |
|                         | To store ledger Control A/c | 500 |

(i) Material (Direct) issued to production- Rs. 1,000

|                             |                             |      |
|-----------------------------|-----------------------------|------|
| Work-in-process control A/c | — Dr.                       | 1000 |
|                             | To store ledger Control A/c | 1000 |

(ii) Material (Indirect) issued to production- Rs. 200

|                                 |                             |     |
|---------------------------------|-----------------------------|-----|
| Production overhead control A/c | — Dr.                       | 200 |
|                                 | To store ledger Control A/c | 200 |

Material worth Rs. 100 is issued from stores for repairs

|                                 |                              |     |
|---------------------------------|------------------------------|-----|
| Production Overhead control A/c | — Dr.                        | 100 |
|                                 | To stores ledger control A/c | 100 |

### Journal Entries related to Labour

Direct wages paid to workers- Rs. 1,000

|                   |                            |      |
|-------------------|----------------------------|------|
| Wages control A/c | — Dr.                      | 1000 |
|                   | To cost ledger control A/c | 1000 |

Indirect wages paid to workers in the production- Rs. 700

|      |                                 |       |     |
|------|---------------------------------|-------|-----|
| (i)  | Wages Control A/c               | — Dr. | 700 |
|      | To Cost Ledger Control A/c      |       | 700 |
| (ii) | Production Overhead Control A/c | — Dr. | 700 |
|      | To Wages Control A/c            |       | 700 |

**Journal Entries related to Direct Expenses**

Direct expenses incurred Rs. 500 for Job No. 12

|                                  |       |     |
|----------------------------------|-------|-----|
| Job no. 12 A/c (WIP Control A/c) | — Dr. | 500 |
| To Cost ledger control A/c       |       | 500 |

**Journal Entries related to Overheads**

Overhead expenses incurred Rs. 500 (Production Rs. 150; Administrative Rs. 150; Selling and Distribution Rs. 200)

|   |       |     |
|---|-------|-----|
| Production Overhead Control A/c               | — Dr. | 150 |
| Administrative overhead control A/c           | — Dr. | 150 |
| Selling and distribution overhead control A/c | — Dr. | 200 |
| To cost ledger control A/c                    |       | 500 |

Carriage Inward (Direct to Factory)- Rs. 100

|                                 |       |     |
|---------------------------------|-------|-----|
| Production Overhead control A/c | — Dr. | 100 |
| To cost ledger control A/c      |       | 100 |

Production overhead recovered- Rs. 1,000

|                                    |       |      |
|------------------------------------|-------|------|
| Work-in-process Ledger control A/c | — Dr. | 1000 |
| To production overhead control A/c |       | 1000 |

Under recovery of overheads

|  |       |      |
|--|-------|------|
| Costing Profit and loss A/c            | — Dr. | xxxx |
| To Administrative Overhead control A/c |       | xxxx |

Over recovery of overheads

|                                  |       |      |
|----------------------------------|-------|------|
| Production Overheads control A/c | — Dr. | xxxx |
| To costing profit & loss A/c     |       | xxxx |

**Journal Entries related to Sales**

|                                |       |      |
|--------------------------------|-------|------|
| Cost ledger Control A/c        | — Dr. | xxxx |
| To costing profit and loss A/c |       | xxxx |

**Journal Entries related to Profit/Loss**

In case of Profit

Costing profit and loss A/c — Dr. xxxx

To cost ledger control A/c

xxxx

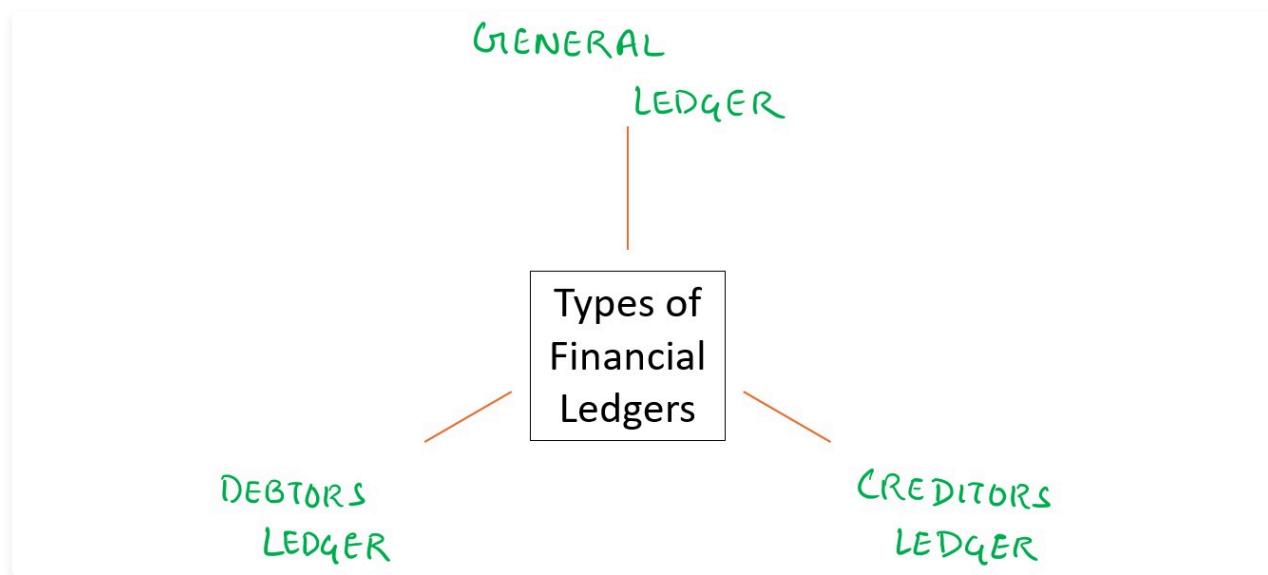
In case of Loss

Cost ledger control A/c — Dr. xxxx

To costing profit and loss A/c

xxxx

## 2. Non-Integrated Accounting system



The various financial ledgers maintained under financial accounting are as below.

**a. General Ledger**

The General Ledger constitutes the following accounts:

1. Real, nominal and personal accounts except those of trade debtors and trade creditors.
2. A total account, termed as 'Cost Ledger Control Account'. It records all items of expenditure and income which relate to cost accounts. This account is a memorandum account only.

**b. Debtors Ledger**

It contains personal accounts of all trade debtors.

**c. Creditors Ledger**

It contains personal accounts of all trade creditors.

**d. Cost ledger control account (in financial books)**

Since the costing department is not a distinct entity from the Financial Department and all the purchases and sales are recorded through financial books, a Cost Ledger Control Account must be opened in the financial books. This is only a memorandum account. In this account, all the items of revenue and expenditure affecting cost accounts are recorded. This account is just the reverse or contra of General Ledger Adjustment Account in the Cost Ledger and, therefore, the balance of this account should tally with the balance of its counterpart in the cost ledger.

## **2. Non-Integrated Accounting system**

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The advantages of Non-Integrated Accounting System are as stated below.

1. This system tends to coordinate the functions of different selections of the accounts department since all efforts are integrated and directed towards achievement of one aim that is providing a high level of efficiency.
  2. The accounting procedures can be simplified and the system can be centralised with the object of achieving a greater control over the organization.
  3. The system creates conditions which are eminently suitable for the introduction of mechanized accounting.
  4. There is no possibility of overlooking any expense under the system.
  5. As cost accounts are posted straight from the books of original entry, there is no delay in obtaining the data.
  6. There is automatic check on the correctness of the cost data. It ensures that all legitimate expenditure is included in Cost accounts and reliable and proved data is provided to the management for its decisions'.
  7. Integrated accounting widens the outlook of the accountant.
  8. It can be maintained according to convenience as it need not be statutorily maintained.
- 

## **2. Non-Integrated Accounting system**

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The limitations of Non-Integrated Accounting System can be mentioned as below:

1. The Financial transactions other than cost incurred are not recorded in the system.
  2. Transactions involving payment other than that of cost are not included in the system. For example, loss on fixed assets.
  3. There is always a difference between the profits reported as per the cost accounting system and the Financial Accounting System.
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### **3. Integrated Accounting System**

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Under Integrated Accounting System (also known as Integral Accounting System), there will be no separate set of books for Costing and Financial records. Integrated accounts provide the information required for Cost Accounting and Financial Accounting. Thus, integrated accounts provide the information necessary for preparing profit and loss account and balance sheet as per the requirement of law and also helps in exercising effective control over the liabilities and assets of its business. Under this system, there is no need for a separate cost ledger. However, there will be a number of subsidiary ledgers; in addition to the useful Customers' Ledger and the Purchase Ledger, there will be: (a) Stores Ledger; (b) Stock Ledger and (c) Job Ledger.

The features of integrated accounting system are listed below.

1. Complete analysis of cost and sales is kept
2. Complete details of all payments in cash are kept
3. Complete details of all assets and liabilities are kept and this system does not use a notional account to represent all impersonal accounts

In integrated accounting system, general ledger adjustment account is eliminated and detailed accounts for assets and liabilities are maintained. In integrated system, all accounts necessary for showing classification of cost will be used but the cost ledger control account/ General Ledger Adjustment Account of non-integrated accounting is replaced by the following accounts:

1. Bank account
  2. Receivables (Debtors) account
  3. Payables (Creditors) account
  4. Provision for depreciation account
  5. Fixed assets account
  6. Share capital account
- 

### **3. Integrated Accounting System**

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The benefits of Integrated Accounting System are as follows:

1. No need for reconciliation as it maintains single set of accounting records.
  2. Easy method to maintain accounts and avoid unnecessary complications.
  3. There is no possibility of different profit figures being reported in integrated accounting system.
  4. There is economy of scale due to the savings in the maintenance of books and general accounting.
  5. There is saving of time, because two different sets of books need not be maintained.
-

### 3. Integrated Accounting System

PQR Enterprises operates an integral system of accounting. You are required to pass the journal entries for the following transactions that took place for the year ended 30 June, 2020:

|   | (in Rs.) |
|---|----------|
| Raw materials purchased (50% on credit)     | 6,00,000 |
| Materials issued to production              | 4,00,000 |
| Wages paid to workers                       | 2,00,000 |
| Factory overheads incurred                  | 80,000   |
| Factory overheads charged to production     | 1,00,000 |
| Selling and distribution overheads incurred | 40,000   |
| Finished goods at cost                      | 5,00,000 |
| Sales (50% credit)                          | 7,50,000 |

Solution:

The journal entries under integral system are given below.

1.

*Stores ledger control A/c — Dr. 600,000*

*To Bank*

*To sundry creditors*

*300,000*

*300,000*

(Being raw materials purchased)

2.

*Work-in-process control A/c — Dr. 400,000*

*To stores ledger control A/c*

*400,000*

(Being issue of materials)

3.

*Wages control A/c — Dr. 200,000*

*To Bank A/c*

*200,000*

(Being payment of wages)

4.

*Factory overhead control A/c — Dr. 80,000*

*To Bank*

*80,000*

(Being factory overhead incurred)

5.

Work-in-process control A/c — Dr. 100,000  
To factory overhead control A/c 100,000

(Being overhead charged to production)

6.

Selling and distribution overheads control A/c — Dr. 40,000  
To Bank 40,000

(Being selling & distribution overheads incurred)

7.

Finished goods control A/c — Dr. 500,000  
To work in process control A/c 500,000

(Being finished goods at cost)

8.

Bank A/c — Dr. 375,000  
Sundry debtors A/c — Dr. 375,000  
To Sales 750,000

(Being sale of goods)

## 4. Reconciliation of Cost and Financial Accounts

When non-integrated system of accounting is followed, cost accounts and financial accounts should be reconciled to make the cost accounts reliable. Sufficient details are required to locate the differences between the two sets of accounts. The treatment of expenses should be same under cost and financial accounts. The General Ledger Adjustment Account in the Cost Ledger need to be studied to analyse the difference from financial accounts. The reconciliation of balances of the two sets of accounts can be done by preparing a **Memorandum Reconciliation Account**. In this account, the items charged in one set of accounts but not in the other or those charged in excess as compared to the other are identified and collected. These items of differences are either added or subtracted from the profit as shown by one of the accounts. Finally, the profits from two sets of accounts are reconciled.

## **4. Reconciliation of Cost and Financial Accounts**

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Reconciliation of Cost and Financial Accounts is necessary due to the following reasons:

1. It finds out the reasons for the difference in the profit or loss in cost and financial accounts.
  2. It ensures the mathematical accuracy and reliability of cost accounts in order to have cost ascertainment, cost control and to have a check on the financial accounts.
  3. It contributes to the standardisation of policies regarding stock valuation, depreciation and overheads.
  4. It facilitates more coordination and promotes better co-operation, between the activities of financial and cost sections of the accounting department.
  5. Reconciliation places management in better position to acquaint itself with the reasons for the variation in profits paving the way for more effective internal control.
-

## 4. Reconciliation of Cost and Financial Accounts

### CAUSES OF DIFFERENCES IN FINANCIAL AND COST ACCOUNTS



The various causes of differences in Financial Accounts and Cost Accounts can be described as below.

#### Items included in Financial Accounts only

There are certain financial expenses and income which are accounted for in financial accounts and not in cost accounts. This leads to a difference between financial and cost accounts. The various financial expenses and income are listed below.

##### (a) Purely Financial Expenses:

- i. Interest on loans or bank mortgages.
- ii. Expenses and discounts on issue of shares, debentures etc.
- iii. Other capital losses i.e., loss by fire not covered by insurance etc.
- iv. Losses on the sales of fixed assets and investments
- v. Goodwill written off
- vi. Preliminary expenses written off
- vii. Income tax, donations, subscriptions
- viii. Expenses of the company's share transfer office, if any.

##### (b) Purely Financial Income:

- i. Interest received on bank deposits, loans and investments
- ii. Dividends received
- iii. Profits on the sale of fixed assets and investments
- iv. Transfer fee received
- v. Rent receivables

#### Items included in Cost Accounts only (notional expenses)

Certain expenses are included in cost accounts only. This can, possibly, be a cause of difference between financial and cost accounts. The various items that are included in Cost Accounts only are given below.

- i. Charges in lieu of rent where premises are owned
- ii. Interest on capital at notional figure though not incurred
- iii. Salary for the proprietor at notional figure though not incurred
- iv. Notional Depreciation on the assets fully depreciated for which book value is nil.

#### Items whose treatment is different in the two sets of accounts

The objective of cost accounting is to provide information to management for decision making and control purposes while financial accounting conforms to external reporting requirements. Hence, there are chances that certain items are treated differently in the two sets of accounts. For example, LIFO method is not allowed for inventory valuation in India as per Accounting Standard 2 issued by the Council of ICAI. However, this method may be adopted for cost accounts as it is more

suitable for arriving at costs which may be used as a base for deciding selling prices. Similarly, cost accounting may use a different method of depreciation than what is allowed under financial accounting.

#### **Varying basis of valuation**

The methods of valuation under cost and financial accounts can be different. For example, in financial accounts, stocks are valued either at cost or market price, whichever is lower. But in Cost Accounts, stocks are only valued at cost.

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## **4. Reconciliation of Cost and Financial Accounts**

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Reconciliation of cost and financial accounts can be done with the help of the following steps.

1. Ascertainment of profit as per financial accounts
  2. Ascertainment of profit as per cost accounts
  3. Reconciliation of both the profits.
-

## 4. Reconciliation of Cost and Financial Accounts

Prepare a reconciliation statement and memorandum reconciliation account with the help of the following information.

| Particulars  | (in Rs.) |
|--|----------|
| Profit as per cost accounts                        | 10000    |
| Works overheads under-recovered in cost accounts   | 500      |
| Interest on capital included in financial accounts | 500      |
| Dividends received                                 | 1000     |
| Rent for owned building charged in cost accounts   | 300      |
| Profit as per financial books                      | 10300    |

**Solution:**

There is a difference of Rs. 300 between the profit as shown by the financial books and the profit as shown by the cost books. A reconciliation statement can be prepared on the basis of the following points:

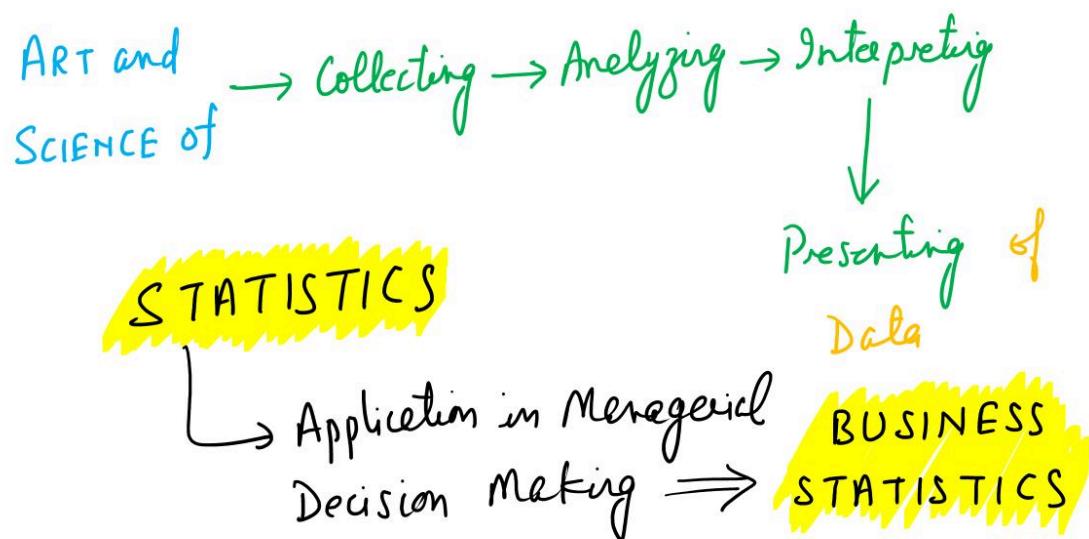
1. Profit as per cost accounts may be taken as the base to arrive at the profit as per financial accounts.
2. Works overheads are charged more in financial accounts as compared to cost accounts (by Rs. 500). Thus, the amount of Rs. 500 should be subtracted from the base profit.
3. When interest on capital is included as an expense, there is a decrease in profits as per financial books. Thus, the amount of Rs. 500, should be subtracted from the base profit.
4. Dividend received has been credited in financial books. This means the profit as shown by the financial books is more than the profit as shown by the cost books by Rs. 1000. Hence, Rs. 1000 should be added to the profit as shown by cost books.
5. No charge is made in financial books for rent on owned buildings. Thus, the profit in financial books is higher as compared to profit in cost books. Thus, the amount is added to the profit as shown by the cost books.

| Reconciliation Statement                             |        |       |
|--|--------|-------|
| Particulars  | +      | -     |
| Profit as per Cost Accounts                          | 10,000 |       |
| Less: Works overheads under-charged in cost accounts |        | 500   |
| Interest on capital included in financial accounts   |        | 500   |
| Add: Dividends received                              | 1000   |       |
| Rent on owned buildings                              | 300    |       |
|  | 11,300 | 1,000 |
| Profit as per Financial Accounts                     | 10,300 |       |

The memorandum reconciliation account can be prepared on the same lines as a reconciliation statement, the only difference is that in the former 'Dr.' denotes '-' while 'Cr.' Denotes '+'.

| Dr.   |        | Memorandum Reconciliation Account |        | Cr. |
|---|--------|-----------------------------------|--------|-----|
| Particulars   | (Rs.)  | Particulars                       | (Rs.)  |     |
| To works overheads under-charged in cost accounts     | 500    | By profit as per cost accounts    | 10,000 |     |
| To interest on capital included in financial accounts | 500    | By dividends received             | 1,000  |     |
| To profit as per financial accounts                   | 10,300 | By rent on owned building         | 300    |     |

## 1. Statistics

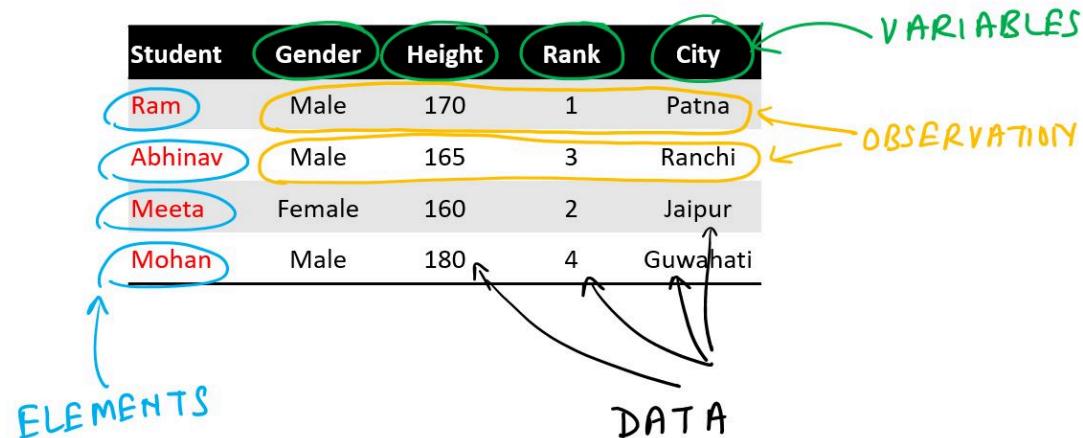


Statistics is both an art and a science encompassing the systematic gathering, organization, analysis, interpretation, and presentation of data. It involves employing mathematical techniques and methodologies to explore and understand patterns, trends, and relationships within datasets.

Managerial statistics, also known as business statistics, is the application of statistical methods and techniques to aid managerial decision-making in business and organizational settings. It involves using data analysis to solve business problems, make informed decisions, and improve operational efficiency and effectiveness.

## 2. Data

In statistics, data is the most important thing for any study. Data are the distinct factual pieces of the information. The data is considered as a plain fact. It is also called as the raw data, from which the statistics are extracted.



Data are the facts and figures collected, analyzed, and summarized for presentation and interpretation.

All the data collected in a particular study are referred to as the **data set** for the study.

The data set is comprised of Elements, Variables and Observations.

**Elements** are the entities, based on which the data is collected. Elements are very important feature of the data.

**Variables** are the characteristics of interest for the corresponding elements. A quantity whose value changes across the population and can be measured is called variable. For instance, consider a sample of employed individuals. The variables for this set of the population can be industry, location, gender, age, skills, job-type, etc. The value of the variables will differ with each employee.

