Sales Boost Strategy
AT
ADKON Weighing Solutions

PROJECT REPORT SUBMITTED

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IN

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BACHELOR OF SCIENCE IN MATHEMATICAL SCIENCES

DEPARTMENT OF OPERATIONAL RESEARCH
DEEN DAYAL UPADHYAYA COLLEGE
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DECLARATION

I hereby declare that the project report entitled "Sales Boost strategy at ADKON weighing solutions" is being submitted to the Department of Operational Research, Deen Dayal Upadhyaya College, University of Delhi 110078 in partial fulfilment of the requirement for the award of the degree of Bachelor of Science in Mathematical Sciences. I have prepared this report under the guidance and supervision of Dr. (Mrs.) Veena Jain, Associate Professor, Deen Dayal Upadhyaya College, University of Delhi, New Delhi-11078

The project is based on my original research and has not been submitted for the award of any degree or diploma from any other university or institution to the best of my knowledge.

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CERTIFICATE

I hereby certify that the Project titled" Sales Boost strategy at ADKON weighing solutions" which is submitted by Yashwardhan Jha (21015587039), for the fulfilment of the requirements for awarding of the degree of Bachelor of Science in Mathematical Sciences is a record of the project work carried out by the student under my guidance and supervision. To the best of my knowledge, this work has not been submitted in any part or fulfilment for any Degree or Diploma to this University or elsewhere, of Bachelor of Science (B.sc.) Mathematical Sciences in a record of the project

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ABSTRACT

This project aims to improve the inventory management practices of ADKON Weighing Solutions by integrating marketing, sales, and operational strategies. The primary objective is to optimize inventory levels for all categories of weighing machines to meet customer demand efficiently. By analysing historical sales data and demand forecasts, the project seeks to determine the Economic Order Quantity (EOQ) and reorder points for each category item , considering the ordering time of 1 month and lead time of 12 days.

Furthermore, the project will focus on media marketing strategies to promote the weighing machines to specific customer segments, such as MNCs, factories, jewellery shop owners, industrialists, and retail shop owners. Utilizing digital platforms, including social media and online advertising, will enhance product visibility and increase market penetration.

Lastly, the project will apply Facility location problem to determine the most ideal location among the 8 hotspot zone for setting up a new warehouse that will minimize costs, maximize service levels, or achieve a balance of both.

By optimizing inventory management practices, implementing targeted marketing strategies, and deciding a new location for their new store, the project seeks to improve ADKON's sales performance, enhance customer satisfaction, and increase market share in the weighing solutions industry.

Keywords – **Inventory, Marketing, EOQ, Facility location problem.**

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Chapter - 1 Introduction to Operations Research

1.1 Introduction

Operations research, abbreviated as OR, is a discipline concerned with the development and implementation of advanced analytical tools for better decision making. It is sometimes considered a branch of the mathematical sciences. Operations research finds optimal or near-optimal solutions to complicated decision making problems by combining tools from other quantitative sciences including modelling, statistics, and optimization. Operations research interacts with many other fields, including industrial engineering, due to its emphasis on practical applications. Operations research is frequently focused on determining the maximum (of profit, performance, or yield) or minimum values of some real-world objective (of loss, risk, or cost). Its methods have grown to address problems in a variety of industries, having originated in military activities before World War II.

1.2 History

McClosky and Trefthen coined the term "Operational Research" in 1940 in a small town in the United Kingdom called Bowdsey. This new science came as a result of research into military operations during WWII. There were strategic and tactical problems that were so complex that expecting adequate solutions from individuals or specialists was unrealistic. As a result, military leaders convened scientists from various disciplines and organised them into teams to help solve strategic and tactical problems, i.e., to discuss, evolve, and suggest ways and means to improve the execution of various military projects. They proposed certain approaches that demonstrated remarkable progress as a result of their collaborative efforts, experience, and deliberations. This new method of studying the system's operations in a systematic and scientific manner was known as Operations Research or Operational Research (abbreviated as O.R.). The success of military teams drew the attention of industrial managers looking for solutions to their problems immediately after the war. Industrial operation research developed along different lines in the United Kingdom and the United States of America. The critical economic situation in the United Kingdom necessitated a drastic increase in production efficiency as well as the creation of new markets. The nationalisation of a few key industries expanded the potential field for OR. As a result, OR quickly spread from military to government, industrial, social, and economic planning.

India was one of the first countries to use O.R. The first operational research unit, known as the Regional Research Laboratory, was established in Hyderabad in 1949. Simultaneously, an additional unit was established in the Defence Science Laboratory to address the Stores, Purchase, and Planning issues. An O.R. unit was established in the Indian Statistical Institute in Calcutta in 1953. The goal was to employ O.R. techniques in National Planning and Survey. The Operations Research Society of India was founded in 1955 and was one of the first members of the International Federation of Operations Research Societies. Today, the use of O.R. techniques has spread from the army to a diverse range of departments at all levels.

1.3 Scientific Method in Operations Research

The scientific method is the most important feature of Operations Research. It is divided into three phases: Judgement Phase: This phase consists of the following steps: (i) identifying the real-life problem, (ii) selecting an appropriate goal and the values of various variables related to the goals, (iii) selecting an appropriate scale of measurement, and (iv) formulating an appropriate model of the problem, abstracting the essential information so that a solution at the decision-goal makers can be sought. Research Phase: This is the largest and longest of the two phases. However, the remaining two are equally important because they serve as the foundation for a scientific method. This phase includes: (i) observations and data collection to gain a better understanding of the problem, (ii) hypothesis and model formulation, (iii) observation and experimentation to test the hypothesis with additional data, (iv) analysis of the available information and hypothesis verification using preestablished measures of effectiveness, (v) predictions of various results from the hypothesis, and (vi) generalization of the results and conjectures. Action Phase: This phase consists of making recommendations for the decision-making process by those who first posed the problem for consideration, or by anyone in a position to make a decision affecting the operation in which the problem occurred.

1.4 Advantages and Limitations of Operations Research

Better Systems: Often, an O.R. approach is initiated to analyse a specific decisionmaking problem, such as the best location for factories, whether to open a new warehouse, and so on. It also aids in the selection of cost-effective modes of transportation, job sequencing, production scheduling, and the replacement of old machinery, among other things.

Better Control: The management of large organisations recognises that providing continuous executive supervision to every routine task is a difficult and costly endeavour. An O.R. approach may provide an analytical and quantitative foundation for the executive to identify the problem area. The most commonly used applications in this category are those for production scheduling and inventory replenishment.

Better Decisions: O.R. models aid in decision making and reduce the possibility of making incorrect decisions. The O.R. approach provides the executive with a better understanding of how he makes decisions.

Better Coordination: An operations-research-oriented planning model aids in the coordination of a company's various divisions.

Some Limitations:

Reliance on an electronic computer: O.R. techniques attempt to find an optimal solution while taking all factors into account. These factors are enormous in modern society, and quantifying them and establishing relationships between them necessitate voluminous calculations that can only be handled by computers.

Non-Quantifiable Factors: Only when all of the elements related to a problem can be quantified can O.R. techniques provide a solution. Quantification is not possible for all relevant variables. Unquantifiable factors have no place in O.R. models.

Money and Time Expenses: When the basic data is subject to frequent changes, incorporating it into the O.R. models is an expensive endeavour. Furthermore, a reasonably good solution now may be preferable to a perfect O.R. solution later on.

Implementation: Decision implementation is a delicate task. It must account for the complexities of human relationships and behaviour.

1.5 Applications of Operations Research

Aside from scientific advancement, O.R. is primarily concerned with the techniques of applying scientific knowledge. It provides an understanding that provides the expert/manager with new insights and capabilities to determine better solutions to his decision-making problems quickly, competently, and confidently. O.R. has successfully entered many different areas of research in recent years, including Defence, Government, Service Organizations, and Industry. We briefly describe some O.R. applications in management functional areas:

1. Project Allocation and Distribution:
   (i)Optimal project resource allocation, including men, materials, machines, time, and money.
   (ii) Identifying and deploying the appropriate workforce.
   (iii) Project planning, management, and control.

2. Production and Facility Planning:
   (i) Choosing the size and location of the factory.
   (ii) Estimate the number of facilities needed.
   (iii) Forecasting for various inventory items, as well as calculating economic order quantities and reorder levels.
   (iv)Scheduling and sequencing of production runs through proper machine allocation.
   (v) Transportation loading and unloading; and
   (vi) Warehouse location determination.
   (vii) Decisions on maintenance policy.

3. Program Decisions:
   (i) What, when, and how to buy to reduce procurement costs.
   (ii) Policies for bidding and replacement.

4. Marketing:
   (i) The timing of product introduction.
   (ii) Advertising media selection.
   (iii) Product mix selection
   (iv) Customer preferences for product size, colour, and packaging.

5. Organisational Behaviour:
   (i) Personnel Selection, Determination of Retirement Age and Skills
   (ii) Job assignment and recruitment policies.
   (iii) Employee recruitment.

