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An Analysis on various Machine Learning Algorithms (AI) & Nature Inspired Algorithms for modern Inventory Management

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***Abstract*—The following article refers to importance of AI and Machine Learning methods in handing inventory in an optimized manner. In the era of online shopping or retail shopping: stock managing, supply handling, items on hold, holding charges, return on Investment etc. affects the profitability and existenceof the entire channel of demand and supply. AI plays a majorrole in managing this with less or minimum human intervention and applying intelligence to maximize profit and make decision making strong. Here in this paper, we have reviewed few sets of algorithms that are AI based or Nature inspired and their contribution in this area of Inventory management which have proved their importance. Businesses can assess and manage their inventory levels, estimate demand, spot abnormalities, and automate repetitive operations with the help of AI based techniques like machine learning, natural language processing, and computervision. With the growth in the business, decision making using these algorithms can ease the very need of industry today. Many huge platforms like Amazon, Oracle and many others have shownthe importance of implementing these methods for InventoryHandling and Management.**

***Index Terms*—AI-powered inventory management, Machine Learning, Nature inspired Algorithm, Applied AI techniques in Supply Chains.**

I. Introduction

Any firm that requires regulating and supervising the manufacturing and supply process of goods and services from manufacturing to distribution must have inventory management. While inefficient inventorymanagement can lead to missed sales, increased carrying costs, and decreased customer satisfaction, effective inventory management can assure smooth operations, reduce wastage, and increase profitability. As a result, companies are constantlylooking for methods to enhance their inventory management systems in order to obtain a competitive advantage.

Businesses now have the opportunity to automate their inventory management procedures and significantly improve their operations thanks to the development of artificial intelligence (AI). Businesses can assess and manage their inventory levels, estimate demand, spot abnormalities, and automate repetitive operations with the help of AI based approaches like Machine Learning, natural language processing (NLP), and Computer Vision. Large-scale data analysis, precise demand forecasting, and real-time insights provided by AI-powered inventory management systems allow organizations to make knowledgeable decisions about inventory levels, order quantities, and deliveryschedules.

AI can therefore assist firms in lowering stock-outs,overstocks, and the expenses related to managing inventories.As more companies come to understand the advantages of this technology, there is a growing trend toward the deployment of AI in inventory management. According to a McKinsey study, the use of artificial intelligence (AI) in inventory management could save costs by up to 50% and boostinventory turnover by up to 25%. The use of AI in inventory management, however, is not without its difficulties. To reap the rewards of AI, businesses must navigate challenging data integration, process re-engineering, and change management.

The type of operations carried out affects how an organization manages its inventory. Utilizing technologies like AI will enhance how the organization manages its inventory. The following are some advantages that artificial intelligencecan bring to the management and enhancement of inventory management functions, per Kvartalyani2021's research:

- Automation of Inventory Monitoring: AI can assist companies in tracking their inventory levels in real-time, allowing them to make wise choices about restocking and order fulfillment. Businesses may decrease stockouts, minimize overstocks, and boost customer satisfaction by automating inventory monitoring.
- Data mining for Prediction: AI can accurately forecast

future demand for goods and services by analyzing huge number of data in enormous amount. By ensuring that the correct products are available at the right time, this function helps firms maximize inventory levels, save carrying costs, andenhance sales.

- **Robot Automation:** Routine processes like order picking and packing can be automated by robots driven by AI, cutting labor costs and decreasing errors. This feature enables firms to handle orders swiftly and precisely, increasing customer satisfaction and lowering inventory management expenses.
- **Forecasting Error Reduction:** AI can assist companies in identifying forecasting errors and anomalies, ensuring that inventory levels are optimized and orders are accurately filled. By lowering the possibility of stockouts and overstocks, this feature can increase customer happiness and profitability.
- **Consumer Experience Improvement:** Businesses can modify their inventory management procedures to satisfy customer needs by utilizing AI to assess customer behavior and preferences. By ensuring that the correct products are available at the right time, this function helps organizations increase customer happiness and sales.

