WGU C951

Task 3 (Revision 2) (Attempt 3)

MACHINE LEARNING PROJECT PROPOSAL

Andrew Duliba

Student ID # 003300689

Date 07/31/2023

Table of Contents

A. Project Overview.....pg3
A.1. Organizational Need pg3
A.2. Context and Background.....pg3
A.3. Outside Works Review pg3-6
A.4. Solution Summary..... pg6
A.5. Machine Learning Benefits.....pg7
B. Machine Learning Project Design.....pg7
B.1. Scope pg7
B.2. Goals, Objectives, and Deliverables pg10
B.3. Standard Methodology pg12
B.4. Projected Timeline pg15
B.5. Resources and Costs..... pg15
B.6. Evaluation Criteria pg16
C. Machine Learning Solution Design..... pg16
C.1. Hypothesis..... pg16
C.2. Selected Algorithm..... pg17
C.2.a Algorithm Justification..... pg17
C.2.a.i. Algorithm Advantage pg17
C.2.a.ii. Algorithm Limitation pg17
C.3. Tools and Environment pg17
C.4. Performance Measurement..... pg17
D. Description of Data Sets pg18
D.1. Data Source pg16
D.2. Data Collection Method..... pg16
D.2.a.i. Data Collection Method Advantage..... pg16
D.2.a.ii. Data Collection Method Limitation pg16
D.3. Data Normalization..... pg16
D.4. Data Security..... pg19
References.....pg20

A. Project Overview

A.1. Organizational Need

The proposed project aims to address the organizational need of improving the inventory management system at ChairCare Solutions, a company that sells medical wheelchairs and parts. The current system lacks a user-friendly dashboard and an efficient way of displaying and calculating its key performance indicators (KPIs). Specifically, ChairCare Solutions would like to have the ability to predict future sales. For this reason, a machine learning engineer will be hired to do a design overhaul on their current Inventory MGMT system as well as implement machine learning capacities to predict future sales metrics.

A.2. Context and Background

ChairCare Solutions requires an upgraded inventory management system to streamline operations, enhance decision-making, and improve overall efficiency. By upgrading ChairCare Solutions UI they will be able to better track their inventory. Additionally, by implementing machine learning techniques, particularly in forecasting future sales, the company can make data-driven inventory decisions, optimize stock levels, and improve customer satisfaction.

A.3. Outside Works Review

In section A3 below, the first URL, from Yale University, provides an introduction to linear regression, covering its basic mathematical principles while also giving real-world examples of its use case (Linear Regression). Specifically, this article shows how to apply linear regression to a dataset onto a scatterplot. This is directly relevant to the inventory management system, as it can help predict future inventory needs based on past sales data. Next, it details its predictive capacities by using a common method of linear regression known as "least squares regression." This method is used to create a line that best fits future data relative to past data variances. For my inventory management system solution, I intend to use this scatter plot diagram to implement a visual KPI display with machine learning integration. Additionally, in the article, there is an example showing how to apply linear regression to a scatter plot using two variables. The example uses the variables of the number of TVs in a household and the number of people per physician in a given country to predict the wealth of that country. Since these two variables are positively associated the linear regression equation is able to take two ambiguous datasets and merge them to predict other relevant statistics. I felt this example was useful and intuitive to use for an inventory MGMT system where several different data sets can be used to predict relevant KPIs for reporting. Lastly, this example can be adapted to the inventory management system by replacing the variables with relevant inventory and sales data.

The second URL, from IBM, offers an overview of linear regression within the context of machine learning. It explains different types of linear regression models giving a holistic understanding of the mathematical concept (About Linear Regression). Specifically, it covers what linear regression is, how it uses past data to create accurate predictions, why linear regression is important, and gives detailed examples of when and how to use linear regression effectively for your machine learning solutions, which is directly relevant to the inventory management system. One of the examples covered linear regressions in relation to sports

statistics where different player stats could be used to predict their performance in future games. I felt this example correlated well with products in an inventory MGMT system being similar to players in an upcoming game, both have meaningful stats to use to predict future outcomes. This article helped to build a comprehensive understanding of linear regression as it follows the logical questioning of answering what linear regression is and how to use it properly in a machine-learning solution. Lastly, it helped me apply the example of sports statistics to products and parts for my inventory management system.

The third URL, an article from KDnuggets, presents a list of essential machine learning algorithms, including linear regression. It discusses the 3 types of machine learning/AI algorithms known as "supervised learning", "unsupervised learning", and "reinforcement learning" (Li). Next, several machine learning algorithms are covered to give a broad overview of what solutions might be best suited for a machine learning solution. It discusses the strengths, weaknesses, and common use cases of these algorithms, which helped me ultimately choose linear regression for my machine learning algorithm. As a side note, this article was posted on the student resources for choosing a machine learning solution for a capstone project catered towards machine learning.

