

SalesVision - Fashion Retail Management System with Demand Prediction

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Abstract – The fashion industry is one of the most expansive, dynamic, and influential sectors in the global economy. It encompasses fashion retailing which acts as a bridge between the manufacturers and customers. Given the volatile nature of the fashion industry, forecasting demand for fashion items has grown increasingly complex. The objective of this research study is to develop a web application that collect and analyze retail sales data and forecast demand for men's fashion products to overcome the struggles of maximizing sales, confronted by the industry. The emergence of sophisticated data analysis tools powered by advanced artificial intelligence models, has brought about a positive influence in the field of business analytics. Power BI, a popular data analytics tool, has been utilized in this research for data analysis and visualization to aid the prediction of customer demand for men's fashion products through a dedicated web application. Alongside its demand prediction capabilities, the web application offers a suite of robust features encompassing product management, customer relations, order processing, deliveries, and supplier interactions. This paper presents the process of analyzing sales, forecasting demand, and the outcomes of each research segment.

Keywords – Demand Prediction, Data Analytics, Business Intelligence, Men's Fashion Retail, Power BI

I. INTRODUCTION

In today's dynamic world, clothing serves a purpose beyond mere necessity. It has evolved into a mode of self-expression, personal preferences, and a reflection of cultural significance. The dynamic nature of the fashion industry reflects the constant shift in human desire on a daily basis. The global fashion industry is now a 1.7 trillion-dollar [1] venture committed to the business of designing, manufacturing, retailing, and marketing clothes.

Moreover, the Sri Lankan fashion eCommerce sector is poised for substantial growth, projected to reach US\$441.2 million by 2023 and constituting 18.3% of the country's total eCommerce market. This underscores the industry's

transformative power, both on a global scale and within regional contexts [2].

In the ever-evolving landscape of the fashion industry, understanding consumer behavior and accurately predicting demand has become important for retailers seeking to optimize their sales strategies and foster business growth. However, due to the high volatile nature of the fashion market, accurately predicting demand for products is considerably more difficult. Some specific challenges faced by the fashion retail industry are as follows,

- The frequent shift of fashion trends
- Excessive volatility of consumer demand
- Existence of a vast consumer group.

Moreover, retail industry in Sri Lanka confronts a unique set of challenges that are specific to its local context. One significant challenge is the reluctance to embrace new technologies, which hampers the industry's potential for growth and innovation. The prevalent low levels of computer literacy among both retailers and consumers further exacerbates this issue, impeding the adoption of modern solutions.

The significance of addressing these challenges cannot be overstated. Precise demand forecasting and streamlined operations can significantly boost profitability, reduce waste, and greatly enhance customer satisfaction. The rapid fluctuations in demand within fashion retail present formidable challenges, encompassing issues such as understocking, overstocking, customer demand comprehension, and capital management. The failure to effectively address these challenges can have real-world consequences, jeopardizing a retailer's financial health and long-term viability.

The primary objective of this research study is to develop a web application that will offer predictive insights into the demand for men's fashion products by analyzing historical sales data using Power BI.

The proposed solution, SalesVision offers a comprehensive solution to address these challenges within the retail industry. This is an all-in-one web platform which incorporates a demand prediction feature. The system is designed to be both cost-effective and user-friendly, thus eliminating the reliance on costly third-party business analysts.

Demand prediction will be powered by Power BI, a powerful data analysis tool developed by Microsoft Corporation [3]. System database will be connected to Power BI. Power BI Live Dashboard component will be used to display results obtained. Overview of demand prediction system is shown in Fig. 1.

In the subsequent sections, the paper is structured as follows: Section II conducts a literature review on the research topic, Section III defines the study's methodology, and Section IV discusses the obtained results. Lastly, Section V concludes the paper by summarizing the key findings and proposing future research directions.

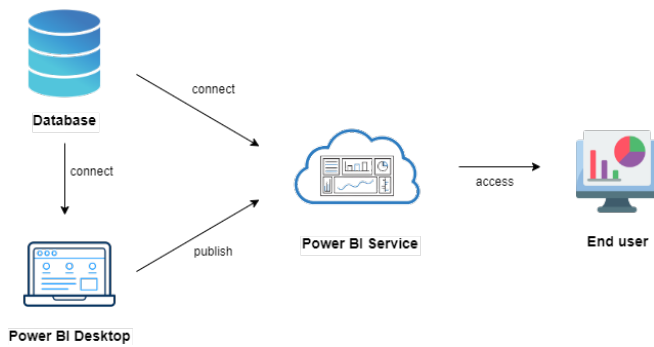


Fig. 1. System overview

II. RELATED WORKS

Multiple demand prediction research studies have been done over the past few years with different drawbacks regarding the research. Initially, people utilized traditional statistical methods to achieve this. But with recent advancements of Artificial Intelligence, researchers are beginning to use data analysis tools and ML models, to implement demand prediction which has the ability to effectively analyze large datasets and identify nonlinear relationships between features.

