

Walmart Sales Forecasting & BI Dashboard Report

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Author— Aditya Dutta
Python, Jupyter, Power BI

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Business Questions & hypothesis

1. What long-term sales patterns exist across Walmart stores?

Hypothesis: Weekly sales may display recurring seasonal patterns, but the extent and consistency of these patterns need to be validated.

2. How much do major retail holidays affect Walmart's weekly sales?

Hypothesis: Holidays likely contribute to sales spikes, but the magnitude and duration of the impact may differ between holidays.

3. Are all markdown promotion types equally effective in driving sales?

Hypothesis: Some markdown categories may contribute more significantly to weekly sales than others, depending on product type and timing.

4. Can time series forecasting provide Walmart with reliable short-term sales projections?

Hypothesis: Incorporating seasonality into forecasting models may improve forecast accuracy, but performance will need to be evaluated against actual sales trends.

5. Do sales drop immediately after major holiday peaks?

Hypothesis: Sales likely experience a temporary decline immediately following major holiday peaks, as consumers reduce spending after completing large holiday purchases.

Approach & Technical Challenges

1. Dataset sourced from Kaggle Walmart Recruiting - Store Sales Forecasting competition.
2. Cleaning steps:
 - Missing values handled for Markdown1-5 fields
 - Holidays merged into main dataset
 - Weekly sales aggregated across all stores & departments for forecasting
3. Technical challenges addressed:
 - Sparse markdown data
 - Handling aggregation mismatch between historical and forecasted sales
 - Designing DAX measures for Power BI to handle zeros
 - Avoiding aggregation distortion when integrating forecasted data into BI dashboard

Dataset Description

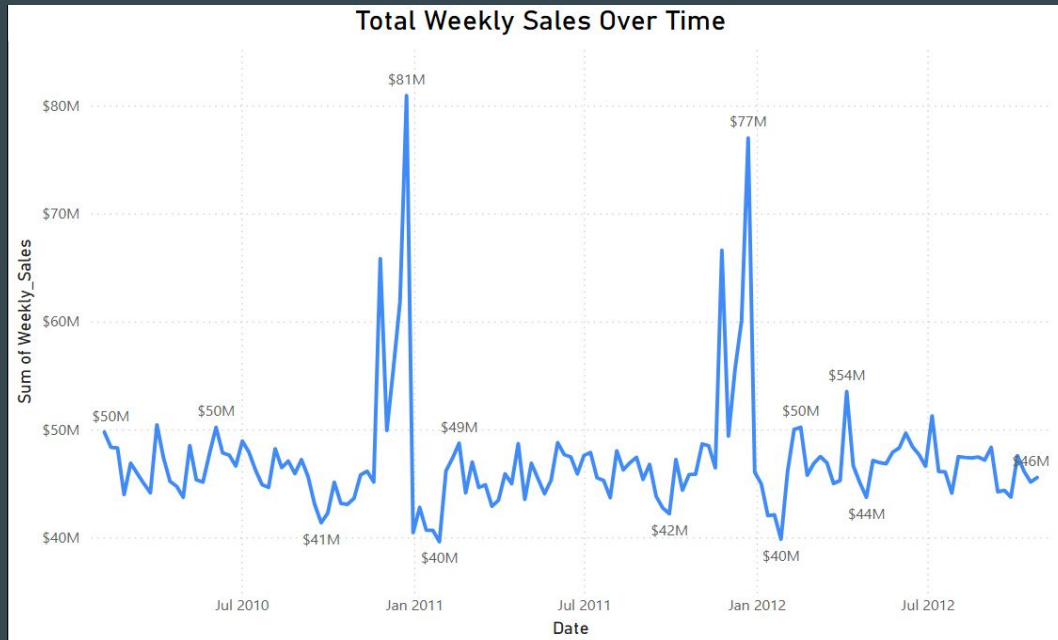
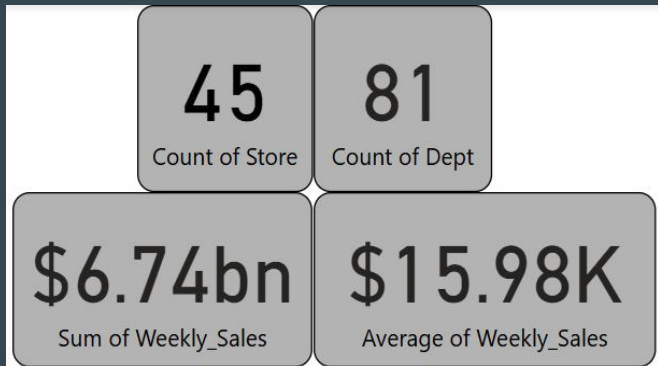
1. Dataset sourced from Kaggle Walmart Recruiting - Store Sales Forecasting competition.
2. Contains weekly sales data for multiple Walmart stores and departments across the United States.
3. Dataset includes the following key fields: Date, Store, Dept, Weekly_Sales, IsHoliday, Markdown1 to Markdown5, Store Type, and Store Size.
4. Data cleaning involved handling missing values, merging holiday calendars, and preparing features for exploratory analysis and forecasting.

