

## Applications of Predictive Analytics

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### ABSTRACT

Predictive analytics involves looking at historical data to predict future outcomes. It is a data science that involves collecting and using current data to predict future outcomes in various industries. It uses data mining techniques, machine learning, and statistical modeling to find patterns in data and identify risks and opportunities. This powerful tool has become necessary in today's world, enabling organizations to predict trends, reduce risks, and make informed decisions. You can use predictive analytics to analyze historical data, uncover patterns, and forecast future outcomes. These forecasts predict industry trends and behaviors, guide informed business and investment decisions, and are sometimes used to boost efficiency, increase profits, and protect information. In this paper, we will go over predictive data analytics and provides some of its applications.

**KEYWORDS:** data, data analytics, predictive analytics, applications.

### INTRODUCTION

Predictive analytics is a subset of advanced analytics that uses machine learning, data modeling, artificial intelligence, deep learning algorithms, and data mining to forecast outcomes based on patterns in vast historical datasets. It uses data, statistical algorithms, and machine learning to forecast future outcomes based on historical data, helping businesses anticipate and prepare for future events with a high degree of accuracy. Companies rely on predictive analytics to detect patterns in data that identify risks and opportunities. Predictive analytics is no longer a futuristic concept; it is a powerful tool reshaping the business landscape. It is a transformative technology that is revolutionizing businesses across various sectors. Its ability to extract valuable insights from data and predict future trends empowers businesses to make more informed decisions, optimize operations, and ultimately drive significant growth [1].

Predictive analytics is one of the advanced technologies being used in the modern world. It is a powerful technique that “predicts” the future, in a sense. It can help answer key questions, such as how many products a business could sell in the next three

months and how much profit it is likely to make. Predictive analytics goes beyond limits when it comes to productivity. Nowadays, it is being used in all major industries, such as healthcare, finance, insurance, retail, manufacturing, etc. Predictive analytics techniques are also being used for many predictions like weather forecasting, translation, decision-making, video games, etc. Predictive analytics can help predict the future growth of any real-life entity with the help of advanced modern technologies such as machine learning, big data, statistical models, artificial intelligence, etc. Figure 1 shows the word cloud for predictive analytics [2].

### WHAT IS PREDICTIVE ANALYTICS?

As its name implies, predictive analytics is about predicting future trends such as sales demand, exchange rates, and other important metrics. The technique relies on the application of statistical modeling and regression analysis to historical data to determine and understand trends and formulate future trends. Strictly speaking, predictive analytics does not predict the future, but rather use probability theories to determine what is likely to happen based on

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patterns and trends revealed by analyzing historical data [3]. Predictive analytics accurately anticipates customer demand, preventing overstocking and stockouts while adapting to market changes. Figure 2 illustrates predictive analytics [4], while Figure 3 show different components of predictive analytics [5].

In general, analytics provides an efficient way to improve planning because it gives you better forecasts. There are different types of data analytics. They are briefly explained as follows [6]:

- *Descriptive Analytics:* Descriptive analytics examines what has happened over the years. They are capable of detecting trends in historical data. Analytics can uncover trends and postulate probable reasons for change by comparing the same data from various periods. It can be seen as the baseline of the industry, which basically assesses past and current data for more meaningful insights and delivers it to the people to use their own intelligence and knowledge to make decisions.
- *Predictive Analytics:* This assists businesses in predicting what might happen and the impact of various situations, such as possible supply chain bottlenecks. Managers can be proactive rather than responsive by pushing them to evaluate these prospective circumstances before they occur. Predictive analytics may be used to identify patterns and trends as well as anticipate breakdowns that may impact suppliers and, consequently, production processes. Predictive analytics for the supply chain leverages data, statistical algorithms, and machine learning techniques to identify the likelihood of future outcomes.
- *Prescriptive Analytics:* Prescriptive analytics builds on predictive analytics and dives deeper into predicting future insights on what next can be done. Prescriptive analytics uses the findings of descriptive and predictive analytics to recommend what measures a business should take to achieve its objectives. Because prescriptive analytics is increasingly complicated, they need more powerful software capable of rapidly processing and interpreting large amounts of data.
- *Cognitive Analytics:* Cognitive analytics attempts to mimic human thought and behavior, and they can assist companies in answering challenging, complex problems. Cognitive analytics does this by utilizing artificial intelligence (AI), which allows it to be better over time. With the use of AI in the industry, answering complex questions and drawing out contextual conclusions on how humans would have interacted with the situation.

