

AI-Driven RFM E-Commerce

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Bachelor of Science in Computing and Information System

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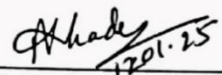
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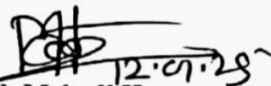
APPROVAL


This Project titled **AI-Driven RFM E-Commerce**, Submitted by Rakibuzzaman, ID No: 191-16-408 to the Department of Computing and Information Systems, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computing & Information Systems and approved as to its style and contents. The presentation has been held on 12-01-2025.

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I hereby declare that, this project has been done by us under the supervision of, **Md. Sarwar Hossain Mollah, Associate Professor and Head, Department of CIS, Daffodil International University**. I also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

The findings that support my concept, "**AI-Driven RFM E-Commerce**," may be read in its entirety. In this article, the techniques utilized to transform the idea into a working website are discussed in depth. One module that sticks out among system users is the admin dashboard. I have been working on student project, which uses artificial intelligence to analyze dynamic customer, sales, and product data. The needs will be similar to what specifically mentioned. Three main areas & Dashboard are the emphasis of this project's development of AI-driven insights: Product Analysis (Dashboard-1): Predicting trends and performance by using forecasting models. Transaction/Sales Analysis (Dashboard-2): Finding trends and useful information in sales data. Customer Analysis (Dashboard-3): Recognizing consumer trends and segmenting them to improve decision-making. Technical Information Integration: To ensure smooth viewing and interaction, the dashboards will be integrated using frames. Data Handling: In order to enable real-time updates and more profound insights, I want to integrate the data with a dataset to make it static. For both the user interface and database backend, I have used **Python**, respectively. No costly software or computer components are required to set up my system application; all you need is your desktop machine and internet access. Almost any user with a regular internet connection may use my platform-neutral solution at any time and from any location. I may change my system to meet certain needs as well.

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CHAPTER 1

Introduction

1.1 Introduction

An application that shows the relationships and interactions between other applications is called a system. On computers, the "System" page contains connections to applications, programming, and tools for system management. Even if the word "system" may signify different things depending on the context, the idea is basically the same. A complete framework is created by the "**AI-Driven RFM E-Commerce**" through the integration of several technologies. This framework's several modules implement the restrictions outlined for each system in question. There are several systems in each module. The web-based application provides a wide range of functions. I've been working on a student project that analyzes dynamic consumer, sales, and product data using artificial intelligence. The requirements will be comparable to those I discussed earlier. This project focuses on developing AI-driven dashboards in three key areas.

An innovative project called AI-Driven Displays for Dynamic Product, Sales, and Customer Insights aims to revolutionize the way companies evaluate and use their data. Product achievement, sales trends, and customer behavior are three crucial areas where this initiative uses artificial intelligence to provide real-time, actionable data. By using these data, companies may better understand their consumers, foresee market trends, and improve sales tactics, all of which help them make better decisions and spur growth. The creation of three web-based dashboards is part of the project. In order to examine past data, spot patterns, and anticipate product performance, the Product Analysis Dashboard employs AI-driven forecasting models. This provides insights into the market environment and product strategy. With an emphasis on sales data, the Transaction/Sales Monitoring Dashboard looks for trends, pinpoints peak times, and highlights irregularities or inefficiencies to optimize processes and boost revenue. Targeted marketing and increased client retention are made possible by the client Analysis Dashboard, which uses behavioral models and clustering algorithms to categorize customers and examine their purchasing patterns. An dataset will manage dynamic, real-time data processing to deliver the most recent insights at all times, and the dashboards will be displayed via frames for easy user engagement. By combining cutting-edge AI methods with useful

business applications, this methodology provides a revolutionary way to comprehend and respond to important indicators, enabling companies to prosper in a data-driven environment.

CHAPTER 2

Initial Study

2.1 Project Proposal

Objectives

To give companies a comprehensive set of AI-powered tools that give them dynamic, immediate data about customer behavior, sales, and product performance. This project intends to increase operational efficiency, facilitate sustainable corporate growth in a competitive environment, and improve decision-making by fusing sophisticated data processing and artificial intelligence capabilities with user-friendly dashboards.

Beyond this, I may strive to achieve the following:

- Utilize forecasting models powered by AI to examine past product data.
- Determine market trends and forecast how well a product will do in the future.
- Encourage data-driven choices in marketing, inventory control, and product development.
- Examine sales data to find trends and patterns.
- Find inconsistencies and irregularities in the sales process.
- Streamline company operations and maximize income sources.
- To divide up your clientele according to their behavior, use clustering techniques.
- Examine consumer purchasing patterns and forecast their desires.
- Facilitate focused marketing tactics and improve client retention.

Benefits of the website:

- Create dynamic dashboards that are updated in real time to provide useful business information.
- For smooth data management, combine AI capabilities with dataset.
- Give companies the tools they need to make data-driven choices to boost productivity and expansion.
- Utilize forecasting models powered by AI to examine past product data.

2.2 Background

Businesses are depending more and more on sophisticated analytics to obtain a competitive advantage in the data-driven business world of today. Although there is a great deal of potential for actionable insights in the massive quantity of data produced by sales transactions, customer contacts, and product performance, extracting useful information frequently calls for advanced tools and approaches [1]. Businesses can now analyze complicated information, spot patterns, and predict trends with unprecedented precision thanks to artificial intelligence (AI), a game-changing technology [2]. By using AI, firms may forecast future events and make well-informed decisions in addition to understanding their existing performance [3].

This increasing demand for cognitive, real-time data analysis is addressed by the initiative. It focuses on creating a series of visualizations that leverage AI to provide useful information in three crucial business domains: customer behavior, sales transactions, and product performance. The system will foresee trends and optimize products to satisfy market expectations by evaluating product data. Customer behavior analysis will allow for segmentation and customized tactics to increase customer happiness and retention, while sales transaction analysis will reveal trends, identify irregularities, and improve operational efficiency [4]. By combining cutting-edge AI models with immediate information processing via a SQL database, this initiative closes the gap between pure data and useful insights. The user-friendly and accessible dashboards will be seamlessly integrated into current systems by being inserted using frames. The project is to enable organizations to make better decisions, spur development, and preserve a competitive edge in a changing marketplace by tackling important issues in data analysis and visualization [5].

2.3 Problem Area

- Difficulties in syncing and combining data from several sources while maintaining analytical accuracy and dependability.
- Maintaining excellent speed and real-time responsiveness becomes more challenging as user expectations and data quantities rise.
- Ensuring that AI models adjust to changing business situations while offering precise, objective, and useful insights.

- Preventing breaches of private client and company information and making sure that data protection laws like the CCPA and GDPR are followed.
- Overcoming reluctance to integrate AI-driven technologies into conventional workflows and creating user-friendly dashboards for non-technical users.

2.4 Possible Solution

- Design that is responsive to screen sizes.
- Easy to use and intuitive website functionality with a respectable user interface.
- Use extract, transform, and load (ETL) procedures to clean and normalize data from various sources.
- Make use of automated data validation methods to guarantee consistency, correctness, and completeness.
- Enhance real-time responsiveness by optimizing database queries and utilizing caching strategies.
- Retrain AI models often using different and up-to-date datasets to enhance predictions and lessen bias.
- Employ secure authentication procedures, role-based access controls, and encryption to safeguard data.
- Create dashboards that are easy to use, adaptable, and have clear representations based on user requirements.
- Give users thorough instruction and assistance so they can adjust to AI-powered technologies.

CHAPTER 3

Literature Review

3.1 Discussion on problem domain based on published articles

According to recent research, AI-driven dashboards for customer, sales, and product insights encounter a number of difficulties. Integrating data from several sources can cause problems with quality and consistency, which makes real-time analysis challenging (Davenport & Harris, 2017). Another major issue is scalability, as companies find it difficult to analyze massive amounts of data rapidly while maintaining performance (McKinsey & Company, 2020). Additionally, to avoid biases and guarantee the veracity of insights, AI models need to be updated on a regular basis (Russell & Norvig, 2021). Sensitive data security issues and adherence to laws like GDPR continue to be major considerations (Forbes Insights, 2019). Finally, if dashboards are not easy to use or made available to non-technical individuals, it will be challenging to ensure user acceptance (Accenture, 2021).

3.2 Discussion on problem solutions based on published articles

Published solutions highlight the significance of organizing data, scalability, model stability, and user involvement in order to overcome the difficulties posed by AI-driven dashboards. Businesses should use strong data cleansing methods for data integration and quality, and use machine learning for the identification of anomalies to increase accuracy (Gartner, 2020). Implementing cloud-based approaches with elastic resources can help with scalability, enabling systems to manage increasing data volumes without sacrificing speed (Accenture, 2021). Continuous monitoring and retraining of models utilizing representative and varied datasets is essential to ensuring AI model dependability in order to prevent bias and increase prediction accuracy (McKinsey & Company, 2020). Adding encryption, encrypted APIs, and privacy-focused artificial intelligence models can improve data security and ensure adherence to legal requirements such as GDPR (Forbes Insights, 2019). By integrating these technologies, businesses may successfully handle the difficulties and realize AI-driven analytics' maximal potential.

3.3 Comparison of three/four leading solutions

The image displays two website banners. The top banner is for Tableau, featuring the Tableau logo (a colorful grid) and the text 'Experience the new Tableau'. Below this, it says 'Humans with agents drive success together, from data to decisions.' There are two buttons: 'REGISTER FOR 2025 PREVIEW' and 'TRY TABLEAU FOR FREE'. The background shows a Tableau dashboard and a blue robot character. The bottom banner is for AptaCloud, with the AptaCloud logo and the text 'Boost Your Business with AptaCloud's Tailored Power BI Consulting Solutions'. It includes a 'Get Started Today' button and an illustration of three hexagonal icons representing data analysis, consulting, and technology. The background is dark blue with a network pattern.

Best Features:

- Dashboards and visualization choices that are very customizable.
- Robust interface with on-premises and cloud-based databases, among other data sources.
- Sophisticated analytics driven by AI, such as trend analysis and forecasting.
- Robust drag-and-drop tool for building user-friendly dashboards.
- Cost-effective pricing structure, particularly for businesses that currently use Microsoft products.
- Smooth interaction with the Microsoft product suite, including SharePoint, Azure, and Excel.

- AI-powered dashboards that update constantly (like Quick Insights and Cortana Integration).
- Interface that is simple enough for individuals with little technological expertise to utilize.

Limitations

- Reliance on technology;
- Internet access fees;
- User acceptability and interface issues;
- Safety and secrecy concerns

3.4 Recommended Approach

Table 1: Modules descriptions

Actuators	Functions
Product Analysis (Dashboard 1)	<ul style="list-style-type: none"> ● Customer segment ● Select date range ● Product info ● Predict trends & performance ● Net sales
Transaction/Sales Analysis (Dashboard-2)	<ul style="list-style-type: none"> ● Analyze transaction data ● Identify sales patterns ● Detect sales anomalies ● Flag irregular transactions ● Identify peak, net sales times ● Total sales overtime ● Adjust strategies accordingly
Customer Analysis (Dashboard-3)	<ul style="list-style-type: none"> ● Segment customers by behavior ● Age input ● Detect trends in customer activity ● Identify key age, gender groups ● RFM analysis ● Recommend personalized products ● Design tailored marketing strategies

	<ul style="list-style-type: none">• Frequency & Monetary analysis
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CHAPTER 4

Methodology

4.1 What to Use

An innovative project called AI-Driven Displays for Dynamic Product, Sales, and Customer Insights aims to revolutionize the way companies evaluate and use their data. Product achievement, sales trends, and customer behavior are three crucial areas where this initiative uses artificial intelligence to provide real-time, actionable data. By using these data, companies may better understand their consumers, foresee market trends, and improve sales tactics, all of which help them make better decisions and spur growth. The creation of three web-based dashboards is part of the project. Along with the system architecture and theoretical underpinnings, the approach includes the procedure for identifying features pertinent to this project. I'll go over how to utilize the AI-Driven RFM E-Commerce to accomplish a project's objective in this chapter. The accepted method is the SDLC life cycle model, which is a comprehensive framework for planning, building, etc. I am familiar with a variety of SDLC model types. The Big Bang, Spiral, Waterfall, Agile, Iterative, and Dynamic system design models are some of the paradigms utilized in software development. Each model provides a framework to guide the development and use of the all-components platform. The particular needs of the SDLC model will tailor the tourist development domain in order to provide an efficient development process that aligns with the goals of the Dynamic Product, Sales, and Customer Insights project.

4.2 Why to use

Determining the system architecture was the initial stage of the development process. Determining the elements and their interrelationships was a part of this. Important considerations in the system infrastructure architecture were scalability, security, and dependability. It required keeping the database administration and back-end features of the product separate from the user interface. To guarantee safe transactions and safeguard computer data, security measures were also integrated into the design. Every software project needs to follow the agile methodology. I am familiar with several of the terminology used in the agile methodology, including feature-driven the environment,

scrum, crystal, flexible systems building technique, and kanban. Nevertheless, I used the DSDM process when working on my project. The DSDM approach is advantageous for a number of reasons. Iterative development makes use of the dynamic system development approach, which allows for flexibility in changing needs. This tactic works well when prompt delivery is necessary. The Dynamic System Development Method requires software projects to be delivered on a regular basis. The company can implement advantages sooner thanks to this agility strategy, which also enhances reporting on market changes and reduces time to market. To help team members see potential risks early in the project's lifespan, this agile approach incorporates risk management strategies into its operations. When precautions are implemented, risk management becoming less of an issue. For these reasons, I approached my project using the DSDM agile strategy.

