

Sales Forecasting using RNN

Kalaiarasan T R, Anandkumar V, Ratheesh Kumar A M

Abstract: *In today's world, big malls and marts are in need of advanced prediction of sales forecasting for the future demand of the products. This leads the manufacturer to produce sufficient product without excess production and to avoid such loss, we need to predict the future demand of a product using Recurrent Neural Network. Long Short Term Memory (LSTM) model deals with the most important past behaviors and understands whether or not those behaviors are important features in making future predictions. Thus, we can reduce the wastage of the product and an increase in profit. In addition, the sales team can communicate with the manufacturing unit in case of insufficient product. This leads to avoiding excess quantity preparation from the production unit. Sales prediction and forecasting is always a best practice for company development.*

Index Terms - Sales Forecasting; Recurrent Neural Network; Long Short Term Memory (LSTM) Model.

I. INTRODUCTION

With the rapid development of global malls and markets, there is a need for advancement predictive of sales forecasting. Each organization is trying to attract more customers using personalized and short-time offers which make the prediction of future volume of sales of every item which helps in increase in their profit. In order to avoid such loss, we need to predict the future demand of a product using Recurrent Neural Network. By using LSTM models, we can assess the most important past behaviors and verify whether those past behaviors are features used in invoking future predictions. By using Long Short-Term Memory, we can predict the demand for a product by analyzing the sales of the product which have been sold in the previous years. Thus, we can reduce the wastage of the product and an increase in profit. The sales team can communicate with the manufacturing unit in case of insufficient product. This leads to avoiding excess quantity preparation from the production unit. Sales forecasting is always a best practice for company development. Without sales forecasting, the company leads to stock more products.

II. LITERATURE SURVEY

Multiple linear regressions establish a relationship between dependent variable (Y) and independent variables

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(X). Random forests operate by constructing many decision trees at training time and outputting the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees. The major advantage is time-consuming but the drawback is it takes large data [1]. Factor analysis is done on the data collected to find out the most important factors affecting sales in the region. It is to describe the covariance among various variables using few unknown, unobservable variables, the so called factors. The major advantage is the technique involves data reduction, as it attempts to represent a set of variables by a smaller number, but the drawback is it is hard to decide how many factors to be included [2].

III. EXISTING SYSTEM

Sales Forecasting involves the estimation of future sales. Detailed precise forecasts make formidable business decisions and enhance short term and long term performance of the company involved. Factor analysis involves a mathematical way to describe differences between the known correlated variables via unknown factors. Factor analysis is done on the collected data to estimate the important factors affecting sales in the region.

IV. PROPOSED SYSTEM

Sales Forecasting is an integral part of operations and supply chain management. In supply chain management, forecasting is commonly employed as a lens to study the business value of sharing information between retailers and manufacturers. Information related to the demand of end-customers helps manufacturers to boost their forecasting accuracy and reduce the well-known bull-whip effect includes a brief overview or summary of your project. Overestimating future demand results in increased costs associated with the storage and possible disposal of excess inventory resulting from overproduction. Underestimating future demand results in inventory shortages and the loss of sales opportunities and customer good-will. The main objective of the proposed paper is to develop a web-based application for sales prediction and forecasting with the available dataset. This leads the manufacturer to produce sufficient product without excess production. So times excess production leads to a huge loss for the company, especially food-based industries. This project helps both sales team and production unit to manufacture the product according to the customer needs.



Sales Forecasting using RNN

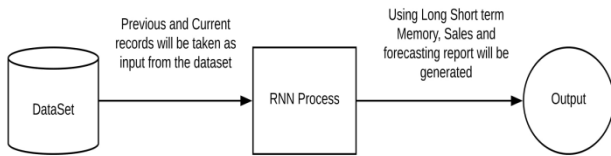


Fig 1: Context diagram of Sales Forecasting

V. METHODOLOGY

A. Recurrent Neural Network

One of the issues of the recurrent neural network is related to sequence as a direct cycle is formed with their connections. The next state can be retained using the current output as input for the next step resembling as running a program with standard inputs and selected internal variables.

The easiest recurrent neural network is seen as a fully connected network if we consider opening the time axes.