- Comment to evaluator: I've added 3 new outside sources to my proposal, but would like to mention, the original three, despite being graded as unsatisfactory, were the primary sources of the rest of my paper.

The fourth URL, from Liquid Web, delves into the application of AI in inventory management, highlighting the benefits of predictive analytics in optimizing stock levels and reducing costs ("AI in Inventory Management"). This article is relevant to the inventory management application because it details the importance of AI and machine learning in predicting future sales and managing inventory levels, which is exactly what ChairCare Solutions needs. The article provides a comprehensive overview of how AI can be used to analyze past sales data and predict future sales trends, which is crucial for the inventory management system. The insights from this article will be instrumental in integrating the machine learning component of my inventory management system, specifically in the area of sales prediction and inventory optimization.

The fifth URL, from Matellio, discusses the role of machine learning in inventory management, emphasizing its potential in enhancing productivity, ensuring accuracy and scalability, aiding in replenishment management, and assisting in waste management ("7 Ways Machine Learning Can Shape the Future of Inventory Management"). This article is directly related to my project as it provides practical insights into how machine learning can be leveraged to improve various aspects of inventory management. The article also provides examples of how machine learning can be used to automate the stocking and fulfillment processes, how to stock products more efficiently, and how to make the delivery processes more efficient. These insights will be invaluable in refining the machine learning component of my inventory management system.

The sixth URL, an article from Supply Chain Data Analytics, provides an in-depth discussion on the use of regression analysis in supply chain management and enterprise resource planning (ERP), with a focus on demand forecasting and inventory control ("Regression analysis for SCM and ERP"). This article is highly relevant to my project as it provides a detailed overview of

different types of regression models used for demand forecasting and inventory control, including linear regression, time series regression, logistic regression, and Poisson regression. The article also provides examples of how major companies like Amazon, Walmart, Procter & Gamble, and Ford use regression analysis to optimize their supply chain operations. Although, this article mentions many different regression models, the only model I am interested in is linear regression. Despite this, gaining a holistic understanding of all regression models helped to reinforce my decision to choose linear regression for the inventory management system over all the others.

A3a. Relation to Project Development

http://www.stat.yale.edu/Courses/1997-98/101/linreg.htm:

Relation to the Project: This work is relevant to the development of an inventory MGMT application with machine learning integration because it serves as a foundational resource for understanding the principles and methodology behind linear regression. It provides insights into the use cases of linear regression, sales prediction being one of them, which will be a key feature in the inventory management application. Since linear regression can be used to predict future sales, this means it can be used to optimize inventory levels. For example, if a linear regression model is used to predict that sales of a particular product will increase in the next month, then the inventory level of that product can be increased to ensure that there is enough stock to meet demand. Additionally, the article covers a specific example where linear regression is applied to. In this example, there is a data set with two variables, the number of people per television set and the number of people per physician for 40 countries. Linear regression is applied to predict the wealth of each country since both variables are positively associated with wealth. Examples like these are beneficial for helping to develop a use case for using linear regression to solve machine learning problems.

https://www.ibm.com/topics/linear-regression:

Relation to the Project: This work aligns with the development of the inventory MGMT application because it offers practical insights and examples of how linear regression can be applied in machine learning scenarios. Specifically, the article mentions three examples, one on how to analyze pricing elasticity, one on how to assess risk in an insurance company, and one on sport analysis. In the example detailing sports analysis, the article describes how linear regression can be used for predictive capabilities. Although the example uses sports statistics, there is an obvious carry-over to inventory MGMT as the statistics of players is no different than the statistics of products. These insights were useful in developing and reinforcing my choice to use linear regression for this project and relate to my project because sales prediction is a key need for ChairCare Solutions.

https://www.kdnuggets.com/2016/08/10-algorithms-machine-learning-engineers.html:

Relation to the Project: Although this article covers a broad range of machine learning algorithms beyond linear regression, it is important and relevant to the development of ChairCares application, because it offers a broad range of machine learning concepts. Understanding the different algorithms and their respective strengths and limitations will

reinforce the choice to use linear regression. Additionally, it provides a broader perspective on the potential applications of machine learning beyond linear regression that could be implemented in the future. Again this article is relevant to the project because it not only identifies the core concepts of linear regression and how it is applied, but additionally, this article provides many other machine learning concepts that could be used in the future for ChairCare solutions and their machine learning needs.