4.3 Section of methodology

Pre-Project Phase:

- **Feasibility Study:** In this stage, the project concept's technological, financial, and functional viability are assessed. It entails balancing the project's possible advantages, expenses, and risks.
- **Conditions Gathering:** At this point, the needs for the program are gathered and recorded. Determining the project's scope requires an understanding of business requirements, customer requests, and restrictions.
- **Planning:** Part of the planning phase is developing an effort program that details the project's goals, schedule, necessary resources, and deliverables. It is essential to identify the parties involved in the project, define roles and duties, and establish a plan for interaction and risk management.

Project Lifecycle Phase:

- **Data Collection:** I gathered online data and examined site statistics data to provide a reliable data collection. About 3 types of data uses: Product, customer & Sales data, because it is challenging to find and acquire statistics about the conditions of the many travel destinations (**Data contains**).

- **Data preparation:** After the data was obtained in its format from several industry suppliers, each component was managed independently. Many data sets can have errors, particularly noisy ones.
- **Data Preprocessing:** The findings expanded and contracted as each attribute was assessed. All of the data underwent preprocessing in order to eliminate null values and duplicates. I was worried about overfitting, so I limited my number of modifications to the largest and most agreeable ones.
- **Model Selection:** For the analysis, use the RFM analysis AI model.
- **Performance Evaluation:** This section covers each consequence. Following the initial training and testing, these strategies did not provide us sufficient reliability for the subsequent two courses. To advise the route destination and all details, they created an AI web-based application and created visuals for the f1 measures, recall, performance, and confusion matrix.
- **Design:** Using the requirements that have been acquired, the software design is constructed in this stage. Database, building, and user interface development are only a few of the high-level and comprehensive design tasks it involves.
- **Development:** Using the design requirements as a guide, the program is coded at this step. To produce a functional software product, the developer develops the source code, performs unit tests, and assembles components.
- **Testing:** By putting the program through its paces, this process aims to guarantee that it is both high-quality and functional. Unit, user validity, integration, and system testing are just a few of the many testing techniques it covers.
- **Deployment:** Following approval and a thorough testing process, the software is placed into use. The program must be installed, configured, and set up in the proper environment.

Post-Project Phase:

- **Maintenance:** The software moves into the maintenance stage following deployment. To make sure the program keeps functioning and adapts to changing requirements, this phase entails regular maintenance, bug repairs, and upgrades.

- **Evaluation:** By comparing the project's actual results with its stated goals, its efficacy may be assessed. It assists in determining what needs to be changed and what can be learned for future projects.
- **Closure:** The project officially ends at this moment. It include completing the project's documentation, monitoring its artifacts, and doing a project evaluation or post-mortem.

These parts offer a disciplined approach to managing software development projects and aid in achieving effective results, from early planning to post-deployment assistance.

4.4 Implementations plans

At this point in the project, the general public can now use the finished application. Once a bug has been identified and fixed, the new system must be enabled. This section selects the settings, protocols, and release requirements. The new system is subsequently evaluated and put into use if everything works as planned.

Features:

- interactive graphics and real-time data updates.
- user-friendly UI with customizable drag-and-drop functionality.
- predicting trends with forecasting models.
- information on inventory optimization and product performance.
- determining the times of highest sales.
- detecting anomalies in transactions that are not normal.
- consumer segmentation driven by AI.
- Predicting preferences and analyzing behavior.
- RFM analysis for demand prediction and sales forecasting.
- automated creation of reports with export capabilities.
- support for user role-based customized views.
- design that adapts to mobile and online devices.
- Features that are accessible to a range of user demands.

CHAPTER 5

Planning

5.1 Project Plan

Through the integration of many technologies, the "**AI-Driven RFM E-Commerce**" build a comprehensive framework. These limitations are implemented for each system by the various modules of this framework. Every module contains a number of different systems. The web-based application offers many different features. A student project I've been working on uses artificial intelligence to examine dynamic consumer, sales, and product data. The needs will be similar to what I previously mentioned. The goal of this project is to create dashboards powered by AI in three main domains. With this web-based application, it provides a variety of services, A student project I've been working on analyzes dynamic customer, sales, and product data using artificial intelligence. The requirements will be comparable to those I discussed earlier. The creation of AI-driven insights in this project is focused on three key areas and Dashboard. Every project must have its possibilities, cost, schedule, risk management, and information server protocols set up before it can begin development. Before the project is started, preparation is necessary to reduce risks that might jeopardize the developer's ability to complete it. Setting targets and objectives, managing risks, adhering to deadlines, and other elements are all part of project planning. Software project plans frequently employ time boxes, which are standard project planning tools. These technologies are necessary for the systematic and cautious distribution of employment inside a simple tourism management system.

5.1.1 Management plan

Describe the project team's duties and responsibilities as well as the project management procedure. Create the reporting and communication routes to guarantee a fruitful partnership. Determine the phases of the issue-resolution process for decision-making and escalation.

Table 2: Management Planning

No	Task Name	Duration	Start Date	End Date
1	Introduction	10	1-7-24	10-7-24
2	Initial Study	5	10-7-24	15-7-24
3	Literature Review	5	16-7-24	20-7-24
4	Methodology	3	21-7-24	23-7-24
5	Planning	10	24-7-24	03-8-24
6	Feasibility	15	04-8-24	18-8-24
7	Foundation	5	19-8-24	23-8-24
8	Exploration	14	24-8-24	07-9-24
9	Engineering	30	08-9-24	08-10-24
10	Deployment	18	09-10-24	26-10-24
11	Testing	10	27-10-24	07-11-24
12	Implementation	5	08-11-24	12-11-24
13	Critical Appraisal and Evaluation	4	13-11-24	16-11-24
14	Lessons Learning	3	17-11-24	20-11-24
15	Conclusion	10	21-11-24	01-12-24
	Total	147days		

5.1.2 Resource Allocation

Determine all of the project's resources, such as staff, tools, and software. Based on the workload and project schedule, decide how best to allocate the resources. Assign duties and obligations to team members while making sure they possess the requisite knowledge and abilities.

Table 3: Resource Allocation

No	Task Name	Duration	Resource
1	Introduction	10	End User
2	Initial Study	5	Analyst

3	Literature Review	5	Analyst
4	Methodology	3	Analyst
5	Planning	10	Analyst, Designer, Developer
6	Feasibility	15	Analyst
7	Foundation	5	Designer
8	Exploration	14	Designer , Developer
9	Engineering	30	Developer
10	Deployment	18	Analyst, Developer
11	Testing	10	Analyst, Developer, Tester, Users
12	Implementation	5	Analyst, Developer
13	Critical Appraisal and Evaluation	4	Analyst, Tester and Developer
14	Lessons Learning	3	Analyst, Users
15	Conclusion	10	Analyst
	Total	147 days	

5.1.3 Time Boxing

To make development and testing easier, divide the project into many time periods or iterations. Determine the duration of each time box as well as the tasks and outputs required for every iteration. For every time box, establish specific objectives and supply resources.

Table 4: Time Boxing

Time -Box	Task Name	Duration	Resource
TB1	Introduction	10	End Users, Analyst
	Initial Study	5	Analyst
	Literature Review	5	Analyst
TB2	Methodology	3	Analyst

	Planning	10	Analyst, Designer, Developer
	Feasibility	15	Analyst
TB3	Foundation	5	Designer
TB4	Exploration	14	Designer, Developer
	Engineering	30	Developer
TB5	Deployment	18	Analyst, Developer
	Testing	10	Analyst, Developer, Tester, Users
TB6	Implementation	5	Analyst, Developer
TB7	Critical Appraisal and Evaluation	4	Analyst, Tester and Developer
	Lessons Learning	3	Analyst, Users
TB8	Conclusion	10	Analyst
	Total	147days	

CHAPTER 6

Feasibility

6.1 All possible types of feasibility

6.1.1 Operational feasibility

A feasibility study assesses the possibility that all pertinent elements—such as engineering, planning, legal, and financial considerations—will be taken into account to ensure a project's successful completion. The degree to which a system matures, utilizes the scope defined during opportunity definition, and satisfies the criteria specified during the project or requirement analysis phase of development of the system is known as operational practicability. This project's objective is to provide AI-powered dashboards across three key disciplines. This web-based application offers a range of functions, including I've been working on a student project that uses artificial intelligence to evaluate dynamic customer, sales, and product data. The suggested concept revolves around a web application that functions as an artificial intelligence product. Before beginning this assignment, I tried to find out more about a few pertinent online applications that are meant to transform how companies evaluate and understand data. The technology will use artificial intelligence to provide dynamic, real-time information in three main areas: consumer behavior, sales trends, and product performance. Businesses may foresee trends, optimize transactions, and improve consumer segmentation strategies by using interactive dashboards to access actionable insights.

6.1.2 Technical feasibility

Hardware	Software	Dataset
MacBook Air M1, Wi-Fi, Router, Cable, Android Phone	Android Studio, Google Chrome Browser, Windows, MS Word	Online

6.1.3 Technology

Client side	Server side
Looker studio	Python

6.2 Cost Benefit Analysis

Project managers analyze the advantages and disadvantages of various project paths, including connections, activities, business demands, and investments, using the cost-benefit analysis concept. A cost-benefit analysis helps me choose the optimal course of action to achieve my goal at the lowest possible cost out of all the possibilities available.

Project Name: AI-Driven RFM E-Commerce

Table 5: Cost Benefit

Equipment	1 st Year	2 nd Year	3 rd Year	4 th Year	Total
Web Based Application	20000				20000
Domain & Hosting		10000	10000	10000	30000
Software	1000				1000
Internet	2000	2000	2000	2000	8000
Training	5000				5000
Development		5000			5000
Maintenance	10000	10000	10000	10000	4000
Total					73,000 BDT.

6.3 DSDM Dynamic System Development Method (DSDM)

Instead than focusing on a particular application development tool or technology, the Dynamic Systems Development Method, or DSDM for short, is an agile project and software development management organizational structure. It strongly emphasizes iterative development methods, regular software delivery, and cooperation between development teams and business stakeholders. Keep in mind that DSDM does not need the

use of certain tools or technologies, such as **Python** in particular. These web development tools are widely known and definitely useful for DSDM applications.

CHAPTER 7

Foundation

7.1 Some potential approaches

7.1.1 Interview

For every project, arranging interviews is essential. An interview about an AI-Driven RFM E-Commerce web application would discuss how the platform gives firms access to real-time data and AI-powered features. Its capacity to offer dynamic, configurable dashboards, forecast and segment data using machine learning, and link smoothly with databases would all be discussed. Because of the app's emphasis on scalability, security, and user-friendly design, organizations can make data-driven choices effectively. Future developments like generative AI and improved automation would demonstrate how it may be used to further optimize operations and client interaction.

7.1.2 Observation

Through the combination of AI and sophisticated analytics, the web application for AI-Driven RFM E-Commerce has a clear potential to revolutionize corporate operations. Key company demands like trend detection, client segmentation, and revenue management are met by its real-time data analytics, forecasting capabilities, and intuitive dashboards. The program is appropriate for a variety of sectors since it guarantees scalability and security through cloud architecture and role-based access restrictions. Additionally, observations show that its smooth database integration and adaptable design improve usability. Its influence may grow even further with future developments like artificial intelligence (AI) and deeper technology, which would provide companies even more potent instruments for operational effectiveness and decision-making.

7.1.3 Data Collection

To give a trustworthy data collection, I collected data online and looked at site statistics data. Since it is difficult to locate and obtain information regarding the circumstances of the numerous trip locations, there are three categories of data uses: product, customer, and sales data. **(23053, 10), (5647, 4), (23, 4)**

[16]:

	Transaction ID	Customer ID	Transaction Date	Prod Subcat Code	Prod Cat Code	Qty	Rate	Tax	Total Amt	Store Type
10	29258453508	270384	20-02-2014	5	3	5	1497	785.925	8270.925	e-Shop
11	25455265351	267750	20-02-2014	12	6	3	1360	428.400	4508.400	e-Shop
12	1571002198	275023	20-02-2014	6	5	4	587	246.540	2594.540	e-Shop
14	36554696014	269345	20-02-2014	3	5	3	1253	394.695	4153.695	e-Shop
15	56814940239	268799	20-02-2014	7	5	5	368	193.200	2033.200	e-Shop

[13]:

	Prod Cat Code	Prod Cat	Prod Subcat Code	Prod Subcat
0	1	Clothing	4	Mens
1	1	Clothing	1	Women
2	1	Clothing	3	Kids
3	2	Footwear	1	Mens
4	2	Footwear	3	Women

[127]:

	Customer ID	DOB	Gender	City Code
0	268408	02-01-1970	M	4.0
1	269696	07-01-1970	F	8.0
2	268159	08-01-1970	F	8.0
3	270181	10-01-1970	F	2.0
4	268073	11-01-1970	M	1.0

Fig: Sample of datasets

7.2 Specific problem are identification and description

There are a number of distinct issues with the online application for AI-Driven RFM E-Commerce. Data integration is a significant problem as companies frequently use disparate, disjointed data sources, which makes it difficult to efficiently combine and handle this

information. The absence of real-time information, which hinders responsiveness to operational irregularities, demand swings, and market trends, is another major obstacle. Scalability is also an issue since many older systems lack the strong infrastructure needed to handle growing user demands and massive databases. Furthermore, without sophisticated AI models, client segmentation and behavioral analysis might be challenging, producing generic insights that fall short of promoting tailored interaction. Another major issue is forecasting accuracy, as poor models or missing data can lead to lost opportunities and inefficient use of resources. Last but not least, these online apps' user experience frequently presents difficulties, with excessively complicated interfaces and little customization choices making them less accessible to non-technical users. For a web application to be dependable, effective, and user-friendly, these issues must be resolved.