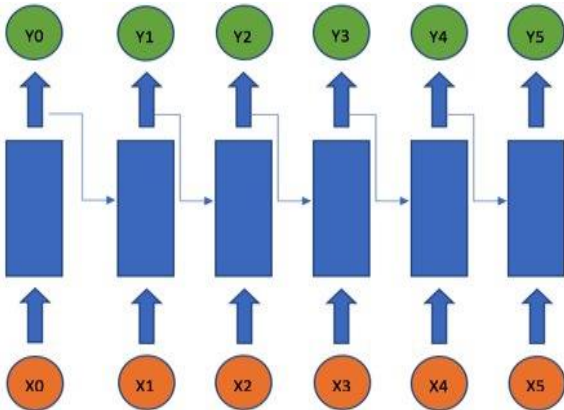


Fig 2: Working of Recurrent Neural Network

B. Long Short-Term memory

Long Short Term Memory networks – usually just called “LSTMs”- are a special kind of RNN, capable of learning long-term dependencies. They were introduced by Hochreiter & Schmidhuber (1997), and were refined and popularized by many people in following work. They are widely used on a large set of issued and designed specifically to eliminate long-term dependency. The default behavior LSTM has the ability to capture and store information for a longer span of time. The main component of LSTM is the cell state, a horizontal line that keeps running all through. The cell state always runs down the entire chain with less frequent interactions. It’s very easy for information to just flow unchanged along with it. LSTM has all the rights to include or exclude the information to the cell state, that are let through by structures called gates. It is a way to decide whether to let the information through or not. It consists of a sigmoid network layer and performs multiplication operation. The output value of the sigmoid layer ranges between zero and one indicating the individual component to decide whether to go through or not. A value zero indicates “let nothing through” and one indicates “let everything through”.

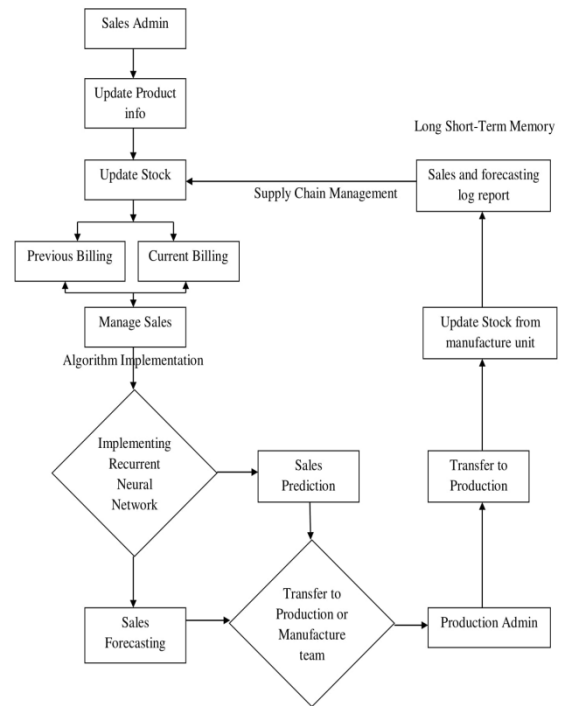


Fig 3: Flow diagram of Sales Forecasting using RNN

The concept of the system architecture of sales forecasting using recurrent neural networks are been explained with variant features, the foremost part is based on sales propelled by the sales admin. Sales administrative provides support to the management team within a company’s sales department. The major task of the sales admin is to update the information, characteristics features of the product and the stocks which are been used for the needs and availability in the market. Managing the information on the stock and updating the stock value plays a major role in sales forecasting and also for the company’s profit. The predominant part of the stock update is the billing process. The process is been categorized into previous billing and current billing. The previous billing is the payment process which significantly denotes the bill amount that has been paid in the previous years for the stocks, and the current billing is invoice payment that is currently being paid. These billing forms are the sales techniques where they are being managed. Managing sales are profit based sales and important function of sales forecasting sectors. They are hyperactively used for a profitable sale, productivity, marketing and economically useful for the consumers. The generality of RNN is the continuous form of the working part. It is discreetly used for the sales updating norms, amount of product that has been produced, and the wide continuity of product sales in the previous year’s till on to the date. RNN is the memory states which store the sales ratio of the previous years. These lead to the sales which are been predictive which are highly effort able for the manufacturing to produce the desired amount of goods and also they share their hands in profit of the goods and the products which are being manufactured by the company. RNN also paved way for the sales forecasting which highly helps the

manufacturing unit, the process of estimating the future sales and the accuracy of these sales forecasting enables companies to take important business decisions and can improve in their performance for the profitable sales. The biggest share of the product sales are acclaimed by the product admin, the product admin has to check up with the product produced with the objective of maximizing the sales revenues, profitable share and their marginal values. The product admin has to check for the quality and quantity of the product that has been produced and also the major responsibility of updating the stocks when they are being sold out and check up with the quantity of the products. The products are been checked up with sales management and ended up with the production which are directly related up with the LSTM (Long Short Term Memory) they are been used for classifying, processing and making predictions along with the time series, by which the products are been checked for the sales forecasting and reported by checking up with the time series of previous year's sales of the already existing products, these are the continuous range of checking up the product that is sold in the previous year's data are been stored in the memory for the improvement of the sales for the future use.

