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Revolutionizing Sales Predictions Using SARIMA Model and Power BI Graphs

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ABSTRACT: Today, many shopping company track sales data for individual items to predict future customer demand and adjust inventory management. In order to stay ahead of the competition and generate more profit, a model should be created to help forecast and calculate the sales of various products. Therefore, to predict sales in a large market, you need to use a very important tool called machine learning (ML).

ML is the field of computer science that gives machines, computers, the ability to learn without any type of programming. Using machine concepts and data science fundamentals, a model can be built to help predict sales. Due to the growing competition among companies, it is imperative to have predictive models that can help gain useful insights to maximize profits and stay ahead of competitors.

KEYWORDS: Machine Learning, Sales Forecasting, ARIMA, SARIMA.

I. INTRODUCTION

Good forecasts play an important role in many areas of science, industry, commerce and economic activity. In today's consumer-centric business environment, companies striving for strong sales performance must often balance meeting customer demand while controlling inventory costs. Holding a large inventory can meet customer demand at any time, but it will cause inventory backlog, which will lead to problems such as capital occupation, inventory depreciation, and profit margin decline.

In contrast, lower inventory concentration can reduce inventory spend, but can lead to cost overruns due to missed sales opportunities, lower customer satisfaction, and more. Sales forecasting is the process of determining future sales, and forecasting can be used to maintain necessary inventory levels to avoid understock or overstock issues. Sales forecasts can impact areas of the business such as financial planning, marketing, and account management. Therefore, improving the accuracy of sales forecasts has become a critical part of business operations.

Various methods were developed and the best method was identified for each case study. AUTOREG (Autoregressive), ARMA (Autoregressive Moving Average), ARIMA (Autoregressive Integrated Moving Average), Seasonal ARIMA (SARIMA), Single Exponential Smoothing Forecast, Holt's Exponential Smoothing Method, and Holt-Winters models are all considered. Of these, the seasonal ARIMA method (SARIMA) has the lowest error measures.

II. RELATED WORK

In her work, Theresa Hoang Diem Ngo uses time series, which are collections of observations of one variable that occur in a positive pattern over time. The most typical patterns are uptrends or downtrends, cycles, seasonal and uneven swings. Analysts take note of this distribution and assume that it will repeat itself in the future, recreating a time series event as an appropriation of its historical attributes. Using the Box-Jenkins technique, this study focuses on identifying appropriate time series replicates by comparing the aggregate autocorrelation function (ACF) and fractional autocorrelation function (PACF) with the academic autocorrelation functions. Eliete Nascimento Pereira uses wavelet decomposition to detect time series forecasts.

Combinations of forecasting methods, including autoregressive integrated moving average (ARIMA) and artificial neural networks, were used to obtain higher value time series forecasts. This study introduces wavelet



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decomposition, ARIMA and the hybrid neural network multilayer perception model. Time series forecasting is the result of these mutually linear models. Wahyudi used an ARIMA model to try to predict the price movements of stocks listed on the Indonesian stock exchange. An elegant SARIMA model using the Indonesian composite stock price index based on an empirical survey (0, 0, 1).

The AIC criterion was used to determine the model. In a food business, time series techniques are used to forecast and forecast demand. The study shows how historical demand data can be used to forecast future demand and how these estimates affect supply chains. Using the Box-Jenkins time series program, several Autoregressive Integrated Moving Average (ARIMA) models were developed using historical demand data and the best model was selected based on four performance criteria : Akaike criterion, Schwarz Bayes criterion, maximum likelihood and criterion error. These correlations help build a forecast using an SARIMA model to predict future sales.