7.3 Possible solution

A web application can incorporate a number of ways to address the issues with AI-Driven RFM E-Commerce. To ensure smooth data flow into the dashboard, it is possible to combine disparate data sources through the use of strong ETL (Extract, Transform, Load) technologies and APIs. Businesses may make dynamic decisions by incorporating real-time data processing using technologies such as streaming frameworks (like Apache Kafka), which provide quick actionable insights. The infrastructure can effectively manage increasing data volumes and user demands if the application is deployed on cloud platforms like AWS, Google Cloud, or Microsoft Azure. This helps to address scalability concerns. I have been working on student project, which uses artificial intelligence to analyze dynamic customer, sales, and product data. The needs will be similar to what I specifically mentioned. Three main areas & Dashboard are the emphasis of this project's development of AI-driven insights: Product Analysis (Dashboard-1): Predicting trends and performance by using forecasting models. Transaction/Sales Analysis (Dashboard-2): Finding trends and useful information in sales data. Customer Analysis (Dashboard-3): Recognizing consumer trends and segmenting them to improve decision-making. Technical Information Integration: To ensure smooth viewing and interaction, the dashboards will be integrated using frames. Data Handling: In order to enable real-time updates and more profound insights, I want to integrate the data with a dataset.

7.4 Overall Requirement List

- Functional Requirements
- Non-Functional Requirements.

7.4.1 Functional Requirements

7.4.1.1 Product Analysis

- Customer segment
- Select date range
- Product info
- Predict trends & performance
- Net sales

Sales analysis:

- Analyze transaction data
- Identify sales patterns
- Detect sales anomalies
- Flag irregular transactions
- Identify peak, net sales times
- Total sales overtime
- Adjust strategies accordingly

Customer analysis:

- Segment customers by behavior
- Age input
- Detect trends in customer activity
- Identify key age, gender groups
- RFM analysis
- Recommend personalized products
- Design tailored marketing strategies
- Frequency & Monetary analysis

7.4.2 Non-Functional Requirements

7.4.2.1 Security

Each user of the system has an account, and only those who have been given authorization and a password may access it. I use both JavaScript to encrypt the credentials.

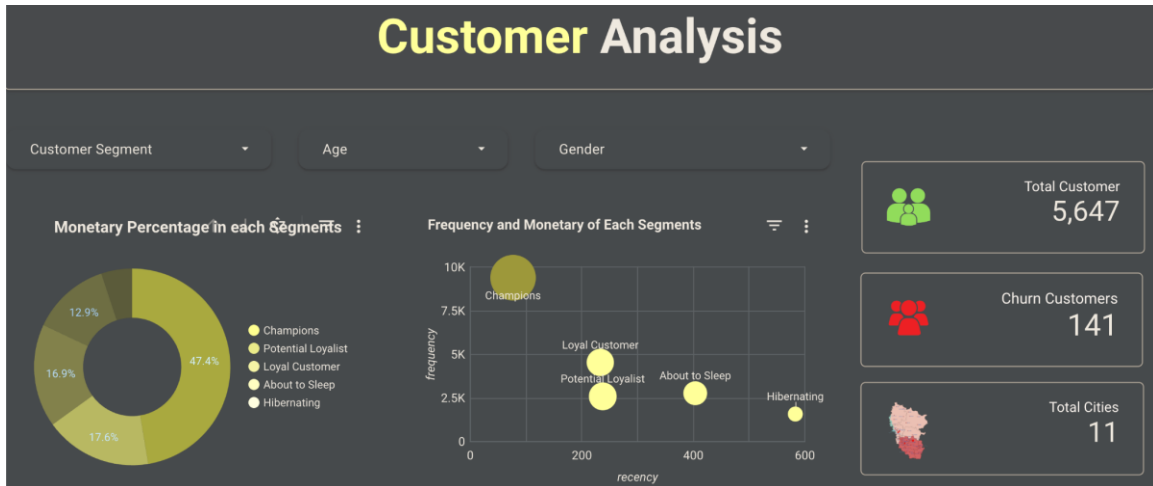


Fig 1: User Interfaces

7.4.2.2 Performance

Records are easy to update and maintain.

7.4.2.3 Availability

Users merely need a PC with an Internet connection to access the system from anywhere at any time. Numerous web browsers, including as Internet Explorer, Mozilla, Opera, and Chrome, are compatible with the system.

7.4.2.4 User Friendly

The technology has an interesting user interface and is easy to use.

- When a large number of people use the website at once, there shouldn't be any noticeable slowness or downtime.
- The website must be able to handle large amounts of data.
- The website's style and design should be straightforward and user-friendly.
- It must be simple to add new features and functionalities to the website without requiring extensive editing or reworking.
- The website must be maintained in order to fix faults and issues that arise after distribution.

7.5 Which technology to be implemented

The program I'm working on is entirely web based. I'm developing my project (**Language**).

Looker studio: Google provides a robust business intelligence and data visualization application called Looker Studio, which was originally known as Google Data Studio. It gives customers the ability to connect, display, and exchange data from several sources via interactive reports and dashboards. Looker Studio's intuitive UI, editable templates, and real-time data integration enable businesses to make informed decisions. It may be used in a variety of sectors and use cases since it supports a large number of connections.

7.6 Recommendation and justifications

To give organizations the ability to make data-driven decisions in real time, it is advised that they implement AI-Driven RFM E-Commerce. By utilizing cutting-edge AI technologies like anomaly detection for sales analysis, clustering for customer segmentation, and machine learning for forecasting, these dashboards offer actionable information. By integrating the architecture with cloud platforms, scalability and high availability are guaranteed, allowing the application to effectively manage increasing user demands and data volumes. Both technical and non-technical people may use the dashboards thanks to the user-friendly design, and security is improved by role-based access restrictions. Businesses may overcome issues with fragmented data sources and sluggish insights by putting in place strong data integration pipelines and real-time processing frameworks. Furthermore, operational efficiency is improved by the system's capacity to provide customized, automated reports. The potential of this solution to improve customer happiness, boost revenue growth, and optimize product strategies justifies its use in today's cutthroat corporate situations.

CHAPTER 8

Exploration

8.1 Use case

This section analyzes both functional and non-functional needs using use-case data and visuals.

Product Analysis

- Customer segment
- Select date range
- Product info
- Predict trends & performance
- Net sales

Sales analysis:

- Analyze transaction data
- Identify sales patterns
- Detect sales anomalies
- Flag irregular transactions
- Identify peak, net sales times
- Total sales overtime
- Adjust strategies accordingly

Customer analysis:

- Segment customers by behavior
- Age input
- Detect trends in customer activity
- Identify key age, gender groups
- RFM analysis
- Recommend personalized products
- Design tailored marketing strategies
- Frequency & Monetary analysis

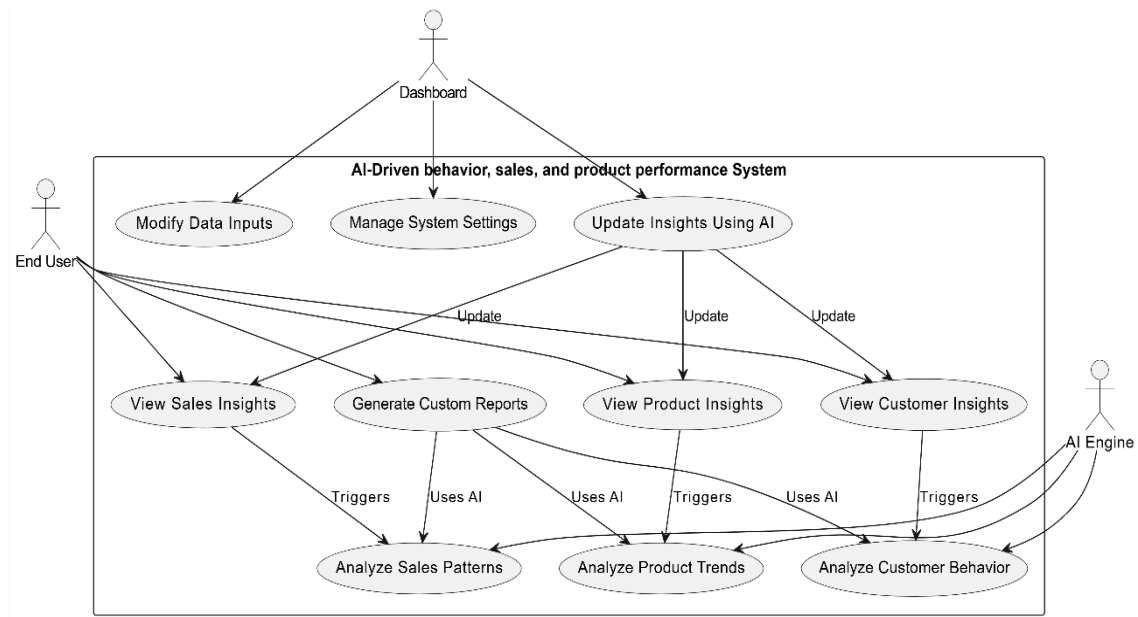


Fig 3: Use case

8.2 Activity diagram

Explain the system's dynamic features. It resembles a flow chart that illustrates the relationship between one task and another. You may use the activity to explain the system's operation. As a result, control is shared throughout operations. The entire activity diagram for every module is as follows: In charge.

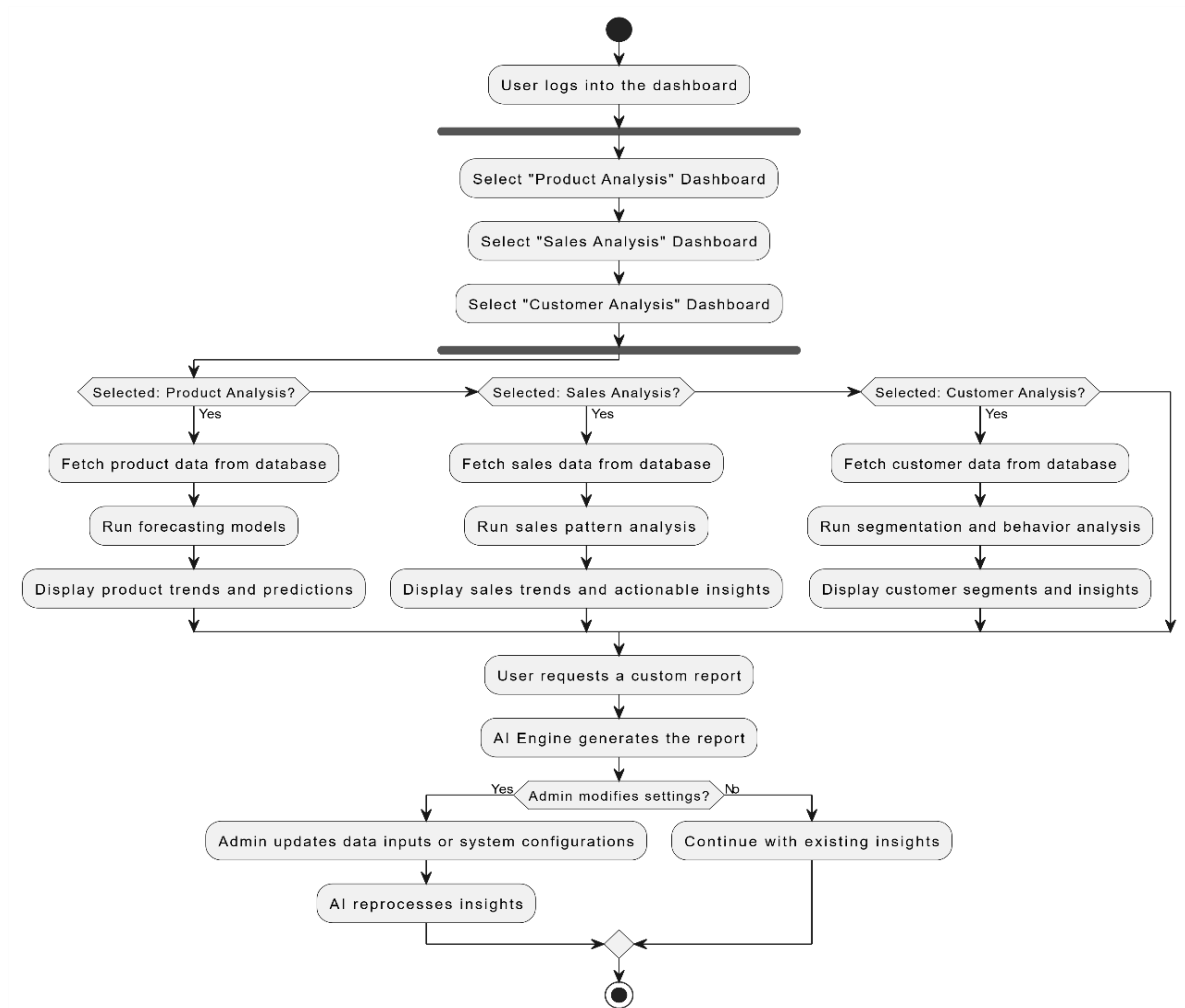


Fig 4: Activity Diagram.