It helps with more meaningful data and scale experience and knowledge with better decisions.

- *Diagnostics Analytics:* This gives the ability to identify the root-cause. It is characterized by techniques such as drill-down, data discovery, data mining, and correlations. It involves analyzing overall performance and figuring out why errors, mistakes, and delays occur. It lets the manager know the delays, breakdowns, and disruptions in the demand and supply processes and the reasons behind them.

Figure 4 shows these major types of data analytics [7]. Unlike diagnostic and descriptive analytics, which were designed to analyze situations after they happened, predictive analytics utilizes advanced data analytics techniques to forecast future outcomes. In the supply chain, the time has come to shift from mere descriptive and diagnostic analytics to predictive and prescriptive analytics. Predictive analytics is a branch of data analytics that makes predictions about future outcomes using historical data combined with statistical modeling, data mining techniques, and machine learning. Figure 5 shows predictive analytics process [8].

## APPLICATIONS OF PREDICTIVE ANALYTICS

The predictive analytics capabilities are vast but primarily used to anticipate potential issues in the near and distant future. Some of the applications of predictive analytics are shown in Figure 6 [9]. Predictive data analytics is used across many industries to anticipate future outcomes of a given scenario. Predictive analytics is playing an increasingly important role in a wide range of industries, including retail, healthcare, finance, risk management, and manufacturing. Common applications include the following [9-12]:

1. *Healthcare:* An example of using algorithms for rapid, predictive analytics for prevention comes from the healthcare industry. Predictive analytics is used to analyze vast amounts of patient records, medical images, genetic information, and administrative data, leading to enhanced patient care and better patient outcomes. Healthcare applications include medical diagnosis, disease prediction and prevention, and clinical trial. Many healthcare facilities nowadays use advanced software systems to carry out various medical processes with the help of available datasets from medical institutions and predictive analytics. With the help of predictive analytics in healthcare, diseases can be easily predicted based on the symptoms and suggest preventive treatment,

testing of medicines, and their results. Figure 7 shows predictive analytics for healthcare [13].

