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Forecast of the Trend in Sales Data of a Confectionery Baking Industry Using Exponential Smoothing and Moving Average Models

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ABSTRACT

Starch-containing foods such as bread, pastries, and cakes are usually baked at a moderately high temperature in an oven. When these products are later exposed to room temperature, the associated gelatinized starch begins to harden which causes retrogradation and molecular realignment. Due to this circumstance, manufacturers need to have a fairly accurate estimate of products demand in order to determine the precise amount of baking powder and additives for use in their production so as not to incur losses in their business arising from the stale and consequentially unsalable products. This research was therefore focused on selecting the best forecasting model using a prominent confectionery firm in Abeokuta, Ogun State, Nigeria as a case study. The study was based on 24-week operational period sales data collected from the company. The moving average model and the exponential smoothing model were the two forecasting models considered in this research. The data obtained was thoroughly reviewed and the results of the forecasting models were compared. The most effective model was the exponential smoothing model as it produced the lowest mean absolute percentage error on the average of 3.7347 for the cumulative days of sales under review as against the 15.1713 for the moving average model. However, the exponential smoothing model was considered the best forecasting model for minimizing forecasting error in this study.

1. INTRODUCTION

Making decisions requires a great deal of planning, strategy, and information [1]. Small bits of information have historically impacted the various segments of the manufacturing chain. Daily planning is crucial for management to make every significant decision [2]. Planning might take the form of determining the quantity needed, the quantity to be generated, and the storage methods [3]. The most crucial step we can take to increase the efficacy and efficiency of the logistics process in many supply chains is to raise the caliber of the demand forecasts. Using a planned marketing strategy and several unpredictable and competitive elements, demand forecasting estimates sales for a certain future time [4]. How much can be sold given the circumstances, it asks? The scenario considers the state of the general economic, social, and legal concerns, as well as the characteristics of vendors, buyers, and the market. The situation also involves the company's, its rivals', and interest groups' actions. Demand forecasting knowledge has advanced in the same way that science always does by accumulating data from tests of numerous plausible hypotheses in experiments [5]. Demand is the area where forecasting is most frequently employed, even though many products are projected. The demand projection will directly affect a wide range of business operations. Hugos [6] asserts that for every supplier, producer, or retailer, predicting product demand is essential. The amounts that should be ordered, produced, and shipped will be determined by forecasts of future demand. Forecasting demand is required because it takes time for finished items to get from the suppliers' raw materials to the customers' hands in the fundamental operational process. Most businesses are unable to simply wait for demand to materialize before acting on it. Instead, they must foresee and prepare for future demand to respond quickly to consumer orders as they come in. Forecasts give people power because it implies that we can change variables right now to change the future [7]. Higher productivity is the goal for every food-based sector, especially confectionaries, in terms of lowering production costs, increasing product demand, and maintaining competitiveness by lowering the cost of their varied products [8].

Even when sufficient care and professionalism are put into the efficient creation of the products in the manufacturing of bread, cakes, and confections, a poor profitability index is nevertheless seen. Retailers and vendors base their demand for bread on the amount of stock that is currently available as well as the amount of the prior stock that was sold because bread is a perishable product made from flour with a concise shelf life that must be consumed within the first 24 hours of production. The amount of the order cannot be guaranteed since, barring exceptional circumstances, the merchants must wait until the residual stock levels fall to an average of around 9% of the starting stock before placing an accurate order. The bakers rarely produce enough goods to meet demand since they are unsure of how many to order. Most of the time, they either produce less than what is required or less than what is required, which results in one of two outcomes: either significant loss for bakers and retailers because of underproduction or excessive production leading to waste because bread must be consumed within the first 24 hours of production (depreciation of product due to staleness). Both the stores and the bakeries ultimately suffer losses because of this. The need to reduce excessive manufacturing capacity, which will also reduce daily losses and shortages, maximize sales volume and profit margin, grow the client base, maintain high standards of quality, and boost the worth of the product, is essential. As a result, before production starts, the assurance of the actual demand quantity can be made available. Bakeries use their judgment on how much bread was sold the day before to estimate the quantity to be manufactured. Reliable projections must be made to ensure that the production amount is as close as feasible to the actual demand quantity [9]. Therefore, it is necessary to use forecasting methodologies to forecast the quantity of actual demand, thereby increasing sales and decreasing wastages and losses.

Businesses that give quick delivery to their clients tend to compel their market rivals to maintain completed product inventories to offer quick order turnaround times [10]. As a result, almost all organizations involved are required to produce or at the very least order parts following an estimate of future demand. Accurate demand forecasting also gives the company the chance to reduce costs by balancing manufacturing volumes, optimizing transportation, and generally organizing effective logistical operations. In general, correct demand projections result in operations that are efficient and provide high levels of customer service, while inaccurate forecasts invariably result in operations that are inefficient, expensive, and/or provide a low standard of customer service. Numerous studies have examined the use of various forecasting models in a variety of technical and industrial applications. Liu et al. [11] used the exponential smoothing and seasonal autoregressive integrated moving average models to anticipate the trend in the prevalence of acute hemorrhagic conjunctivitis in China from 2011 to 2019. Consequently, the moving model with the lowest mean absolute percentage error (MAPE) and root mean squared error (RMSE) was chosen for in-sample modeling. Also, Rabbani et al. [12] used univariate time series analysis, such as exponential smoothing and seasonal autoregressive integrated moving average models, to develop temporal variations to forecast accidents and fatalities in Pakistan. Upon determining the lowest RMSE, mean absolute error (MAE), MAPE, and normalized Bayesian estimation technique, the results showed that the exponential model fit perfectly on accident data than the moving average model. In predicting telecommunication data, Nalawade and Pawar [13] utilized an autoregressive integrated moving average model. This model utilized auto regression, moving average, or a mix of both. Using evaluation metrics such as RMSE, sum of squared regression, MAPE, mean absolute deviation (MAD), and maximum absolute error, it is possible to determine how well the model performs. The findings demonstrated that the accuracy of forecasting using autoregressive integrated moving average models is 7.6% better than that using neural network methods. Moreover, Jere et al. [14] compared the performance of Holt Winters exponential smoothing models (HWES) and auto-regressive integrated moving average. The error indicators including MAE, mean percentage error, RMSE, mean absolute scaled error, and MAPE demonstrated that HWES is a suitable model with adequate forecast accuracy. The HWES has lower error than the autoregressive integrated moving average models. In order to anticipate how changes in temperature would affect the amount of energy produced at a Nigerian Agricultural Institute, Kazeem et al. [15] used multivariate linear regression (MLR) and artificial neural network (ANN) models. Of the two models examined in this study, the ANN model performed the best. On train data and test data, respectively, the mean squared error was reduced by 42% and 39%, showing that ANNs outperformed the MLR model. The ANN fared noticeably better than the MLR, according to additional metrics like MAE and MAPE.

Most of the application of forecasting models in literature are centered on predicting future events in health, telecommunications, energy and agriculture but very little investigators had bothered on their use in confectionery forecasting. The study, therefore, aims to establish an effective and efficient model that will forecast how much is produced each day in the selected baking and confectionery company. Additionally, it will show how this approach is used in the sales and operations of the bakery and confections sector. The remaining part of this paper, which are in three sections have the data source, the procedure for data collation and forecasting models, and the performance statistics index as sub-headings in section 2. The results and discussion is presented in section 3. The conclusions is presented in section 4 of the paper.

2. METHODOLOGY

2.1 Data source

The data used in this study were obtained from XXX Bakery and Confectionery located in Abeokuta, Southwestern, Nigeria. The company makes several varieties of confectionaries and baked items therefore, customers have a wide range of confectionaries to choose from. Confections include vanilla, chocolate, strawberry, and chicken pizza, chicken pie sausages, bread, and sponge cakes in flavors. The products come in a variety of sizes and shapes and are primarily divided into six main pricing ranges. However, there is variation in the demand for various products. The data derived from sales is transformed into a uniform size for simple data collecting, analysis, and interpretation. To select an acceptable forecasting model, the generated data will be employed. The data collected was for a period of one hundred and sixty-eight days (24 weeks). The data was collected physically and not from any National Scientific Data Sharing Platform.

