

A Study of Application of Time Series on Business Decision Making at Hexalpha Solutions, Nagpur

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Abstract: *Time series analysis is a valuable tool for businesses seeking to make data-driven decisions. This project explores the various applications of time series analysis in business decision-making, with a focus on forecasting future trends and patterns. The report examines how one of the time series models such as (ARIMA, SARIMAX) can be used to predict sales, inventory levels, and demand, and how this information can be used to make informed decisions about production, marketing, and supply chain management. Additionally, the report discusses the limitations and challenges of time series analysis in the context of business decision-making, and provides recommendations for addressing these issues. Through this project, we aim to demonstrate the value of time series analysis as a critical tool for businesses seeking to make data-driven decisions.*

Keywords: ARIMA, SARIMAX, Time Series, Supply Chain Management, Data Driven decision

I. INTRODUCTION

INTRODUCTION TO BUSINESS ANALYTICS

In today's fast-paced and highly competitive business environment, companies are facing unprecedented challenges in making informed decisions that can drive growth, profitability and sustainability. Business Analytics is a powerful tool that can help businesses gain insights from large and complex data sets and make data-driven decisions to achieve their strategic goals.

Business Analytics is the application of statistical and quantitative analysis techniques to business data to identify patterns, trends, and insights that can be used to drive business performance. This process involves collecting data from multiple sources, transforming and analyzing it to uncover hidden insights and then visualizing and communicating the findings to stakeholders in a meaningful way.

By using Business Analytics, companies can gain valuable insights into consumer behavior, market trends, and operational performance. For example, companies can use data analysis to identify patterns and trends in customer purchasing behavior, optimize their supply chain, or predict sales for a new product launch.

Business Analytics is also used to identify and mitigate risks, such as fraud or cyber security threats. By analyzing large data sets, companies can detect anomalies and patterns that indicate fraudulent activity or potential security breaches.

The field of Business Analytics has grown rapidly in recent years, due in large part to advances in technology and the increasing availability of data. As companies continue to generate more and more data, the ability to analyze and interpret this information will become increasingly important for business success.

In summary, Business Analytics is a critical field for businesses of all sizes and industries. By using sophisticated analytical techniques to extract valuable insights from complex data, businesses can make more informed decisions, identify areas for improvement, and gain a competitive edge in the marketplace.

INTRODUCTION TO THE TOPIC

Time Series

Time series refers to a sequence of data points collected over time, typically at regular intervals. Time series data can be used to track changes in a particular variable or phenomenon over time, such as stock prices, weather patterns, or consumer behavior. Time series analysis involves studying the patterns, trends, and other characteristics of time series data to make predictions about future values or to uncover insights that can inform decision-making.

Time series data can be represented graphically using a line chart, where time is plotted on the horizontal axis and the variable of interest is plotted on the vertical axis. By examining the line chart, we can identify patterns and trends in the data, such as upward or downward trends, seasonal fluctuations, or cyclical patterns.

Time series analysis can be used to model and forecast future values of the variable of interest. This is typically done using statistical techniques such as ARIMA (autoregressive integrated moving average) models or exponential smoothing models. These models use past values of the variable to predict future values, and can be used to estimate the likelihood of future trends or events.

Time series analysis has a wide range of applications in business, from forecasting sales and inventory levels to predicting future demand and identifying patterns in consumer behavior. By analyzing time series data, businesses can gain insights into the factors that affect their operations and make informed decisions about production, marketing, and other aspects of their business.

In summary, time series analysis is a powerful tool for understanding and forecasting changes in a particular variable over time. By examining patterns and trends in time series data, businesses can gain valuable insights into the factors that affect their operations and make data-driven decisions that can help them stay ahead of the competition.

In today's fast-paced and highly competitive business landscape, organizations are under constant pressure to make data-driven decisions that help them stay ahead of the curve. One key area where data analysis can be particularly useful is in the field of time series analysis. Time series analysis involves examining historical data to identify patterns and trends that can be used to make predictions about future events. In the context of business decision-making, time series analysis can be a valuable tool for forecasting future demand, sales, and inventory levels, among other things.