**Observations** are the set of measurements that are collected for a specific element.

We will understand this with the help of an example.

| Earnings (in thousand Rs.) | Teacher | Doctor | Painter |
|----------------------------|---------|--------|---------|
| Weekly                     | 5       | 8      | 2       |
| Monthly                    | 150     | 100    | 80      |
| Annually                   | 1800    | 2000   | 800     |

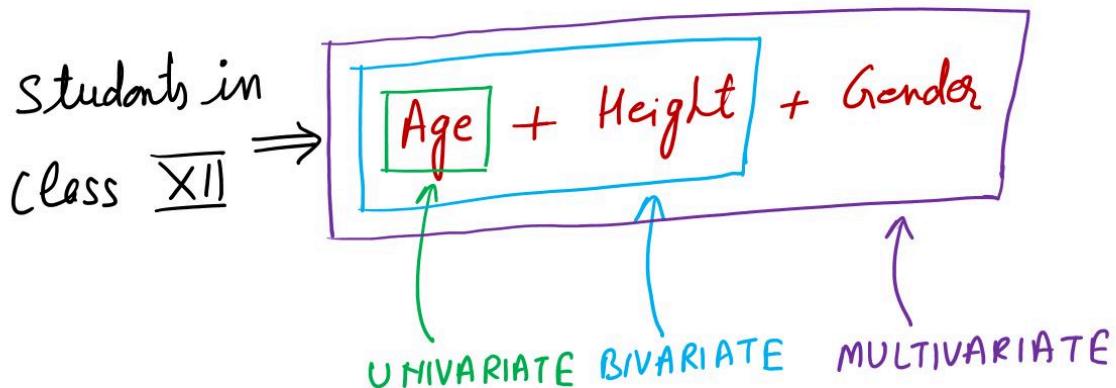
In the above table:

**Elements:** Teacher, Doctor, Painter

**Variables:** Weekly, Monthly, and Annual earning

**Observations:** 5, 150, 1800, 8, 100, 2000, 2, 80, 800

### 3. Types of Variables



There are three types of variables. We will use example of data on houses to explain these 3 types.

#### 1. Univariate Variables

Univariate data involves a single variable or characteristic, with one piece of information recorded for each item.

In the example of univariate data for housing prices, you might have a dataset consisting solely of the selling prices of houses in a particular area. Each entry records a single piece of information (price) for each house. Analyzing this univariate dataset would involve calculating summary statistics such as the average selling price, median price, range of prices, or standard deviation, providing insights into the typical pricing and the variability of housing prices in that area.

#### 2. Bivariate Variables

Bivariate data involves exactly two variables recorded for each item, allowing the study of the relationship between these two variables.

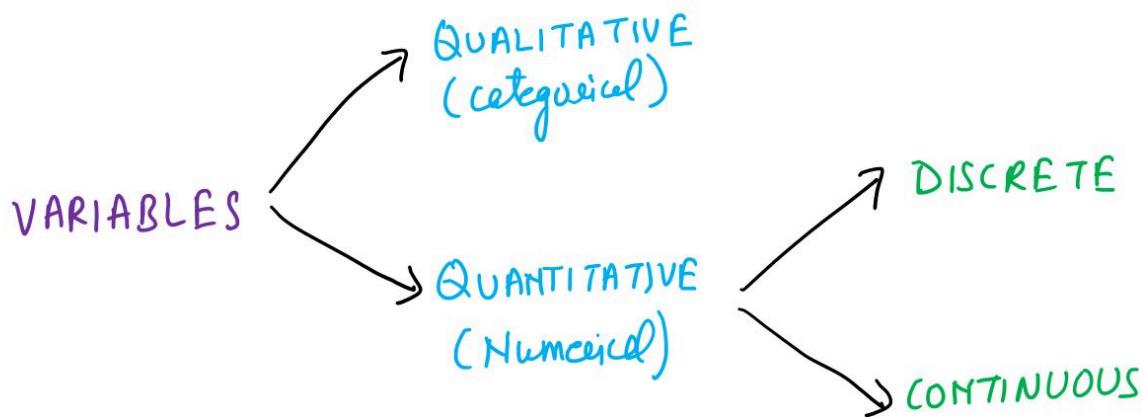
Moving to bivariate data for housing prices, you could expand the dataset to include two variables per entry. For instance, alongside the selling price, you could include the square footage of each house. By studying these two variables together, you can explore the relationship between house size and selling price. Using techniques like scatter plots, you can visualize how changes in square footage relate to changes in house prices, allowing you to understand if there's a correlation or pattern between the two.

#### 3. Multivariate Variables

Multivariate data involves three or more variables recorded for each item, enabling the study of relationships among multiple variables.

Expanding further to a multivariate dataset for housing prices, you could include additional factors influencing house prices, such as location, number of bedrooms, and neighborhood crime rate. Each entry in the dataset would now consist of multiple variables—selling price, square footage, location, number of bedrooms, and crime rate. Analyzing these multiple variables together enables a comprehensive understanding of how various factors collectively influence housing prices. Employing advanced statistical methods like regression analysis, you can predict housing prices based on these multiple variables and uncover complex relationships among them, providing valuable insights for real estate decisions.

## 4. Categorical and Quantitative Variables



Data can be classified as either categorical or quantitative.

### 1. Qualitative Variables (Categorical Variables)

Qualitative variables represent characteristics or qualities and can't be measured numerically. They are categorical and often described by labels or categories.

Examples of Qualitative Variables are:

- Hair Color: Categorizing individuals based on hair color—blonde, brunette, red, black, etc.
- Vehicle Types: Classifying vehicles by type—sedan, SUV, truck, motorcycle, etc.
- Educational Levels: Grouping individuals by education level—high school graduate, bachelor's degree, master's degree, etc.

### 2. Quantitative Variables (Numerical Variables)

Quantitative variables, in contrast to qualitative variables, can be measured numerically. They can further be classified into discrete and continuous variables.

**2.1 Discrete Variables:** Discrete variables represent countable and finite values. They take on specific numerical values and often whole numbers.

Examples of Discrete Variables are:

- Number of Children in Families: Counting the number of children in different families—0, 1, 2, 3, etc. (whole numbers).
- Number of Books in a Library: Counting the quantity of books in different libraries—100, 500, 1000, etc. (whole numbers).
- Customer Complaints in a Week: Recording the count of complaints received by a company—0, 5, 10, 20, etc. (whole numbers).

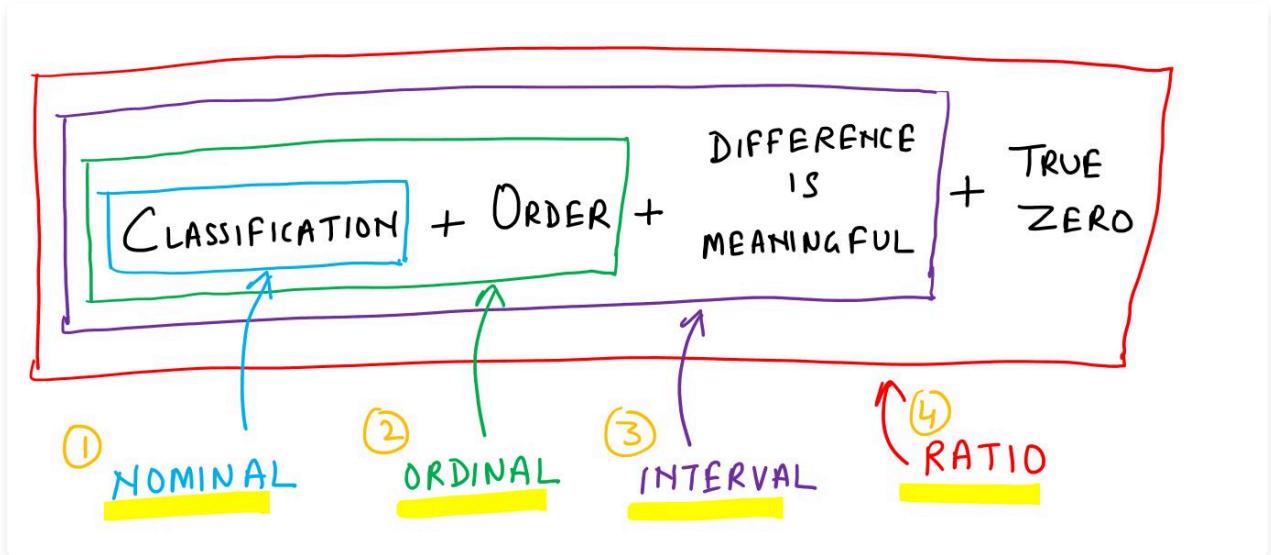
**2.2 Continuous Variables:** Continuous variables can take on any value within a given range. They are measured and can include fractional or decimal values.

Examples of Continuous Variables are:

- Weight of Individuals: Measuring the weight of people in kilograms or pounds—62.5 kg, 75.2 kg, 150 lbs, etc. (fractional or decimal values).
- Temperature: Measuring temperatures in degrees Celsius or Fahrenheit—23.5°C, 68.2°F, etc. (fractional or decimal values).
- Time Taken for a Process: Measuring time in hours, minutes, or seconds—3.25 hours, 45.6 minutes, etc. (fractional or decimal values).

## 5. Scales of Measurement

Nominal, Ordinal, Interval, and Ratio are defined as the four fundamental levels of measurement scales that are used to capture data in the form of surveys and questionnaires.



### 1. Nominal Scale

Nominal Scale, also called the categorical variable scale, is defined as a scale used for labeling variables into distinct classifications and doesn't involve a quantitative value or order. This scale is the simplest of the four variable measurement scales. Calculations done on these variables will be futile as there is no numerical value of the options.

Examples:

- Categorizing individuals by their political party preference— BJP, Congress, AAP, TMC etc.
- Classifying pets owned by households— dog, cat, fish, bird, etc.
- Grouping individuals based on marital status—single, married, divorced, widowed.
- Preference of smartphone- Apple – 1, Samsung – 2, OnePlus – 3.

### 2. Ordinal Scale

Ordinal Scale is defined as a variable measurement scale used to simply depicting the order of variables and not the difference between each of the variables. These scales are generally used to depict non-mathematical ideas such as frequency, satisfaction, happiness, a degree of pain, etc. It is quite straightforward to remember the implementation of this scale as 'Ordinal' sounds similar to 'Order', which is exactly the purpose of this scale.

In the Ordinal Scale, while there exists a clear order among categories, the distinctions between them lack precise numerical significance. Additionally, the presence of a zero point holds no meaningful value in this scale.

Examples:

- Classifying educational levels in order—High School Diploma, Associate's Degree, Bachelor's Degree, Master's Degree, Doctorate.
- Ranking movies by viewer preference—1 star, 2 stars, 3 stars, 4 stars, 5 stars.
- Categorizing pain levels—Mild, Moderate, Severe, Extreme.
- Ordering job positions within a company—Intern, Associate, Manager, Director, Vice President.

### 3. Interval Scale

The interval scale of measurement encompasses all the qualities of ordinal data, but in addition, the intervals between values represent a consistent and meaningful measurement. Interval data are always numeric (never categorical). In an interval scale, the differences between values hold significance, reflecting a fixed unit of measurement. However, the presence of a zero point doesn't indicate an absence but rather serves as a reference point without inherent meaning.

For example, three students with SAT scores of 620, 550, and 470 can be ranked or ordered in terms of best performance to poorest performance. In addition, the differences between the scores are meaningful. For instance, student 1 scored 620 – 550 = 70 points more than student 2, while student 2 scored 550 – 470 = 80 points more than student 3.

Examples:

- Temperature in Celsius or Fahrenheit
- Dates of Month
- Years on the Calendar
- IQ Scores
- Ph Level
- Credit Card Numbers
- Latitude and Longitude Coordinates

#### **4. Ratio Scale**

The scale of measurement for a variable is a ratio scale if the data have all the properties of interval data and the ratio of two values is meaningful. Variables such as distance, height, weight, and time use the ratio scale of measurement. This scale requires that a zero value be included to indicate that nothing exists for the variable at the zero point.

Examples:

- Temperature in Kelvin
  - Height in Centimeters
  - Weight in Kilograms
  - Distance in Meters
  - Time in Seconds
  - Age in Years
  - Income in Rupees
-

## 6. Cross-Sectional and Time Series Data

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Data can also be grouped as cross sectional and time series data.

### 1. Cross-sectional Data

Cross-sectional data refer to observations collected from distinct individuals, entities, or groups at a specific point in time. This data collection method allows for comparisons among different subjects but only at a single moment, focusing on variation across various units within a population that share similar characteristics.

Examples of Cross-sectional Data:

- **Household Income Survey:** Gathering income data from various households in a country at a particular time to compare income levels among different socio-economic groups.
- **Educational Assessment:** Comparing test scores of students from different schools within a city on a specific date to analyze academic performance across diverse educational institutions.
- **Market Research on Consumer Preferences:** Collecting data on product preferences from customers of various age groups at a specific time to understand market trends among different demographics.

### 2. Time-series Data

Time-series data entails observations recorded at consistent intervals over time. This data collection method focuses on tracking changes, patterns, or trends within a single subject or variable, allowing for analysis of developments or variations over a specified time frame.

Examples of Time-series Data:

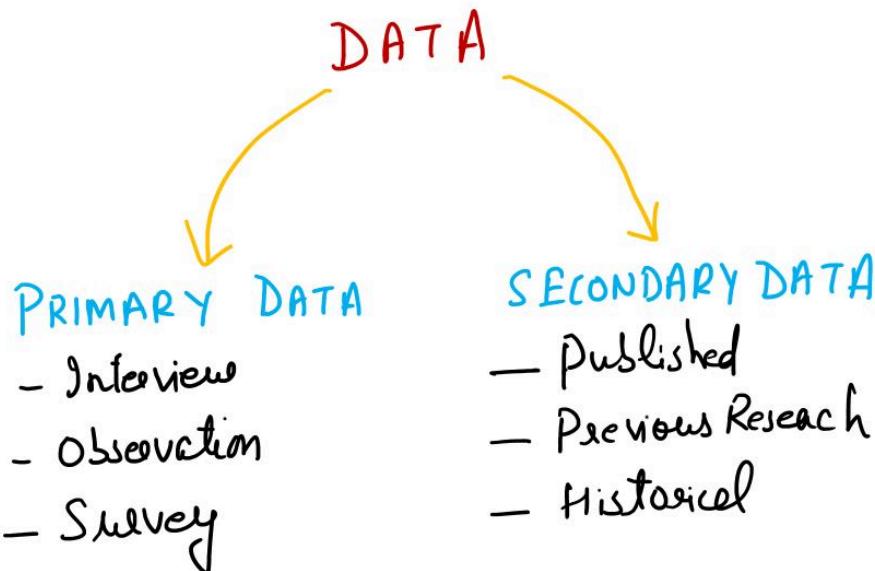
- **Stock Price Movements:** Monitoring the daily closing prices of a particular stock over several months to analyze its price fluctuations and trends.
- **Climate Data:** Recording daily temperature readings over a year to identify seasonal changes and patterns in temperature variations.
- **Economic Indicators:** Collecting monthly unemployment rates over several years to assess long-term trends and fluctuations in employment levels within an economy.

In summary, cross-sectional data involve observations from different units at one specific point in time, facilitating comparisons among distinct entities. Time-series data, on the other hand, comprises observations of a single entity or variable at regular time intervals, enabling analysis of trends, patterns, and changes over time.

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## 7. Sources of Data

Data collection methods are used for collection of data for social research. While deciding about the method of data collection to be used for the study the research should be well acquainted with types of data: Primary and Secondary.



The **primary** data are those which are collected afresh and for the first time and thus happens to be original in character. The **secondary** data are those sort of data that researcher would be using for the study and accordingly he will have to select one or the other method of data collection.

Primary data is the data collected by the researcher themselves. Some of the sources for collecting primary data area:

- Interview
- Observation
- Action research
- Case studies
- Life histories
- Questionnaires
- Ethnographic research
- Longitudinal studies

**Secondary sources** are data that already exists and is sourced from some place, that has originally collected it. Secondary sources include:

- Previous research
- Official statistics
- Mass media products
- Diaries
- Letters
- Government reports
- Web information
- Historical data and information

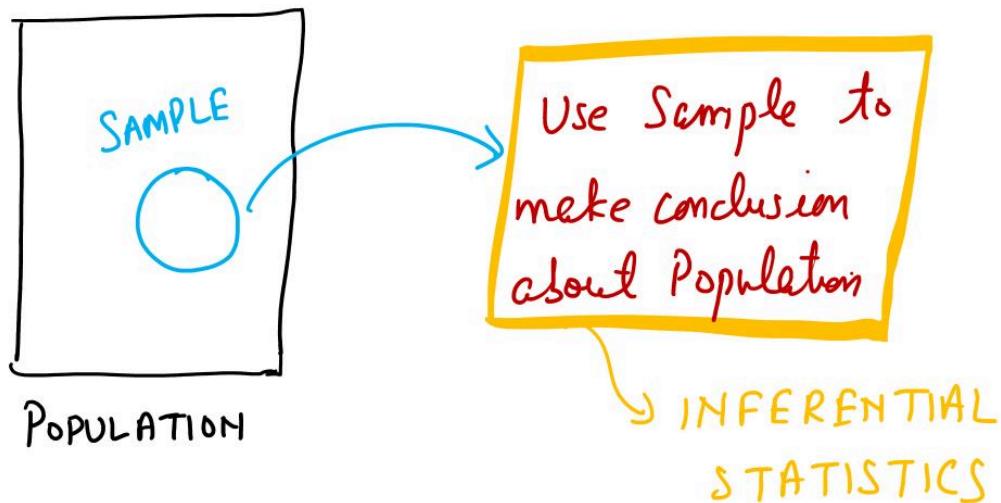
The combination of qualitative and quantitative and primary and secondary research is known as **triangulation** or **methodological pluralism**.

**Tertiary sources** of information are based on a collection of primary and secondary sources. Examples of tertiary sources include:

- textbooks (sometimes considered as secondary sources)

- dictionaries and encyclopedias
  - manuals, guidebooks, directories, almanacs
  - indexes and bibliographies
-

## 8. Inferential statistics



Inferential statistics involves using data from a sample to make conclusions or predictions about a larger population. It helps in generalizing findings beyond the observed sample to a broader population. This branch of statistics aids in drawing inferences, making predictions, and testing hypotheses about populations based on sample data.

### Sample and Population

The **population** refers to the entire group that you want to draw conclusions about. It's the larger group or universe of interest, but it's often impractical or impossible to collect data from every individual within it.

A **sample** is a subset of the population that is selected for study. It's chosen to represent the population accurately and is used to make inferences or generalizations about the entire population.

Consider a scenario where you want to determine the average height of all students in a school (population). It's impractical to measure the height of every student, so you select a group of 100 students (sample) and measure their heights. By using inferential statistics, you can make estimations or draw conclusions about the average height of all students in the school based on the measured heights of the sample.

### Descriptive vs. Inferential Statistics

**Descriptive statistics** summarize and describe data from a sample or population. For instance, calculating the mean, median, or standard deviation of the heights of the 100 students in the school sample represents descriptive statistics.

**Inferential statistics**, on the other hand, allow you to make predictions or inferences about a larger population based on data collected from a sample. For example, using the heights of the 100 students to estimate the average height of all students in the school is an application of inferential statistics.

Descriptive statistics would involve calculating the average height of the 100 measured students in the sample. Meanwhile, inferential statistics would take this information further to estimate the average height of all students in the school, providing a confidence interval or hypothesis test result to infer if the sample's average represents the entire student body.

In essence, descriptive statistics help in summarizing and describing data, while inferential statistics aid in making predictions or drawing conclusions about larger populations based on sample data.

# 1. Introduction

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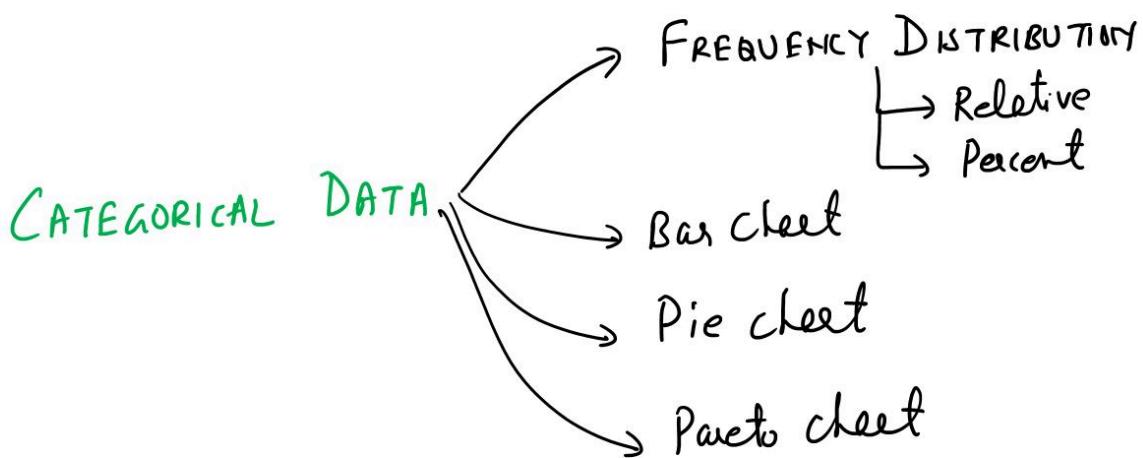
The presentation of information is vital in uncovering patterns, trends, and insights. Tabular and graphical methods serve as indispensable tools for organizing and visualizing data in a coherent and interpretable manner.

Tabular methods involve structured arrangements of data into rows and columns, facilitating clear and systematic presentation, while graphical methods employ visual representations such as charts, graphs, or diagrams to illustrate patterns and relationships within datasets. Both approaches play pivotal roles in conveying complex information effectively, offering different perspectives for data interpretation and aiding in informed decision-making.

Whether through organized tables or visually appealing graphs, these methods serve as fundamental pillars in transforming raw data into comprehensible and actionable insights.

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## 2. Summarizing Categorical Data



The categorical data can be summarized through any of the following methods:

1. Frequency Distribution
2. Relative Frequency Distribution and Percent Frequency Distribution
3. Bar Charts and Pie Charts

Let us discuss them, one by one.

