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Forecasting Sales for a Local Restaurant in Jeddah: A Time Series Approach

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Abstract

This paper examines a range of time series forecasting techniques for a casual dining restaurant in Jeddah using daily sales data. Accurate sales forecasting is essential for restaurants as it directly impacts inventory management, operational planning, and customer satisfaction. In the food industry, products have a very short shelf life, which makes balancing supply and demand especially challenging. When forecasts are inaccurate, the restaurant may face two major issues: food shortages that lead to customer dissatisfaction or overstock that results in increased costs and food waste. By applying and comparing different forecasting techniques, this study aims to identify the method that provides the most reliable and practical results. The findings will benefit restaurant managers in planning inventory more efficiently, reducing waste, improving decision-making, and ultimately enhancing overall business performance. This research highlights the importance of data-driven strategies in today's competitive food service industry.

Keywords

Restaurant Sales Forecasting, Demand Planning, Inventory Control, Time Series Forecasting techniques, Forecast Errors

1. Introduction

With the race of providing products and services and the high competitiveness among businesses in this century, meeting customer demands is a complex process that needs excellent tools to make the right decisions specifically in the restaurant sector where consumers' preferences are changing rapidly as well as the existence of many different

dining options. This makes demand forecasting one of the crucial factors that directly impact the performance of restaurants. Due to this dynamic nature of the restaurant sector, this paper will focus on sales forecasting of local casual dining restaurants in Jeddah which specializes in Uzbek cuisine. The restaurant offers many types of traditional Uzbek dishes that blend the traditional flavors with the modern presentation. The restaurant concept focused on offering a comfortable dining experience combining quality and authenticity, rather than focusing on fast service or fine dining.

In restaurant sector, where daily demand fluctuates due to several factors such as seasonality, weekends and competitors' appearance, this makes having reliable demand forecasting highly significant. Accurate sales forecasting enables restaurant managers to make right purchasing decisions, control inventory in a more efficient manner, and reduce food waste as well as unnecessary costs which can all enhance the profitability of the restaurant. On the other hand, having unreliable forecasting may lead to several negative consequences including shortage, overproduction, increasing costs, and reducing customer satisfaction.

Accordingly, the aim of this paper is to use two different forecasting techniques to forecast the restaurant's main products' sales using historical sales data. This will lead to understanding demand patterns. The performance of the two methods will be evaluated by using common error measures for the purpose of determining which methods provide accurate futures estimations of the sales.

1.1 Objective
To identify the forecasting technique that delivers the highest accuracy in predicting future restaurant sales using historical sales data.

1.2 Scope of the Study
The paper examines the sales performance of a casual dining restaurant in Jeddah that offers Uzbek food. The data used covers around one year of sales for key products, reflecting the restaurant's primary menu offerings. The scope of the study focuses on internal sales data without considering external aspects like competitor pricing, marketing efforts, or broader economic signals. The forecasting analysis will utilize two quantitative forecasting approaches, enabling the evaluation of accuracy through various statistical error measures such as Mean Absolute Deviation (MAD) and Mean Squared Error (MSE) and Mean Absolute Percentage Error (MAPE).

1.3 Significance of the Study
The significance of the study stems from the use of two different quantitative forecasting methods using real life restaurant sales data, which offers valuable insights into demand patterns and variations in Jeddah's local dining restaurants.

The paper finding will support restaurant management to predict changes in customer demand accurately, enhance resource utilization, and schedule production more precisely. In addition, the results can be considered as a useful reference for other small and medium-sized restaurants aiming to adopt data-driven forecasting methods to enhance operational efficiency and increase their market competitiveness.

2. Literature Review
Sales forecasting has been widely examined within the hospitality and food service sectors due to the industry's sensitivity to demand fluctuations, seasonality, and operational constraints. Specifically, the casual dining category, between fast food and fine dining, is a category that has unique forecasting problems. Independent of the standardized menus and the regularity of the customer traffic as in fast food establishments, or the reliance on the restaurant reservation processes and smaller volumes like fine dining restaurants, the casual dining restaurants have changing walk-in customer demand and different customer segments. This uncertainty enhances the significance of the predictive models which can respond to short-term volatility and long-term seasonality. From this perspective, there are many studies that have explored different forecasting methods for the restaurant sector, ranging from traditional statistical methods to modern approaches that involve the use of Machine Learning (ML).