Data Cleaning & Preparation

1. Missing values present in the Markdown1 to Markdown5 fields were handled by imputing or excluding during analysis depending on sparsity.
2. Holiday data was merged with the main dataset to classify each week as holiday or non-holiday, and map specific holidays (Christmas, Thanksgiving, Super Bowl, Labor Day).
3. Weekly sales data was aggregated across all stores and departments for forecasting purposes to align scope between historical and forecast periods.
4. Features were engineered for seasonality analysis and time series modeling, including date-based features and grouping by week.

Q1: Walmart Weekly Sales Trends

Aggregate total weekly sales across all stores and departments to identify overall seasonality and trend patterns.



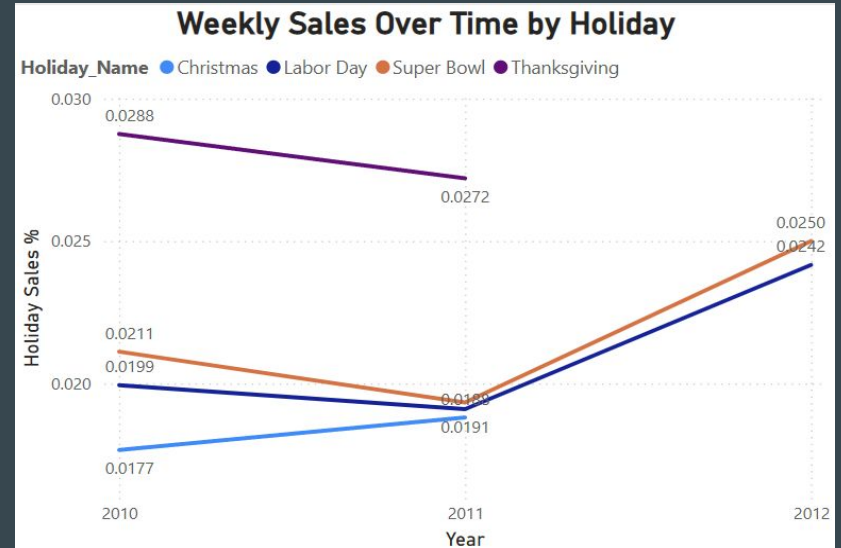
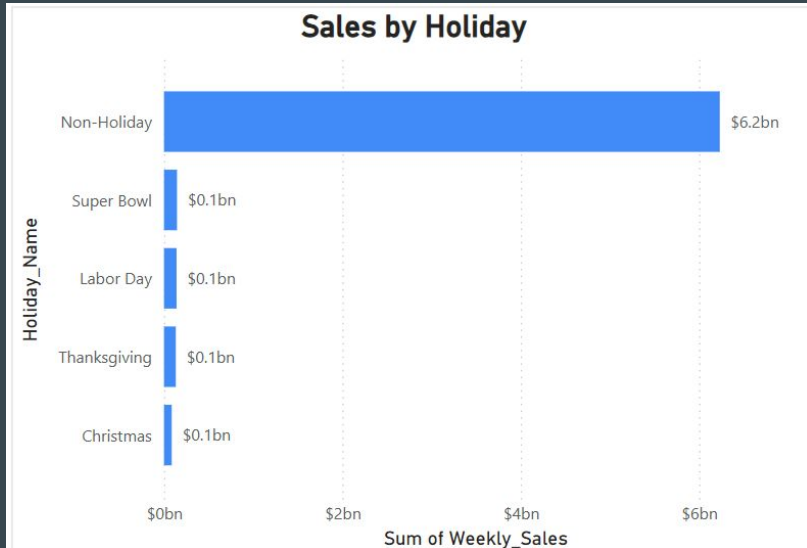
Key Findings :

