



DEVELOPMENT OF AN INTERACTIVE DASHBOARD AND EST-BASED FORECASTING MODEL FOR REAL-TIME DECISION MAKING IN SUPPLY CHAIN MANAGEMENT.

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Abstract: The objective of the project is to develop an Interactive Dashboard for Supplier Weight and Delivery Weight Forecasting using an ETS (Error, Trend, Season) model built using Python to support data-driven decision making within a large engineering manufacturing organisation. The study comprises two integrated components designed to illustrate how visualization and forecasting can facilitate improvements in supply chain monitoring and planning. The organization relies on consistent supplier deliveries and accurate weight forecasting based on historical data for its large-scale manufacturing operations. The manual evaluation of supplier on-time delivery performance and weight of deliveries was often ineffectual and could lead to poor speculation. An Interactive Dashboard was generated in Power BI to visualize supplier performance and delivery timelines. A Forecasting Model was developed in Python with an ETS model predicting the weight of delivery in the future based on historical trends. Combining the analytical power of the Python statistical tool with the data visualization through Microsoft Power BI will help provide actionable insights to improve supply chain management processes and how decisions will be made in the future. The use of an interactive dashboard allowed all users to see how suppliers are performing and the trend regarding weights, and with Python's ETS modelling, a clear prediction of the future delivery weights enables faster decision-making and would lead to increased transparency while using data-informed planning methods to transform supply chain operations.

Keywords: Interactive dashboard, time series forecasting, ETS model, supply chain management, Power BI, Python.

INTRODUCTION

Background of the Study:

In the present demanding environment of manufacturing, lean supply chain management is one of the critical factors in achieving productivity and timely supply. In order to be mindful of customer expectations with regards to timely shipping as well as to minimize delays, staying informed on supplier status with respect to outstanding shipments and forecasting future weights of outstanding shipments is critical. Follow-up on supplier's performance as well as projecting future shipping patterns can be very labour intensive and full of human error.

Research Problem:

In manufacturing organizations, production is regular only when material is supplied by vendors on time and in the right quantity (weight). When there are problems with timely order production, order delays and high production costs result. When the supplier's order delivery weight is inaccurate and/or the supplier is probably late, the current state of supplier and order weight data is stored in multiple systems (or locations), making it impossible for a single management person to review the information quickly and take action to prevent the customer problems from escalating. Predicting delivery weights in advance is also challenging, as manual checks or basic methods often miss important patterns like seasonal changes or sudden supply issues.

Objectives of the Study:

The main objective of this study is to design and develop an interactive dashboard that can display real-time information on pending suppliers. The system will integrate a Python ETS forecasting model to predict future delivery weights using historical data, helping managers plan production more effectively. The specific objectives are:



Objective 1: Design and implement an interactive Power BI dashboard which visually represents historical data through slicers and dynamic charts to allow proper analysis and exploration of data.

Objective 2: Create a predictive forecasting model using the Exponential Smoothing (ETS) algorithm in Python to forecast short-term trends with high accuracy and minimize forecasting errors.

Significance of the Research:

This study addresses the need for an integrated solution that combines visualization and predictive analytics for supply chain management. By developing a functional model that displays pending supplier details and predicts delivery weights in one platform, the research contributes to bridging the gap between traditional tracking methods and advanced analytical tools in industrial operations.

REVIEW OF LITERATURE

As discussed by Mahmud & Iqbal (2024), their research explored the role of interactive dashboards in an organization's ability to increase their visibility and efficiency. Their research established that incorporating Python-based forecasting methods within Power BI improves real-time monitoring and enables interactive scenario analysis of routine processes such as procurement and supply chain forecasting.

Aspin (2022) conducted an evaluation on principles for designing effective dashboards focusing on the integration of Python scripts into Power BI. This will expand the analytical capabilities of Power BI for forecasting and automation purposes.