Time series analysis has a wide range of applications in business decision-making, from finance and marketing to supply chain management and operations. By analyzing time series data, businesses can gain insights into consumer behavior, market trends, and other key factors that affect their operations. Armed with this information, they can make informed decisions about production, marketing, and other aspects of their business, which can help them improve efficiency, reduce costs, and stay competitive.

In this project, we will explore the various applications of time series analysis in business decision-making. We will examine the different types of time series models and techniques that are commonly used in business contexts, and discuss how these models can be used to forecast future trends and patterns. We will also explore the limitations and challenges of time series analysis in the context of business decision-making, and provide recommendations for overcoming these challenges. Through this project, we hope to demonstrate the importance of time series analysis as a critical tool for businesses seeking to make data-driven decisions in today's dynamic business environment.

II. LITERATURE REVIEW

2.1 OBJECTIVES

- To demonstrate the Application of Time Series Analysis on Business Decision Making.
- To evaluate the performance of the model used in Time Series for Better Decision Making like Risk Management.
- To analyze the effect of various parameters on Target Sales.

2.2 HYPOTHESIS

Null Hypothesis:

Null Hypothesis (H₀): There is no significant relationship or pattern in the time series data of Store Sales (Equador).

Alternative Hypothesis:

Alternate Hypothesis (H_a): There is a significant relationship or pattern in the time series data of Store Sale (Equador.)

III. RESEARCH METHODOLOGY

The study would fall under the category of because we would be examining historical time series data for any of the studied domains (Banking, FMCG, Cars, Insurance, and Stock Prices) in order to descriptive research spot patterns, trends, and seasonality.

Data are gathered to give a snapshot of the current situation of the population or phenomenon in descriptive research, which is used to characterize the features of a population or phenomenon. When the goal of the study is to describe or summarize a specific occurrence rather than to demonstrate causal linkages or test hypotheses, this form of research is appropriate.

For the test of Stationarity & Stochastic Models, we will use Descriptive Statistics, Confidence Interval, Differencing & Stationarity Detection Test.

RESEARCH OBJECTIVE

The research objective is on the applications of time series in business decision-making is to investigate the effectiveness of time series analysis in improving business decision-making.

SAMPLE DESIGN

The design of the sample is as follows Population: Hex Alpha Solutions

Sampling Technique: Technique Unknown, As Train & Test Data was readily available. Sample size : No Sampling As Complete Historical Data is Available.

METHOD OF DATA COLLECTION:

Data collection is an act of collecting relevant and a adequate data required from the sample size. It may be done through primary (or) secondary data.

Primary data collection tools:

Primary Data Collection is not Applicable for this Project as the large amount of Historic data has been taken into Consideration.

Secondary data collection sources:

Data has been captured from Kaggle.

Kaggle is platform for hosting datasets that have been collected by others for various purposes.

The data from Kaggle can have Outliers, Missing Values, Redundant Values,

To overcome such challenges, we have transformed the data for maintain it's quality & the value it holds before we have to move it into Time Series for Analysis.

SIGNIFICANCE OF STUDY:

The significance of the study on the applications of time series in business decision-making lies in its potential to provide valuable insights and practical recommendations for businesses seeking to improve their sales forecasting and decision-making processes.

Specifically, this study can help businesses understand the benefits and limitations of time series analysis techniques such as ARIMA, exponential smoothing, and machine learning models in the context of sales forecasting. By evaluating the accuracy and reliability of these techniques, as well as identifying the key challenges and limitations associated with their implementation, this study can provide practical guidance for businesses seeking to adopt time series analysis in their decision-making processes.

Furthermore, this study can contribute to the broader field of business analytics by advancing our understanding of the role of time series analysis in improving business decision-making. By developing a framework for implementing time series analysis in a business context, this study can provide a roadmap for businesses seeking to leverage this powerful technique to gain insights into customer behavior, identify market trends, and make more informed strategic decisions.

Overall, the significance of this study lies in its potential to help businesses optimize their operations, increase efficiency, and ultimately improve their bottom line by making more informed decisions based on accurate and reliable sales forecasts.

Literature Review:

Time series analysis has a long history of applications in various fields, including economics, finance, engineering, and social sciences. In recent years, the use of time series analysis has gained traction in the business world as well, as companies seek to make data-driven decisions in an increasingly competitive marketplace.

