|  |
| --- |
| BELGIUM CAMPUS |
| MLG382 PROJECT CYO |
|  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | | Student | Student Number | | Karl Christiaan Schmutz | 577511 | | Noah Blaauw | 601195 | | Gordon Mullin | 600248 | | Eduard Jacobus Engelbrecht | 600237 |   14/04/2025 |

Contents

[Introduction 2](#_Toc195534674)

[Research Problem 3](#_Toc195534675)

[Dataset Details 4](#_Toc195534676)

[ML Model(s) 5](#_Toc195534677)

[Web Application 6](#_Toc195534678)

[Development Process 7](#_Toc195534679)

[Deployment Steps 8](#_Toc195534680)

[Conclusion 9](#_Toc195534681)

[References 10](#_Toc195534682)

# Introduction

For small to medium businesses Inventory Management has become a hard requirement (Praveen et al., 2020), the importance of effective inventory management cannot be underestimated. It allows for operational efficiency and improving customer satisfaction whilst, traditional approaches frequently prove to be lacking in addressing the issues associated with fluctuating demand, variable supplier lead times, and the associated risks of overstocking or stockouts. The application of machine learning presents a comprehensive solution by harnessing historical sales data, analysing market trends, and evaluating supply chain variables. Using these predictions organizations can mitigate risks. According to (Praveen et al., 2020) high competition, labour unrest and changes in governmental laws can be addressed with predictions for products and services. This produces precise demand forecasts and optimizes inventory levels. Applying an inventory management methodology gives predictive insights and encourages better decision making (Chaudhary et al., 2023). Inventory management then changes from a reactive measure to a proactive strategy.

# Research Problem

Vertex PC Supply faces multiple internal inventory management challenges that significantly impact both operational efficiency and customer satisfaction. Despite collecting vast amounts of sales and inventory data, the company struggles to understand how to change this information into a proactive response to stop these issues from happening. Below are the Key issues discussed:

* Frequent Stockouts of High-Demand Items:
  + Incorrect demand forecasting often leads to empty shelves during peak demand period, resulting in lost sales and a decline in customer trust (Chaudhary et al., 2023).
* Excess Inventory and Elevated Carrying Costs:
  + Over purchasing of certain items causes surplus inventory, and a demand for capital incurring unnecessary storage expenses (Chaudhary et al., 2023).
* Failure to Adapt:
  + Inventory management models fail in adapting to immediate market changes. This is due to relying on obsolete algorithms and static data (Pasupuleti et al., 2024), leading to unusable data that fails in providing any complex prediction analysis.
* Cost and Complexity:
  + Designing machine learning models can take a long time before it is effective and beneficial to the business. Costs are impacted not only by the time required for the model to be developed and deployed but also the expertise required to design it (Chaudhary et al., 2023).
* Unstructured Data Performance:
  + Neural networks tend to perform poorly when handling unstructured inventory data, leading to less accurate predictions (Praveen et al., 2020). The data must be fixed and ready for analysis before any model application can be done.

The aim of this research is to design and implement a machine learning framework that addresses these challenges by predicting future demand accurately and recommending optimal reorder quantities and timings. By doing so Vertex PC Supply can improve inventory turnover, reduce costs and elevate service levels across its entire distribution network.

# Dataset Details

The dataset utilized for this research contains various data from Vertex PC Supply, which provides essential variables that significantly impact inventory management decisions. Following are attributes within the dataset:

|  |  |
| --- | --- |
| Attribute | Description |
| RegionName | Region of operation |
| CountryName | Country of transaction |
| State | State within country |
| City | City of transaction |
| WarehouseName | Warehouse fulfilling order |
| CategoryName | Product category (e.g., GPU) |
| ProductName | Specific product name |
| ProductStandardCost | Standard unit cost |
| Profit | Profit per unit |
| ProductListPrice | Product list price |
| CustomerCreditLimit | Customer’s credit limit |
| Status | Order status |
| OrderDate | Date of order |
| OrderItemQuantity | Quantity per order item |
| PerUnitPrice | Price paid per unit |
| TotalItemQuantity | Total items in order |

The dataset provided by [Kaggle](https://www.kaggle.com/datasets/hetulparmar/inventory-management-dataset) captures essential details across geographic locations, product specifications, financial metrics and order details. It includes attributes such as region, country, and warehouse to track the flow of inventory, alongside product categories and specific component names for precise analysis. Pricing elements like standard cost, list price, and per-unit price help in financial evaluation, whilst quantities and order dates enable demand forecasting and trend analysis. Additional fields such as customer credit limits and order status support customer management and operational efficiency. Combining these attributes provides a comprehensive view to effectively apply machine learning for inventory optimization and decision making.

# ML Model(s)

# Web Application

# Development Process

# Deployment Steps

# Conclusion

# References

Praveen, K.B. et al. (2020) 'Inventory Management using Machine Learning', *International Journal of Engineering Research & Technology (IJERT)*.