(iv) Training programme scheduling

6. Finance:
   (i) Capital needs, cash flow analysis
   (ii) Credit policies, credit risks, and so on.
   (iii) Investment choice.
   (iv) The company's profit plan.

7. Research and Development:
   (i) Product launch planning
   (ii) Oversight of R&D projects.
   (iii) Identification of research and development priorities.
   (iv) Project selection and budget preparation.
   (v) Development project dependability and control as a result, it is possible to conclude that operation research can be widely used in management decisions and can also be used as a corrective measure.

1.6 Some Operation Research Techniques

Linear Programming: Linear Programming (LP) is a mathematical technique for allocating a fixed number of resources to meet a number of demands in such a way that some objective is optimised while other defined conditions are also met.

Queuing Theory: Queuing theory helps in estimating the number of people waiting in queue, the expected waiting time in the queue, the server's expected idle time, and so on. Thus, this theory can be applied in situations where decisions must be made to minimise the length and duration of the queue while spending the least amount of money.
Inventory

Control Models: It is concerned with the acquisition, storage, and handling of inventories in order to ensure inventory availability whenever needed while minimising waste and losses. It assists managers in determining the best reordering time, level, and quantity.

Nonlinear Programming: These methods can be used when the optimization problem or some of the constraints are not linear. Non-linearity can be created by factors such as a discount on the purchase price of large quantities.

Network Scheduling-PERT and CPM: A network scheduling technique is used to plan, schedule, and monitor large projects. Such large projects are common in the fields of construction, maintenance, computer system installation, R&D design, and so on.

Projects undergoing network analysis are divided into individual tasks, which are then arranged in a logical sequence by determining which activities should be performed concurrently and which should be performed sequentially.

Game Theory: It is used to make decisions in conflicting situations with one or more opponents (i.e., players). In game theory, we consider two or more people with different goals, each of whose actions influences the game's outcomes. The game theory provides solutions to such games, assuming that each player wishes to maximise his profits while minimising his losses.

Transportation Problem: The transportation problem is a subset of linear programming problems in which the goal is to minimise the cost of distributing a product from multiple sources to multiple destinations.

Simulation: It is a technique that entails creating a model of a real-world situation and then conducting experiments on it. When it is too dangerous, difficult, or time consuming to conduct a real study or experiment to learn more about a situation, simulation is used.

Chapter - 2 Inventory Management

2.1 Introduction to Inventory Management

Inventory management is a critical component of supply chain management that involves overseeing the flow of goods from manufacturers to warehouses and ultimately to retailers or end consumers. It encompasses a series of processes and strategies aimed at efficiently managing a company's inventory of raw materials, work in progress, and finished products. Effective inventory management is essential for businesses to meet customer demand, minimize holding costs, and maximize profits. It requires a careful balance between having enough inventory to

2.2 Importance of Inventory Management

Effective inventory management is crucial for several reasons. Firstly, it helps in ensuring that the right amount of inventory is available at the right time to meet customer demand. This prevents stockouts, which can lead to lost sales and dissatisfied customers. Secondly, it helps in minimizing holding costs by optimizing inventory levels and reducing excess inventory. Thirdly, it enables businesses to improve their cash flow by freeing up capital that would otherwise be tied up in excess inventory. Finally, it helps in reducing the risk of obsolescence by ensuring that inventory is used or sold before it becomes outdated.

2.3 Need of Inventory Management

Meeting Customer Demand: Inventory management ensures that businesses have enough stock to meet customer demand. Maintaining the right balance of inventory prevents stockouts (when demand exceeds supply) and overstocking (when supply exceeds demand), both of which can lead to lost sales and dissatisfied customers.

- **Minimizing Holding Costs**: Inventory represents a significant investment for businesses. Holding excess inventory ties up capital and incurs costs such as storage, insurance, and obsolescence. Effective inventory management helps in minimizing these holding costs by optimizing inventory levels.

- **Optimizing Production and Purchasing**: Inventory management helps in optimizing production and purchasing decisions. By having a clear understanding of inventory levels and demand patterns, businesses can schedule production and place orders with suppliers more efficiently.

- **Reducing the Risk of Obsolescence**: Certain products may become obsolete or expire if they are not sold in a timely manner. Inventory management helps in reducing the risk of obsolescence by ensuring that inventory is used or sold before it becomes outdated.
- Improving Cash Flow: Effective inventory management improves cash flow by reducing the amount of capital tied up in excess inventory. This capital can be used for other business purposes, such as investment in new products or expansion.

- Enhancing Customer Satisfaction: By ensuring that products are available when customers need them, inventory management helps in enhancing customer satisfaction. Satisfied customers are more likely to become repeat customers and recommend the business to others.

2.4 Types of Inventory Costs

- **Ordering Costs:** These are the costs associated with placing and receiving an order for inventory. They include costs such as the cost of preparing and processing purchase orders, the cost of transportation and delivery, and any other costs incurred in acquiring the inventory. Ordering costs are typically fixed per order and can be reduced by ordering larger quantities less frequently (though this may lead to higher holding costs).

- **Holding Costs:** Holding costs, also known as carrying costs, are the costs incurred by holding inventory in stock over a period of time. These costs include storage costs (rent, utilities, insurance), handling costs (moving and managing inventory), obsolescence costs (depreciation, spoilage), and opportunity costs (the cost of capital tied up in inventory that could be invested elsewhere). Holding costs are typically calculated as a percentage of the inventory value per unit time.

- **Shortage Costs**: Shortage costs, also known as stockout costs, are the costs incurred when demand for a product exceeds the available inventory. These costs include lost sales revenue, backordering costs (expediting orders, additional shipping costs), and potential loss of customer goodwill. Shortage costs can vary depending on the nature of the business and the importance of the product to customers.

In addition to these main types of inventory costs, there are other costs that may be relevant depending on the specific circumstances of the business, such as setup costs (costs associated with preparing machines for production), holding costs for perishable goods (such as food or pharmaceuticals), and costs related to quality control and inspection.

2.5 Factors affecting inventory management

- **Demand Variability**: Fluctuations in customer demand can impact inventory levels. High demand variability may require higher safety stock levels to prevent stockouts, while low demand variability allows for lower inventory levels.

- **Lead Time**: The time it takes for an order to be delivered after it is placed (lead time) affects inventory management. Longer lead times may require higher safety stock levels to cover demand during the lead time.

- **Supplier Performance**: The reliability and performance of suppliers can impact inventory management. Unreliable suppliers or delays in delivery can lead to stockouts and excess inventory.

- **Economic Order Quantity (EOQ):** EOQ is the optimal order quantity that minimizes total inventory costs. Factors such as ordering costs, holding costs, and demand rate influence the EOQ.

- **ABC Analysis**: ABC analysis categorizes inventory into three categories based on value and importance. A items are high-value items that require tight control, while C items are low-value items that require less control. This categorization helps in prioritizing inventory management efforts.

- **Technology and Automation**: The use of technology and automation, such as inventory management software and barcode scanners, can improve inventory accuracy and efficiency.

- **Storage and Handling Costs**: The costs associated with storing and handling inventory, such as rent, utilities, and labour costs, can impact inventory management decisions.

- **Seasonality**: Seasonal fluctuations in demand can impact inventory levels. Businesses may need to adjust inventory levels to meet seasonal demand patterns.

- **Regulatory Requirements**: Regulatory requirements, such as safety regulations or expiration dates for certain products, can impact inventory management practices.

- **Forecasting Accuracy**: The accuracy of demand forecasting can impact inventory management. More accurate forecasts can help in reducing excess inventory and stockouts.

2.6 Inventory management Techniques

- Just-in-Time (JIT) Inventory Management: JIT inventory management aims to minimize inventory levels by only ordering inventory when it is needed. This helps in reducing holding costs and improving cash flow. However, it requires close coordination with suppliers and carries the risk of stockouts if not managed properly.

- b. Economic Order Quantity (EOQ): EOQ is a formula used to calculate the optimal order quantity that minimizes total inventory costs. It takes into account the cost of ordering inventory, holding inventory, and the demand rate. By using the EOQ formula, businesses can determine the most cost-effective order quantity.

- c. ABC Analysis: ABC analysis categorizes inventory into three categories based on their value and importance. Category A items are high-value items that account for a significant portion of inventory value but a small portion of total inventory count. Category B items are moderate-value items, and Category C items are low-

value items. This helps in prioritizing inventory management efforts based on the value and importance of items.

- d. Just-in-Case (JIC) Inventory Management: JIC inventory management involves holding buffer inventory to protect against unexpected fluctuations in demand or supply. While this can help in reducing the risk of stockouts, it can also lead to higher holding costs if not managed properly.

- 4. Inventory Management Systems

- Inventory management systems (IMS) are software tools that help businesses manage their inventory more efficiently. These systems can track inventory levels in real-time, automate the ordering process, and generate reports to help businesses make informed decisions about their inventory. Some popular IMS include SAP, Oracle, and QuickBooks.

