Comparison of Sales Prediction in Conventional Insights and Machine Learning Perspective

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Abstract. Generally, the predictions of sales volume can be regarded as using the system of the forecasting model to estimate the future sales quantity and amount for products and services**.** Accurate sales forecasting based on the previous sales situation can promote enterprise do better in the future income and encourage enterprises to establish and maintain a highly efficient sales management team. This paper will analyze traditional sales forecasting methods and sales forecasting methods based on big data models which related to the perspective of machine learning, and then compare them. According to the analysis, the two sales forecasting methods have their own advantages and disadvantages. In the future, enterprises can adopt the two sales forecasting methods in parallel to maximize the utilization advantage of sales forecasting for enterprises. These results shed light on guiding further exploration of choosing appropriate sales model for enterprises.

Keywords: Sales Forecasting; Time Series; Prediction Explanation; Machine Learning; Intelligent System.

1. Introduction

Sales forecasting is an important function of enterprise management. In nowadays' fierce business competition environment, the way to predict the future according to the existing data and formulate appropriate strategies is the key to the success of enterprises. Sales forecast has always been the top priority in the core data of enterprises, which takes a decisive part in guiding the strategic direction of enterprises. Accurate sales forecast is a sign of benign operation and stable and sustainable development of an enterprise, which can not only strengthen the confidence of investors, but also encourage the morale of employees. On the contrary, whether the forecast result is too high or too low, it will affect enterprise operation, capital investment and personnel arrangement, and may even cause a domino effect.

The role of sales forecast is as follows. Firstly, sales forecasting can mobilize the enthusiasm of sales staff, promote product sales as soon as possible, and complete the transformation from use value to value. Second, enterprises can sell the production, arrange production, and avoid product backlog according to the sales forecast data. Third, the corporations can manage product inventory reasonably and effectively, and set up inventory early warning for products after forecasting, which has guiding significance for the arrangement of production schedule. Lastly, After the sales forecasting, reference data can be provided for the replenishment arrangement of products.

Sales forecasting in the role of enterprise management is very obvious, ever also has been a lot of business pain points, many enterprise's sales forecast and actual sales amount is large, some companies even in the last week of quarter cannot accurately estimate the sales for the quarter, so that greatly affect the quarterly sales target and sales commissions. The lack of modern sales data management platform, the low efficiency and lag of the sales forecast summary process, the dependence on the subjectivity of sales personnel caused by the guarantee or overestimate phenomenon, will cause the sales forecast and the reality of the disconnect.

This study will analyze qualitative and quantitative methods of sales forecasting, including traditional sales forecasting model and machine learning big data analysis model, and then compare them to analyze their applicable aspects and defects in enterprise development, in order to provide ideas for the future management of enterprises [1].

2. Factors and Metrics of Sales Prediction

According to the market environment, the factors influencing the sales forecast are internal and external factors: External Factors including demand trends, economic changes, industry competition trend and Movement by the government and consumer groups etc. Internal factors including marketing strategy, sales policy, sales staffs, production status etc. Since production guarantees output. Under the premise of normal sales, production problems, will also have a huge influence on the sales revenue of the enterprise. The output of the product needs to ensure the sales needs.

Based on the above analysis, enterprises should combine multiple considerations to make sales forecasts to ensure their accuracy and timeliness. The current situation of most enterprises' sales forecast can be divided into three stages. The Primary stage is oral forecast and report summary. Through the weekly sales meeting, the enterprise asks the sales staff about the current sales situation and the sales opportunities being followed up, and summarizes the sales estimates of the sales staff through the spreadsheet. Such a sales forecasting process not only takes time for sales staff to communicate with customers about sales, but also has low accuracy. When the sales team reports to the decision-making level, the forecast results are likely to be out of line with the sales situation. Lagged information and lack of insight into the report, it is likely to cause a significant decline in the timeliness and reliability of high-level decision-making. Subsequetly is the intermediate stage, which corresponds to CRM Sales management platform. The sales management platform is the basic of a modern enterprise management platform, which can collect and store the complete sales data as much as possible, and predict the sales trend through big data analysis. At present, the sales insight report of CRM platform mainly forecasts the sales trend through the general mathematical statistical model, which lacks the mathematical statistical model of business logic and market practice, cannot accurately forecast the sales. Therefore, it can not provide in-depth insight and help to sales staff, and improve sales performance. Due to the unequal effort and return of sales staff, their enthusiasm to update data in time will also be frustrated, which may lead to the loss and lag of data, and further affect the accuracy of sales forecast model. Finally, the Advanced Stage, Revenue Intelligence System (RIS). The advanced stage of revenue intelligence system, based on the business model polished by years of sales analysis experience in the industry, supplemented by advanced business intelligence technology, and through carefully designed and easy to understand visual automatic insight report, can solve most of the foreseeable pain points in sales forecasting in a one-stop shop.

