IBP PROJECT

Intelligent Business Performance Analytics and Decision Support Platform For Small Business

CSIS 4495 – Section 002

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Introduction

In today's competitive business environment, small businesses (e.g. retails store) increasingly use data to understand how they are performing and to support decision-making. However, many analytics tools mainly show past results and charts. They often do not provide enough support for forecasting, business suggestions, or user interaction. As a result, business users may find it difficult to use data results to take clear actions.

The main issue addressed in this project is the lack of analytics systems that combine performance analysis, time-based comparison, forecasting, recommendations, and user interaction in one platform. Traditional business intelligence dashboards usually show what has already happened, but they do not explain what may happen next or what actions should be taken.

Although previous studies have examined business intelligence, predictive analytics, and recommendation systems, these tools are often developed separately. Many existing systems do not offer a complete analytics process that includes user feedback, automated reporting, and interactive analysis. This creates a gap between what is taught in academic courses and how analytics is used in real business situations.

This project aims to reduce this gap by developing a business performance analytics and decision-support platform for small businesses. The platform combines data ingestion, analysis, forecasting, recommendations, reporting, and user interaction. The expected benefits include better decision-making, earlier identification of performance problems, and a reusable analytics framework that can be applied to different business environments.

Proposed Research Project

1 Research Objectives

The objectives of this project are to:

- Design and implement an end-to-end analytics pipeline from data ingestion to decision support
- Enable comparative sales performance analysis across time periods
- Apply forecasting models to predict sales and inventory demand
- Generate business recommendations based on analytics results
- Analyze both numeric and text-based data (e.g., sales data and reviews)
- Demonstrate practical data analytics skills and can be presented to potential employers.

2. Research Methodology and System Design

2.1 Research Design and Objectives

This project uses a design-and-implementation research approach, where data analytics techniques are applied in a working system to solve real business decision-making problems. The project focuses on combining data collection, analysis, forecasting, and reporting on one platform that helps users understand data and make better business decisions.

The main objectives of this research are to:

- Design an end-to-end data analytics process for business performance analysis

- Apply analytical and predictive methods learned from previous courses to real business data

- Examine how historical data, forecasts, and customer feedback can support better business decisions

- Demonstrate the practical use of data analytics through a system that can be reused in real business situations

This approach follows common practices in applied data analytics and business intelligence studies, where systems are evaluated based on how useful, easy to understand, and helpful they are for decision-making, rather than only on theoretical performance.

2.2 Data Collection and Ingestion

Data for this project will be collected through manual uploads of structured files in CSV or Excel format a front-end interface. This method is suitable for small business environments.

The datasets used in this project include:

- Sales transaction data, such as dates, products, quantities, and prices

- Inventory data, such as stock levels

- Customer reviews or other text-based feedback

A Python-based backend will handle the data upload process. Uploaded files will be checked to ensure they follow the correct structure, use valid data types, and contain all required fields.

2.3 Data Processing and Storage Strategy

An ELT (Extract–Load–Transform) approach will be used to ensure data tracking, flexibility, and reliable analysis. All data will be stored and processed in SQL Server, which supports structured queries and works well with analytics tools such as Power BI.

The data system is organized into three logical layers:

- Layer 1 (Raw Data): Uploaded files are stored in their original form without changes. This helps keep a record of the original data and allows the data to be processed again if needed.

- Layer 2 (Clean Data): Data is checked, cleaned, and converted into consistent formats. This layer is used as the main source for analysis.

- Layer 3 (Analytics Data): Data is aggregated and transformed to support KPI calculations, time-period comparisons, forecasting inputs, and reporting.

This layered design helps ensure accurate and reliable analysis in later stages.

2.4 Analytics and Comparative Analysis

Using the clean data layer (Layer 2) as the main source of reliable data, the system calculates key business performance indicators such as:

- Revenue, profit, and sales volume

- Average order value

- Product-level performance shows how well each product sells, while time-period performance shows how sales change over time.

Comparative analysis is used to study performance trends over time. Sales results are compared using month-over-month and quarter-over-quarter analysis to identify growth trends, seasonal patterns, and unusual changes in performance.

Searchable time ranges allow users to focus their analysis on specific periods of interest. This design is based on concepts learned in business statistics and data visualization courses, where analyzing data over time is important for evaluating business performance.

2.5 Forecasting and Predictive Analytics

Predictive analytics techniques are used to forecast future sales performance and inventory demand. Forecasting models are trained using historical data from past periods. The predicted results are stored separately from actual sales data so they can be compared once real results are available.