2.2 Procedure

The first step in conducting this study was gathering and critically analyzing the sales and demand data for twenty-four weeks, after which appropriate alterations were made to suit the situation at hand. The next step was the application of the forecasting models that were considered when conducting this investigation. The forecasting models applied to the data include (i) The exponential smoothing model and (ii) The moving average model. Each technique used to apply these models to the sales data was closely examined for any errors, corrections, and modifications (mathematical, computational, data misevaluation, and formula or figure distortion) during the analysis. The model with the smallest divergence from the actual sales record was considered the best prediction approach for the company's products.

2.2.1 Exponential smoothing model

The most utilized class of techniques for smoothing discrete time series to forecast the near future is exponential smoothing. The objective behind exponential smoothing is to smooth the original series in the same manner that the moving average does, then use the smoothed series to forecast future values of the variable of interest. However, in exponential smoothing, we want the more recent values of the series to have a higher influence on the forecast of future values than the more distant observations. Weighted averages are used to calculate forecasts, and as observations are gathered from further in the past, the weights decline exponentially, with the oldest observations having the smallest weights (see Eq. (1)):

$$y_{T+1}|_T = \alpha y_T + \alpha(1-\alpha)y_{T-1} + \alpha(1-\alpha)^2 y_{T-2} + ..., \quad (1)$$

where, $0 \le \alpha \le 1$ is the smoothing parameter. The one-step-ahead forecast for time $T+1$ is a weighted average of all the observations in the series y_1…, y_T. The rate at which the weights decrease is controlled by the parameter α. Formally, the exponential smoothing equation employed is given in Eq. (2).

$$y_{T+1|_T} = \alpha y_T + (1-\alpha) y_{T|_{T-1}} \quad (2)$$

where, $y_{T+1/T}$=forecast for the next period; y_T=observed sales value of series in period t; α=smoothing constant; and $\hat{y}_{T/T-1}$=old forecast for period t.

2.2.2 Moving average model

The simple moving average (SMA) method is used with time-series data to smooth out short-term fluctuations and long-term trends. The simple moving average is given by Eq. (3).

$$SMA_k = \frac{P_{n-k+1} + P_{n-k+2} .... + P_n}{k} = \frac{1}{k}\sum_{i=n-k+1}^{n} P_i \quad (3)$$

When calculating the next mean $SMA_{k,\ next}$ with the same sampling width k the range from n=k+2 to $n+1$ is considered. A new value P_{n+1} comes into the sum and the oldest value P_{n-k+1} drops out. This simplifies the calculations by reusing the previous mean $SMA_{k,\ prev}$ shown in Eq. (4).

$$SMA_{k,next} = \frac{1}{k}\sum_{i=n-k+2}^{n+1} P_i = \frac{1}{k}\left(\underbrace{P_{n-k+2} + P_{n-k+3} + ... + P_n + P_{n+1}}_{\sum_{i=n-k+2}^{n+1} P_i} + \underbrace{P_{n-k+1} - P_{n-k+1}}_{0} \right) \quad (4)$$

2.3 Performance statistic index

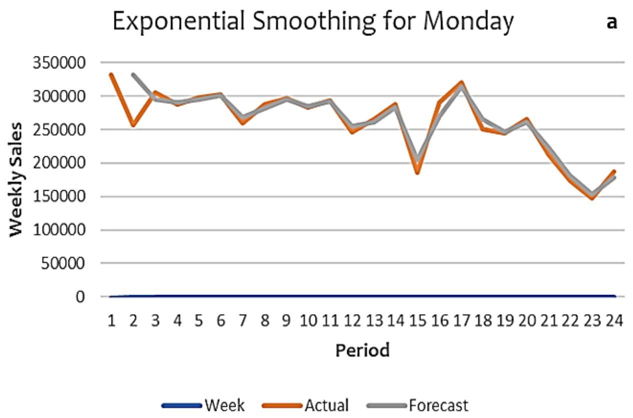
To compare the predicting capabilities of the exponential smoothing model and the moving average model, one metric was used: the mean absolute percentage error (MAPE). The accuracy of fitting was evaluated using MAPE [16]. The lower the MAPE value, the greater the prediction ability. MAPE is expressed as a percentage. The mathematical formula is shown in Eq. (5).

$$MAPE = \frac{1}{n}\sum_{t=1}^{n} \frac{\left\| \hat{y}_t - y_t \right\|}{y_t} \times 100\% \quad (5)$$

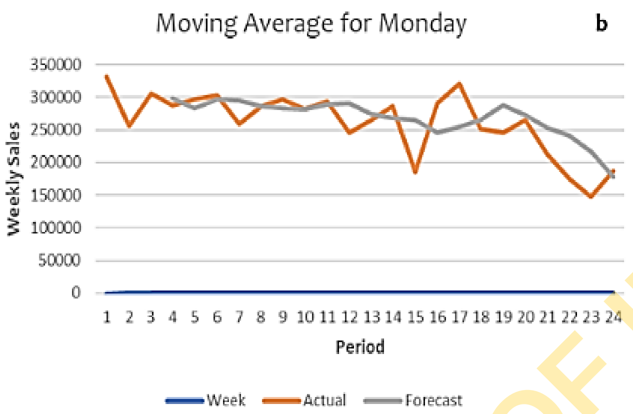
where, y_t-actual sales at time t; $\hat{y}_t$-predicted sales; n-number of predictions.

3. RESULTS AND DISCUSSION

The data were collected from the company's daily sales and are represented as shown in Table 1. The model applications and analysis are presented in Tables 2-15, and subsequently, the forecasts with the least MAPE for each day were plotted against the actual sales values as shown in Figures 1 (a-n). The data in Table 1 is better appreciated in the graph provided in Figure 2. According to sales statistics, the company sold more goodies on the weekends and had poor sales during the middle of the week because most customers had free time on the weekends and were extremely busy during the middle of the work week. The weekly trend in sales also show a downward trend in sales. Moreover, an outside factor that influences the company's sales demand is the seasonal effect. Also, the strike action of the flour-producing companies in the country was said to have affected the supply of flour for production in their establishment and this invariably caused the fluctuation among some days in the data provided. Another cause of sales drops in some of the days was attributed to price increase of petroleum products and epileptic power supply which therefore caused price increases of the company's goods. Generally, sales are often higher on weekends than on weekdays and are at their lowest on Wednesdays. As computed in the last column of the Table 1 for the average weekly sales and the spread of daily sales across the 24 weeks shown in Table 1. Figure 1 shows that the trend in the sales data for each day of the study period was not linear, making it impossible to use linear regression [17, 18]. However, it could be deduced form this figure and as indicated in the last column of Table 1, that the sales are badly affected from the early weeks of data collection, and this trend continues till the end of the twenty-fourth week. As it was mentioned earlier, the trend in reduced sales was unconnected with hike in the price of petroleum products, which are mostly used in transportation, and production of goods. This reduced production of confections, and there was also low demand from customers arising from market inflation, which reduces the purchasing power of the customers.



(a)



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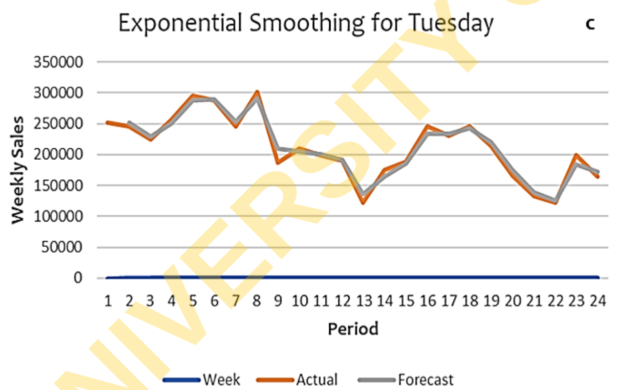

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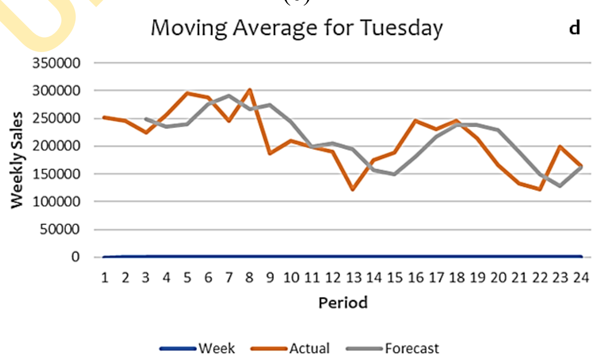