Kane, Mache, and Khan (2025) proposed a configuration architecture that integrates various statistical forecasting models, including ARIMA (Auto-Regressive Integrated Moving Average), Prophet (from Facebook), and ETS (Exponential Smoothing State Space Model), in Power BI dashboards. Their research found evidence that interactive dashboards are an excellent medium to facilitate both analytical and forecasting activities for users.

Siebert, Groß, and Schroth (2021) provided an overview of the statistical libraries for generating forecasts using Python, including explanations on how to implement models, such as ETS, forming a conceptual framework for using Python ETS models for demand and delivery forecasting within business dashboards.

According to Qi, Li, Wang, and Jia (2022), an enhanced ETS approach combines statistical features with machine learning to yield better selection of model components, demonstrating that hybrid approaches may lead to a more accurate forecast. Tirupati, Joshi, and Singh (2023) researched how the interactive dashboards of Power BI along with real-time updating helps Companies to visually see trends, identify anomalies and enhance their decision-making processes.

Shah and Thaker (2024) looked at traditional methods of econometrics and machine learning when they forecast time-series data. They found that many of the traditional methods (like ETS) work well still today under the same time series data conditions.

Morozov (2023) did a review on how well the different models (ETS, ARIMA, and ANN) did in terms of truthfulness, consistency, and resources for certain time-series tasks.

Thamizharasan, Vasanthavelan, Siva, and Priya (2024) studied how to use AI/ML technology in Power BI to include time series forecasting models with scripts written in Python improve accuracy of the forecast.

RESEARCH METHODOLOGY

Research Design

This study is an applied research project with a descriptive and developmental approach, aimed at solving practical problems in supply chain management. The main purpose is to improve the process of tracking pending suppliers and forecasting delivery weights to support better planning and decision-making. Historical data on suppliers and delivery weights was collected from organizational records, providing the base for analysis, forecasting, and model development.

Research Model

The research model comprises three main components:

Input Stage - Historical data on pending suppliers and delivery weights is collected from organizational records.



Processing Stage - The Python Exponential Smoothing model is used to assess the trend, seasonality and estimate the future delivery weight.

Output Stage - Using an interactive dashboard that includes information regarding pending vendors, delivery weights over time, and forecasting for vendors to assist in their planning and decision making.

Hypotheses

H1: An interactive dashboard integrating pending supplier details and delivery weight forecasting will significantly improve the visibility of supplier performance.

H2: Applying the Python ETS (Exponential Smoothing) model will improve forecast accuracy for delivery weights when compared to traditional or manual prediction methods.

Organizational Data

- PO's from 10-17-2023 until 4-23-2024 - (49) pending suppliers
- **Deliveries of weight:** 5016 (Delivery weights from 1-1-2023- 12-30-2023) in weekly format from week 29-52 of 2023.

Tools for Data Collection

- ERP System - Main source of data (purchase orders, supplier details, pending deliveries, and delivery weights)
- ERP Reports - Used to extract pending supplier data and goods receipt information
- Excel/CSV Exports - Data downloaded for further use

Analytics Tools

The study uses Python for forecasting, Power BI for the dashboard, Excel for the preparation, and ERP for the data source to provide an effective analysis and visualization of information

Software Used

- Python (Statsmodels, Pandas, NumPy, Matplotlib, and Seaborn) – ETS Forecasting
- Power BI — for dashboard development
- Excel — for data preprocessing and storage
- Google Colab — for model development and testing
- ERP/E-Procurement System — as the data source

DATA ANALYSIS AND INTERPRETATION

System Overview

This study involves the development of two systems designed to showcase the power of interactive data visualization and predictive modelling. The dashboard component leverages Power BI for historical trend analysis, and the forecasting component is implemented in Python using the Exponential Smoothing (ETS) method to predict future delivery weight.

Model 1: Interactive Data Visualization Dashboard in Power BI

This system centres around displaying pending suppliers data insights as a collection of interactive dashboards. The interactive dashboard allows users to view datasets using slicers, filters, drill-downs, and cards. Visualization options such as bar charts, line charts, and pie charts are utilized to visualize performance trends and patterns.