Prediction accuracy refers to the degree of similarity between the predicted value and the actual value. The closer the predicted value and the actual value, the higher the prediction accuracy. The $\hat{y}$ is used to denote the predicted value of the model and y to denote the true value of the model. There are four main assessment methods. MSE is the abbreviation of Mean Square Error, which means Mean Square Error. The specific formula is as follows:

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2 \quad (1)$$

This formula represents the sum of the squares of the distance between each predicted value and the actual value, with a larger value indicating a larger error. RMSE stands for root mean square error, which is the square root of MSE, somewhat similar to the difference between variance and standard deviation. People don't have the same intuitive understanding of the mean square deviation as the variance, and they don't know whether the mean square deviation is equal to 100 is more accurate or less accurate. Therefore, the root mean square error (RMS) is created. By comparing the root mean square error with the actual value, we can have an intuitive understanding of the prediction accuracy. MAE is the abbreviation of Mean Absolute Error, which represents the Mean Absolute Error, and the formula is as follows:

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|\hat{y}_i - y_i| \quad (2)$$

The mean absolute error is just taking the mean square error of squaring the difference between the predicted value and the actual value instead of finding the absolute value. Somewhat similar to RMSE. MAPE is the abbreviation of Mean Absolute Percentage Error, which means the average Absolute Percentage Error. The formula is as follows:

$$MAPE = \frac{1}{n}\sum_{i=1}^{n} |\frac{\widehat{y_i} - y_i}{y_i}| \quad (3)$$

It provides a more intuitive representation of the accuracy of a forecast, somewhat similar to the concept of an increase.

3. Conventional Sales Prediction

Qualitative prediction method is a prediction method that makes inferences intuitively and development trend of the predicted object based on the analysis and subjective judgment ability of the forecaster who has rich practical experience and extensive professional knowledge. This method is usually adopted in the case of incomplete and inaccurate data obtained by the enterprise, in order to make a more specific and accurate judgment on the sales of the enterprise in the future through the data analysis.

3.1 Judgment analysis method.

Based on the plentiful practical experience and the experts with the ability of comprehensive judgment familiar with the changes of the market, judgment analysis method is usually in the forecast period of the sales situation after comprehensive analysis and research to make the judgment of product sales trend. The experts involved in the judgment and prediction can be both inside and outside the enterprise. The judgment analysis method can be divided into:

3.2 Opinion gathering method

Known as subjective judgment method, it is the judgment and prediction made by leaders, supervisors and business personnel who are familiar with the sales business and sensitive to the trend of future development and change of the market. Based on their years of practical experience, they pool their wisdom, analyze various opinions and comprehensively analyze and evaluate them. Thus, it is necessary for all relevant people not only to obtain a comprehensive understanding of the overall social and economic trend and the development strategy of the enterprise, but also to have a comprehensive understanding of the current sales situation of the enterprise to exchange information and complement each other. On this basis, through the collection and analysis of opinions, a relatively comprehensive and objective sales judgment can be made.

3.3 Delphi method

Known as expert opinion method, refers to the anonymous method of making sales forecasts based on expert opinions. As for who the experts are, it is up to the company to determine, and it is best if there is consensus on the experts. The Delphi method usually involves convening a meeting with a group of experts. The results obtained in the first phase can be summarized and used as the basis for the prediction in the second phase. By evaluating the judgment, observation and expectation of all the experts in the group, the prediction results with less bias can be obtained.

3.4 Expert panel method

This kind of objective and fair judgment method is lead by a prediction group consist of experts from all related aspects organized by the company, and runs extensive investigation, research and discussion through various forms of symposiums. Then, the collection of the scientific research results from the expert group are used to turn out the final prediction.