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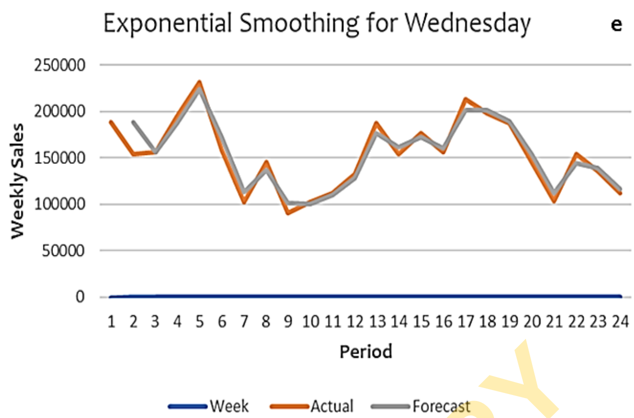

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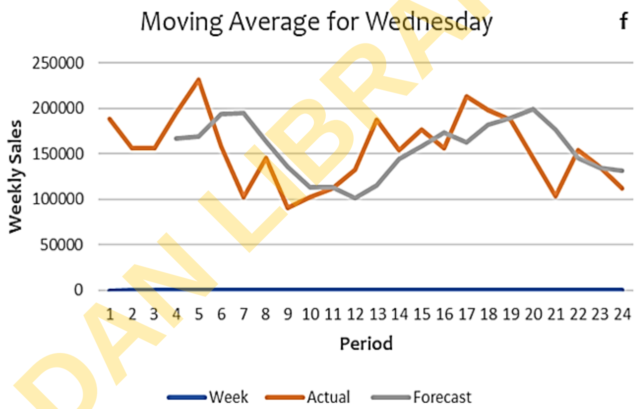

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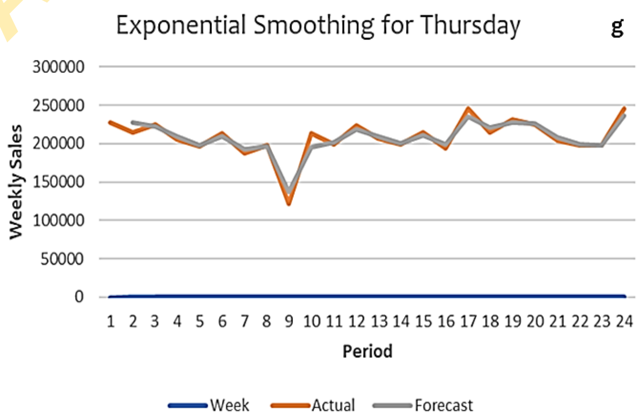

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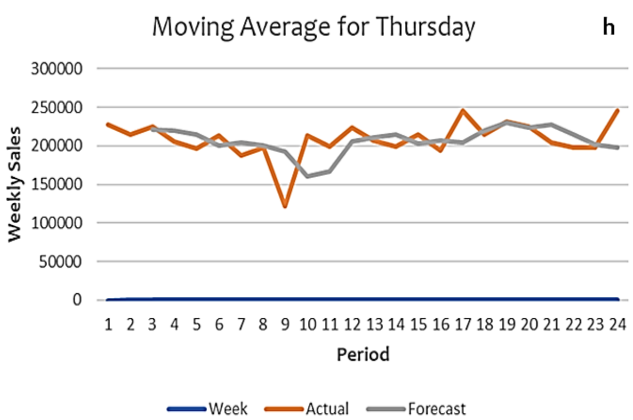

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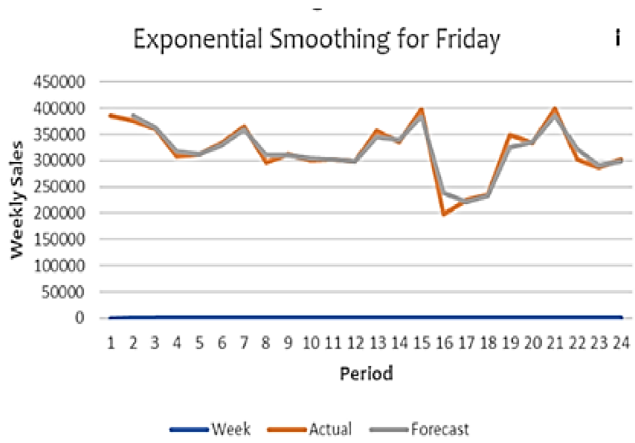
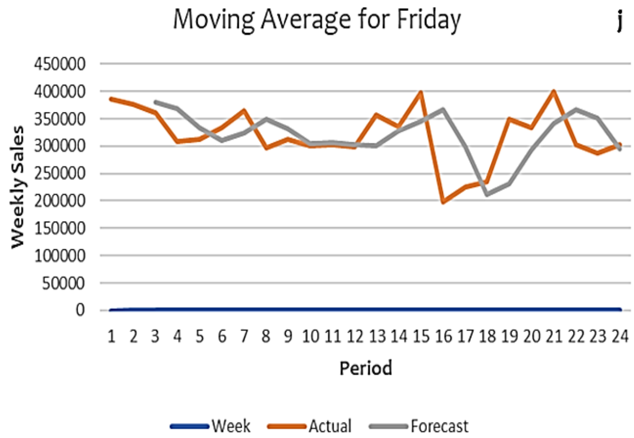


(i)



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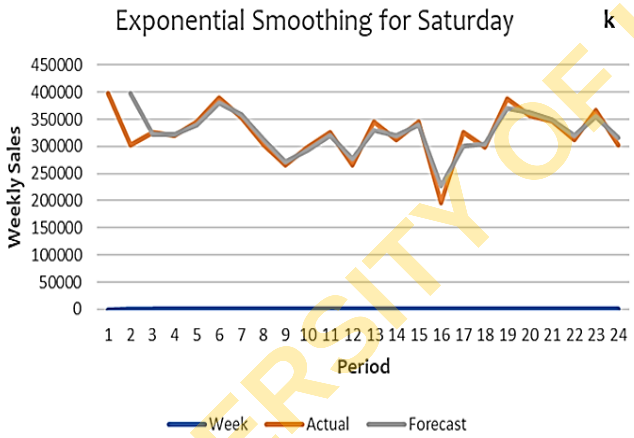

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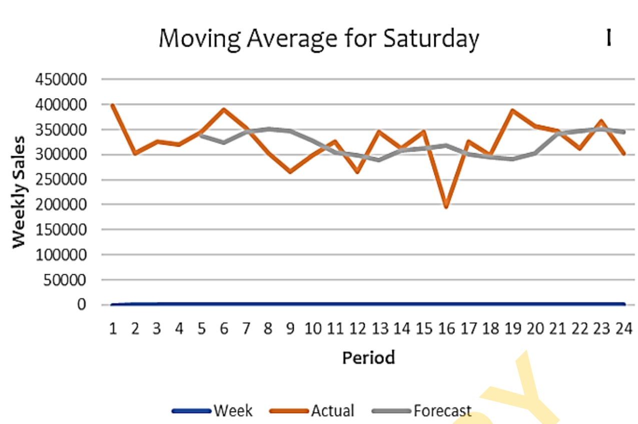

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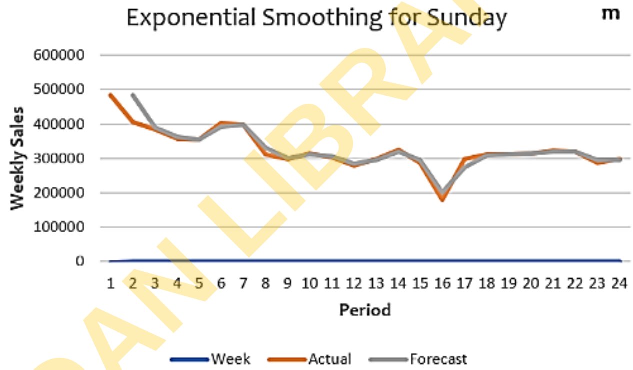