Input: Pre-processed and cleaned pending suppliers dataset.

Output: An interactive dashboard with key performance indicators (KPIs), trend visualizations, and exploratory capabilities of data.

Model 2: Forecasting Model (ETS Method in Python)

The purpose of this project is to create a one-week (7-day) forecast using existing trend-based historical data via Exponential Smoothing (ETS) in Python. The ETS model will capture the level, trend, and seasonal components of the historical data by assigning relatively more weight to the most recent data point(s) in order to improve the predictive accuracy of future observations.

Input: Time-series historical data (date and value columns).

Output: Results provide 1st week forecast, with historical and predicted values plotted across the predicted timeframe.



Technology Stack

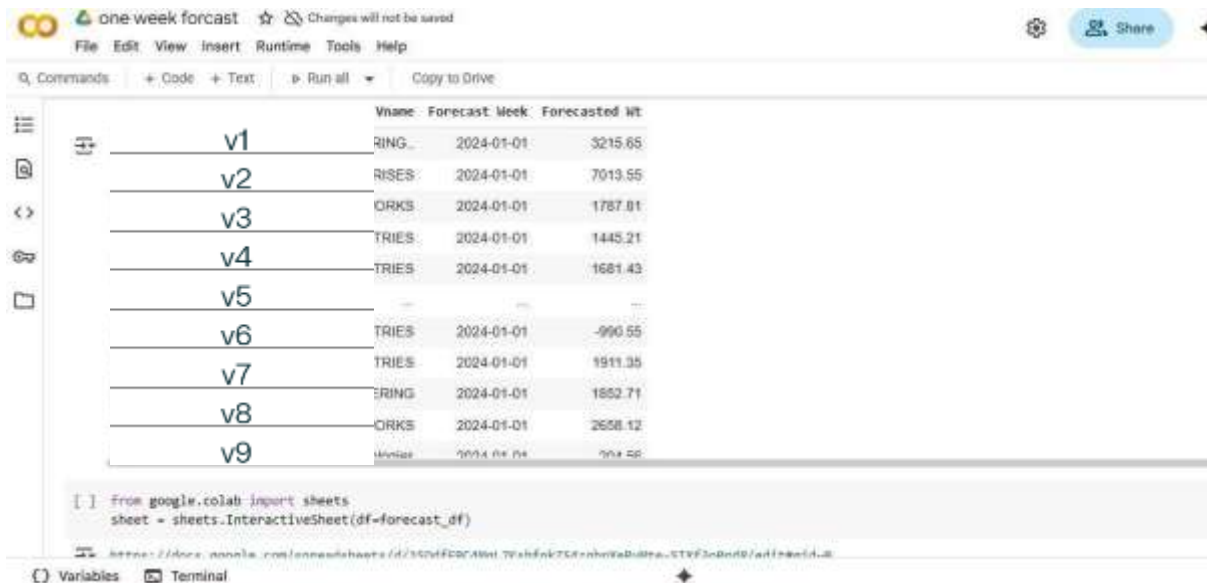
Category	Tools / Libraries
Programming Languages	Python 3 (in conjunction with DAX for BI calculation purposes)
Data Visualization tools	Power BI (for creating an interactive dashboard) and matplotlib for plotting graphically.
Forecasting Model	Statsmodels (Exponential Smoothing – ETS), Pandas
Data Handling	Pandas, NumPy
Evaluation Metrics	MAE (Mean Absolute Error), RMSE (Root Mean Square Error)
Data Preparation	Power Query (in Power BI), Pandas
Development Environment	Power BI Desktop, Google Colab

