

## AI and Machine Learning Based Predictive Data Analytics for Business Decision Making

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### Abstract

Artificial Intelligence (AI) and Machine Learning (ML) have emerged as disruptive technologies that are redefining how organisations analyse data and formulate critical business decisions. In the contemporary digital economy, enterprises produce substantial quantities of structured and unstructured data from several sources, including online transactions, social media platforms, consumer interactions, and corporate systems. Conventional analytical techniques frequently prove inadequate for the proper processing and interpretation of extensive datasets. Consequently, predictive data analytics driven by AI and machine learning has emerged as a vital instrument for organisations aiming to get significant insights from data and enhance decision-making processes. Predictive data analytics employs statistical algorithms, machine learning techniques, and data mining approaches to examine historical and real-time data for the purpose of forecasting future trends, behaviours, and results. AI-driven predictive models may uncover concealed patterns and links inside extensive datasets, allowing firms to foresee market fluctuations, comprehend customer inclinations, and manage operational risks with greater efficacy. These competencies enable organisations to transition from reactive decision-making to proactive, data-driven initiatives. This study investigates the influence of AI and machine learning on predictive data analytics to improve business decision-making. The study emphasises the principal methodologies employed in predictive analytics, such as regression analysis, decision trees, neural networks, and deep learning models. It additionally examines diverse business applications including sales forecasting, customer behaviour prediction, fraud detection, supply chain optimisation, and marketing campaign analysis. Organisations may optimise operational efficiency, improve customer satisfaction, and secure a competitive edge in dynamic marketplaces by utilising predictive analytics. The research employs a qualitative methodology, analysing secondary data from academic publications, research articles, and industry reports pertinent to artificial intelligence and predictive analytics. The results demonstrate that AI-driven predictive analytics markedly improves the precision and rapidity of business decision-making by delivering real-time insights and automated analytical functions. Nonetheless, obstacles including data privacy concerns, substantial implementation costs, and the necessity for proficient data professionals persist as significant issues that organisations must confront. AI-driven predictive data analytics constitutes a robust methodology for enhancing strategic planning and optimising organisational performance within a data-centric business landscape.

**Keywords:** Artificial Intelligence, Machine Learning, Predictive Analytics, Business Intelligence, Data-Driven Decision-Making.

## Introduction

In the contemporary digital economy, organisations produce significant quantities of data from several sources, including online transactions, social media interactions, sensors, and corporate information systems. The swift expansion of data has generated both prospects and obstacles for enterprises. Although extensive datasets harbour significant information, unprocessed data cannot yield meaningful insights without appropriate analysis and interpretation. Consequently, enterprises increasingly depend on sophisticated analytical technologies to convert data into usable insights. Predictive data analytics has become a crucial methodology enabling organisations to examine historical data and anticipate future patterns, behaviours, and outcomes.

Artificial Intelligence (AI) and Machine Learning (ML) have considerably enhanced the efficacy of predictive data analytics. These technologies allow computer systems to autonomously discern patterns from extensive datasets and produce precise predictions without explicit programming. Machine learning techniques, including regression models, decision trees, and neural networks, assist organisations in uncovering concealed patterns and relationships within data. Employing these strategies enables firms to forecast client behaviour, anticipate market trends, optimise operational procedures, and mitigate potential hazards.

Historically, commercial judgements were frequently grounded in managerial experience, intuition, or restricted statistical analysis. While these methodologies offered some direction, they frequently proved inadequate in intricate and evolving commercial contexts. Conversely, AI-powered predictive analytics offers immediate insights, automated projections, and data-informed suggestions. This empowers managers to expedite and enhance decision-making through credible evidence.

Numerous industries, such as finance, healthcare, retail, manufacturing, and marketing, are currently implementing predictive analytics solutions to enhance performance and secure competitive advantages. Applications like sales forecasting, fraud detection, demand prediction, and customer segmentation illustrate the increasing significance of AI-driven analytics in contemporary corporate settings.

This paper investigates the role of artificial intelligence and machine learning in predictive data analytics and assesses how these technologies facilitate effective business decision-making in data-driven organisations.

## Background of the Study

The swift progression of digital technologies has profoundly altered organisational operations and decision-making processes. In recent years, enterprises have produced vast quantities of data from diverse sources, including online transactions, social media platforms, mobile applications, customer relationship management systems, and enterprise resource planning systems. The extensive volume of data, also known as big data, has generated new potential for organisations to acquire useful insights and enhance their decision-making processes. Nonetheless, the management and analysis of extensive datasets by conventional analytical techniques have grown progressively difficult.