Forecast accuracy is measured by comparing predicted values with actual outcomes using common error measures. This forecasting and evaluation process shows the practical use of machine learning concepts, with a focus on checking model performance and improving results over time, rather than only producing predictions.

2.6 Recommendation and Decision Support

To turn analytics results into useful actions, the system provides business recommendations based on:

- KPI trends

- Results from performance comparisons

- Forecast outcomes

These recommendations may help identify products or time periods with weak performance, suggest changes to inventory levels, or highlight possible growth opportunities. This decision-

support function helps convert data analysis into practical guidance and reflects how analytics is used in real business decision-making.

2.7 Analysis of Text-Based Data

To add more analytical depth beyond numeric data, the project includes analysis of text-based customer feedback. Customer reviews are processed to extract keywords and classify sentiment as positive, neutral, or negative.

Sentiment trends are then analyzed together with sales performance to provide additional insight into service quality and customer experience. Although customer feedback is collected after purchases, it can still be used to explain customer satisfaction, support quality control, and indicate possible future sales trends. This use of both numeric and text data reflects applied data mining concepts learned in machine learning courses.

2.8 Reporting and Interaction

Analytical results are presented through automated business review reports that can be accessed from the front-end interface. These reports combine:

- KPI summaries
- Trend and comparison analysis
- Forecast results
- Business recommendations

Users can select specific time periods to generate reports using searchable time ranges. This reporting function helps support better decision-making and allows insights to be shared clearly with stakeholders.

2.9 Additional Features for Future Development

Several advanced features are considered for future extensions of the project, including:

- A chat-based analytics assistant that allows users to request insights using natural language
- Downloadable reports in PDF format
- Automated email delivery of business reports
- User feedback functions that allow stakeholders to provide comments and observations

These features are identified as future extensions to keep the current project scope manageable, while demonstrating awareness of more advanced analytics capabilities and system enhancements.

Technologies and Frameworks

Category	Technology
Operating System	Windows
Programming Language	Python
Backend Framework	FastAPI
Database	SQL Server
Data Processing	Pandas
Visualization	Power BI
Front-end	HTML, CSS (minimal UI)
Analytics & Machine Learning	Python (forecasting, recommendation logics)

Expected Results and Contributions

The expected outcomes of this project include:

- A working analytics and decision-support platform that can be used to analyze business data

- Improved analytical capability compared to traditional business intelligence dashboards by including forecasting and recommendations

- A reusable system structure that can be applied to different business scenarios

- Practical understanding of how analytics, forecasting, and user interaction (includes uploading data, selecting time ranges, viewing analytics results) can be integrated into one system

This research helps connect analytical techniques learned in academic courses with practical decision-support systems used in real business environments.
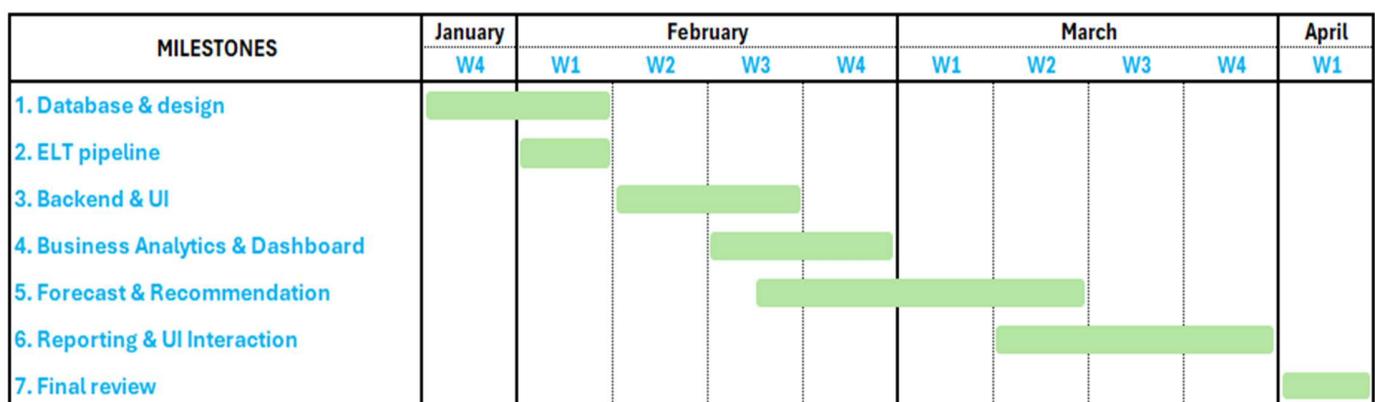
Project Planning and Timeline