## 2. Summarizing Categorical Data



A frequency distribution is a tabular summary of data showing the number (frequency) of items in each of several non-overlapping classes.

Frequency distribution displays how often different values or ranges of values occur in a dataset. It organizes raw data into groups or intervals, known as classes or bins, and then records the number of occurrences or frequencies within each class. This method helps in summarizing and understanding the distribution or pattern of data, especially when dealing with large datasets.

Let us use the following example to demonstrate the construction and interpretation of a frequency distribution for categorical data. Coke, Pepsi, and Sprite are three popular soft drinks.

Data From a sample of 30 Soft Drink Purchases is tabled below.

|        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|
| Coke   | Sprite | Sprite | Pepsi  | Coke   | Sprite |
| Pepsi  | Coke   | Pepsi  | Coke   | Pepsi  | Pepsi  |
| Sprite | Pepsi  | Coke   | Sprite | Sprite | Coke   |
| Pepsi  | Coke   | Pepsi  | Coke   | Pepsi  | Pepsi  |
| Coke   | Pepsi  | Sprite | Pepsi  | Coke   | Sprite |

To develop a frequency distribution for these data, we count the number of times each soft drink appears in above table. Coke appears 10 times, Pepsi appears 12 times and Sprite appears 8 times.

These counts are summarized in the frequency distribution as shown below:

| Soft Drink | Frequency |
|------------|-----------|
| Coke       | 10        |
| Pepsi      | 12        |
| Sprite     | 8         |
| Total      | 30        |

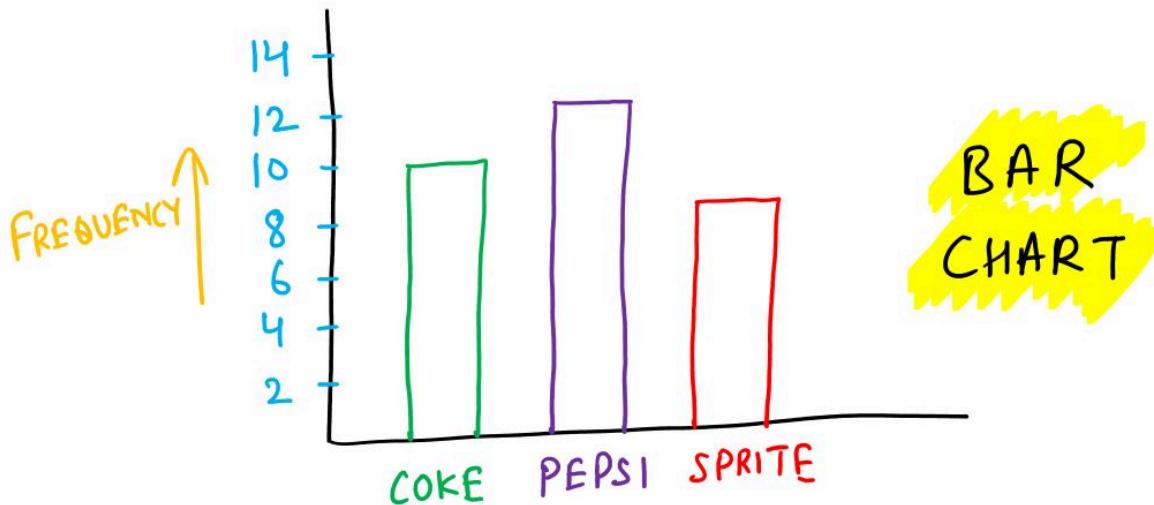
Viewing the frequency distribution, we see that Pepsi is the leader, Coke is second and Sprite is third. The frequency distribution summarizes information about the popularity of the three soft drinks.

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## 2. Summarizing Categorical Data

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Another widely used qualitative data graphing technique is the **bar graph** or **bar chart**. A bar chart is a graphical device for depicting categorical data summarized in a frequency, relative frequency, or percent frequency distribution. On one axis of the graph (usually the horizontal axis), we specify the labels that are used for the classes (categories). A frequency, relative frequency, or percent frequency scale can be used for the other axis of the chart.



The bar graph is qualitative because the categories are non-numerical, and it may be either horizontal or vertical. A bar graph generally is constructed from the same type of data that is used to produce a pie chart. However, an advantage of using a bar graph over a pie chart for a given set of data is that for categories that are close in value, it is considered easier to see the difference in the bars of bar graph than discriminating between pie slices.

A **side-by-side bar** chart uses sets of bars to show the joint responses from two categorical variables.

---

## 2. Summarizing Categorical Data

30 SOFT DRINKS

|                             |             |           |                       |                           |
|-----------------------------|-------------|-----------|-----------------------|---------------------------|
| C S S P C S                 | Coke(c) =   | 10        | $10/30 = 0.33$        | 33%                       |
| P C P C P P                 | Pepsi(p) =  | 12        | $12/30 = 0.40$        | 40%                       |
| S P C S S C                 | Sprite(s) = | 8         | $8/30 = 0.27$         | 27%                       |
| P C P C P P                 | TOTAL =     | 30        | 1.00                  | 100%                      |
| C P S P C S                 |             |           |                       | ↑<br>PERCENT<br>FREQUENCY |
| CLASS<br>categories of data |             | FREQUENCY | RELATIVE<br>FREQUENCY |                           |

The relative frequency of a class equals the fraction or proportion of items belonging to a class. For a data set with n observations, the relative frequency of each class can be determined as follows:

$$\text{RELATIVE FREQUENCY} = \frac{\text{FREQUENCY OF CLASS}}{n}$$

The percent frequency of a class is the relative frequency multiplied by 100.

$$\text{PERCENT FREQUENCY} = \frac{\text{FREQUENCY OF CLASS}}{n} \times 100$$

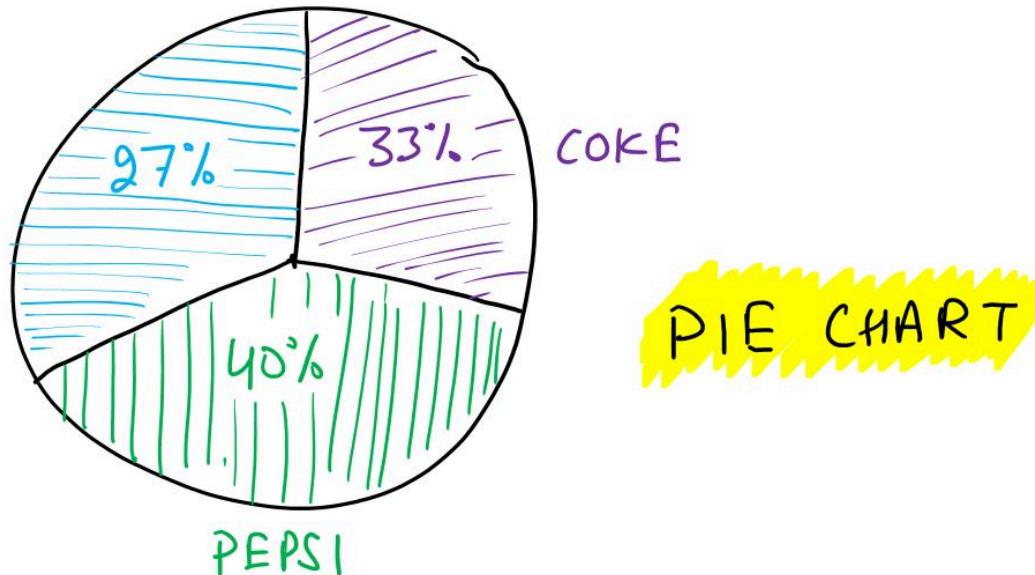
In the previous example, Relative frequency of coke =  $\frac{10}{30} = 0.33$

And Percent frequency of coke =  $(\frac{10}{30}) \times 100 = 33\%$

## 2. Summarizing Categorical Data

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A **Pie chart** is a circular depiction of data where the area of the whole pie represents 100% of the data and slices represent a percentage breakdown of the sublevels. Pie charts show the relative magnitudes of the parts to the whole. They are widely used in business, particularly to depict such things as budget categories, market share, and time/resource allocations. Generally, it is more difficult for the viewer to interpret the relative size of angles in a pie chart than to judge the length of rectangles in a bar chart.



The pie chart provides another graphical device for presenting relative frequency and percent frequency distributions for categorical data. To construct a pie chart, we first draw a circle to represent all the data. Then we use the relative frequencies to subdivide the circle into sectors, or parts, that correspond to the relative frequency for each class.

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## 3. Summarizing Quantitative Data

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The Quantitative Data can be summarized through any of the following methods:

1. Frequency Distribution
2. Dot Plot
3. Histogram and Frequency Polygon
4. Cumulative Frequency Distributions
5. Ogive
6. Stem-and leaf display
7. Crosstabulations
8. Scatter Diagram

Let us discuss them, one by one.

---

## 4. Frequency Distribution

|    |    |    |    |
|----|----|----|----|
| 12 | 14 | 19 | 18 |
| 15 | 15 | 18 | 17 |
| 20 | 27 | 22 | 23 |
| 22 | 21 | 33 | 28 |
| 14 | 18 | 16 | 13 |

### PROCESS OF FREQUENCY DISTRIBUTION

① Number of class (5-15)      ③ Class Int.      ② Width of class =  $\frac{\text{Highest Value}}{\text{Classes}}$

classes = 5       $5 \times 5 = 25$        $10 - 14 = 4$        $10 - 14 = 4 = 20\%$ .  
 $15 - 19 = 4$        $15 - 19 = 4 = 40\%$ .  
 $20 - 24 = 5$        $20 - 24 = 5 = 25\%$ .  
 $25 - 29 = 4$        $25 - 29 = 4 = 10\%$ .  
 $30 - 34 = 5$        $30 - 34 = 5 = 5\%$ .  
 $\frac{20}{100} = 100\%$ .

$$\begin{aligned} \text{Width of class} &= \frac{33 - 12}{5} = 4.2 \\ &\approx 5 \end{aligned}$$

As understood earlier, the frequency distribution is a tabular summary of data showing the number (frequency) of items in each of several non-overlapping classes. This definition holds good for quantitative as well as qualitative data.

It is important to understand concept of class here. Consider the quantitative data in table given below. These data show the time in days for 20 software projects undertaken by TCS.

| Projects Time (In Days) |           |           |           |
|-------------------------|-----------|-----------|-----------|
| Project 1               | Project 2 | Project 3 | Project 4 |
| 12                      | 14        | 19        | 18        |
| 15                      | 15        | 18        | 17        |
| 29                      | 27        | 22        | 23        |
| 22                      | 21        | 33        | 28        |
| 14                      | 18        | 16        | 13        |

#### Grouping of Data into Classes

Classes in a frequency distribution refer to the categories or intervals into which data is grouped or divided. They represent the ranges within which the raw data is organized for analysis and presentation. These classes are essential in summarizing and understanding the distribution of data, especially when dealing with large datasets.

Let us go through the steps to divide the data into classes.

#### Step 1 - Number of Classes

First, we decide the number of classes. For a small number of data items, as few as 5 or 6 classes may be used to summarize the data. For a larger number of data items, a larger number of classes is usually required. The goal is to use enough classes to show the variation in the data, but not so many classes that some contain only a few data items.

In our example, we take  $n = 5$ , because we decided to summarize the data with five classes.

#### Step 2 - Width of Class

The second step in constructing a frequency distribution for quantitative data is to choose a width for the classes. As a general guideline, we recommend that the width will be the same for each class. Thus, the choices of the number of classes and the

width of classes are not independent decisions. A larger number of classes means a smaller class width, and vice versa. To determine an approximate class width, we begin by identifying the largest and smallest data values.

$$\text{CLASS WIDTH} = \frac{\text{LARGEST VALUE} - \text{SMALLEST VALUE}}{\text{NUMBER OF CLASSES}}$$

In our example, class width of given data =  $\frac{33-12}{5} = 4.2$

We decide to round up and use a class width of 5 days.

The width of class is also known as *Class Interval Width*.

### Step 3- Class Limits

Class limits must be chosen so that each data item belongs to one and only one class. The lower class limit identifies the smallest possible data value assigned to the class. The upper class limit identifies the largest possible data value assigned to the class. In developing frequency distributions for qualitative data, we did not need to specify class limits because each data item naturally fell into a separate class. But with quantitative data class limits are necessary to determine where each data value belongs.

Using this TCS data, we selected 10 days as the lower class limit and 14 days as the upper class limit for the first class. This class is denoted as 10 –14. The smallest data value, 12, is included in the 10 –14 class. We then selected 15 days as the lower class limit and 19 days as the upper class limit of the next class. We continued defining the lower and upper class limits to obtain a total of five classes: 10–14, 15–19, 20–24, 25–29, and 30–34. The difference between the lower class limits of adjacent classes is the class width. Using the first two lower class limits of 10 and 15, we see that the class width is  $15 - 10 = 5$ .

Let us make a new table to show class widths and class limits:

| Time (days) | Frequency |
|-------------|-----------|
| 10-14       | 4         |
| 15-19       | 8         |
| 20-24       | 5         |
| 25-29       | 2         |
| 30-34       | 1         |
| Total       | 20        |

### Mid Point of Class

In some applications, we want to know the midpoints of the classes in a frequency distribution for quantitative data. The class midpoint is the value halfway between the lower and upper class limits. The mid point for 10-14 class is 12, for 15-19 class is 17, for 20-24 class is 22 and so on. The mid point of a class is also called *Class Mark*.

### Frequency Density

Frequency density is calculated as the ratio of the frequency of observations in a class to the class width. It allows for a standardized comparison of frequencies across different class intervals, especially when the intervals vary in width.

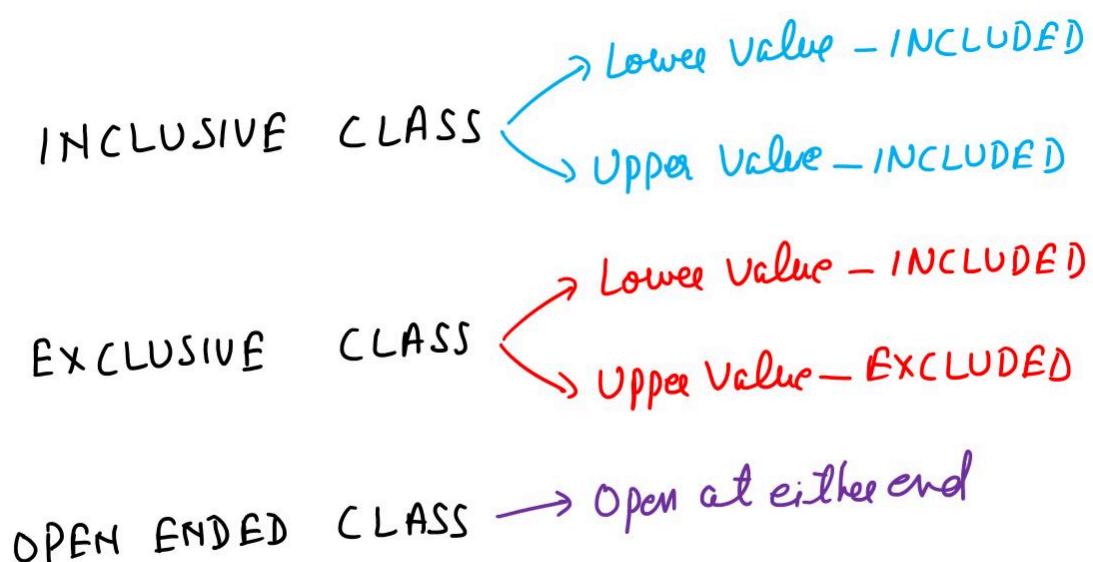
$$\text{FREQUENCY DENSITY} = \frac{\text{CLASS FREQUENCY}}{\text{WIDTH OF CLASS}}$$

### Relative Frequency and Percent Frequency

Similarly, we can calculate Relative Frequency and Percent Frequency Distributions for TCS data, which is shown below:

| Time (days) | Frequency | Relative Frequency | Percent Frequency |
|-------------|-----------|--------------------|-------------------|
| 10-14       | 4         | 0.20               | 20%               |
| 15-19       | 8         | 0.40               | 40%               |
| 20-24       | 5         | 0.25               | 25%               |
| 25-29       | 2         | 0.10               | 10%               |
| 30-34       | 1         | 0.05               | 5%                |
| Total       | 20        | 1.00               | 100%              |

## 5. Types of Classes



Classes in frequency distributions can be categorized into three types based on their boundaries and how they encompass data values:

### 1. Inclusive Classes

Inclusive classes include both the lower and upper limits as part of the interval. The values at the endpoints are considered part of the class.

Consider a dataset of ages grouped into intervals. An inclusive class might be defined as "10-20," where both the ages 10 and 20 are included in the interval, meaning any value from 10 to 20 (inclusive) falls within this class.

### 2. Exclusive Classes

Exclusive classes include the lower limit but exclude the upper limit from the interval. The upper value is part of the next class.

Continuing with the age dataset, an exclusive class could be "10-20." Here, the lower age, 10, is included in the class, but the upper age, 20, is excluded, implying that values between 10 and up to, but not including 20, belong to this class. The value of 20 or 20.1 will be part of class "20-30".

### 3. Open-ended Classes

Open-ended classes have one limit undefined, typically used for the lowest or highest interval, where the value extends indefinitely.

In the age dataset, an open-ended class might be "60 and above." Here, 60 is the lower limit, indicating that the class includes all ages equal to or greater than 60, without specifying an upper limit.

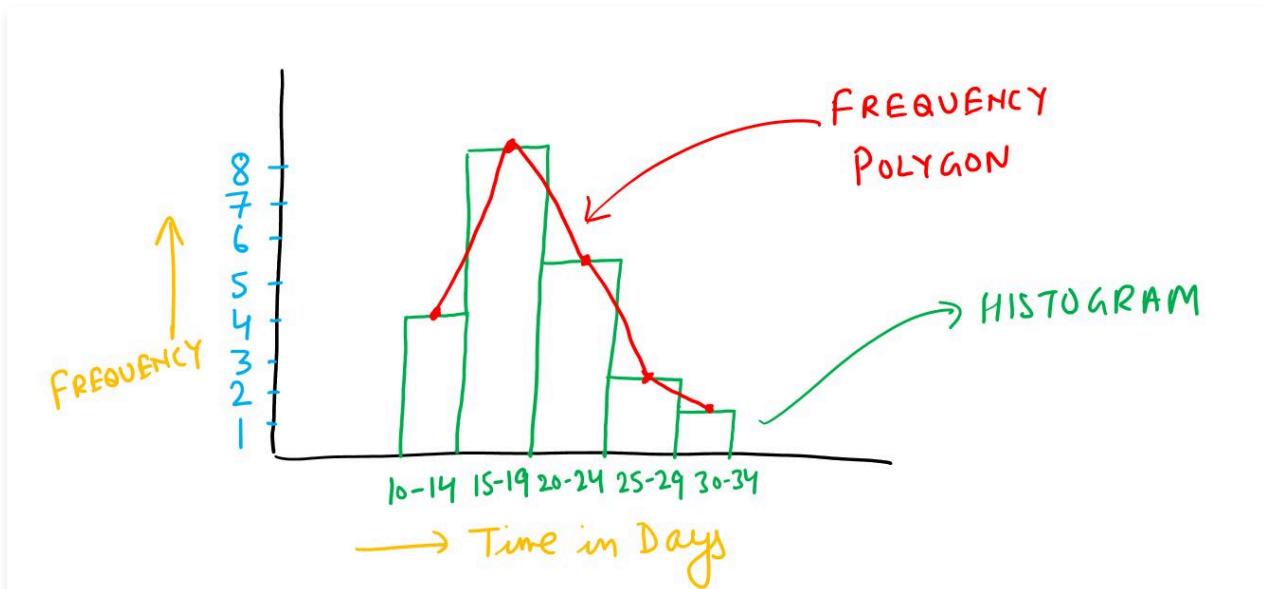
## 6. Histogram and Frequency Polygon

Till now, we have discussed the tabular representation of data. Let us now discuss Histogram, which is graphical representation of data.

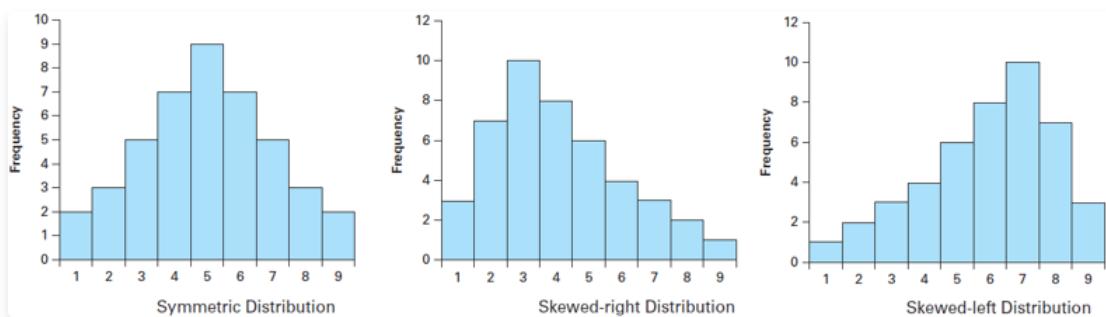
Histogram can be prepared for data previously summarized in either a frequency, relative frequency, or percent frequency distribution.

A histogram is constructed by placing the variable of interest on the horizontal axis and the frequency, relative frequency, or percent frequency on the vertical axis. The frequency, relative frequency, or percent frequency of each class is shown by drawing a rectangle whose base is determined by the class limits on the horizontal axis and whose height is the corresponding frequency, relative frequency, or percent frequency.

The histogram for TCS data is shown here.



We can describe graphically the shape of the distribution by a histogram. That is, we can visually determine whether data are evenly spread from its middle or center. Sometimes the center of the data divides a graph of the distribution into two "mirror images," so that the portion on one side of the middle is nearly identical to the portion on the other side. Graphs that have this shape are symmetric; those without this shape are asymmetric or skewed.



The shape of a distribution is said to be **symmetric** if the observations are balanced, or approximately evenly distributed, about its center.

A distribution is skewed, or asymmetric, if the observations are not symmetrically distributed on either side of the center. A **skewed-right distribution** (sometimes called positively skewed) has a tail that extends farther to the right. A **skewed-left distribution** (sometimes called negatively skewed) has a tail that extends farther to the left.