By delivering insights that conventional inventory management methods were unable to deliver, the use of artificial intelligence (AI) to inventory management has fundamentally changed the way firms' function. Here are a few ways AImight assist firms in gaining insightful data for inventorymanagement:

- **Predictive Analytics** - AI can evaluate previous data and estimate future demand for goods and services, enabling businesses to decide on inventory levels, production plans, and order fulfillment in a well-informed manner. Businesses can adjust their inventory management procedures by using predictive analytics to uncover trends and patterns in customer behavior.
- **AI** is able to gather and analyze data in real-time, giving businesses access to the most recent data on inventory levels, stockouts, and order fulfillment. This feature can assist firms in promptly adjusting their inventory levels, lowering the possibility of stockouts, and enhancing customer happiness.
- **AI** can effectively identify products and their properties, such as size, color, and texture, using image recognition. The risk of overstocks or stockouts can be decreased by using this function to assist firms manage their inventory levels more efficiently.
- **Artificial Intelligence (AI)** can employ natural language processing (NLP) to analyze consumer reviews and feedback, giving firms insightful data about customer preferences and product demand. By adjusting inventory management procedures to fit client needs, firms canboost revenue and customer satisfaction.
- **Robotic Process Automation (RPA):** AI-driven robots are able to automate a variety of rote operations, including inventory management, order fulfillment, and warehouse management. This function can aid companies in lowering personnel expenses, minimizing mistakes, and enhancing operational effectiveness.
- Businesses may optimize their inventory levels, cut expenses, and improve customer happiness by using AI to give them useful inventory management insights. Businesses can obtain a competitive edge in today's market and succeed over the long run by utilizing AI in inventory management.

This paper intends to analyze the value that artificial intelligence can provide to inventory control. The report covers recent research and offers insights into the advantages and difficulties of applying AI in this setting. The study looks at case studies of companies that have used AI-powered inventory management systems, as well as the results they have obtained. The ultimate goal of this research paper isto give readers a thorough grasp of how AI adds value to inventory management while also providing helpful advice forcompanies looking to implement this technology.

II. Literature Review

A. Applied AI techniques in Supply Chains

Machine learning algorithms improve demand forecasting by incorporating large amounts of historical data, including customer behavior and market trends, into forecasting models. It can optimize inventory levels in real-time and helpidentify potential vulnerabilities and risks. Machine learning algorithms also reduce the risk of stock shortages or excess inventory, and minimize supply chain disruptions. The qualityof data used to train the algorithms must be ensured to avoid inaccurate forecasts. Machine learning models can be used to predict future demand based on historical data, market trends, and external factors. Accurate demand forecasting is crucial for businesses to optimize inventory levels and reduce stock- outs, which can lead to loss of revenue and customer dissatisfaction. The use of machine learning in demand forecasting has led to better prediction accuracy, reduced inventory costs, and improved customer satisfaction. According to the author'swork in [1], while recurrent neural networks and support vector machines do the best, their forecasting accuracy[22] is not statistically substantially better than that of the regression model.

Machine learning models [14] like as random forest and decision trees can help businesses identify critical variables that contribute to inventory risk, such as supplier performance, lead times, and customer demand. By analyzing historical data, businesses can gain valuable insights into potential vulnerabilities and take corrective action to mitigate risk. The useof machine learning in identifying vulnerabilities can lead to improved supply chain resilience, enhanced risk management,and cost savings. This author in [2] created tools for debuggingand checking software which offers inspiration for more investigation into methods for examining and evaluating neuralnetworks.

Machine learning models such as SVM and KNN can be used to analyze real-time data such as social media, weather patterns, and transportation information to predict potential disruptions in the supply chain. By proactively identifying potential disruptions, businesses can take corrective actionto avoid inventory shortages or excesses, reducing the riskof loss of revenue and customer dissatisfaction. The use of machine learning in risk management can improve supply chain resilience and enhance overall business operations. The author in [3] provides a thorough examination of each categoryin order to pinpoint any unresearched or missing components and to suggest future lines of inquiry at the intersection of SCRM and AI.

Deep learning, a subset of machine learning, has the potential to revolutionize the field of inventory management by automating tasks and improving decision-making. On the basis of the relational approach, the author in research [4] attempts to propose a smart, sustainable supply chain practicesframework.

Professional contracts such as supplier agreements, purchase orders, and service contracts contain critical information that impacts inventory management. Deep learning models[10] such asConvolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) can be used to automatically extract key information from professional contracts. By automating the process of information extraction, businesses can improve the speed and accuracy of inventory management, reduce the likelihood of errors, and minimize the risk of contractual disputes. The use of deep learning in professional contract management has the potential to transform the way businesses manage their inventory, leading to cost savings and improved customer satisfaction.