4. Sales Prediction Based on Machine Learning

Quantitative forecasting method is usually due to relevant data from the past record, applying mathematical methods in modern society to deal with those datas, and set up the models of forecasting to investigate the trends of markets. The more data enterprises have, the more specific forecasting method could be determined to measure the quantity of market demand. The quantitative forecasting methods used for sales forecasting can be divided into the following two categories according to different types [2-4].

4.1 Time series analysis

Time series analysis uses the correlation between variables and time to predict the future data through the analysis of previous data. When observing the revenue of sales, scholars know how to rank sales revenue by year or month to see how it changes. Time series analysis has become a representative method in sales forecasting.

4.2 Causal prediction analysis

Causal prediction analysis is a method to predict the development trend of things by using the causal relationship of their development. It is generally based on the past grasp of historical data, to find out the dependence between the variables of the prediction object and its related variables, to establish the corresponding causal prediction mathematical model. Then, the sales volume or sales volume of the object in the planning period is determined by solving the mathematical model [5].

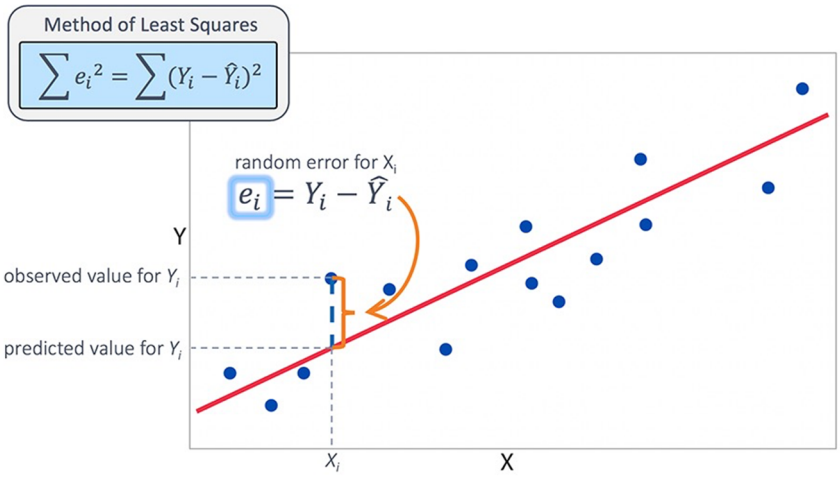

Fig. 1 Linear Regression Model

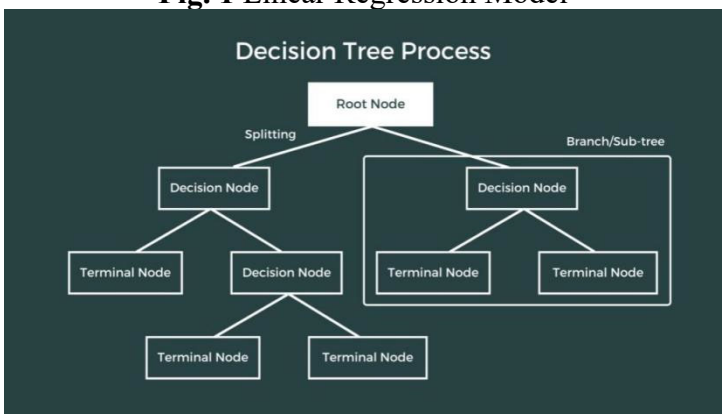

Fig. 2 Decision Tree Process

There are many specific methods used in causal prediction, the most commonly used and the simplest is regression analysis. Since the enterprise product sales are often linked to some certain function relation exists between the variable factors in the real market conditions, researchers can

take advantage of this relationship, choose the most appropriate related factors to establish a mathematical model of forecasting sales or sales. It tends to gain than using the method of trend prediction is more ideal results. Regression analysis mainly includes unary regression linear method (there is one related factor of the forecast object) and multiple regression method (there are two or more related factors of the forecast object)

- Linear Regression Model (as shown in Fig.1). It is assumed that the sales volume is linearly related to the factors affecting the sales volume, including error distribution, linear equation and activation function.
- Decision Tree Regression (as depicted in Fig.2). Its principle is a model constructed by making stepwise decisions on characteristic variables through IF-THEN rules.
- Grey Prediction Theory Model (as illustrated in Fig.3). Grey prediction is a kind of system method which is not strict. Based on Grey System theory, Grey forecasting technology could find the law of action and set the load forecasting model in the case of few data.
- BP Neural Network (as exhibited in Fig. 4). BP Neural network is a nonlinear model that simulates the work of brain neurons. The BP neural network architecture is composed of several layers of interconnected neurons, usually including the input layer, the output layer and a number of hidden layers. The input layer in the sales prediction is the relevant factor variables that affect the sales change. The output layer is sales volume. The middle hidden layer is a nonlinear mapping between the relevant factor variables and sales volume, which is usually a function. The neural network can be trained to achieve the convergence of the target by adjusting the weight of the link chain according to the learning rule [6-9].