IMPLEMENTATION

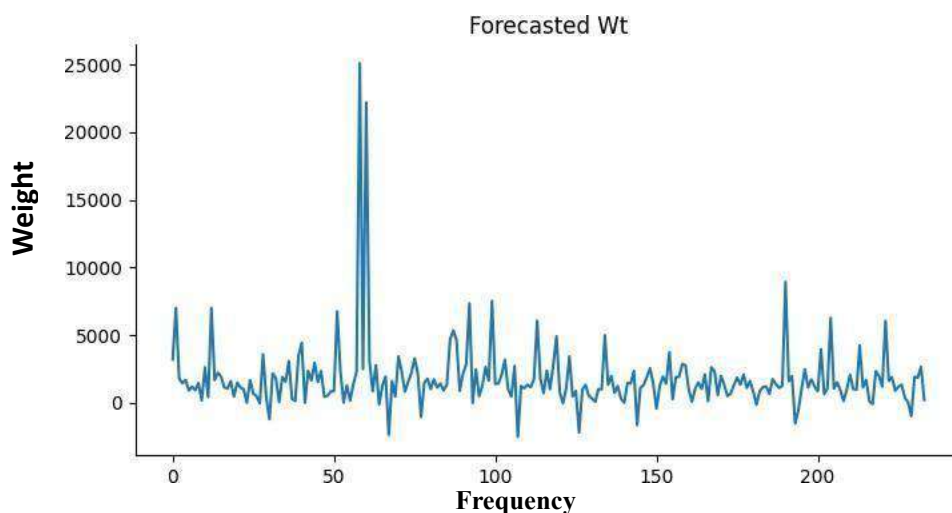
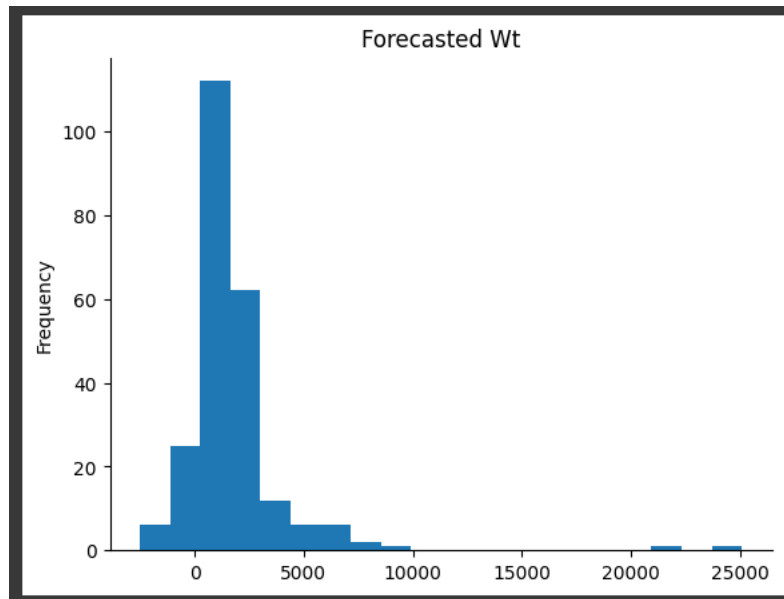
A. Delivery Weight Forecasting using Exponential Smoothing (ETS)

The first phase involved developing a predictive model to forecast delivery weight for the next week using historical purchase order data. The dataset was loaded into Google Colab, and extensive pre-processing was performed to ensure compatibility with time series modelling. The dataset was organized by delivering monthly summary information by aggregating arriving packages (by total weight of all packages). All missing values (if any) have been handled appropriately; also, date formats have been standardized using the pandaslibrary. A cleaned version of this dataset was then fitted into an ETS model using statsmodels.tsa.holtwinters in the Python programming language. The model was optimized with additive trend and seasonal components to suit business seasonality patterns. The trained ETS model was used to forecast delivery weight for the next week, achieving reasonable performance with low residual errors.

Forecast Output



Visualizations:



INTERPRETATION

The first chart, a histogram, indicated, for forecasted weights, where the majority fell within a range between 0 and 5000. There were some apparent outliers from the raw data which forecast weight was greater than 20,000.