Fuzzy expert systems use fuzzy logic to model expert knowledge and decision-making in inventory management. Deep learning models such as deep belief networks (DBN) can be integrated with fuzzy expert systems to improve the accuracy of risk analysis and decision-making. The integration of deep learning with fuzzy expert systems can lead to better inventory risk management by identifying potential risks in the supply chain and taking corrective action to mitigatethem. This can improve supply chain resilience, minimizeinventory costs, and enhance overall business operations. Theuse of fuzzy expert systems and deep learning in inventory management has the potential to significantly improve risk management capabilities for businesses. On the basis of the relational approach, the author in research [15] attempts to propose a smart, sustainable supply chain practices framework. The use of robotics in inventory management[21] can help businesses reduce costs, increase efficiency, and improve accuracy.Robots can work around the clock, handle a high volume of products, and provide real-time inventory data. Automated Storage and Retrieval Systems (ASRS), Automated Guided Vehicles (AGVs), and Autonomous Mobile Robots (AMRs) can be integrated with warehouse management systems tooptimize inventory levels. Robotics is particularly useful forbusinesses with high-volume inventory. Robots can be used for inventory scheduling tasks, ensuring that products are stored in the optimal location and that there is sufficient space available for incoming products. Robots can also be used for inventory forecasting, which involves predicting future inventory levels based on historical data and other factors. The use of robotics in inventory management can lead to cost savings, increased efficiency, and improved accuracy. Robotics is an attractive option for businesses with high-volume inventory. In [6], the author examines developments in supply-chain automation from the 20th century and discusses the history[9] of automation from the perspectives of material flow, information flow, supervision and control, and relationship automation. Future work discussion is also discussed in the same

Robotics can be used for advanced automation and scheduling tasks, allowing for 24/7 inventory management and in- creased efficiency. A Business Rule Management System (BRMS) and an ontology-based Multi-Agent System (MAS) are suggested by the author of [7] in order to address the cooperative manufacturing difficulties of manufacturing knowledge representation, sharing, and reasoning.

Machine Learning Methods Comparison

Table:1 Machine Learning Methods Comparison

Models	Pros	Cons
DT (Decision Tree)	1.Can capture certain non-linear relationships 2.Easy to derive feature importance 3.Easilyinterpretable through visualization	1.Causes prediction banding for regression problems 2.Prone to over fit
RF (Random Forest)	1.Can capture most non-linear relationships 2.Ensemble method provides higher accuracy 3.Easy to derive feature importance	1.Causes prediction banding for regression problems 2.Higher computational cost than DTs 3. Less interpretable than DTs
LR (Linear Regression)	1.Simplest model to implement 2.Easy to derive feature importance	1.Cannot capture nonlinear relationships 2.Computationally easy
NN (Neural Network)	1.Can capture most non-linear relationships 2.High accuracy for problems with lots of data	1.Hard to explain 2.Hard to interpret 3.Computationally intensive

Comparing the Machine learning algorithms in terms of performance parameters, for a dataset[21] which showed that all performance evidently better in identifying correct observations than violating ones (0,1) respectively. This might be detailed by the certitude that there are many fewer observations of breaches than instances of proper activities. Correctly predicting a violating firm using machine learning methods is more difficult than predicting a lawful firm due to the fairly smaller instances size of companies involved in violation

In terms of precision (0.50), RF outperforms the other four

technologies for predicting violations of data (label = 1). The findings demonstrate that, among all the classed observations, RF distinguishes more genuine violating observations than the other four techniques as infringing. Among the four methods, KNN has the highest recall, demonstrating that it is the most accurate at identifying the observations of genuine violators. In terms of recall and f1-score (0.94; 0.90), RF outperforms the other four techniques for predicting lawful companies (label = 0). In the construction industry, RF performs better overall at detecting corporate malfunction.