One of the key applications of time series analysis in business is forecasting. Time series models can be used to predict future values of a variable, such as sales or demand, based on past trends and patterns. This can be particularly useful for businesses that need to make decisions about production, inventory, and marketing. For example, a retail business can use time series analysis to forecast demand for a particular product and adjust its inventory levels accordingly.

Another application of time series analysis in business is anomaly detection. Time series models can be used to identify unusual or unexpected patterns in data, which can be an indication of a problem or an opportunity. For example, a sudden spike in website traffic for an e-commerce business could indicate a marketing campaign is performing well, or it could be the result of a technical glitch.

Time series analysis can also be used for trend analysis, to identify long-term patterns in data that may be useful for strategic planning. For example, a company can use time series analysis to identify long-term trends in consumer behavior or market conditions, which can inform its overall business strategy.

There are several different time series models and techniques that are commonly used in business contexts, including ARIMA models, exponential smoothing, and state space models. These models have different strengths and weaknesses, and the choice of model will depend on the specific data and business problem at hand.

One of the key challenges of time series analysis in business is data quality. Time series data can be subject to noise, outliers, and missing values, which can affect the accuracy of the models. Another challenge is selecting the appropriate time horizon for forecasting, as different business decisions may require different levels of forecasting accuracy.

In conclusion, time series analysis is a valuable tool for businesses seeking to make data-driven decisions. By using time series models to analyze historical data and make predictions about future trends and patterns, businesses can gain valuable insights into consumer behavior, market conditions, and other key factors that affect their operations. However, there are also several challenges associated with time series analysis in business, including data quality issues and selecting the appropriate time horizon for forecasting. By addressing these challenges, businesses can make more informed decisions and gain a competitive edge in the marketplace

Findings of the Study can be summarized below:

The data contains information about the daily sales of a retail store over a two-year period. The data includes information on the date, daily sales, and a number of other variables such as promotional events and holidays.

The data shows clear patterns over time, including seasonal and trend components, which makes it suitable for time series modeling.

Since, the model is showing patterns, Trends, Seasonality, affecting sales, therefore we refuse the Null Hypothesis.

ARIMA modeling was used to forecast future sales based on the historical data. The best-fit model was found by analyzing the ACF and PACF plots and evaluating the performance of different models using metrics such as AIC and BIC.

The final ARIMA model was able to accurately forecast sales for the next several months, which could be useful for business planning and decision-making.

IV. CONCLUSION

Time series modeling can be a powerful tool for businesses looking to make informed decisions about future operations. By identifying patterns and trends in the data, businesses can make better decisions about resource allocation, inventory planning, and sales projections.

ARIMA modeling is just one of many time series modeling techniques that can be used to analyze data. Other techniques, such as exponential smoothing or Prophet, may be more appropriate for different types of data or business contexts.

To make the most of time series modeling, it is important to carefully preprocess the data, select an appropriate modeling technique, and evaluate the performance of the model using appropriate metrics. This requires a solid understanding of both the data and the modeling techniques being used.

In conclusion, the application of time series modeling to business decision-making is a promising area of study, and further research in this area could help businesses make more informed decisions about their operations.

V. SUGGESTIONS

Inventory Management: With a flat sales forecast, the business can adjust its inventory levels accordingly. There may not be a need to increase or decrease inventory substantially, as the sales are expected to remain stable. This can help in optimizing the stock levels and avoiding excess inventory or stockouts.

Resource Allocation: Since the sales are expected to remain constant, the business can allocate its resources effectively. This includes human resources, marketing budgets, and operational activities. It may not be necessary to invest heavily in expanding the workforce or launching extensive marketing campaigns, but rather focus on maintaining the current level of operations efficiently.

Pricing and Promotions: If the sales forecast indicates a flat curve, it suggests that customer demand is relatively stable. The business can adjust its pricing strategy accordingly, considering factors such as competition, cost structure, and profit margins. Moreover, promotional activities can be tailored to maintain customer loyalty and sustain the current sales levels rather than aggressively seeking growth.

Expansion and Investment Decisions: A flat sales forecast might influence the decisions related to business expansion or investment in new markets. It may indicate that the current market saturation level has been reached, and further expansion efforts may not yield significant returns. The business can focus on optimizing existing operations rather than pursuing aggressive expansion strategies.

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