https://www.liquidweb.com/blog/ai-inventory-management/

Relation to the Project: This work is relevant to the development of an inventory MGMT application with machine learning integration because it provides a detailed overview of how AI and machine learning can be used to optimize inventory levels and reduce costs. The article discusses how AI can be used to analyze past sales data and predict future sales trends, which is a key feature of the inventory management system I am developing. The insights from this article will be invaluable in enhancing the machine learning component of my inventory management system, particularly in the area of sales prediction and inventory optimization. ("AI in Inventory Management").

https://www.matellio.com/blog/machine-learning-for-inventory-management/

Relation to the Project: This work aligns with the development of the inventory MGMT application because it shows how machine learning can be applied in inventory management scenarios. Specifically, the article discusses how machine learning can enhance productivity, ensure accuracy and scalability, aid in replenishment management, and assist in waste management ("7 Ways Machine Learning Can Shape the Future of Inventory Management"). These insights are directly applicable to my project as they provide practical examples of how machine learning can be used to improve various aspects of inventory management, which is a key need for ChairCare Solutions.

https://www.supplychaindataanalytics.com/regression-analysis-for-erp-and-scm/

Relation to the Project: This work is relevant to the development of an inventory MGMT application with machine learning integration because it provides a detailed overview of how regression analysis can be used in supply chain management, which is a key need for my inventory management system. Additionally, the article focuses on demand forecasting and inventory control, which will relate to some of the projects deliverables, goals, and scope that will be discussed later in the project. The insights from this article will be crucial in understanding regression analysis and implementing it successfully into my machine learning solution for the inventory management system ("Regression analysis for SCM and ERP").

A.4. Solution Summary

The proposed solution involves implementing linear regression for sales forecasting. By analyzing historical sales data and leveraging the regression-js library, the inventory management system will generate predictions of future sales for each month of the upcoming year. This solution will provide valuable insights for inventory planning and optimization. It will also assist fellow ChairCare employees who run reports each week, month, and year by equipping them with the ability to quickly forecast the upcoming metrics for specific KPIs. This

machine learning solution will improve the company's decision-making and enable their employees to work more optimally.

A.5. Machine Learning Benefits

Benefits of the Proposed Machine Learning Solution:

1. Accurate Sales Forecasts: The machine learning solution will provide ChairCare Solutions with accurate predictions of future sales, enabling better inventory planning and optimization.
2. Improved Decision-Making: By having a general idea as to how much you will sell a product, you will generally have an idea of how much inventory you will need to fill. By utilizing predictive forecasts, the company can make data-driven decisions, such as adjusting production levels, identifying potential stockouts, and optimizing procurement strategies, all of which lead to improved decisions.
3. Enhanced Efficiency: The solution will automate the calculation of key performance indicators, saving time and effort previously spent on manual calculations. This solution will benefit the employees of ChairCare by improving their workflow.
4. Improved Customer Satisfaction and Retention: By optimizing stock levels and reducing instances of out-of-stock situations, which can be very problematic for customer retention and satisfaction. By utilizing machine learning, the company can ensure timely product availability, leading to improved customer satisfaction and retention.

B. Machine Learning Project Design

B.1. Project Scope

The scope of the proposed machine learning project is to develop an upgraded inventory management system that includes a user-friendly login and dashboard, KPI displays, and sales forecasting capabilities. The scope of the project includes critical project activities such as goals, deliverables, tasks, project members, deadlines, and milestones.

The scope of the project includes the following three goals:

Goal 1: To improve the organizational impact of the inventory management system by increasing sales and reducing costs.

Goal 2: To implement machine learning capabilities into the inventory management system to enable accurate sales forecasting.

Goal 3: To enhance the security of the inventory management system to protect sensitive data.

The scope of the project includes the following three deliverables:

Deliverable 1: A machine learning-enabled inventory management system that can accurately forecast sales.

Deliverable 2: A more secure inventory management system that protects sensitive data.

Deliverable 3: A report that summarizes the project's impact on sales, costs, and security.

The scope of the project includes the following tasks and their intended outcomes:

- **Analysis and Redesign:** The existing inventory management system will be analyzed to identify areas for improvement. The system will then be redesigned to address existing UI issues and enhance the overall user experience.
    - **Intended outcome:** The redesigned system will be more user-friendly and intuitive, making it easier for users to find the information they need and make informed decisions.
- **User Log-in Screen Upgrade:** The user log-in screen will be enhanced with improved security measures and a streamlined authentication process.
    - **Intended outcome:** The upgraded log-in screen will be more secure and easier to use, reducing the risk of unauthorized access to the system.
- **User-Friendly Dashboard Upgrade:** A user-friendly dashboard will be developed that presents relevant information in a visually appealing and intuitive manner. The dashboard will provide real-time data updates, customizable views, and interactive visualizations.
    - **Intended outcome:** The dashboard will provide users with a central location to view and interact with important inventory data, making it easier to track performance and make informed decisions.
- **Key Performance Indicator (KPI) Displays:** KPI displays will be implemented to track and monitor important metrics related to inventory management. These displays will highlight key performance indicators, such as sales, stock levels, turnover rates, and customer satisfaction.
    - **Intended outcome:** The KPI displays will provide users with a clear view of how the inventory management system is performing, helping them identify areas for improvement, and speeding up the reporting process.
- **Sales Forecasting using Linear Regression:** Machine learning capabilities will be integrated into the inventory management system to enable accurate sales forecasting. Linear regression algorithms will be used to analyze historical sales data and predict future sales trends. Linear regression will be integrated into one of the visual displays to automate reporting and display predictions to improve ChairCare Solutions' business decisions.
- **Intended outcome:** The sales forecasting capabilities will help ChairCare Solutions to make better decisions about inventory levels and pricing, leading to increased sales and profits.

The scope of the project includes the following project members:

Project Member 1: Andrew Duliba - Machine Learning Engineer

Project Member 2: Bob Davis - QA Tester

Project Member 3: John Johnson - ChairCare Solutions CEO

Project Member 4: Diane Gilmore - Reporting Specialist

The scope of the project includes the following deadlines and milestones

1. **Deadline**: July 15th, 2023

- **Milestone**: Completion of the planning and design phase of the project. This milestone will be completed when all project members have signed off on the completion of this phase and have mutually agreed on how the inventory management system will function and look.

1. **Deadline**: August 5th, 2023

- **Milestone**: Completion of the Development Iteration 1 phase. This milestone will be completed when the login screen and dashboard have been completed (not including the KPI displays). Once all project members have signed off on the completion of these tasks this phase will be completed and the milestone will be met.

1. **Deadline**: August 20th, 2023

- **Milestone**: Completion of the Development Iteration 2 phase. This milestone will be completed when KPI displays have been incorporated into the dashboard with all of the inventory management product data incorporated into the inventory management system. Additionally, users must be able to query the products within the system so that they may add, remove, and delete items. Once all project members have signed off on the completion of these tasks this phase will be completed and the milestone will be met.

1. **Deadline**: August 28th, 2023

- **Milestone**: Completion of documentation and testing. This milestone will be completed when all the necessary documentation has been completed to verify the inventory MGMT systems completion, and all functionality has been tested by a QA tester. Once all project members have signed off on the completion of these tasks this phase will be completed and the milestone will be met.

The scope of the project does not include the following:

- **Data cleaning:** The project will not include a full-scale data cleaning effort.
- **Other applications of machine learning:** The project is focused on sales forecasting. The project does not include other applications of machine learning, such as customer segmentation or product recommendations.

In summary, the project scope encompasses activities such as analysis, redesign, log-in screen upgrade, dashboard upgrade, KPI displays implementation, and sales forecasting integration. The intended outcomes include an improved user experience, enhanced security measures, a user-friendly dashboard, informative KPI displays, and accurate sales forecasting. These outcomes collectively aim to enhance efficiency, usability, and decision-making capabilities within the inventory management system.

B.2. Goals, Objectives, and Deliverables

The proposed project is a comprehensive effort to improve the inventory management system at ChairCare Solutions. The project has three main goals, three objectives, and three deliverables.

The proposed project has the following goals:

- **Goal 1:** To improve the organizational impact of the inventory management system by increasing sales and reducing costs. This goal relates to cost savings and could be considered a "cost goal."
    - The goal is to enhance the efficiency and effectiveness of the inventory management system, resulting in increased sales and decreased costs for ChairCare Solutions. By optimizing inventory levels, improving demand forecasting, and streamlining processes, the system will drive better sales performance and cost savings. This will give ChairCare Solutions the necessary insights to align its inventory levels with incoming demand and capitalize on market opportunities, resulting in an increase in sales.
- **Goal 2:** To implement machine learning capabilities into the inventory management system to enable accurate sales forecasting. This goal relates to cost savings and productivity since it automates the ability to report KPIs due to its predictive capabilities. This goal could be considered either a "cost goal," or a "productivity goal."
    - The goal is to leverage machine learning algorithms to enhance the accuracy of sales forecasting. Machine learning can be used to analyze historical sales data and incorporate external factors, such as market trends and seasonality, which can be used to provide reliable sales prediction through mathematical calculation. Machine learning can be utilized to help ChairCare Solutions make more informed decisions regarding their inventory planning, production, and sales strategies resulting in cost savings and productivity improvements.
- **Goal 3:** To enhance the security of the inventory management system to protect sensitive data. This goal relates to improvement and could be considered an "improvement goal."
    - The goal is to strengthen the security measures within the inventory management system. By enhancing the system's security, ChairCare Solutions can safeguard sensitive data, protect against unauthorized access, and maintain compliance with data privacy regulations. As ChairCare Solutions grows, it's important to establish a security backbone in its inventory MGMT system. For this reason, scalability will be implemented into its security system contributing to an overall improvement to the inventory MGMT system.