2. **Business:** As we move into a world of technological advances where more and more data is created and stored digitally, businesses are looking for ways to take advantage of this opportunity and use this information to help generate profits. Businesses can appropriately use big data for their profit by successfully applying the predictive analytics. Predictive analytics can be used and is capable of providing many benefits to a wide range of businesses, including asset management firms, insurance companies, and communication companies. It is a set of business intelligence (BI) technologies that uncovers relationships and patterns within large volumes of data that can be used to predict behavior and events. Unlike other BI technologies, predictive analytics is forward-looking, using past events to anticipate the future. In business, predictive models exploit patterns found in historical and transactional data to identify risks and opportunities. Predictive analytics enables businesses to make informed decisions by analyzing trends and patterns in historical data. By leveraging advanced statistical techniques and machine learning algorithms, businesses can glean invaluable insights from historical data to anticipate future trends, optimize operations, and ultimately, drive significant growth. Figure 8 shows predictive analytics for business [14].
3. **Retail:** Companies in the retail industry make use of predictive analytics to study extensive datasets, including sales transactions, customer demographics, inventory levels, and market trends. The insights help retailers prepare for shifts in consumer behavior, tailor offerings to meet customer preferences, and drive higher sales while providing a more satisfying shopping experience for customers. Tableau is a well-known data visualization tool that comes with powerful predictive analytics capabilities. It simplifies data processing to make decision-making more efficient and offers time-series analysis, letting users perform predictive analytics, such as forecasting, within a visual analytics interface. Predictive analytics achieved through machine learning helps retailers understand customers' preferences. It works by analyzing users' browsing patterns and how frequently a product is clicked on in a website.
4. **Marketing:** In marketing, consumer data is abundant and leveraged to create content, advertisements, and strategies to better reach potential customers where they are. By examining historical behavioral data and using it to predict what will happen in the future, you engage in predictive analytics. Predictive analytics can process large datasets containing customer information, purchasing behavior, demographics, and engagement metrics to help marketers anticipate trends, target audiences, and allocate resources, driving higher ROI on marketing investments. Marketers use predictive analytics to answer questions about marketing campaigns, such as how a consumer might react to a new type of visual branding. A good predictive analytics example for marketing is the toy industry. Predictive analytics techniques can help the toy maker gain deeper insight into the most likely reaction from consumers. Figure 9 shows predictive analytics for marketing [15].
5. **Finance:** Every business needs to keep periodic financial records, and predictive analytics can play a big role in forecasting your organization's future health. Using historical data from previous financial statements, as well as data from the broader industry, you can project sales, revenue, and expenses to craft a picture of the future and make decisions.
6. **Manufacturing:** In the manufacturing industry, predictive analytics can process sensor data, equipment logs, maintenance records, and production metrics. Predictive models are then developed to minimize stockouts, reduce maintenance costs, and optimize inventory levels. In the manufacturing field, algorithms can be trained using historical data to accurately predict when a piece of machinery will likely malfunction. Manufacturing applications include inventory management, predictive maintenance, quality control, and defect detection.
7. **Supply Chains:** Supply chains are under constant pressure to anticipate various issues, such as a spike in fuel costs, fewer drivers available to deliver goods, and a shortage of goods to satisfy an order. Using predictive models enables the players in the supply chain to get ahead of potential problems and minimize their impact on the steady flow of goods. Predictive analytics leverages historical data from sales, inventory levels, transportation routes, weather conditions, and supplier performance to anticipate changes in demand. It is transforming supply chain management by providing businesses with the ability to forecast demand with greater accuracy.
8. **Forecasting:** Some of the most common uses of predictive modeling techniques is using past data

to create accurate forecasts about future inventories, demand, and need for services or supplies. With forecasting, historical data is pulled from a database to look at past performance and anticipate what is most likely to happen soon.

9. *Fraud Detection:* Fraud is typically detected by looking for patterns of activity over a period of time. Someone engaging in fraud has figured out the best time or window of opportunity to engage in fraudulent activities. Predictive analytics techniques can be used to identify fraud patterns in an organization. By detecting unusual patterns or anomalies in transaction data, predictive analytics uncover fraudulent activities and avoid financial losses. One predictive analytics example is looking for customer fraud and determining if there is a pattern of bad orders or a fluke in purchasing patterns. Sifting through the data helps uncover issues and prevents them from reoccurring in the future.
10. *Insurance:* Similar to fraud, unexpectedly high and suspicious claims are the bane of insurance companies. They would like to avoid paying such claims. Though the objective is simple enough, predictive modeling has had only partial success in eliminating this source of high loss to companies.
11. *Customer Relationship Management (CRM):* One of the most impactful applications of predictive analytics lies in enhancing customer relationship management. Instead of relying on generic marketing strategies, businesses can utilize predictive models to understand individual customer behavior, preferences, and needs with unprecedented accuracy. It involves predicting customer churn (customer leaving), recommending products based on past purchases, and personalizing marketing campaigns. CRM uses predictive analysis in applications for marketing campaigns, sales, and customer services.
12. *Risk Management:* In today's interconnected world, businesses face a multitude of risks, ranging from financial fraud to operational disruptions. Predictive analytics plays a vital role in mitigating these risks by identifying potential threats and vulnerabilities before they materialize. By analyzing historical data on fraudulent activities, predictive models can identify patterns and anomalies that indicate potential fraud.
13. *Customer Service:* Customer segmentation is performed based on insights by predictive

analytics. Customers are placed into different segments depending on their purchase patterns. For example, book buyers will form one cluster while t-shirt buyers will constitute another. Tailored marketing strategies are then developed for each of the segments depending on their characteristics. Predictive analytics using machine learning can also detect dissatisfied customers and help sellers design products aimed to retain existing customers and attract new ones.

