PROJECT PROPOSAL
TIME SERIES ANALYSIS OF CUSTOMER INTERACTION PATTERNS IN RETAIL ENVIRONMENTS

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Introduction

Project Overview

This project aims to conduct a time series analysis of customer interactions in retail spaces to identify patterns and peak engagement hours. By understanding when and how customers interact in-store, retailers can optimize staffing, improve customer experiences, and make data-driven decisions about promotions and layout.

Significance

Retailers increasingly need to understand customer patterns to remain competitive. This analysis will provide insights into customer behaviour, offering actionable intelligence for better operational planning, tailored marketing campaigns, and enhancing in-store experiences. By predicting busy periods, stores can effectively adjust resources and promotions, aligning with customer demand.

Background and Significance

Retail Industry Challenges

In today's competitive landscape, brick-and-mortar stores face challenges from online shopping, requiring deeper insights into in-store customer behaviour to differentiate themselves. Analysing foot traffic and customer interaction data is essential for strategic decision-making and effective resource allocation.

Role of Customer Interaction Analysis

Retailers benefit significantly from understanding the timing, frequency, and nature of customer interactions. Such data allows for better decision-making regarding store operations, marketing timing, and staff scheduling. Peak hour identification helps in allocating adequate resources during high foot traffic, ensuring better customer service and potentially increasing sales.

Literature Review

Previous Research

Studies in retail analytics indicate the importance of understanding foot traffic patterns. Research shows that high-engagement hours often align with peak sales periods, allowing retailers to make data-driven decisions to capitalize on these times. Common methods include time series forecasting models and consumer behaviour analysis.

Theoretical Foundation

This analysis will rely on time series analysis and consumer behaviour theory. Time series models such as ARIMA are widely used to analyse temporal data in retail and predict future trends. Additionally, theories in consumer behaviour suggest that

customers' engagement with stores often correlates with broader social patterns, such as holidays, seasons, and weekly routines.

Research Gaps

While there are numerous studies on retail analytics, few focus on fine-grained, time-based analyses of customer interactions. This project will address this gap by examining interaction data in high temporal resolution, providing a detailed view of customer behaviour in-store.

Research Design and Methods

Data Collection

Shopper Interaction Dataset

This dataset includes images of individual that comes to different sections of the store.

Shopper Interaction Dataset

This dataset includes information on individual and group interactions, dwell time, and movement patterns within the store. It captures data on when customers enter, how long they stay, and the frequency of their interactions with different sections of the store.

Data Preprocessing

Preprocessing will include cleaning missing values, filtering outliers, and aggregating data by time intervals (e.g., hourly or daily summaries). Additional steps will include normalization for consistent scaling and feature engineering to extract interaction characteristics like average dwell time per visit or hourly foot traffic peaks.

Time Series Modelling

Models such as ARIMA will be applied to analyse time-dependent patterns in the data. Each model will be evaluated based on accuracy metrics like Mean Absolute Error (MAE) or Root Mean Square Error (RMSE).

We will compare model performance to select the most accurate method for predicting customer interaction trends.

Preliminary Suppositions and Implementations

Hypotheses

Peak Hour Hypothesis

It is hypothesized that customer interactions are highest during weekends and evenings.

Seasonal Impact Hypothesis

Seasonal events, like holiday seasons or special promotions, are likely to impact traffic and customer engagement within the store.

Sales Correlation Hypothesis

Increased customer interactions are expected to positively correlate with sales volume, suggesting that traffic analysis can act as a sales performance indicator.

Preliminary Implementation

Initial Analysis

As a first step, we will visualize traffic and interaction data over time, identifying any immediate trends or outliers.

Model Setup

We will prepare the data for time series modelling and test preliminary model fits to observe predictive performance.

Data Interpretation

Preliminary findings, such as consistent peak hours or days, will guide further investigation.

Conclusions

Expected Outcomes

The analysis is expected to reveal peak engagement hours, which will help in resource allocation and staff scheduling. The insights into traffic patterns can also inform decisions on optimal times for in-store promotions, enhancing customer experience.

Applications

The findings can be applied to various aspects of retail management, from optimizing staff schedules to aligning marketing campaigns with peak engagement times. Additionally, they could support long-term planning by understanding seasonal fluctuations in customer behaviour.

References

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