Study and analysis Sales Prediction Model For Online Marketing Using Machine Learning Techniques

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Abstract

Because of this, machine learning is now a very important part of the real world. Every business can use Machine Learning's cutting-edge applications, which are too many to list. In today's competitive market, sales and marketing goals that don't take into account how customers buy things don't work. Machine learning is getting better, and this is having a big effect on sales and marketing. Because of these changes, it's easier to figure out important things like how people buy things, who they want to sell to, and how sales will go over the next few years. This lets the sales staff plan for a jump in their company. This study looks at past sales data to make predictions about how well Big Mart Corporations will do in the future. In the study of sales forecasting, ML models like Linear Regression, K-Neighbors Regressor, XGBoost Regressor, and Random Forest Regressor are used a lot. In addition to the item's weight, fat content, and visibility, the forecast includes data parameters like the type of item, the item's MSRP, the year the outlet opened, the size of the outlet, and the type of outlet location.

Keywords Sales Prediction, Online Marketing, Machine Learning Techniques

Introduction

Developing accurate projections of future sales has always been one of our top priorities. It is essential for all of the suppliers to have a reliable method of determining what will occur in order to maintain the efficient operation of the marketing organisations. Performing this process by hand has the possibility of making significant errors that could damage the administration of the business and, more importantly, would take a significant amount of time, which is not what we want in our fast-paced world. There is a significant amount of reliance placed on the commercial sectors of the economy, which are expected to produce sufficient goods to fulfil the need of the entire world. Reaching the target audience in the market is the primary objective of business sectors[1]. It is significant that the organisation has been successful in accomplishing this objective through the utilisation of a forecasting system. The process of forecasting requires looking at data from a variety of sources, such as how individuals behave, current market patterns, and other factors. This analysis would also be helpful to businesses in terms of effectively managing their finances. The technique of forecasting can be used for a variety of purposes, such as determining how much of a product will sell in a specific amount of time or how much demand there will be for a product in the future. In this context, the application of machine learning could prove to be extremely

beneficial. The study of how computers can learn to perform specific jobs more effectively than humans is known as machine learning. They are put to use to carry out specialised activities in a rational manner in order to achieve improved results for the development of society. The science of mathematics serves as the foundation for the field of machine learning. It is possible to achieve the best possible results by making use of a variety of mathematical paradigms. Additionally, machine learning has been useful in terms of sales forecasting[2]. It assists us in developing a more accurate forecast of the direction that future sales will take. In the paper that we wrote, we discussed the ways in which machine learning algorithms could be utilised to analyse sales data from a supermarket. Based on a few key features of the raw data that we have, the objective here is to make a prediction as to how the products will be sold and how many of them will be sold in total. The data that was gathered has also been analysed and investigated in order to gain as much information as possible on the subject. At each crucial stage of their marketing plan, corporate organisations would benefit from the assistance of analysis in making judgments that are grounded in probabilities.

Related work

In the past, sales and demand forecasting relied heavily on machine learning. This study will focus mostly on the sales of various foods. So many methods have been devised to deal with prediction since it is so crucial in so many fields. Models based on statistics, hybrid models, and machine learning are all options. Auto regressive moving average and auto regressive integrated moving average are two statistical methods that could be used to manage this project (ARIMA)[3]. Graphic clusters that were nonpartisan were used by both remşlek and ule Gündüz Oudüc in their experimentation with different warehouses based on their sales history. Because of the Bayesian network technique, they were able to get better predictions from the application. According to a poll conducted using Machine Learning, the amount of food that will be sold in the future may be predicted. In this study, data analysts were asked about factors like temporal granularity, output variables, and input variables. The study's main objective was to enhance the precision with which demand forecasts are made. Both internal and external point-of-sale data were utilized[4] in the testing process (POS). Machine Learning techniques such as Boosted Decision Tree Regression and Bayesian Linear Regression were used during the evaluation phase. Random Forests, k-Nearest Neighbors, and XGBoost were all used to do intriguing study on restaurant-goers. Based on the restaurant's attributes, two real-world data sets from two separate booking sites were used to create many input variables. XGBoost performs the best on this dataset, as evidenced by the findings. Holmberg and Halldén agreed that restaurants' daily sales were significantly impacted by the weather. XGBoost has been found to be more precise than the alternative technique. They also discovered that incorporating weather into their model increased its efficiency by 2–4 percent. They investigated two potential machine learning methods: XGBoost and neural networks. Their forecasts are now more accurate because they consider a wider range of data, such as previous sales and weather conditions. Recently, some research[5] have looked at solely the sales model without considering how training and testing data are linked. Instead, they relied on data that had been gathered during training. There are more errors as a result of this, and the results are less precise. Clustering techniques have been developed as a result of current research in order to categorise all of the forecasting data into a number of distinct groupings. Predictive models can benefit from this by reducing the amount of time spent calculating and increasing their performance. Customers' demands were predicted using SVM (Support Vector Machine)[6]. I created a smart model that relies on supporting vector machines to address issues with the distribution and disclosure of new models.