14. *Human Resources:* Predictive analytics using machine learning identifies employee churn rate and keeps human resources (HR) departments informed of the same. Models can be trained with datasets that have details such as an employee's monthly income, allowances, increments, insurance, and so on. The models learn from past records of ex-employees and find patterns to understand the reasons for leaving. They then predict if new employees are likely to resign or not, empowering HR to minimize the risk.

Other applications include government, entertainment and hospitality, weather forecasting, Internet of things, cybersecurity, demand forecasting, and ecommerce.

#### **BENEFITS**

Predictive analytics has become part of mainstream business. By using data to forecast future trends, companies gain the needed insights to benefit from better decision-making. Other benefits of predictive analytics include the following [16,17]:

- *Improved Decision-making:* Through predictive analytics, businesses improve their decision-making process. This allows organizations to develop market strategies tailored to the insights gained from data analysis, leading to more effective decision-making processes. From personalized healthcare and education to urban planning and environmental sustainability, data-driven insights will guide decision-making for a better future. For example, ecommerce companies can make informed decisions about their inventory by predicting which products are likely to be in demand. Figure 10 shows how predictive analytics helps in making better decisions [1].
- *Enhanced Efficiency:* Predictive analytics also drives operational efficiency by automating processes. By leveraging predictive analytics, businesses can optimize their operational processes and allocate resources more efficiently. This leads to cost savings, improved productivity, and better utilization of available resources.

- *Enhanced Customer Experience:* Predictive analytics enables businesses to enhance the customer experience by providing personalized product recommendations based on user behavior. By analyzing customer data, businesses can understand individual preferences and tailor their offerings accordingly, leading to increased customer satisfaction and loyalty.
- *Personalization:* Predictive analytics are widely used in order to personalize customer experiences. Netflix, for example, uses predictive algorithms and data from a user's viewing history to recommend movies and shows.
- *Risk Reduction:* Likelihood of default by a buyer or a consumer of a service may be assessed in advance by the credit score applying the predictive analytics. The credit score is generated by the predictive model using all the data related to the person's creditworthiness. This is applied by credit card issuers and insurance companies to identify the fraudulent customers.

Figure 11 shows some benefits of predictive analytics [9].

## CHALLENGES

While the challenges and risks associated with predictive analytics can seem daunting, they can be avoided if those behind predictive models are well-trained and knowledgeable in data. Other challenges of predictive analytics include the following [8,12]:

- *Ethical Concerns:* Predictive analytics often uses personal data, and it is important to handle this information responsibly. As the use of personal data in analytics grows, ensuring data privacy and security will be paramount. Regulations and best practices will continue to evolve to protect individuals. Mitigating bias in data and algorithms will be crucial to ensure fair and responsible use of predictive analytics across different demographics and social groups.
- *Data Quality:* The quality of data used, for example, can present a problem since if the data is inaccurate or incomplete, the predictions made will likely be that way, too. Using poor quality data is always going to deliver poor quality results due to the fact that most predictive analytics models are literal in terms of how they process data. Ultimately, the quality of the data delivered from predictive analytics depends on the quality of the data source.
- *Data Bias:* If the data used to train a model contains biases, then those biases can carry over into the predictions. This can lead to unfair or

harmful outcomes, which can be especially problematic in areas like hiring, lending, or law enforcement. People are prone to putting their inherent biases into their queries no matter how hard they try to keep them out. These biases then become part of the modeling process and result in data that is not as accurate as it could be.

- *Privacy and Security:* Privacy and security are two major issues businesses face when using predictive analytics. The data analytics process sometimes involves going through user accounts for data, something the user agrees to when they sign up. However, the business is responsible for preserving account security and must act responsibly with the resulting data. Personal information is easily abused and used for fraudulent activities, and the business can be held liable for their failure to maintain privacy and security.
- *Interpretability:* The effectiveness of the data that is delivered by predictive analytics is dependent on the person who is reading the data. The data derived from the model may be excellent, but if the person reading the results doesn't have a good idea of what they are looking for, the data is essentially useless. Whoever prepares the data needs to make it accessible for readers who can understand the results, but may not be able to parse the syntax, so the data makes sense.