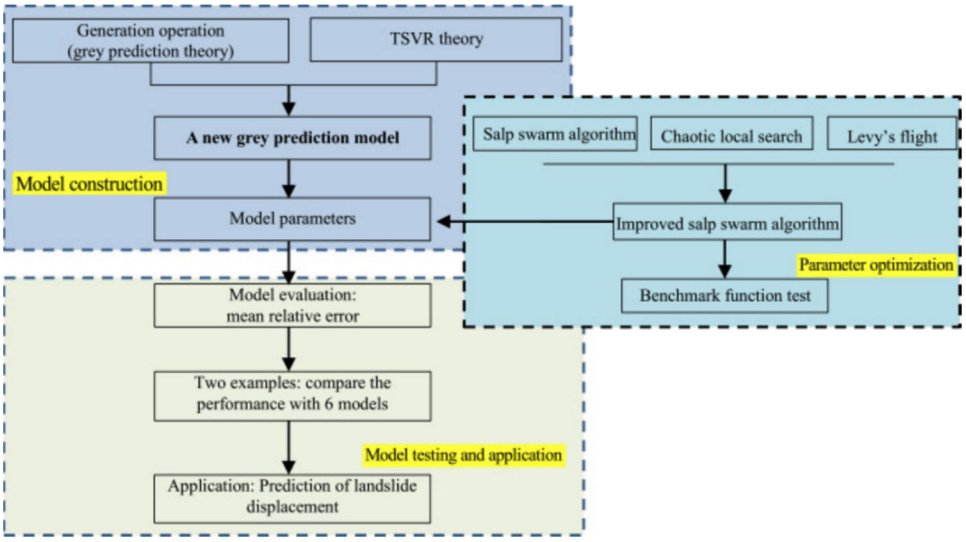

Fig. 3 Grey Prediction Theory Model

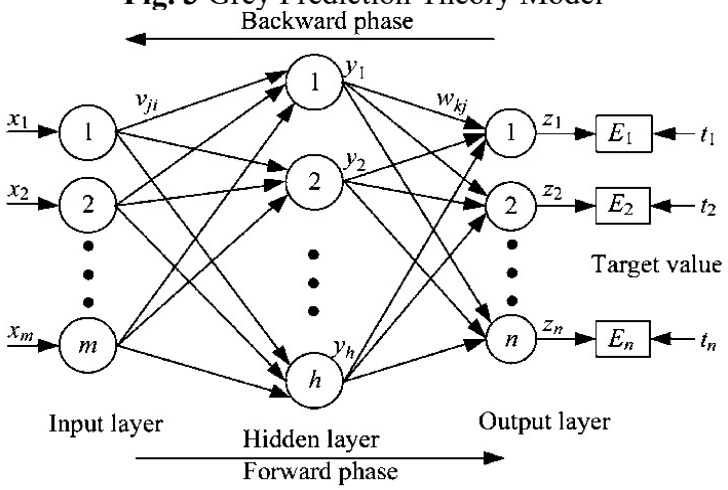

Fig. 4 BP Neural Network

There are four basic steps in sales forecasting using machine learning(as illustrated in Fig.5): determining the forecast target, collecting and understanding the data, building the model, and evaluating the metrics. The first step is to determine the prediction target, i.e., one should study the object of its prediction. The prediction method will be different if the prediction object is different and the scene is different. In addition, business objectives are also important because they need to be aligned with the business. Therefore, there are two trade-offs to determine the prediction target, namely prediction accuracy and model interpretability. The second step is the data gathering or understanding phase. This step usually consists of three small sub-steps, namely: data collection, data exploration and data preprocessing. Because the original data collected may be of very poor quality and needs to be cleaned, data preprocessing is necessary. There are many methods of data preprocessing. Here are two common methods of data preprocessing, missing value processing and data conversion. Missing value handling means that when one finds a missing value, one needs to understand what the reason behind the missing value is. If the latter business causes the loss, then it is necessary to consider the way to deal with the missing value. There are generally two methods to deal with the missing value: direct deletion method and interpolation method. People need to transform the data before importing the model. Generally, there are two methods: directly transform the data and box-CAx transform. The third step is to apply modeling, namely regression algorithms in machine learning. The last step is the evaluation.