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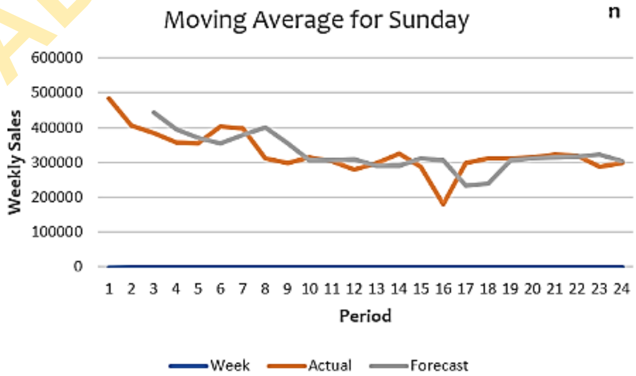

(n)

Figure 1. (a-n): Comparison of forecasting models for weekly sales data

Table 1. Daily sales data for twenty-four weeks

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Weekly Average
1	331200	251400	188750	227580	385500	397500	482500	323490
2	256600	245200	156400	214600	375400	302500	405000	279386
3	305450	224500	156400	224500	360000	325500	385000	283050
4	287500	256000	195000	205000	308000	320000	356000	275357
5	297500	295400	231000	196000	312500	345000	355000	290343
6	302500	287500	158000	213500	333500	389000	402500	298071
7	259500	245600	102300	187000	365000	352000	397000	272629
8	287000	302000	145600	198400	297500	302000	312500	263571
9	297000	187500	90540	121500	312500	264880	298740	224666
10	282500	210330	102300	213000	301230	298700	315000	246151
11	294000	198750	112300	198800	302540	325400	302500	247756
12	245660	189700	132500	223000	298700	265000	278900	233351
13	265000	123000	187900	206500	356400	345600	298700	254729
14	287000	175640	154600	198700	335640	312540	325600	255674
15	185000	187900	177000	214500	397000	345600	287000	256286

16	290500	245600	156400	194500	198700	196540	178900	208734
17	320200	231200	213000	245100	225780	325460	298970	265673
18	251000	245800	198000	214500	235460	298750	312000	250787
19	245000	214000	187000	231450	348790	387500	312540	275183
20	265400	165400	145600	224500	332540	356470	314500	257773
21	212000	132540	103200	204500	398700	346500	321500	245563
22	174500	123000	154600	198400	302500	312500	320540	226577
23	147800	198700	135600	197800	287500	365400	287950	231536
24	186500	165020	112300	245600	302540	302540	298750	230464

Table 2. Analysis of Monday data using exponential smoothing method

Exponential Smoothing for Monday						MAPE			
Week	Monday	α= 0.2	α= 0.4	α= 0.6	α= 0.8	0.2	0.4	0.6	0.8
1	331200								
2	256600	331200	331200	331200	331200	29.07248636	29.07248636	29.07248636	29.07248636
3	305450	266370	276140	285910	295680	12.79423801	9.595678507	6.397119005	3.198559502
4	287500	301860	298270	294680	291090	4.994782609	3.746086957	2.497391304	1.248695652
5	297500	289500	291500	293500	295500	2.68907563	2.016806723	1.344537815	0.672268908
6	302500	298500	299500	300500	301500	1.32231405	0.991735537	0.661157025	0.330578512
7	259500	293900	285300	276700	268100	13.25626204	9.942196532	6.628131021	3.314065511
8	287000	265000	270500	276000	281500	7.665505226	5.74912892	3.832752613	1.916376307
9	297000	289000	291000	293000	295000	2.693602694	2.02020202	1.346801347	0.673400673
10	282500	294100	291200	288300	285400	4.10619469	3.079646018	2.053097345	1.026548673
11	294000	284800	287100	289400	291700	3.129251701	2.346938776	1.56462585	0.782312925
12	245660	284332	274664	264996	255328	15.74208255	11.80656191	7.871041277	3.935520638
13	265000	249528	253396	257264	261132	5.838490566	4.378867925	2.919245283	1.459622642
14	287000	269400	273800	278200	282600	6.132404181	4.599303136	3.066202091	1.533101045
15	185000	266600	246200	225800	205400	44.10810811	33.08108108	22.05405405	11.02702703
16	290500	206100	227200	248300	269400	29.05335628	21.79001721	14.52667814	7.263339071
17	320200	296440	302380	308320	314260	7.420362274	5.565271705	3.710181137	1.855090568
18	251000	306360	292520	278680	264840	22.05577689	16.54183267	11.02788845	5.513944223
19	245000	249800	248600	247400	246200	1.959183673	1.469387755	0.979591837	0.489795918
20	265400	249080	253160	257240	261320	6.149208742	4.611906556	3.074604371	1.537302185
21	212000	254720	244040	233360	222680	20.1509434	15.11320755	10.0754717	5.037735849
22	174500	204500	197000	189500	182000	17.19197708	12.89398281	8.595988539	4.297994269
23	147800	169160	163820	158480	153140	14.45196211	10.83897158	7.225981055	3.612990528
24	186500	155540	163280	171020	178760	16.60053619	12.45040214	8.300268097	4.150134048
					Sum	288.5781051	223.7017004	158.8252957	93.94889104
					Mean	12.54687413	9.726160886	6.90544764	**4.084734393**

Table 3. Analysis of Tuesday data using exponential smoothing method

Exponential Smoothing for Tuesday						MAPE			
Week	Tuesday	α= 0.2	α= 0.4	α= 0.6	α= 0.8	0.2	0.4	0.6	0.8
1	251400								
2	245200	251400	251400	251400	251400	2.528548124	2.528548124	2.528548124	2.528548124
3	224500	241060	236920	232780	228640	7.376391982	5.532293987	3.688195991	1.844097996
4	256000	230800	237100	243400	249700	9.84375	7.3828125	4.921875	2.4609375
5	295400	263880	271760	279640	287520	10.67027759	8.002708192	5.335138795	2.667569397
6	287500	293820	292240	290660	289080	2.19826087	1.648695652	1.099130435	0.549565217
7	245600	279120	270740	262360	253980	13.64820847	10.23615635	6.824104235	3.412052117
8	302000	256880	268160	279440	290720	14.94039735	11.20529801	7.470198675	3.735099338
9	187500	279100	256200	233300	210400	48.85333333	36.64	24.42666667	12.21333333
10	210330	192066	196632	201198	205764	8.683497361	6.512623021	4.341748681	2.17087434
11	198750	208014	205698	203382	201066	4.661132075	3.495849057	2.330566038	1.165283019
12	189700	196940	195130	193320	191510	3.816552451	2.862414338	1.908276226	0.954138113
13	123000	176360	163020	149680	136340	43.38211382	32.53658537	21.69105691	10.84552846
14	175640	133528	144056	154584	165112	23.97631519	17.98223639	11.9881576	5.994078798
15	187900	178092	180544	182996	185448	5.219797765	3.914848324	2.609898882	1.304949441
16	245600	199440	210980	222520	234060	18.79478827	14.09609121	9.397394137	4.698697068
17	231200	242720	239840	236960	234080	4.982698962	3.737024221	2.491349481	1.24567474
18	245800	234120	237040	239960	242880	4.751830757	3.563873068	2.375915378	1.187957689
19	214000	239440	233080	226720	220360	11.88785047	8.91588785	5.943925234	2.971962617
20	165400	204280	194560	184840	175120	23.50665054	17.62998791	11.75332527	5.876662636
21	132540	158828	152256	145684	139112	19.83401237	14.87550928	9.917006187	4.958503093
22	123000	130632	128724	126816	124908	6.204878049	4.653658537	3.102439024	1.551219512
23	198700	138140	153280	168420	183560	30.4781077	22.85858078	15.23905385	7.619526925
24	165020	191964	185228	178492	171756	16.32771785	12.24578839	8.163858926	4.081929463
					Sum	336.5671114	253.0574706	169.5478297	86.03818893
					Mean	14.63335267	11.00249872	7.371644771	**3.740790823**