The second chart was a line plot where the forecasted weights can also be observed over time. Again, the chart implies peaks in weight forecast at those sudden timeframes. These peaks align with the outliers seen in the histogram and may represent unusually large delivery predictions for certain vendors.

Overall, the forecasts are generally stable with occasional high variations that may require further investigation.

Business Interpretation

The forecasted values represent a reliable estimation of future delivery weights. When used alongside historical trends, this helps:

- Anticipate stock requirements.
- Identify underperforming vendors early.
- Avoid supply chain disruptions.

B. Interactive Dashboard with Visual Forecasting Insights

To deliver an interactive visualization experience, a dashboard was created using Power BI. Key dashboard features included:

- Vendor-wise and product-wise delivery forecasts
- Slicers to filter by purchase order item or project name



- Tooltips to show additional metadata
Providing this data through a visual means enables users to monitor patterns in the performance of their suppliers and better forecast their activities, allowing for more accurate plans for future activity.

SYSTEM DEMONSTRATION (Power BI Interactive Dashboard of pending suppliers)

All demonstration outputs and visualizations for the models are provided below to showcase their functionality and performance



This dashboard provides a visual summary of **pending subcontracting orders** from different vendors, dealing persons, and time periods. It helps users understand the **total value and weight of goods pending**, the **status of purchase orders**, and **trends over time** — allowing companies to track supplier performance and manage delays efficiently.

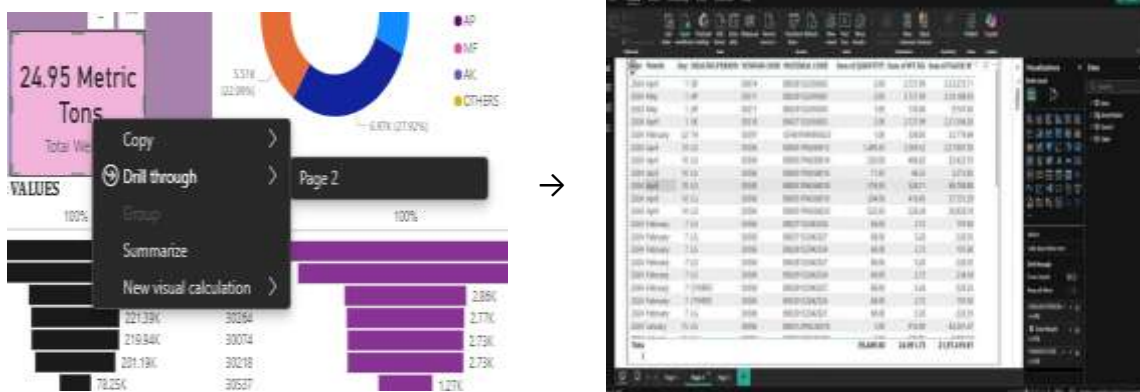
Highlights:

- **Status Cards** : "Over Due" and "Pending" boxes show the **type of pending orders**.
- **Summary Cards**:
- **Total Value** of all pending orders: ₹0.22 Crores.
- **Total Weight**: 24.95 Metric Tons.

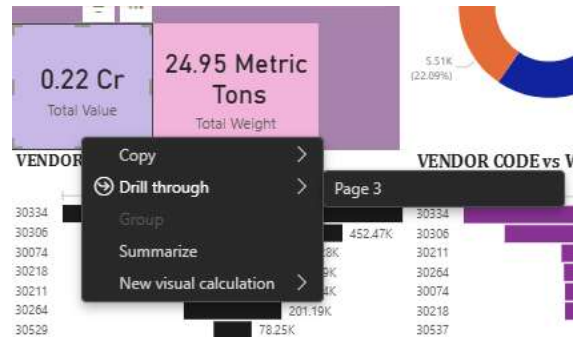
These cards give a **quick snapshot** of the total subcontracting workload still pending.