- Total sales: approximately \$6.7 billion during the dataset period.
- Average weekly sales: \$47 million.
- Sales show strong seasonality with peaks roughly every 50-52 weeks.
- Sales cycles align with US retail calendar events.
- No significant long-term upward or downward sales trend during dataset period — mostly stable cyclical behavior.

Q2: Holiday Impact on Sales

Question: How much do major retail holidays affect Walmart's weekly sales?

Approach: Categorize weeks by holiday type (Christmas, Thanksgiving, Labor Day, Super Bowl, Non-Holiday). Analyze weekly sales grouped by holiday category.



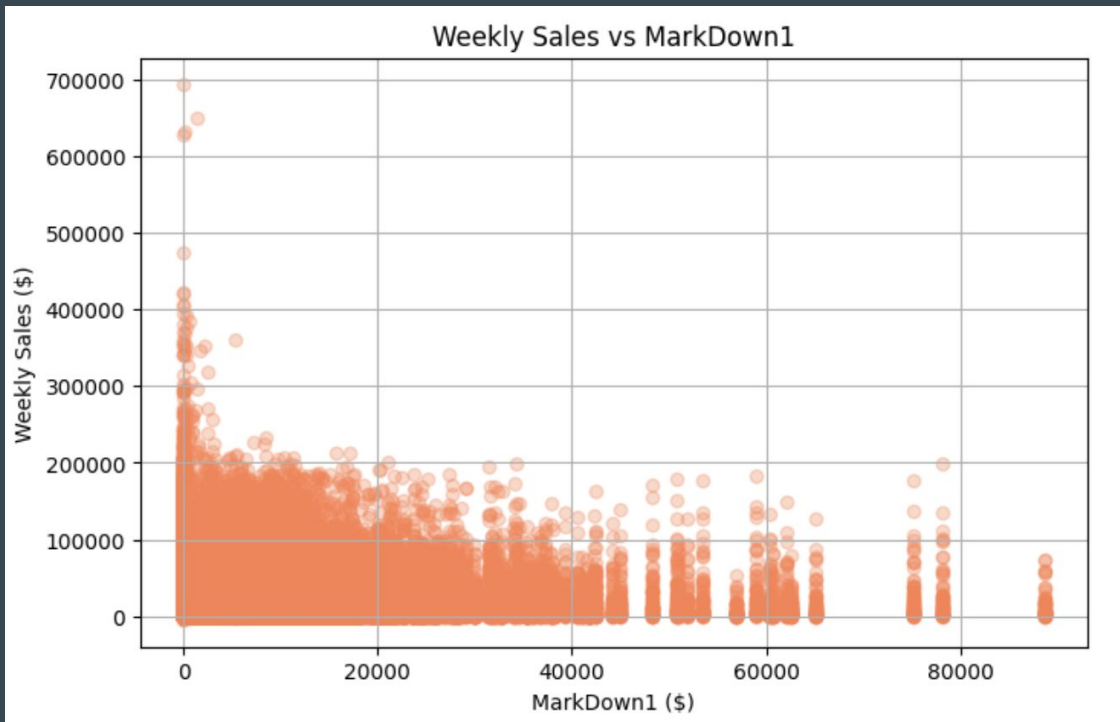
Key Findings :