8.3 Requirement catalogue

Functional requirements:

Product Analysis

- FR1: Customer segment
- FR2: Select date range
- FR3: Product info
- FR4: Predict trends & performance
- FR4: Net sales

Sales analysis:

- FR1: Analyze transaction data

- FR2: Identify sales patterns
- FR3: Detect sales anomalies
- FR4: Identify peak sales times
- FR5: Highlight seasonal trends
- FR6: Suggest pricing adjustments
- FR7: Streamline business operations
- FR8: Adapt to market trends
- FR9: Adjust strategies accordingly

Customer analysis:

- FR1: Segment customers by behavior
- FR2: Group similar customer profiles
- FR3: Detect trends in customer activity
- FR4: Identify key age, gender groups
- FR5: Predict future customer preferences
- FR6: Design tailored marketing strategies
- FR7: Frequency & Monetary analysis

Non-Functional Requirements:

- NFR1: Each user of the system is given an account, and only those who have been granted authorization and a password can access it. I use both JavaScript to encrypt the credentials.
- NFR2: Maintaining and updating records is simple.
- NFR3: Users simply need a PC with an Internet connection to access the system from anywhere at any time. Numerous web browsers, including as Internet Explorer, Mozilla, Opera, and Chrome, are compatible with the system.
- NFR4: The technology has an engaging user interface and is easy to use.

User Interface Requirements:

- UIR1: A user-friendly interface with intuitive navigation that makes accessing various functions and capabilities simple.
- UIR2: Responsive design can adapt to different screen and device sizes.
- UIR3: Icons offer visual signals to help users comprehend and operate the system.

Security and Privacy Requirements:

- SR1: Safe authentication and authorization procedures to safeguard user information and accounts.

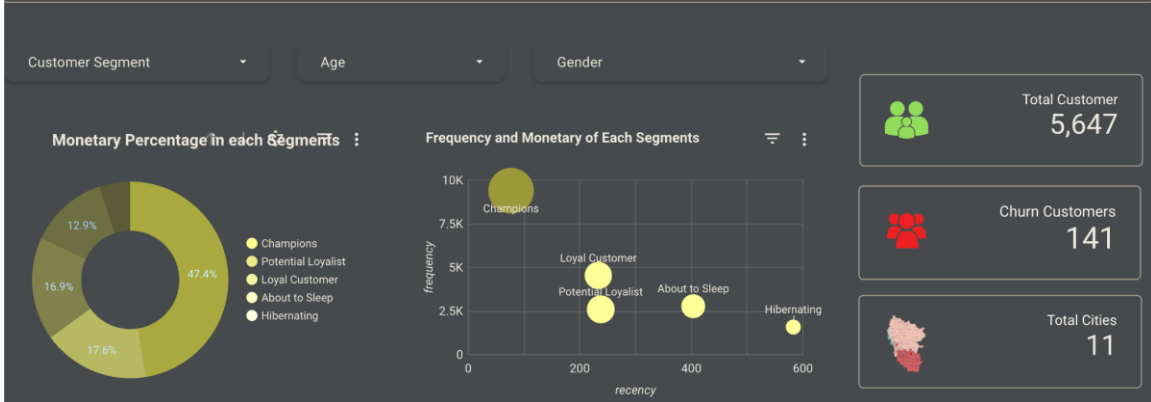
8.4 Prioritized Requirement List (PRL)

Table 6: Prioritized requirement list

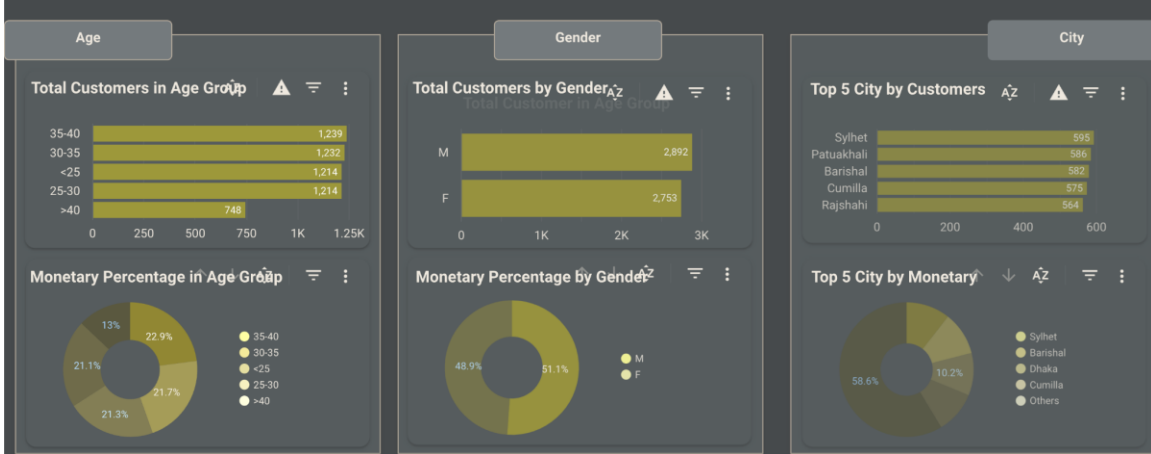
Requirement ID	Requirement Description	Priority	Dependencies	Status	Validation Criteria
RQ1	Display real-time product trends and performance.	High			Successfully.
RQ2	Integrate AI forecasting models for predicting future trends.	High	RQ1		Integrate AI forecasting models for predicting future trends.
RQ3	Analyze historical sales data for patterns and insights.	High	RQ1		Analyze historical sales data for patterns and insights.
RQ4	Enable customer segmentation based on behavior, demographics, and purchase patterns.	High	RQ1		Enable customer segmentation based on behavior, demographics, and purchase patterns.

8.5 Prototype of new system

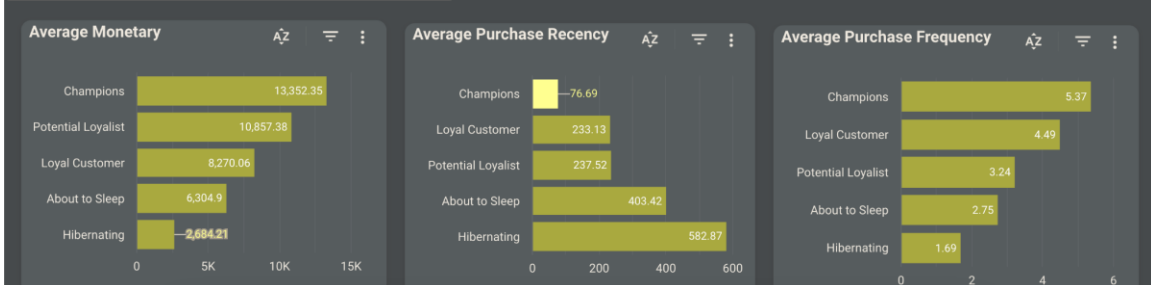
Customer Analysis



Demographic Analysis



RFM Analysis



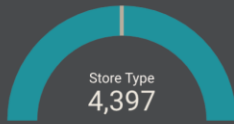
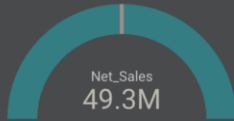
Sales Performance

Jan 1, 2011 - Dec 31, 2011

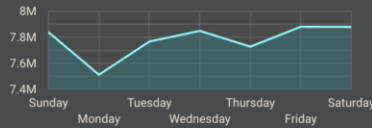
Age

Customer Segment

Total Sales Over Time



Weekly



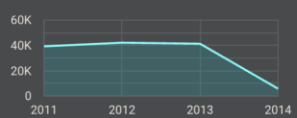
Monthly



Daily



Yearly



Total Sales Over Time By Each Customer Segment



Total Profit
5.1M

Total Quantity
62.7K

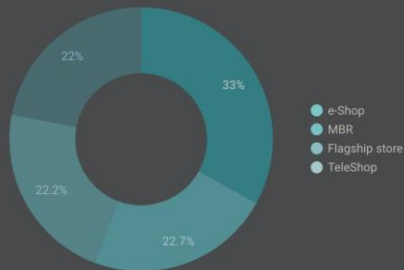
Avg. Profit Percentage
9.54

Total Profit Over Time By Each Customer Segment

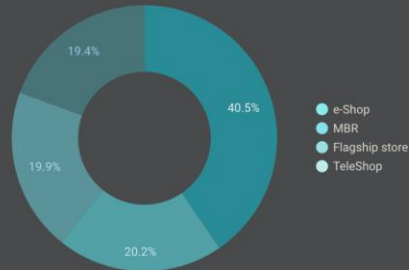


Store Category Analysis

Percentage of Customers in Store Category



Percentage of Monetary in Store Category



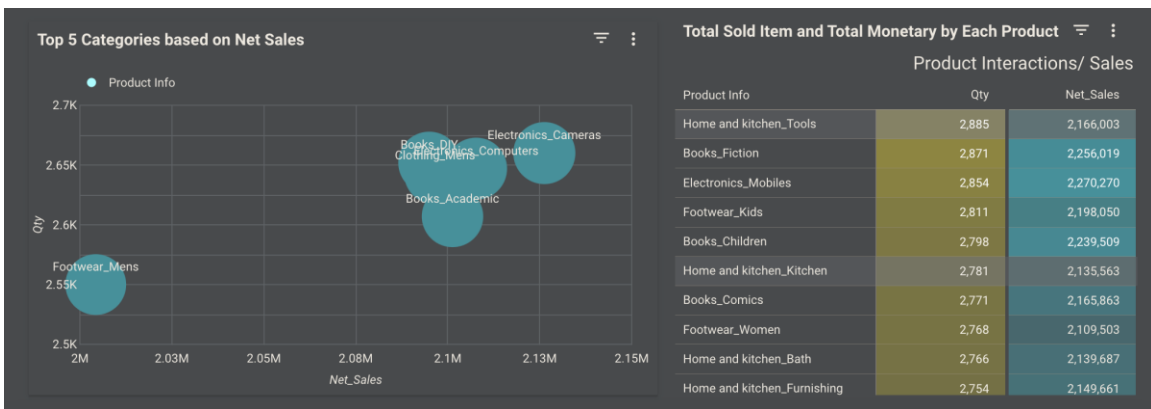
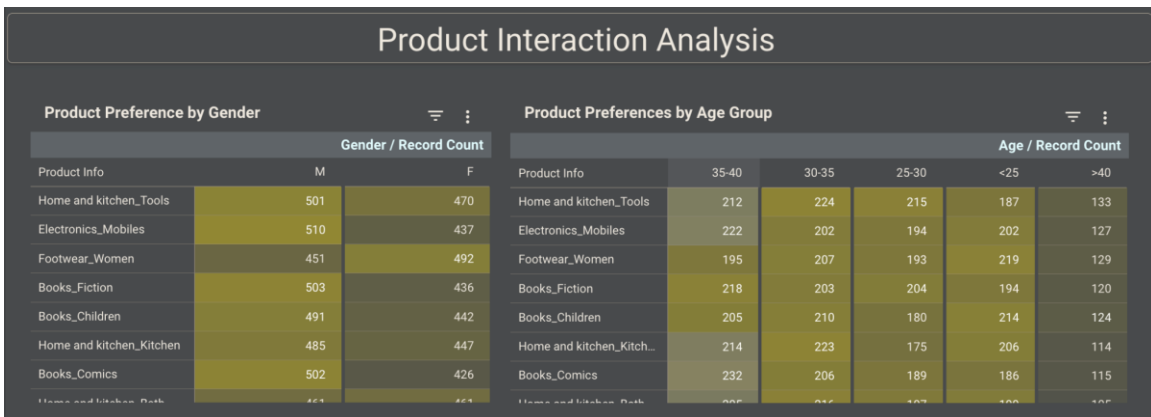
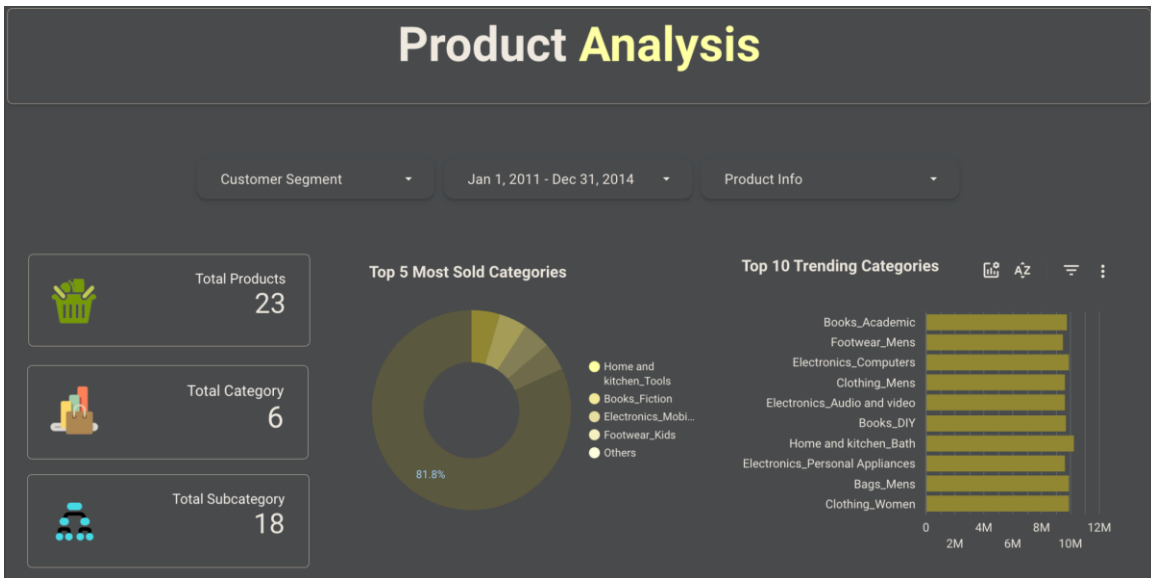