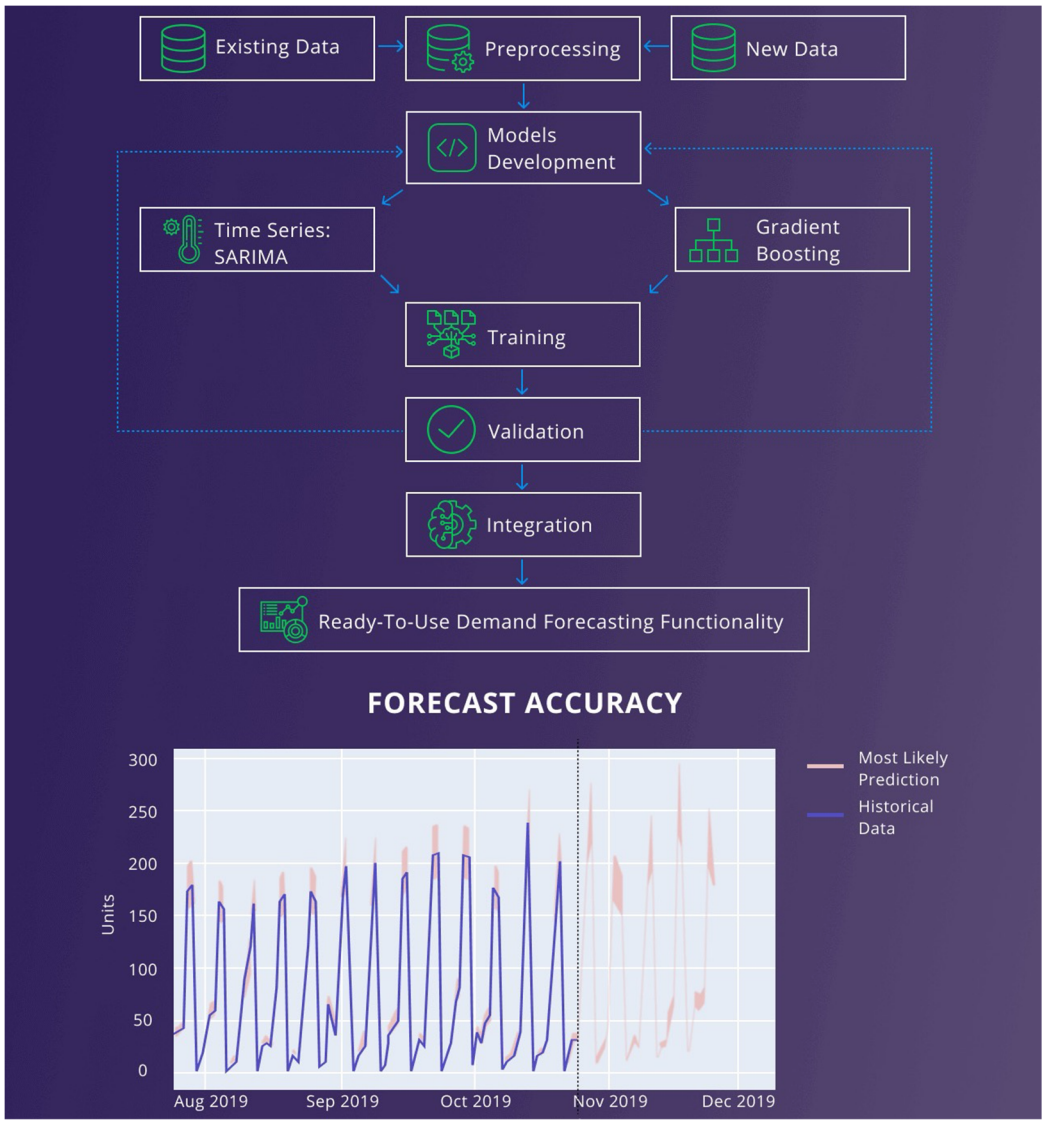

Fig. 5 Four Basic Steps

5. Comparison

This paper will compare the advantages and disadvantages of traditional sales forecasting model and machine learning sales forecasting based on data analysis. The traditional sales forecasting model is mainly time series method(as shown in Fig. 6). The advantages are simple, easy to grasp, make full use of the original time series data, good accuracy, and better results when combined with other models. The disadvantage is that it cannot show the internal connection and analyze the correlation between two factors. The selection of constant has a great influence on the result of data correction, and can only be used for short-term prediction.