This section highlights several studies relevant to forecasting restaurant sales and provides an empirical foundation for the methods used in the study.

2.1 Sales Forecasting in the Restaurant Industry

Sales forecasting has always been a priority for the management of restaurants, especially in casual dining, where the demand rises and falls during the week. Weekends, promotions, holidays, and seasons have a direct impact on sales. A good forecast turns that pattern into action: what to buy, how much to prep, and who to schedule. When it is accurate, purchasing tightens, waste drops, and labor matches real demand. Previous studies show the impact clearly: reliable forecasts tighten procurement, lower uncertainty, and steady food-service operations (Posch and Truden, 2021), while forecast accuracy directly influences inventory cost, menu planning, and consistency of service (Cranage and Andrew, 1992). Recent evidence emphasizes the point, in catering settings, precise demand predictions lead to cut preparation errors and streamlined kitchen flow (Rodrigues et al., 2024). Therefore, it can be concluded that the accuracy of forecasting has an impact on almost all aspects of the operations of a restaurant.

2.2 Methods of Forecasting in the Restaurant Sector

A variety of forecasting methods have been used in the restaurants and hospitality sectors, including basic time-series methods to advanced ML methods. These approaches may be generally divided into qualitative and quantitative. Qualitative methods (e.g., Delphi method, expert judgment) are very much dependent on managerial intuition and are not appropriate in data-intensive conditions. Quantitative methods, on the other hand, rely on statistical or computational models based on historical data.

2.2.1 Traditional Quantitative Methods of Restaurant Sales Forecasting

Due to their low implementation cost, simple application, and consistent accuracy, moving averages (MA), exponential smoothing (ES), and Autoregressive Integrated Moving Average (ARIMA) remain the dominant traditional forecasting approaches in restaurant and food-service settings.

2.2.2 Moving Average (MA)

MA models are widely used for smoothing short-term fluctuations. Cranage and Andrew demonstrated that MA works effectively when restaurants experience stable weekly sales patterns, although its simplicity limits responsiveness to sudden demand shifts (Cranage and Andrew, 1992).

2.2.3 Exponential Smoothing (ES)

Among the most common methods to utilize in the short-term sales forecasting in restaurants is ES. The model places more emphasis on the recent observations as older data is gradually diminishing. This is what makes it especially appropriate in the conditions when the demand of customers varies quickly. Research has shown that ES often outperformed more complex models in real-world forecasting competitions, demonstrating greater robustness and consistency across noisy datasets (Makridakis, Hibon and Moser, 1979). ES is also inexpensive and easy to implement, which is why it can be served to small and medium-sized businesses (SME) with little analytical capabilities.

2.2.4 ARIMA Models

Another statistical model that can be widely used in restaurant forecasting is the ARIMA model. It incorporates the non-stationary time series data in autoregressive (AR) and MA elements. ARIMA models capture autocorrelation structures and seasonality. Previous research has shown that, when periodic demand patterns are stable and historical data is sufficient, ARIMA produces strong forecasts in food canteens and restaurants (Posch and Truden, 2021). However, the method requires expert tuning and rests on a stationarity assumption that may not be held in dynamic restaurant environments.

Overall, traditional models are particularly well suited to casual dining, as they can be implemented with limited data, are easy to update, and do not require high investment costs.

2.2.5 ML Models for Restaurant Sales Forecasting

In recent years, the use of ML models in the restaurant forecasting process has been growing. ML methods have gained traction for capturing nonlinear demand and for considering external drivers such as weather, holidays, and special events.

Techniques such as random forests and gradient boosting have been shown to improve meal demand forecasting accuracy, particularly under high variability conditions (Rodrigues et al., 2024). Another study also indicates that models such as Facebook Prophet can incorporate weather conditions and holiday effects, leading to stronger and

more accurate restaurant sales predictions (Göktürk, 2024). Furthermore, ensemble techniques, including stacking, have demonstrated notable accuracy improvements in food demand forecasting (Seyam et al., 2025).