### Frequency Polygon

A **frequency polygon**, like the histogram, is a graphical display of class frequencies. However, instead of using bars or rectangles like a histogram, in a frequency polygon each class frequency is plotted as a dot at the class midpoint, and the dots are connected by a series of line segments. Construction of a frequency polygon begins by scaling class midpoints along the

horizontal axis and the frequency scale along the vertical axis. A dot is plotted for the associated frequency value at each class midpoint. Connecting these midpoint dots completes the graph.

The frequency polygon is also called *Percent Polygon*.

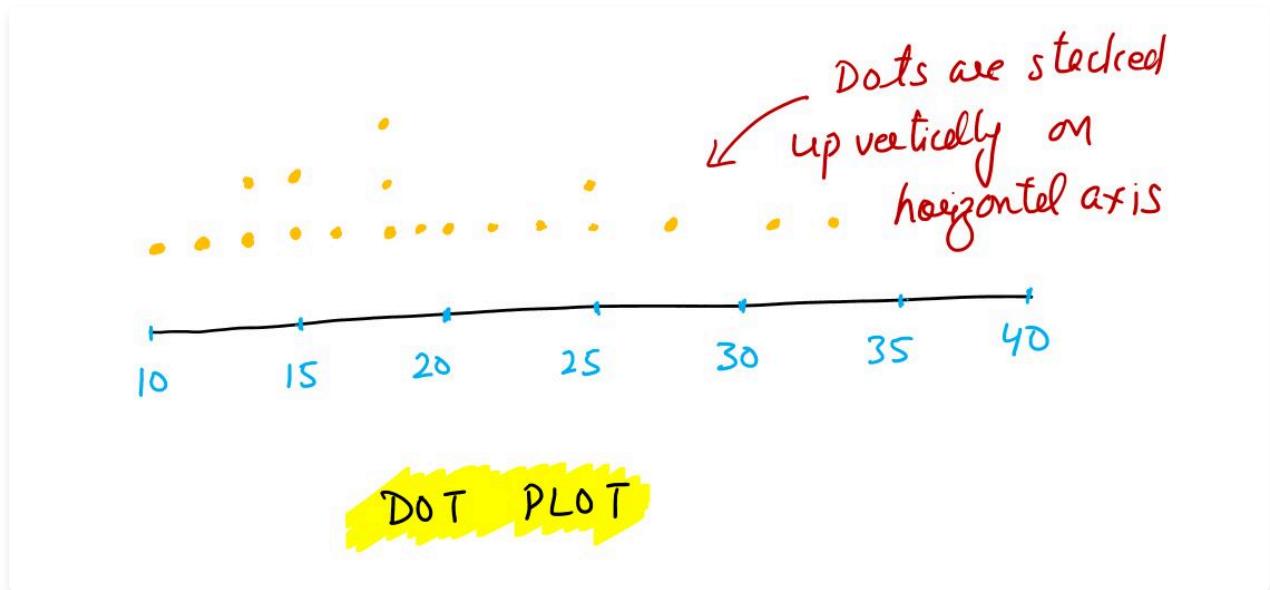
## 7. Dot Plot

One of the simplest graphical summaries of data is a **dot plot**.

A relatively simple statistical chart that is generally used to display continuous, quantitative data is the dot plot. In a dot plot, each data value is plotted along the horizontal axis and is represented on the chart by a dot. If multiple data points have the same values, the dots will stack up vertically. If there are a large number of close points, it may not be possible to display all of the data values along the horizontal axis.

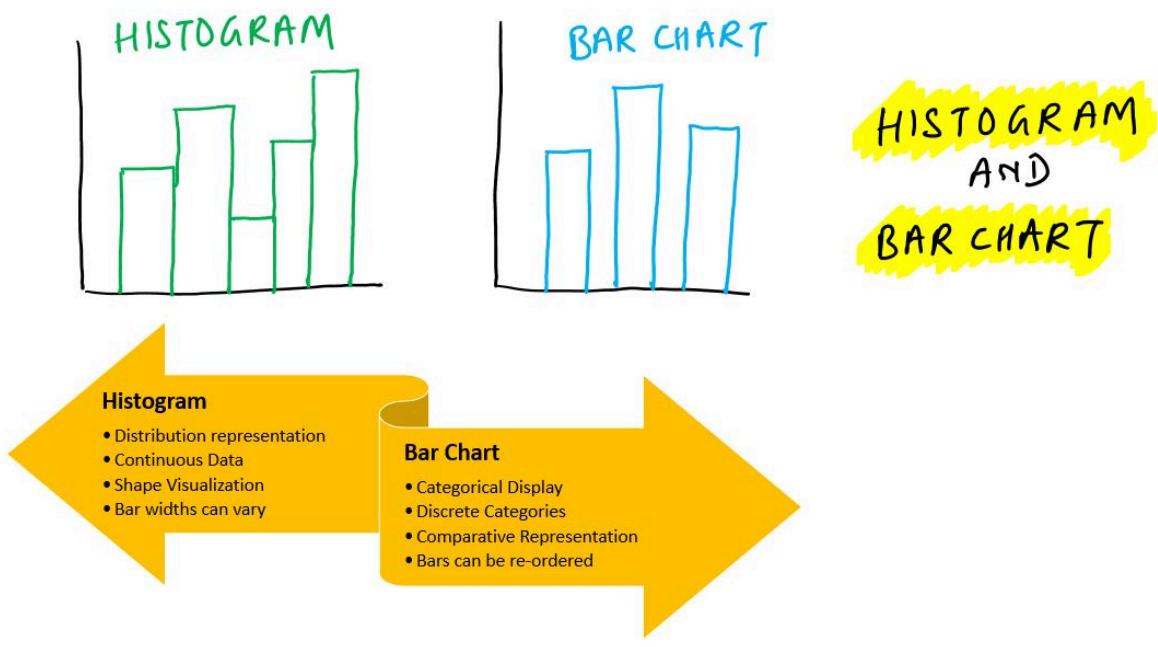
Dot plots can be especially useful for observing the overall shape of the distribution of data points along with identifying data values or intervals for which there are groupings and gaps in the data.

Dot plot for TCS Data in previous example is shown below.



## 8. Bar Chart and Histogram

Histograms and bar charts are both tools used to represent frequency distributions, but they differ in their suitability based on the type of data being depicted.



### Bar Chart

**Data Type:** Primarily used for categorical (qualitative) data, showcasing distinct categories.

**Appropriate Usage:** Ideal for displaying non-continuous data and discrete categories. Bars can be rearranged based on preference.

**Examples:** Displaying revenue generated by different products or the percentage of people preferring specific coffee brands.

### Histogram

**Data Type:** Suitable for numerical (quantitative) data, especially when dealing with continuous variables.

**Appropriate Usage:** Perfect for representing continuous data and providing insight into the shape of distribution (like skewness). Bars in a histogram represent ranges of values rather than distinct categories.

**Examples:** Representing the heights of students in a class, weights of products, scores of exam takers, or response times at a ticket counter.

### Key Differences

**Data Type:** Bar charts are for categorical data, while histograms are for numerical data.

**Data Representation:** Histograms show continuous data distribution with bars representing ranges, whereas bar charts depict individual categories.

**Bar Ordering:** Bars in a bar chart can be rearranged, but a histogram's bars are fixed in their order, as they represent ranges of values.

**Class Width:** Histograms can have unequal class widths to represent different ranges, while bar charts for categorical data maintain uniform bar widths.

In summary, while both histograms and bar charts serve the purpose of depicting frequency distributions, the choice between them depends on the nature of the data, whether it's categorical or numerical, and whether the focus is on the distribution's shape and characteristics (suitable for histograms) or the discrete categories or proportions (suitable for bar charts).

## 9. Cumulative Frequency Distributions

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The cumulative frequency distribution uses the number of classes, class widths, and class limits developed for the frequency distribution. However, rather than showing the frequency of each class, the cumulative frequency distribution shows the number of data items with values less than or equal to the upper class limit of each class.

To understand how the cumulative frequencies are determined, consider the class with the description "less than or equal to 24." The cumulative frequency for this class is simply the sum of the frequencies for all classes with data values less than or equal to 24.

Cumulative frequency distribution for TCS Data is shown below:

| Time (days)              | Cumulative Frequency | Cumulative Relative Frequency | Cumulative Percent Frequency |
|--------------------------|----------------------|-------------------------------|------------------------------|
| Less than or equal to 14 | 4                    | 0.20                          | 20%                          |
| Less than or equal to 19 | 12                   | 0.60                          | 60%                          |
| Less than or equal to 24 | 17                   | 0.85                          | 85%                          |
| Less than or equal to 29 | 19                   | 0.90                          | 95%                          |
| Less than or equal to 34 | 20                   | 1.00                          | 100%                         |

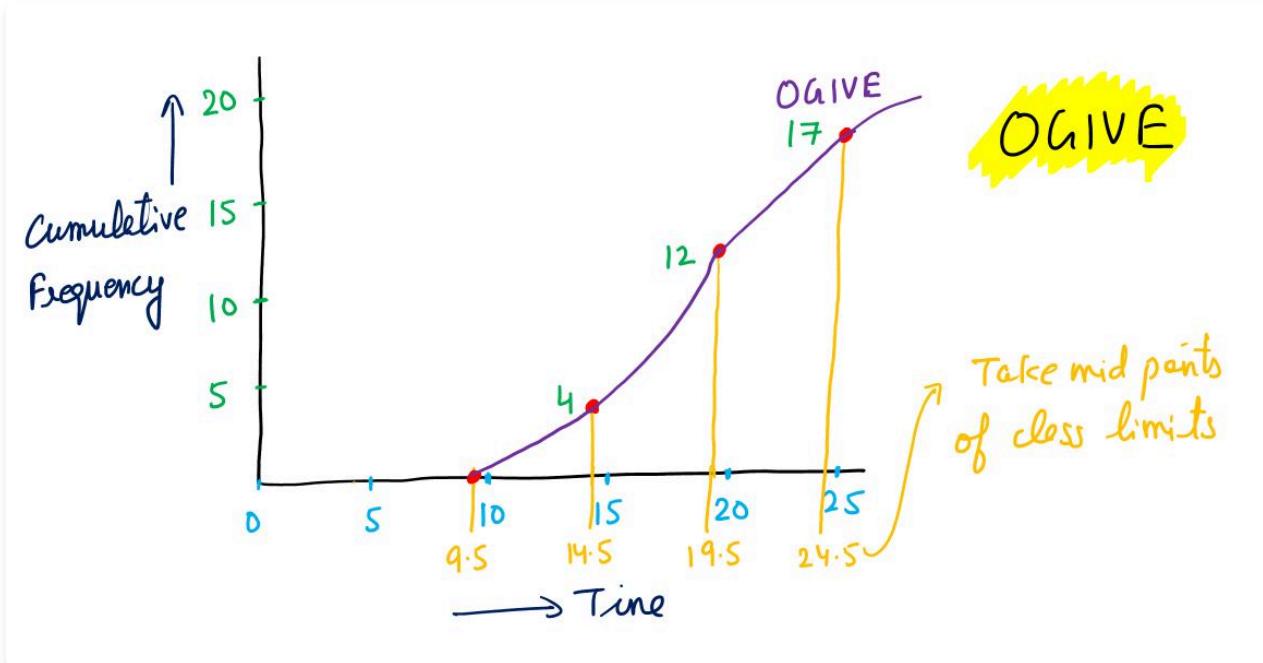
From this Cumulative Frequency analysis of TCS data, we can conclude that the TCS finished 60% of projects in less than or equal to 19 days.

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## 10. Ogive

A graph of a cumulative frequency distribution, called an ogive, shows data values on the horizontal axis and either the cumulative frequencies, the cumulative relative frequencies, or the cumulative percent frequencies on the vertical axis. The ogive is constructed by plotting a point corresponding to the cumulative frequency of each class.

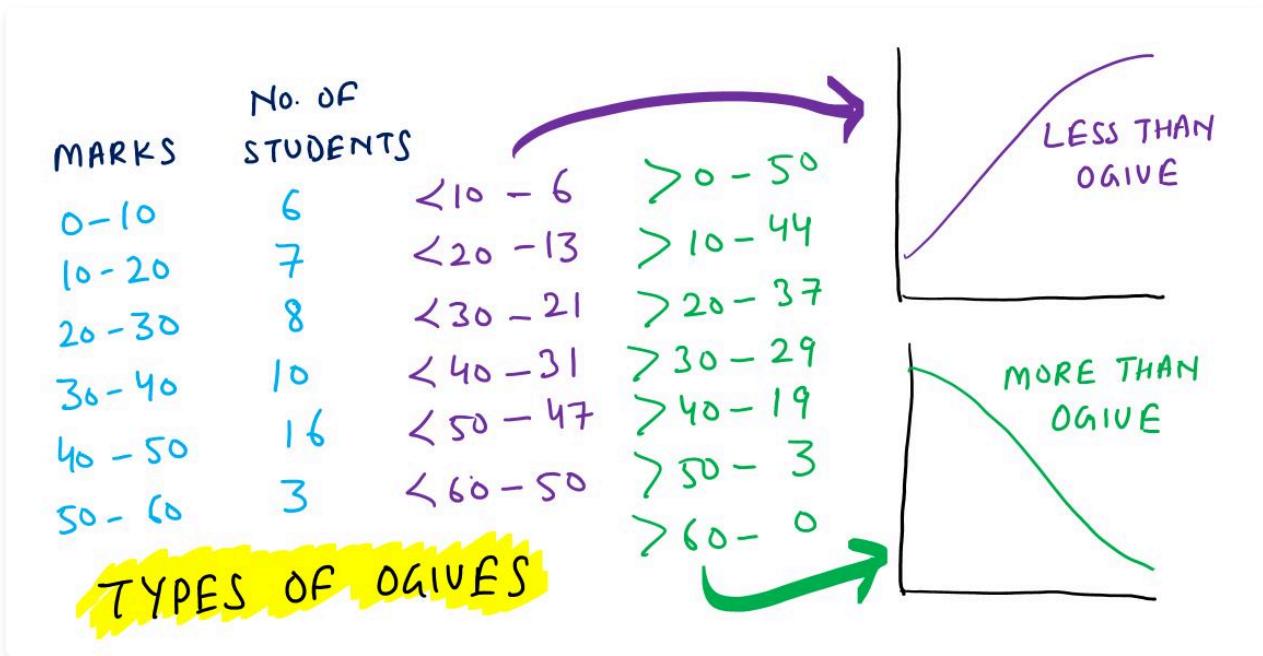
The Ogive is also known as Cumulative Frequency Polygon or Cumulative Percent Polygon.



Cumulative Frequency Ogive for the TCS data is given in the figure. Similarly, we can draw ogive for Cumulative Relative Frequency or Cumulative Percent Frequency.

## 10. Ogive

Ogives show the cumulative frequencies of data in a distribution. They come in two main types.



### Less Than Ogive

This type of ogive plots cumulative frequencies **less than the upper boundary of each class interval**. It starts from the left-hand side of the graph and increases gradually as each data point's frequency is added cumulatively.

It helps visualize the number of data points that fall below a certain value or interval, providing insights into the distribution's lower end.

Suppose you want to understand how many students scored below a certain mark. A less than ogive would be useful here. For instance, if you're interested in knowing how many students scored below 80%, the less than ogive would help visualize the cumulative count of students who achieved less than that threshold.

Similarly, when analyzing income distribution in a population, a less than ogive could show how many individuals earn below a particular income level. For example, it could illustrate the cumulative number of people earning less than Rs 50,000 monthly.

### More Than Ogive

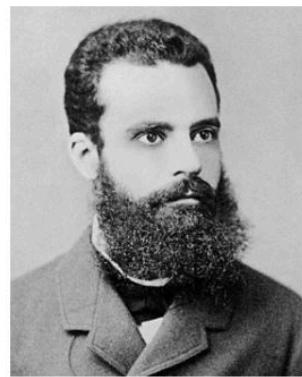
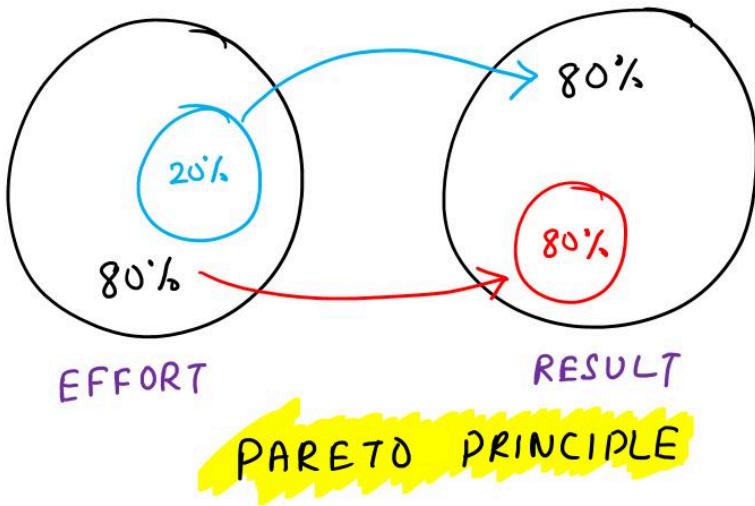
Contrary to the Less Than Ogive, this type represents cumulative frequencies **greater than the upper boundary of each class interval**. It begins from the right-hand side of the graph and ascends gradually as cumulative frequencies are added, showing the count of data points above certain values or intervals.

It offers a view of the data points exceeding specific values or intervals, revealing information about the distribution's upper end.

In a service industry, if you want to understand how many customers waited more than a certain duration, a more than ogive would be beneficial. For instance, it could depict the cumulative count of customers who waited more than 10 minutes in a queue.

Similarly, analyzing delivery times for packages, a more than ogive might display the cumulative count of deliveries that took longer than a specified time frame, like more than 3 days for delivery.

## 11. Pareto Chart



Vilfredo Pareto

A Pareto chart is used to identify and prioritize the most significant factors contributing to a problem or a situation.

It is based on the Pareto Principle, also known as the 80/20 rule, which suggests that roughly 80% of effects come from 20% of the causes. It combines both bar and line graphs to represent data and their cumulative impact.

Pareto charts were named after an Italian economist, Vilfredo Pareto, who observed more than 100 years ago that most of Italy's wealth was controlled by a few families who were the major drivers behind the Italian economy.

Pareto charts are versatile and can be applied across various fields to prioritize and address critical issues. Here are few examples:

### 1. Quality Control in Manufacturing

Use Pareto charts to identify the most common types of defects in a manufacturing process. This helps focus efforts on fixing the most frequent issues that contribute to a significant portion of product defects.

### 2. Customer Complaint Analysis

Analyze customer complaints in a service-oriented business. Determine the most frequent complaints to prioritize improvements that will have the most substantial impact on customer satisfaction.

### 3. Inventory Management

Utilize Pareto analysis to identify the most commonly stocked items that contribute to the majority of sales. This allows for efficient inventory management by focusing on the vital few items instead of the less impactful ones.

### 4. Healthcare Services

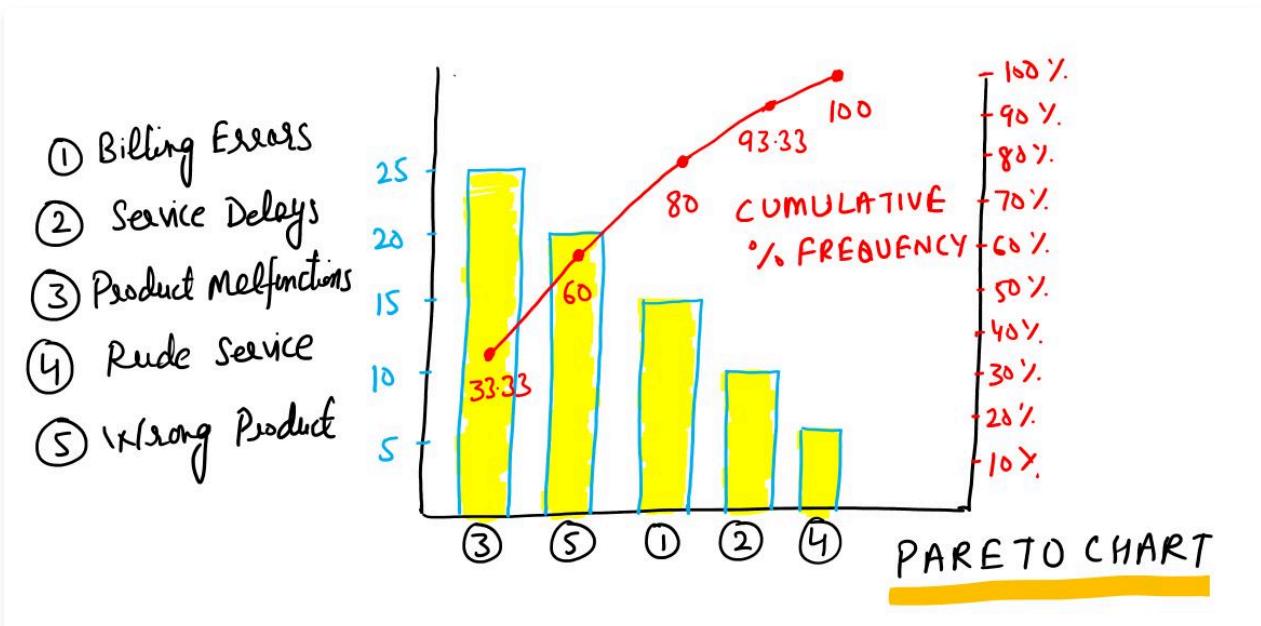
Apply Pareto charts in healthcare to identify the most common medical errors or issues causing patient dissatisfaction. Prioritize addressing these issues to improve overall patient care and safety.

### 5. Project Management

In project management, use Pareto charts to identify the most common reasons for project delays or issues. This enables project managers to address key factors that significantly impact project timelines and success.

## 11. Pareto Chart

We will use example of analyzing customer complaints in a service center over a month.



### 1. Data Collection

Gather data on different categories or factors related to a specific issue or problem.

We will gather data on various types of complaints received:

Billing Errors  
Service Delays  
Product Malfunctions  
Rude Service  
Wrong Product Sent

### 2. Frequency Determination

Count the occurrences or frequency of each category.