Fig 4: Interfaces for project

CHAPTER 9

Engineering

An innovative project called AI-Driven Displays for Dynamic Product, Sales, and Customer Insights aims to revolutionize the way companies evaluate and use their data. Product achievement, sales trends, and customer behavior are three crucial areas where this initiative uses artificial intelligence to provide real-time, actionable data. By using these data, companies may better understand their consumers, foresee market trends, and improve sales tactics, all of which help them make better decisions and spur growth. The creation of three web-based dashboards is part of the project. In order to examine past data, spot patterns, and anticipate product performance, the Product Analysis Dashboard employs AI-driven forecasting models. This provides insights into the market environment and product strategy. With an emphasis on sales data, the Transaction/Sales Monitoring Dashboard looks for trends, pinpoints peak times, and highlights irregularities or inefficiencies to optimize processes and boost revenue. Targeted marketing and increased client retention are made possible by the client Analysis Dashboard, which uses behavioral models and clustering algorithms to categorize customers and examine their purchasing patterns. A dataset, real-time data processing to deliver the most recent insights at all times, and the dashboards will be displayed via frames for easy user engagement. By combining cutting-edge AI methods with useful business applications, this methodology provides a revolutionary way to comprehend and respond to important indicators, enabling companies to prosper in a data-driven environment.

Features:

- interactive graphics and real-time data updates.
- user-friendly UI with customizable drag-and-drop functionality.
- predicting trends with forecasting models.
- information on inventory optimization and product performance.
- determining the times of highest sales.
- detecting anomalies in transactions that are not normal.
- consumer segmentation driven by AI.
- Predicting preferences and analyzing behavior.

- Machine learning for demand prediction and sales forecasting.
- RFM analysis
- support for user role-based customized views.
- design that adapts to mobile and online devices.
- Features that are accessible to a range of user demands.

9.1 Class Diagram

To display the source content for the interclass connections, a class was created. In this instance, the class defines the variables and behaviors of an entity and may be used as a single programming description or as a distinct entity within a program.

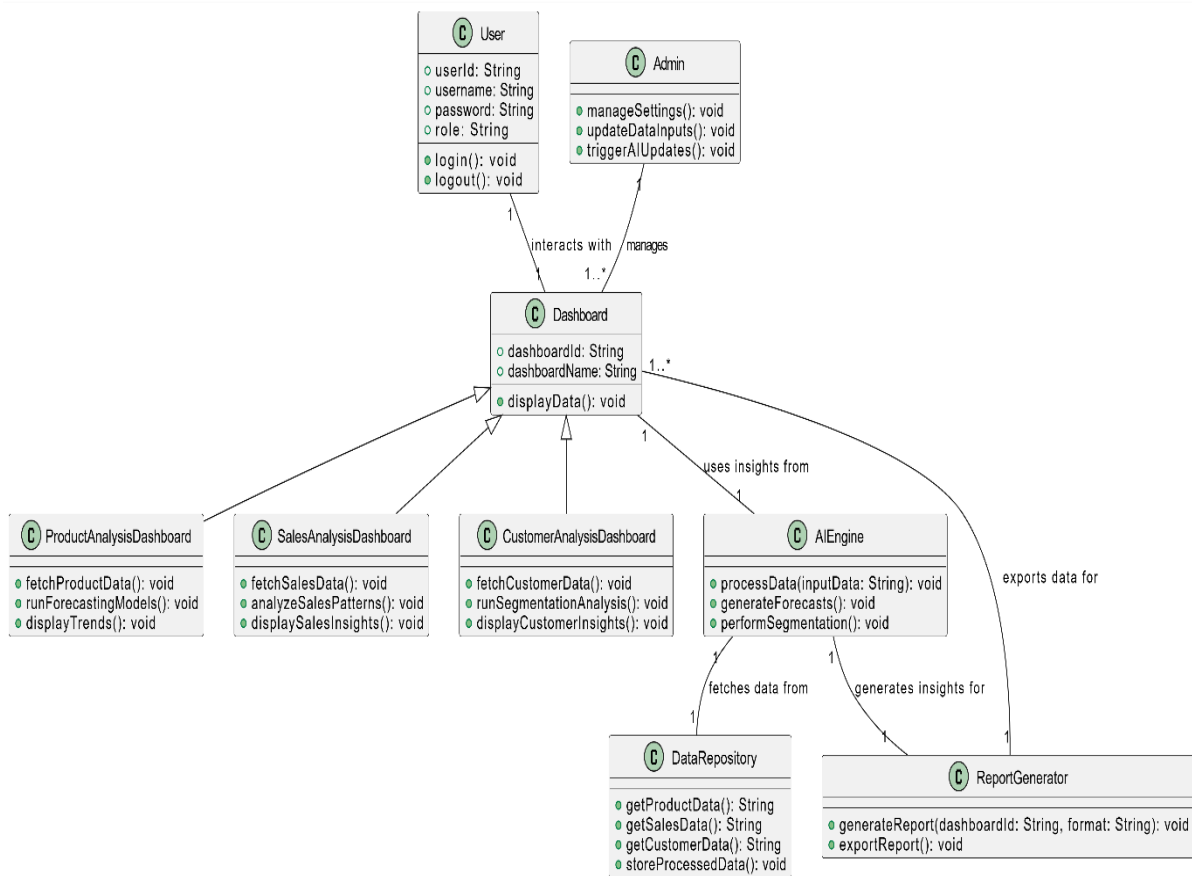


Fig 6: Class Diagram

9.2 ER diagram

In design, institutional means of communication—also known as the ER model, ER Diagram, or ERD—are a kind of structural application. The three primary pieces of information that the ERD provides and communicates in a distinct way are the constrained system's primary components and the relationships among them. With this, the Customer, Sales & Product dashboard entity-relationship diagram is finished.

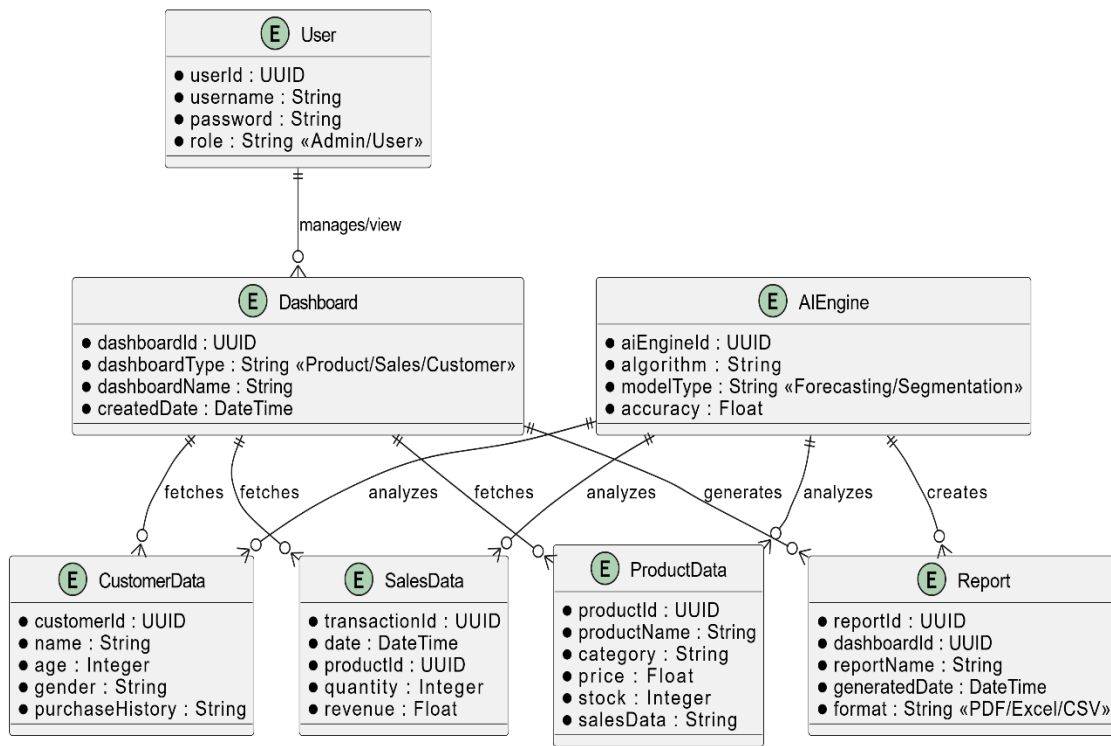


Fig 8: ER Diagram.

9.3 Sequence Diagram

This is all about three dashboard diagram: Customer, Sales & Product dashboard.

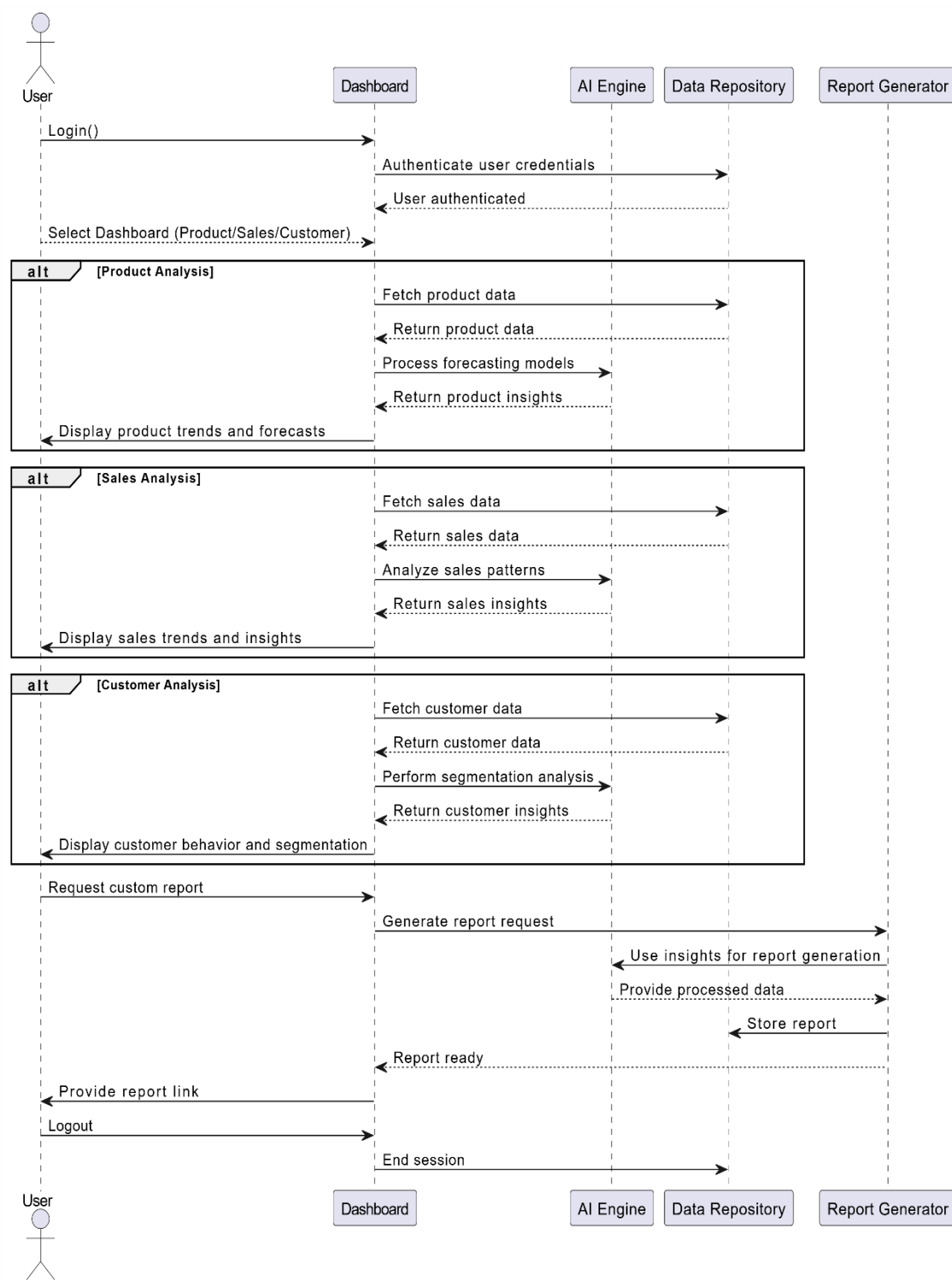


Fig 10: Sequence Diagram

CHAPTER 10

Development

10.1 Core Module Samples

Type Markdown and LaTeX: α^2

```
[2]: #import necessary packages

import numpy as np
import pandas as pd
from sklearn.cluster import KMeans
import scipy.sparse as sparse
from scipy.sparse import csr_matrix
import os

from sklearn import preprocessing
import seaborn as sns
```