III. METHODOLOGY

To select the best model among several suitable models, we must use appropriate criteria for the measurement of precision as well as the measurement of the goodness of fit of the model. In this article, we rely on certain criteria such as (Ayalew et al., 2012, Makridakis et.al., 1998, Polhémus, 2011):

Root Mean Square Error (RMSE)

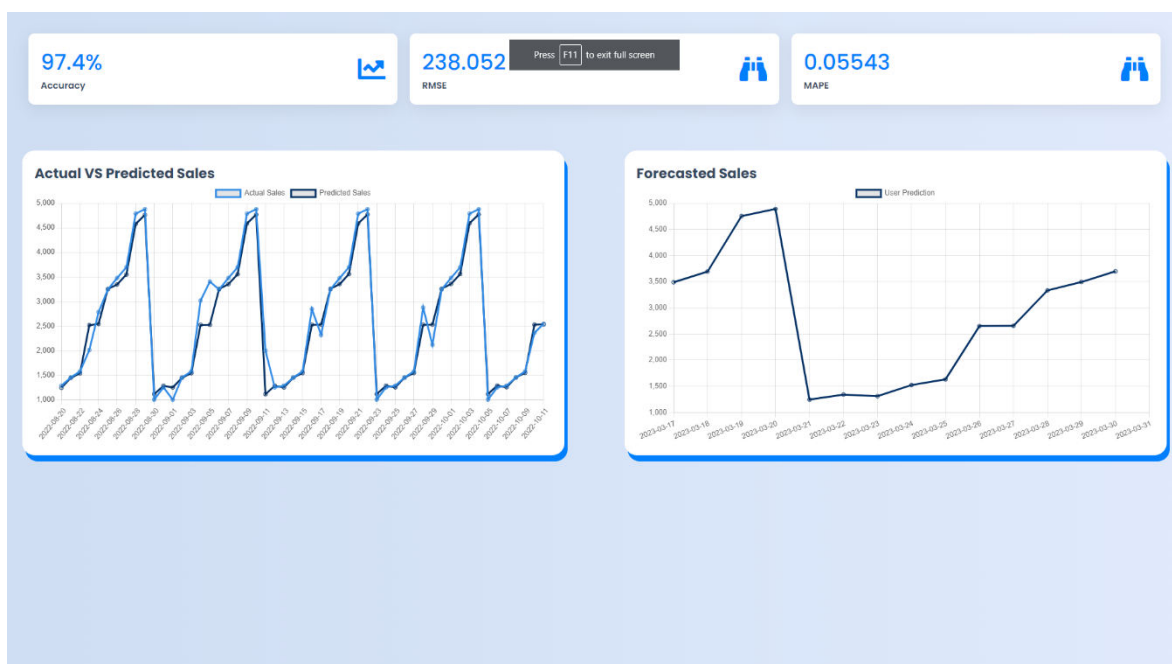
$$RMSE = \sqrt{\frac{\sum_{t=1}^n a_t^2}{n-c}}$$

where t is the period, n is the total number of observations, and c is the number of model parameters. RMSE has the advantage of being more mathematically tractable.

Mean Absolute Percentage Error (MAPE)

$$MAPE = \frac{\sum \frac{|A-F|}{A} \times 100}{N}$$

The model selected is the one with the lowest mean absolute percentage error. The advantage of MAPE is that it is easier to explain and easier to explain to non-experts.





IV. EXPERIMENTAL RESULTS

Figures a,b, c, d and e shows the results of text detection from an image and inpainting by using exemplar based inpainting algorithm. Figs. (a) shows the original image. (b) is the image obtained by applying first set of criteria. All objects whose area greater than 10000 and filled area greater than 8000 are eliminated and major axis lengths are in between 20 to 3000 are considered to be text. Still, some small non-text objects are detected.

