

PREDICTION OF SALES BY USING FORECASTING TECHNIQUES

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Abstract—

The whole world is looking curious about future, anxious to understand what will happen in the next moment. Correspondingly, retailers are moreover curious about the destiny of their business, it's empowering and their future arrangements. Walmart is the world's greatest retailer and furthermore has a tremendous staple chain over the world. It was at first settled in America 1962. In 2019, it has in excess of 11,000 stores in 28 nations however the deals vary all around. Numerous business procedures, rebate rates will be presented for the improvement of deals. Retailers consistently attempt to pull in the everyday citizens to visit their store. They generally center on improving the future deals. Utilizing some Machine picking up determining models, we can evaluate the future deals dependent on the past information. Our point is to apply time arrangement gauging models to retail deals information, which contains week after week deals of 45 Walmart stores across United States from 2010 to 2012. There are different components which impacts the investigation of week after week deals - markdown, buyer per record, IsHoliday (Boolean worth returns whether it is occasion or not), size of the store, joblessness, store type, fuel cost and temperature. The anticipating models applied for the information are Auto Regressive Integrated Moving Average (ARIMA) model and Feed Forward Neural Networks (FFNN). The dataset will be separated into preparing and testing datasets. The anticipated qualities will be checked with the test information and precision will be determined. In view of the exactness we finish up which of the two models will better for the business expectation.

Keywords— *Auto Regressive Integrated Moving Average (ARIMA), Feed Forward Neural Networks(FFNN), Machine Learning, Artificial Intelligence*

INTRODUCTION

Many examinations contemplate proposed different forecasts on the securities exchange and proposed different arrangements. The observable strategies fall into two general groupings, specifically, quantifiable and sensitive handling techniques. Quantifiable systems consolidate, among others, exponential smoothing, and Auto Regressive Integrated Moving Average (ARIMA), and summarized autoregressive contingent heteroskedasticity (GARCH) instability [1]. The proposed model is likewise called a Box-Jenkins model or framework, is typically used in examination and climate figures. It is for the most part seen as the most capable envisioning methodology in human science and is used broadly for time game plan. The usage of ARIMA for foreseeing time game plan is fundamental with helplessness as it doesn't expect data on any essential model or associations as in some various procedures. ARIMA fundamentally relies upon past estimations of the course of action similarly as past botch terms for deciding [2, 3]. Its wide use is a direct result of the couple of unmistakable features of ANNs that make them charming to the two authorities and present day experts. As communicated in [4], ANNs are data driven, self-adaptable procedures with very few prior doubts. They are moreover incredible pointers with the ability to summarized target realities from the results picked up from one of a kind data, permitting right gathering of the idle bit of the masses. In addition, ANNs are general surmised as a framework can successfully inaccurate a perpetual ability to the perfect level of precision. Finally, ANNs have been viewed as outstandingly capable in dealing with nonlinear issues joining those in the certified world [4]. This is as opposed to various ordinary techniques for time course of action desires, for instance, ARIMA, which acknowledges that the game plan is created from direct methods and in like manner might not be right for most authentic issues that are nonlinear [5, 6]. There is a building up a need to settle significantly nonlinear, time-variety gives a similar number of employments [7]. In this paper, the proposed framework is to anticipate week by week deals of the Walmart dependent on verifiable information gave. Break down the multi variation information and plot the diagrams of the factors with the objective variable. Standardize the information utilizing min max standardization. Apply Seasonal and Trend decomposition using Loess (STL) to the information and watch the conduct of the bend over the timeframe.

RELATED WORK

It presents two right now acclaimed approaches to manage non-straight time game plan conjecture issues - ARIMA and Feed Forward Neural Networks. The dataset contains step by step bargains data of 45 Walmart stores and has 421,570 models. There are moreover various components which impact the step by step bargains. IsHoliday field re establishes a Boolean worth which addresses whether it is event or not. The dataset is taken from Kaggle's online stage [1].

Methodologies used: As a significant framework, Decision Tree was executed on the information. It is called as a benchmark methodology since it is advantageously finished. The tree was acknowledged utilizing MATLAB. Accidental Trend Decomposition and ARIMA model is regularly utilized for foreseeing the time strategy information. Separating methodology shows the ordinariness, plan and other little redirections of bit by bit deals information. To check, the information ought to be changed over to fixed data [1].

Results: STL and ARIMA model performed well achieving a WMAE of 2878.6 yet it didn't speak to immense arrangements spikes on specific days. For example, Easter is a moving event. This model couldn't immaculately envision the yield on that day [1].