1) Data Onboarding and Preprocessing

```
[4]: tran_df = pd.read_csv('data/Transactions.csv')
cust_df = pd.read_csv('data/Customer.csv')
prod_df = pd.read_csv('data/prod_cat_info.csv')
```

i) Check the datatype, shape and missing elements

Let's check for any mismatch in datatype, any missing instances and also their shape.

```
[6]: print(tran_df.shape)
print(cust_df.shape)
print(prod_df.shape)
```

```
(23053, 10)
(5647, 4)
(23, 4)
```

```
[7]: print(tran_df.info())
print(cust_df.info())
print(prod_df.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 23053 entries, 0 to 23052
Data columns (total 10 columns):
#   Column          Non-Null Count  Dtype
---  ---
0   transaction_id  23053 non-null  int64
1   cust_id         23053 non-null  int64
2   tran_date       23053 non-null  object
3   prod_subcat_code 23053 non-null  int64
4   prod_cat_code   23053 non-null  int64
5   Qty             23053 non-null  int64
6   Rate            23053 non-null  float64
7   Tax             23053 non-null  float64
8   total_amt       23053 non-null  float64
9   Store_type      23053 non-null  object
dtypes: float64(2), int64(6), object(2)
```

```

memory usage: 1.8+ MB
None
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5647 entries, 0 to 5646
Data columns (total 4 columns):
#   Column      Non-Null Count  Dtype
---  ---
0   customer_Id 5647 non-null    int64
1   DOB         5647 non-null    object
2   Gender      5645 non-null    object
3   city_code   5645 non-null    float64
dtypes: float64(1), int64(1), object(2)
memory usage: 176.6+ KB
None
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 23 entries, 0 to 22
Data columns (total 4 columns):
#   Column      Non-Null Count  Dtype
---  ---
0   prod_cat_code 23 non-null    int64
1   prod_cat      23 non-null    object
2   prod_sub_cat_code 23 non-null   int64
3   prod_subcat   23 non-null    object
dtypes: int64(2), object(2)
memory usage: 868.0+ bytes
None

```

```
[8]: cust_df.isnull().sum()
```

```

[8]: customer_Id    0
     DOB            0
     Gender         2
     city_code      2
     dtype: int64

```

ii) Rename the column name for more clarity and merging issues

```

[10]: tran_df.columns = ['Transaction ID', 'Customer ID', 'Transaction Date', 'Prod Subcat Code',
                        'Prod Cat Code', 'Qty', 'Rate', 'Tax', 'Total Amt', 'Store Type']
     cust_df.columns = ['Customer ID', 'DOB', 'Gender', 'City Code']
     prod_df.columns = ['Prod Cat Code', 'Prod Cat', 'Prod Subcat Code', 'Prod Subcat']

```

2) EDA (Exploratory Data Analysis)

```

[12]: #first make a copy, we don't want to ruin our main dataframe
     tran_df2 = tran_df.copy()
     cust_df2 = cust_df.copy()
     prod_df2 = prod_df.copy()

```

```
[13]: prod_df2.head()
```

```

[13]:

```

	Prod Cat Code	Prod Cat	Prod Subcat Code	Prod Subcat
0	1	Clothing	4	Mens
1	1	Clothing	1	Women
2	1	Clothing	3	Kids
3	2	Footwear	1	Mens
4	2	Footwear	3	Women

Feature Engineering

1. Remove inappropriate rows (Total amount can't be negative).
2. Convert Transaction Date to date time format.
3. Calculate netsales (without Tax)

```
[127]: cust_df2.head()
```

```
[127]:
```

	Customer ID	DOB	Gender	City Code
0	268408	02-01-1970	M	4.0
1	269696	07-01-1970	F	8.0
2	268159	08-01-1970	F	8.0
3	270181	10-01-1970	F	2.0
4	268073	11-01-1970	M	1.0

```
[129]: # Remove inappropriate rows
tran_df2 = tran_df2[tran_df2['Total Amt'] > 0]
```

```
[131]: tran_df2.head()
```

```
[131]:
```

	Transaction ID	Customer ID	Transaction Date	Prod Subcat Code	Prod Cat Code	Qty	Rate	Tax	Total Amt	Store Type	Net_Sales
10	29258453508	270384	2014-02-20	5	3	5	1497	785.925	8270.925	e-Shop	7485
11	25455265351	267750	2014-02-20	12	6	3	1360	428.400	4508.400	e-Shop	4080
12	1571002198	275023	2014-02-20	6	5	4	587	246.540	2594.540	e-Shop	2348
14	36554696014	269345	2014-02-20	3	5	3	1253	394.695	4153.695	e-Shop	3759
15	56814940239	268799	2014-02-20	7	5	5	368	193.200	2033.200	e-Shop	1840

```
[133]: #convert date to datetime format
tran_df2['Transaction Date'] = pd.to_datetime(tran_df2['Transaction Date'],format="mixed",dayfirst = True)
```

```
[135]: #Calculate netsales (without Tax)
tran_df2['Net_Sales'] = tran_df2['Qty'] * tran_df2['Rate']
```

ii) [Product Data]

```
[138]: prod_df2.groupby('Prod Cat Code')['Prod Cat'].value_counts()
```

```
[138]:
```

Prod Cat Code	Prod Cat	count
1	Clothing	3
2	Footwear	3
3	Electronics	5
4	Bags	2
5	Books	6
6	Home and kitchen	4

Name: count, dtype: int64

```
[140]: prod_df2.groupby('Prod Subcat Code')['Prod Subcat'].value_counts()
```

```
[140]:
```

Prod Subcat Code	Prod Subcat	count
1	Mens	2
	Women	1
2	Furnishing	1
3	Comics	1
	Kids	1
	Women	1
4	Kids	1
	Mens	1
	Mobiles	1
	Women	1
5	Computers	1
6	DIY	1
7	Fiction	1
8	Personal Appliances	1
9	Cameras	1
10	Audio and video	1
	Kitchen	1
	Non-Fiction	1
11	Bath	1
	Children	1
12	Academic	1
	Tools	1

Name: count, dtype: int64

Feature Engineering

We will merge the category and subcategory for the simplicity in model building

1. Merge Prod_Cat_Code and Prod_subcat_code to 'Product Code'
2. Merge Prod_Cat and Prod_Subcat to 'Product Info'

```
[143]: #merge 'Prod Cat' with 'Prod Subcat'
prod_df2['Product Info'] = prod_df2['Prod Cat'].astype(str) + '_' + prod_df2['Prod Subcat'].astype(str)

[145]: #merge 'Prod Cat Code' and 'Prod Subcat Code'
prod_df2['Product Code'] = prod_df2['Prod Cat Code'].astype(str) + '_' + prod_df2['Prod Subcat Code'].astype(str)

[147]: prod_df2.head()

[147]:
```

	Prod Cat Code	Prod Cat	Prod Subcat Code	Prod Subcat	Product Info	Product Code
0	1	Clothing	4	Mens	Clothing_Mens	1_4
1	1	Clothing	1	Women	Clothing_Women	1_1
2	1	Clothing	3	Kids	Clothing_Kids	1_3
3	2	Footwear	1	Mens	Footwear_Mens	2_1
4	2	Footwear	3	Women	Footwear_Women	2_3

RFM (Recency, Frequency, Monetary)

```
[150]: #check the unique items of each feature
for i in tran_df2.columns:
    print(i, ':', tran_df2[i].nunique())

Transaction ID : 20876
Customer ID : 5506
Transaction Date : 1123
Prod Subcat Code : 12
Prod Cat Code : 6
Qty : 5
Rate : 1431
Tax : 4194
Total Amt : 4194
Store Type : 4
Net_Sales : 4194
```

```
[152]: tran_df2['Transaction Date'].max()
```

```
[152]: Timestamp('2014-02-20 00:00:00')
```

```
[154]: #Fix Today (Now should be the max date)
import datetime as dt

Now = dt.datetime(2014,2,20) #YYYY-MM-DD
```

i) Compute Recency

Recency means the the duration between today and the last purchase from a customer

```
[157]: #Recency
RFM = tran_df2.groupby('Customer ID').agg({'Transaction Date':lambda x: (Now - x.max()).days})
```

ii) Compute Frequency

Frequency means how frequently a customer buy product. in other words, how many transactions a customer has made.

```
[159]: #Frequency
RFM['Frequency'] = tran_df2.groupby('Customer ID').agg({'Transaction ID':lambda x: len(x)})
```

iii) Compute Monetary Value

How much money a customer paid so far, sum of net sales

```
[163]: #Monetary
RFM['Monetary'] = tran_df2.groupby('Customer ID').agg({'Net_Sales':lambda x: sum(x)})

[165]: #rename the column name
RFM = RFM.rename(columns = {'Transaction Date': 'Recency'})

[167]: RFM = RFM.drop_duplicates()

[169]: print(RFM['Frequency'].max())
print(RFM['Monetary'].max())
print(RFM['Recency'].max())

11
40695
1121

[171]: #normalization
RFM['recency_normalized']=pd.qcut(RFM['Recency'],5, labels=False)
RFM['recency_normalized']=RFM['recency_normalized']+1
RFM['frequency_normalized']=pd.qcut(RFM['Frequency'],5, labels=False)
RFM['frequency_normalized']=RFM['frequency_normalized']+1
RFM['monetary_value_normalized']=pd.qcut(RFM['Monetary'],5, labels=False)
RFM['monetary_value_normalized']=RFM['monetary_value_normalized']+1

[173]: RFM_Array = np.array(RFM.iloc[:,3:6])
RFM_NORM = preprocessing.normalize(RFM_Array)
```

iv) Elbow Method for finding perfect k

From the plot we find k = 5 is an optimal number for the Clustering approach

```
[176]: # Elbow method
import matplotlib.pyplot as plt

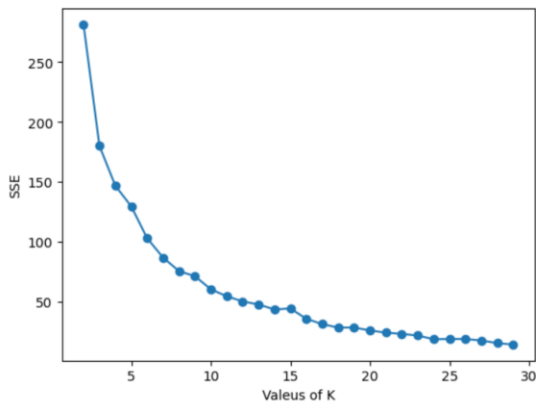
Ks = range(2,30)

results = []

for k in Ks:
    model = KMeans(n_clusters= k)
    model.fit(RFM_NORM)

    results.append(model.inertia_)

plt.plot(Ks, results, 'o-')
plt.xlabel('Valeus of K')
plt.ylabel('SSE')
plt.show()
```



```
[177]: from sklearn.cluster import KMeans

# Creating our Model
kmeans = KMeans(n_clusters = 5)

# Training our model
kmeans.fit(RFM_NORM)

# You can see the labels (clusters) assigned for each data point with the function labels_
kmeans.labels_

# Assigning the labels to the initial dataset
RFM['Cluster'] = kmeans.labels_

[178]: RFM = RFM.reset_index()
```

iv) Let's Name The Clusters

Champions (They are the champions) [highest monetary, frequency and lowest recency]

Loyal customer (Up-sell higher value products)

Potential Loyalist (Up-sell lower value products)

About to Sleep (Win them back. Talk to them. Make them special offers. Make them feel valuable)

Hibernating (they are losing, promote to get them back)

```
[181]: #Reverse Mapping the recency
RFM['recency_normalized'].replace({1:5,2:4,3:3,4:2,5:1},inplace = True)
```

```
[184]: #calculate score by summing up recency, frequency, monetary
RFM['Score'] = RFM['recency_normalized'] + RFM['frequency_normalized'] + RFM['monetary_value_normalized']
```

```
[187]: #check the mean score by cluster
tmp = pd.DataFrame(RFM.groupby('Cluster')['Score'].mean())
```

```
[189]: #sort in descending order
tmp = tmp.sort_values(by = 'Score', ascending = False)
```

```
[191]: tmp
```

```
[191]:
```