Chapter - 3 Marketing Management

3.1 Introduction to Marketing

Marketing is the process of creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large. It involves understanding and meeting the needs and wants of customers through the development and promotion of products, services, or ideas. Marketing is a critical business function that helps companies to identify and reach their target audience, build brand awareness, and ultimately drive sales and revenue.

Effective marketing involves a combination of strategic planning, market research, advertising and promotion, and sales management. Businesses must identify their target market and create a marketing mix that includes the right product or service, the right price, the right distribution channels, and the right promotional tactics to reach and persuade potential customers.

Marketing can take many forms, including traditional advertising channels such as print and television, as well as newer digital channels such as social media and email marketing. In today's digital age, businesses must have a strong online presence and utilize various digital marketing techniques to remain competitive and reach their target audience.

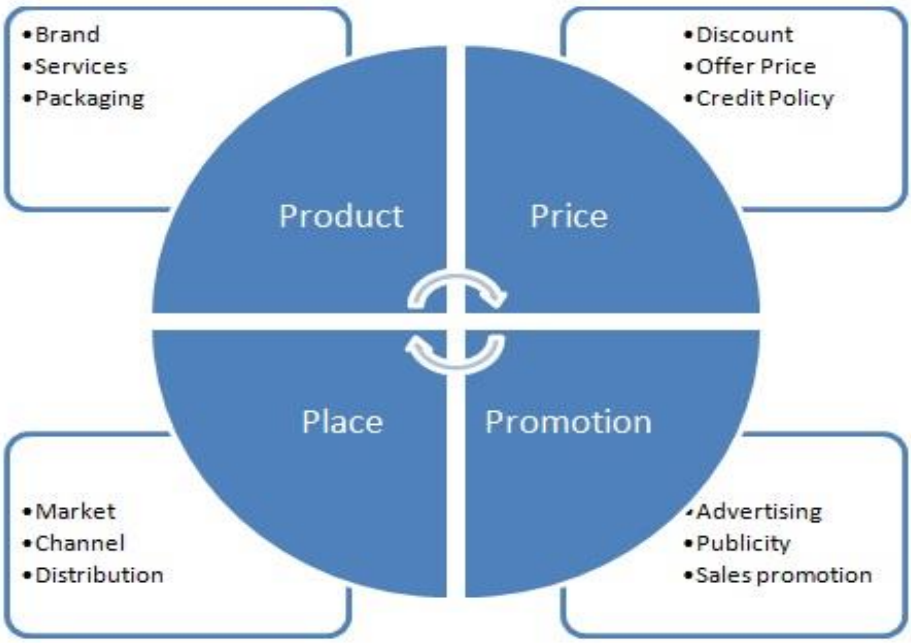
Marketing is a dynamic and constantly evolving field, and businesses must continually adapt their strategies to keep up with changing consumer preferences, emerging technologies, and shifting market trends. By effectively utilizing marketing techniques, businesses can build strong relationships with their customers, increase their brand awareness and reputation, and ultimately drive growth and success.

The following are the various aspects in the ranging field of Marketing:

i. Marketing requires an understanding of consumer’s needs and wants.
ii. Understanding consumer’s needs and wants requires a constant analysis and knowledge of the market.
iii. Marketing involves matching a product to a specific market.
iv. Marketers must understand what consumers are buying.
v. Marketers must be aware of how well the needs of consumers are or can be satisfied by the competition.
vi. Marketing recognizes the overall objectives of the firm and develops strategies that meet those objectives within the capabilities of the firm.

4P's OF MARKETING

- **PRODUCT**: Product refers to an item or items the business plans to offer to customers. The product should seek to fulfil an absence in the market, or fulfil consumer demand for a greater amount of a product already available.
- **PRICE**: Price refers to how much the company will sell the product for. When establishing a price, companies must consider the unit cost price, marketing costs, and distribution expenses as well as the competition product prices.
- **PLACE**: Place refers to the distribution of the product. Key considerations include whether the company will sell the product through a physical storefront, online, or through both distribution channels.
- **PROMOTION**: Promotion, the fourth P, is the integrated marketing communications campaign. Promotion includes a variety of activities such as advertising, selling, sales promotions, public relations, direct marketing, sponsorship, and guerrilla marketing.



3.2 MARKETING RESEARCH

Marketing research is the process of gathering and analysing information about customers, markets, and competitors to inform and support marketing decisions. It involves collecting data from various sources, such as surveys, interviews, focus groups, and online analytics, and analysing this data to identify trends, patterns, and insights that can be used to make informed decisions.

Marketing research can be used to help businesses understand their target market, assess customer needs and preferences, evaluate the effectiveness of marketing campaigns, and monitor competitor activity. By conducting marketing research, businesses can make more informed decisions about their products, services, and marketing strategies, and improve their chances of success in the marketplace.

Marketing research can be divided into two main categories: qualitative and quantitative research. Qualitative research involves collecting non-numerical data through methods such as interviews, focus groups, and observation. It is used to gain insights into customer attitudes, behaviours, and preferences. Quantitative research, on the other hand, involves collecting numerical data through methods such as surveys and online analytics. It is used to measure customer opinions, behaviours, and preferences on a larger scale.

Marketing research is an important tool for businesses of all sizes and types, as it provides valuable information that can be used to make more informed decisions and improve marketing performance. However, it is important to conduct marketing research in a systematic and rigorous manner, using appropriate research methods and techniques, to ensure that the data collected is accurate and reliable.

PURPOSE OF MARKETING RESEARCH

The purpose of marketing research is to provide businesses with information that can be used to make informed decisions about their products, services, and marketing strategies. Specifically, marketing research is used to:

1. Identify customer needs and preferences: By gathering information about customer attitudes, behaviours, and preferences, businesses can better understand what their customers want and need, and develop products and services that meet those needs.
2. Evaluate the effectiveness of marketing campaigns: Marketing research can be used to assess the impact of marketing campaigns, such as advertising and promotions, and identify areas for improvement.
3. Monitor competitor activity: Marketing research can help businesses keep track of their competitors and identify opportunities to gain a competitive advantage.
4. Identify market trends and opportunities: By analysing market data and trends, businesses can identify new opportunities for growth and expansion.

5. Make informed decisions: Marketing research provides businesses with the information they need to make informed decisions about product development, pricing, distribution, and promotion

Overall, the purpose of marketing research is to help businesses make more informed decisions about their marketing activities, and improve their chances of success in the marketplace.

THE MARKETING RESEARCH PROCESS

The marketing research process is a systematic approach to collecting, analysing, and interpreting data about customers, markets, and competitors. The process typically involves the following steps:

1. Defining the research problem: The first step in the marketing research process is to define the research problem or question that needs to be addressed. This involves clarifying the purpose of the research, identifying the target audience, and specifying the information needed.
2. Designing the research study: Once the research problem has been defined, the next step is to design the research study. This involves selecting the appropriate research method (e.g. survey, focus group, observational research), determining the sampling strategy (i.e. how to select participants), and developing the research instruments (e.g. survey questions, interview scripts).
3. Collecting data: The third step in the marketing research process is to collect data. This involves administering surveys, conducting interviews or focus groups, or collecting data through observational methods. Data can be collected through online or offline channels, depending on the research method chosen.
4. Analysing the data: After data has been collected, the next step is to analyze the data to identify patterns, trends, and insights. This involves using statistical methods and software to analyze the data and draw conclusions.
5. Interpreting the results: Once the data has been analyzed, the next step is to interpret the results. This involves identifying the key findings and drawing conclusions based on the data.
6. Reporting the results: The final step in the marketing research process is to report the results. This involves communicating the findings to the stakeholders, such as the marketing team, senior management, or external clients, in a clear and concise manner

Overall, the marketing research process is designed to provide businesses with the information they need to make informed decisions about their marketing activities. By following a systematic approach to collecting, analyzing, and interpreting data, businesses can gain valuable insights into customer needs, preferences, and behaviours, and develop marketing strategies that are more effective and successful.

CLASSIFICATION OF MARKETING RESEARCH

Marketing research can be classified into different types based on various criteria. The following are some of the commonly used classification systems:

1. Based on the Purpose:

- Exploratory Research: This type of research is conducted when the researcher has a vague idea about the research problem and needs to explore it further. The purpose of exploratory research is to generate insights and ideas that can be used to develop a more focused research study.

- Descriptive Research: This type of research is used to describe the characteristics of a target population, such as their demographics, preferences, and behaviours. The purpose of descriptive research is to provide a detailed and accurate picture of the target population.

- Causal Research: This type of research is used to establish cause-and effect relationships between variables. The purpose of causal research is to test hypotheses and identify the factors that influence consumer behaviour.

2. Based on the Data Collection Method:

- Primary Research: This type of research involves collecting data directly from the target population through surveys, interviews, observations, or experiments

- Secondary Research: This type of research involves analysing existing data sources, such as government reports, industry publications, and academic research papers.