Time	Milestone	Actions
Jan 26 – Feb 8, 2026	Database & design	- Search for suitable datasets for the project - Identify key business entities, including sales, products, inventory, and customer reviews - Design a relational database schema in SQL Server - Define data relationships and primary keys

Feb 2 – Feb 8, 2026	ELT pipeline	• Implement data ingestion from CSV and Excel files • Load raw data into SQL Server without changing the original content • Check file structure and required fields for correctness • Prepare clean and standardized datasets for analysis
Feb 9 – Feb 22, 2026	Backend & UI	• Develop a Python-based backend for file upload and data processing • Create a simple user interface for uploading data and selecting parameters • Connect the backend to SQL Server for data storage and retrieval • Test the complete data flow from file upload to database storage
Feb 16 – Mar 1, 2026	Business Analytics & Dashboard	• Define and calculate key business KPIs such as revenue, sales volume, and average order value • Perform product-level and time-based performance analysis • Build dashboards to show trends and comparisons • Enable time-range filtering for analytics
Feb 19 – Mar 15, 2026	Forecast & Recommendation	• Train forecasting models using historical sales data • Generate future sales and inventory demand forecasts • Compare forecast results with historical performance • Produce basic business recommendations based on analytics and forecasts

Mar 9 – Mar 29, 2026	Reporting & UI Interaction	• Generate automated business review reports • Combine KPIs, trends, forecasts, and recommendations into clear reports • Allow users to select time ranges when generating reports • Present analytical results clearly through the user interface
Mar 30 – Apr 5, 2026	Final review	• Review and validate all system components • Test the accuracy of analytics and report outputs • Finalize documentation and the research report • Prepare for project presentation

MILESTONES	January W4	February W1	W2	W3	W4	March W1	W2	W3	W4	April W1
1. Database & design	███									
2. ELT pipeline		██								
3. Backend & UI			███							
4. Business Analytics & Dashboard				███						
5. Forecast & Recommendation					███	██				
6. Reporting & UI Interaction							████			
7. Final review										██

Project Contract

This project is an individual effort. I agree to complete the scope and milestones outlined in this proposal and to maintain regular progress tracking.

Work log

Date	Number of Hours	Description
Jan 11, 2026	3	- Explored potential project ideas related to data analytics and advanced analytics applications. - Identified the requirement that the project output should be reusable and suitable for a portfolio. - Defined the project knowledge gap and learning objectives.

Jan 13, 2026	1.5	- Researched system architecture options, focusing on integration between front-end and Python-based backend services.
		
		- ChatGPT prompts:
		  • *"how to make interaction between backend and frontend by python?"*
		  • *"which APIs are used for interaction other than fastAPI?"*
		  • *"compare these APIs, including fastAPI, in term of a researched project"*

Jan 14, 2026	4	- Researched database management system options for the project.
		
		- Researched interaction between Python and SQL Server.
		
		- Studied how Power BI connects to SQL Server to generate dashboards.
		
		- ChatGPT prompts:
		  • *"which dbms is good for a researched project of business intelligence platform?"*
		  • *"compare PostgreSQL and sqlServer developer edition?"*
		  • *"compare integration between tableau and power BI to sql server"*

Jan 15, 2026	2	- Designed the overall project workflow from data ingestion to front-end visualization.

		- Drafted the idea and scope.
		- ChatGPT prompts:
		  • *"wording the scope"*
		  • *"how to publish power BI dashboard to website"*

Jan 20, 2026	4	- Researched advanced features including sales forecasting, business recommendations, and text-based analysis.
		- Refined the project flow and the final list of core features.
		- ChatGPT prompts:
		  • *"how to use machine learning to analyze texts?"*
		  • *"what roles of ML and NLP in text analytics"*

Jan 21, 2026	2	- Prepared the initial draft of the proposal, including research objectives and an outline of the research methodology and system design. - ChatGPT prompts: • *"wording the input paragraphs"*
Jan 22, 2026	3	- Continued drafting the proposal, focusing on research methodology and system architecture details. - ChatGPT prompts: • *"wording the input paragraphs"*
Jan 23, 2026	4	- Searched for suitable datasets recommended by the instructor. - Updated the project timeline to extend the schedule by two additional weeks and adjusted milestone activities.
Jan 25, 2026	3	- Polished the proposal draft and reviewed content for clarity, structure, and consistency. - Submitted the proposal to the instructor for feedback and suggestions.

Jan 26, 2026	0.5	- Final review and submitted the final proposal through the course portal.

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