Count the occurrences of each type of complaint:

Billing Errors: 15  
Service Delays: 10  
Product Malfunctions: 25  
Rude Service: 5  
Wrong Product Sent: 20

### 3. Ordering

Arrange categories from the most frequent to the least frequent.

Arrange the categories from most frequent to least frequent:

Product Malfunctions (25)  
Wrong Product Sent (20)  
Billing Errors (15)  
Service Delays (10)  
Rude Service (5)

### 4. Bar Chart

Construct a bar chart where the bars represent the frequency of each category in descending order. The bar chart is shown in the figure.

### 5. Line Graph

Plot a line graph showing the cumulative percentage total on the secondary axis.

Calculate the percentage for each category:

Product Malfunctions:  $25 / \text{Total Complaints (75)} = 33.33\%$

Wrong Product Sent:  $20 / \text{Total Complaints (75)} = 26.67\%$

Billing Errors:  $15 / \text{Total Complaints (75)} = 20\%$

Service Delays:  $10 / \text{Total Complaints (75)} = 13.33\%$

Rude Service:  $5 / \text{Total Complaints (75)} = 6.67\%$

The line graph of the cumulative percentage is shown in the figure.

#### Conclusion

This Pareto chart visually demonstrates that addressing Product Malfunctions and Wrong Products Sent could potentially resolve over 60% of the complaints, making them the most critical areas for improvement.

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## 12. Exploratory Data Analysis

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The techniques of exploratory data analysis consist of simple arithmetic and easy-to-draw graphs that can be used to summarize data quickly.

Let us look at the method of Stem and leaf display.

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## 12. Exploratory Data Analysis

Stem-and leaf display—can be used to show both the rank order and shape of a data set simultaneously.

To understand the Exploratory Data Analysis lets us take data on number of questions answered correctly in an aptitude test. These data result from a 150-question aptitude test given to 50 job aspirants, recently interviewed for a position at Honda manufacturing plant. The data indicate the number of questions answered correctly.

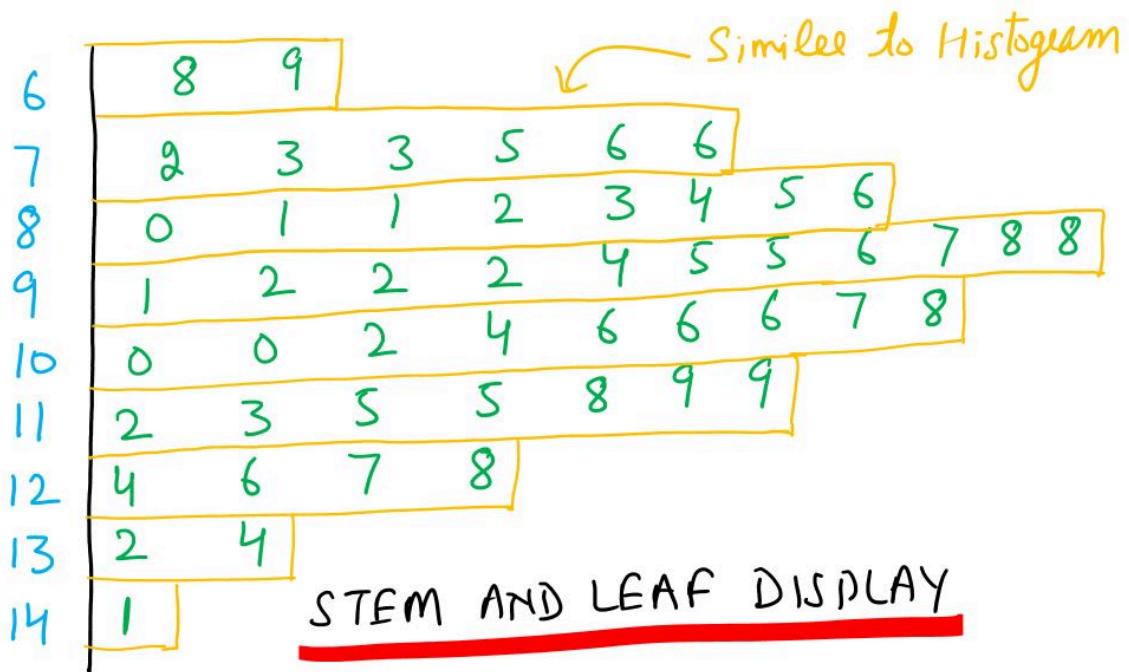
112 72 69 97 107  
73 92 76 86 73  
126 128 118 127 124  
82 104 132 134 83  
92 108 96 100 92  
115 76 91 102 81  
95 141 81 80 106  
84 119 113 98 75  
68 98 115 106 95  
100 85 94 106 119

To develop a stem-and-leaf display, we first arrange the leading digits of each data value to the left of a vertical line. To the right of the vertical line, we record the last digit for each data value. Continuing to place the last digit of each data value on the line corresponding to its leading digit(s) provides the following:

|    |   |   |   |   |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|---|---|---|---|
| 6  | 9 | 8 |   |   |   |   |   |   |   |   |   |   |
| 7  | 2 | 3 | 6 | 3 | 6 | 5 |   |   |   |   |   |   |
| 8  | 6 | 2 | 3 | 1 | 1 | 0 | 4 | 5 | 8 | 8 | 5 | 4 |
| 9  | 7 | 2 | 2 | 6 | 2 | 1 | 5 | 8 |   |   |   |   |
| 10 | 7 | 4 | 8 | 0 | 2 | 6 | 6 | 0 | 6 |   |   |   |
| 11 | 2 | 8 | 5 | 9 | 3 | 5 | 9 |   |   |   |   |   |
| 12 | 6 | 8 | 7 | 4 |   |   |   |   |   |   |   |   |
| 13 | 2 | 4 |   |   |   |   |   |   |   |   |   |   |
| 14 | 1 |   |   |   |   |   |   |   |   |   |   |   |

STEM AND LEAF DISPLAY

With this organization of the data, sorting the digits on each line into rank order is simple. Doing so provides the stem-and-leaf display shown here.



The numbers to the left of the vertical line (6, 7, 8, 9, 10, 11, 12, 13, and 14) form the **stem**, and each digit to the right of the vertical line is a **leaf**. It is shown in the left figure.

To focus on the shape indicated by the stem-and-leaf display, let us use a rectangle to contain the leaves of each stem. Doing so, we obtain figure, shown on the right.

Rotating this page counterclockwise onto its side provides a picture of the data that is similar to a histogram with classes of 60–69, 70–79, 80–89, and so on.

Although the stem-and-leaf display may appear to offer the same information as a histogram, it has two primary advantages.

1. The stem-and-leaf display is easier to construct by hand.
  2. Within a class interval, the stem-and-leaf display provides more information than the histogram because the stem-and-leaf shows the actual data.
-

## 13. Crosstabulations

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Crosstabulation is used to summarize data in a way that reveals the relationship between two variables. A **crosstabulation** is a tabular summary of data for two variables. It is also called Contingency Table.

Let us illustrate the use of a crosstabulation by considering the following application based on data from Zomato's review of 300 restaurants in Mumbai. The quality rating and the meal price data were collected for a sample of 300 restaurants.

Quality rating is a categorical variable with rating categories of good, very good, and excellent. Meal price is a quantitative variable that ranges from Rs 10 to Rs 49.

A crosstabulation of the data for meal price is shown in the table.

|                |           | Meal Price |           |           |           |
|----------------|-----------|------------|-----------|-----------|-----------|
|                |           | Rs. 10-19  | Rs. 20-29 | Rs. 30-39 | Rs. 40-49 |
| Quality Rating | Good      | 42         | 40        | 2         | 0         |
|                | Very Good | 34         | 64        | 46        | 6         |
|                | Excellent | 2          | 14        | 28        | 22        |
|                | Total     | 78         | 118       | 76        | 28        |

Above example of cross tabulation shows frequency distribution. Similarly, we can also show Relative Frequency or Percent Frequency.

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## 13. Crosstabulations

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The data in two or more crosstabulations are often combined or aggregated to produce a summary crosstabulation showing how two variables are related. In such cases, we must be careful in drawing a conclusion because a conclusion based upon aggregate data can be reversed if we look at the unaggregated data. The reversal of conclusions based on aggregated and unaggregated data is called **Simpson's paradox**.

To provide an illustration of Simpson's paradox we consider an example involving the review of two restaurants in Patna. Lakshmi restaurant and Khana Khazana both serve Chinese food and Mughlai food.

For each restaurant a crosstabulation was developed based upon two variables: Review (Good or Poor) and Type of Food (Chinese and Mughlai). Suppose that the two crosstabulations were then combined by aggregating the type of review data.

The resulting aggregated crosstabulation contains two variables: Review (Good or Poor) and Restaurant (Lakshmi or Khana Khazana).

This crosstabulation shows the number of reviews in which the food was Good or Poor for both restaurants.

The following crosstabulation shows these results along with the column percentages in parentheses next to each value:

| Review | Lakshmi    | Khana Khazana | Total |
|--------|------------|---------------|-------|
| Good   | 129 (86%)  | 110 (88%)     | 239   |
| Poor   | 21 (14%)   | 15 (12%)      | 36    |
| Total  | 150 (100%) | 125 (100%)    | 275   |

A review of the column percentages shows that 86% of the reviews were Good for Lakshmi restaurant, while 88% of the reviews were good for restaurant Khana Khazana. From this aggregated crosstabulation, we conclude that Khana Khazana has good reviews.

The following unaggregated crosstabulations show the specialties of Lakshmi and Khana Khazana restaurants.

### Restaurant Laxmi Review

| Review | Chinese   | Mughlai    | Total |
|--------|-----------|------------|-------|
| Good   | 29 (91%)  | 100 (85%)  | 129   |
| Poor   | 3 (9%)    | 18 (15%)   | 21    |
| Total  | 32 (100%) | 118 (100%) | 150   |

### Restaurant Khana Khazana Review

| Review | Chinese    | Mughlai   | Total |
|--------|------------|-----------|-------|
| Good   | 90 (90%)   | 20 (80%)  | 110   |
| Poor   | 10 (10%)   | 5 (20%)   | 15    |
| Total  | 100 (100%) | 25 (100%) | 125   |

From the crosstabulation and column percentages for restaurant Lakshmi, we see that the review for Chinese were good in 91% cases and for reviews for Mughlai were good in 85% cases. While for Restaurant Khana Khazana, we see that the 90% reviews were good for Chinese, and 80% reviews were good for Mughlai. Thus, when we unaggregate the data, we see that restaurant Lakshmi has better reviews. This result contradicts the conclusion we reached with the aggregated data crosstabulation that showed restaurant Khana Khazana has better reviews. This reversal of conclusions based on aggregated and unaggregated data illustrates **Simpson's paradox**.

## 14. Scatter Diagram and Trendline

A scatter diagram is a graphical presentation of the relationship between two quantitative variables, and a trendline is a line that provides an approximation of the relationship.

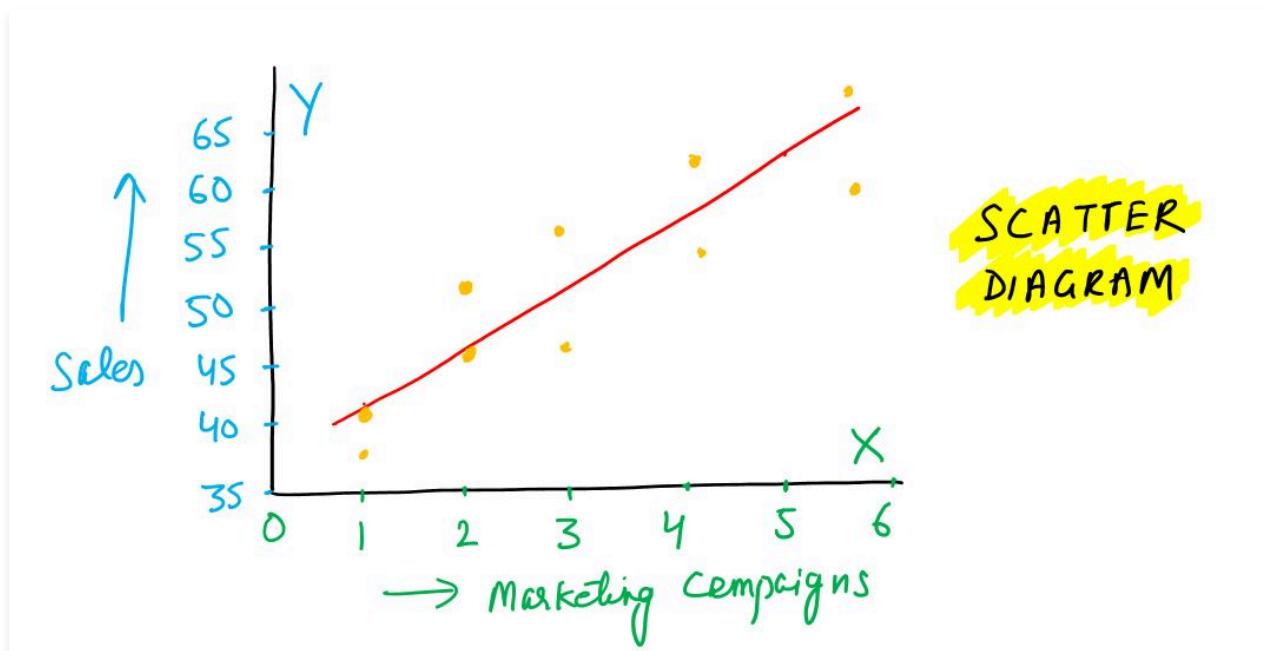
As an illustration, consider the relationship between marketing campaigns and sales. During past 10 months, the company launched many marketing campaigns to promote sales. The managers want to investigate whether a relationship exists between the number of marketing campaigns and sales.

The data on the number of commercials shown and sales in different months is shown in the table.

**Months Number of Commercial (X) Sales (in Lakhs) (Y)**

|    |   |    |
|----|---|----|
| 1  | 2 | 50 |
| 2  | 5 | 57 |
| 3  | 1 | 41 |
| 4  | 3 | 54 |
| 5  | 4 | 54 |
| 6  | 1 | 38 |
| 7  | 5 | 63 |
| 8  | 3 | 48 |
| 9  | 4 | 59 |
| 10 | 2 | 46 |

Scatter diagram and trendline for above data is shown below:



The scatter diagram in the figure indicates a positive relationship between the number of marketing campaigns and sales. Higher sales are associated with a higher number of marketing campaigns. The relationship is not perfect in that all points are not on a straight line. However, the general pattern of the points and the trendline suggest that the overall relationship is positive.

## 14. Scatter Diagram and Trendline

Scatter diagrams, also known as scatter plots, are graphs that display the relationship between two variables. They can exhibit various patterns, indicating different types of relationships between the variables being studied.

Here are three types of scatter diagrams and the relationships they suggest:

### 1. Positive Relationship

In a positive relationship, as one variable increases, the other variable also tends to increase. The points on the graph tend to form an upward-sloping pattern from left to right.

For example, as the number of hours studied increases, the exam scores also tend to increase. Each increase in one variable is associated with an increase in the other.

### 2. No Apparent Relationship

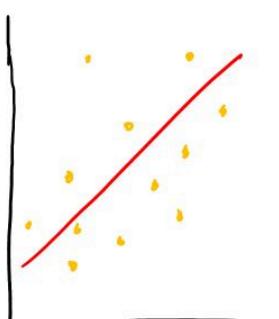
When there's no discernible pattern or trend between the variables, they show no apparent relationship. Points on the graph are scattered randomly with no observable trend, forming a shapeless cloud or cluster.

For instance, when comparing shoe size and IQ scores, there might not be a significant correlation or connection between the two variables.

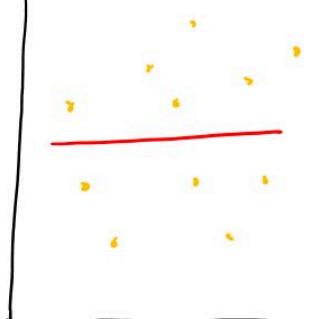
### 3. Negative Relationship

In a negative relationship, as one variable increases, the other variable tends to decrease. The points on the graph exhibit a downward-sloping pattern from left to right.

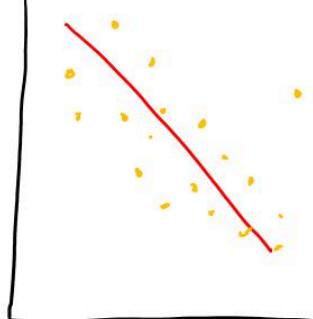
For example, as the amount of rainfall decreases, the instances of flooding tend to increase. Each increase in one variable corresponds to a decrease in the other.



+ve Relationship



No Relationship



-ve Relationship

### TYPES OF SCATTER DIAGRAMS

The left most diagram depicts a positive relationship. The middle diagram shows no apparent relationship between the variables. The right most diagram depicts a negative relationship where  $y$  tends to decrease as  $x$  increases.

## 1. Entrepreneur

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An entrepreneur is someone who perceives an opportunity and creates an organization to pursue it, i.e., one who assimilates the idea, resources and organization for creating and pursuing a new venture.

The concept of 'entrepreneur' is associated with 3 elements, i.e., risk-bearing, organizing and innovating. Hence, an entrepreneur can be defined as a person who tries to create something new, organizes production and undertakes risks and handles economic uncertainty involved in enterprise.

According to **F. A. Walker**, "Entrepreneur is one who is endowed with more than average capacities in the task of organizing and coordinating the factors of production, i.e. land, labour capital and enterprises."

**International Labour Organization (ILO)** defines entrepreneurs as those people who have the ability to see and evaluate business opportunities, together with the necessary resources to take advantage of them and to initiate appropriate action to ensure success.

Frank Young defined entrepreneur as a change agent.

### Copreneurs

When both husband and wife together start and run a business venture, then they are called copreneurs. Emergence of copreneurs in the present times is a reflection of the fact that women's role in business is increasing.

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## **2. Concept of Entrepreneurship**

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Entrepreneurship is defined as a systematic, purposeful and creative activity of identifying a need, mobilizing resources and organizing production with a view to deliver value to the customers, returns for the investors and profits for the self, in accordance with the risks and uncertainties associated with business.

The definitions of Entrepreneurship, as given by some prominent thinkers, are as follows.

Entrepreneurship is a process to shatter the status quo through new combinations of resources and new methods of commerce.

**Joseph Alois Schumpeter**

Entrepreneurship is a matter of foresight and willingness to assume risks, which is not necessarily connected with the employment of labour in some productive process.

**Richard Cantillon**

Entrepreneurship is equivalent to enterprise which involves the willingness to assume risks in undertaking an economic activity particularly a new one.

**William Diamond**

Entrepreneurship is the ability to create and build something from practically nothing. A human creative activity.

**Jaffrey J.A. Timmons**

Entrepreneurship is a process by which individuals, either on their own or inside organization, pursue opportunities without regard to the sources they currently control.

**Janil and Howard Stevenson**

Entrepreneurship is the purposeful activity of an individual or a group of associated individuals, undertaken to initiate, maintain or aggrandise profit by production or distribution of goods and services.

**Arthur H. Cole**

Entrepreneurship meant the function of seeking investment and production opportunity, organising an enterprise to undertake a new production process, raising labour, arranging the supply of raw materials, finding site, introducing a new technique, discovering sources of raw materials and selecting top managers of day operations of the enterprise.

**Everett E. Hessins**

Entrepreneurship is neither a science nor an art. It is a practice. It has knowledge, base knowledge in entrepreneurship is a means to an end, it is not just about making money. It is about imagination, flexibility, creativity, willingness to think continuously, readiness to take risks, affiliate to moguls, agents of proton action and capacity to see change as an opportunity. It is also about marrying passion and process with a good dose of perseverance.

**Peter F. Drucker**

Entrepreneurship is the creation of an innovative economic organisation. Core network of organisations for the purpose of gain or growth under conditions of risk and uncertainty.

**M. Low and J. Mac Millan**

Entrepreneurship connotes innovativeness, an urge to take risk in face of uncertainties and an intuition.

**V. R. Gaikwad**

Entrepreneurship involves, (i) Perception of an opportunity (ii) Organizing an industrial unit, and (iii) Running the industrial unit as a profitable going and growing concern.

**H. N. Pathak**

The definition of entrepreneurship includes more than the mere creation of a business, it also includes the generation and implementation of an idea.

**H. Aldrich and C. Zimmer**

Entrepreneurship is the dynamic process of creating incremented wealth. The wealth is created by individuals who assume the major risks in terms of equity, time and /or career commitment or provide unlike for some produce or service.

**Robert Ronstadt**

Entrepreneurship is the process of creating something new with value by devoting the necessary time and effort assuming the accompanying financial, psychic, and bold risks and receiving the resulting rewards of monetary and personal satisfaction and independence.

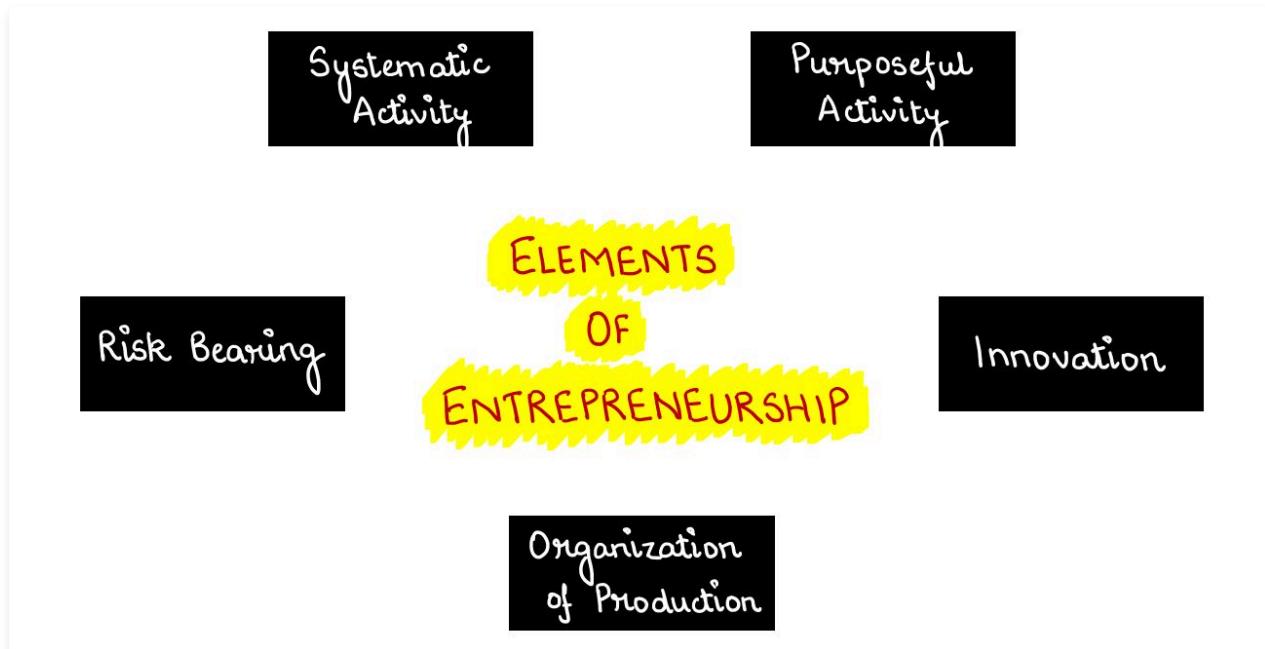
**Robert D. Hisrich**

Entrepreneurship is the attempt to create volume through regulation of business opportunity, the management of risk-taking appropriate to the opportunity and through the communicative and management skills to mobilize human, financial and scattered resources necessary to bring a project to functioning.