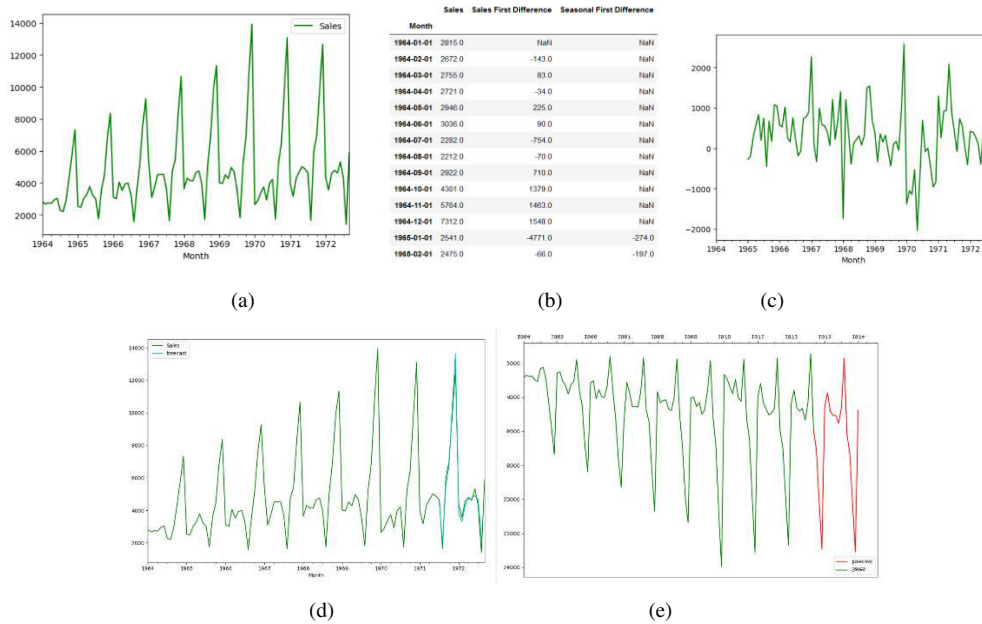
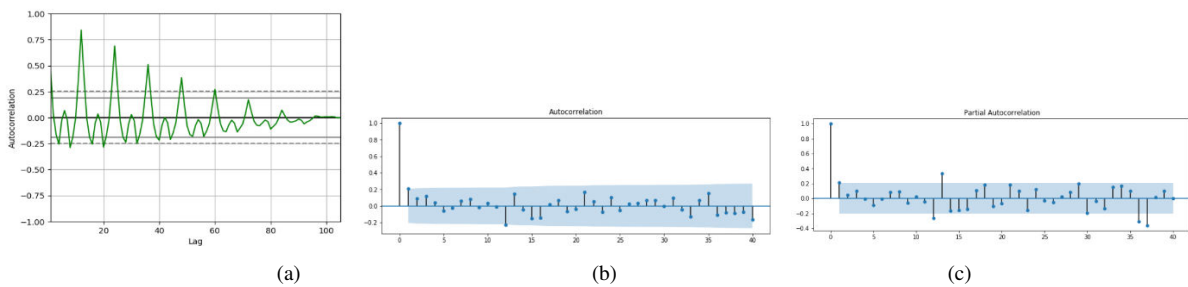


Fig. Visualizing data(a) we find it to be following a seasonal trend (b) Non-stationary is converted into stationary by the means of using differencing method (c) Graph showing the stationary dataset plotted. (d) Sales forecasting for pre-existing values. (e) Predicting sales and forecasting sales for the next two years.



ARIMA Model Results

Dep. Variable:	D.Sales	No. Observations:	104				
Model:	ARIMA(1, 1, 1)	Log Likelihood:	-951.126				
Method:	css-mle	S.D. of innovations:	2227.262				
Date:	Wed, 18 Mar 2020	AIC:	1910.251				
Time:	13:40:32	BIC:	1920.829				
Sample:	02-01-1964	HQIC:	1914.536				
			-09-01-1972				
	coef	std err	z	P> z	[0.025	0.975]	
	const	22.7838	12.405	1.837	0.069	-1.530	47.098
	ar.L1.D.Sales	0.4343	0.089	4.866	0.000	0.259	0.609
	ma.L1.D.Sales	-1.0000	0.026	-38.503	0.000	-1.051	-0.949

Roots

	Real	Imaginary	Modulus	Frequency
AR.1	2.3023	+0.0000j	2.3023	0.0000
MA.1	1.0000	+0.0000j	1.0000	0.0000

(d)



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Fig. For an AR model, the theoretical PACF “shuts off” past the order of the model. The phrase “shuts off” means that in theory the partial autocorrelations are equal to 0 beyond that point.(a) most extreme lag of x that is used as a predictor (b) Autocorrelation (c) Partial-autocorrelation (d) Results of S-ARIMA model