VI. ALGORITHM

Putting all correlation observations together the result is a function Fr whose pseudocode is shown below. As an input, it takes the price π of a product π at the prediction day t, the periodicity, and a price range δ . The upper and lower price limits are set to $\pm\delta$ percent. Using the periodicity from the previous analysis the algorithm looks for prices $\pi(w)$ that occur on days $w = t \text{ modulo period}$. If the price on such a day is outside of the upper or the lower limit (day 1 in our example), the sales quantity is ignored. If the price is inside the boundary, we include the corresponding quantity on that day ($p(w)$) in the quantity list (QtyList). After all matching quantities have been selected; the forecast quantity is computed as a linear trend ($\text{trend}(\text{Qtylist})$) of these quantities. If the prices fall outside the boundary, no forecast is generated. The procedure may be repeated with enlarged upper and lower limits if needed. For this, we define an easy forecasting model that considers the trend setting of the sale product, period and the influence of price for predicting the sale quantities.

```

Input: t &gt; T // prediction day
 $\pi$  (input) // price at day t
 $\delta$  (input) // price range (e.g.  $\pm 10\%$ ) period (input)
Def: u, l // upper & lower price limit
QtyList // list of sales quantities
w // = t - n * period
 $\hat{x}_t$  // predicted quantity at day t
for each  $\pi \in \Pi$ 
{
u :=  $\pi(1 + \delta/100)$ 
l :=  $\pi(1 - \delta/100)$ 
w := t - period
while (w  $\geq$  1)
{

```

```

if ( $\pi(w) \leq u$  &  $\pi(w) \geq l$ )
QtyList.add(p(w)) // p(w) is Qty on day w
w := w - period
}
if (QtyList  $\neq \emptyset$ )
 $\hat{x}_t := \text{trend}(\text{QtyList})$ 
return  $\hat{x}_t$ 
else
return nil
}

```

VII. RESULTS

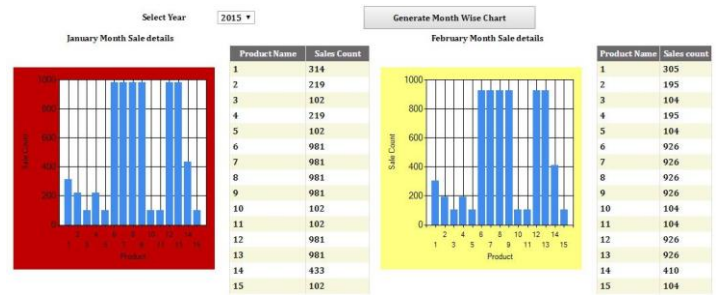


Fig 4. Month wise chart which tells the sales details of the product in month wise

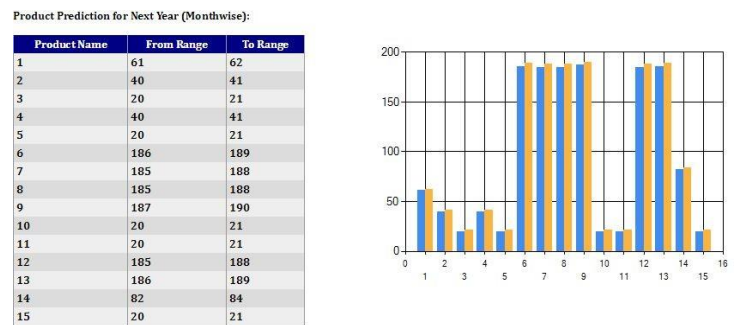


Fig 5. Predicted month wise chart which tells the sales details of the product in month wise for the next year

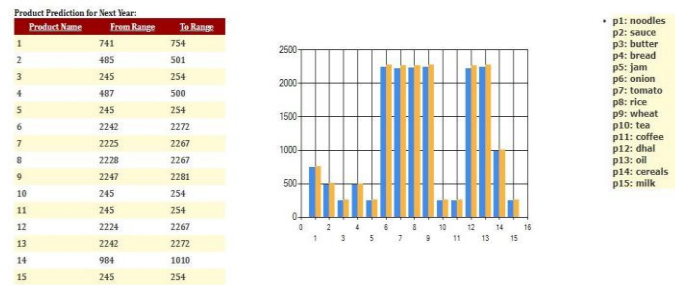


Fig 6. Predicted product for the next year which tells the predicted sales details of the product next year



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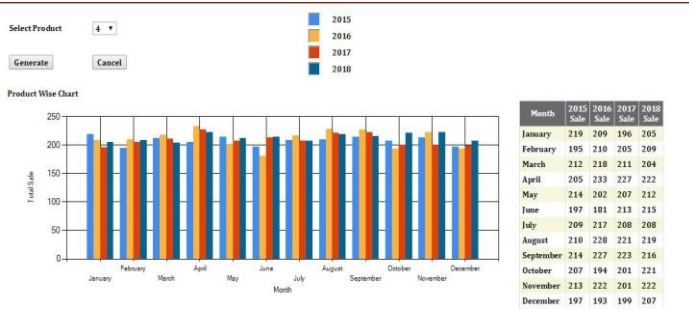


Fig 7. Predicted product for the next year which tells the predicted sales details of the product next year along with the year wise and the month wise

VIII. CONCLUSION

Thus by applying the Recurrent Neural Network, we can predict the future demand for a product to achieve improved sales. Accurate sales forecasts enable companies to make informed business decisions thus increasing the profit. By using LSTM, we can predict the demand for a product by analyzing the sales of a product which have been sold in the previous years.

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