Business measure assists with envisioning the image by checking the business we get an overall thought of coming quite a while on the off chance that any developments are required, by then those developments are done in the retail location's goal so achievement is developed significantly more highly and it besides encourages the clients to be glad by giving the things required by them in required time. Right now, Data applications are utilized for checking the courses of action. They are Hive, R Programming and Tableau. SQL is given by hive which gave the course to the informational index aside in HDP. Guide Reduce is utilized for pre-arranging the dataset[2].

Techniques Used: The information amassed will be dealt with in Hadoop Distributed File System (HDFS). The information after the pre-preparing will be in an un-reasonable arrangement. By that point, separating bucketing is applied utilizing hive. Man-made insight models which give competent outcomes will be applied to the gigantic dataset. The outcomes acquired are goliath and from this time forward completions are irksome [2].

Results: Numerical depiction of the measure bargains and the accuracy of offers foreseen is evaluated by 80% low insistence bargains, 80% high sureness bargains and 95% low

conviction bargains and 95% high sureness bargains, jumble up factor can be found between the anticipated arrangements and the watched bargains data, let us consider with a model, if we have to find the goof factor of month June in both the foreseen bargains and the watched bargains data then we can comprehend it by isolated between anticipated arrangements and the watched bargains data, if the detachment between them is amazingly low or irrelevant, by then the blueprints foreseen is cautious [2].

One key requirement for productive manifestations mastermind the overseers is the possibility of its stock association. Assorted stock association systems are commonly utilized for various kinds of things dependent on their preferred position plans, thing properties, and deftly arrange. We need to effectively anticipate the proposition of 111 perhaps air delicate things around the time of enormous air occasions at 45 of Walmart's retail stores in the U.S. Normally, we may imagine an uptick in the courses of action of umbrellas before a noteworthy tornado, at any rate it is risky for empowering chiefs to envision the part of stock expected to avoid being inaccessible or over-trouble amidst and after that storm [3].

Methods used: Supply chain, Inventory the chiefs, Big Data, Artificial Neural Networks.

Results: RNN and time slack model with a comparable structure that we fixed for MLP for every datum set (3 layers and 70 Neurons for Devent and 3 Layers and 90 Neurons for Dweather). Show 6 displays the results of getting ready for RNN and timing slack. Besides, we stripping for various events and spared the common of its plan achieves Exhibit 6.

Present day and age where rivalry is horrible and choosing business, decisions are continuously irksome, the affinity to decisively make desires is of remarkable congruity. 8 For example, it would be extraordinarily important to have the ability to anticipate the great and awful occasions of a country's economy or the instabilities of its budgetary trade costs. Deciding has been done over a wide show of spaces and circles including natural fields, for instance, atmosphere or even in games execution on account of the beneficial thought of desire. Deals" envisioning uses designs recognized from credible data to predict future arrangements, engaging taught decisions including designating or occupying current stock or enough administering future creation [4].

Strategies utilized: Random Forests, Gradient Boosting, Extra Trees, Sales Forecasting, Mean Absolute Error, Mean Squared Error, R2 score.

Results: In this examination, the last 20% of the arrangement dataset was used as the local test-set. The Gradient Boosting count was taken as a norm and the MAE was seen to be 5771.5, with a R2 score of 0.80 that proposes that 80% of the foreseen characteristics were precise. These were the best results gained with the `n_estimators` hyper boundary, which implies the amount of decision trees that are used for backslide, set at 200. The distinctive hyper boundaries were set to their default regards. The Random Forest figuring performs a lot of better than anything Gradient Boosting in that its MAE was resolved as 1979.4, with a R2 score of 0.94. These execution estimations were the best cultivated with the `n_estimators` hyper boundary set at 150, while the `min_samples_split` boundary, which decides the base number of tests needed to section an inside center, and `min_tests_leaf` boundary which demonstrates the base number of tests needed to be at a leaf center point, are set at 2 and 1 independently. The `n_estimators` boundary was set to 150, while the `min_tests_split` and `min_tests_leaf` boundaries were set at 2 and 1 independently, to get the best results wherein the MAE was 1965.5 and R2 score was 0.94.

I. ARCHITECTURES AND METHODS USED

We have applied the gauging procedures for Store 1 and Department 1 of the Walmart dataset. Before applying the calculations we have investigated the information to discover the connection between different factors and the objective variable. Checked week by week deals are influenced by different components or not. Ex: From the examination, we inferred that a week by week deal in the week which has a unique occasion has a larger number of deals than the typical days. Missing qualities assuming any, at that point, we discovered the level of missing qualities in every segment. In our dataset, just Markdown 1-5 sections have the missing qualities. 65% of the information has invalid qualities. Checked Markdown influences week by week deal. Calculations were utilized to locate the missing qualities since expectations can't be made utilizing invalid qualities.