Table:2 Results of Various Algorithms

Method	Label	Precision	Recal	F1-Score	Accuracy
DT	1	0.92	0.29	0.14	71
	0	0.09	0.75	0.83	
RF	1	0.57	0.57	0.57	93
	0	0.96	0.96	0.96	
LR	1	0.33	0.14	0.20	90
	0	0.93	0.98	0.95	
KNN	1	0.18	0.86	0.78	66
	0	0.98	0.65	0.22	

NLP can be used to extract data from supply chain maps and analyze it to identify patterns and trends. By analyzing customer feedback and sentiment, businesses can make informed decisions about which products to stock and how to optimize their supply chain. This can help businesses to visualize their inventory flows, optimize their inventory management processes, and make data-driven decisions. The author provides insight into the creation and use of data analytics methods in the examination of supply chain data. The final section of the work [8] emphasizes the value of domain expertise in effectively developing features.

Natural Language Processing (NLP) can help businesses automate complex tasks, such as product classification and inventory tracking. NLP can also help businesses optimize their inventory levels by analyzing customer demand and sales data. By streamlining inventory management processes, businesses can reduce the need for manual intervention, increase efficiency, and make data-driven decisions. The core concepts related big data, and it's management, analyzing the prospects, and future possibilities, particularly in the sector more focused on health care, are covered by the author in [9].

Computer Vision/Machine Vision is a cutting-edge technology that can identify product defects in real-time. By analyzing product images, it can detect deformities, cracks, and discoloration, improving product quality and reducing waste. Computer Vision/Machine Vision can also automate the inspection process, increasing efficiency and reducing the need for manual intervention. Computer Vision/Machine Vision is a powerful tool that can help businesses improve their inventory management processes. By detecting defective products in real-time, it can help reduce the risk of shipping faulty products to customers. Automated inspection using Computer Vision/Machine Vision technology can streamline the inventory management process, leading to reduced waste and improved efficiency. The author's suggested model in [10]makes use of all the data produced by various integrated technologies throughout the manufacturing chain, which meets the requirements of managing quality in the real time scenario of Industry 4.0. The model is based on predictive analysis tofind patterns in the data and recommend remedial measures to ensure product quality.

Speech recognition technology is a valuable tool for inventory management, by analyzing customer interactions and sales calls, it can predict future demand and help businesses optimize inventory levels. This can result in more efficient inventory management, reduced risk of stockouts, and improvedcustomer satisfaction. By identifying patterns and predicting future demand, it can help in making merchandising data-driven based on rational prediction and optimize their inventory levels. This can lead to more efficient inventory management processes and increasedcustomer satisfaction. Through the use of a plaque test in Verocells, the author of study [11] determined how long SARS- CoV-2 remained viable in river water and wastewater samples under a variety of simulated environmental circumstances.

Table:3 AI Techniques & their Applications

AI Techniques	Application in Supply Chains	References
Machine learning	Vulnerabilities in Demand & Forecasting Handling Risk	Carbonneau,Laframboise,& Vahidov (2008) [1]Gu, Dolan-Gavitt, and Garg (2017) [2] Baryannis, Dani, and Antoniou (2019) [3]
Deep Learning	Professional contracts Risk Mitigation & Monitoring	Shokouhyar et al. (2019)[4]Soleymani and Nejad (2018) [5]
Robotics	Scheduling which is automated using advanced techniques	Viswanadham (2002) [6] Sadik and Urban (2017) [7]
Natural Language processing	Supply chain related maps Advancement in automation	Wichmann et al. (2020) [8] Dash et al. (2019) [9]
Machine Vision	Defective detection in product	Benbarrad et al. (2021) [10]
Speech Recognition	Forecasting Demand	Torres-Franco (2021) [11]

NSGA-II (Non-dominated Sorting Genetic Algorithm II), NRGA (Nondominated Ranking Genetic Algorithm), and MOPSO (Multi-Objective Particle Swarm Optimization). These cutting-edge methods utilize advanced mathematical models to optimize inventory levels and reduce storage costs, while also considering important factors such as demand, lead time, and order frequency. NSGA-II, NRGA, and MOPSO represent highly effective approaches for minimizing total inventory cost and storage space. These methods employ sophisticated algorithms that enable the identification of

optimal solutions to even the most complex inventory management challenges.

			cy level	m (SPEA2)