Although the ML models tend to be more accurate than the conventional time-series methods, they are associated with difficulties including higher computational and implementation costs, the need for large and clean historical datasets, complex hyperparameter tuning, overfitting risks when data is limited, and low interpretability for nontechnical managers. As shown in (Mitra, Saha and Tiwari, 2024), deep clustering frameworks can raise accuracy but demand advanced modeling expertise and more computing resources than traditional methods. Consequently, ML is the future of forecasts in hospitality, however, it is not as feasible in small restaurants with limited resources and technology levels.

2.3 A Critical Comparison Between Traditional Models versus ML

Comparative studies report mixed results; in many restaurant settings, traditional methods match or even outperform ML. In a large-scale investigation, the study found that simpler statistical models frequently beat more complex techniques, particularly when datasets are small or noise is high (Makridakis, Hibon and Moser, 1979). Likewise, traditional Bayesian and ARIMA models achieve comparable accuracy to ML while demanding less data and computational effort (Posch and Truden, 2021).

One study adds an important nuance: ML tends to win only when enriched with broad feature sets such as weather, digital promotions, and holiday effects. Without those inputs, traditional models equal or surpass ML for daily restaurant sales forecasting (Hossain and Parvin, 2025).

2.4 Forecasting Model Evaluation Using Error Measures

Testing the effectiveness of the forecasting models must be an objective statistical analysis that measures the accuracy of the prediction. The most common error measures that are applied in restaurant demand forecasting are MAD, MSE, MAPE (Kim and Kim, 2016).

2.4.1 MAD

MAD is used to note the mean value of the absolute difference between the actual and the predicted values. It is easy to interpret and gives the straight sense of average deviation of the forecasts. These are lower MAD values which mean higher accuracy (Kim and Kim, 2016). The MAD is also less sensitive to large outliers than metrics of squared error and so it is appropriate in the presence of occasional extreme values in the dataset like extreme values on weekends or holidays (Rodrigues et al., 2024).

2.4.2 MSE

MSE is an average of squared forecast errors. In contrast to MAD, it punishes greater errors and focuses on model resilience to great errors. A model that has lesser values of MSE is better since this implies lesser averages of squared differences between the actual sales and the predicted sales (Schmid, Roidl and Kirchheim, 2025).

2.4.3 MAPE

MAPE is a percentage of actual values used to express the forecast error, MAPE is popular in hospitality since it allows managers to read the error as a percentage. Nevertheless, it becomes volatile when the real values are near to zero, because dividing by very small actual values magnifies even tiny absolute errors, resulting in disproportionately large percentage errors and unstable interpretations (Schmid, Roidl and Kirchheim, 2025).

The insight from the existing literature shows that there is a necessity of the localized empirical study that implements statistical forecasting techniques to real-life data of small and medium-sized casual dining restaurants. The current paper will attempt to address this gap by testing sales data of a local Uzbek restaurant in Jeddah. This study can be used in practical application to the operational planning of small restaurants by providing a comparison of the performance of ES and ARIMA to determine how statistical models can assist in improving operational planning in a small restaurant setup. The following section outlines the methodology adopted in this paper, including the data used and the forecasting methods selected.

3. Methodology

3.1 Data Description

The dataset was taken from a restaurant in Jeddah, Saudi Arabia. The restaurant operates daily from 2:00 PM to 12:00 AM and offers 58 menu items. Each sale is recorded automatically through the point-of-sale system, capturing the item name, quantity sold, and total sales value. In total, 9,495 daily records were collected between 7 January 2025 and 28 September 2025.

3.2 Data Mapping and Cleaning

The data was processed and cleaned using Microsoft Excel. The dataset includes four key variables: Date, Item, Sales Value, and Sales Quantity. Total sales were aggregated weekly for each item. Weekly aggregation captures short-term sales trends and reduces random daily variation. Daily data is often distorted by weekends or special events, while monthly data can hide useful short-term patterns. Weekly data provided a balanced view of sales performance.

Weeks 28 and 29 were missing due to a system failure. Their values were estimated using the average sales of the previous three weeks. The Figure 1 shows the weekly sales trend. Sales dropped early in the period, then gradually increased over time.