The project has the following objectives:

- **Objective 1:** To increase sales by 10% by providing accurate sales forecasting and insights.
    - The objective is to develop a machine learning-enabled sales forecasting model that delivers accurate predictions and insights via linear regression. By predicting accurate sales forecasts, ChairCare Solutions can use this information to align inventory levels with demand, which in turn will less out of stock situations and

more market opportunities. With increased market opportunities and superior predictive capabilities, the targeted sales increase will be 10%.

- **Objective 2:** To reduce costs by 5% by optimizing inventory levels and reducing waste.
    - The objective is to optimize inventory levels and minimize waste in order to reduce costs and increase savings. By leveraging accurate sales forecasts, ChairCare Solutions can align inventory levels with demand, minimize stockouts, and reduce overstocking. This will lead to improved inventory turnover, reduced carrying costs, and overall cost savings of 5%. Additionally, it will benefit customer satisfaction due to decreased stock outages.
- **Objective 3:** Develop a machine learning-enabled sales forecasting model with a target accuracy of 90%:
    - The objective is to build a sophisticated machine-learning model that will be able to forecast future sales with an accuracy of 90%. Machine learning models, specifically linear regression, utilize historical sales to make accurate predictions and have demonstrated extreme accuracy on various data sets. This machine learning method will provide ChairCare Solutions with reliable sales forecasts to support informed decision-making and optimize inventory planning.

The project will have the following deliverables:

- **Deliverable 1:** A machine learning-enabled inventory management system that can accurately forecast sales. This deliverable is the ultimate deliverable of the project, the remaining deliverables are subsections or parts of this deliverable.
    - The deliverable is an upgraded inventory management system integrated with machine learning capabilities. It will include a sales forecasting model developed using machine learning algorithms, such as linear regression. The system will provide accurate sales predictions to support inventory planning and decision-making as well as streamlined reporting capabilities.
- **Deliverable 2:** An upgraded login and dashboard for the inventory MGMT system. This deliverable is a component of the software system that is the Inventory MGMT system.
    - The login screen will provide a more user-friendly UI and will be enhanced with state-of-the-art two-factor authentication, making ChairCare Solutions' data more secure from cyber-attacks. Additionally, the dashboard will provide a more user-friendly UI that will have improved navigation and KPI visibility. These deliverables will aid in improving the overall functionality and workflow of ChairCare Solutions and are consistent with the wants and needs of the company.
- **Deliverable 3:** A report that can be auto-generated through the upgraded system's improved functionality.
    - The deliverable is a comprehensive report that captures the company's current and future sales and costs. It will include an analysis of the achieved sales increase, and cost reduction, and be able to reliably make accurate predictions for these key financial figures. The report will provide valuable insights for stakeholders and serve as a reference for future decision-making.

The proposed project has the potential to significantly improve the efficiency and effectiveness of ChairCare Solutions' inventory management system. The project's goals and objectives are aligned with the company's overall business goals, and the deliverables are specific, measurable,

achievable, relevant, and time-bound. Additionally, the goals are qualitative in nature, the objectives are quantitative, and the deliverables are clearly defined making it so that each portion properly corresponds to their necessary descriptions.

B.3. Standard Methodology

For this project, we will apply the CRISP-DM (Cross-Industry Standard Process for Data Mining) methodology. The project will go through the following phases:

1. **Business Understanding:**

- **Determine business objectives/data goals:** Gain a deep understanding of ChairCare Solutions' inventory management business objectives. ChairCare Solutions' objectives, success criteria, and desired business outcomes will be defined and agreed upon
- **Assess situation:** The project members will assess the situation and determine the resources, requirements, risks, and contingencies ChairCare Solution has (Hotz). Once complete the project members will conduct a cost-benefit analysis.
- **Produce project plan:** Once all of these steps are complete, the project team will make a project plan and present it to ChairCare Solutions. The plan will include all the technologies, tools, scope, goals, objectives, deliverables, team members, etc. ChairCare Solutions will then sign off on the project plan officially kicking off the project's start.