These are the issues that this model attempts to address. Support Vector Machines have been demonstrated to be superior to Artificial Neural Networks at estimating consumer demand for goods, according to this study. Mean absolute error (MAE)[7], mean squared error (SE), and median average error (MAE) were the most commonly used metrics in previous studies (MAE). We employed k-fold cross validation on both the training data and the test data to ensure their validity. We're looking at things like the greatest error, the accuracy, and the mean absolute error in this investigation. The stratified K-fold crossvalidation[8] method was utilised to collect the most useful information from this study during the training and testing phases. Algorithms for predicting sales will be selected as part of this project.

Proposed Methodology

Machine Learning applied in Sales Prediction Model For Online Marketing

The application of machine learning by digital marketers may not yet be completely defined, but those who have used it have noticed a significant improvement in the performance of their campaigns after putting it into practise. mainly due to the fact that algorithms for machine learning are able to generate incredibly[9] detailed and accurate insights. In today's world, marketing teams have the potential to acquire a more in-depth grasp of the industry in order to better their strategies. Digital marketers are making use of it to improve their understanding of the demographics of the audience they are trying to reach. They then come up with novel approaches to enhance the relationship with, and engagement of, their customers.

The application of machine learning in marketing consistently clears the way for the investigation of uncharted territories. The following is a list of some of the areas[10] in which it is currently possible for marketers to make use of algorithms that are based on machine learning:

1. Content marketing

Businesses have, over the course of a number of years, been making concerted attempts to offer content that is constructed with the intention of engaging a certain audience. The content's relevance is another factor that helps to decide how successful it will be. The content's ability to tell an engaging story and to elicit a response from the audience are also important factors in determining how successful the content will be.

Because machine learning tools observe trends and generate[11] content ideas, you may tailor your material to the specific audience you have in mind.

2. Predictive Customer Behavior

Marketers can improve their understanding of the behaviours of their customers by using machine learning algorithms. The vast majority of purchasing choices are made without any kind of logic or reason at all. Intuition, cultural norms, emotional states, and trust all play important parts in the process that is being described. People have a propensity to engage in the same behaviours, such as repeating their routines, making the same purchases, and acting on the same urges. Thanks to algorithms that were developed[12] expressly for this function,

it is now feasible to fully automate the process of learning about the preferences and purchasing patterns of a consumer.

3. Enhance Customer Experience

This is one of the few sectors that can nearly totally be automated by utilising machine learning, making it one of the more unique possibilities. Algorithms allow for the recognition of customer demands and the subsequent conveyance of those requests to the suitable location. consider the enhancement of the overall quality of the customer experience to be the most significant growth benefit that will result from the use of machine learning.

Chatbots and other technologies in a similar vein make it currently feasible to automate customer service procedures totally or partially. This opens up new opportunities for businesses. In addition to automating boring activities, responding to inquiries that are regularly asked, and answering those enquiries, they also generate a personalised experience for the customer support department[13] to provide.

4. Advertising

As a result of the consumer data analysis and predictions generated by machine learning algorithms, digital marketers are able to come up with targeted promotions that have a better probability of delivering better returns on investment. This is because these promotions are based on customer data. As a result of having access to machine learning algorithms[14], digital marketers are now in a position to make this a reality. Reinforcement algorithms can be used to identify, among other things, which marketing channels offer the best opportunities for conversion and where advertisements should be placed. We are able to assist you with optimising the time that the advertisements are shown, in addition to other things.