	Score
Cluster	
4	12.943478
3	10.953198
1	9.835526
2	7.521383
0	4.347857

```
[193]: tmp = tmp.reset_index()
```

```
[196]: #name the cluster in the order
Cluster_name = ['Champions', 'Loyal Customer', 'Potential Loyalist', 'About to Sleep', 'Hibernating']

tmp['Cluster_name'] = Cluster_name
```

```
[198]: RFM = RFM.merge(tmp[['Cluster', 'Cluster_name']], how='left', on = 'Cluster')
```

```
[200]: RFM.drop(['Score', 'Cluster'], axis = 1, inplace = True)
```

```
[202]: #Let's see the average of each segment for monetary, frequency and recency. This will help us in naming the clusters
```

```
print("Mean Monetary by segment: ",RFM.groupby("Cluster_name")["Monetary"].mean())
print()
print("Mean frequency by segment: ",RFM.groupby("Cluster_name")["Frequency"].mean())
print()
print("Recency by segment: ",RFM.groupby("Cluster_name")["Recency"].mean())
```

```
Mean Monetary by segment: Cluster_name
About to Sleep      8864.181001
Champions          13082.602609
Hibernating        3411.365714
Loyal Customer     12180.466459
Potential Loyalist  9793.834704
Name: Monetary, dtype: float64
```

```
Mean frequency by segment: Cluster_name
About to Sleep      3.129208
Champions           5.776522
Hibernating         1.950714
Loyal Customer      3.680187
Potential Loyalist  4.690789
Name: Frequency, dtype: float64
```

```
Recency by segment: Cluster_name
About to Sleep     355.989081
Champions          56.953043
Hibernating        522.882143
Loyal Customer     97.589704
Potential Loyalist 215.231908
Name: Recency, dtype: float64
```

v) Plot Clusters

A 3d scatter plot by plotly. Ref: <https://plotly.com/python/3d-charts/>

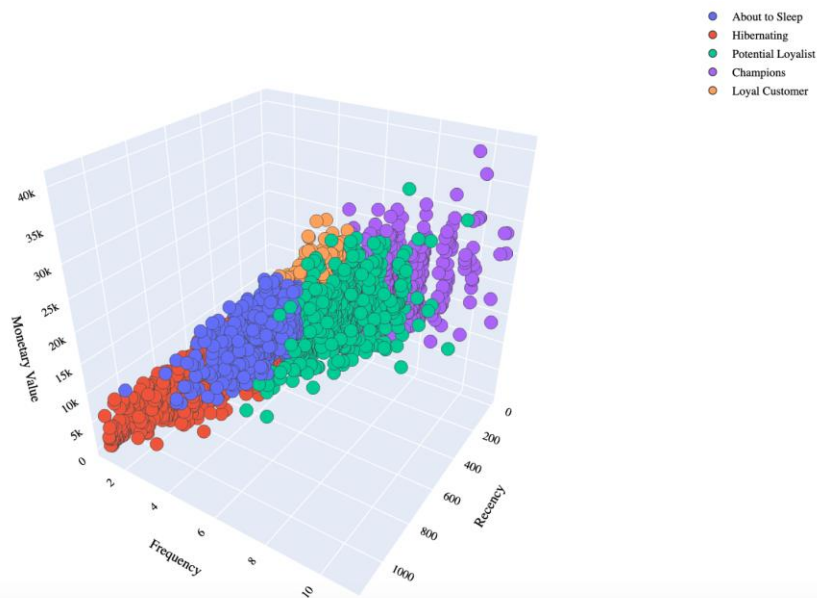
```
[205]: import plotly.graph_objects as go
```

```
PLOT = go.Figure()
```

```
for C in list(RFM.Cluster_name.unique()):
```

```
    PLOT.add_trace(go.Scatter3d(x = RFM[RFM.Cluster_name == C]['Recency'],
                               y = RFM[RFM.Cluster_name == C]['Frequency'],
                               z = RFM[RFM.Cluster_name == C]['Monetary'],
                               mode = 'markers', marker_size = 8, marker_line_width = 1,
                               name = str(C)))
```

```
[207]: PLOT.update_layout(width = 1000, height = 800, autosize = True, showlegend = True,
                       scene = dict(xaxis=dict(title = 'Recency', titlefont_color = 'black'),
                                     yaxis=dict(title = 'Frequency', titlefont_color = 'black'),
                                     zaxis=dict(title = 'Monetary Value', titlefont_color = 'black')),
                       font = dict(family = "Gilroy", color = 'black', size = 12))
```



```
[208]: ccluster_data = RFM.copy()
ccluster_data = ccluster_data.rename({'Customer ID':'Customer_ID'},axis =1 )

[209]: ccluster_data = ccluster_data.to_csv('customer_cluster.csv', index=False)
```

i) Merge Cluster, Customer Features and Product Features

1. Merge cluster from RFM data to transactional data
2. Merge Gender, City from Customer data to transactional data
3. Merge Product info from Customer data to transactional data (No common feature available so, first merge prod cat code, prod subcat code in transactional data then merge from product data)

```
[215]: rm_df = RFM.copy()

rm_df.set_index('Customer ID', inplace = True)
rm_df.head()
```

```
[215]:
```

Customer ID	Recency	Frequency	Monetary	recency_normalized	frequency_normalized	monetary_value_normalized	Cluster_name
266783	365	4	8102	2	3	3	About to Sleep
266784	443	3	5153	2	2	2	Hibernating
266785	203	7	25740	3	5	5	Potential Loyalist
266788	373	4	5514	2	3	2	About to Sleep
266794	8	11	25446	5	5	5	Champions

```
[217]: # merge cluster
rm_df2 = tran_df2.merge(rm_df['Cluster_name'], how = 'left', on = 'Customer ID')

#merge customer's features [Gender and City]
rm_df2 = rm_df2.merge(cust_df2[['Customer ID','City Code', 'Gender']], how='left', on = 'Customer ID')
```

```
[219]: #merge 'Prod Cat Code' and 'Prod Subcat Code' of transactional data
rm_df2['Product Code'] = rm_df2['Prod Cat Code'].astype(str) + '_' + rm_df2['Prod Subcat Code'].astype(str)
```

```
[221]: #merge product features [Product Info]
rm_df2 = rm_df2.merge(prod_df2[['Product Code','Product Info']], how='left', on = 'Product Code')
```

```
[223]: #again check the unique items of each feature
for i in rm_df2.columns:
    print(i, ':', rm_df2[i].nunique())
```

```
Transaction ID : 20876
Customer ID : 5506
Transaction Date : 1123
Prod Subcat Code : 12
Prod Cat Code : 6
Qty : 5
Rate : 1431
Tax : 4194
Total Amt : 4194
Store Type : 4
Net_Sales : 4194
Cluster_name : 5
City Code : 10
Gender : 2
Product Code : 23
Product Info : 23
```

```
[225]: merged_data = rm_df2.copy()
merged_data = merged_data.rename({'Transaction ID': 'Transaction_ID', 'Customer ID': 'Customer_ID', 'Transaction Date':'Transaction_Date', 'Pr
```

```
[227]: merged_data.to_csv('merged_data.csv')
```

Figure 8: Code Sample

10.2 Probability problem break down

Establish explicit success criteria, such as reaching a 30% rise in sales for a product category, and define the context, such as anticipating consumer reaction to a sales offer, before breaking down a probability problem in AI-driven dashboards for dynamic product, sales, and customer insights. Determine the pertinent random factors that affect the result, such as the number of clients targeted (X), the number of responders (Y), and the ensuing rise in sales (Z). To evaluate probability based on previous response rates or sales trends, analyze historical data. Give the right probability distributions, such a normal distribution for sales growth or a binomial distribution for client reactions. Utilize these distributions in formulae or simulations such as Monte Carlo analysis to determine the probability of reaching particular results. Lastly, incorporate these probabilistic observations into the dashboard to generate data-driven suggestions, such improving advertising tactics or client segmentation.

10.3 Prioritization while developing

Priority Area	Requirements and Explanation
Core Functionality	The AI-powered dashboard has to consolidate a number of tasks, including tracking sales success, analyzing consumer behavior, and making dynamic product suggestions. Businesses should be able to evaluate and improve their marketing plans, sales funnels, and client retention initiatives with the help of these dashboards.
UX (User Experience)	Assure a user-friendly interface that presents dynamic information in an easy-to-understand manner, including real-time sales results and customer trends. Simplicity must be given top priority in the design so that consumers may obtain actionable information fast and enhance their decision-making.
Security and Data Management	Put strong data protection mechanisms in place, such as role-based access restrictions, secure authentication, and encrypted storage. To guarantee adherence to data protection laws, secure sensitive information such as sales records, client data, and company analytics.

Optimization Performance	Improve dashboard speed with real-time data updates, effective data query optimizations, and sophisticated caching techniques. Even with big datasets or significant user activity, these enhancements will enable quick, easy access to insights.
Integration with External Systems	Facilitate integration with important external systems, including database systems (like MongoDB), ERP (like SAP), and CRM (like Salesforce). Consistent data flow is ensured via seamless connection, which enables the dashboard to present precise and current information from many data sources.
Quality Assurance and Testing	Use automated testing methods to verify the dashboard's functionality, making sure that elements like data visualization and integration perform as intended and that insights are correct. Test often using real-world datasets to find and fix any issues before to release.
User Feedback and Continuous Improvement	Gather end-user input on a frequent basis to improve dashboard functionality and features. Utilize user input to enhance the entire experience, find fresh insights, and develop AI models. Dashboards powered by AI should constantly adapt to changing business requirements.

CHAPTER 11

Testing

Project Name	AI-Driven RFM E-Commerce		
Name of product	AI-Driven RFM E-Commerce		
Product description	Advanced E-Commerce Dashboard using RFM Model		
Project description	Advanced E-Commerce Dashboard using RFM Model		
Project duration	Project Type	Testing/ Verification	
	Start date	End date	
	1-7-2024	1-12-2024	

11.1 Test Plan Acceptance

Describe the goals and limitations of the exam. Determine the important actors and get their consent before implementing the test strategy. Indicate in detail the acceptance standards for every stage of testing.

11.2 Unit Testing

When performing unit tests, test each module independently while integrating the structure as a whole. Since the software's architecture is the smallest part of each module, unit testing helps focus verification efforts on it. It's also known as module testing. Every system module is looked at separately. Additionally, make sure that every browser can use this approach.

11.3 Validation Testing

Software testing uses validation and verification procedures to make sure a system meets specifications and performs as planned. It may also be referred to as software quality assurance.

11.4 Integration Testing

Integration testing addresses the issues around the two inspection and program development concerns. A number of high-order tests are conducted after software integration. The main objective of this testing technique is to use unit-tested components to build a program structure that complies with design criteria.

11.5 TEST CASES

Table 7: Test Case

Case ID	Case Name	Expected Result	Actual Result	Result (Pass/Fail)
1	Core Functionality: Product Insights	The dashboard provides accurate, real-time product performance insights, including sales trends and stock levels.	Accurate insights displayed	Pass
2	Core Functionality: Sales Tracking	The dashboard displays up-to-date sales data, including total revenue, region-specific sales, and sales growth.	Sales data updated as expected	Pass
3	Core Functionality: Customer Behavior Analysis	The system identifies customer behavior patterns, such as purchasing trends and churn likelihood, accurately.	Behavior patterns identified correctly	Pass
4	UX: Interface Accessibility	The dashboard interface is user-friendly and all insights are easy to locate and understand.	Interface is intuitive and easy to navigate	Pass

5	UX: Insight Visualization	Data visualizations (charts, graphs, tables) are rendered correctly and dynamically update in real time.	Visualizations update dynamically	Pass
6	Security: Data Encryption	All sensitive data is encrypted during storage and transmission.	Data encryption works as expected	Pass
7	Security: Role-Based Access Control	Users have access only to data and features aligned with their roles (e.g., Admin, Analyst).	Access control enforced correctly	Pass

CHAPTER 12

Implementation

12.1 Training

User	Training	Time	Comment
Admin or Clients	Done	15 Days	No Comment

12.2 Big Bang Implementation

Using AI-powered dashboards gives organizations a degree of data-driven decision-making that is unmatched and offers a novel approach to dynamic product, sales, and customer insights. With the use of state-of-the-art artificial intelligence, these sophisticated dashboards analyze enormous volumes of data in real time and provide actionable insights that enable businesses to spot patterns, improve their tactics, and improve consumer interaction. By combining clever algorithms with user-friendly visuals, companies can track performance indicators, find hidden trends, and quickly adjust to changes in the market. In addition to increasing productivity, this game-changing approach encourages creativity, helping businesses maintain their competitiveness in a constantly changing market.

