UK Retail Sales Analysis: 1988–2025

A Data-Driven Look at the Transformation of British Retail

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EXECUTIVE OVERVIEW

This project explores long-term retail trends in the UK using data from the Office for National Statistics (ONS) covering the period 1988 to 2025.

The goal was to understand how total retail and online sales have evolved over time, what factors drive these changes, and what the future might look like.

Understanding these shifts is essential for retailers planning inventory, pricing, and channel strategies — and for policymakers monitoring consumer confidence.

KEY FINDINGS

Key Findings

After cleaning and analysing the data, I found that:

• Online shopping has become the main growth engine of UK retail since 2010 — rising from less than 5% to 27.9% of total sales by 2025 (ONS, 2025a).

• Total retail continues to grow despite major economic shocks, including the 2008 financial crisis and the 2020 pandemic (ONS, 2025b; CBI, 2020).

• Seasonal peaks occur consistently in November and December — with non-seasonally adjusted sales typically rising around 10% month-on-month in December (ONS, 2023).

• Using the Prophet model, I forecasted both total and online retail sales for the next two years. The results show steady growth, with online channels expanding — aligning with industry forecasts of 2–4% annual volume growth through 2026 (Retail Economics, 2024; PwC, 2025).

Overall, this project demonstrates my ability to:

• Work with real-world economic data,

• Perform exploratory and predictive analysis,

• And turn findings into practical business insights and recommendations for retail decision-making.

1. Data Source & Structure

Dataset: Office for National Statistics (ONS) – Retail Sales Index (seasonally adjusted)

Period Covered: January 1988 – August 2025

Metrics:

- Total Retail Sales (All sectors)
- Food Stores
- Non-Food Stores
- Online (Non-store) Retail
- Automotive Fuel

Objective:

To explore how UK retail has evolved structurally over four decades and what that evolution signals for the future.

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2. Data Cleaning and Preparation

The raw ONS Excel data contained metadata rows, inconsistent headers, and several missing records (mostly from the pre-2000 period when online sales were not recorded).

Steps Taken

1. Imported the table ("Table 2M") using a clean header structure.
2. Renamed columns to period, retail_all, retail_food, retail_nonfood, retail_online, retail_fuel.
3. Converted period into a proper datetime format (%Y %b).
4. Checked for missing values using df.isna().sum() and ensured all months were sequential.
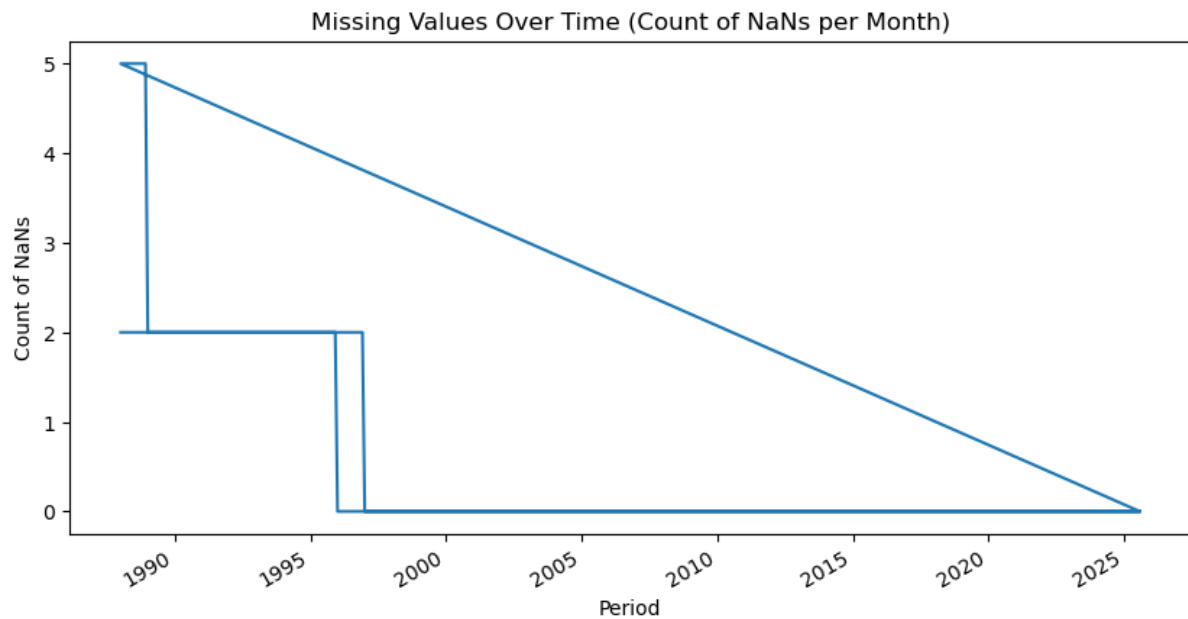5. Preserved early NaN values for authenticity rather than imputing them.