5. Customer retention

The capability of machine learning to simplify risk estimations will allow you to cut down on the number of clients that quit your company, which will allow you to increase your profits. Research that was presented in the Harvard Business Review revealed that the cost of recruiting new customers is often five to twenty-five times higher than the cost of maintaining relationships with existing clients. If you are provided with information about the client's gender, age, and income, among other qualities, you will be able to determine the type of customer who is most likely to defect. This will allow you to better target your marketing efforts.

6. Price Optimization

An algorithm that makes use of machine learning can be of assistance to you in optimising product pricing by taking into account factors such as the segmentation of customers, price elasticity, the position of the product, and the duration of the sales period. Because of this, it is possible to price your things in a manner that is both competitive and does not price you out of the market. As a result, the profits that the firm makes will not be negatively impacted in any way.

7. Forecast Prediction

You are able to make predictions about a wide range of indicators by making use of machine learning algorithms. Because of this, you will be able to successfully optimize[15] your inventory by accurately predicting the demand for the products you sell. You will no longer need to be concerned about oversupply, which can result in lost sales or supply problems, once you implement machine learning. If your predictions are accurate, you will have the option to be proactive rather than reactive, which can significantly boost your revenue.

8. Anomaly Detection

When a mission-critical system fails, the amount of time you have to take corrective action can have a significant impact on the outcome of the situation. However, it is not always easy to ensure that adequate resources are available to monitor all of the metrics and systems that are essential to your business. Algorithms designed for machine learning can process massive volumes of data, develop highly accurate models, and limit the number of false positives they produce.

E-commerce[16] websites typically include a tool that forecasts future product sales, and while it is just one of many significant features, it is a very useful one. because sellers who operate their businesses locally and engage in e-commerce are impacted. They are currently trying to market their items through a variety of different approaches in an effort to turn a profit on their product sales, which are currently in the red. They initially had success in selling their wares by promoting "Free Home Delivery," which is something that would be highlighted in the campaign. The phrase "Free Home Delivery" is utilised because consumers have come to anticipate the ability to shop for things online from the comfort of their own homes and e-commerce companies offer this capability. However, not all store owners are able to sell their wares via e-commerce; consequently, some stores have been forced to close permanently. While they are working on an e-commerce website, management will attempt to do an analysis of how well the website is doing business. They are attempting to conduct an investigation into the nature of the necessary alterations. Data Scientists and Data Analysts Work on Forecasting Sales Because of This, Developers Will Be Able to Develop or Modify Their Portal to Encourage Customers to Shop More Data Scientists and Data Analysts work on predicting sales. Due to the fact that many different business vendors are being impacted by the expansion of e-commerce, this project will assist the vendors in estimating the sales of the products.

When it comes to deep learning, the structure of the entire connection layer[17] is the most crucial one. The neurons in the network are connected to one another at every level, and there are a large number of neurons packed into each layer. The convolutional neural network is a framework for deep learning that performs extraordinarily well in the field of vision. This structure had its start as an inspiration from the biological vision system that exists in living organisms. Input layers, output layers, convolution layers, and pool layers are the four types of layers that make up a convolutional neural network. The configuration is, all things considered, quite analogous to that of a full connection. To begin, the entire connection layer is regarded as the most fundamental structure in deep learning. This is because the connection layer is where all of the learning takes place. The neurons in each layer of the network are responsible for creating each and every one of the countless connections that exist between the various layers of the network. On the other hand, a convolutional neural network is a