Table 4. Analysis of Wednesday data using exponential smoothing method

Exponential Smoothing for Wednesday						MAPE			
Week	Wednesday	α= 0.2	α= 0.4	α= 0.6	α= 0.8	0.2	0.4	0.6	0.8
1	188750								
2	154220	188750	188750	188750	188750	22.3900921	22.3900921	22.3900921	22.39009208
3	156400	154656	155092	155528	155964	1.11508951	0.83631714	0.55754476	0.278772379
4	195000	164120	171840	179560	187280	15.8358974	11.8769231	7.91794872	3.958974359
5	231000	202200	209400	216600	223800	12.4675325	9.35064935	6.23376623	3.116883117
6	158000	216400	201800	187200	172600	36.9620253	27.721519	18.4810127	9.240506329
7	102300	146860	135720	124580	113440	43.5581623	32.6686217	21.7790811	10.88954057
8	145600	110960	119620	128280	136940	23.7912088	17.8434066	11.8956044	5.947802198
9	90540	134588	123576	112564	101552	48.6503203	36.4877402	24.3251602	12.16258008
10	102300	92892	95244	97596	99948	9.19648094	6.8973607	4.59824047	2.299120235
11	112300	104300	106300	108300	110300	7.1237756	5.3428317	3.5618878	1.7809439
12	132500	116340	120380	124420	128460	12.1962264	9.14716981	6.09811321	3.049056604
13	187900	143580	154660	165740	176820	23.5870144	17.6902608	11.7935072	5.896753592
14	154600	181240	174580	167920	161260	17.2315653	12.923674	8.61578266	4.307891332
15	177000	159080	163560	168040	172520	10.1242938	7.59322034	5.06214689	2.531073446
16	156400	172880	168760	164640	160520	10.5370844	7.9028133	5.2685422	2.6342711
17	213000	167720	179040	190360	201680	21.258216	15.943662	10.629108	5.314553991
18	198000	210000	207000	204000	201000	6.06060606	4.54545455	3.03030303	1.515151515
19	187000	195800	193600	191400	189200	4.70588235	3.52941176	2.35294118	1.176470588
20	145600	178720	170440	162160	153880	22.7472527	17.0604396	11.3736264	5.686813187
21	103200	137120	128640	120160	111680	32.8682171	24.6511628	16.4341085	8.217054264
22	154600	113480	123760	134040	144320	26.5976714	19.9482536	13.2988357	6.649417853
23	135600	150800	147000	143200	139400	11.2094395	8.40707965	5.60471976	2.802359882
24	112300	130940	126280	121620	116960	16.5983972	12.4487979	8.29919858	4.149599288
					Sum	436.812451	333.206861	229.601272	125.9956819
					Mean	18.9918457	14.4872548	9.98266399	**5.478073125**

Table 5. Analysis of Thursday data using exponential smoothing method

Exponential Smoothing for Thursday						MAPE			
Week	Thursday	α= 0.2	α= 0.4	α= 0.6	α= 0.8	0.2	0.4	0.6	0.8
1	227580								
2	214600	227580	227580	227580	227580	6.048462	6.048462	6.048462	6.048462
3	224500	216580	218560	220540	222520	3.52784	2.64588	1.76392	0.88196
4	205000	220600	216700	212800	208900	7.609756	5.707317	3.804878	1.902439
5	196000	203200	201400	199600	197800	3.673469	2.755102	1.836735	0.918367
6	213500	199500	203000	206500	210000	6.557377	4.918033	3.278689	1.639344
7	187000	208200	202900	197600	192300	11.3369	8.502674	5.668449	2.834225
8	198400	189280	191560	193840	196120	4.596774	3.447581	2.298387	1.149194
9	121500	183020	167640	152260	136880	50.63374	37.97531	25.31687	12.65844
10	213000	139800	158100	176400	194700	34.3662	25.77465	17.1831	8.591549
11	198800	210160	207320	204480	201640	5.714286	4.285714	2.857143	1.428571
12	223000	203640	208480	213320	218160	8.681614	6.511211	4.340807	2.170404
13	206500	219700	216400	213100	209800	6.392252	4.794189	3.196126	1.598063
14	198700	204940	203380	201820	200260	3.140413	2.35531	1.570206	0.785103
15	214500	201860	205020	208180	211340	5.892774	4.41958	2.946387	1.473193
16	194500	210500	206500	202500	198500	8.226221	6.169666	4.113111	2.056555
17	245100	204620	214740	224860	234980	16.51571	12.38678	8.257854	4.128927
18	214500	238980	232860	226740	220620	11.41259	8.559441	5.706294	2.853147
19	231450	217890	221280	224670	228060	5.858717	4.394038	2.929358	1.464679
20	224500	230060	228670	227280	225890	2.476615	1.857461	1.238307	0.619154
21	204500	220500	216500	212500	208500	7.823961	5.867971	3.91198	1.95599
22	198400	203280	202060	200840	199620	2.459677	1.844758	1.229839	0.614919
23	197800	198280	198160	198040	197920	0.242669	0.182002	0.121335	0.060667
24	245600	207360	216920	226480	236040	15.57003	11.67752	7.785016	3.892508
					Sum	228.758	173.0806	117.4033	61.72586
					Mean	9.946002	7.525246	5.104489	**2.683733**

Table 6. Analysis of Friday data using exponential smoothing method

Exponential Smoothing for Friday						MAPE			
Week	Friday	α= 0.2	α= 0.4	α= 0.6	α= 0.8	0.2	0.4	0.6	0.8
1	385500								
2	375400	385500	385500	385500	385500	2.690464	2.690463506	2.690463506	2.690463506
3	360000	372320	369240	366160	363080	3.422222	2.566666667	1.711111111	0.855555556
4	308000	349600	339200	328800	318400	13.50649	10.12987013	6.753246753	3.376623377
5	312500	308900	309800	310700	311600	1.152	0.864	0.576	0.288

6	333500	316700	320900	325100	329300	5.037481	3.778110945	2.51874063	1.259370315
7	365000	339800	346100	352400	358700	6.90411	5.178082192	3.452054795	1.726027397
8	297500	351500	338000	324500	311000	18.15126	13.61344538	9.075630252	4.537815126
9	312500	300500	303500	306500	309500	3.84	2.88	1.92	0.96
10	301230	310246	307992	305738	303484	2.993062	2.244796335	1.49653089	0.748265445
11	302540	301492	301754	302016	302278	0.3464	0.259800357	0.173200238	0.086600119
12	298700	301772	301004	300236	299468	1.028457	0.771342484	0.514228323	0.257114161
13	356400	310240	321780	333320	344860	12.95174	9.713804714	6.475869809	3.237934905
14	335640	352248	348096	343944	339792	4.948159	3.711119056	2.474079371	1.237039685
15	397000	347912	360184	372456	384728	12.36474	9.273551637	6.182367758	3.091183879
16	198700	357340	317680	278020	238360	79.83895	59.8792149	39.9194766	19.9597383
17	225780	204116	209532	214948	220364	9.595181	7.196385862	4.797590575	2.398795287
18	235460	227716	229652	231588	233524	3.288881	2.466661004	1.644440669	0.822220335
19	348790	258126	280792	303458	326124	25.99386	19.49539838	12.99693225	6.498466126
20	332540	345540	342290	339040	335790	3.909304	2.931978108	1.954652072	0.977326036
21	398700	345772	359004	372236	385468	13.27514	9.956358164	6.637572109	3.318786055
22	302500	379460	360220	340980	321740	25.44132	19.08099174	12.72066116	6.360330579
23	287500	299500	296500	293500	290500	4.173913	3.130434783	2.086956522	1.043478261
24	302540	290508	293516	291450	299121	5.122391	2.653425321	3.348750922	1.114736028
					Sum	254.8531	191.8124763	128.7718054	65.73113445
					Mean	11.08057	8.339672884	5.598774147	**2.857875411**