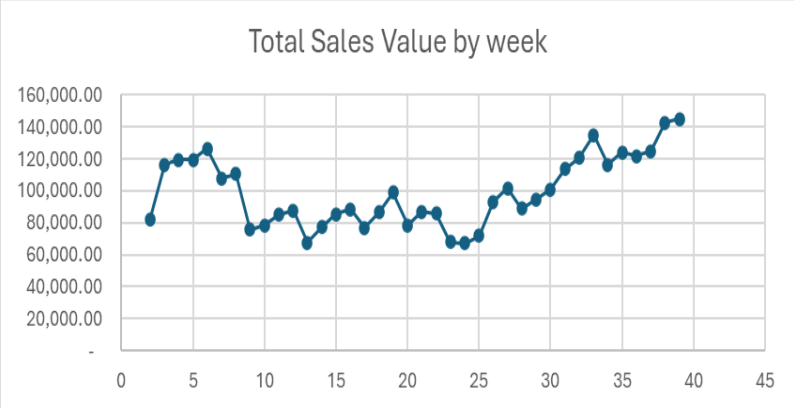

Figure 1: Weekly sales overview

3.3 ABC Classification

ABC classification is a method used to group items based on how much they contribute to total sales. It divides products into three categories:

- Class A: High-value items that generate the largest share of revenue.
- Class B: Medium-value items with a moderate impact on sales.
- Class C: Low-value items that contribute the least to total sales.

This approach helps managers focus on the products that drive most of the restaurant's income. By knowing which items are most important, management can improve stock control, pricing, and forecast decisions.

The process started by calculating each item's total sales value and ranking all items from highest to lowest. Then, the contribution percentage of each item to total sales is computed. The cumulative percentage helped define the boundaries between the three classes

3.4 Double Exponential Smoothing (DES) Forecasting

The sales data were forecasted using the DES method. This method tracks both sales levels and trends. It adjusts smoothly to weekly changes. Main Course A and Main Course B were chosen for the analysis as they are the best-selling items and together make up 36.7 percent of total sales. The smoothing parameters alpha and beta were set to 0.4 and 0.2. These settings keep the model steady and responsive. After forecasting, the actual and predicted sales were compared.

3.5 ARIMA Forecast

After that, ARIMA forecasting technique was used with the model (1,1,1). A ready template was used, and sales data were plugged directly into the file to find the forecasted sales.

3.6 Forecast Error Measures

The forecasted data were tested using three error measures: MAD, MSE, and MAPE. MAD shows the average size of the forecast errors. MSE highlights large errors by squaring them. MAPE expresses accuracy as a percentage of actual sales. Together, these measures show how close the forecast is to real sales performance.

4. Finding/Results

The results of ABC classification showed the following:

- Ten items (Class A) made up about 80 percent of total sales.
- Thirteen items (Class B) represented the next 15 percent of sales, bringing the cumulative total to 95 percent.
- The remaining 35 items (Class C) accounted for the last 5 percent.

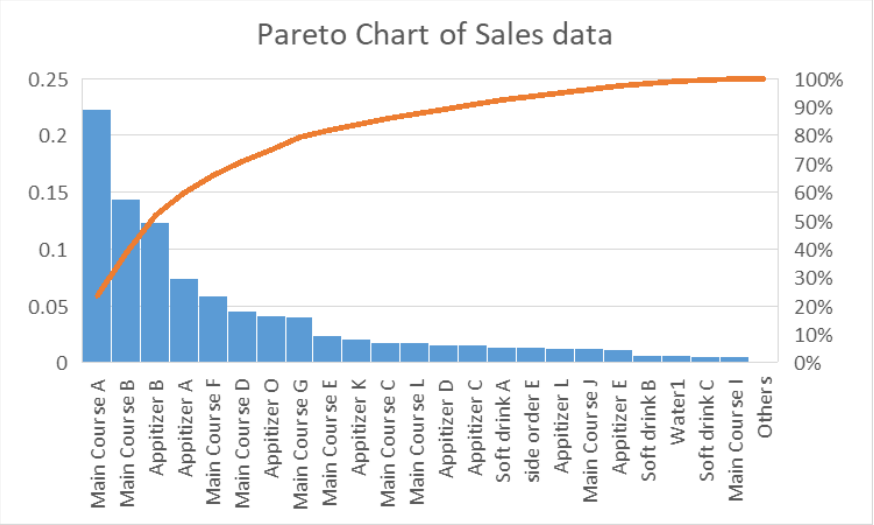

Figure 2. Pareto Chart of sales data

The Pareto chart in Figure 2 shows that only a few items bring in most of the restaurant's revenue. Main Course A and Main Course B recorded the highest sales. Together, they made up 36.7 percent of total revenue. These two items are the key sources of income and need regular tracking to manage stock and plan demand effectively.