1. **Data Understanding:**

- **Collect initial data:** The project team will analyze and collect the current inventory systems data related to their inventory.
- **Describe data:** The data that was analyzed and collected will be examined to identify properties such as data format, number of records, attributes, etc. All of this will be described in a separate document.
- **Explore data:** Beyond just a description of the data, the project team will begin to identify and document relationships within the data set (Hotz). How objects in the dataset are linked together by private and foreign keys to gain a better understanding of how to make changes to the dataset.
- **Verify data quality:** Lastly, the project team will determine the quality of the data. Is the current data in the inventory system cluttered and unorganized? Is the data clean? This will be documented with the rest of the observations the team made throughout this project phase.

1. **Data Preparation:**

- **Select data:** After gaining a better understanding of the underlining data that constitutes the current inventory MGMT system, the team will begin selecting the data they deem relevant to the project plan.
- **Clean data:** If there are any errors in the current data they selected, they will begin the process of cleaning the data. Without properly cleaned data, all of the issues ChairCare Solutions had previous to the project team's involvement will remain without this necessary step.

- **Construct data:** Once cleaned, if the data is incomplete, new attributes will be added to the dataset. This will aid in the completion of the project plan. Some new attributes may be necessary to add in order to properly implement the machine learning solution. With this in mind, the data will be constructed to match the needs of the machine-learning solution.
- **Integrate data:** The newly constructed data will be reformatted and integrated into the old to create a new data set.
- **Format data:** If any of the data shows improper data typing, that data will be reformatted to match its proper typing. For example, from a string value to a numeric value. Once completed the data set will be fully prepared and the next phase will begin (Hotz).

1. **Modeling:**

- **Select modeling techniques:** The project team will select the machine learning method of linear regression that was discussed and agreed upon by ChairCare Solutions while preparing the project plan.
- **Generate test design:** The project team will split the prepared data set into training, test, and validation sets (Hotz). These sets will be crafted with test design in mind to specifically query the data within the set based on testing criteria.
- **Build model:** In this step, the project team will use the machine learning solution to build the model of their data. Since Linear regression was chosen, this means the linear regression solution will use the data set to create a best-fit line that will reliably predict the future sales of ChairCare products.
- **Assess model:** The model created by the linear regression solution will be analyzed and verified for its accuracy. Specifically, one of the objectives of the project was for the machine learning solution to be within 90% accuracy. Other key objectives will be verified later on after the inventory systems deployment. This will be completed by a data specialist project member and a reporting specialist project member. Now the modeling phase is complete and the project team will begin the next phase.

1. **Evaluation:**

- **Evaluate results:** Similar to the asses model portion of the model phase, this part of the evaluation phase will more closely verify that the model meets the business success criteria, which will be linked to the project plans objectives. The team will verify if the machine learning solution has 90% accurate predictive capabilities. The other objectives cannot be tested until the end of the quarter so these success criteria will be tested later on.
- **Review process:** In this step, the project team will review the project up until this point. They will determine if anything was overlooked, if all the steps detailed in the project plan were followed, summarize their finding, and correct anything if needed (Hotz).
- **Determine next steps:** Based on the results and review process the team will sit down with ChairCare Solutions and discuss whether or not to add anything to the existing project, begin deployment, or start a new project (Hotz).

1. **Deployment:**

- **Plan deployment:** When given the confirmation from ChairCare Solutions to move forward with deployment, the team will discuss with ChairCare Solutions how they would like to go about deployments. This involves documenting any key dates or needs from ChairCare Solutions and compiling this documentation into an official plan to be signed off on.
- **Plan monitoring and maintenance:** Some of the most important documentation to be noted for the deployment plan is how the deployment will be monitored and maintained. Avoiding issues during the post-project phase is integral to the success of a project, so consulting with ChairCare Solutions as to how this step will be conducted will be documented and signed off on before launch. (Hotz).
- **Produce final report:** The project team will put together a final report based on all other phase findings up until this point. This report will be presented to prep the team for the next step of deployment which is a retrospective or review.
- **Review project:** The team will use all the information fresh on their mind from the final report to conduct a retrospective. In the review, the team will discuss everything that went well and everything that went wrong. Additionally, the team will discuss what they could have done better, or added to the project (Hotz). All of this information will be documented and saved for future projects to contribute to the success of future endeavors.

Following the CRISP-DM methodology ensures a structured approach to project implementation, allowing for iterative development, continuous evaluation, and refinement of the machine-learning solution. Each phase will be carefully executed with specific tasks and actions tailored to the project's scope, goals, objectives, and deliverables detailed within the project plan.

B.4. Projected Timeline

The project team will utilize the agile methodology concept of sprints in tandem with the CRISP-DM methodology to iterate through and complete the inventory MGMT system project. For this reason, the projected timeline will be broken down into 4 separate sprints.