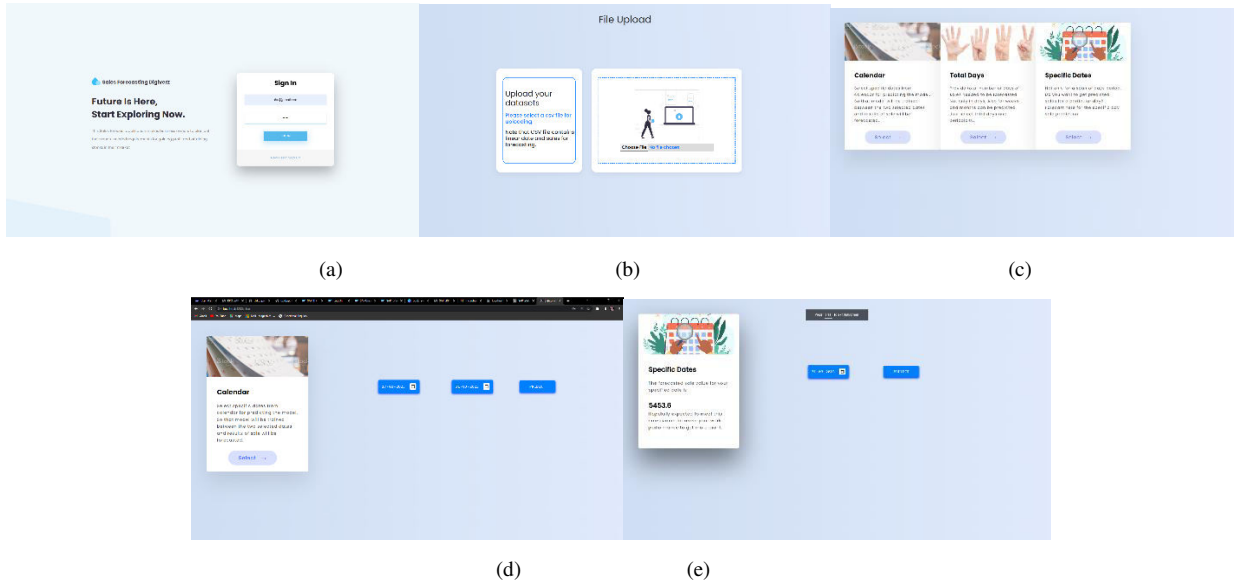


Fig.Outputs (a) Login page (b) File upload page (c) Three option for predicting sales (d) Calendar option (e) Specific date options

To eliminate small objects, connected component labelling is applied to the resultant image.(c) represents text detection by applying second set of criteria which eliminates all the objects whose area is less than 300 and filled area is less than 500.

VI. CONCLUSION

An accurate forecast of demand for perishable products can increase a distributor's competitiveness and improve performance. Various forecasting methods have been implemented in companies with varying degrees of reliability. In this article, we try to analyze the performance of the most common analytical method (SARIMA) to forecast the daily and monthly sales of companies linked to major retailers.

Pursuing this objective, we first try to choose an appropriate parametric or non-parametric forecasting method depending on the characteristics of the data and the business knowledge of the product. Second, we improved the prediction results by using additional external factors.

The MAPE and RMSE measures are used to assess the reliability of predicted sales values. With this in mind, both models provided results in the range of fair or good predictions. However, it is clear that the accuracy of the predictions is highly dependent on the quality of the data.

Since promotions in particular can increase product sales, we sought to determine how taking this external factor into account could improve our forecast results. For this, the SARIMAX approach was used, where promotion was added as an external variable to the SARIMA model. As expected, the results improved significantly. It is, however, recognized that for some products, other influencing external factors may need to be taken into account to further improve the quality of forecasts.

The results of this article can improve business profitability by increasing the number of sales and reducing the amount of scrap using *sophisticated* forecasting methods. Businesses can use the enhanced forecasting model to optimize inventory levels, improve purchasing bargaining power, and ensure availability of products.

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