B. Work related to Nature Inspired Algorithms

References	Modeling Features	Demand type	Objectives	Solving Methodology
Pasandideh et al. (2013) [12]	Multi Item Multi Objective	Deterministic	Minimizing total inventory cost and storage space	NSFA-II and MOPSO
Mousavi et al. (2014) [13]	Multi Item Multi Objective	Deterministic and Variable	Minimizing total inventory cost and storage space	PSO & GA
Tavana (2016) [14]	Multi Item Multi Objective	Constant	Minimizing total inventory cost and storage space	NSGA-II, NRGA and MOPSO
Park & Kyung (2014) [15]	Multi Item	Stochastic	Minimizing total inventory cost and the order file rate	PSO
Sarwar et al. (2019) [16]	Multi item Multi Objective EOQ	Constant	Total inventory cost minimization and layout management	MOPSO
Sadeghi et al. (2014) [17]	Multi Objective	Deterministic	Minimize total VMI cost & maximize the system reliability	Hybrid Bat Algorithm (HBA)
Huseyinov & Bayrakdar (2019) [18]	Multi Objective	Stochastic	Maximizing the profit and the warehouse occupan	NSGA-II and Strength Pareto Evolutionary Algorithm

The challenge of minimizing total inventory cost and storage space has been a long-standing concern for businesses. In order to address this challenge, the use of deterministic methods such as NSFA-II (Non-dominated Sorting Fruit Fly AlgorithmII) and MOPSO (Multi-Objective Particle Swarm Optimization) have emerged as key solutions. These methods are based on mathematical models that aim to optimize inventory levels while taking into account a variety of factors, including demand, lead time, and storage costs. NSFA-II and MOPSO are powerful and efficient approaches to minimizing total inventory cost and storage space. NSFA-II uses a swarm-based algorithm to search for optimal solutions, while MOPSOemploys a particle swarm optimization algorithm.

Through these methods, businesses can identify the optimal inventory levels needed to minimize total cost and storage space. The use of NSFA-II and MOPSO provides businesses with valuable tools for minimizing total inventory cost and storage space.By considering a range of factors and utilizing advanced mathematical models, these methods can help businesses optimize inventory levels, make data-driven decisions, and achieve greater efficiency in inventory management. There was an annual cap on the total number of orders in the multi- product EPQ model described in the [12] article. To reduce total inventory costs to minimal range and the space to store requirements, the challenge was stated as a multi-objective nonlinear programming problem, with the objective of determining the optimal order quantities for the product. Two meta-heuristic and multi-objective solution algorithms, NSGA-II and MOPSO, were used to solve the model by the author.

Inventory management is a critical area of focus for businesses, with minimizing total inventory cost and storage spacebeing a primary objective. To achieve this objective, two highly effective methods have emerged as key solutions: PSO (Particle Swarm Optimization) and GA (Genetic Algorithm), which are both deterministic and variable. These methods use sophisticated algorithms to optimize inventory levels and reduce storage costs, while also considering other critical factors such as demand, lead time, and order frequency. The use of PSO and GA represents a powerful approach to minimizing total inventory cost and storage space. While they operate via different mechanisms, with PSO utilizing a swarm- based algorithm and GA leveraging a genetic optimization algorithm, both approaches are highly adept at finding optimalsolutions to complex inventory management challenges. For supply chains where suppliers control retailers' stock in light of central warehouse constraints, [13] examines a vendor managed inventory (VMI) problem. To reduce the overallinventory cost of the supply chain, the author figured out how many shipments were received by merchants and vendors, andhow much to order from each.

Through the utilization of advanced mathematical models and state-of-the-art algorithms, businesses can optimize inventory levels, reduce storage costs, and achieve enhanced efficiency in inventory management. In paper [14], the author explores a

more realistic multi-product inventory control problem with the objectives of reducing the overall cost of inventory and the amount of space needed to keep it. Inflationary pricing was used, replenishment cycles made were restricted, and shortages were permitted. First, author formalized the issue as a bi-objective model,and then used three multi-objective[4] evolutionary algorithms (MOEA) to locate Pareto front solutions.

Inventory management is an essential aspect of businesses, and pruning the total inventory cost to a minimal level and order file rate isa critical objective. To achieve this aim, the Particle Swarm Optimization (PSO) algorithm has emerged as a powerful stochastic method. By leveraging advanced probabilistic models and adaptive learning algorithms, PSO optimizes inventory levels and reduces the order file rate while considering the important factors such as demand, lead time, & replenishment policy. PSO is a sophisticated and cutting-edge approachto minimizing total inventory cost and order file rate. It employs advanced stochastic techniques and adaptive learningto identify optimal solutions to even the most complex inventory management challenges.

