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Technical Evolution: The Effect of Machine Learning Algorithms on Business Decision-Making Today

Introduction

The rise of machine learning has been a big trend among companies today. In business, we can see how machine learning has affected people's decision-making process by machine learning algorithms providing in-depth data analysis through pattern recognition and results from training the algorithms with data. Machine learning is effective for prediction tasks, while decision tasks still require human knowledge and decision-making skills. In this paper, we will discuss the role of data and the advantages of machine learning in business decision-making, real-world studies of machine learning's effect on business decision-making, challenges of machine learning in business decision-making, and the future trend of where machine learning is heading for business decision-making.

Role of Data and Advantages of Machine Learning in Business

In business, there are two terms that we need to care about when it comes to machine learning: Business Intelligence and data. Business Intelligence is "the process that transforms data into information and then into knowledge," and data "are raw facts and figures, [where] data and knowledge are information analyzed, understood, and explained" *(Reshi & Khan, 2014)*. Business intelligence uses operational and historical data in parallel with analytical tools to present information that can aid in business decision-making, in which machine learning and data mining can be used to provide valuable insights *(Reshi & Khan, 2014)*. As such, the power of Business Intelligence can be divided into two approaches: managerial and technical. The managerial approach "focuses on the process of gathering data from internal and external sources of analyzing them in order to generate relevant information" *(Reshi & Khan, 2014)*.

On the other hand, the technical approach "focuses on the technological tools that support the process" through methods such as data mining, query, and machine learning *(Reshi & Khan, 2014)*. With both approaches combined, Business Intelligence can help one have more informed decision-making and help come up with a competitive company strategy.

The business industry has been rapidly evolving and has been getting more difficult for decision-makers to understand their competitors and market trends; however, the evolution of machine learning and data science has improved the quality of Business Intelligence that can provide insight into company positioning and give a competitive advantage, as tools like machine learning can help "rapidly ingest, analyze and act upon mounds of data [to make] faster, more informed decisions about what's more likely to resonate" with the consumers *(Flower, 2023)*. For example, by resonating more with the consumers, "businesses can also use data to inform their strategies and drive targeted marketing campaigns to help ensure promotions engage the right audiences" after conducting managerial and technical approaches in Business intelligence *(5 Key Reasons Why Data Analytics Is Important to Business | Penn LPS Online, 2022)*. The most effective use of machine learning in business decision-making requires a clear idea of business needs and goals, understanding the type of data and how the data will be processed, considering the infrastructure and resources for machine learning, and regularly monitoring the performance of machine learning models that they produce accurate predictions *(Karunakaran, Kanisha, 2023)*.

Today, people have real-time data that can help businesses use the most up-to-date data and "operate with agility, pivoting with ease when market winds shift" *(Flower, 2023)*. Combining real-time data and the two Business Intelligence approaches can help companies consistently be updated with their consumer trends, market trends, and how their competition is performing. Another benefit of using real-time data along with machine learning and Business Intelligence is that businesses can detect operational inefficiencies, where "operational inefficiencies can eat up as much as 30% of an organization's revenue" *(Flower, 2023)*. In addition to decreasing operational inefficiencies, Business Intelligence can minimize risk while maximizing profit *(5 Key Reasons Why Data Analytics Is Important to Business | Penn LPS Online, 2022)*. After conducting research through the lens of Business Intelligence, a company may detect gaps where consumer needs are unmet, which signifies a need for innovation. In this case, "data analytics allows businesses to understand their current target audience, anticipate and identify product or service gaps, and develop new offerings to meet these needs" *(5 Key Reasons Why Data Analytics Is Important to Business | Penn LPS Online, 2022)*. The role of data and the advantages of machine learning have been helping companies to keep up with the market trend and their

competitors through the lens of Business Intelligence, which is possible due to the power of data.