There are two main models for sales forecasting based on machine learning(as shown in Fig. 7). The first is the grey forecasting theory model. The advantage is that you don't need a lot of data. The generation of irregular original data can get a strong regularity of the generation sequence, simple operation, easy to check, do not consider the distribution law, do not consider the trend of change. The disadvantage is that it can only be used for medium and long term exponential growth forecasting, and the results are poor for time series with poor volatility. The second is BP neural network model. The advantages are good approximation effect, fast calculation speed, easy to establish mathematical model, high precision. The disadvantage is that the input-output relationship of the prediction system cannot be displayed. The convergence speed is slow, it is difficult to deal with massive data, the network fault tolerance is poor, and the algorithm is incomplete (easy to fall into local minimum) [10, 11].

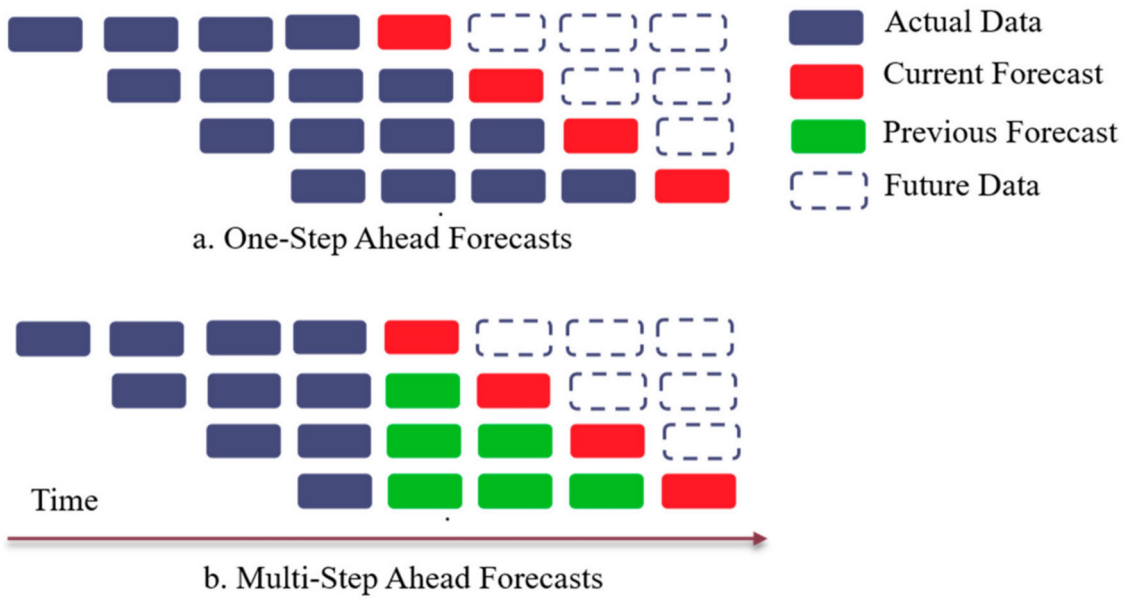

Fig. 6 Time Series Method

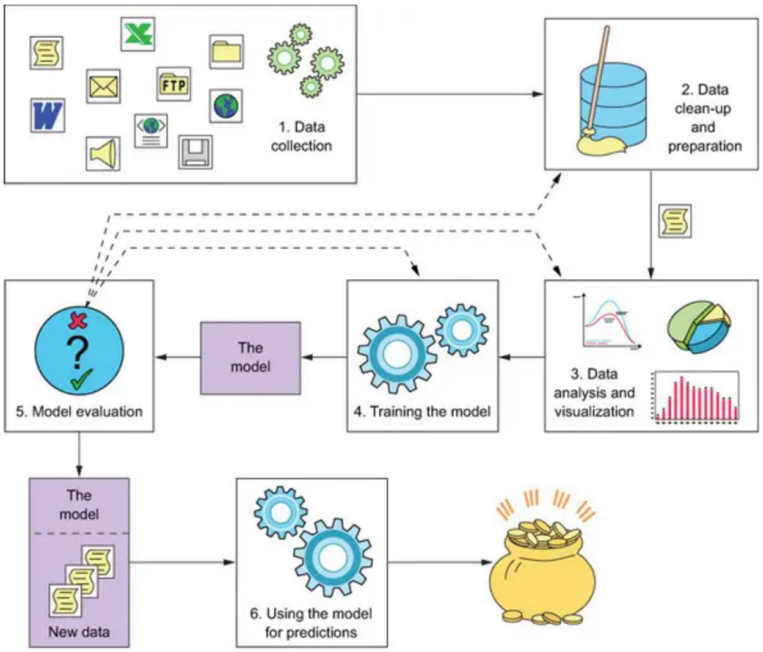

Fig. 7 Machine Learning Method

6. Limitations and Future Outlooks

As a matter of fact, the sales forecasting has three main disadvantages: time intensive completion, expensive technical tools, internal deviation. Although there are multiple approaches to sales forecasting, two broad approaches include manual and data-driven processes. In a traditional manual system, salespeople can prepare their own forecasts by looking at the current account and overall expected sales. Forecasting takes less time than selling. In more data-driven processes, organizations typically have marketing, IT, and sales people involved in building systems that collect and interpret data.

As for expensive technical tools, manual processing is not technology oriented. A typical sales organization will also use database software to monitor ongoing relationships with customers. When collecting and analyzing data in preparation for a forecast, the more hardware and software programs are required. Businesses will pay software providers for licenses.

Regarding to internal deviation, the challenge faced by corporate marketing and sales representatives in preparing forecasts is that internal bias is inevitable. Sales reps look better and tend to earn more commissions when they meet higher sales targets. This natural desire to have lofty ambitions can lead to overestimation. When sales expectations are high, businesses may spend too much on inventory and resources to prepare for sales events.