The [15] suggests employing particle swarm optimization (PSO) to improve a supply chain's overall cost and order filling price simultaneously. By factoring in information quality level (IQL), which is established by the availability of lead time history data, the starting stock levels of all the levels in a supply chain are automatically adjusted. The correlation of IQL with important terms like overall cost and order refill rates are analyzed using analyses of variance.

Given these results, it's clear that the suggested method is superior to PSO in locating solutions that minimize stockpiles while maximizing order fulfillment. Businesses can leverage advanced optimization algorithms such as the Hybrid Bat Algorithm (HBA) to reduce the total VMI cost and increase system reliability to maximum level. HBA is an innovative approach that combines global and local optimization techniques to solve complex inventory management challenges. By leveraging HBA, businesses can identify optimal solutions that minimize the total VMI cost while enhancing system reliability. One of the key advantages of HBA is thatit is able to find optimal solutions quickly and efficiently. This is particularly important in inventory management, whereeven small improvements in efficiency can have a significant impact on costs and profitability.

Additionally, HBA can be customized to serve the specific needs of a merchandising, allowing it to be used in a wide range of inventory management scenarios. NSGA-II is an innovative optimization algorithm that is used to optimize multiple objectives simultaneously. It can be used to identify solutions that maximize profit while minimizing warehouse occupancy levels. SPEA, on the other hand, is a robust optimization algorithm that is used to handle large-scale optimization problems NSGA-II (Non-dominated Sorting Genetic Algorithm II) is a powerful optimization algorithm that is based on genetic algorithms.

It works by using a ranking system to evaluate and rank different solutions, and then selecting the best solutions based on their ranking. NSGA-II is designed to handle multiple objectives and has been proven to be highly effective in a wide range of optimization problems. SPEA (Strength Pareto Evolutionary Algorithm) is another multi-objective optimization algorithm that is based on genetic algorithms.

It works by assigning a strength value to each solution and then selecting the best solutions based on their strength values. SPEA is designed to handle large-scale optimization problems and has been used tosolve a variety of complex optimization problems. In [16] this study, the author uses a combination of NSGA-III and SPEA2to solve a multi-objective, single-period, multi-item inventory issue. When compared to NSGA-III, SPEA2 performed better on both measures of diversity and convergence. However, the author designed NSGA-III to handle optimization situations with multiple objectives.

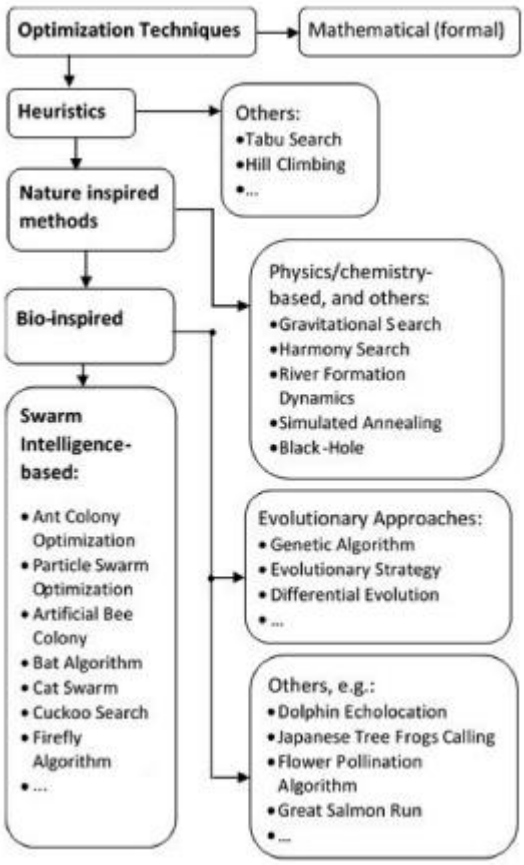

Fig.1 Taxonomy of NIA

III.WORKING PARADIGM-PROPOSED WORK

One of the primary advantages of AI-based inventory models is improved accuracy in forecasting demand. By analyzing customer data and other relevant information, AI algorithms can predict future demand more accurately than traditional methods. This enables businesses to optimize their inventory levels, reducing the risk of stock outs or overstocks. Addition-ally, AI-based inventory models can help businesses to reducecosts by identifying inefficiencies and waste in their supply chain. By providing real-time insights into inventory levelsand customer demand, AI can also help businesses to make more