Real-World Case Studies

We can see examples of machine learning used in various business decision-making sectors. For example, Google used its artificial intelligence created by the DeepMind to optimize the use of air conditioning in its data centers, and through the decision made by the prediction of air conditioning, there was a "40 percent reduction in energy used in a highly energy-intensive operation" *(Agrawal et al., 2019)*. Another example is the use of prediction tasks through machine learning/artificial intelligence: artificial intelligence "may directly substitute capital for labor in prediction tasks [as] tasks like demand forecasting are already prediction tasks," and these jobs have been continuously and increasingly being replaced by artificial intelligence due to multiple parts of human resources being based on predictive tasks *(Agrawal et al., 2019)*. On the other hand, it is difficult to say that artificial intelligence replaces jobs that are predictive tasks, as "most applications of artificial intelligence have multiple forces that impact jobs, both increasing and decreasing the demand for labor [, and the] net effect is an empirical question and will vary across applications and industries," but prediction task jobs are more easily replaceable by machine learning/artificial intelligence while decision tasks still require human rationality *(Agrawal et al., 2019)*. Predictive tasks and decision tasks are complements of each other, and if the prediction is more accurate and informational, decision-makers can lean on making probability-based decisions.

We can also see the effect of machine learning making predictions on what kind of startups will succeed depending on elements such as a country's fiscal policies, investment in innovations, and the industries the startups belong to. In the study by Zibikowski and Antosiuk, they analyze the success of startups by using three different machine learning models – logistic regression, support vector machine, and gradient boosting classifier – on the pre-processed dataset from Crunchbase database with as much bias removed as possible "by purposefully limiting the set of predictors to information known at the beginning of the company's operations" *(Żbikowski & Antosiuk, 2021)*. After running the three machine learning models, the study concluded that the gradient boosting classifier model – XGBoost algorithm – has the highest probability of accurately predicting the future success of a business *(Żbikowski & Antosiuk, 2021)*. All three models were able to predict better than recall, which means the models were able to find only companies that fit the most popular pattern of success, and the XGBoost algorithm proved to be the most effective using features like startup's location and operation in industries *(Żbikowski & Antosiuk, 2021)*.

As we can see in these two studies, the use of machine learning/artificial intelligence has proven to be effective when it comes to predicting the companies' success and operation efficiencies, but decision-making ultimately depends on the human element as prediction is not the same as decision-making, and prediction does not mean anything without decision-making.

Challenges and Considerations

One of the biggest challenges and concerns of using machine learning in business decision-making is the implication of bias. For example, we can consider algorithmic bias in marketing through machine learning in three major dimensions: design bias, contextual bias, and application bias *(Akter et al., 2022)*. Bias can be seen in multiple subdimensions like model, data, method, cultural, and social ways, which all fall under the three major dimensions. In marketing, the "benefits of ML-based marketing models are increasingly questioned due to the unfair or unjust effects on specific customer groups" *(Akter et al., 2022)*. In a world where multiple companies have engulfed big data, decision-makers must consider bias in all machine learning models.

Future Trend of Machine Learning in Business Decision-Making

Machine learning has shown its effectiveness in business decision-making, and the future of further implications of machine learning in business seems promising. According to Ambadipudi, machine learning can automate manufacturing processes, add more customization during production to fit consumer preferences, personalize the consumer shopping experience, and help healthcare develop treatments through rapid diagnosis while preventing certain diseases *(Ambadipudi, 2023)*. Machine learning is a field that can be applied to anything that needs prediction, and an algorithm running predictive analysis proves to be effective in multiple fields, which aid in business decision-making.

Conclusion

Machine learning in modern business decision-making is essential to coming up with competitive strategic decisions. In the time of big data like today, machine learning speeds up the process of prediction tasks with high accuracy and condensation of patterns in datasets, which can heavily influence decision-making in a manner that is backed up by probability and quantifiable data; however, we also have to beware of potential in bias in datasets and the machine learning models themselves. Decision-makers need to be aware that

while machine learning models provide valuable and real-time information, the ultimate decision needs to be made by a human. Machine learning provides a more valuable and detailed insight to help make a better decision based more on the probability of success and other quantifiable data through analysis done by machine learning.

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