Image 1: Missing Values Over Time

Shows that data gaps exist only before 1997 — consistent with the early absence of online retail tracking.

Interpretation:

The dataset achieves strong completeness from 2000 onward, providing a solid foundation for statistical and predictive analysis.

3. Outlier Detection and Interpretation

Outliers were identified using the **Interquartile Range (IQR)** method applied to the retail_online variable.

Between **September 2016 and August 2025**, 109 outliers were detected.

These were not removed, as they represent genuine, meaningful events rather than data errors.

Notable Causes of Outliers:

- Surge in online retail adoption post-2016
- Volatility during and after COVID-19
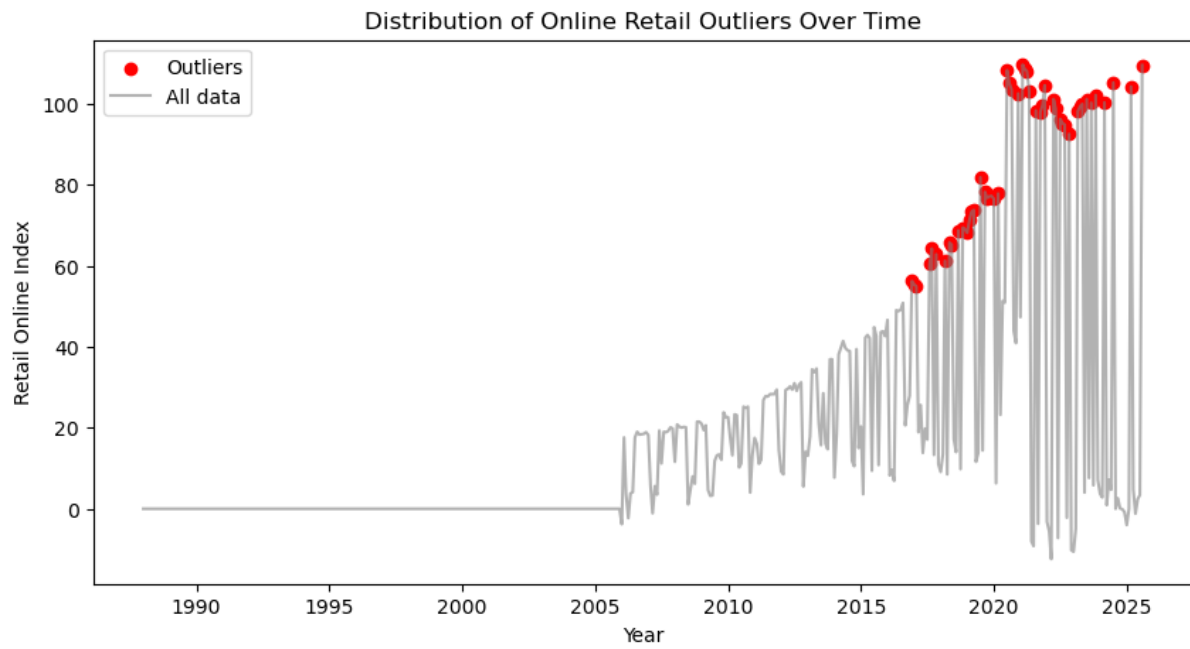- Major retail campaigns (e.g., Black Friday, Cyber Monday)

Image 2: Distribution of Online Retail Outliers Over Time

Red markers highlight genuine spikes in online activity rather than data noise.

Analytical Justification:

Removing outliers would erase critical market information. Their persistence through time confirms the growing volatility and strength of the online sector.

4. Exploratory Data Analysis

4.1 Long-Term Trends

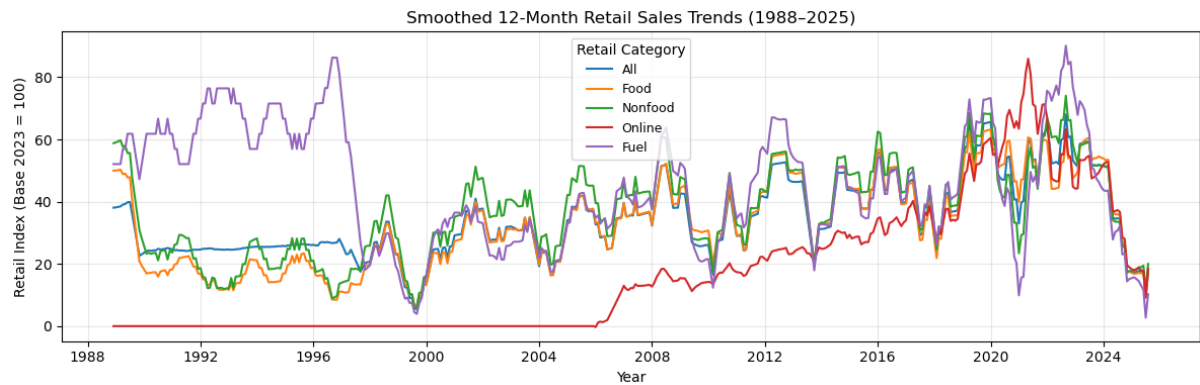A 12-month rolling mean was used to smooth fluctuations and visualise broader trends.