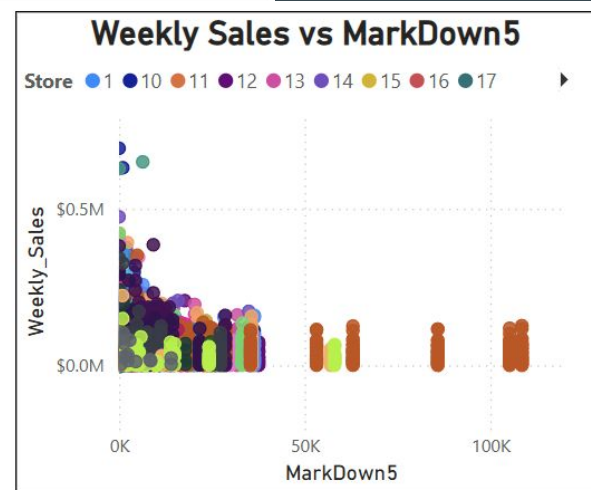
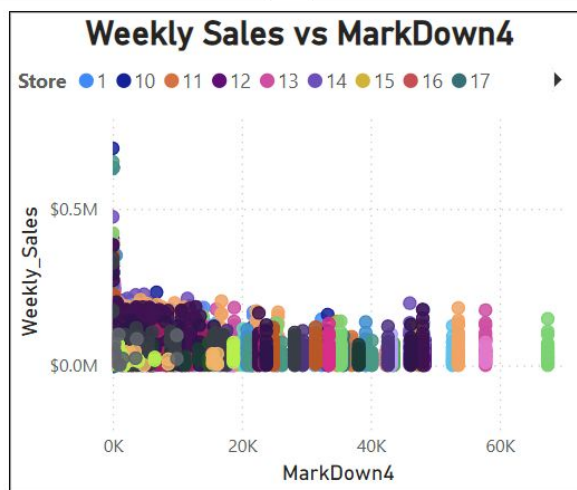
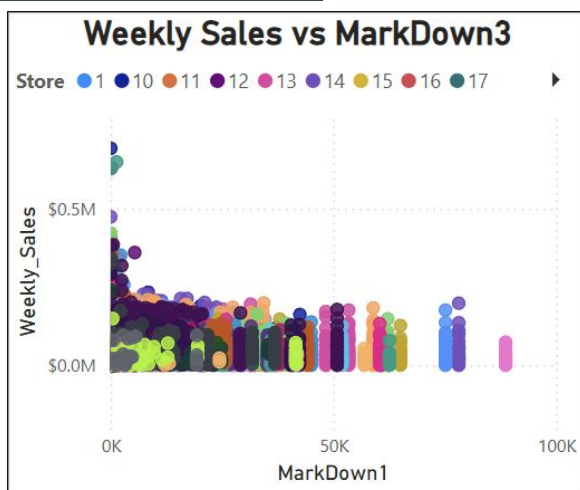
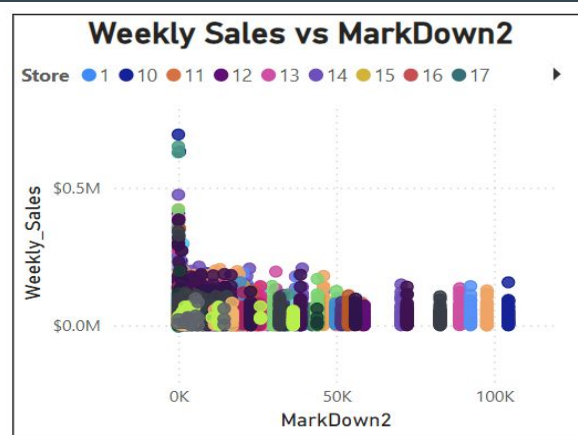
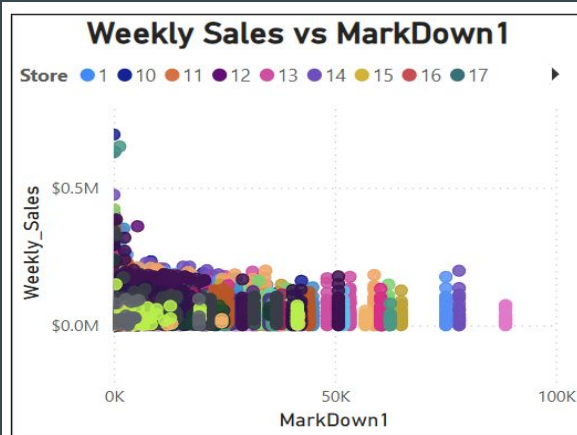
- Christmas generates the highest weekly sales spikes.
- Thanksgiving and Super Bowl also produce strong but smaller increases.
- Labor Day shows moderate uplift.
- Non-Holiday weeks still represent the majority of total sales volume.
- Holiday-driven peaks strongly reinforce Walmart's seasonal sales cycles.