Table 7. Analysis of Saturday data using exponential smoothing method

Exponential Smoothing for Saturday						**MAPE**			
Week	Saturday	α= 0.2	α= 0.4	α= 0.6	α= 0.8	0.2	0.4	0.6	0.8
1	397500								
2	302500	397500	397500	397500	397500	31.40496	31.40495868	31.40495868	31.40495868
3	325500	307100	311700	316300	320900	5.652842	4.239631336	2.826420891	1.413210445
4	320000	324400	323300	322200	321100	1.375	1.03125	0.6875	0.34375
5	345000	325000	330000	335000	340000	5.797101	4.347826087	2.898550725	1.449275362
6	389000	353800	362600	371400	380200	9.048843	6.786632391	4.524421594	2.262210797
7	352000	381600	374200	366800	359400	8.409091	6.306818182	4.204545455	2.102272727
8	302000	342000	332000	322000	312000	13.24503	9.933774834	6.622516556	3.311258278
9	264880	294576	287152	279728	272304	11.21111	8.40833585	5.605557233	2.802778617
10	298700	271644	278408	285172	291936	9.057918	6.793438232	4.528958822	2.264479411
11	325400	304040	309380	314720	320060	6.564229	4.923171481	3.282114321	1.64105716
12	265000	313320	301240	289160	277080	18.23396	13.6754717	9.116981132	4.558490566
13	345600	281120	297240	313360	329480	18.65741	13.99305556	9.328703704	4.664351852
14	312540	338988	332376	325764	319152	8.462277	6.346707621	4.231138414	2.115569207
15	345600	319152	325764	332376	338988	7.652778	5.739583333	3.826388889	1.913194444
16	196540	315788	285976	256164	226352	60.67365	45.50524066	30.33682711	15.16841355
17	325460	222324	248108	273892	299676	31.6893	23.76697597	15.84465065	7.922325324
18	298750	320118	314776	309434	304092	7.152469	5.364351464	3.57623431	1.788117155
19	387500	316500	334250	352000	369750	18.32258	13.74193548	9.161290323	4.580645161
20	356470	381294	375088	368882	362676	6.96384	5.222879906	3.481919937	1.740959969
21	346500	354476	352482	350488	348494	2.301876	1.726406926	1.150937951	0.575468975
22	312500	339700	332900	326100	319300	8.704	6.528	4.352	2.176
23	365400	323080	333660	344240	354820	11.58183	8.6863711	5.790914067	2.895457033
24	302540	352828	340256	327684	315112	16.62193	12.46645072	8.310967145	4.155483572
					Sum	318.784	246.9392675	175.0944979	103.2497283
					Mean	13.86018	10.73648989	7.612804257	**4.489118621**

Table 8. Analysis of Sunday data using exponential smoothing method

Exponential Smoothing for Sunday						**MAPE**			
Week	Sunday	α= 0.2	α= 0.4	α= 0.6	α= 0.8	0.2	0.4	0.6	0.8
1	482500								
2	405000	482500	482500	482500	482500	19.1358	19.13580247	19.13580247	19.13580247
3	385000	401000	397000	393000	389000	4.155844	3.116883117	2.077922078	1.038961039
4	356000	379200	373400	367600	361800	6.516854	4.887640449	3.258426966	1.629213483
5	355000	355800	355600	355400	355200	0.225352	0.169014085	0.112676056	0.056338028
6	402500	364500	374000	383500	393000	9.440994	7.080745342	4.720496894	2.360248447
7	397000	401400	400300	399200	398100	1.108312	0.831234257	0.554156171	0.277078086
8	312500	380100	363200	346300	329400	21.632	16.224	10.816	5.408
9	298740	309748	306996	304244	301492	3.68481	2.76360715	1.842404767	0.921202383
10	315000	301992	305244	308496	311748	4.129524	3.097142857	2.064761905	1.032380952
11	302500	312500	310000	307500	305000	3.305785	2.479338843	1.652892562	0.826446281
12	278900	297780	293060	288340	283620	6.769451	5.077088562	3.384725708	1.692362854
13	298700	282860	286820	290780	294740	5.30298	3.977234684	2.651489789	1.325744895
14	325600	304080	309460	314840	320220	6.609337	4.957002457	3.304668305	1.652334152

15	287000	317880	310160	302440	294720	10.75958	8.069686411	5.379790941	2.68989547
16	178900	265380	243760	222140	200520	48.33985	36.254891	24.16992733	12.08496367
17	298970	202914	226928	250942	274956	32.12898	24.09673211	16.06448808	8.032244038
18	312000	301576	304182	306788	309394	3.341026	2.505769231	1.670512821	0.83525641
19	312540	312108	312216	312324	312432	0.138222	0.103666731	0.069111154	0.034555577
20	314500	312932	313324	313716	314108	0.498569	0.373926868	0.249284579	0.124642289
21	321500	315900	317300	318700	320100	1.741835	1.306376361	0.870917574	0.435458787
22	320540	321308	321116	320924	320732	0.239596	0.179696762	0.119797841	0.059898921
23	287950	314022	307504	300986	294468	9.05435	6.790762285	4.527174857	2.263587428
24	298750	290110	292270	294430	296590	2.89205	2.169037657	1.446025105	0.723012552
					Sum	201.1511	155.6472797	110.143454	64.63962821
					Mean	8.7457	6.76727303	4.788845824	**2.810418618**

Table 9. Moving average analysis for Monday

Week	Monday	2 week	MAPE	3 week	MAPE	4 week	MAPE	5 week	MAPE
1	331200								
2	256600								
3	305450	293900	3.781306						
4	287500	281025	2.252174	297750	3.565217				
5	297500	296475	0.344538	283183.3	4.812325	295187.5	0.777311		
6	302500	292500	3.305785	296816.7	1.878788	286762.5	5.202479	295650	2.264463
7	259500	300000	15.60694	295833.3	14.00128	298237.5	14.92775	289910	11.71869
8	287000	281000	2.090592	286500	0.174216	286750	0.087108	290490	1.216028
9	297000	273250	7.996633	283000	4.713805	286625	3.493266	286800	3.434343
10	282500	292000	3.362832	281166.7	0.471976	286500	1.415929	288700	2.19469
11	294000	289750	1.445578	288833.3	1.75737	281500	4.251701	285700	2.823129
12	245660	288250	17.33697	291166.7	18.52425	290125	18.10022	284000	15.60694
13	265000	269830	1.822642	274053.3	3.416352	279790	5.581132	281232	6.125283
14	287000	255330	11.03484	268220	6.543554	271790	5.299652	276832	3.542857
15	185000	276000	49.18919	265886.7	43.72252	272915	47.52162	274832	48.55784
16	290500	236000	18.76076	245666.7	15.43316	245665	15.43373	255332	12.10602
17	320200	237750	25.74953	254166.7	20.62253	256875	19.7767	254632	20.4772
18	251000	305350	21.65339	265233.3	5.670651	270675	7.838645	269540	7.386454
19	245000	285600	16.57143	287233.3	17.2381	261675	6.806122	266740	8.873469
20	265400	248000	6.556142	272066.7	2.511932	276675	4.248304	258340	2.660136
21	212000	255200	20.37736	253800	19.71698	270400	27.54717	274420	29.4434
22	174500	238700	36.79083	240800	37.99427	243350	39.45559	258720	48.26361
23	147800	193250	30.75101	217300	47.023	224225	51.70839	229580	55.33153
24	186500	161150	13.59249	178100	4.504021	199925	7.198391	208940	12.03217
		Sum	310.373		274.2963		286.6712		294.0583
		Mean	14.10786		**13.06173**		14.33356		15.47675

Table 10. Moving average analysis for Tuesday

Week	Tuesday	2 week	MAPE	3 week	MAPE	4 week	MAPE	5 week	MAPE
1	251400								
2	245200								
3	224500	248300	10.60134						
4	256000	234850	8.261719	240366.7	6.106771				
5	295400	240250	18.6696	241900	18.11104	244275	17.30704		
6	287500	275700	4.104348	258633.3	10.04058	255275	11.2087	254500	11.47826
7	245600	291450	18.66857	279633.3	13.85722	265850	8.245114	261720	6.563518
8	302000	266550	11.73841	276166.7	8.554084	271125	10.22351	261800	13.31126
9	187500	273800	46.02667	278366.7	48.46222	282625	50.73333	277300	47.89333
10	210330	244750	16.36476	245033.3	16.49947	255650	21.54709	263600	25.32687
11	198750	198915	0.083019	233276.7	17.37191	236357.5	18.92201	246586	24.06843
12	189700	204540	7.822878	198860	4.828677	224645	18.42119	228836	20.63047
13	123000	194225	57.9065	199593.3	62.271	196570	59.81301	217656	76.9561
14	175640	156350	10.98269	170483.3	2.93593	180445	2.735709	181856	3.539057
15	187900	149320	20.5322	162780	13.36881	171772.5	8.583023	179484	4.478978
16	245600	181770	25.98941	162180	33.9658	169060	31.1645	174998	28.74674
17	231200	216750	6.25	203046.7	12.17705	183035	20.83261	184368	20.25606
18	245800	238400	3.010578	221566.7	9.858964	210085	14.53011	192668	21.61595
19	214000	238500	11.4486	240866.7	12.55452	227625	6.366822	217228	1.508411
20	165400	229900	38.99637	230333.3	39.25836	234150	41.5659	224900	35.9734
21	132540	189700	43.1266	208400	57.23555	214100	61.53614	220400	66.28942
22	123000	148970	21.11382	170646.7	38.73713	189435	54.0122	197788	60.80325
23	198700	127770	35.69703	140313.3	29.38433	158735	20.11324	176148	11.34977
24	165020	160850	2.526966	151413.3	8.245465	154910	6.12653	166728	1.035026
		Sum	419.9221		463.8249		483.9878		481.8243
		Mean	**19.08737**		22.0869		24.19939		25.35917