Organisations are increasingly utilising advanced technologies like Artificial Intelligence (AI) and Machine Learning (ML) to analyse data more efficiently in response to this challenge. Artificial Intelligence denotes the ability of machines to execute tasks that ordinarily necessitate human intelligence, including learning, thinking, and problem-solving. Machine learning, a branch of artificial intelligence, allows computers to acquire knowledge from previous data and enhance their performance over time without direct programming. These technologies have been essential in the advancement of predictive data analytics, which emphasises projecting future events based on historical trends and data analysis.

Predictive data analytics enables organisations to foresee trends, comprehend customer behaviour, and detect potential problems prior to their manifestation. Utilising machine learning algorithms and statistical models, enterprises may produce precise forecasts that facilitate strategic planning and operational decision-making. Consequently, predictive analytics has emerged as a vital instrument for organisations aiming to enhance efficiency, mitigate uncertainty, and secure a competitive edge in the marketplace.

The rising implementation of AI and machine learning technologies across diverse sectors, including banking, healthcare, retail, manufacturing, and marketing, underscores their escalating significance in business contexts. Organisations may now make informed, data-driven decisions that improve productivity, customer satisfaction, and overall business performance. Consequently, comprehending the significance of AI and machine learning in predictive data analytics is essential for contemporary enterprises striving to maintain competitiveness in an increasingly data-centric environment.

### **Objectives of the Study**

The primary aims of this research are:

- To investigate the function of artificial intelligence and machine learning in predictive data analytics.
- To examine the use of predictive analytics in facilitating business decision-making.
- To ascertain the applications of predictive analytics across diverse business sectors.
- To assess the advantages and obstacles of AI-driven predictive analytics solutions.

### **Research Hypotheses**

In accordance with the research objectives of the study “AI and Machine Learning Based Predictive Data Analytics for Business Decision Making,” the subsequent hypotheses are established to investigate the correlation between artificial intelligence, predictive analytics, and corporate decision-making processes.

- Artificial Intelligence and Machine Learning technologies substantially enhance predictive data analytics within business organisations.
- The utilisation of predictive data analytics markedly enhances the efficacy of commercial decision-making.
- AI-driven predictive analytics markedly improves the precision of forecasting in corporate operations, including sales, consumer behaviour, and market trends.
- The implementation of AI-driven predictive analytics enhances organisational performance and provides a competitive edge.
- The deployment of predictive analytics tools assists organisations in mitigating operational risks and uncertainties in decision-making.
- A substantial correlation exists between the application of machine learning algorithms and the efficacy of data-driven decision-making in enterprises.

These hypotheses facilitate study by analysing the impact of AI and machine learning technologies on predictive analytics and the role of predictive insights in enhancing strategic and operational decisions inside organisations. Evaluating these hypotheses can yield empirical information regarding the efficacy and influence of predictive data analytics in contemporary corporate settings.

### **Literature Review**

**Thomas H. Davenport and Jeanne G. Harris (2017):** Davenport and Harris assert that predictive analytics enables organisations to transition from conventional descriptive analysis to anticipatory and proactive decision-making. Through the application of advanced analytics and artificial intelligence technology, enterprises may discern patterns in previous data and predict future results. Their research indicates that organisations employing predictive analytics achieve strategic benefits via enhanced planning, increased operational efficiency, and more informed managerial decisions.

**Foster Provost and Tom Fawcett (2013):** Provost and Fawcett examine the significance of machine learning methodologies in predictive analytics for commercial applications. Algorithms like decision trees, regression models, and neural networks assist organisations in analysing intricate datasets and producing precise forecasts. Their research demonstrates that the amalgamation of data science and business intelligence empowers companies to make data-driven decisions and enhance overall organisational efficacy.

**Pankaj Jalote (2018):** Jalote examines the growing significance of data analytics and artificial intelligence in contemporary corporate settings. His work elucidates how machine learning methodologies assist organisations in analysing extensive datasets and discerning significant patterns that facilitate strategic decision-making. Jalote asserts that predictive analytics enables firms to anticipate market trends, optimise operational efficiency, and augment organisational productivity by facilitating more precise, data-driven decision-making for management.