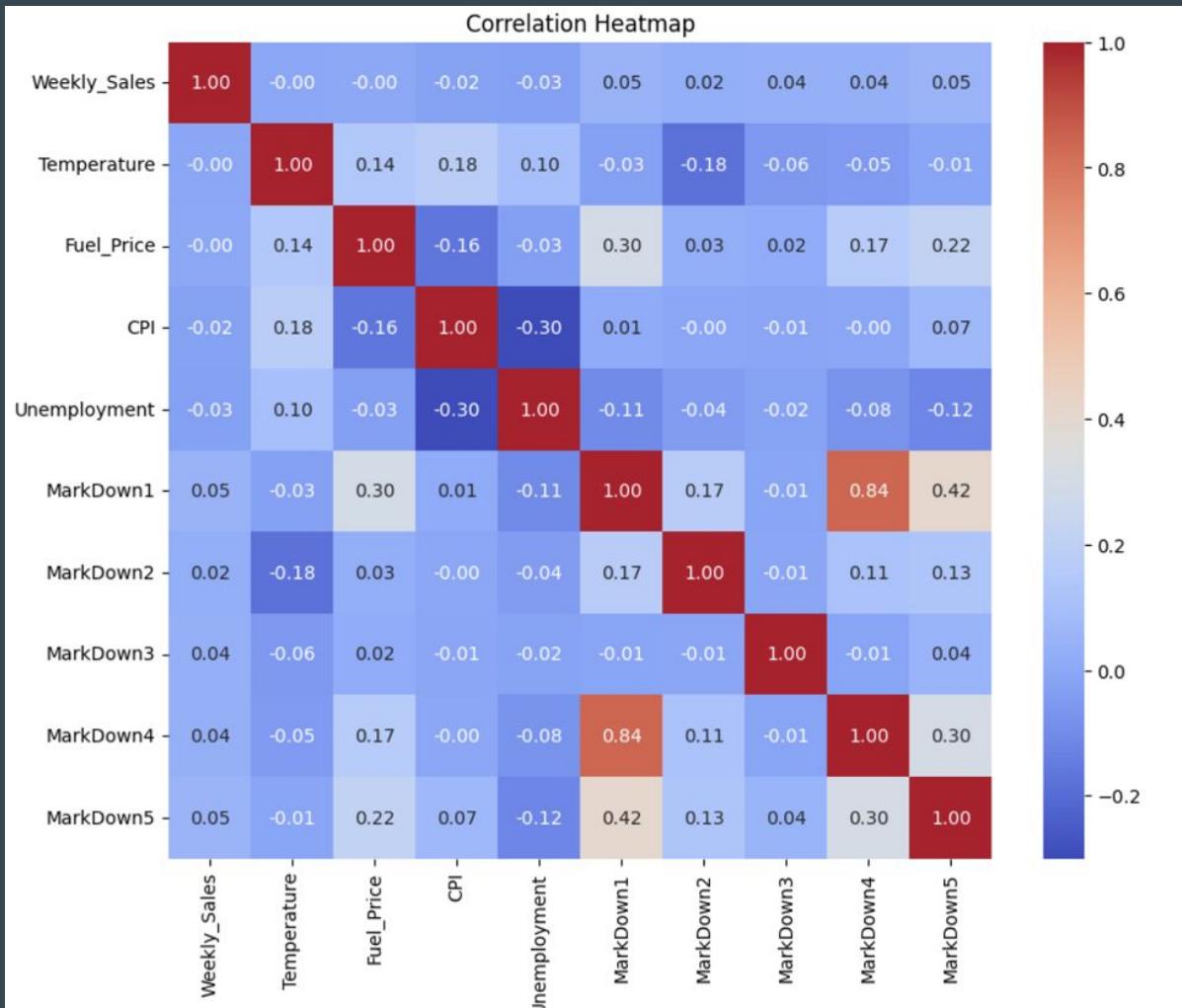
Q3: Markdown Promotion Effectiveness

Question: Are all markdown promotion types equally effective in driving sales?

Approach: Analyze correlation between Weekly_Sales and Markdown1 to Markdown5 fields. Visualize using scatterplots to explore relationships.







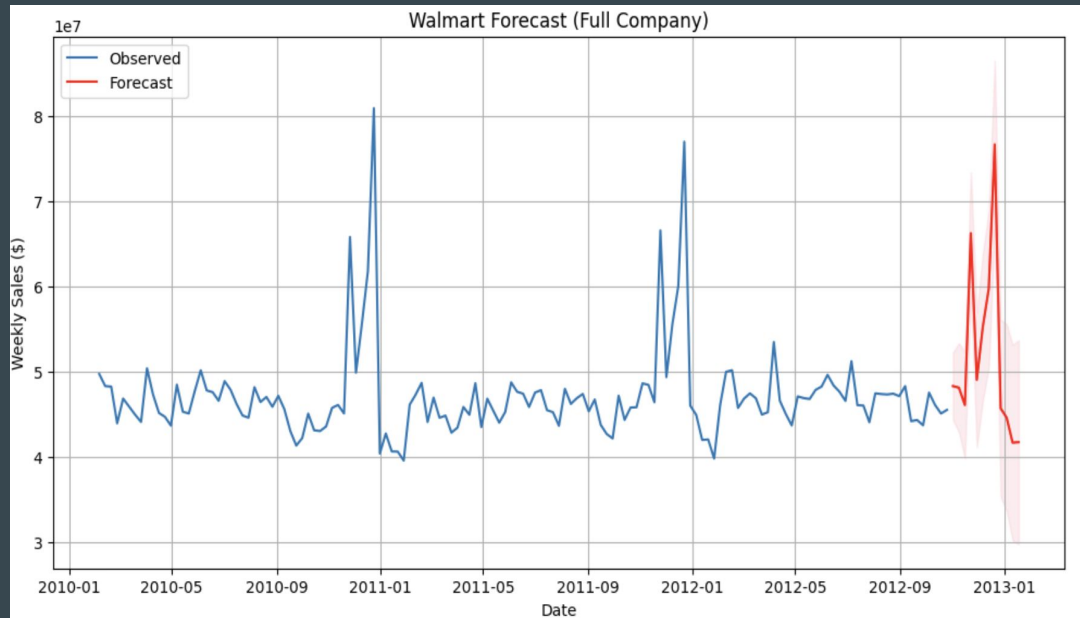
Key Findings:

- Markdown5 shows strongest positive correlation with Weekly_Sales.
- Markdown1 contributes moderately to sales increases.
- Markdown2, Markdown3, Markdown4 show low or no meaningful correlation.
- Promotions need to be targeted; not all markdowns have equal sales impact.

Q4: Sales Forecasting

Question: Can time series forecasting provide Walmart with reliable short-term sales projections?

Approach: Aggregate total weekly sales for all stores and departments. Fit SARIMAX $(0,1,1)(0,1,0,52)$ model to forecast 12 weeks ahead, incorporating seasonality.