Ganhewa N. B. et al [4] utilizes ML mechanisms to deliver sales forecasts of fashion products, customer segmentation which helps in targeted marketing and predicts consumer demands based on products reviews. However, they have only conducted the research in the context of women's clothing. The Evolutionary Neural Network (ENN) was proposed for the fashion sales forecasting model in the study conducted by K. F. Au et al [5]. They came to the conclusion that the model presented is unreliable for fashion products. Extreme Learning Machine (ELM) has been utilized by Z. L. Sun et al [6], to forecast sales in the retail fashion industry. However, training data and the testing data in this dataset were normalized. This model was used to investigate the relationship between sales volume and the symbolic attributes that affected sales, such as color, size, and price. However, ELM is not the most dependable method, as the outcomes differ from run to run. M. Raje et al [7] has used Power BI as tool to monitor the business performance in real-time. However, they have not explored

the possibility of using Power BI to analysis sales data in the context of men's fashion retail. P. R. C. Patil et al [8] has utilized Power BI to analyze historical sales data. However, they have not explored the possibility of integrating Power BI results with a web application. Ren, S et al [9] is comprehensive analysis of forecasting methods and challenges the fashion retailers are facing in big data era. However, they have not conducted analysis on any sales dataset. In the research by Huber, J et al [10], the primary focus lies in predicting the day-to-day demand through machine learning techniques, with a emphasis on calendric special days. However, their evaluation has been limited to standard machine learning models.

Overall, there are plenty of research studies conducted regarding the fashion industry but very few of them are done concerning demand prediction on men's fashion items. Also, few researchers have explored the possibility of using Power BI as a tool for data analysis and demand prediction in men's fashion retail.

III. METHODOLOGY

The research was conducted systematically to develop a sales analysis and demand prediction system using Power BI. The stages involved in this process are as shown in Fig. 2.

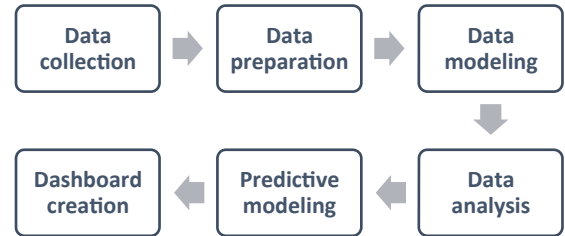


Fig. 2. Flow diagram

1) *Data Collection*: The foundation of any data-driven analysis is the quality and relevance of the data collected. In this initial phase, a representative sample is sourced from the ecommerce application [11], emphasizing the sales data from 2020. This dataset comprises historical sales transactions, customer information, product details and other relevant data that affect sales and demand. It serves as the foundational dataset for all subsequent analyses.

2) *Data Preparation*: High-quality data is not only about quantity but also about cleanliness and consistency. Data preparation is a critical step that ensures data accuracy and reliability. The collected data is subsequently cleaned and transformed to achieve this goal. Data cleaning involves handling missing values, removing duplicates, and dropping unnecessary columns, such as the image column, while data transformation involves standardizing data formats and encoding categorical variables.

3) *Data Modeling*: In this stage a well-structured data model is created for effective analysis. Relationships are established between different tables such as sales, products to connect related data. Measures and calculated columns are created, frequently using Data Analysis Expressions (DAX), to perform calculations and aggregations. This stage also involves identifying key performance indicators (KPIs) that will be used to measure and evaluate sales performance.

opportunities based on a clear understanding of these dynamics over time.

| Quarter | Sales (M) | Orders (%) |
|------------|-----------|------------|
| Qtr 1 2020 | 0.7 | 40 |
| Qtr 2 2020 | 0.6 | 45 |
| Qtr 3 2020 | 0.5 | 30 |
| Qtr 4 2020 | 0.7 | 50 |
| Qtr 1 2021 | 1.1 | 60 |
| Qtr 2 2021 | 0.9 | 55 |
| Qtr 3 2021 | 0.6 | 35 |
| Qtr 4 2021 | 1.1 | 65 |
| Qtr 1 2022 | 1.9 | 80 |
| Qtr 2 2022 | 1.4 | 70 |
| Qtr 3 2022 | 0.8 | 40 |
| Qtr 4 2022 | 1.7 | 75 |
| Qtr 1 2023 | 2.8 | 90 |
| Qtr 2 2023 | 2.0 | 55 |
| Qtr 3 2023 | 1.1 | 60 |

Fig. 3. Sales and orders by year and quater Chart

Sales by Category: As shown in Fig. 4, the pie chart visually represents how sales are distributed across different men's fashion retail product categories. Each category's slice size corresponds to its contribution as a percentage of total sales, making it easy to grasp the relative importance of each category.