3. Based on the Research Setting:

- Field Research: This type of research is conducted in the natural setting of the target population, such as a retail store or a consumer's home.

- Laboratory Research: This type of research is conducted in a controlled environment, such as a laboratory or a focus group facility.

4. Based on the Time Dimension:

- Cross-Sectional Research: This type of research is conducted at a single point in time to collect data about a target population.

- Longitudinal Research: This type of research is conducted over a period of time to track changes in the target population's behaviors and preferences.

Overall, the classification of marketing research is useful for understanding the different types of research that can be conducted based on the purpose, data collection method, research setting, and time dimension. This helps researchers and businesses to select the most appropriate type of research to meet their specific needs and objectives.

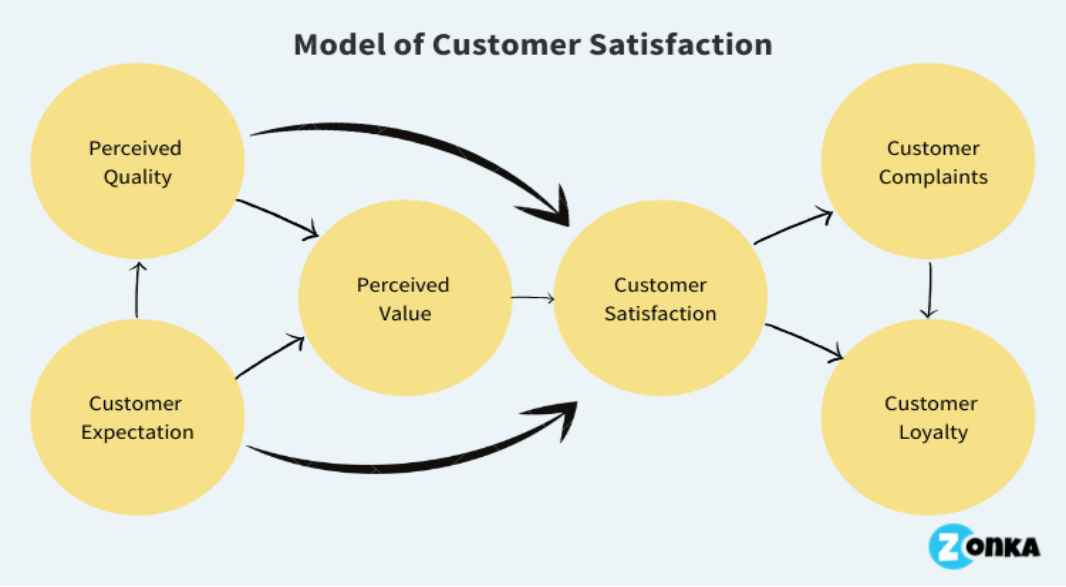
3.3 CUSTOMER SATISFACTION

Customer satisfaction is a measure of how happy or satisfied a customer is with a product, service, or overall experience with a company. It is an important concept in business because satisfied customers are more likely to continue doing business with a company, make repeat purchases, and recommend the company to others.

Customer satisfaction can be measured in a variety of ways, such as through surveys, customer feedback, reviews, and social media engagement. It can also be measured through metrics such as customer retention rates, repeat purchase rates, and Net Promoter Score (NPS).

Businesses can improve customer satisfaction by understanding their customers' needs and preferences and tailoring their products, services, and customer experience to meet those needs. They can also improve customer satisfaction by providing excellent customer service, addressing customer complaints and concerns promptly and effectively, and by regularly seeking and acting on customer feedback.

Overall, customer satisfaction is an important concept in business because it can have a significant impact on a company's success and growth. By prioritizing customer satisfaction and taking steps to improve it, businesses can build a loyal customer base, increase customer retention rates, and ultimately drive revenue growth.



FACTORS AFFECTING CUSTOMER SATISFACTION

There are a variety of factors that can affect customer satisfaction. Some of the most common factors include:
1. Quality of the product or service: The quality of the product or service is one of the most important factors that can affect customer satisfaction. Customers expect high-quality products and services that meet their needs and exceed their expectations.

2. Price: The price of a product or service can also impact customer satisfaction. Customers want to feel like they are getting a good value for their money, and if they feel like the price is too high for the quality of the product or service, they may be dissatisfied.

3. Customer service: The level of customer service provided by a company can also impact customer satisfaction. Customers want to feel valued and respected, and if they receive poor customer service or feel like their concerns are not being addressed, they may be dissatisfied.

4. Brand reputation: The reputation of a company's brand can also impact customer satisfaction. Customers want to do business with companies that have a good reputation and are known for providing high-quality products and services.

5. Convenience: Convenience is another important factor that can impact customer satisfaction. Customers want products and services that are easy to access and use, and if they have to jump through hoops or encounter barriers to using a product or service, they may be dissatisfied.

6. Personalization: Customers also want products and services that are tailored to their specific needs and preferences. Companies that can provide personalized experiences are more likely to satisfy their customers.

Overall, customer satisfaction is impacted by a variety of factors, and companies that prioritize customer satisfaction by focusing on these factors are more likely to build a loyal customer base and drive business success.

WHY STUDY CUSTOMER SATISFACTION

There are several reasons why studying customer satisfaction is important:

1. Customer retention: Satisfied customers are more likely to remain loyal to a company and continue doing business with them, leading to increased customer retention rates.

2. Reputation: Satisfied customers are more likely to share positive experiences with others, which can help to build a company's reputation and attract new customers.

3. Competitive advantage: Companies that prioritize customer satisfaction and deliver high-quality products and services are more likely to stand out in a competitive marketplace and gain a competitive advantage.

4. Revenue growth: Satisfied customers are more likely to purchase more products or services, leading to increased revenue growth for a company.

5. Cost savings: Satisfied customers are less likely to require expensive customer service interventions, such as returns or refunds, which can result in cost savings for a company.
6. Customer insights: Studying customer satisfaction can provide valuable insights into customer preferences, needs, and expectations, which can inform product development and marketing strategies.

Overall, studying customer satisfaction is critical for companies that want to build a loyal customer base, grow their business, and remain competitive in today's marketplace

Chapter – 4 Facility Location Problem

A facility location model is a mathematical and analytical tool used to determine the most optimal locations for facilities such as warehouses, factories, distribution centers, or retail outlets. The objective is to minimize costs, maximize service levels, or achieve a balance of both. These models consider various factors, including transportation costs, customer locations, facility operating costs, and service level requirements.

Types of Facility Location Models:
Single-Facility Location Model: Determines the optimal location for a single facility to minimize costs or maximize efficiency.

Multi-Facility Location Model: Determines the optimal locations for multiple facilities while considering interactions and dependencies between them.

Continuous Location Model: Considers a continuous space for potential facility locations, not restricted to predefined points.

Discrete Location Model: Considers a set of predefined potential facility locations.

Dynamic Location Model: Considers changes over time, such as demand fluctuations or facility relocations.

Common Approaches and Techniques:
Center of Gravity Method: Aims to find a central location that minimizes transportation costs by considering the geographic distribution of demand points.

Linear Programming: Uses optimization techniques to minimize or maximize an objective function (e.g., cost, distance) subject to constraints.

Integer Programming: Similar to linear programming but considers discrete variables, making it suitable for selecting specific locations from a set of potential sites.

Heuristic Methods: Uses rules of thumb or iterative processes to find near-optimal solutions, often used when exact solutions are computationally infeasible.

Simulation Models: Use simulation techniques to evaluate the performance of different location scenarios under varying conditions.

Key Factors Considered in Facility Location Models:
Demand Points: Locations of customers or demand centers that need to be served.

Transportation Costs: Costs associated with transporting goods between facilities and demand points.

Facility Operating Costs: Costs to operate a facility, including labor, utilities, and maintenance.

Service Levels: Requirements for the speed and reliability of service to customers.

Geographic and Environmental Constraints: Physical limitations, regulatory requirements, and environmental considerations.

Capacity Constraints: The maximum output or capacity a facility can handle.

Example:
Objective: Minimize total transportation and operating costs for a network of warehouses serving retail stores.

Define the Problem:

Locations of retail stores (demand points)
Potential warehouse locations
Transportation costs per unit distance
Operating costs for each potential warehouse
Formulate the Model:

Decision variables: Binary variables indicating whether to open a warehouse at a potential location

Objective function: Minimize the sum of transportation costs and warehouse operating costs
Constraints: Ensure all demand points are served, capacity constraints of warehouses, budget constraints
Solve the Model:

Use linear or integer programming to find the optimal solution.
Analyze Results:

Evaluate the selected locations, total costs, and service levels.
Perform sensitivity analysis to understand the impact of changes in parameters.
Benefits of Facility Location Models:
Cost Efficiency: Minimizes transportation and operating costs.
Improved Service Levels: Ensures timely and reliable service to customers.
Strategic Planning: Aids in long-term planning and decision-making.
Scalability: Can be adapted to changing demand and business conditions.
Facility location models are essential tools in supply chain management, logistics, and operations planning, helping businesses optimize their distribution networks and enhance overall efficiency.