## CONCLUSION

Predictive analytics is the practice of using statistical algorithms and machine learning techniques to analyze historical data, identify patterns, and predict future outcomes. It is an advanced branch of data science that uses historical data, statistical modeling, and machine learning to answer the question, "What might happen next?" It is the process of using data to forecast future outcomes with a high degree of precision. It is used in predicting the future events. It facilitates to visualize the future and is reliable and accurate than previous tools.

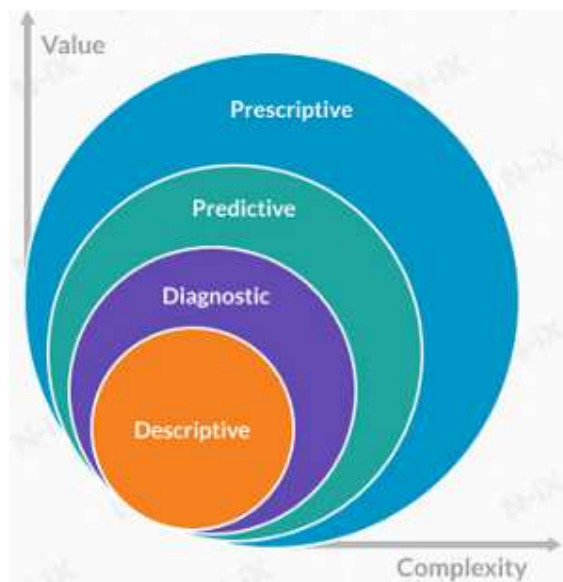
Traditional forecasting methods often rely on historical trends and simple statistical models, which can be prone to errors, particularly in volatile markets. Predictive analytics, however, leverages more sophisticated algorithms, incorporating a wider range of data sources and accounting for external factors that might influence demand. More information on the applications of predictive analytics is available from the books in [18-23].

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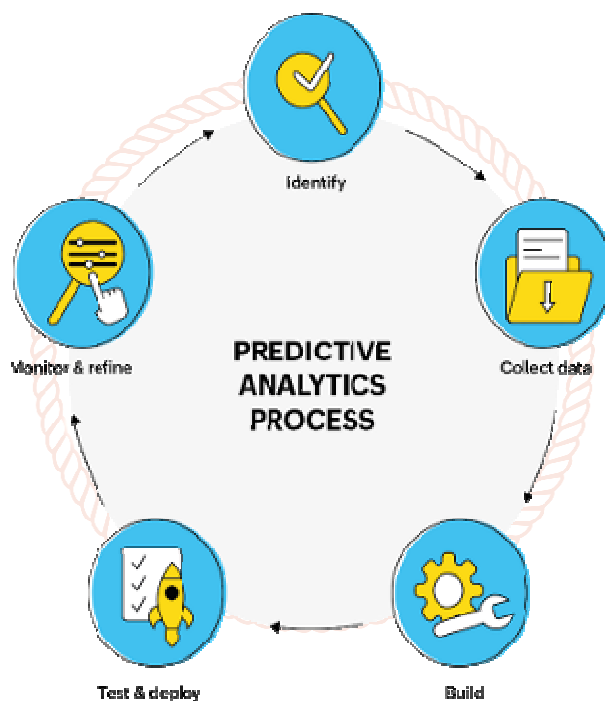
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**Figure 4 Types of data analytics [7].**



**Figure 5 Predictive analytics process [8].**

Predictive analytics uses:



**Figure 6 Some applications of predictive analytics [9].**



Figure 7 Use of predictive analytics in healthcare [13].



Figure 8 Predictive analytics for business [14].