Sales by Category

| Category | Percentage |
|-------------|------------|
| Accessories | 24.88% |
| Shirt | 17.45% |
| Trouser | 11.22% |
| Shoes | 9.13% |
| Sweater | 9.05% |
| T-Shirt | 8.66% |
| Jeans | 7.97% |
| Bag | 7.96% |
| Shorts | 3.68% |

Fig. 4. Sales by category chart

IV. RESULTS AND DISCUSSION

Sales By City: Fig. 5 displays a map showcasing the distribution of sales across different cities. It offers a visual insight into the performance of sales in various geographic areas and helps decision-makers in regional marketing and logistics planning.

Sales by City

Map showing sales locations in South India and Sri Lanka. The map includes labels for cities and regions: Kottakkal, Tiruppur, Coimbatore, Tiruchirappalli, Thiruvallur, Thirunelveli, Taluka, Madurai, Jaffna, Mullaitivu, Trinadrum, Thiruvananthapuram, Colombo, Badulla, Keelagamulla, Galle, and Laccadive Sea. The regions shown are KERALA, TAMIL NADU, and SRI LANKA. Orange circles of varying sizes represent sales volume at each location.

Fig. 5. Sales by city map

Sales and Orders by Year and Quarter: Fig. 3 displays this chart, which utilizes a combination of line and clustered column charts to present vital insights into business performance. Along the horizontal axis, it tracks the progression of years and quarters, providing a chronological framework for analysis. On the left, clustered columns denote sales figures for each quarter, enabling a straightforward comparison of sales performance between different time frames. On the right, the chart represents the number of orders with a continuous line, offering a visual perspective on order volume fluctuations. This chart facilitates the identification of correlations and disparities between order volume and sales revenue, aiding decision-makers in optimizing strategies and seizing growth

Sales by Product: This chart enables a straightforward comparison of sales performance among different products, facilitating the swift identification of top-performing and under-performing items. It is a valuable tool for decision-makers in shaping strategies related to product management and inventory optimization.

Sales By Brand: The bar chart visually represents the sales contribution of each brand. This chart is essential for evaluating brand performance and provides decision-makers in marketing and brand management with valuable insights.

B. Demand Prediction

The evaluation of the prediction model yielded positive results. Initially, the model was applied to the testing dataset to predict sales quantities. The forecasted values were then compared with the actual values from the testing dataset, as shown in Table 1.

TABLE 1. Comparison between the actual and predicted values

| Test Sales Value | Predicted Sales Value |
|------------------|-----------------------|
| 395930 | 416126 |
| 526050 | 462886 |
| 570260 | 571157 |

To evaluate the predictive performance of the model, Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and Root Mean Square Error (RMSE) were utilized as performance metrics. The results are summarized in Table 2.

TABLE 2. Performance metrics

| | |
|------|-------------|
| MAE | 30559 |
| MAPE | 4.866378% |
| RMSE | 41742.43482 |

As shown in figure 6 the prediction chart for a 6-month period. This chart provides valuable insights into the forecasted sales trends and allows decision-makers to plan and strategize accordingly. The positive evaluation results reinforce the model's effectiveness in predicting future demand, enabling better-informed decisions in the men's fashion retail sector.

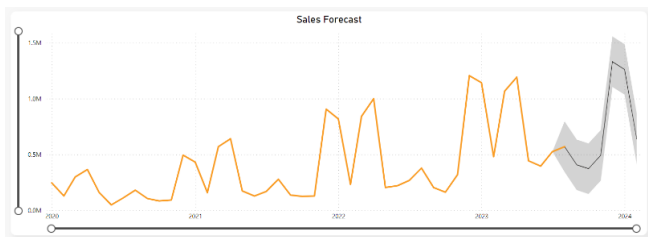


Fig. 6. Sales forecast chart

V. CONCLUSION

This study has effectively addressed the intricate challenges associated with demand prediction and sales analysis, harnessing the power of historical sales data and robust analytical techniques. The integration of the Power BI-powered dashboard has emerged as a pivotal tool, providing comprehensive insights into sales performance and demand trends. This research highlights the transformative potential of Power BI within the fashion retail sector, facilitating data-driven decision-making that empowers retailers and fuels growth and innovation.

Furthermore, this study paves the way for exciting avenues of future research. One promising recommendation is to delve into personalized marketing strategies as the next logical step, recognizing their potential to further revolutionize the fashion retail industry. By building upon these findings, researchers can continue to drive progress in this dynamic and evolving field, ultimately shaping the future of fashion retail through data-driven insights and strategic innovation.

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