Chapter – 5 COMPANY PROFILE AND PROBLEM STATEMENT

5.1 About Company

Company Overview: ADKON Weighing Solutions, established in 2004 by four enterprising individuals, Navin Kr Jha, Kamal Gurrani, Anoop Saxena, and Vivek Khanna, marks a journey of passion and determination. Leaving behind their secure jobs at ATCO Ltd, these visionaries embarked on a new venture, naming it "ADKON" as a blend of their names. Specializing in the sale of weighing machines across various scales, ADKON has grown to become a trusted name in the industry.

Registered with sales tax, legal metrology, and the labor office, ADKON ensures compliance and quality in all its operations. With an estimated turnover of 50 LPA, the company has established a strong foothold in the market. To streamline sales and transportation, Kanpur has been divided into four regions, with each partner overseeing sales and after-sales service in their designated area.

Beyond weighing machines, ADKON also offers a range of related products such as cord wires, cables, load cells, platforms, and batteries. Looking ahead, the company's vision is to expand its revenue streams by venturing into the manufacturing of machines, aiming to not only sell but also produce high-quality weighing solutions. This vision underscores ADKON's commitment to growth, innovation, and customer satisfaction, solidifying its position as a leader in the weighing solutions industry.

Mission Statement: "ADKON Weighing Solutions is committed to providing superior weighing solutions to their customers, ensuring accuracy, reliability, and efficiency in every product they offer. Their mission is to be a trusted partner in the weighing industry, delivering innovative solutions that exceed customer expectations. We strive to achieve excellence in all aspects of their operations, from sales and service to manufacturing, with a focus on continuous improvement and customer satisfaction. Through their dedication to quality, integrity, and innovation, they aim to contribute to the success and growth of our customers, employees, and stakeholders."

Vision for the Future: ADKON Weighing Solutions aims to transition into a manufacturing powerhouse in the weighing industry. By leveraging their expertise and experience in selling weighing machines and related products, they plan to establish state-of-the-art manufacturing facilities that adhere to the highest standards of quality and innovation.

Their goal is to offer a comprehensive range of manufactured weighing solutions that cater to various industries and applications. This expansion into manufacturing will not only broaden their product portfolio but also enable them to have greater control over quality, customization, and cost-effectiveness.

5.2 Problem Statement

Boosting the sales and implementing new strategies for the business of ADKON weighing solutions.

Offering a wide range of diversified products, ADKON Weighing Solution finds it challenging to manage inventory and determine when to place orders because their products are imported

from Delhi to Kanpur. In addition, they struggle to determine the best approach for marketing and how much money to allocate to each area in order to reach a larger customer base.
They intend to locate their new warehouse near one of the eight major hotspot sites (from which they receive their large orders), cutting down on travel time and consequently on expenses.

Proposed Solution

In order to overcome these challenges, we will be implementing inventory management techniques in these machines based on their price and nature to ensure when we can re order these quantities to find a feasible solution, apart from that we will be implementing marketing budget allocation model for the company for them to ensure the right way of marketing to reach the maximum audience apart from that we will also be implementing the facility location model to ensure that we open a warehouse in the location that reduces the distance travelled from each of these locations and allows us to save time.

Fig 5.1 Details about the weighing scales

Serial No.	Name and Category	Selling Price	Remarks
Re	Tier 1, Max weight 600g/ min 10mg	10000 Rs	High calibration and small platform size
2	Tier 2 A, Max weight 100Kg/ min 10g	6000 Rs	Moderate calibration and small platform size
3	Tier 2 B, Max weight 200kg/ min 10g	6500 Rs	moderate calibration and medium platform size
4	Tier 2 C, Max weight 300kg/10g	7500 Rs	High calibration and large platform size
5	Tier 3 A, Max weight 10Kg/1g	2500 Rs	Very low calibration and small platform size
6	Tier 3 B, Max weight 20kg/2g	2800 Rs	Low calibration and small platform size
7	Tier 3C, Max weight 30kg/5g	3300 Rs	High calibration and small platform size

Chapter 6- DATA ANALYSIS and RESULTS

Inserting all the libraries and loading excel sheet for the data set of 2022 and 2023 sales.

```
import pandas as pd
import matplotlib.pyplot as plt

# Load the provided Excel file
file_path = r'C:\Users\HP\sales for 2023.xlsx'
sales_df = pd.read_excel(file_path, index_col=0)

# Display the loaded data
print(sales_df)

# Create a bar graph
plt.figure(figsize=(10, 6))

# Plot the data
sales_df.plot(kind='bar', figsize=(14, 8))

# Add labels and title
plt.xlabel('Month')
plt.ylabel('Quantity')
plt.title('Sales for 2023 by Machine Type')
plt.legend(title='Machine Type')
plt.grid(axis='y')

# Save the plot as a PNG file
plt.savefig('sales_trend_2022.png')

# Show the plot
plt.show()
```

fig 6.1 Sales for 2022

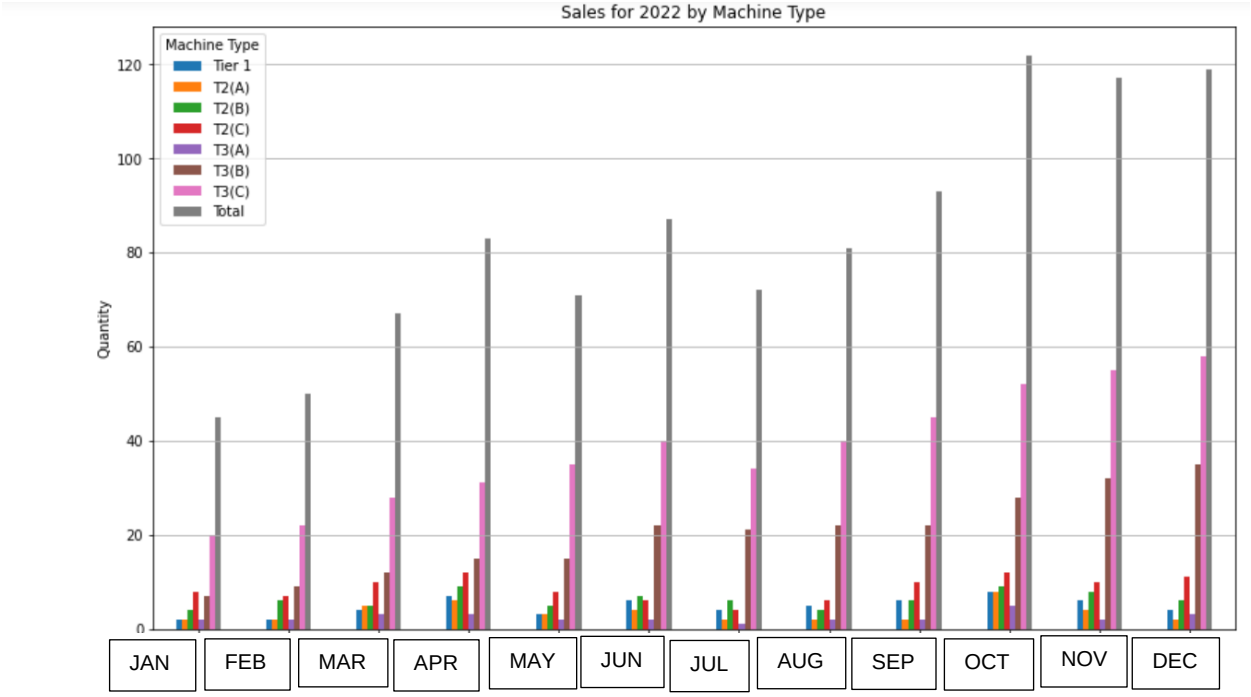
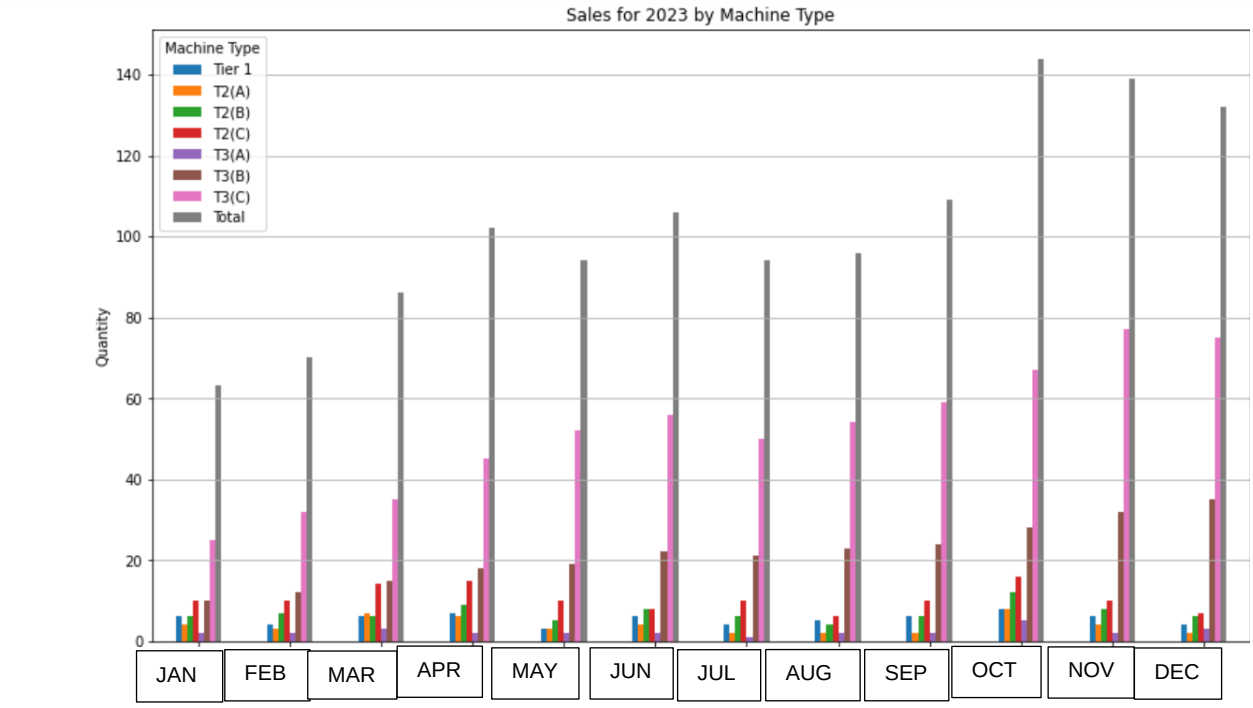