**Soumen Chakrabarti (2019):** Chakrabarti emphasises the importance of machine learning and data mining methodologies in deriving insights from extensive commercial data. His research elucidates that predictive models empower organisations to comprehend client behaviour, refine marketing strategies, and enhance business forecasting. The research highlights that AI-driven analytics solutions assist organisations in converting raw data into meaningful insights that facilitate successful management decision-making.

**Ashok Goel (2020):** Goel underscores the significance of artificial intelligence in addressing intricate business challenges and facilitating astute decision-making. His research elucidates that machine learning algorithms empower organisations to scrutinise extensive and dynamic datasets to produce predictive insights. Goel asserts that AI-driven predictive analytics boosts strategic planning, optimises operational performance, and affords enterprises a competitive edge in the progressively data-centric global economy.

### Research Methodology

#### Research Design

This study employs a qualitative research design grounded in the examination of existing academic literature, research articles, and industry reports pertinent to artificial intelligence, machine learning, and predictive analytics. The design facilitates the analysis of their role and influence on company decision-making processes.

#### Method of Data Collection

- Secondary data has been acquired from:
- Journals that undergo peer review
- Scholarly articles
- Literature
- Sector analyses
- Digital academic repositories including Google Scholar, Scopus, and IEEE

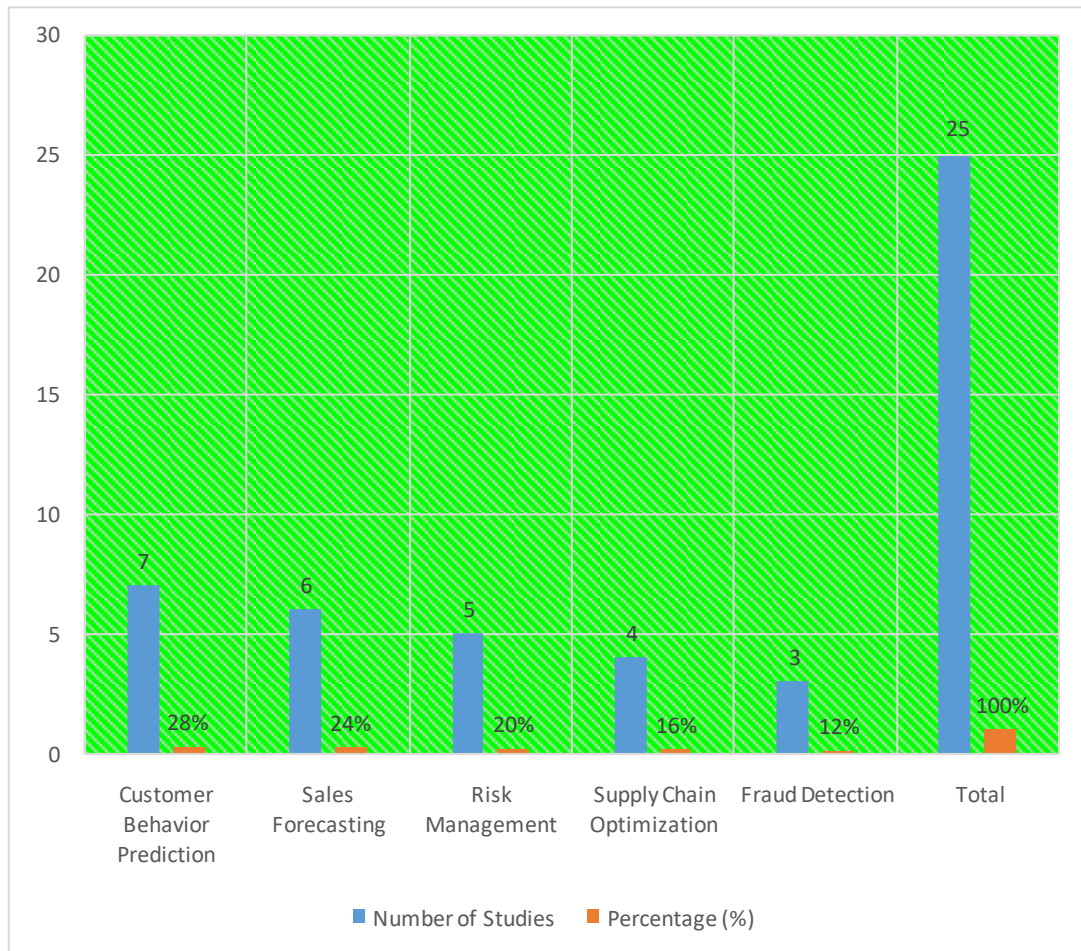
#### Sample Size

Approximately 20 to 25 academic articles and reports concerning predictive analytics and artificial intelligence in business decision-making were examined.