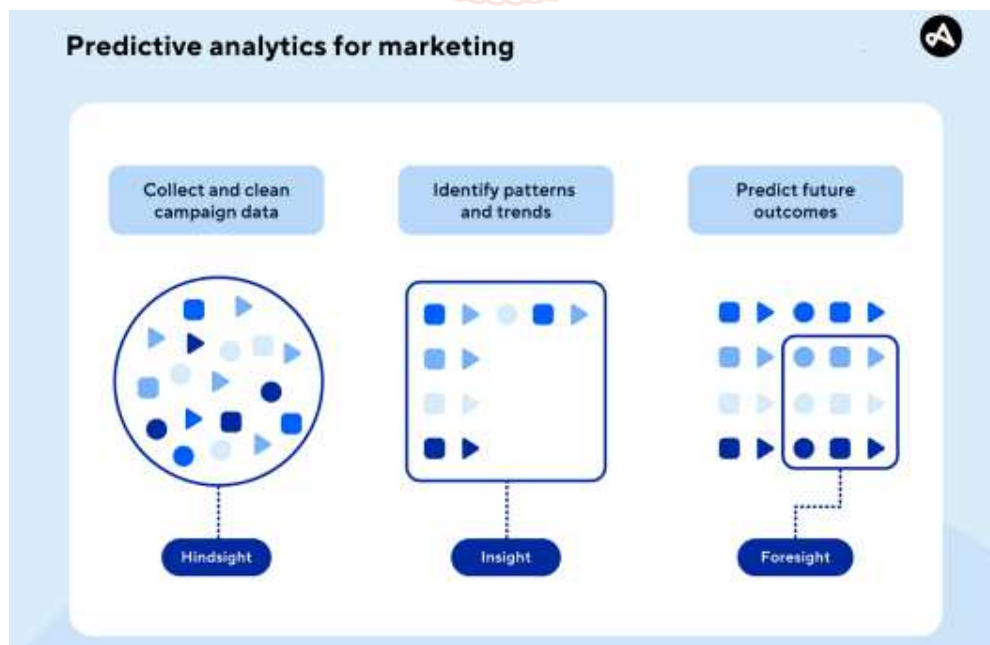


Figure 9 Predictive analytics for marketing [15].



Figure 10 How predictive analytics helps in making better decisions [1].

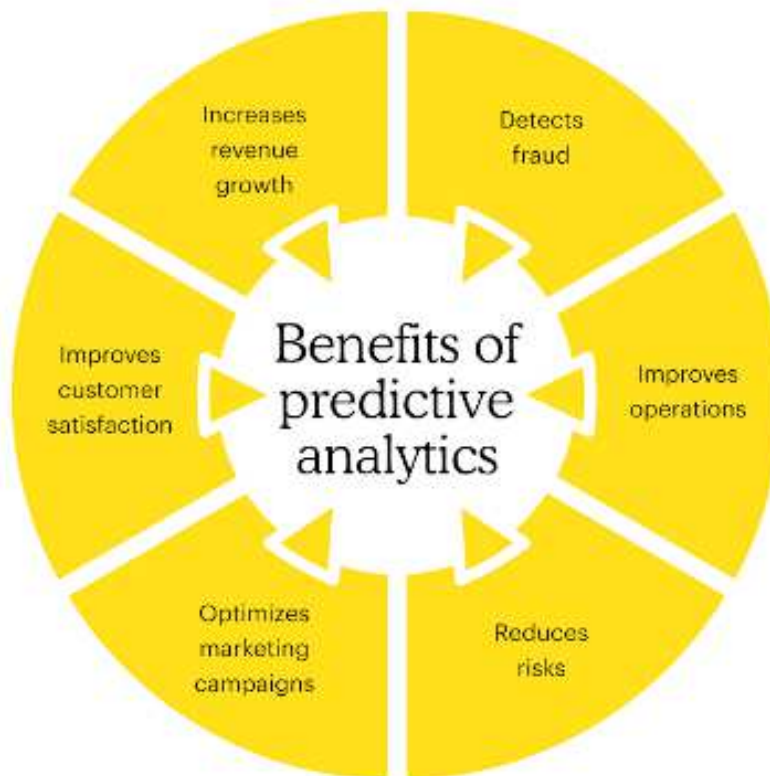


Figure 7 Some benefits of predictive analytics [9].