Drill-through feature is enabled dashboard for tracking overdue and pending supplier POs across delivery months and vendor code:

For other details



For pending Type:



MATERIAL CODE	over due	Sum of WT KG	Sum of VALUES
88031FW260018	over due	484.20	22,422.79
88031FW260019	over due	410.45	37,781.29
88031FW260020	over due	410.09	42,261.67
88031FW260021	over due	328.05	22,779.84
88031FW260022	over due	264.74	19,201.91
88031FW260023	over due	220.00	22,722.03
88031FW260024	over due	226.24	20,828.78
88031FW260025	over due	148.81	10,214.25
88031FW260026	over due	125.00	9,747.45
88031FW260027	over due	125.00	27,869.68
88031FW260028	over due	107.96	9,885.22
88031FW260029	over due	75.62	5,199.33
88031FW260030	over due	66.00	19,253.00
88031FW260031	over due	46.55	3,273.86
88031FW260032	over due	37.15	2,378.21
Total		24,951.72	21,97,419.91

Interactive drill features to help users explore data in detail. By right-clicking on a specific data point such as a vendor name or delivery month users can open detailed pages that show more specific information, like pending PO numbers, item names, quantities, and the person in charge (PIC). These drill-through pages help users easily find the cause of delays, evaluate vendor or employee performance, and make better decisions .

RESULTS AND DISCUSSION

Key Results of the Study

The system was developed with Power BI's interactive dashboard for monitoring pending supplier deliveries and a Python-based forecasting module using the Exponential Smoothing (ETS) method. This combination of descriptive and predictive analytics provides both real-time visibility and short-term forecasting of supplier performance.

The Power BI dashboard presents a clear view of supplier-related pending orders segmented by vendor name, delivery dates, material category, and delay duration. Metrics for total pending weight, delayed deliveries, and age analysis are shown in a dynamic display available to procurement personnel via interactive visuals, filters and drill downs. Procurement personnel can use these items to identify bottlenecks, prioritize follow-ups and reduce risks in the supply chain.

In addition, the short-term future delivery prediction model (Python ETS) generates delivery trend forecasts based on historical data collected on a weekly basis over a historical time period. It smoothed out irregularities in the data and minimizes the impact of extreme outliers to produce stable one (1) week forecasts that closely align with actual delivery trends. The model demonstrated high accuracy for vendors with consistent historical patterns.

Practical Implications

The forecasted values represent a reliable estimation of future delivery weights. Forecasts developed from prior historical trends, as well as, forecasts from the Python ETS will allow procurement personnel to anticipate their stock requirements, identify vendors who do not perform as well as others and help to mitigate supply chain disruptions.



FINDINGS

- Interactive dashboards provided an easy to read/understand view of supplier performance, delivery status and weight trends for both procurement personnel and suppliers. Each procurement employee needs to be trained on how to use both the interactive dashboards and the forecasting tools.
- The Python ETS model effectively forecasted future delivery weights and showed seasonal or recurring patterns in supply.
- The system helped management identify supplier issues early and plan materials and resources in advance.
- Utilizing data visualisation reactivity (real-time) as well as having accurate data forecasts gives you the opportunity of making faster decisions.
- Implementing this method changed Supply Chain Operations by increasing visibility, control and data-based operational planning.
- The forecasting module demonstrated that ETS models work well in predicting weekly delivery weights using past data, giving stable and useful results.

SUGGESTIONS /FUTURE RECOMMENDATIONS

Based on Findings

- Connect the interactive dashboard with ERP data to help track supplier performance as well as pending deliveries in real-time.
- Continue to test the accuracy and reliability of the Python ETS forecasting method by comparing its results to those derived from advanced machine learning (ML) methodologies in order to improve forecasting accuracy.
- Continually gather feedback from procurement/operations managers and suppliers regarding how to improve the interactive dashboards and automate tools that will assist suppliers with their order and shipment preferences.
- Gather continuous feedback from managers and suppliers to refine the dashboard and include useful features like supplier preference tracking.
- Implement the system across selected value streams and deploy it on cloud or local environments for improved flexibility, accessibility, and scalability.