The first method is forecasting using DES for main course A and main course B. Figure 3 and Figure 4 show the actual versus the forecasted data. The results showed a close match. The model captured the sales pattern with strong accuracy.

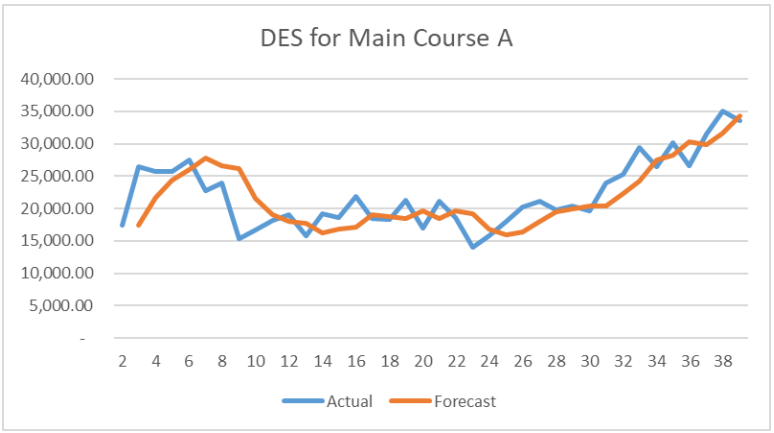

Figure 3: DES Actual vs Forecast sales for Main course A

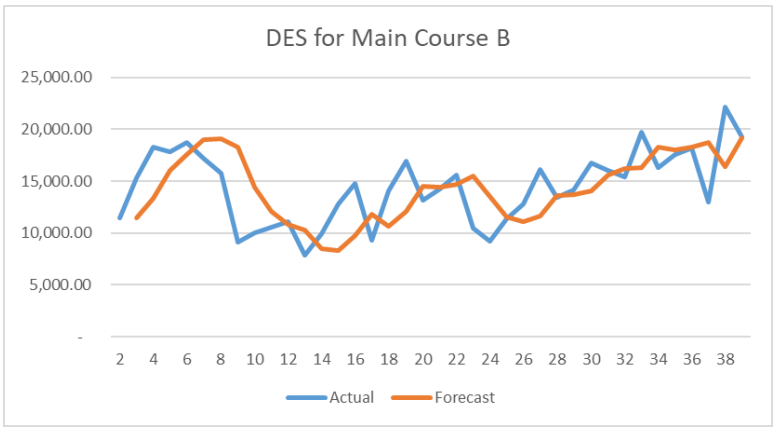

Figure 4. DES Actual vs Forecast sales for Main course B

The second method is forecasting using ARIMA(1,1,1) for main course A and main course B. Again, the Figure 5 and Figure 6 show a strong accuracy between the actual sales and the forecasted sales.