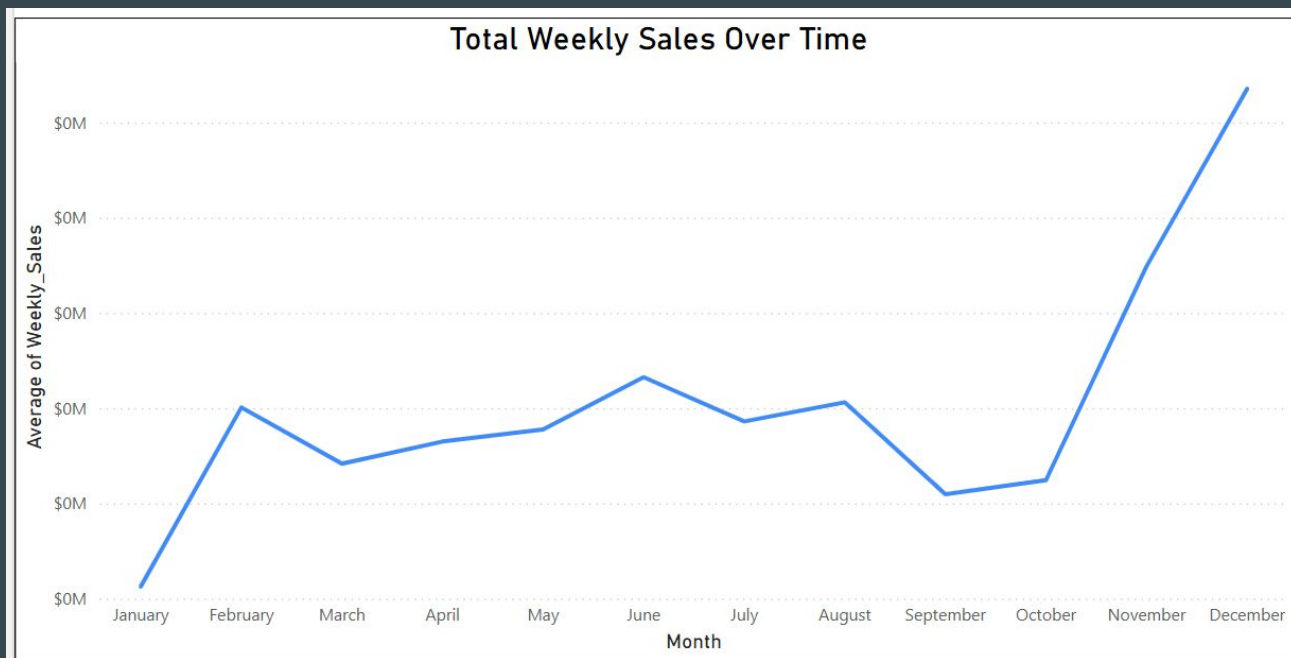


Key Findings :

- SARIMAX model successfully captured strong weekly seasonality patterns.
- Forecast projects stable sales continuation with expected weekly fluctuations.
- Confidence intervals widen slightly further into forecast horizon, indicating increasing uncertainty.
- Forecasting model aligns well with historical sales behavior.