**John J. Kao**

Entrepreneurship is that form of social decision which is performed by economic innovators.

## 2. Concept of Entrepreneurship



The various definitions of entrepreneurship identify following basic elements of entrepreneurship:

### Systematic Activity

Entrepreneurship is not a mysterious gift or charm and something that happens by chance. It has certain temperamental, skill and other knowledge and competency requirements that can be acquired, learnt and developed, both by formal educational and vocational training as well as by observation and work experience. Such an understanding of the process of entrepreneurship is crucial for dispelling the myth that entrepreneurs are born rather than made.

### Purposeful Activity

Purpose of entrepreneurship is creation of value for personal profit and social gain.

### Innovation

Entrepreneurs constantly look out to do something different and unique to meet the changing requirements of the customers.

### Organization of Production

Entrepreneur, in response to a perceived business opportunity, mobilizes the resources into a productive enterprise or firm. The core of organization of production is the knowledge about availability and location of the resources as well as the optimum way to combine them.

### Risk bearing

The enterprise may earn profit or incur loss, which depends on various factors like changing customer preferences, increased competition, shortage of raw materials etc. An entrepreneur needs to be bold enough to assume the risk involved and hence an entrepreneur is a risk-bearer not risk-avoider. This risk-bearing ability keeps him to try on and on which ultimately makes him to succeed. The Japanese proverb "Fall seven times, stand up eight" applied to entrepreneur.

### 3. Stages in Entrepreneurial Development

Stages in  
Entrepreneurial  
Development

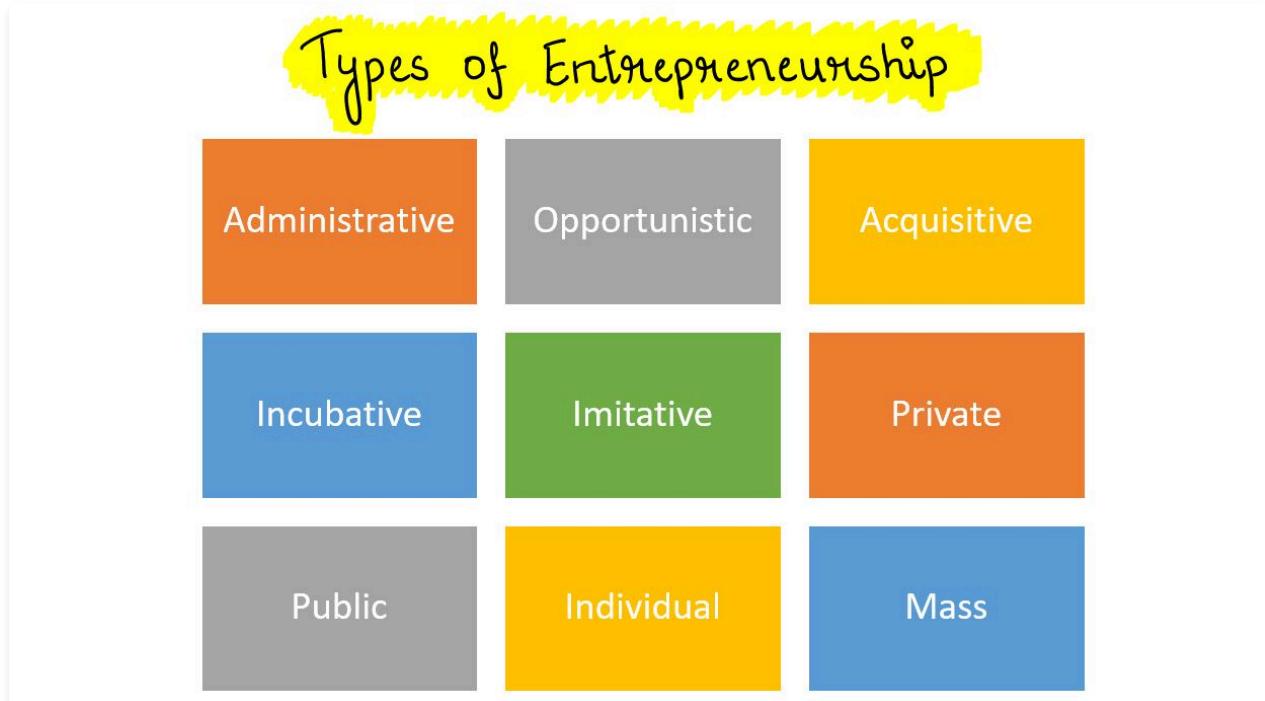


Entrepreneurship development passes through the following stages:

1. The entrepreneur perceives an opportunity and wishes to strive to make the most of it; in the process, he desires to meet his personal goals.
2. He translates the opportunity into a product idea or a service idea, which he could offer to the society.
3. He analyses the various things required to be done to concretize the concept or idea, outlines the steps required and makes a tentative plan of action.
4. He goes about collecting the resources men, money, machine and materials necessary to commence the venture.
5. He will make 'trial runs' and 'experiments', till he feels confident that the enterprise has been successfully launched and will take off.

## 4. Types of Entrepreneurship

Hans Schollhammer (1980) has classified entrepreneurship into 5 categories such as administrative, opportunistic, acquisitive, incubative and imitative entrepreneurship. But, with the change of time, the classification has increased.



The entrepreneurship can be classified into following 9 types:

### 1. Administrative Entrepreneurship

The entrepreneurial activity under this category is centered on administrative techniques and functions. It gives a new option to handle prevailing or future situations in a more effective way that provides advantages and competitive edge. Total Quality Management, job redesigning, new techniques of doing things, participative management or management by consensus are few of the examples of administrative entrepreneurship that increases overall organizational efficiency and that makes the firm successful and sustainable in the competitive market environment.

### 2. Opportunistic Entrepreneurship

There is a proverb "Hit! while the iron is hot". It is the best exhibit of the characteristic of this category of entrepreneurship. Environmental changes always offer new opportunities. But everybody is not equally capable of identifying and to utilize that opportunity on time. The entrepreneurship that identifies, exploits and executes the opportunity in the first hand is regarded as opportunistic entrepreneurship.

### 3. Acquisitive Entrepreneurship

The entrepreneurship that learns from others' competencies is acquisitive entrepreneurship. It acquires something new of value front, the competitive environment or achieves the competitors' technical capacities. It keeps the entrepreneurship sustainable in the competitive environment. The failure never restrains them from acquisition but motivates them further to discover such a thing with a new visitor. The examples are Flipkart-Amazon or Ola-Uber.

### 4. Incubative Entrepreneurship

This category of entrepreneurship generates and nurses new ideas and ventures within the organization. It executes them in a productive manner and ensures material gain for the organization. They pursue and help to get differentiated technologies to promote creations and innovations. Microsoft, Nokia etc. always incubate new varieties or types of product and create product differentiation.

### 5. Imitative Entrepreneurship

The entrepreneurship that imitates a good or service operating in the market under a franchise agreement is the imitative entrepreneurship. It is the medium that spreads technology over the world. It adopts an existing technology in countries over

the world. It also adopts an existing technology with minor modification appropriate to the local condition. The example is Aloo Tikki Burger by McDonalds in India.

#### **6. Private Entrepreneurship**

The entrepreneurship that is initiated under private sector is private entrepreneurship. The government gives various support services through private and public concerns that encourage private initiative in taking entrepreneurial ventures. A layer and mutual relationship between private and public sectors would make economic development speedy and balanced.

#### **7. Public Entrepreneurship**

The entrepreneurship that is undertaken by the government through its various development agencies is public entrepreneurship. All countries, developed or underdeveloped, take a public initiative in venture ideas to fulfill the initial deficiency of private entrepreneurs. The example is 'Make in India'.

#### **8. Individual Entrepreneurship**

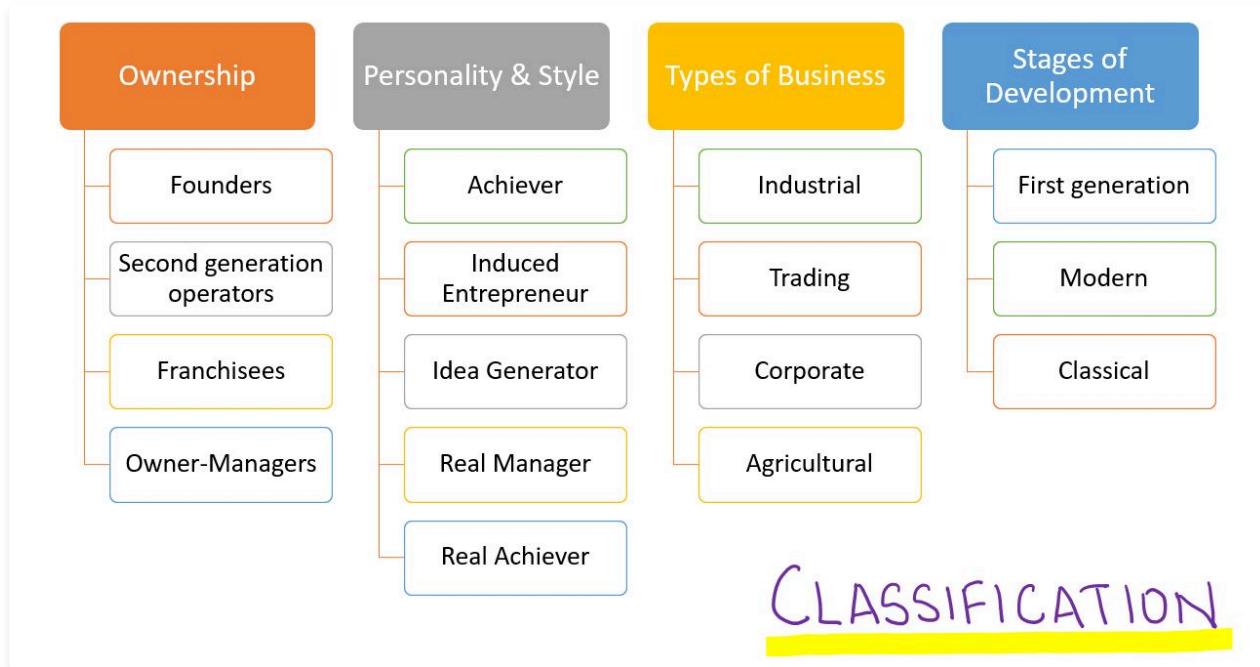
The entrepreneurship that is undertaken by an individual or a family with the personal initiative is individual entrepreneurship.

#### **9. Mass Entrepreneurship**

This type of entrepreneurship increases small and medium enterprises in a country. It is about inspiring and helping millions of job-seekers to become job-creating entrepreneurs. "Mass entrepreneurship" refers to the millions of ordinary local businesses that typically hire five or more people, use local inputs and serve local needs in every community. These range from a beauty salon or a food caterer to a motorbike repair shop or artisan collective. In most thriving economies, they form the backbone of the economy and employment. Nurturing entrepreneurial mindsets early and creating support infrastructure can lead to mass entrepreneurship in India and abate the job crisis.

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## 5. Classification of Entrepreneurs



The Entrepreneurs can be classified on the following basis.

- (i) Ownership
- (ii) Personality Traits and their Style of Running Business
- (iii) Type of Business, and
- (iv) Stages of Development.

Apart from above, Clarence Danhof also classified the entrepreneurs into 4 categories, i.e., Innovative, Imitative, Fabian, and Drone Entrepreneurs.

The classification of Entrepreneurs is discussed next.

## 5. Classification of Entrepreneurs

On the basis of ownership, entrepreneurs can be classified as follows.

### 1. Founders or Pure Entrepreneurs

As the term suggests, they are those individuals who are the founders of the business. They are the ones who conceptualize a business plan and then put in efforts to make the plan a success.

### 2. Second-generation operators of family-owned businesses

They are the individuals who have inherited the business from their fathers and forefathers.

### 3. Franchisees

It is a method of doing business wherein the parent owner (the franchiser) licenses his trademarks and tried and proven methods of doing business to a franchisee in exchange for a recurring payment.

### 4. Owner-Managers

When a person buys a business from the founder and then invests his time and resources in it, he is called the owner-manager.

## **5. Classification of Entrepreneurs**

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On the basis of Personality Traits and their Style of Running Business, entrepreneurs can be classified as follows.

### **1. Achiever**

These types of entrepreneurs have personal desires to excel. The only drive that pushes them is the desire to achieve something in life, the desire to make a mark in society, the desire to prove their excellence. No matter how many hurdles come in their way, they are totally determined.

### **2. Induced Entrepreneur**

These types of entrepreneurs are induced by some external factors to start a business. The external factors could be like supporting government policies, unemployment, family support, facilitating institutional support, etc.

### **3. Idea Generator**

These kinds of entrepreneurs are highly creative people who are always in search of innovative ideas for setting up new business ventures. They have the ability to sense the demand much ahead of others.

### **4. Real Manager**

The real managers run the business in a systematic manner. They analyze business situations, assess the demands of future, both in terms of opportunities and threats and then take actions based on the above assessments. They believe in incremental changes rather than radical transformations.

### **5. Real Achievers**

The real achievers are full of life. They are looking for the achievement of not even their own goals but also of people associated with themselves like employees, suppliers and distributors.

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## **5. Classification of Entrepreneurs**

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On the basis of type of Business, entrepreneurs can be classified as follows.

### **1. Industrial Entrepreneur**

Industrial entrepreneur is an entrepreneur who is into manufacturing of a product. He identifies the needs and wants of customers and accordingly manufactures products to satisfy these needs and wants.

### **2. Trading Entrepreneur**

Trading entrepreneur is one who undertakes trading activities (buying and selling of goods and services) and is not concerned with the manufacturing of products. He identifies potential markets, stimulates demands and generates interests among buyers to purchase a product.

### **3. Corporate Entrepreneur**

Corporate entrepreneur is a person who demonstrates his innovative skill in organizing and managing a corporate undertaking (which is registered under some statute or act that gives it a separate legal entity).

### **4. Agricultural Entrepreneur**

Agricultural entrepreneurs are those entrepreneurs who undertake business related to agricultural activities.

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## **5. Classification of Entrepreneurs**

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On the basis of stages of development, entrepreneurs can be classified as follows.

### **1. First Generation Entrepreneur**

A first-generation entrepreneur is one who starts an industrial unit by means of an innovative skill. He is essentially an innovator combining different technologies to produce a marketable product or service.

### **2. Modern Entrepreneur**

A modern entrepreneur is one who undertakes business to satisfy the contemporary demands of the market. They undertake those ventures which suit the current socio-cultural trends. For example, Nykaa and Zivame.

### **3. Classical Entrepreneur**

A classical entrepreneur or a stereo-type entrepreneur is one whose aim is to maximize the economic returns at a level consistent with the survival of the firm, with or without element of growth.

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## **6. Classification by Clarence Danhof**

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Clarence Danhof classified the entrepreneurs into following 4 categories:

### **1. Innovative Entrepreneurs**

Innovative entrepreneurs are the forbearers of change in the business. They are full of creative ideas and offer innovative products to the society. It is because of these innovative entrepreneurs that many important changes occur in our society. The example is Oyo Rooms.

### **2. Imitative Entrepreneurs**

Imitative entrepreneurs adapt a successful innovation. They are risk averse and so they do not try out new ideas or products, but if a new idea is accepted by the market, they imitate the new idea and hence join in the competition.

### **3. Fabian Entrepreneurs**

Fabian entrepreneurs are highly cautious and sceptic in their approach. They are not readily interested in introducing any change in their organization and when they do so it is because unless they are clear that without such change, they would be out of the market. The examples are Kodak and Nokia.

### **4. Drone Entrepreneurs**

Drone entrepreneurs are not open to creativity and change. They do not like changing the working of organizations with the changing times. They prefer facing losses to introducing changes in their present processes, equipments and policies. The example is Beedi business in India.

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## 7. Theories of Entrepreneurship

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### THEORIES OF ENTREPRENEURSHIP

Schumpeter's Theory of Innovation

Mc-Cleland's Need Achievement Theory

Hagen's Status Withdrawal Theory

Max Weber's Theory of Social Change

Kunkel's Theory of Social Behavior

Hoselitz's Theory of Marginal Groups

Cochoran's Theory of Model Personality

Peter Drucker's Theory of Systematic Innovation

The following theories of Entrepreneurship are discussed next.

- Schumpeter's Theory of Innovation
  - Mc-Cleland's Need Achievement Theory
  - Hagen's Status Withdrawal Theory
  - Max Weber's Theory of Social Change
  - Kunkel's Theory of Social Behavior
  - Hoselitz's Theory of Marginal Groups
  - Cochran's Theory of Model Personality
  - Peter Drucker's Theory of Systematic Innovation.
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## 7. Theories of Entrepreneurship

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Joseph Schumpeter in 1934 developed the famous innovative theory of entrepreneurship. Schumpeter has tried to establish correlation between the economic activity and economic development of a country. According to him, an entrepreneur can earn economic profits by introducing successful innovations. Here innovation refers to any new policy that an entrepreneur undertakes to reduce the overall cost of production or increase the demand for his products.

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## **7. Theories of Entrepreneurship**

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This theory of entrepreneurship is developed by David McClelland. According to him, high achievement motive induces an individual towards entrepreneurship. It is a tendency to strive for excellence, one's performance, achieving high levels of success for the sake of personal accomplishment and not for the sake of just monetary rewards. The motive of high-achievement guides the actions of people and induces them towards entrepreneurship.

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## **7. Theories of Entrepreneurship**

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It was developed by E. Hagen. He attributed the withdrawal of status of a group as the starting point for entrepreneurship development process. According to Hagen, entrepreneurship is a function of status withdrawal which forces the members of group who has lost its status to become aggressive and innovative and become entrepreneurs. However, this process has a long-term process. After three-four generations, this situation takes place in the status loosing group and the members of such group try to regain their status by showing aggressive entrepreneurial drive.

He further stated that withdrawal of status respect would give rise to 4 possible reactions and create 4 different personality types:

1. **Retreatist:** He who continues to work in a society but remains different to his work and position.
  2. **Ritualist:** He who adopts a kind of defensive behaviour and acts in the way accepted and approved in his society but no hopes of improving his position.
  3. **Reformist:** He is a person who foments a rebellion and attempts to establish a new society.
  4. **Innovator:** He is a creative individual and is likely to be an entrepreneur.
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## **7. Theories of Entrepreneurship**

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John Kunkel's theory deals with social behaviour in the context of entrepreneurship supply. According to Kunkel, supply of entrepreneurs is a function of social, political and economic structure. Individuals are performing various activities in a society; of these activities some are accepted by the society and those activities are rewarded. The reward acts as a stimulating factor for the repeated behaviour of an individual. This pattern of social behaviour is nothing but entrepreneurial behaviour.

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## **7. Theories of Entrepreneurship**

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Max Weber studied the entrepreneurship issues from the sociological point of view and presented his theory of social change. This theory provides an analysis of religion and its impact on entrepreneurial culture. Weber found a relationship between protestant ethic and the spirit of capitalism. He found his thesis true about other communities also, e.g. Hindu, Jain and Juda. He held that Protestants progressed fast in bringing capitalism because their ethical value system provided them with rational economic attitude, while the Jews and Jains failed to develop industrial capitalism because of their value of 'Pariha' (the restriction on having any contact with other communities).

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## **7. Theories of Entrepreneurship**

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Cochoran's theory is related to the supply of entrepreneurship. It is also called "theory of cultural values". Cochoran states that cultural values, role expectations and social sanctions are the key determinants of the supply of entrepreneurship. He further opines that an entrepreneur is neither a super normal individual nor a person deviating from the established routine, but represents a society's model personality.

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## **7. Theories of Entrepreneurship**

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Peter Drucker, the management guru has developed the theory of systematic innovation. Drucker's thought on entrepreneurship have been presented in his book 'Innovation and Entrepreneurship – Practice and Principles.'

He writes that systematic innovation means monitoring 7 sources for innovative opportunity.

The first 4 lie within the enterprise; they are essentially symptoms:

1. The unexpected — The unexpected success, failure or outside event.
2. The incongruity — between reality as it actually is and reality as it is assumed to be or as it "ought to be."
3. Innovation based on process need.
4. Changes in industry structure or market structure that catch everyone unawares.

The second set of sources for innovative opportunity involve changes outside the enterprise or industry:

5. Demographics — population changes.
  6. Changes in perception, mood and meaning.
  7. New knowledge, both scientific and non-scientific.
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## **7. Theories of Entrepreneurship**

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Hoselitz has emphasized the role of culturally marginal groups in the development of entrepreneurship. Hoselitz states that marginal men, because of their ambiguous position from a cultural and social stand point are better suited to make creative adjustments in situations of change and in the course of this adjustment process, they become more innovative and establish a number of enterprises. Hoselitz emphasised the role of culturally marginal groups like Jews and Greeks in Medieval Europe and the Lebanese in West Africa, the Chinese in South Asia, the Indians in West Africa in promoting economic development.