#### Data Analysis

**Table 1: Significant Applications of Predictive Analytics in Business (Derived from 25 Studies)**

Application Area	Number of Studies	Percentage (%)
Customer Behavior Prediction	7	28%
Sales Forecasting	6	24%
Risk Management	5	20%
Supply Chain Optimization	4	16%
Fraud Detection	3	12%
<b>Total</b>	<b>25</b>	<b>100%</b>



**Interpretation**

Table 1 illustrates the distribution of primary applications of predictive analytics discovered in the examined studies. The findings indicate that 28% of the studies concentrate on predicting client behaviour, suggesting that organisations extensively employ predictive analytics to comprehend customer preferences and purchase trends. Sales forecasting constitutes 24%, underscoring its significance in production and inventory planning. Risk management and supply chain optimisation account for 20% and 16%, respectively, indicating their significance in operational planning. Fraud detection is present in 12% of the studies, predominantly within the financial and banking industries.

**Table 2 Advantages of AI-Driven Predictive Analytics in Business Decision-Making**

Benefit	Number of Studies	Percentage (%)
Improved Decision Accuracy	8	32%
Operational Efficiency	6	24%
Competitive Advantage	5	20%
Risk Reduction	4	16%
Customer Satisfaction	2	8%
<b>Total</b>	<b>25</b>	<b>100%</b>

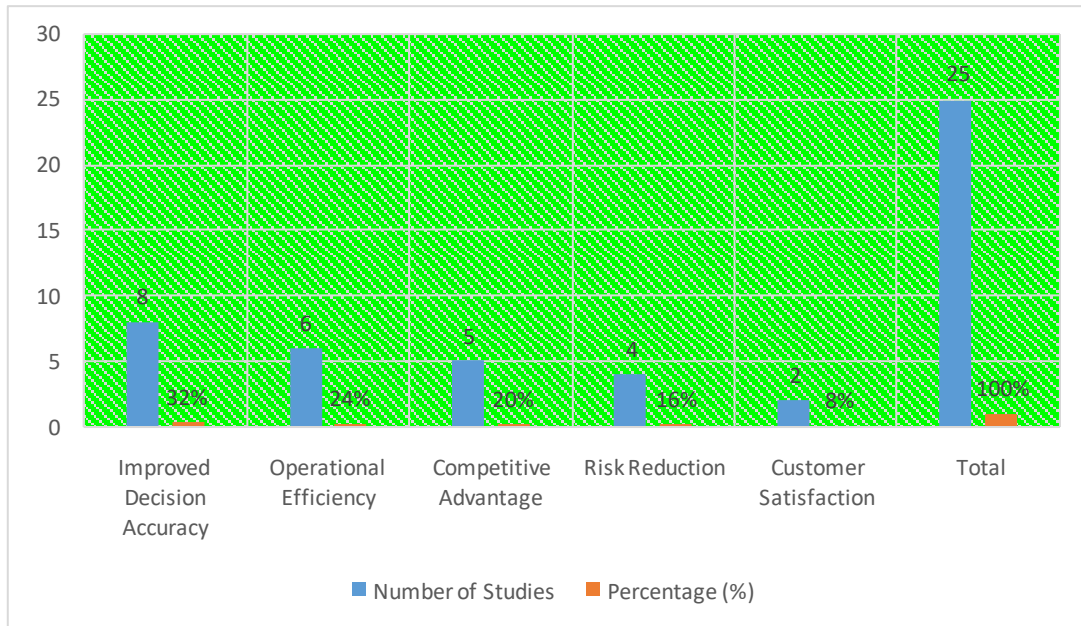


Table 2 delineates the principal advantages of predictive analytics as identified in the examined studies. The findings reveal that enhanced decision accuracy is the most commonly cited advantage (32%), indicating that predictive analytics substantially improves data-driven decision-making. Operational efficiency constitutes 24%, illustrating the role of AI-driven analytics in automating procedures and enhancing productivity. Competitive advantage and risk mitigation constitute 20% and 16% respectively, but customer happiness accounts for 8%. These findings underscore that predictive analytics is essential for enhancing business performance and strategic planning.