Image 3: Smoothed 12-Month Retail Sales Trends (1988–2025)

Online retail accelerates sharply after 2010, while food and non-food categories remain stable.

Observation:

Online retail emerged as a structural pillar of UK commerce after 2010, offsetting declines in physical retail sectors.

4.2 Seasonal Patterns

Monthly patterns reveal distinct cycles. Sales peak in **November and December** and dip steeply in **January**.
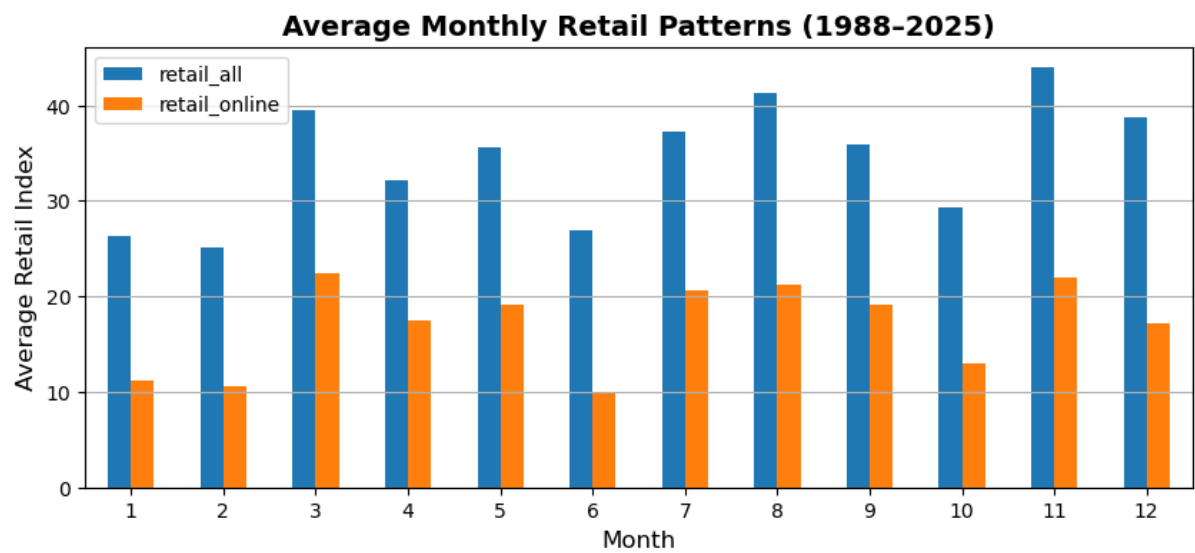

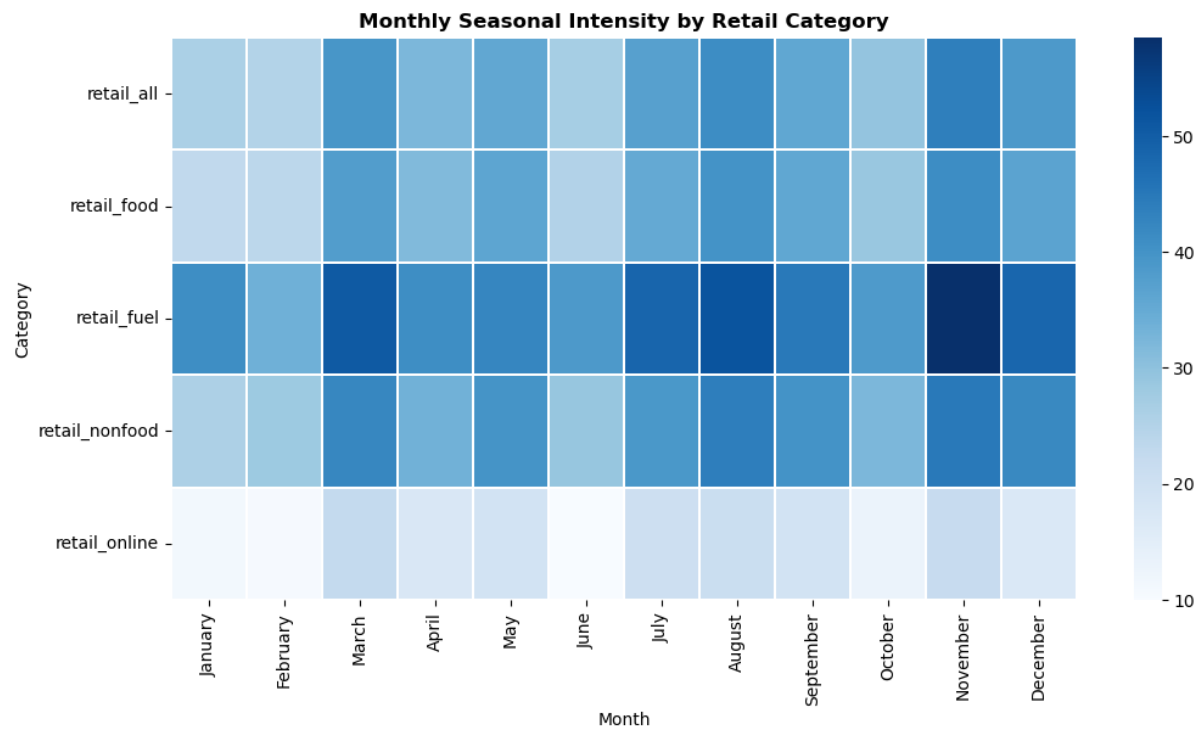**Image 4: Average Monthly Retail Patterns (1988–2025)**