fig 6.2 Sales for 2023



6.1 Demand Forecasting

We have the demands received for the years 2022 and 2023, on observing the graph, seasonal trends and time series analysis, we have forecasted the demand for 2024 using holt winter algorithm, which states,
The Holt-Winters algorithm, also known as Triple Exponential Smoothing, is a forecasting technique used for time series data that exhibits both trend and seasonality. It is an extension of exponential smoothing and was developed by Charles Holt and Peter Winters in the 1960s.

Key Concepts of Holt-Winters Algorithm:
Level: Represents the baseline value of the series.
Trend: Represents the increase or decrease in the series over time.
Seasonality: Represents the repeating short-term cycle in the series.

On closely observing the graphs, we may find that in the month of March, April and October the demands where high in comparison to the previous months, where as in the months of July and august the demands where low in comparison to the previous months.

```
import pandas as pd
import numpy as np
from statsmodels.tsa.holtwinters import ExponentialSmoothing
# Load the provided Excel file
file_path = r'C:\Users\HP\sales for 2023.xlsx'
demand_df = pd.read_excel(file_path, index_col=0, parse_dates=True)
# Display the loaded data
print(demand_df)
# Define the seasonal variations
seasonal_variations = {
    'January': 1.02, 'February': 1.02, 'March': 1.12, 'April': 1.15,'May': 1.02, 'June': 1.02, 'July': 0.96, 'August': 0.94,
    'September': 1.02, 'October': 1.20, 'November': 1.02, 'December': 1.02
}
# Prepare the data
months = list(seasonal_variations.keys())
years = [2022, 2023]
columns = demand_df.columns
# Convert month names to datetime for proper indexing
month_numbers = {month: i+1 for i, month in enumerate(months)}
# Apply Holt-Winters method for each category
forecast_results = {}
for category in columns:
    # Prepare the time series data
    ts_data = []
    for year in years:
        for month in months:
            ts_data.append(demand_df.at[month, category] / seasonal_variations[month])
    ts_index = pd.date_range(start='2022-01-01', periods=len(ts_data), freq='M')
```

```
            ts_data.append(demand_df.at[month, category] / seasonal_variations[month])
    ts_index = pd.date_range(start='2022-01-01', periods=len(ts_data), freq='M')
    ts_series = pd.Series(ts_data, index=ts_index)
    # Apply Holt-Winters method
    hw_model = ExponentialSmoothing(ts_series, trend='add', seasonal='add', seasonal_periods=12)
    hw_fit = hw_model.fit()
    # Forecast for 2024
    forecast = hw_fit.forecast(12)
    forecast_results[category] = forecast
# Convert forecast results to DataFrame for better visualization
forecast_df = pd.DataFrame(forecast_results)
forecast_df.index = months
# Display the forecast results
print(forecast_df)
```

Fig 6.3 Expected Demand using Holt winter algorithm:-

	Tier 1	T2(A)	T2(B)	T2(C)	T3(A)	T3(B)	T3(C)	Total
Jan-24	8	6	8	14	2	13	33	84
Feb-24	6	4	9	12	3	16	38	88
Mar-24	7	8	8	16	3	18	44	104
Apr-24	9	8	11	18	4	21	51	122
May-24	5	4	8	12	2	23	56	110
Jun-24	6	4	8	10	2	26	62	118
Jul-24	4	2	8	12	1	25	60	112
Aug-24	6	4	6	8	2	25	59	110
Sep-24	6	4	8	12	3	24	59	116
Oct-24	8	10	12	16	5	28	67	146
Nov-24	6	4	8	10	2	32	77	139
Dec-24	4	2	8	9	3	37	87	150

This tables offers us the demand that ADKON weighing solution would be receiving in the coming months.
Now let us discuss about the inventory management technique that should be implemented for the above mentioned dataset for each category.

Fig 6.4 Expected Revenue

Revenue Table								
Months	Tier 1	T2(A)	T2(B)	T2(C)	T3(A)	T3(B)	T3(C)	Total
Jan 2024	80000	36000	48000	84000	12000	78000	198000	536000
Feb 2024	60000	24000	54000	72000	18000	96000	228000	552000
Mar 2024	70000	48000	48000	96000	18000	108000	264000	652000
Apr 2024	90000	48000	66000	108000	24000	126000	306000	768000
May 2024	50000	24000	48000	72000	12000	138000	336000	680000
Jun 2024	60000	24000	48000	60000	12000	156000	372000	732000
Jul 2024	40000	12000	48000	72000	6000	150000	360000	688000
Aug 2024	60000	24000	36000	48000	12000	150000	354000	684000
Sep 2024	60000	24000	48000	72000	18000	144000	354000	720000
Oct 2024	80000	60000	72000	96000	30000	168000	402000	908000
Nov 2024	60000	24000	48000	60000	12000	192000	462000	858000
Dec 2024	40000	12000	48000	54000	18000	222000	522000	916000
Total	750000	360000	612000	894000	192000	1728000	4158000	8694000

6.2 INVENTORY TECHNIQUES

1. **Tier 1 (JIT):**
   - **Formula:**
     $Reorder\ Point = (Maximum\ Daily\ Usage \times Lead\ Time) + Safety\ Stock\ Level$
     Reason to implement JIT here is because of the high value of these items and also the problem faced in managing the calibration of these machines, if any problem is faced.
2. **T2 (A), T3 (B), T3 (C) (EOQ):**
   - **Formula:** $EOQ = \text{sqrt}(2DS/H)$
     Reason to implement EOQ here is that these are low valued items and managing them in the inventory is comparatively easy.
3. **T2 (B) (Periodic Review System):**
   - **Formula:** Review inventory levels at fixed intervals (e.g., weekly) and place orders to maintain a certain level of inventory.
     Reason to implement PRS is because low demand and easy to manage delivery allows us to manage them easily.
4. **T2 (C) (JIT):**
   - **Formula:**
     $Reorder\ Point = (Maximum\ Daily\ Usage \times Lead\ Time) + Safety\ Stock\ Level$
     High valued item as well as larger platform size, takes more space in the warehouse and is also difficult to transport.

5. **T3 (A) (Periodic Review System):**
    - Review inventory levels at fixed intervals (e.g., weekly) and place orders to maintain a certain level of inventory.
      Reason to implement PRS is to ensure that these items are low in demand and can be transported easily, if in case we are short on stock, these can be restocked easily.

JUST IN TIME

Inventory Management technique for Tier 1 and T2(C) Machines.

Tier 1:-
Cost of the Machine 10000Rs
Average monthly sales if maximum sales were considered, in the month of April was 10.
Days in a month 30,
Dail sales :- 10/30 = 1/3,
Lead time 12 days
(1/3)*12= 4 units
Safety stock to meet in those 12 days be 3.

Reorder point for Tier 1 machines will be of 7 units, a reorder should be made as soon as the 4 units are consumed.

Tier 2
category C or T2(C):
Cost of machines:- 7500 Rs
Average Monthly sales if maximum sales were considered is 18.
Days in a month 30,
Daily sales:- 18/30= 3/5,
Lead time 12 days
0.6*12= 7.2 units or 7 units.
Safety stock to meet demand in those 12 days will be 2 units

Reorder point for T2(C) machines will be of 9 units for the first 15 days of the months, a reorder should be made as soon as the first 7 units are consumed.
Just in time inventory will be applied twice in a month in this case.