structure for deep learning that was modelled by biological systems for vision. It was inspired by these biological systems. The name "biological vision system" has been given to this structure in order to pay homage to the biological mechanisms that are responsible for clear vision. In a convolution neural network, there are four distinct types of layers: the input layer, the output layer, the convolution layer, and the pool layer. The overall structure is comparable to the connection layer in that it is made up of multiple layers and fulfils functions[18] that are comparable to those of the connection layer. It is possible to combine the convolution layer with the pooling layer in a number of different ways and then place this combination in the hidden layer in order to achieve the highest potential level of performance from the model. By sharing the parameters of the convolution kernel across the convolution layer and the kernel, it is feasible to considerably reduce the total number of model parameters. Again, the pooling layer has the ability to extract important information and reduce the number of model parameters. To put it another way, the convolutional neural network makes a huge reduction in the number of model parameters, which makes the process of training the model significantly less difficult and time-consuming. Even with the pooling layer taken out of the equation, the overall performance of the convolutional network in the visual field is still quite satisfactory. It is able to compete at the highest levels of image recognition and even take the lead. It is possible to utilise the convolution layer as the pooling layer so long as the step size of the convolution kernel is set to . As a consequence of this, the researchers involved in this study decided[19] to ground the fundamental architecture of the convolution neural network in the overall convolution structure.

In this study, pretraining the network with an unsupervised denoising autoencoder (DAE) is being examined as a means of increasing the training effect that is delivered by a deep learning model. A hidden layer that is able to perform nonlinear mapping is introduced by the single-layer self-encoder (AE), which is situated between the input and output layers. In order to successfully carry out input reconstruction, it is important to ensure that the vectors of the input layer and the output layer are identical to one another one hundred percent of the time. As a consequence of this, the formulas for the hidden layer are $X1 = F1\ (x)$, while the formulas for the output layer are $y = F2\ (x)\ (x1)$. AE does not simply build an identity mapping because the number of neurons in the hidden layer does not correspond to the dimension of the input feature. It is able to extract the variables in input characteristics that have the most potent influence thanks to the middle hidden layer that it possesses, and it can also extrapolate the statistical features that are present in samples. After the pretraining phase[20] is finished, its place will be taken by a brand new output layer that has been modified specifically to accommodate the requirements of supervised learning. As a direct consequence of this, conventional learning under supervision will be attainable. In the event that the hidden layer contains more neurons than the input feature has dimensions, there is a possibility that AE may be over-completed, which will lead to the extraction of information that is unrelated to the feature that was input into the network. In addition, DAE enables you to enter a custom value to customise the amount of neurons that are contained within the buried layer. As a consequence, DAE is capable of corrupting the input samples, which means that a specified probability dictates that zero will be the value of one or more of the eigenvalues of the input values. There are striking similarities between AE and a number of different[21] methodologies. As a direct consequence of this fact, the DAE method was implemented, amongst other things, during the unsupervised pretraining phase of this particular project. In the event that the model requires a significant number of hidden layers,

an output layer will be created directly behind each hidden layer. This layer will replicate the output vector of the previous hidden layer by using that vector as an input, and it will also utilise the output of the previous hidden layer as an input. Everything[22] is going to take place at the exact same time. On the basis of this, the model may contain an endless number of levels that are hidden. The basic educational stages depicted in Figure 1 are incorporated into the model that has been proposed for this article. is comprised of a number of distinct layers. You are free to combine the convolution and pooling layers in the hidden layer in any way that you see suitable in order to achieve the greatest possible performance from your model. It's possible that the convolution kernel parameters will be shared throughout layers in order to cut down on the total number of model parameters. By utilising a pooling layer, it is feasible to further minimise the number of model parameters. The fully connected neural network, on the other hand, is more complicated than the convolutional neural network, which significantly[26] reduces the model parameters and makes it easier to train the model. Even after removing the pooling layer from the convolution network, the visual performance of the network is still rather strong; in fact, it can even surpass the competition in certain picture recognition tests. A convolution layer[27] that has a convolution kernel step size of 2 may be utilised in the pooling layer of a neural network. A comprehensive convolution structure is used as the foundation for the convolution neural network that has been developed as a result of this.