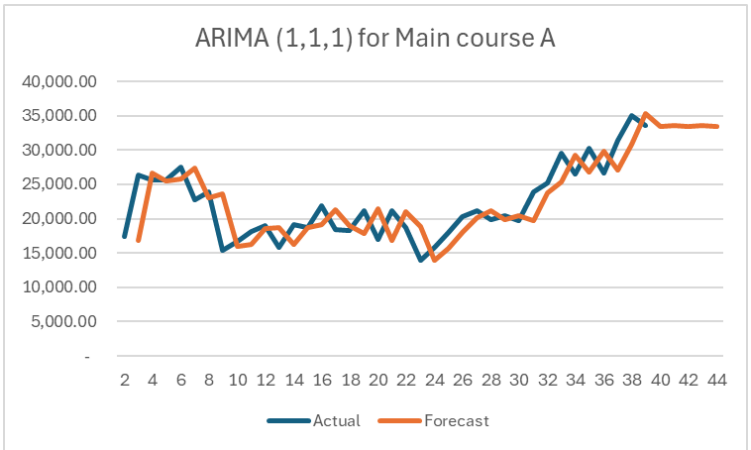

Figure 5. ARIMA Actual vs Forecast sales for Main course A

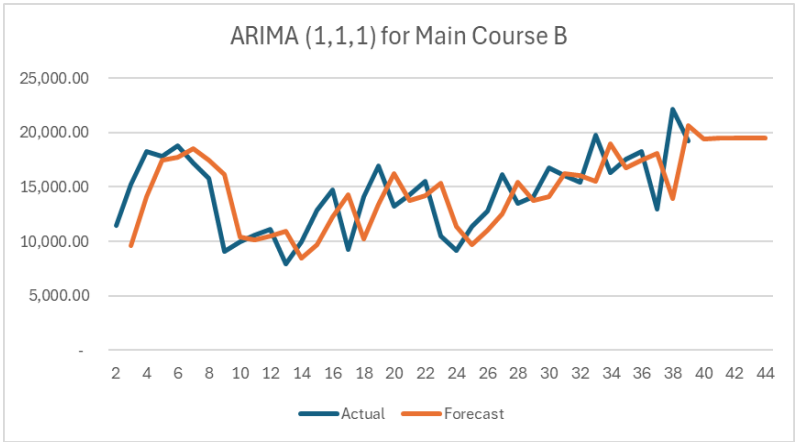

Figure 6. ARIMA Actual vs Forecast sales for Main course B

The forecasted values closely followed the actual weekly sales patterns, indicating that the DES and ARIMA methods were an appropriate and reliable forecasting technique for this dataset.
For a more accurate comparison, the error measures were calculated for both as shown in Table 1.

Table 1. Error Measures for DES and ARIMA for Main Course A and Main Course B

Forecast error Measure		MAD	MSE	MAPE
Item	Forecast Technique			
Main Course A	DES	2,810.39	12,926,191.52	13.49%
	ARIMA	2,708.32	11,480,116.11	12.80%
Main Course B	DES	2,605.85	11,316,739.78	20.03%
	ARIMA	2,520.73	10,175,425.28	18.88%

The results showed relatively low MAD and MAPE values, confirming that the forecasts were closely aligned with actual sales and that the model achieved a high level of accuracy in predicting short-term demand as shown previously in the literature. However, the ARIMA forecasting method shows slightly lower error values, which indicate better forecasting projection.

5. Discussion

The results of this study show how sales analysis and forecasting improve restaurant decisions. The ABC classification found that about 20 percent of menu items produce nearly 80 percent of total revenue. This follows the Pareto principle. Managers should focus on these top items when planning inventory, coordinating with suppliers, and promoting menu choices to keep them available and maintain customer satisfaction. Both the DES and ARIMA (1,1,1) models were used to predict sales. Each model followed the weekly sales pattern of Main Course A and Main Course B, showing steady demand that fits short-term forecasting. The ARIMA model gave slightly better results. For Main Course A, the MAPE dropped from 13.49 percent with DES to 12.80 percent with ARIMA. For Main Course B, the MAPE decreased from 20.03 percent to 18.88 percent. This shows that ARIMA tracked the actual data more closely. The other error measures, MAD and MSE, were low for both models. This means both are reliable forecasting tools. Models should be reviewed often to keep their accuracy. Using ABC classification with forecasting helps managers plan better. By identifying the main revenue items and predicting their sales, they plan purchases, manage inventory, and assign staff more efficiently, which can lead to reduced waste, improved resource use, and increased profit and customer satisfaction.

6. Conclusion

This study implements ABC classification, DES, and ARIMA Forecasting techniques to evaluate and forecast sales in a casual dining restaurant in Jeddah. According to ABC Analysis, Main courses A and B of the menu items generated nearly 37 percent of total sales. Emphasizing the importance of focusing management efforts on these high-revenue items.

Sales Forecasting of Main course A and B using both DES and ARIMA showed values that aligned closely with actual sales. This confirmed the method's suitability for short-term forecasting. Moreover, accuracy measures such as MAD, MSE, and MAPE showed low error levels which indicate that the method produced reliable predictions.

Future work could extend this study by including more menu categories, seasonal data, or external factors such as pricing, promotions, and customer behavior.

Overall, the findings underline the value of combining sales classification and forecasting methods in order to support better decision-making in inventory management, production planning, and resource allocation within the restaurant sector.

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