1. Auto Regressive Integrated Moving Average (ARIMA):

It is a popular and broadly utilized factual strategy for time-arrangement determining. ARIMA models are time arrangement relapse models. In relapse we have a dependent variable Y_i and autonomous variable X_i and we linearly regression Y on X , β is coefficient. The errors are white noise.

2. Linear Regression:

$$Y_i = \beta X_i + \epsilon_i$$

3. Auto Regression (AR):

An auto regression model predicts future behavior dependent on past conduct. It is utilized for time arrangement when there is connection between qualities in a period arrangement. With time arrangement we can relapse today on yesterday. What happens today is reliant variable and yesterday is free factor. Φ is a coefficient to be assessed, X_t is reliant variable at time t , X_{t-1} is reactions in past time spans assume the function of autonomous variable.



4. Feed Forward Neural Networks (FFNN)

Neural network is a computational system that predicts the existing data.

5. Construction of neural network

Input layers: Takes inputs from existing data.

Hidden layers: uses back propagation to optimize the weights of the input variables in to improve the prediction of the model.

Output layers: Output of predictions depends on the data from the input layers and hidden layers.

Training and Test Data

Training Data: 2010 to 2012

Testing Data: 2012

Finding the Hidden Layers:

The upper bound on the number of hidden neurons that won't result in over-fitting is:

$N_i N_o$ = number-of-input-neurons.

$N_o N_s$ = number-of-output-neurons.

$N_s N_t$ = number-of-samples-in-training dataset.

α = an arbitrary scaling factor usually 2-10.

Setting α to a value between 5 and 10, but I find a value of 2 will often work without over fitting.

Normalization:

Min Max Normalization is utilized to standardize or normalize the information. As our information is bi variation and the qualities are in thousands, the calculation may not deal with the information authentically. Have to standardize the information, all the qualities will be somewhere in the range of 0 and 1.

$$v = (v - \min_F) / (\max_F - \min_F)$$

IV. RESULTS AND OBSERVATIONS

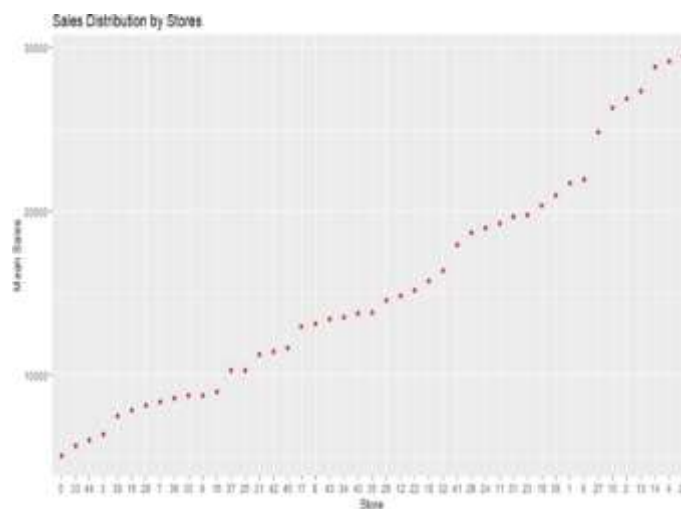


Figure 1: Average sale for all the stores

Figure 1 shown average sale for all the stores. The Mean Sales vary starting with one store then onto the next store. A few stores appropriate low deals and some disseminate high measure of deals. *Figure 2: Average Weekly Sales vs IsHoliday*

Figure 2 shown the average weekly sales based on IsHoliday sales. Weekly sales are more when there is a special holiday in that week and sales are less when there is no holiday.



Figure 3: Weekly Sales vs Temperature

Figure 3 shown the weekly sales Vs Temperature. The weekly sales are low when the average temperature is high.

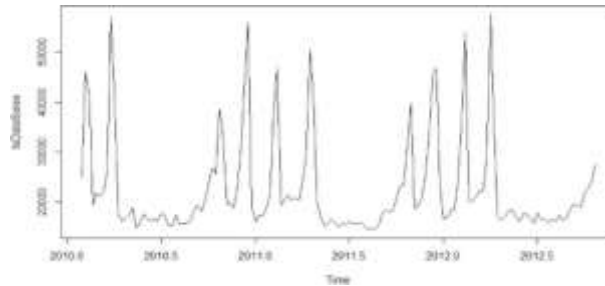


Figure 4: Weekly Sales Graph

Figure 4 shown the 2010.0 to 2012.5; Week after week deals increments at one minute and them fall off at another minute.