Table 11. Moving average analysis for Wednesday

Week	Wednesday	2 week	MAPE	3 week	MAPE	4 week	MAPE	5 week	MAPE
1	188750								
2	156400								
3	156400	172575	10.34207						
4	195000	156400	19.79487	167183.3	14.26496				
5	231000	175700	23.93939	169266.7	26.72439	174137.5	24.6158		
6	158000	213000	34.81013	194133.3	22.8692	184700	16.89873	185510	17.41139
7	102300	194500	90.12708	194666.7	90.29	185100	80.93842	179360	75.32747
8	145600	130150	10.61126	163766.7	12.47711	171575	17.83997	168540	15.75549
9	90540	123950	36.90082	135300	49.43671	159225	75.8615	166380	83.76408
10	102300	118070	15.41544	112813.3	10.27696	124110	21.31965	145488	42.21701
11	112300	96420	14.14069	112813.3	0.457109	110185	1.883348	119748	6.632235
12	132500	107300	19.01887	101713.3	23.23522	112685	14.95472	110608	16.52226
13	187900	122400	34.85897	115700	38.42469	109410	41.77222	116648	37.92017
14	154600	160200	3.622251	144233.3	6.705476	133750	13.48642	125108	19.07633
15	177000	171250	3.248588	158333.3	10.54614	146825	17.04802	137920	22.0791
16	156400	165800	6.01023	173166.7	10.72038	163000	4.219949	152860	2.263427
17	213000	166700	21.73709	162666.7	23.63067	168975	20.66901	161680	24.0939
18	198000	184700	6.717172	182133.3	8.013468	175250	11.4899	177780	10.21212
19	187000	205500	9.893048	189133.3	1.14082	186100	0.481283	179800	3.850267
20	145600	192500	32.21154	199333.3	36.90476	188600	29.53297	186280	27.93956
21	103200	166300	61.14341	176866.7	71.38243	185900	80.13566	180000	74.4186
22	154600	124400	19.53428	145266.7	6.037085	158450	2.490298	169360	9.547219
23	135600	128900	4.941003	134466.7	0.835792	147600	8.849558	157680	16.28319
24	112300	145100	29.20748	131133.3	16.77056	134750	19.9911	145200	29.29653
		Sum	508.2257		481.1439		504.4785		534.6103
		Mean	23.10117		**22.91162**		25.22393		28.13739

Table 12. Moving average analysis for Thursday

Week	Thursday	2 week	MAPE	3 week	MAPE	4 week	MAPE	5 week	MAPE
1	227580								
2	214600								
3	224500	221090	1.518931						
4	205000	219550	7.097561	222226.7	8.403252				
5	196000	214750	9.566327	214700	9.540816	217920	11.18367		
6	213500	200500	6.088993	208500	2.34192	210025	1.627635	213536	0.016862
7	187000	204750	9.491979	204833.3	9.536542	209750	12.16578	210720	12.68449
8	198400	200250	0.93246	198833.3	0.218414	200375	0.995464	205200	3.427419
9	121500	192700	58.60082	199633.3	64.30727	198725	63.55967	199980	64.59259
10	213000	159950	24.9061	168966.7	20.67293	180100	15.44601	183280	13.95305
11	198800	167250	15.87022	177633.3	10.64722	179975	9.469316	186680	6.096579
12	223000	205900	7.668161	177766.7	20.28401	182925	17.97085	183740	17.60538
13	206500	210900	2.130751	211600	2.469734	189075	8.438257	190940	7.535109
14	198700	214750	8.077504	209433.3	5.401778	210325	5.850528	192560	3.090086
15	214500	202600	5.547786	209400	2.377622	206750	3.613054	208000	3.030303
16	194500	206600	6.22108	206566.7	6.203942	210675	8.316195	208300	7.095116
17	245100	204500	16.56467	202566.7	17.35346	203550	16.95226	207440	15.36516
18	214500	219800	2.470862	218033.3	1.647242	213200	0.606061	211860	1.230769
19	231450	229800	0.712897	218033.3	5.796788	217150	6.17844	213460	7.772737
20	224500	222975	0.679287	230350	2.605791	221387.5	1.386414	220010	2
21	204500	227975	11.47922	223483.3	9.282804	228887.5	11.92543	222010	8.562347
22	198400	214500	8.114919	220150	10.9627	218737.5	10.25076	224010	12.90827
23	197800	201450	1.845298	209133.3	5.729693	214712.5	8.550303	214670	8.528817
24	245600	198100	19.34039	200233.3	18.47177	206300	16.00163	211330	13.95358
		Sum	224.9262		234.2557		230.4877		209.4487
		Mean	**10.22392**		11.15503		11.52439		11.02361

Table 13. Moving average analysis for Friday

Week	Friday	2 week	MAPE	3 week	MAPE	4 week	MAPE	5 week	MAPE
1	385500								
2	375400								
3	360000	380450	5.680556						
4	308000	367700	19.38312	373633.3	21.30952				
5	312500	334000	6.88	347800	11.296	357225	14.312		
6	333500	310250	6.971514	326833.3	1.999	338975	1.641679	348280	4.431784
7	365000	323000	11.50685	318000	12.87671	328500	10	337880	7.430137
8	297500	349250	17.39496	337000	13.27731	329750	10.84034	335800	12.87395

9	312500	331250	6	332000	6.24	327125	4.68	323300	3.456
10	301230	305000	1.251535	325000	7.89098	327125	8.596421	324200	7.625403
11	302540	306865	1.429563	303743.3	0.397744	319057.5	5.459609	321946	6.414358
12	298700	301885	1.066287	305423.3	2.250865	303442.5	1.587713	315754	5.709407
13	356400	300620	15.65095	300823.3	15.5939	303742.5	14.77483	302494	15.12514
14	335640	327550	2.410321	319213.3	4.894133	314717.5	6.233613	314274	6.365749
15	397000	346020	12.84131	330246.7	16.81444	323320	18.55919	318902	19.67204
16	198700	366320	84.35833	363013.3	82.69418	346935	74.60242	338056	70.13387
17	225780	297850	31.92045	310446.7	37.49963	321935	42.58792	317288	40.52972
18	235460	212240	9.861548	273826.7	16.29435	289280	22.85739	302704	28.55857
19	348790	230620	33.87999	219980	36.93053	264235	24.24238	278516	20.14794
20	332540	292125	12.15343	270010	18.80375	252182.5	24.16476	281146	15.45498
21	398700	340665	14.55606	305596.7	23.35173	285642.5	28.35653	268254	32.71783
22	302500	365620	20.86612	360010	19.01157	328872.5	8.718182	308254	1.902149
23	287500	350600	21.94783	344580	19.85391	345632.5	20.22	323598	12.55583
24	302540	295000	2.492232	329566.7	8.933254	330310	9.178952	334006	10.40061
		Sum	340.5029		378.2135		351.6139		321.5055
		Mean	**15.47741**		18.01017		17.5807		16.92134