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## 8. Intrapreneurship

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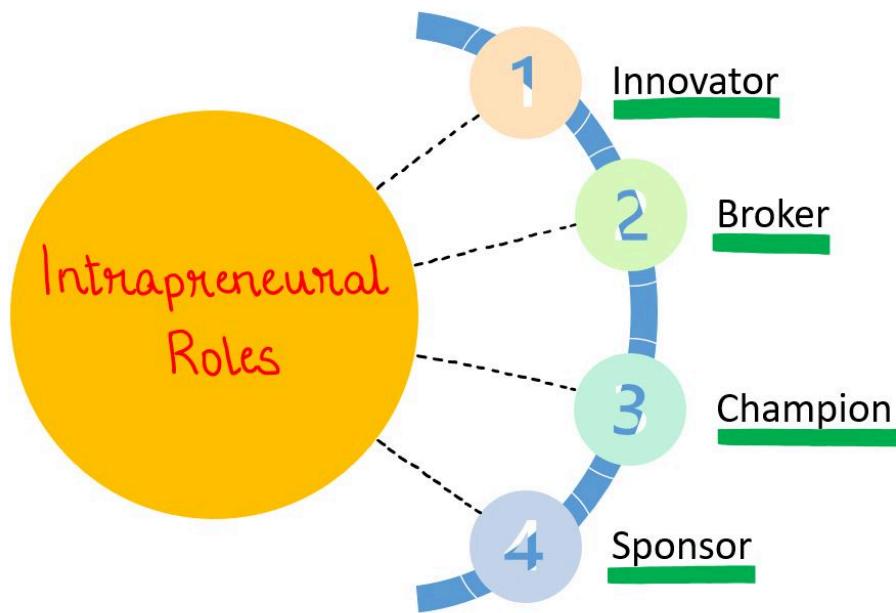
Intrapreneurship is the act of behaving like an entrepreneur while working within a large organization.

An enterprise grows faster, if the planners and decision makers (often executives) are also entrepreneurs, i.e. they are able to perceive further business opportunities and are capable of innovating, using the current enterprise and its available resources as a base.

Intrapreneurship creates a framework where employees with ideas and entrepreneurial skills are granted a certain level of autonomy to develop a project of their own in a controlled and safe environment. In using the often non-tapped energy of would-be entrepreneurs, some organizations have turned themselves into innovation engines and are now market leaders.

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## 8. Intrapreneurship



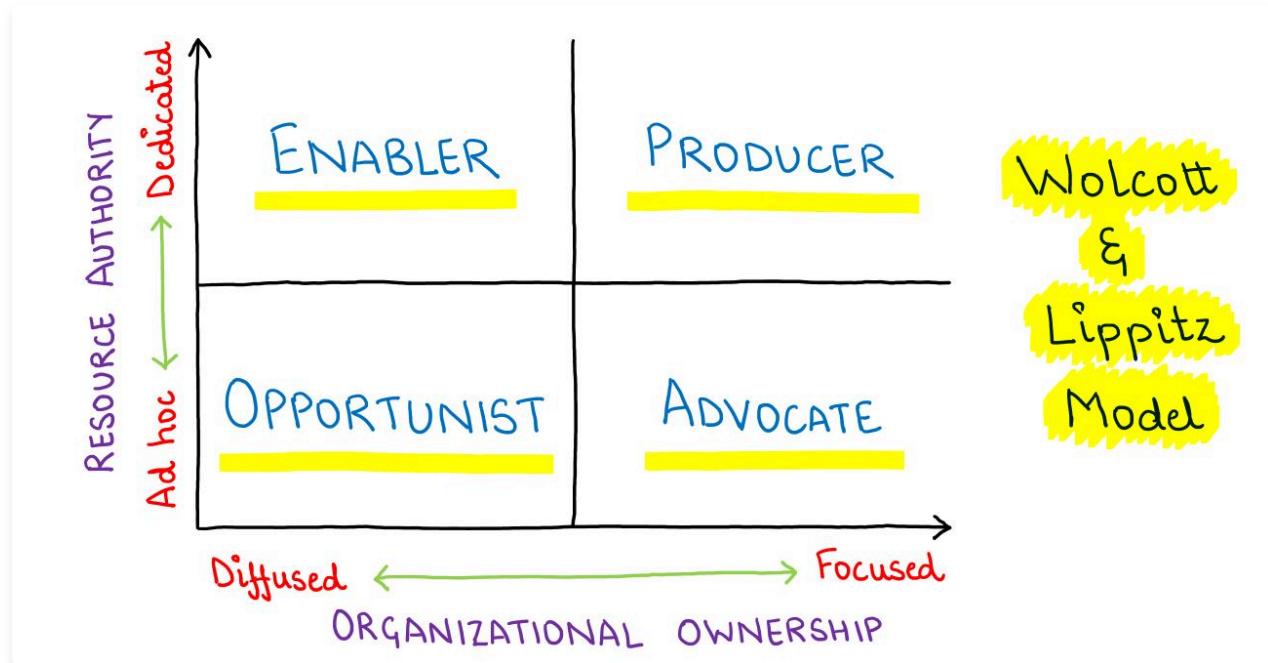
Gifford Pinchot III, an American entrepreneur, author and co-founder Pinchot University, is credited with inventing the concept of Intrapreneurship in a paper that he and his wife, Elizabeth Pinchot, wrote in 1978 titled "Intra-Corporate Entrepreneurship".

The Pinchots first book, "Intrapreneuring: Why You Don't Have to Leave the Corporation to Become an Entrepreneur (1985)" presented an expansion of the Intrapreneurship concept. He suggested 3 roles for Intrapreneur; (a) product champion (b) inventor (c) sponsor.

Hayton and Kelly (2006) suggested that 4 intrapreneurial roles must be present in one or more of the employees in order to be successful.

- The **first** role that has to be fulfilled is the role of the **Innovator**. In order to be innovative, employees must be creative and able to recognize opportunities.
- The **second** role is that of the **Broker**. The broker gives the innovator access to a diverse pool of knowledge. Brokering entails gathering knowledge and information from many different sources, both from existing as well as new sources. By combining the knowledge and information, breakthrough innovations may arise.
- **Third**, they identified the role of the **Champion**. The champion can be considered as the catalyst of an intrapreneurial project. Championing regards a more or less social role within a project team. Champions are motivators. They inspire and enthuse their colleagues by promoting the potential they see in the innovation at hand.
- Finally, Hayton and Kelly suggested that a **Sponsor** must be present in the intrapreneurial environment. A sponsor, as the name already suggests, makes sure that intrapreneurial teams in organizations have access to the resources they need. Sponsors need to be able to recognize potentially profitable intrapreneurial projects; a deep technological and business understanding is crucial in this process. Furthermore, sponsors need to be risk tolerant and possess intrapreneurial persuasiveness.

## 8. Intrapreneurship



According to Wolcott and Lippitz, Corporate entrepreneurship (also called Intrapreneurship) flourishes, or dies, under 2 dimensions that are under direct management control: organization and resources.

1. *Organization*: Who is the responsible for business creation? It can be a group or multiple groups responsible for it.

2. *Resources*: Is there a budget to foster corporate entrepreneurship?

Both dimensions create a matrix with below 4 dominants models.

### 1. Opportunist Model

A model to be used in the initial efforts to support entrepreneurial activities within the organization. It provided tacit support in the organization both from the resources and structure point of view. In the long run, this approach should evolve to a more supporting model.

### 2. Enabler Model

Resources are available but it leaves teams and individual themselves to act in searching for entrepreneurial activities. Therefore, the assumption is that employees are willing to embrace entrepreneurial activities. Therefore, having the proper personnel is vital so the "entrepreneurial DNA" can be found within the employees. A corporate mandate provides with the needed resources to pursue their endeavor, but within their own business units and with the premise that such effort are according to the organization strategy.

### 3. Advocate Model

One of the newest approaches where the organization designates a group to actively advocate for new business creation within the different business units, but it is the business unit responsible to provide the needed resources for the entrepreneurial quest.

### 4. Producer Model

There is an effort corporate wide to support corporate entrepreneurship. It comes from organization units fully dedicated with the needed resources in new project development till the initial launch of the projects. It requires great collaboration from business units in order to easily integrate the output into the whole organization.

## 9. Women Entrepreneurship

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When a woman or group of women embark on initiating, organizing and managing their enterprise, they are termed as women entrepreneur.

As per definition, the woman entrepreneur is the one who assumes dominant financial control (minimum financial interest of 51% of the capital) in an enterprise. Further, it should be giving at least 51% of the employment generated in the enterprise to women".

The challenges faced by women entrepreneurs, governance structure for women entrepreneurship and major schemes of Government of India to promote women entrepreneurship in India are given next.

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## 9. Women Entrepreneurship

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Women entrepreneurs face a series of problems right from the beginning till the enterprise functions. Being a woman, itself poses various problems to a female entrepreneur. The problem of Indian women pertains to her responsibility towards family, society and huge workload. Women in rural areas have to suffer still further. They face tough resistance from men. The attitude of society towards them and constraints in which they have to live and work are not very conducive.

The following are some of the limitations faced by women entrepreneurs:

1. **Patriarchal society:** The gender bias that exists in society is predominantly due to the patriarchal attitude that has existed over a long period of time.
  2. **Lack of opportunities:** Education still has not reached to every female, the lack of education does stand as a barrier, they are no doubt skilled, which enables them to work, but more focused programmes for their education would enable them to overcome this challenge.
  3. **Enabling technologies for women:** There is a need to create more opportunities regarding new methods of production, marketing and other modern technologies.
  4. **Social barriers:** The traditions and customs prevailing in Indian society sometimes stand as an obstacle to women to grow and prosper. In rural areas, they face more social barriers. This can be overcome through education and positive legislation. The government policies are and should continue as a greater measure to support women entrepreneurs.
  5. **Attitude of creditors towards women:** Women entrepreneurs suffer while raising and meeting the financial needs of their business. The society was slightly biased in their attitude towards women entrepreneurs, but the records reflect that the rate of bad debts is the least in the case of women entrepreneurs, and the self-help groups in micro finance is most successful because of them.
  6. **Unorganized sector:** The skilled women work more in the unorganized sector and hence does not get her due. If she can overcome the challenge of education and be aware of all the schemes, she would not only be able to join the organized sector, but be a leader in it.
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## **9. Women Entrepreneurship**

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At present, only about 14% of all enterprises in India are women-led businesses. As per the results of Sixth Economic Census (conducted in 2016), the representation of women in the area of entrepreneurship is very limited as only 13.76 % of establishments are women owned. Majority (83.19 %) of the women owned establishments run without a hired worker and almost 65.7% of the women owned establishments are non-agricultural establishments.

The key challenges for women entrepreneurs in India include access to funding, availability of market, family constraints, lack of confidence in business skills, gender bias etc.

In order to address the problems in development of women entrepreneurship, different Ministries/ Departments of Government of India have taken significant initiatives.

### **Federation of Indian Women Entrepreneurs (FIWE)**

Federation of Indian Women Entrepreneurs (FIWE), a National-level organization, founded in 1993 and registered under Society Act of India in May 1999, is today, one of India's Premier Institution for Women thoroughly devoted towards Entrepreneurship Development in the country. Its head office is in Delhi. FIWE endeavors to provide: Networking platform for women, Technical know-how, Industry research & expertise, Skill development & training and brings the businesswomen on a Common Forum and ensures that their opinions, ideas and visions are collectively and effectively taken up with policy makers and various other agencies respectively for the development of Entrepreneur in Women.

### **Consortium of Women Entrepreneurs of India (CWEI)**

Consortium of Women Entrepreneurs of India (CWEI) was registered in 1996 as a civil society non-profit organization in New Delhi. The CWEI is accredited to Government of India and is a Member of National Board, Ministry of MSME and is working closely with Ministry of Rural Development in the PPP mode to support BPL families in India. It is also the Knowledge Partner to the State Government of Andhra Pradesh, working for the sustainable economic empowerment of women and their families through income generating activities and entrepreneurship development.

### **Federation of Ladies Organization (FLO)**

Federation of Ladies Organization (FLO) was established in 1983, as a division of the Federation of Indian Chambers of Commerce and industry (FICCI) which is the apex body of industry and commerce in India. As an All India Organisation for women, FLO has 15 Chapters pan India, with its Head Office in New Delhi. The members comprise of entrepreneurs, professionals and Corporate Executives.

### **Women Entrepreneurship Platform (WEP)**

Women Entrepreneurship Platform (WEP) was established to promote women entrepreneurs in India by the NITI Aayog in partnership with United States of America. The platform was formally launched in Mar 2018, on the occasion of International Women's Day. The WEP, through its partners, tends to offer services to members under various support areas:

- Incubation and Acceleration
- Entrepreneurship Skilling
- Marketing Assistance
- Funding and Financial Assistance
- Compliances Support
- Social Entrepreneurship

These partners include, Atal Innovation Mission, CRISIL, SIDBI, FICCI, NASSCOM, Google, Facebook, Institute of Chartered Accountants of India (ICAI), Institute of Company Secretaries of India (ICSI), CII, WEE Foundation, Nexus Incubator, Mann Deshi Foundation, Shop Clues, SEWA Bank amongst others.

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## 9. Women Entrepreneurship

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Since women entrepreneurship is highly concentrated in Micro, Small and Medium Enterprises, the Government has dedicated schemes and programs for women entrepreneurs in the sector.

Major schemes and programs which exist for women entrepreneurs are given below.

**Udyam Sakhi portal by Ministry of MSME**

The Ministry of MSME has launched a portal namely "Udyam Sakhi" for encouraging women entrepreneurs and to aid, counsel, assist and protect their interests. Udyam Sakhi network is a platform for emerging Women Entrepreneurs of India to get support, to understand current scenario of industries and to get guidance in various aspects of entrepreneurship. It helps Indian women to start, build and grow businesses and creating business models revolving around low-cost products and services to resolve social inequities.

**Start-up India by the Ministry of Commerce and Industry**

Start-up India aims to build a strong eco-system for nurturing innovation and Start-ups in the country under which 10% of the total corpus of Funds amounting to Rs 1000 crore, has been reserved for women led start-ups.

**TREAD (Trade Related Entrepreneurship Assistance and Development)**

The Government of India has initiated a scheme called "Trade Related Entrepreneurship Development Assistance Scheme (TREAD)" to promote women entrepreneurs. Under this scheme, the Government grants financial assistance of loan amount up to 30% of the total project value as appraised by lending banks which would finance the remaining 70% as loan assistance to applicant women. This scheme specifically focuses on promoting non-farm activities.

**Mahila Coir Yojana**

The Mahila Coir Yojana was aimed at providing self-employment in rural women artisans in coir producing regions. This scheme entails providing training and subsidized equipments and machinery.

**Prime Minister's Employment Generation Program**

It is a major credit-linked subsidy scheme to promote and set up micro, small and medium enterprises and to generate employment in rural and urban areas of the country. The maximum cost of the project under PMEGP scheme is Rs. 25.00 lakhs for manufacturing sector units and Rs. 10.00 lakhs for units under service sector. Under the scheme, the women entrepreneurs are provided 25% and 35% subsidies for the project set up in urban and rural areas, respectively. For women beneficiaries, own contribution is only 5% of the project cost while for general category, it is 10%. All the entrepreneurs including women are eligible for 2 weeks' Entrepreneurship Development Programme (EDP) after the sanction of their projects from banks for financial assistance to setup their unit.

**PM YUVA**

As reported in March 2020, the Ministry of Skill Development and Entrepreneurship (MSDE) is implementing a pilot scheme, Pradhan Mantri YUVA (PM YUVA) towards creating an enabling ecosystem through entrepreneurship education, training, advocacy and easy access to entrepreneurship network. The scheme focuses on students/trainees and alumni coming out from skilling ecosystem [i.e. Industrial Training Institutes (ITIs), Polytechnics, Pradhan Mantri Kuashal Kendras (PMKKs) and Jan Sikshan Sansthanas (JSS)].

**Micro and Small Enterprises - Cluster Development Programme**

Ministry of MSME has announced the scheme for Micro and Small enterprises for enhancing women's productivity and competitiveness as well as capacity building. The name of scheme is Micro and Small Enterprises - Cluster Development Programme (MSE-CDP). The Cluster should have suitable presence of (1) Women entrepreneur (2) Entrepreneur belonging to SC/ ST/ OBC/ Minorities etc. (3) Micro enterprises.

The Government of India promotes women entrepreneurs to represent themselves in International and national trade fairs and exhibitions through 100 % reimbursement of travelling cost.

**Rashtriya Mahila Kosh**

Rashtriya Mahila Kosh (RMK), also known as the National Credit Fund for Women (NCFW), is an initiative of the Indian Government that caters to the credit needs of the poor and asset-less women in the informal sector. The autonomous body

formed under the aegis of the Ministry of Women and Child Development provides micro-credit through Micro Financing Institutions (MFIs) for various activities including the setting up of micro enterprises.

#### Mahila e-Haat

Mahila E-Haat is an initiative for meeting aspirations and needs of women entrepreneurs. It is an online marketing platform for women, where participants can display their products. It is an initiative for women across the country as a part of 'Digital India' and 'Stand Up India' initiatives. The platform has been set up by the Ministry of Women and Child Development, Government of India, under Rashtriya Mahila Kosh (RMK).

#### Other Schemes

Working women's Hostel scheme provides safe and affordable accommodation to working women along with crèche facility for their children. Additionally, the Government of India has also made provisions for providing credit and financial assistance to women entrepreneurs through public sector banks. Public sector banks provide financial assistance to women entrepreneurs for venture and working capital requirements.

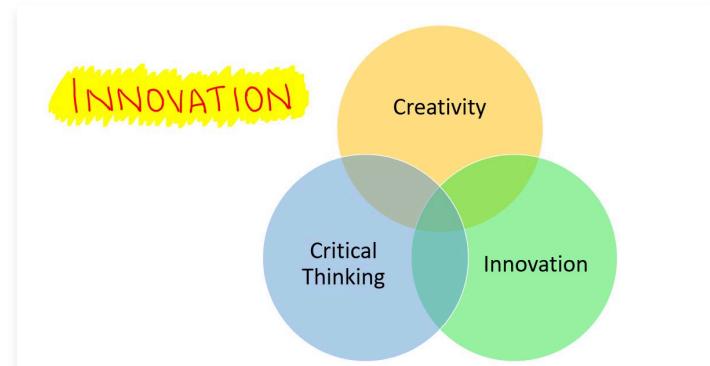
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## 1. Innovation and Creativity

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Most entrepreneurial ventures have survived when they solve problems of people, understanding their needs and accordingly changing the product to their needs. Entrepreneurial actions are efforts to solve problems for others. Therefore, entrepreneurs are *Problem Solvers*. When one solves a problem, a new value is created. In the business world, problem solvers take risks, but often create value by solving a customer or market problem, which is the key to create a profitable enterprise. In day-to-day operations also, entrepreneurs solve many different types of problems.



The 3 ways most entrepreneurs think when they are trying to solve a problem are listed below.

1. **Creativity**, which means to come up with ideas that others have not thought of before. An entrepreneur has to believe that they can come up with new ideas to solve a problem.
2. **Innovation**, which means to think of new ideas and come up with ways to make it work in real life.
3. **Critical Thinking**, which means to understand a situation or problem by asking oneself questions (why, what, when, how) and researching about reasons for the situation or a problem. An entrepreneur has to always think critically when faced with a problem.

Out of all the elements, which are intrinsic to the concept of entrepreneur and entrepreneurship, two elements stand out. These are creativity and innovation. Creativity is the heart of entrepreneurship, while Innovation is the oxygen that is keeping it alive.

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## **2. Creativity**

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Good problem solving occurs when managers have many viable, creative alternatives to consider. To inspire employees to approach problems creatively and to nurture a creative environment, organizations follow 3 general approaches.

These approaches include:

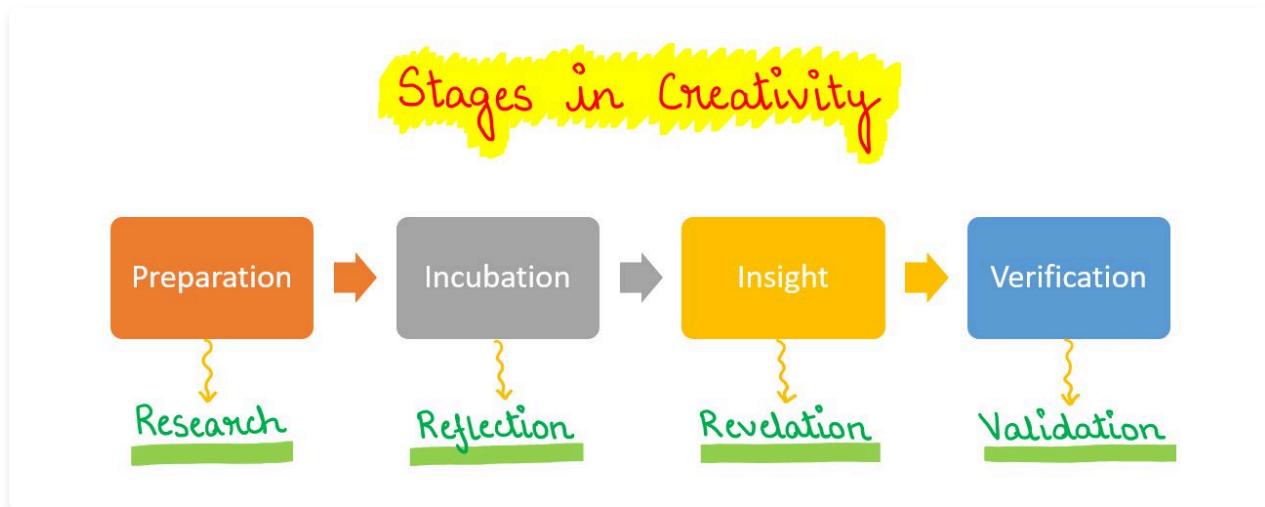
1. hiring creative individuals,
2. applying specific creativity-enhancement techniques, and
3. developing a creative organization.

Creativity is a human capacity; an ability to come up with new and different idea or break through fixed ways of thinking. It relates to thinking out of the box or developing new, inspiring and surprising ideas. Thus, creativity refers to a person's ability to think differently or novel, which means originality of ideas, usefulness of the ideas to the society and nation at large. All humans are born with raw creative ability, however, only a handful few is more creative than many.