Date	Predict	Actual	Date	Predict	Actual
06-01-2012	29048.59718	10767.00	01-08-2012	10200.87227	10600.40
13-01-2012	33057.32665	16094.4	08-08-2012	10300.56493	17664
20-01-2012	37598.82719	18365.1	15-08-2012	10444.21376	17558.62
27-01-2012	24050.03235	10376.18	22-08-2012	10424.63896	16631.41
03-02-2012	24053.61248	20510.40	29-08-2012	10526.82718	15722.82
10-02-2012	22100.04962	36900.40	06-09-2012	10605.08996	17823.37
17-02-2012	21943.07046	54060.1	13-09-2012	20967.70831	16566.18
24-02-2012	22486.12592	20124.22	20-09-2012	21244.10346	16340.06
02-03-2012	34193.30842	20113.03	27-09-2012	21786.92908	15731.10
09-03-2012	32827.30128	21140.07	04-10-2012	20378.53617	16628.31
16-03-2012	21343.97997	22366.00	10-10-2012	16364.75267	16319.92
23-03-2012	18685.99140	22107.7	17-10-2012	20200.0819	17307.7
30-03-2012	18403.46704	20953.00	24-10-2012	20088.52038	16288.6
06-04-2012	19864.40269	57592.12	31-10-2012	23555.03994	16681.74
13-04-2012	19390.73902	38089.23	07-11-2012	23827.63281	18322.37
20-04-2012	17903.25034	10976.19	14-11-2012	22708.08307	19016.22
27-04-2012	17918.25793	18347.6	21-11-2012	23034.70381	19251.5
04-05-2012	18728.63954	17147.94	28-11-2012	26033.2943	18887.83
11-05-2012	19452.82838	18198.2	05-12-2012	28128.87982	23904.47
18-05-2012	19222.22812	18527.79	12-12-2012	28888.94266	22764.01
25-05-2012	18899.00039	10968.55	19-12-2012	24501.4889	24185.27
			26-12-2012	19081.72218	27880.81

Table 1: Result for ARIMA model

Table 1 demonstrated the outcome for ARIMA model; it contains date, purpose of estimate esteem, real worth, forecast esteem and genuine worth. By looking at the results for ARIMA Model the arrangements are extended in foreseen than in genuine.

By then ARIMA model has been applied to the data for the gauge. At last we find the accuracy of the foreseen data. The resulting check model applied to the data is FFNN. NN can show time course of action data enough, even without the data taking care of, for instance, deseasonalizing. At the present time, the layer yields head towards a comparative bearing. The data sources will be mix of time loosened data to foresee step by step bargains an impetus at time t .

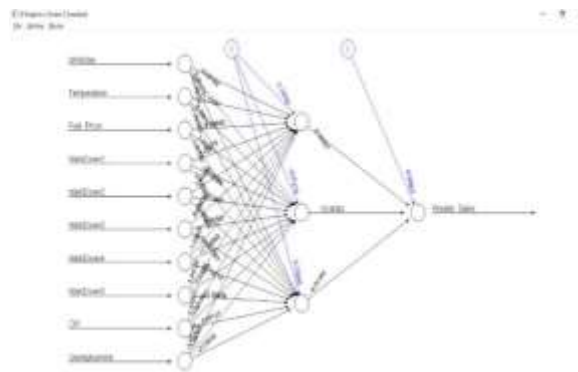


Figure 6: Feed Forward Neural Network Model

Figure 6 appeared, Feed Forward Neural Network Model; by looking at the results for FFNN we consider IsHoliday, Temperature, Fuel Price, CPI(Consumer Per Index), Unemployment to foresee the after quite a while after week bargains.

The best model for Neural Networks is 15 hidden units. FFNN has indicated a decent exactness. The precision demonstrated that the Neural Networks can display the time arrangement information. Which is a precision of FFNN's period figure is measurably higher than the exactness got from a straight relapse and all the models above.

V. CONCLUSION

Feed Forward Neural Networks was adjusted to be compelling model for the business information. This shows that FFNN can successfully display time arrangement information with no pre-handling, for example, de trending or de seasonalizing. We can likewise deduce that utilizing 9 concealed units has given the best precision. ARIMA has likewise indicated an

average exactness yet it very well may be improved. ARIMA couldn't figure for moving occasions, for example, Easter, Good Friday.

Future work will be for improving precision for the bi variant information. An improving the conditions on the objective class, with the goal that other variable additionally influences the week after week deals. STL + ARIMA model ought to be produced for moving occasions. Applying the models for different stores and offices and improve the exactness.

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