Due to the fact that unsupervised pretraining has the potential[23] to improve the training impact of deep learning models, this research presents denoising autoencoder (DAE) as a means of pretraining the network. Between the input and output layers of the single-layer self-encoder, an extra nonlinear mapping layer is added (AE). The goal of the training is to ensure that the vector input from the input layer and the vector output from the output layer are similar. This will allow the input reconstruction to be accomplished[28]. As a direct consequence of this, the X1 value of the hidden layer is equivalent to the function F1 (x), whereas the Y value of the output layer is equivalent to the function F2 (x1). Because the number of neurons in the hidden layer is not proportional to the size of the input feature, a straightforward identity mapping cannot be accomplished. It is able to extract statistical characteristics from samples using its middle hidden layer, as well as the most effective influence factors from the input features, using the same layer. Following the completion[24] of the pretraining phase, the previous output layer will be taken out of the model, and a new output layer will be added in its place in order to carry out regular supervised learning. If the number of neurons in the hidden layer is more than the dimension of the input feature, AE will over-complete the data and extract unnecessary information. On the other hand, DAE has the ability to make the number of neurons in the hidden layer take on any value. Because of this, the input samples have a chance of being corrupted by DAE[29], which means that a certain percentage of the values will have zero eigenvalues. All other practises are equivalent to AE in every conceivable way. This is also the reason why the DAE method is utilised to carry out the unsupervised pretraining that is described in this work. In order to make room for a large number of hidden layers, an output layer will be inserted behind each of the hidden layers individually. In addition, the vector representing the output of the previous hidden layer[30] will be rebuilt, and its output will be used as the input for this layer. The previous hidden layer's output was used. On the basis of this, the model may have any number of additional hidden layers added to it. The first training phases of the model are shown in Figure 1. These training phases were produced as part of this research.
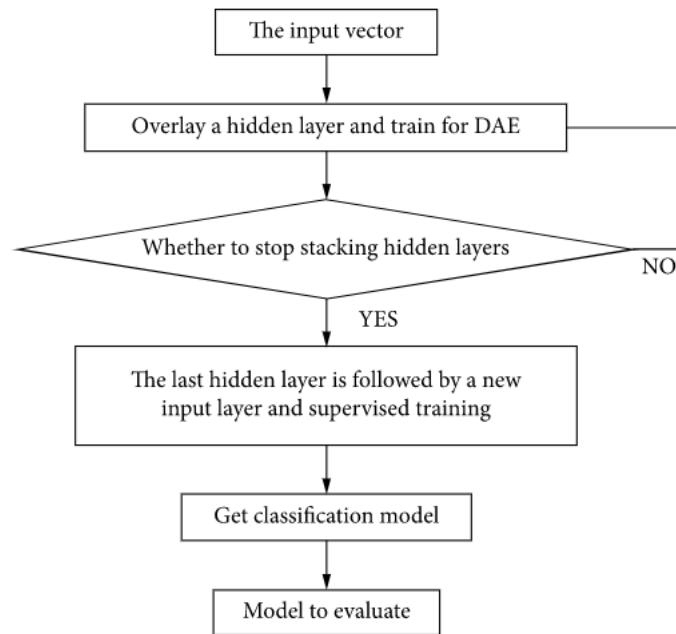
Figure 1: Flow chart of working algorithm

Following the completion of the unsupervised pretraining of the model, which is depicted in Figure 1, it is possible to acquire the final classification model by completing supervised training on the model parameters. This process is sometimes referred to as fine-tuning. After the model has finished the first part of their training, they will be able to go on to this step. When the model does not require unsupervised pretraining[19][25], it is instantly able to proceed to the stage of supervised training. This allows for a faster overall learning process. In addition to this, the accuracy index is utilised during the model evaluation stage in order to assess the level of training success achieved by the model. The accuracy index is the metric that should be used because this work is not concerned with making predictions regarding continuous values but rather making predictions regarding classifications.

Conclusion

In most business management systems, information is critical and sales forecasts are frequently requested. The company's bottom line is heavily influenced by the accuracy of the sales estimate. For sale forecasting, a data mining system or algorithm that can extract unknown knowledge from a training dataset is a very useful component. With the goal of enhancing future sales forecasts, this review paper offers the outcomes of a detailed examination and an analysis of intelligible predictive models. With the most latest forecasting methods, dealing with large amounts of data while retaining high accuracy has never been easier. This problem can be solved with a variety of different machine learning approaches. In terms of forecasting and predicting future sales, the linear regression model delivers the best level of precision imaginable. Certain analytical methodologies, taking into account a wide range of potential future influences, produce a reasonable sales target in the form of a sales prediction. These factors include both internal and external elements, such as changes in economic situations and demand trends, as well as the actual product and marketing strategy themselves.

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