CONCLUSION

Summary of the Study

The study successfully executed a two-part system—a Power BI dashboard and a Python-based ETS forecasting module—for pending supplier management and delivery weight prediction. The Power BI dashboard is an improved visual tool that represents clear, real-time visibility of pending deliveries by suppliers. It improves a team's ability to sense late deliveries, high-risk vendors, or supply bottlenecks more efficiently. The forecasting module provides short-term forecasting using Exponential Smoothing (ETS) of supplier historical data, offering significant predictive value for short-term supply predictions.

The report concludes that using Python's ETS prediction model for developing an Interactive Dashboard / Tool to forecast Supplier and Delivery Weight Future performance has significantly improved the way that this organization monitors its suppliers and forecasts their deliveries. The Interactive Dashboard tool provides the company with a simple but effective way to view, forecast and ultimately make better decisions regarding its supplier performance right now, instead of waiting to see if the supplier has delivered products on time or not. By using a combination of analytics and predictive modeling, this organization is able to plan its resources more intelligently, reduce delays in deliveries and improve overall supply chain performance.

Scope for Future Research

- To enhance accuracy in future estimates, utilize state-of-the-art forecasting methods (ex. machine learning and deep learning).
- In order to have a continuous connection to the entire system, utilize an ERP platform which provides live updates.
- Include pertinent information regarding supplier productivity which include quality, stability, and delivery schedule. Include predictive measures to anticipate risks such as supplier delay or material shortages.
- Build on the prototype from one unit to other plants and departments.
- Work with managers and suppliers to improve their use of the system.
- Move the system to a cloud-based solution so that all locations of the business can have access to the information.

**REFERENCES**

- [1]. Mahmud, D., & Ikbali, M.Z. (2024). A review of real-time dashboarding and predictive business intelligence tools using POWER BI and data analytics for financial reporting.
- [2]. Aspin, Andrew; Pro Power BI Dashboard Creation; Creating Elegant, Attractive, & Interactive Dashboards Using Analytical Data Insights; 2022; ISBN 978-1-56592-065-5; Digital; Available at:
- [3]. Kane, VS, Mache, S. & Khan, A. A Power BI Dashboard Approach to Forecasting Sales Using Both Time Series Forecasting & Business Intelligence; 2025; ISBN 978-1-82025-585-0; Hard Copy Available from:
- [4]. Siebert, J., Gross, J. & Schroth, C. A Systematic Review of Python Packages for Time Series Analysis; 2021; ISBN 978-3-75280-188-3; Digital; Available from:
- [5]. Qi, L., Li, X, Wang, Q. & Jia, S. Feature-Based ETS Model Component Selection; 2022; ISBN 978-9652170126; Hard Copy Available From:
- [6]. Tirupati, KK Joshi, A. & Singh, SP; Improving Data Visualization through Power BI: Leveraging Business Intelligence Applications & Techniques; International Journal of Universal Research Reports; 2023; 10(2) 676-711; Digital; Available at
- [7]. Shah, D. & Thaker, M.; Time Series Forecasting Methods: Research Literature Review & Systematic Time Series Forecasting Methods; International Journal of Research and Analytical Reports; 2024; (1);749-762; Digital; Available from:
- [8]. Morozov V.; Machine Learning Techniques for Time Series Forecasting: Comparison Between ETS & ARIMA; CEUR Workshops; 2023; (3624); Digital; Available From:
- [9]. Kinast, K.B. (2024). The effect of increasing temperature: predictive analysis of time series data. Mathematics, 6(3), 41.
- [10]. 10.Thamizharasan, T., Vasanthavelan, R., Siva, M., and Priya, V. (2024). Using AI/ML to visualize data for sales and forecasting predictive analytical capabilities of a company or organization in Power Bi. International Journal of Creative Research Thoughts.