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### 3. Stages in Creativity

The different stages of creativity are explained as follows.



#### 1. Preparation

Preparation involves gathering, sorting, and integrating information and other materials to provide a solid base for a later breakthrough. The discoveries of penicillin, the benzene ring, or gravity, while each involved a moment of insight, would have been impossible without a firm grasp of related information. Thus, Preparation is the first stage in the process of creativity. At this stage, an individual becomes curious about solving a given problem. Problems can be any sort of artistic challenges or tasks. In preparation stage, an individual performs research on the topic of problem. At this stage, goals are created, thoughts are organized and brainstorming is done to formulate different ideas.

#### 2. Incubation

During the incubation stage, the mind is not consciously focused on the problem. The individual may be relaxed, asleep, reflective, or otherwise involved. At this stage, synthetization of ideas using imagination takes place.

#### 3. Insight

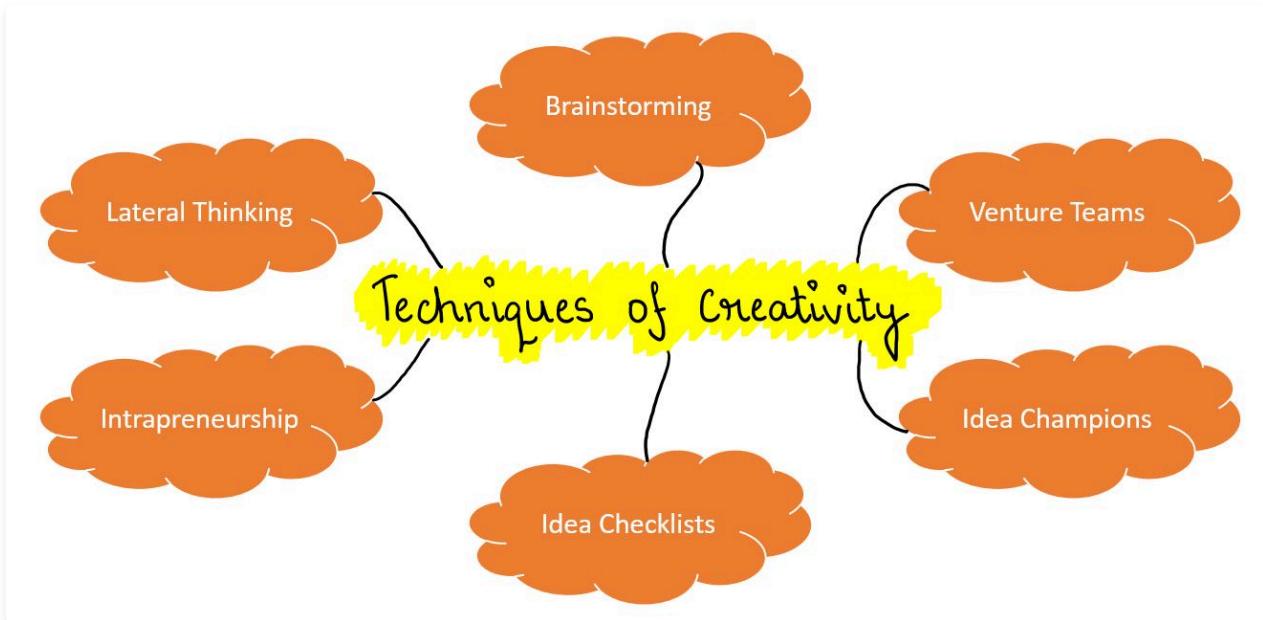
At insight (or illumination) stage, various ideas on the specified topics are generated in the mind of an individual at the very moment. These ideas provide a basis for creative response. They can be either the pieces of the whole idea or the whole idea itself.

#### 4. Verification

Finally, verification is necessary. This is the last stage in the process of creativity. At this stage, activities are performed to demonstrate, if the illusion occurred satisfies the need and the criteria defined in the preparation stage. In this stage, the ideas are studied, evaluated and seen if they can be developed for practical use.

## 4. Techniques of Creativity

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There are a number of techniques of creativity, but following widely practiced ones are discussed next one by one.

- Brainstorming
  - Venture Teams
  - Idea Champions
  - Idea Checklists
  - Intrapreneurship
  - Lateral Thinking.
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## 4. Techniques of Creativity

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Brainstorming is a widely used technique in organizations to foster creativity and generate a large number of ideas within a group setting. It was first introduced by advertising executive Alex Faickney Osborn in the 1940s. The primary goal of brainstorming is to encourage free-flowing, uninhibited thinking that can lead to innovative solutions and ideas.

Here's how a typical brainstorming session works:

### 1. Group Formation

A diverse group of individuals with different backgrounds, perspectives, and expertise come together. This diversity is crucial for generating a wide range of ideas.

### 2. Clear Objective

The session begins with a clearly defined problem or challenge. This helps focus the brainstorming efforts and ensures that the ideas generated are relevant to the task at hand.

### 3. No Criticism

One of the key principles of brainstorming is the suspension of judgment. Participants are encouraged to refrain from criticizing or evaluating ideas during the initial phase. This helps create an open and non-threatening environment that promotes creativity.

### 4. Quantity Over Quality

The focus is on generating a large quantity of ideas. The idea is that a greater number of ideas increases the chances of finding innovative and valuable solutions. Participants are urged to think freely and come up with as many ideas as possible.

### 5. Combining and Improving Ideas

After the initial idea generation phase, the group can start to explore and combine different ideas. This collaborative effort often leads to the development of more refined and creative solutions.

### 6. Time Constraints

Brainstorming sessions are usually time-limited to prevent overthinking and encourage spontaneous idea generation.

### 7. Recording Ideas

Ideas are typically written down or displayed where everyone can see them. This not only helps in organizing and documenting the ideas but also allows participants to build upon each other's contributions.

### 8. Facilitator's Role

A facilitator may guide the session, ensuring that it stays on track, reminding participants of the rules, and encouraging equal participation.

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## 4. Techniques of Creativity

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A venture team, often associated with the concept of skunk works, is a specialized and temporary group within an organization created to work on specific projects or tasks that require a high degree of creativity, innovation, and autonomy. The term "skunk works" was originally coined by Lockheed Martin during World War II for its Advanced Development Programs (ADP) division, which operated in a separate and secretive location.

Here are key characteristics of venture teams:

### Temporary Formation

Venture teams are not permanent structures within an organization. They are assembled for a specific project or task and are disbanded once the project is completed or reaches a certain milestone.

### High Autonomy

Members of venture teams are often given a high degree of autonomy. This autonomy allows them to work independently of the organization's usual bureaucracy, policies, and procedures. It fosters an environment where creative thinking is not constrained by traditional organizational constraints.

### Innovative Focus

These teams are typically tasked with projects that require a high level of innovation and creativity. The goal is to explore new ideas, develop cutting-edge solutions, or create breakthrough products or services.

### Separate Location and Facilities (Skunk Works)

To enhance the autonomy of the venture team, they may operate in a separate location or facility, often referred to as a "skunk works." This separation is intended to provide a distinct environment conducive to creativity and free thinking.

### Cross-Functional Collaboration

Venture teams often consist of individuals with diverse skills and backgrounds, encouraging cross-functional collaboration. This diversity can lead to a richer pool of ideas and perspectives.

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## 4. Techniques of Creativity

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Idea Champions are individuals within an organization who take on the responsibility of advocating, promoting, and driving the successful implementation of a particular idea or innovation. These individuals play a crucial role in the innovation process and are often instrumental in overcoming resistance to change.

Idea champions are passionate advocates for a specific idea or innovation. They believe in the value and potential impact of the idea and work to garner support from others within the organization.

Idea champions demonstrate leadership qualities by taking initiative and assuming responsibility for the success of the proposed change. They may be senior managers, project leaders, or individuals with the expertise and passion for the particular idea.

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## 4. Techniques of Creativity

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Idea checklists are tools designed to stimulate creative thinking by prompting individuals or teams to consider different perspectives and approaches to problem-solving. These checklists typically consist of a set of questions or prompts that encourage users to explore various dimensions of an idea, product, or situation. The goal is to generate new ideas, uncover potential improvements, and inspire innovative solutions.

### **SCAMPER**

SCAMPER is an acronym that stands for Substitute, Combine, Adapt, Modify or Magnify, Put to other uses, Eliminate or reduce, and Reverse or rearrange. Each element of SCAMPER represents a different creative thinking prompt:

**Substitute:** Consider substituting one component or element with another. What if you replaced a certain part with something entirely different?

**Combine:** Explore the possibility of combining different elements or ideas. How can you merge various concepts or features to create something new?

**Adapt:** Think about adapting or modifying existing elements to suit a different context or purpose. How can you tweak or adjust an idea to make it more suitable?

**Modify or Magnify:** Consider making modifications to the existing idea. Can you amplify or enhance certain aspects of the idea to improve it?

**Put to Other Uses:** Explore alternative applications for the idea. How might the idea be used in different contexts or for different purposes?

**Eliminate or Reduce:** Consider removing certain elements or simplifying the idea. What happens if you eliminate or reduce certain components?

**Reverse or Rearrange:** Explore the idea of reversing the order of elements or rearranging them. How might the idea look or function if you reverse the process?

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## 4. Techniques of Creativity

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Intrapreneurship refers to the practice of individuals or teams within a large organization behaving like entrepreneurs, taking on initiatives, and pursuing innovative ideas to create new products, services, or processes.

Intrapreneurs, or internal entrepreneurs, operate within the established structure of the organization but exhibit an entrepreneurial mindset, taking risks, and driving innovation within the corporate environment.

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## 4. Techniques of Creativity

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Lateral thinking, introduced by Edward de Bono, is a problem-solving and creative thinking technique that involves approaching challenges from unconventional and non-linear perspectives. The term "lateral" refers to thinking across or beyond traditional patterns, breaking away from the usual sequential and logical thought processes.

Here are key aspects of lateral thinking:

### **Unorthodox Methods**

Lateral thinking encourages individuals to explore unorthodox, out-of-the-box, and unconventional methods when solving problems. It involves looking at a problem from different angles and considering solutions that may not be immediately obvious.

### **Problem Redefinition**

Instead of directly addressing a problem with traditional problem-solving methods, lateral thinking often involves redefining the problem itself. By reframing the issue, new insights and creative solutions may emerge.

### **Metaphorical Thinking**

Metaphors and analogies are often used in lateral thinking to draw connections between seemingly unrelated concepts. This helps in generating fresh perspectives and insights that may lead to creative solutions.

### **Provocative Operation**

Lateral thinking may involve the use of "provocative operations" or deliberate attempts to disrupt conventional thinking. This could include asking unusual questions, making unconventional statements, or introducing elements of surprise to stimulate creative thinking.

### **Divergent Thinking**

Unlike convergent thinking, which focuses on finding a single correct solution, lateral thinking emphasizes divergent thinking—exploring multiple possibilities and considering various potential solutions.

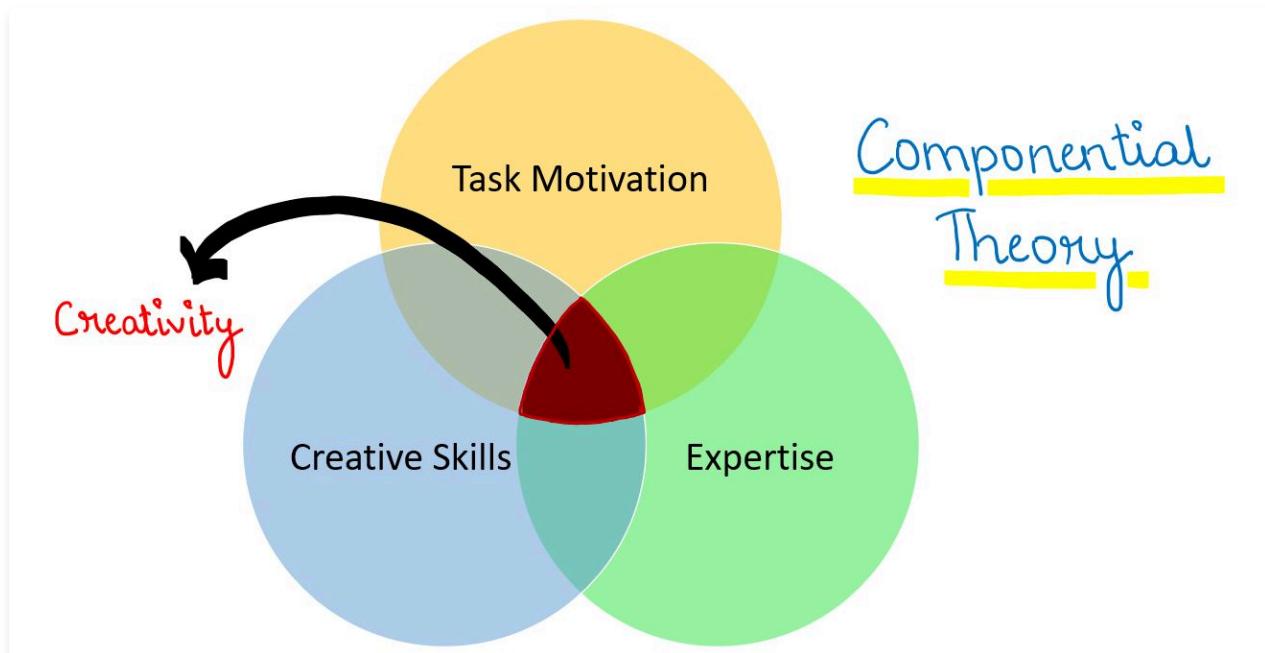
### **Challenging Assumptions**

Lateral thinking encourages individuals to question assumptions and challenge preconceived notions. By doing so, new perspectives emerge, opening up fresh avenues for problem-solving.

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## 5. Componential Theory of Creativity

According to conventional wisdom, creativity is something done by creative people. In contrast to the traditional approach, the *Componential Theory of Creativity* assumes that all humans with normal capacities are able to produce at least moderately creative work in some domain, some of the time—and that the social environment (the work environment) can influence both the level and the frequency of creative behavior.



The theory includes 3 major components of individual (or small team) creativity, each of which is necessary for creativity in any given domain: expertise, creative-thinking skill, and intrinsic task motivation.

### Expertise

Expertise is the foundation for all creative work. It can be viewed as the set of cognitive pathways that may be followed for solving a given problem or doing a given task—the problem solver's "network of possible wanderings." The expertise component includes memory for factual knowledge, technical proficiency, and special talents in the target work domain—such as expertise in gene splicing, or in computer simulation, or in strategic management.

### Creative Thinking

These skills include a cognitive style favorable to taking new perspectives on problems, an application of techniques (or "heuristics") for the exploration of new cognitive pathways, and a working style conducive to persistent, energetic pursuit of one's work. Creative thinking depends to some extent on personality characteristics related to independence, self-discipline, orientation toward risk-taking, tolerance for ambiguity, perseverance in the face of frustration, and a relative lack of concern for social approval. However, creativity skills can be increased by the learning and practice of techniques to improve cognitive flexibility and intellectual independence.

### Intrinsic Task Motivation

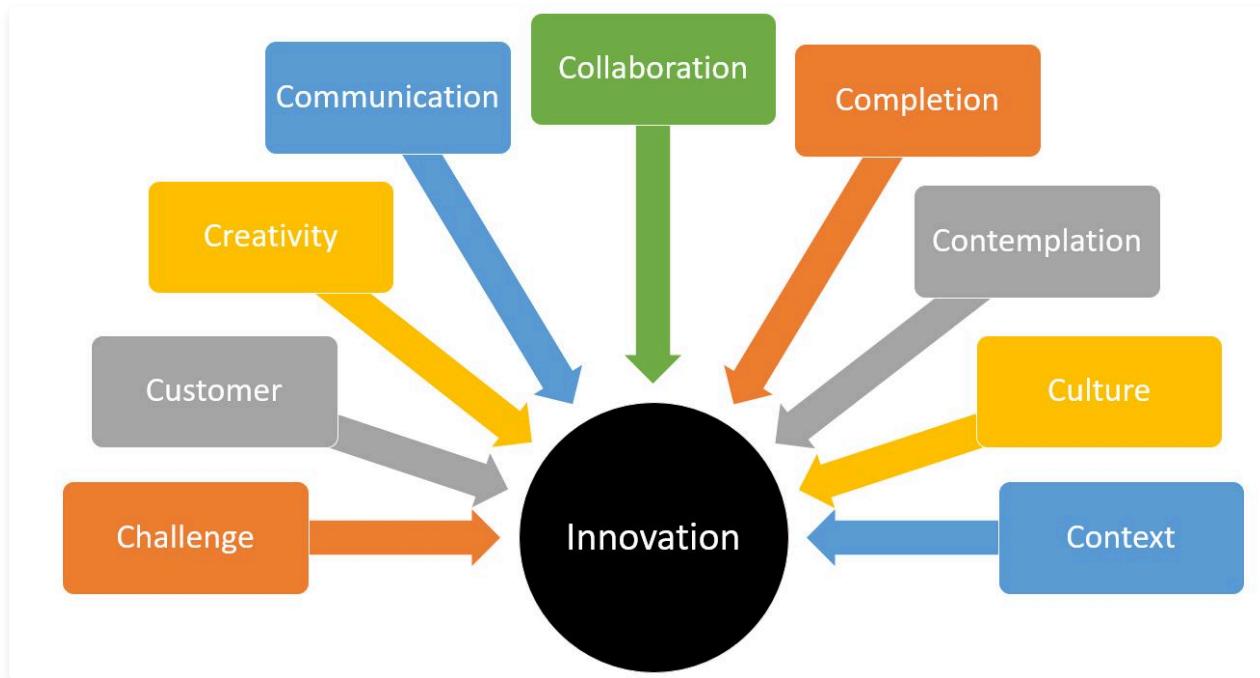
Although the two skill components determine what a person is capable of doing in a given domain, it is the task motivation component that determines what that person actually will do. Motivation can be either *intrinsic* (driven by deep interest and involvement in the work, by curiosity, enjoyment, or a personal sense of challenge) or *extrinsic* (driven by the desire to attain some goal that is apart from the work itself —such as achieving a promised reward or meeting a deadline or winning a competition).

## 6. Innovation



Innovation can be observed as an implementation of ideas that originate from creative processes. It can be defined as the process of translating a novel and creative idea or invention into a good or service that creates value or for which customers will pay. It relates to commercialization of creative invention which occurs, if someone improves on or makes a significant contribution to an existing product, process or service. Thus, it is the oxygen and core process of entrepreneurship.

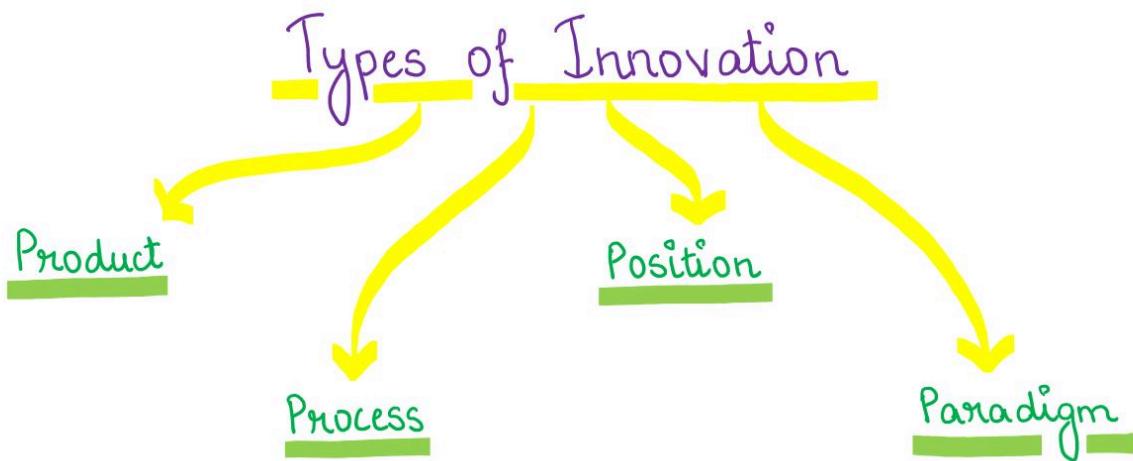
## 6. Innovation



Being an innovator implies, to be always positive in order to sharpen the creative capacity of out of the box thinking. Following 9 C's of innovation have been identified as its elements:

1. **Challenge:** What are we trying to change or accomplish – the “pull”
2. **Customer:** Creating value for your customers – the “push”
3. **Creativity:** Generating and sharing the idea(s) – the “brain”
4. **Communication:** The flow of information and ideas – the “life blood”
5. **Collaboration:** People coming together to work together on the idea(s) – the “heart”
6. **Completion:** Implementing the new idea – the “muscle”
7. **Contemplation:** Learning and sharing lessons lead to higher competency – the “ladder”
8. **Culture:** The playing field of innovation includes:
  - *Leadership* (see the possibilities and positions the team for action – the “role model”)
  - *People* (diverse groups of radically empowered people innovate – the “source of innovation”)
  - *Basic Values* (trust and respect which define and distinguish an innovative organization – the “backbone”)
  - *Innovation Values* (certain values stoke the fires that make the impossible, possible – the “spark”)
9. **Context:** Innovation is shaped by interactions with the world.

## 6. Innovation



Francis and Bessant (2005) have invented how organizations can map innovations. Framework is called "The 4Ps of innovation space". In that framework, every innovation can be mapped somewhere in the 4 dimension space.

Dimensions are process, position, product and paradigm.

### 1. Product innovation

Product innovation (first P of the 4Ps) is the easiest to understand. It means changes in the things which an organization offers. Examples are Apple iPods, Smart Watches.

### 2. Process innovation

Process innovation (second P of 4Ps) is also quite easy to understand. It means changes in the organization's processes. In the other words, it means changes in the ways in which organization is created and delivered. Examples are Ford motors, Zara.

### 3. Position innovation

Position innovation (third P of 4Ps) to understand needs some thinking and it is not as clear as the first two innovation types. It means changes in the context in which the products/services are introduced. Examples are Levis Jeans.

### 4. Paradigm innovation

The last P is meaning for Paradigm innovation. It is by far the hardest to understand. Meaning for that is changes in the underlying mental models which frame what the organization does. Examples are low cost airlines and online financial services.