### Artificial Intelligence and Machine Learning Methods in Predictive Analytics

- **Regression Analysis**

Regression analysis is a statistical method employed to ascertain correlations between dependent and independent variables. In predictive analytics, enterprises utilise regression models to anticipate outcomes such as sales growth, demand trends, and financial performance, thereby empowering managers to make informed decisions.

- **Decision Trees**

Decision tree algorithms are machine learning models that categorise data by partitioning it into branches according to defined criteria. Organisations employ decision trees to examine previous data, discern trends, and forecast future outcomes, including consumer preferences, credit risk, and marketing reactions.

- **Neural Networks (40 words)**

Artificial neural networks are sophisticated machine learning models derived from the architecture of the human brain. They analyse intricate datasets and identify concealed patterns. Organisations employ neural networks for predictive functions including fraud detection, market trend monitoring, and customer behaviour forecasting.

- **Random Forest**

Random forest is an ensemble machine learning method that integrates numerous decision trees to enhance predictive accuracy and minimise errors. It is extensively utilised in predictive analytics to examine intricate information, facilitate categorisation jobs, and improve the accuracy of corporate forecasts.

- **Deep Learning**

Deep learning is a kind of machine learning that employs multi-layer neural networks to examine extensive and intricate information. It is frequently utilised in predictive analytics for picture identification, audio processing, customer behaviour forecasting, and sophisticated data-driven decision-making.

**Utilisation of Predictive Analytics in Commerce**

- **Forecasting Customer Behaviour**

Predictive analytics examines client data and historical purchase trends to anticipate future behaviour. Companies utilise these facts to build tailored marketing tactics, enhance consumer engagement, and elevate sales performance.

- **Sales Projections**

Machine learning models examine historical sales data and market patterns to forecast future demand. This assists organisations in planning production, managing inventory effectively, and allocating resources efficiently.

- **Risk Management**

Predictive analytics enables organisations to discern future financial and operational hazards. In banking and finance, it identifies fraudulent transactions, evaluates credit risk, and enhances risk management tactics.

- **Supply Chain Optimisation**

AI-driven predictive models examine demand trends, logistics information, and inventory status to enhance supply chain efficiency, minimise delays, optimise distribution, and ensure effective resource allocation.

- **Optimisation of Marketing Campaigns**

Predictive analytics assists enterprises in identifying optimal marketing channels and target demographics. Through the analysis of customer data and campaign efficacy, organisations can enhance marketing tactics and attain greater returns on investment.

**Advantages of AI-Enhanced Predictive Analytics**

- **Enhanced Decision-Making**

AI-driven analytics delivers precise insights that assist managers in making data-informed decisions.

- **Enhanced Operational Efficiency**

The automation of predictive models diminishes manual analysis and enhances efficiency.

- **Competitive Advantage**

Organisations employing predictive analytics can forecast market trends and maintain a competitive advantage.

- **Mitigation of Risk**

Predictive analytics assists in recognising future problems and implementing preventive strategies.

- **Client Contentment**

Customised recommendations enhance client engagement and happiness.

**Obstacles to the Implementation of Predictive Analytics**

Notwithstanding its benefits, predictive analytics encounters some obstacles:

- **Data Quality Concerns:** Inaccurate or incomplete data may result in incorrect forecasts.
- **Substantial Implementation Expense:** Sophisticated AI systems necessitate considerable investment in technology and expertise.
- **Data Privacy Concerns:** Managing significant quantities of client data presents privacy and security challenges.

- Shortage of Skilled Professionals: Organisations frequently have deficits of data scientists and AI specialists.
- Model Complexity: Machine learning models may present challenges in interpretation and management.

### Conclusion

Artificial Intelligence and machine learning have transformed predictive data analytics and greatly enhanced company decision-making processes. Through the analysis of previous data and the identification of concealed patterns, predictive models yield significant insights into forthcoming trends, consumer behaviour, and operational dangers. Companies in many sectors are implementing AI-driven analytics to refine strategic planning, augment operational efficiency, and secure competitive advantages.

Organisations must confront issues pertaining to data quality, privacy, and technological skills to fully use the potential of predictive analytics. Subsequent research must concentrate on creating more transparent, scalable, and ethical AI systems for commercial purposes.

AI-driven predictive data analytics serves as a formidable instrument that empowers organisations to make more astute, expedient, and informed decisions in an ever-evolving data-centric environment.

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