In order to improve the accuracy of sales forecast, one can start from both inside and outside the enterprise in the further explorations. Primariy, internal force, data accumulation and through. On the one hand, enterprises should increase the frequency of data update and speed up the progress of data precipitation. On the other hand, enterprises should get through the data boundary of each internal system to achieve data commonality. This common approach also enables companies offering sales forecasting solutions to extend the scope of their solutions to target enterprise supply chain and overall operational efficiency improvement. The rise of integrated solution Products such as SAP (System Applications and Products, enterprise management solutions) is the proof.

Secondly, combine channels to realize empowerment. Looking to the outside world, the division formed by channel providers between brands and consumers once prevented enterprises from obtaining consumer data. Nevertheless, if one can open up the channel and realize the information flow of the whole chain, it will go a long way to improve the accuracy of sales forecast. In the final

analysis, the improvement of sales forecasting accuracy is inseparable from the improvement of forecasting system. More advanced algorithms can help. The old algorithm is one of the biggest problems of the current forecasting system. Owing to the strong timeliness of forecasting, most companies in the market currently use time series algorithm, which causes experience solidification to some extent. Therefore, if one wants to grasp more cutting-edge and cutting-edge algorithms, one can not only learn by closely tracking international journals and related competitions, but also broaden the mind, summarize rules and find ideas from algorithms in other fields.

7. Conclusion

In summary, this paper discusses and investigates the modern sales forecasting methods from the perspective of traditional model and machine learning model based on the sales forecasting model. Portfolio forecasting models are the current trend in sales forecasting. Combined forecasting model is the general trend of sales forecasting at present. Combining two or more models can make up for the deficiency of a single model. According to the analysis, the current situation and application of sales forecasting, the shortcomings of sales forecasting model are summarized and the improvement measures are put forward. In the future, enterprises can use a variety of sales forecasting models for combination forecasting, which can make the results more accurate, so as to ensure that enterprises have a feasible development in sales. Scientific sales forecast is the basis for enterprises to make correct decisions. Making a scientific judgment on the economic benefits and development trend of future economic activities can give enterprise managers and investors timely economic signals. In this case, these results can help enterprises correctly grasp the market demand dynamics, reasonably carry out material procurement and production arrangements, and provide management efficiency and operating efficiency.

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