ECONOMIC ORDER QUANTITY

Inventory Management technique for T2(A) Machines and T3(C) Machines

T2(A) Machines

The Economic Order Quantity (EOQ) formula helps determine the optimal order quantity that minimizes total inventory costs. The formula is:

- EOQ= sqrt(2DS/H)

Demand for Year – 60
Ordering cost – 50Rs
Holding Cost- 10Rs

EOQ=24.49

So, the EOQ for Tier 2 (A) machines with a demand of 60 units is approximately 24.49 units per order. This means that ordering approximately 25 units each time would help minimize total inventory costs for Tier 2 (A) machines with the given assumptions.

T3(C)
The demand is maximum in the case and the this machines is in the most demand because of it's low value and also because of the everyday essential that turns to be a better USP for everyone.

Demand for Year – 700 machines
Ordering Cost - 50Rs
Holding Cost – 10Rs

EOQ=83.67

So, the EOQ for Tier 2 (A) machines with a demand of 700 units is approximately 83.67 units per order. This means that ordering approximately 84 units each time would help minimize total inventory costs for Tier 2 (A) machines with the given assumptions.

T3(B)

The demand is variable in the case and the this machines is in the most demand because of it's low value and also because of the everyday essential that turns to be a better USP for everyone.

Demand for Year – 300 machines
Ordering Cost - 50Rs
Holding Cost – 10Rs

EOQ=54.77

So, the EOQ for Tier 2 (A) machines with a demand of 300 units is approximately 54.77 units per order. This means that ordering approximately 55 units each time would help minimize total inventory costs for Tier 2 (A) machines with the given assumptions.

PERIODIC REVIEW SYSTEM

Establishing Review Periods:
For Tier 2 (B) and Tier 3 (A) machines, let's set a review period of 30 days (1 month). This means that inventory levels will be checked and orders will be placed once every month.
Setting Order Points:
Calculate the average daily demand during lead time for each category.
Determine the standard deviation of demand during lead time to calculate the safety stock.
Add safety stock to the average daily demand to determine the order point.
Placing Orders:
At the end of each month, check the inventory levels for Tier 2 (B) and Tier 3 (A) machines.
If the inventory level is below the order point, place an order to replenish stock up to the target level.
Receiving and Updating Inventory:
When the order is received, update the inventory levels accordingly.
The new cycle begins with monitoring inventory levels until the next review period.

Average daily demand during lead time: 2 units
Lead time: 10 days
Standard deviation of demand during lead time: 1 unit
Safety stock (z-score of 1.28 for 90% service level): 1.28 units
Holding cost per unit per year: Rs10
Ordering cost per order: Rs50
Calculation for Tier 2 (B) Machines:
Average Daily Demand During Lead Time:
Average daily demand = Total demand / Number of days
Average daily demand = 300 units (annual demand) / 365 days = 0.82 units/day (approximately)
Safety Stock:
Safety stock = z-score * Standard deviation of demand during lead time
Safety stock = 1.28 * 1 = 1.28 units
Order Point:
Order point = Average daily demand * Lead time + Safety stock
Order point = 0.82 * 10 + 1.28 = 9.08 units (approximately)

Conclusion:
By using the periodic review system with the calculated order points, you can effectively manage inventory for Tier 2 (B) and Tier 3 (A) machines. This approach ensures that you maintain optimal inventory levels while minimizing excess stock and associated holding.

6.3 Marketing Management

In this 3 Tiers of machines which are subdivided into its sub parts we will be dividing them into categories based on their percentage of revenue share and their demand in the market.

Steps to Apply for Marketing management

- We will Calculate the annual Usage Value: For each category, calculate the annual usage value, which is the annual demand multiplied by the cost per unit.

- Calculate Percentage of Total Usage: Determine the percentage of the total usage value that each category represents. This will help us

Results Based on Revenue and % shares

Based on the number of units sold	Based on the Revenue Generated
Most in Demand:- Tier 3 Machines	Highest revenue generating:- Tier 3 Machines
Medium in Demand:- Tier 2 Machines	Medium Revenue generating:- Tier 2 Machines
Least in Demand:- Tier 1 Machines	Least Revenue generating:- Tier 1 Machines

Fig 6.5

No. of Units Sold

%Share	Quantity	Total	% Share
Tier 1	75	1399	5.360972123
Tier 2	312	1399	22.30164403
Tier 3	1013	1399	72.40886347
Tier 2	Quantity	Total	%share
T2(A)	60	311	19.2926045
T2(B)	102	311	32.79742765
T2(C)	149	311	47.90996785
Tier 3	Quantity	Total	%Share
T3(A)	32	1013	3.15893386
T3(B)	288	1013	28.43040474
T3(C)	693	1013	68.4106614

Revenue Generated

%Share	Revenue	Total	%share
Tier 1	750000	8694000	8.626639061
Tier 2	1866000	8694000	21.46307798
Tier 3	6078000	8694000	69.91028295
Tier 2			
T2(A)	360000	1866000	19.2926045
T2(B)	612000	1866000	32.79742765
T2(C)	894000	1866000	47.90996785
Tier 3			
T3(A)	192000	6078000	3.15893386
T3(B)	1728000	6078000	28.43040474
T3(C)	4158000	6078000	68.4106614

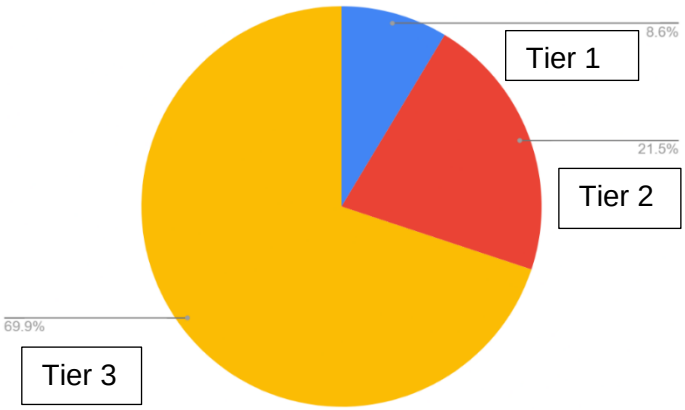


Fig 6.6 Graph Chart for Revenue of all 3 tiers.

Considering that 10% of the annual revenue should be used in the marketing and the revenue made last year was 65,50,400 Rs, we have a marketing budget of 6.5 Lakh Rs, now what's important here is how the budget allocation will be done to advertise about our product and letting it reach more and more customers.

To allocate the marketing budget efficiently, we can use a marketing mix model that considers your revenue-generating items and their target customers. We'll use a simple weighted approach based on the importance of each segment and the effectiveness of each marketing channel.

Key Information
Budget: Rs650,000
Products and Customers:
Tier 3: Retail and grocery shop owners (machines with a max weighing scale range of 30kg)
Tier 2: Wholesalers, farmers, industries, factories
Tier 1: Jewellery shop owners, laboratories (precise measurement)

Steps:
Define Weightings for Each Tier: Assign weightings based on revenue contribution or strategic importance.

Tier 3: 50%
Tier 2: 30%
Tier 1: 20%
Define Effective Channels for Each Tier:

Tier 3: Digital marketing, Print media, OOH, Weekend events, Radio, Influencers
Tier 2: Digital marketing, Print media, OOH, Weekend events, Radio
Tier 1: Digital marketing, Print media, Influencers, Marketing collaterals
Determine Channel Effectiveness and Allocation: Allocate percentages within each tier based on channel effectiveness.

Allocation Breakdown

Tier 3: Retail and Grocery Shop Owners (50% of budget)
Digital Marketing: 30%
Print Media: 15%
OOH: 20%
Weekend Events: 15%
Radio: 10%
Influencers: 10%

Tier 2: Wholesalers, Farmers, Industries, Factories (30% of budget)
Digital Marketing: 35%
Print Media: 20%
OOH: 25%
Weekend Events: 15%
Radio: 5%

Tier 1: Jewellery Shop Owners, Laboratories (20% of budget)
Digital Marketing: 40%
Print Media: 20%
Influencers: 20%
Marketing Collaterals: 20%

Budget Allocation Calculation

Total Budget: Rs650,000
Tier 3: 50% of Rs650,000 = Rs325,000
Digital Marketing: Rs97,500
Print Media: Rs48,750
OOH: Rs65,000
Weekend Events: Rs48,750
Radio: Rs32,500
Influencers: Rs32,500

Tier 2: 30% of Rs650,000 = Rs195,000
Digital Marketing: Rs68,250
Print Media: Rs39,000
OOH: Rs48,750
Weekend Events: Rs29,250
Radio: Rs9,750

Tier 1: 20% of Rs650,000 = Rs130,000
Digital Marketing: Rs52,000
Print Media: Rs26,000
Influencers: Rs26,000
Marketing Collaterals: Rs26,000

Summary
Digital Marketing: Rs217,750
Print Media: Rs113,750
OOH: Rs113,750
Weekend Events: Rs78,000
Radio: Rs42,250
Influencers: Rs58,500
Marketing Collaterals: Rs26,000
This allocation considers the importance of each product tier and the effectiveness of different marketing channels for reaching our target customers in Kanpur.