· Sprint 1: Planning and Design (July 6th - 15th)

· Sprint 2: Development Iteration 1 (July 16th - August 5th)

· Sprint 3: Development Iteration 2 (August 6th - 20th)

· Sprint 4: Testing, Documentation, and Deployment (August 21st - 28th)

· Total Project Duration: 7 weeks

· Start Date: July 6th

· End Date: August 28th

Sprint Schedule

Sprint	Start	End	Tasks
1	July 6th	July 15th	Planning and Design
2	July 16th	August 5th	Development Iteration 1
3	August 6th	August 20th	Development Iteration 2
4	August 21st	August 28th	Documentation and Testing

B.5. Resources and Costs

Resource	Description	Cost
Hardware	- The existing infrastructure is sufficient. - 25,000$ will be set aside to purchase new computer hardware if the current infrastructure were to become damaged at any point during development.	25000$
Software	Vs Code, JavaScript MERN stack, React JS, MongoDB, Express JS, Node JS, regression-js library, recharts library	0$
Labor/Work Hours	- A Machine Learning Engineer has been employed at a rate of 60$ per hour and the time to completion is expected to be 280 hours. - A QA Tester has been employed at a rate of 60$ per hour and the time to completion is expected to be 280 hours. - A Reporting Specialist has been employed at a rate of 60$ per hour and the time to completion is expected to be 280 hours.	16800$ 16800$ 16800$
Cloud Hosting	- A yearly contract with Amazon AWS which includes: 100TB of space and support.	4800$
	Total	(80,200$)

B.6. Evaluation Criteria

Describe the criteria used to evaluate and measure the success of the completed project.

Objective	Success Criteria

To increase sales by 10% by providing accurate sales forecasting and insights.	• Total sales from the previous quarter will be tracked. Upon the completion of the next quarter, the total will be measured and compared to the previous quarter. The expected result will be a 10% increase or greater. If this is not met then the objective will be documented as a failure. If there is a 10% increase in sales, then the objective will be ruled a success. Additional: • Time saved for employees through automated KPI calculations. • Improved efficiency in inventory management processes through employee feedback on workflow.
To reduce costs by 5% by optimizing inventory levels and reducing waste.	• Total inventory costs will be totaled and documented for the previous quarter. Inventory costs will include figures like carrying costs, stock out scenarios, etc. Upon completion of the next quarter the total for that quarter will be totaled and documented. Lastly, the two quarters will be compared and if there is not a 5% reduction in the total inventory costs then the objective will be ruled a failure. If there is a 5% reduction the objective will be a success. Additional: • User feedback on the improved dashboard and login user interface. • Reduction in the number stockout scenarios
Develop a machine learning-enabled sales forecasting model with a target accuracy of 90%:	• A dedicated report specialist will review the predictions made by the machine learning solution for an upcoming month. If the machine learning method of linear regression is 90% accurate or more, then the objective will be deemed successful. If not the objective will be deemed a failure. Additional: • Accuracy of sales forecasting compared to actual sales data. • Forecasting will be improved by 5-10%

C. Machine Learning Solution Design

C.1. Hypothesis

By implementing the machine learning concept of linear regression for sales forecasting, ChairCare Solutions can accurately predict future sales, enabling better inventory planning and optimization. This will lead to lower occurrences where products will be out of stock, which will

improve customer satisfaction and retention. With this machine learning implementation it is hypothesized that the forecasting accuracy will be 90% accurate, and is expected to increase in accuracy by 5-10% over time. Additionally, by optimizing inventory there will be a 5% reduction in inventory costs, and 10% increase in sales due to less frequent out of stock situations.

C.2. Selected Algorithm

The proposed solution will utilize machine learning by using linear regression to forecast future sales. Linear regression is suitable for this problem as it can establish a linear relationship between historical sales data and corresponding factors impacting sales. Linear regression creates a predictive line using $y = a + bx$ based on previously observed data. This line can then be used on a graph to predict future data based on its position on the line within the graph. This model fits perfectly for ChairCare because they not only want to visualize their KPIs but also utilize machine learning. Linear regression would solve both of these.

C.2.a.i.ii Algorithm Justification + Algorithm Advantage + Algorithm Limitation

Linear regression is advantageous for sales forecasting as it can capture underlying trends and patterns in historical data (Li). Additionally, linear regression fits perfectly for ChairCare because it will visually predict their future sales, which was the main purpose for hiring me as a machine learning engineer. Additionally, linear regression is easy to implement and not very expensive computationally. This will save on the costs and maintenance of the project. However, one limitation is that it assumes a linear relationship, which may not be suitable if there are unforeseen upcoming sales hurdles in ChairCare's future. Linear regression is not able to predict market conditions, it is only able to track growth and reduction of sales (Li). With this in mind, the algorithm will have some variance in its predictive capabilities, but with all things in marketing, there will be some degree of variance.