12.3 Scaling

Increasing the capacity of AI-driven dashboards to manage growing data quantities, user expectations, and intricate analytical needs is necessary for scaling them for dynamic product, sales, and customer insights. Businesses may guarantee scalability and smooth performance by utilizing cloud-based architectures, which facilitate the integration of various data sources and instantaneous processing. In order to efficiently evaluate large datasets and provide deeper insights as the corporation expands, advanced machine learning models may be deployed and improved. As the volume of data increases, teams from different departments may extract pertinent insights thanks to customizable capabilities and user-friendly interfaces, which promote cooperation and well-informed decision-making. By ensuring that AI-driven

dashboards continue to be flexible, responsive, and efficient, this scalable strategy enables businesses to adjust to changing market conditions and achieve long-term success.

12.3.1 Design of scaling

Building a modular, cloud-based architecture that facilitates real-time data processing and smooth resource scaling is necessary to design scalable AI-driven dashboards for dynamic product, sales, and customer insights. The approach guarantees effective handling of huge datasets while preserving efficiency by utilizing distributed structures and adaptive artificial intelligence models. Strong safeguards guarantee compliance and dependability, while customizable interfaces and reliable APIs improve use and integration. With this strategy, the dashboards may expand to meet the demands of the company while providing significant insights on a large scale.

12.3.2 Testing Performance

A small service must be created for each of the scanner's capabilities, such as disclosure, vulnerability detection, analysis, and both static and dynamic analysis. Teach the architectural and development teams how to create systems that are both scalable and effective. This entails being aware of elements such as database efficiency, caching, horizontal scalability, and performance monitoring.

12.4 Load Balancing

To improve the overall effectiveness of this application, load balancing is required. With this application, there are a few key considerations.

CHAPTER 13

Critical Appraisal and Evaluation

13.1 Objective that could be met

Providing organizations with real-time, actionable knowledge that can adjust to changing needs is the main goal of growing AI-driven dashboards for dynamic product, sales, and customer insights. These dashboards are designed to aid in decision-making, provide deeper insights, and boost operational efficiency by effectively managing bigger datasets and higher user demands. Businesses may use sophisticated analytics and predictive skills to improve sales performance, optimize product strategies, and customize consumer experiences. Furthermore, scalable solutions guarantee long-term viability, enabling companies to maintain their competitiveness in ever-changing markets while promoting innovation and expansion.

13.1.1 Success rate against each objective

Certain performance measures and business results may be used to gauge how well AI-driven dashboards are growing in relation to each goal. Success for real-time, actionable intelligence is demonstrated by faster decision-making and shorter data processing times, with accuracy rates over 95%. Increases in market share or product acceptance are indicators of improved product strategy, while greater conversion rates and revenue growth—which frequently achieve double-digit percentage increases—are indicators of improved sales performance. Metrics like higher customer satisfaction ratings (CSAT) and retention rates serve as proof of personalized customer experiences. Reduced operating expenses and the system's capacity to manage exponential data expansion without sacrificing performance are indicators of long-term sustainability. When taken as a whole, these metrics demonstrate how well scalable dashboards accomplish their goals.

13.1.2 How much better could have been done

Scalable AI-driven dashboards' performance may have been enhanced by concentrating on a few crucial areas. A deeper analytical basis could be offered by improved data integration capabilities, such as integrating more varied and unstructured data sources. More

sophisticated machine learning models that can learn on their own might produce deeper insights and forecasts that are even more accurate. Investing in interface designs that are easier to understand and use might increase accessibility and acceptance among a variety of user groups. More focus on optimizing real-time analytics and cutting down on latency would also increase responsiveness. Smoother performance under high demands might be ensured by proactively resolving scalability obstacles, such as resource constraints or inefficiencies in the data pipeline. Lastly, frequent feedback loops and user-informed iterative development would promote ongoing enhancement, optimizing these dashboards' capacity to satisfy organizational requirements.

13.1.3 Why it could not be done

Constraints such as a lack of funds, time, and qualified staff prevented the reforms from being completely implemented. Furthermore, ideal performance could have been hampered by difficulties managing older systems, integrating various data sources, and resolving scalability issues. Development timelines are frequently outpaced by rapidly evolving business demands and technological environments, and complexity is increased when innovation is balanced with security and compliance constraints. All of these elements work together to restrict the system's potential.

13.1.4 Which objectives have been missed

Determining if targets were missed entails comparing performance to predetermined benchmarks and figuring out the underlying issues that prevent success. Through strategic enhancements in technological advances, service to customers, editorial control, and advertising techniques, a tourist management website can successfully address these challenges and improve its user experience, thereby propelling its development and achievement in the highly saturated travel industry.

13.1.5 Why these objectives have missed

A number of obstacles relating to technology, operations, strategy, and the market might cause these goals to be missed. A comprehensive plan that includes continual improvement of technological advances, user interface, content strategy, customer service, marketing techniques, and operational procedures is needed to overcome these challenges. A tourist administration web page can improve efficiency and better meet user expectations by addressing these problems methodically and making adjustments to methods based on consumer input and industry trends. This will improve its overall performance metrics and help the website accomplish its goals more successfully.

13.2 Objectives totally not met / touched

Some goals might not be achieved because of implementation flaws or unanticipated difficulties. For example, the scope of insights may be limited if seamless integration with all data sources is not achieved. Due to technological or resource restrictions, advanced predictive analytics or customization capabilities may not be fully implemented. Similar to this, some user demands could go unsatisfied if goals like guaranteeing cross-departmental accessibility or reaching complete scalability under heavy workloads are not fully addressed. These gaps point to areas that need improvement in the future.

13.2.1 Why it could not be touched

These objectives might not have been reached due to major budgetary or administrative challenges, poor infrastructure, or limited user adoption.

CHAPTER 14

Lessons Learned

14.1 Pre-project

To guarantee a successful deployment, careful planning and analysis are required during the pre-project phase of AI-driven dashboards for dynamic product, sales, and customer insights. Understanding stakeholder needs, establishing success measures, and determining corporate objectives are important tasks. To create a successful integration plan, a thorough evaluation of the sources, gaps, and data infrastructure that already exist is essential. Choosing the appropriate platforms, tools, and technologies that support performance and scalability objectives is another aspect of this phase. To foresee future difficulties, feasibility studies and risk assessments are also carried out. The basis for a solid and significant solution is laid by developing a roadmap with precisely defined milestones, deadlines, and resource allocations to guarantee alignment between the technical and business teams.

14.2 Review

To evaluate project progress, spot plan deviations, and make sure everything is moving forward on time, frequent reviews are crucial. Using these assessments, I can assess how well the web application accomplishes its objectives and decide whether it needs any changes or enhancements. Regular user and stakeholder feedback can assist in pinpointing areas that require improvement and promote well-informed decision-making.

14.3 Lessons Learned

Important lessons for next projects were learned via the deployment of AI-driven dashboards for dynamic product, sales, and customer data. Aligning goals and expectations required clear communication between the business and technical teams. As the project grew, early investments in reliable data pipelines and scalable infrastructure greatly decreased bottlenecks. As more non-technical people adopted products with intuitive interfaces, the significance of user-centric design became clear. The necessity for flexible architecture and sophisticated data transformation tools was brought to light by difficulties integrating various data sources. Furthermore, incremental enhancements and ongoing

feedback loops were essential for improving features and guaranteeing long-term success. These observations highlight the necessity of careful preparation, flexibility, and teamwork in projects of this nature.

14.4 Problem Faced

The integration of fragmented data from many sources was one of the issues faced by AI-driven for dynamic product, sales, and customer insights. This resulted in slower data processing and analytics. The system's inability to effectively manage big datasets, especially during periods of heavy traffic, gave rise to scalability concerns. Another challenge was user acceptance; non-technical users needed extra assistance and training since they found the interface complicated. Furthermore, it was difficult to match AI models with changing business requirements since market dynamics frequently changed more quickly than model modifications could. These problems brought to light the necessity of improved preparation, adaptability, and continuous user involvement.

14.5 Problems That are solutions

Such software jobs are hard to do. Even though I develop online apps. While completing the project, I ran across a few common problems, but those aren't the truly tough ones. It might be difficult to come up with workable ideas, though. Several problems faced during the implementation of AI-driven dashboards have inherent solutions that can drive future success. For data integration challenges, adopting robust data integration tools and platforms like ETL (Extract, Transform, Load) pipelines and APIs can streamline the process. To address scalability issues, cloud-based infrastructure and serverless architecture can provide dynamic resource allocation, ensuring the system can handle high data volumes efficiently. For user adoption, improving the interface design to be more intuitive and providing comprehensive training programs can increase usability across non-technical teams. Regularly updating and fine-tuning AI models using continuous feedback and machine learning operations (MLOps) will ensure alignment with evolving business needs. By proactively addressing these areas, organizations can overcome the initial hurdles and enhance the effectiveness of their AI-driven dashboards.

CHAPTER 15

Conclusion

15.1 Summary of the project

The findings that support my concept, "**AI-Driven RFM E-Commerce**," may be read in its entirety. In this article, the techniques utilized to transform the idea into a working website are discussed in depth. One module that sticks out among system users is the admin dashboard. I have been working on student project, which uses artificial intelligence to analyze dynamic customer, sales, and product data. The needs will be similar to what I specifically mentioned. Three main areas & Dashboard are the emphasis of this project's development of AI-driven insights: Product Analysis (Dashboard-1): Predicting trends and performance by using forecasting models. Transaction/Sales Analysis (Dashboard-2): Finding trends and useful information in sales data. Customer Analysis (Dashboard-3): Recognizing consumer trends and segmenting them to improve decision-making. Technical Information Integration: To ensure smooth viewing and interaction, the dashboards will be integrated using frames. Data Handling: In order to enable real-time updates and more profound insights, I want to integrate the data with a dataset.

15.2 Goal of the project

The purpose of this project is to create a web application that serves as An innovative project called AI-Driven Displays for Dynamic Product, Sales, and Customer Insights aims to revolutionize the way companies evaluate and use their data. Product achievement, sales trends, and customer behavior are three crucial areas where this initiative uses artificial intelligence to provide real-time, actionable data. By using these data, companies may better understand their consumers, foresee market trends, and improve sales tactics, all of which help them make better decisions and spur growth. The creation of three web-based dashboards is part of the project. In order to examine past data, spot patterns, and anticipate product performance, the Product Analysis Dashboard employs AI-driven forecasting models. This provides insights into the market environment and product strategy. With an emphasis on sales data, the Transaction/Sales Monitoring Dashboard looks for trends, pinpoints peak times, and highlights irregularities or inefficiencies to optimize processes

and boost revenue. Targeted marketing and increased client retention are made possible by the client Analysis Dashboard, which uses behavioral models and clustering algorithms to categorize customers and examine their purchasing patterns. Dataset will manage dynamic, real-time data processing to deliver the most recent insights at all times, and the dashboards will be displayed via frames for easy user engagement. By combining cutting-edge AI methods with useful business applications, this methodology provides a revolutionary way to comprehend and respond to important indicators, enabling companies to prosper in a data-driven environment.

15.3 Success of the project

This project has achieved great success. The principal actions are:

- Utilize forecasting models powered by AI to examine past product data.
- Determine market trends and forecast how well a product will do in the future.
- Encourage data-driven choices in marketing, inventory control, and product development.
- Examine sales data to find trends and patterns.
- Find inconsistencies and irregularities in the sales process.
- Examine consumer purchasing patterns and forecast their desires.
- Facilitate focused marketing tactics and improve client retention.
- Create dynamic dashboards that are updated in real time to provide useful business information.

- For smooth data management, combine AI capabilities with datasets.
- Give companies the tools they need to make data-driven choices to boost productivity and expansion.
- Utilize forecasting models powered by AI to examine past product data.

15.4 Documentation

The following phases, tasks, and plans were probably part of the documentation:
Preliminary Project Records: This might involve preliminary needs gathering, feasibility studies, and project concepts.

- **Project plan:** A written document that describes the goals, limitations, schedule, resources needed, and risk management techniques for a project.
- **Technical Specifications:** Comprehensive guidelines pertaining to the features, functionalities, and layout of a web application for dynamic product sales.
- **User Documentation:** Provides advice and guidance on how to use the program efficiently to all parties concerned, including the person in charge who searches for holiday spots or packages.
- **Instruction in Testing and Quality Control:** Recording test strategies, scenarios, and outcomes to make sure the software satisfies quality requirements.
- **Plans for deployment and maintenance:** Documentation detailing the required procedures is included, as with plans for application upgrades, deployment, and maintenance.

15.5 Value of the project

The capacity of AI-driven to convert unprocessed data into actionable intelligence, which promotes corporate growth and informed decision-making, is what makes them valuable for adopting dynamic product, sales, and customer insights. These dashboards help businesses improve customer experiences, increase sales success, and optimize product strategy by enabling real-time monitoring, predictive analytics, and trend discovery. They enable teams to concentrate on strategic projects while saving time and money by increasing operational efficiency and decreasing manual data analysis. These systems' scalability and adaptability also guarantee their long-term relevance in a market that is always changing, which makes them an essential tool for preserving a competitive edge and attaining long-term success.

15.6 My Experience

I may use my programming, design, and project management expertise on the web application project for AI-driven dynamics analysis of products, customers, and sales. My experience has made it possible for me to collaborate with stakeholders, effectively oversee project schedules, overcome technical obstacles, and put into practice solutions created especially to satisfy the requirements of tourists who love taking tours. In order to advance my professional skills, I have also strengthened my problem-solving, teamwork, and documentation skills.

References

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