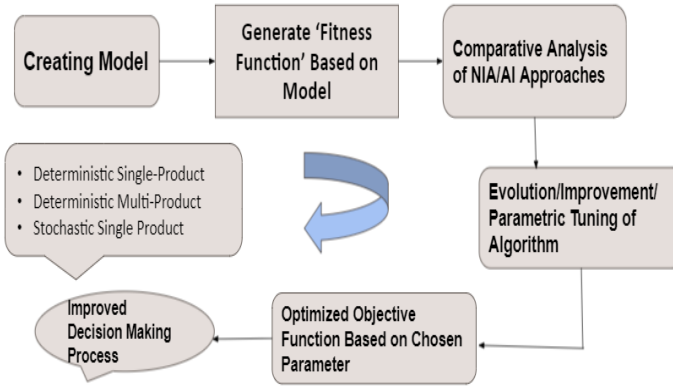

Fig.2 Proposed Model

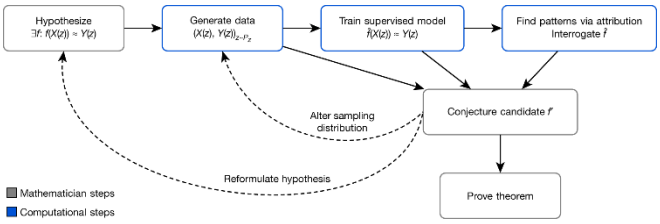

Fig:3 Mathematical and Computational Model

informed decisions and respond quickly to changes inthe market. Ultimately, AI-based inventory models can help businesses to increase profitability by maximizing sales and reducing waste. Keeping this in mind we propose the following steps to develop the AI based inventory models.

To optimize inventory management and increase profitability, businesses can implement an inventory model with the aidof artificial intelligence (AI). The first step in this process as shown in figure 1 is to create an accurate and comprehensive model which involves a mathematical representation of the inventory system. The model [20] must take into account key factors such as demand, lead time, and inventory costs. This model can be used to simulate the behavior of the system and generate predictions about future demand and inventory levels. The second step is to generate a fitness function to evaluate the performance of the model. This function should be designed to reflect the company's specific needs and priorities. The third step is a comparative analysis of nature-inspired algorithms and AI methods to determine the most effective approach for the specific inventory system. After selecting an algorithm, the fourth step is parameter tuning to optimize the performance of the model. This involves adjusting the algorithm's parameters to ensure that it produces accurate and reliable results. The final step is to optimize the objective function, taking into account factors such as demand forecasting and replenishment policies.

By following this proposed inventory model flow with AI, businesses can make data-driven decisions to optimizetheir inventory levels, reduce costs, and increase profits. The improvement in making decision that would surge rise in profit is essential and thus effectively implementing the AI-driven inventory model would surely help in achieving the desired results.

IV. Conclusion

Applied AI techniques can create a major impact on supply chains, improving efficacity, reducing costs, and enhancing customer satisfaction. These techniques empower forecast future demand for products based on historical data and markettrends, they show a significant role in optimizing inventory levels, ensuring that companies have enough stock to meet demand without overstocking and incurring unnecessary costs. Techniques discussed in paper are seen to be used to optimize delivery routes, reducing transportation costs and improving delivery times. Quality Control. Using them for a small retail market may cost more in terms of prior investment for processing and storage. Also, Predictive maintenance using AI can let us know when supply or demand are likely to fail, allowing companies to perform maintenance before abreakdown occurs. can be used to identify potential risks in thesupply chain, such as delays or disruptions caused by weather, natural disasters, or political events. By identifying potential risks in advance, companies can take action to mitigate them and reduce the impact on their supply chain. An effort to improvise the existing methods and to equate it using mathematical modeling will be made to check if the algorithms would be robust enough. We would ensure the same by simulating it in a real data set will be made further in research. Thus, optimizing the resourceand predicting the decisions for the maximum ROI and profit.

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