The percentage allocation for each category was determined based on a combination of the following factors:

- Revenue Contribution: The weightings were assigned based on the relative importance and revenue contribution of each product tier.

- Target Audience: The preferences and behaviors of the target customers for each product tier influenced the choice of marketing channels.
- Channel Effectiveness: The effectiveness of different marketing channels in reaching and engaging the target customers was considered.
- Marketing Objectives: The overall marketing goals such as brand awareness, lead generation, and sales growth were taken into account.

Detailed Explanation:
Revenue Contribution and Strategic Importance:

Tier 3 (Retail and Grocery Shop Owners): This segment was assigned 50% of the budget as it represents a significant portion of your customer base and revenue.

Tier 2 (Wholesalers, Farmers, Industries, Factories): This segment was allocated 30% of the budget due to its importance in bulk purchases and industrial applications.

Tier 1 (Jewellery Shop Owners, Laboratories): This segment received 20% of the budget as it is smaller but requires precision marketing.

Target Audience Preferences:

Tier 3: Retail and grocery shop owners are likely to be more influenced by direct and frequent advertising methods such as digital marketing, print media, OOH (Out-of-Home) advertising, and weekend events. They may also respond to local influencers and radio.
Tier 2: Wholesalers and industrial buyers may prefer digital channels for research, print media for detailed information, OOH for brand visibility, and events for networking and demonstrations.
Tier 1: Jewellery shop owners and laboratories need precise and reliable information, so digital marketing, print media, and marketing collaterals are effective. Influencers can help build trust and credibility in this niche market.

Channel Effectiveness:

- Digital Marketing: Generally effective across all tiers due to its wide reach, targeting capabilities, and measurable results.
- Print Media: Useful for detailed information and credibility, especially in Tier 2 and Tier 1 segments.
- OOH: Good for brand visibility and local presence, particularly effective for Tier 3 and Tier 2.

- Weekend Events: Ideal for direct engagement, demonstrations, and local outreach, important for Tier 3 and Tier 2.
- Radio: Useful for local reach and frequent reminders, especially for Tier 3.
- Influencers: Can build trust and credibility, particularly useful for Tier 1 and Tier 3.
- Marketing Collaterals: Essential for providing detailed and reliable information, crucial for Tier 1.

Channel Allocation:

Digital Marketing:

Broad reach and targeting capabilities.
Higher percentage for all tiers due to its effectiveness.

Print Media:

Provides credibility and detailed information.
Important for Tiers 2 and 1 where detailed specifications are crucial.

OOH (Out-of-Home):

Good for brand visibility in local markets.
Higher allocation for Tiers 3 and 2.

Weekend Events:

Enables direct engagement and demonstrations.
Important for Tiers 3 and 2.

Radio:

Effective for local reach.
Allocated mainly for Tier 3.

Influencers:

Build trust and reach niche markets.
Important for Tiers 1 and 3.

Marketing Collaterals:

Provide detailed, reliable information.
Essential for Tier 1.

Summary:
The allocation was guided by these principles to ensure the budget is used effectively to reach the right audiences with the right messages through the most effective channels.

6.4 Facility Location Problem

Fig 6.7 Distance Matrix:-

	Halsi Road	Naveen Marke	Swaroop Nagar	Bara Bazar	Landmark Colony	Govind Nagar	Jajmau	Phool Bagh
Halsi Road	0	5	7	8	10	9	14	5
Naveen Market	5	0	4	4	3	8	12	1
Swaroop Nagar	7	4	0	5	7	2	6	4
Bara Bazar	8	4	5	0	3	6	7	3
Landmark Colony	10	3	7	3	0	1	12	6
Govind Nagar	9	8	2	6	1	0	5	4
Jajmau	14	12	6	7	12	5	0	3
Phool Bagh	5	1	4	3	6	4	3	0

Problem Statement:- ADKON weighing solution receives multiple orders every day and are planning to set up a new retail store in Kanpur from where there travelling distance can be minimized to all the 8 major hotspot location as mentioned in the above distance matrix. They also can't decide about the perfect way of travelling from one location to other, to deliver their orders and hence being able to save time, resource and visit all the location.

Solution:- We will be solving this problem by facility location problem of integer programming using python to ensure that we get a final result , and our final location to set up a warehouse.

1. **Formulate the Problem:**
   - We have 7 locations (let's call them L1, L2, ..., L8).
   - We want to choose one of these locations as the warehouse.
   - We have a distance matrix DD where $D[i][j]D[i][j]$ represents the distance between location $LiLi$ and location $LjLj$.
2. **Objective:**
   - Minimize the sum of distances from the warehouse to all other locations.
3. **Mathematical Model:**
   - Let xi be a binary variable where xi=1, if a warehouse is located at location Li and 0 otherwise.
   - Our objective function will be:

$$\min \sum_{i=1}^{8} \sum_{j=1}^{8} D[i][j] \cdot x_i$$

   - Subject to:

$$\sum_{i=1}^{8} x_i = 1 \quad \text{(Ensure only one location is chosen)}$$

$$x_i \in \{0,1\} \quad \text{for all } i$$

Implementation Steps:

1. **Construct the Distance Matrix:** *D*

2. **Optimization Approach:** we will Use integer programming (a form of linear programming) to solve the p-Median Problem using Python (with PuLP).

Python Code

```
import pulp
import pandas as pd
# Load the distance matrix
distance_matrix_df = pd.read_excel(r'C:\Users\HP\warehouse distance.xlsx', index_col=0)
distance_matrix_df.columns = distance_matrix_df.iloc[0]
distance_matrix_df = distance_matrix_df[1:]
distance_matrix_df.index.name = 'Location'
distance_matrix_df.columns.name = None
distance_matrix_df = distance_matrix_df.apply(pd.to_numeric)

# Define the problem
problem = pulp.LpProblem("Warehouse_Location", pulp.LpMinimize)

# Define decision variables
x = pulp.LpVariable.dicts("x", distance_matrix_df.index, cat='Binary')

# Objective function: minimize total distance
problem += pulp.lpSum(distance_matrix_df.loc[i, j] * x[i] for i in distance_matrix_df.index for j in distance_matrix_df.columns)

# Constraint: only one warehouse is chosen
problem += pulp.lpSum(x[i] for i in distance_matrix_df.index) == 1
# Solve the problem
problem.solve()
# Extract the optimal warehouse location
optimal_warehouse_location = [i for i in distance_matrix_df.index if pulp.value(x[i]) == 1]
print(f"Optimal warehouse location: {optimal_warehouse_location[0]}")
```

Explanation of the Code:

- Loading the Distance Matrix: Load and clean the distance matrix from the Excel file.
- Defining the Problem: Create a linear programming problem with the objective of minimizing the total distance.
- Decision Variables: Define binary decision variables for each location.
- Objective Function: Set the objective to minimize the total distance from the chosen warehouse to all other locations.
- Constraint: Ensure that only one location is chosen as the warehouse.
- Solving the Problem: Use PuLP's solver to find the optimal solution.
- Extracting the Result: Print the optimal warehouse location.

```
Optimal warehouse location: Phool Bagh
```

The optimal location for the warehouse, based on minimizing the total travel distance to all other locations, is Phool Bagh. The total distance from Phool Bagh to all other locations is 26 units.

Chapter 7- Conclusion

The implementation of EOQ and JIT inventory models has shown potential to significantly reduce holding costs while maintaining enough stock to meet customer demands. This balance is crucial for optimizing operational efficiency and cost-effectiveness.

The targeted marketing strategies developed for different customer segments are poised to enhance market penetration and brand visibility. Utilizing digital platforms for promotion will likely attract a broader customer base and foster stronger customer relationships.

By aligning inventory management with strategic marketing efforts, ADKON Weighing Solutions is expected to see an uplift in sales performance and customer satisfaction. This dual approach ensures that products are available when needed and marketed effectively.

The application of facility location problem has helped ADKON weighing solution in setting up a new warehouse, that ensures less travelling time and less distance to travel, which eventually leads to minimize costs and maximize service levels, or achieve a balance of both.

The integration of optimized inventory management techniques, targeted media promotional strategies, and efficient warehouse planning through the facility location model collectively enhances ADKON Weighing Solutions' operational efficiency, reduces costs, and boosts market presence. These strategic implementations promise to not only meet customer demand more effectively but also position the company for sustainable growth and increased customer satisfaction. This comprehensive approach ensures that ADKON remains competitive and responsive in the dynamic weighing solutions market.

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