C.3. Tools and Environment

The proposed machine learning solution will be developed using the MERN (MongoDB, Express.js, React.js, Node.js) stack inside VS code. MongoDB is a database that will host all the data necessary for upkeeping inventory. The other three Javascript frameworks are libraries that will help with developing the front end and back end of the application. The front end relates to the user interface, or how the application will look to users. The back end relates to what functionality the application will have. For instance, when a user clicks a button, what will that button do? Third-party libraries such as regression-js and recharts will be utilized to implement linear regression and visualize the sales forecasting results. Additionally, when completed, the application will be distributed to employees and installed on their computers for use.

C.4. Performance Measurement

The performance of the machine learning solution will be measured by comparing the linear regression forecast of predicted sales with actual sales. Over time this will provide a qualitative assessment of the solution's performance. Additionally, when It comes to user satisfaction as a performance metric, by collecting user feedback on the dashboard and KPI displays, the inventory MGMT systems success can be tracked.

D. Description of Data Sets

D.1. Data Source

The data for the project will be sourced from ChairCare Solutions' historical sales records, including monthly sales data for the past few years.

D.2. Data Collection Method

The data collection method involves extracting historical sales data from ChairCare Solutions' existing systems. This data will be checked and verified with other employees for accuracy.

D.2.a.i. Data Collection Method Advantage

The advantage of using existing historical sales data is that it provides real-world insights into sales patterns and trends specific to ChairCare Solutions' business over a span of time. By using their existing data as a data set this will enable the machine learning concept of linear regression we have chosen for this project. Without historical data, there will be nothing to compare against to predict future sales and linear regression would be useless. This is why using this historical data set is so advantageous for the machine learning concept we have chosen.

D.2.a.ii. Data Collection Method Limitation

One limitation of relying solely on historical sales data is that it may not capture sudden market changes or external factors that could impact future sales. Additionally, the current historical sales data might be incorrect and contain errors, which could negatively affect our machine learning concept's predictive capabilities.

D.3. Quality and Completeness of Data

The collected data will be formatted and preprocessed for use by the linear regression algorithm. This includes handling missing data, outliers, and data anomalies, ensuring data integrity and accuracy. This data will be displayed using Recharts, a javascript library that utilizes HTML and CSS to create various graphs. Once the display has been created, the data will be moved through a linear regression algorithm via another javascript library known as regression-js. This will display two different lines on a line graph, a solid line with yearly sales, and a dotted line utilizing linear regression that predicts next year's sales. This data set will be verified and checked over by existing ChairCare Solution employees to verify its accuracy so that there are no missing data, outliers, or anomalies in the data set before going live with the improved inventory MGMT application.

D.4. Precautions for Sensitive Data

When working with sensitive data, ChairCare Solutions will exercise appropriate data security measures, including encryption, access controls, and compliance with relevant data protection regulations. Communication about sensitive data will be conducted securely, following established protocols to maintain confidentiality and integrity. If needed, confidentiality contracts can be signed between employees and ChairCare to maintain the secrecy of important

company information. Additionally, since ChairCare Solutions is a medical equipment provider, when necessary, proper protocols will be in place for maintaining patient confidentiality as it applies to HIPPA.

References

Le, James. "The 10 Algorithms Machine Learning Engineers Need to Know." *KDnuggets*, 18 Aug. 2016, www.kdnuggets.com/2016/08/10-algorithms-machine-learning-engineers.html.

"About Linear Regression." *IBM*, www.ibm.com/topics/linear-regression. Accessed 8 July 2023.

"Linear Regression." *Linear Regression*,www.stat.yale.edu/Courses/1997-98/101/linreg.htm. Accessed 8 July 2023.

Hotz, Nick. "What Is CRISP DM?" *Data Science Process Alliance*, 19 Jan. 2023, www.datascience-pm.com/crisp-dm-2/.

"AI in Inventory Management." Liquid Web, 2023, https://www.liquidweb.com/blog/ai-inventory-management/.

"7 Ways Machine Learning Can Shape the Future of Inventory Management." Matellio, 2023, https://www.matellio.com/blog/machine-learning-for-inventory-management/.

Felkl, Linnart M.Sc. "Regression analysis for SCM and ERP." Supply Chain Data Analytics, 2023, https://www.supplychaindataanalytics.com/regression-analysis-for-erp-and-scm/.