Table 14. Moving average analysis for Saturday

Week	Saturday	2 week	MAPE	3 week	MAPE	4 week	MAPE	5 week	MAPE
1	397500								
2	302500								
3	325500	350000	7.526882						
4	320000	314000	1.875	341833.3	6.822917				
5	345000	322750	6.449275	316000	8.405797	336375	2.5		
6	389000	332500	14.52442	330166.7	15.12425	323250	16.90231	338100	13.08483
7	352000	367000	4.261364	351333.3	0.189394	344875	2.024148	336400	4.431818
8	302000	370500	22.68212	362000	19.86755	351500	16.39073	346300	14.66887
9	264880	327000	23.45213	347666.7	31.2544	347000	31.00272	341600	28.96406
10	298700	283440	5.108805	306293.3	2.542127	326970	9.464345	330576	10.67158
11	325400	281790	13.40197	288526.7	11.33169	304395	6.455132	321316	1.255071
12	265000	312050	17.75472	296326.7	11.82138	297745	12.3566	308596	16.45132
13	345600	295200	14.58333	296366.7	14.24576	288495	16.52344	291196	15.7419
14	312540	305300	2.316503	312000	0.172778	308675	1.236642	299916	4.039163
15	345600	329070	4.782986	307713.3	10.96258	312135	9.68316	309448	10.46065
16	196540	329070	67.43157	334580	70.23507	317185	61.38445	318828	62.22041
17	325460	271070	16.71173	284893.3	12.46441	300070	7.801266	293056	9.956369
18	298750	261000	12.63598	289200	3.196653	295035	1.243515	305148	2.14159
19	387500	312105	19.45677	273583.3	29.39785	291587.5	24.75161	295778	23.67019
20	356470	343125	3.743653	337236.7	5.395498	302062.5	15.26286	310770	12.82015
21	346500	371985	7.354978	347573.3	0.309764	342045	1.285714	312944	9.684271
22	312500	351485	12.4752	363490	16.3168	347305	11.1376	342936	9.73952
23	365400	329500	9.824849	338490	7.364532	350742.5	4.011357	340344	6.857143
24	302540	338950	12.03477	341466.7	12.86662	345217.5	14.1064	353674	16.90157
		Sum	300.389		290.2878		265.524		273.7605
		Mean	13.65405		13.82323		**13.2762**		14.40845

Table 15. Moving average analysis for Sunday

Week	Sunday	2 week	MAPE	3 week	MAPE	4 week	MAPE	5 week	MAPE
1	482500								
2	405000								
3	385000	443750	15.25974						
4	356000	395000	10.95506	424166.7	19.14794				
5	355000	370500	4.366197	382000	7.605634	407125	14.6831		
6	402500	355500	11.67702	365333.3	9.233954	375250	6.770186	396700	1.440994
7	397000	378750	4.596977	371166.7	6.507137	374625	5.63602	380700	4.105793
8	312500	399750	27.92	384833.3	23.14667	377625	20.84	379100	21.312
9	298740	354750	18.74874	370666.7	24.07668	366750	22.76562	364600	22.04593
10	315000	305620	2.977778	336080	6.692063	352685	11.96349	353148	12.11048
11	302500	306870	1.444628	308746.7	2.065014	330810	9.358678	345148	14.09851
12	278900	308750	10.70276	305413.3	9.506394	307185	10.14163	325148	16.58229
13	298700	290700	2.678273	298800	0.033478	298785	0.028457	301528	0.946769
14	325600	288800	11.30221	293366.7	9.899672	298775	8.238636	298768	8.240786
15	287000	312150	8.763066	301066.7	4.901278	301425	5.026132	304140	5.972125
16	178900	306300	71.21297	303766.7	69.79691	297550	66.32197	298540	66.87535
17	298970	232950	22.08248	263833.3	11.75257	272550	8.837007	273820	8.412215
18	312000	238935	23.41827	254956.7	18.28312	272617.5	12.6226	277834	10.95064
19	312540	305485	2.257311	263290	15.75798	269217.5	13.86143	280494	10.25341

20	314500	312270	0.709062	307836.7	2.118707	275602.5	12.36804	277882	11.64324
21	321500	313520	2.482115	313013.3	2.63971	309502.5	3.731726	283382	11.8563
22	320540	318000	0.792413	316180	1.360205	315135	1.686217	311902	2.694827
23	287950	321020	11.48463	318846.7	10.72987	317270	10.18232	316216	9.816288
24	298750	304245	1.839331	309996.7	3.764575	311122.5	4.141423	311406	4.236318
		Sum	267.671		259.0196		249.2047		243.5943
		Mean	**12.16687**		12.33426		12.46023		12.82075

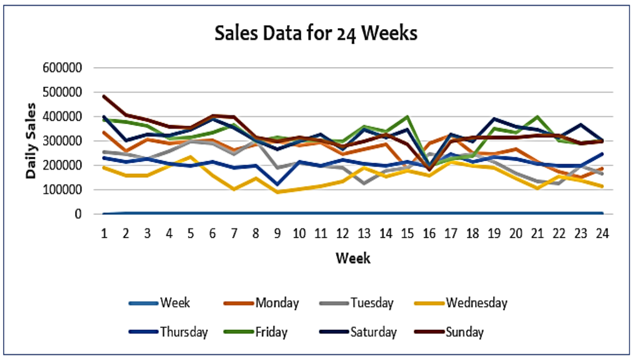

Figure 2. Bakery and confectionery sales data for 24 weeks

Using the combined data, models were created, compared, and the model with the lowest error would be picked for each day. Moving averages of two, three, four, and five weeks would be used, along with exponential smoothing (with = 0.2, 0.4, 0.6, and 0.8). For each day of the week, the best option in each model was determined.

The mean absolute percentage error obtained from using the two forecasting models are provided in Table 16 and a better comparison is shown in Figure 3. The model with the minimum performance criteria was picked as the most optimal forecasting technique as supported in the research [17, 18] for analyzing sales data. The mean values of MAPE for all the days cumulative together are found to be 3.7347 and 15.1713 for the exponential smoothing and moving average, respectively.

Table 16. MAPE comparison for the forecasting models

Day of the week of production	Exponential smoothing model (MAPE)	Moving average model (MAPE)
Monday	4.0847 (α=0.8)	13.06173 (M=3)
Tuesday	3.7407 (α=0.8)	19.08737 (M =2)
Wednesday	5.4780 (α=0.8)	22.9110 (M =3)
Thursday	2.6830 (α=0.8)	10.2200 (M =2)
Friday	2.8570 (α=0.8)	15.4770 (M =2)
Saturday	4.4890 (α=0.8)	13.2762 (M =4)
Sunday	2.8104 (α=0.8)	12.1660 (M =2)

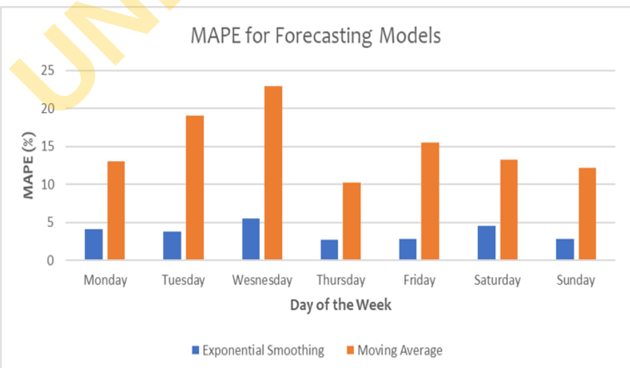

Figure 3. Comparison of mean absolute percentage error for forecasting models

4. CONCLUSION

This study has shown the value of forecasting in strategic planning as well as the way forecasting models can boost the productivity of bakeries and confectionery businesses. The goal of the case study was to emphasize the significance of selecting the most appropriate and effective forecasting models for the company's goods and services. The generated data information from the selected models was subsequently integrated into active decision-making strategy processes to make the best possible use of the limited resources available to the company. To reduce production costs, increase product demand, and maintain competitiveness by lowering the cost of their varied goods, higher productivity is the target for all food-based industries, notably confectionaries. Without using accurate and dependable facts and figures, which can only be achieved by applying forecasting models to the available data, no manager can make accurate strategy decisions. For the study of the data that could be obtained from the company for this project, primarily two forecasting models were considered. Based on the information available, forecasting models were contrasted. The best forecasting model for the day was the one with the highest performance rating, or the one with the lowest MAPE (i.e., Monday or Tuesday or Wednesday, etc.). Considering varying forecasting models, other models could be explored further for possibility of adopting a better model with relatively minimum forecasting error. Also, the period of sales data collected could be extended to one or two years for clearer understanding of factors influencing the sales, and better performance by the models.

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