Deeper Analysis: Monthly Sales Patterns

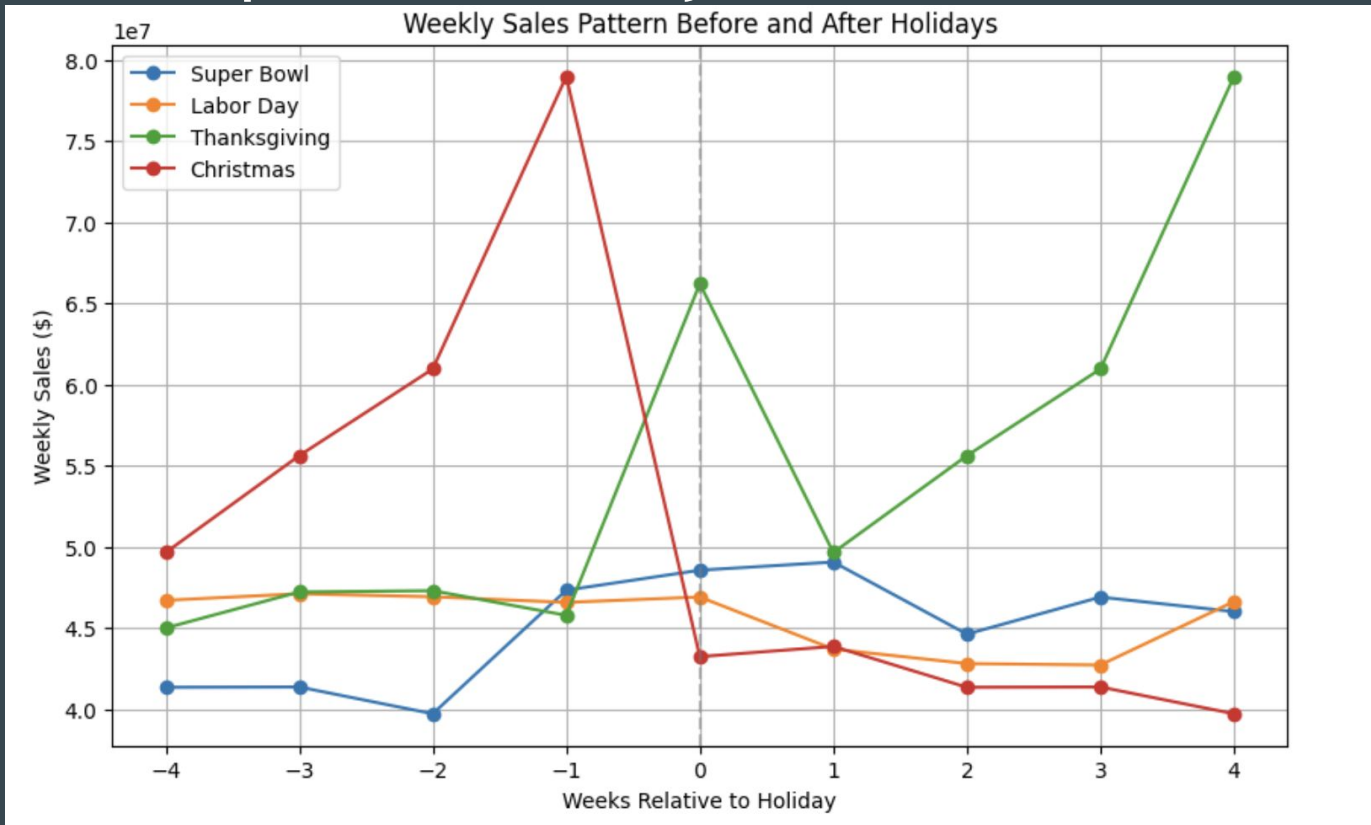
Approach: Aggregate total sales by calendar month across all years to visualize seasonality at a monthly level.



Key Findings:

- November and December account for significant sales uplift.
- Summer months (June - August) have slightly lower average sales.
- Monthly sales patterns further confirm seasonality observed in weekly trends.

Q5. Sales drop after holiday week?



Key Findings:

- Christmas and Thanksgiving show steep sales drops immediately after the peak week.
- Super Bowl shows smaller post-holiday dip.
- Post-holiday demand softens as consumers reduce spending right after high retail activity.
- Useful for inventory planning and post-holiday markdown strategies.

Summary of Key Findings:

1. Walmart's weekly sales demonstrate strong seasonality, with repeating yearly patterns driven by the retail calendar.
2. Non-holiday weeks account for the majority of total sales due to their frequency, while holidays create sharp sales spikes, especially Christmas and Thanksgiving.
3. Among markdown promotions, MarkDown5 shows the strongest positive impact on weekly sales, while others have limited influence.
4. SARIMAX forecasting model successfully projected short-term sales trends by capturing seasonality and generating stable 12-week forecasts.
5. Christmas and Thanksgiving show steep sales drops immediately after the peak week.