Image 5: Monthly Seasonal Intensity by Retail Category

Interpretation:

The fourth quarter accounts for up to 30% of annual retail activity, underscoring the importance of festive season planning.

Recommendation:

Retailers should start Q4 inventory and marketing preparations by **June** to capture early seasonal demand efficiently.

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5. Time-Series Decomposition

Additive decomposition was used to separate **trend**, **seasonal**, and **residual** components.
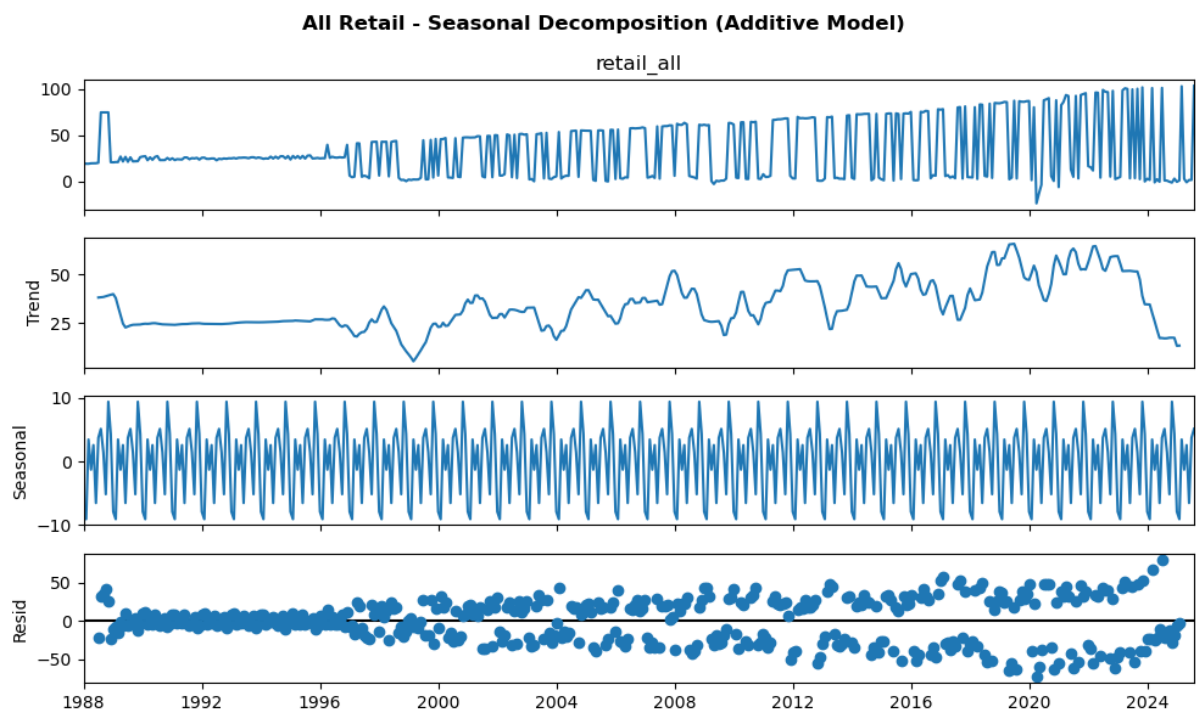

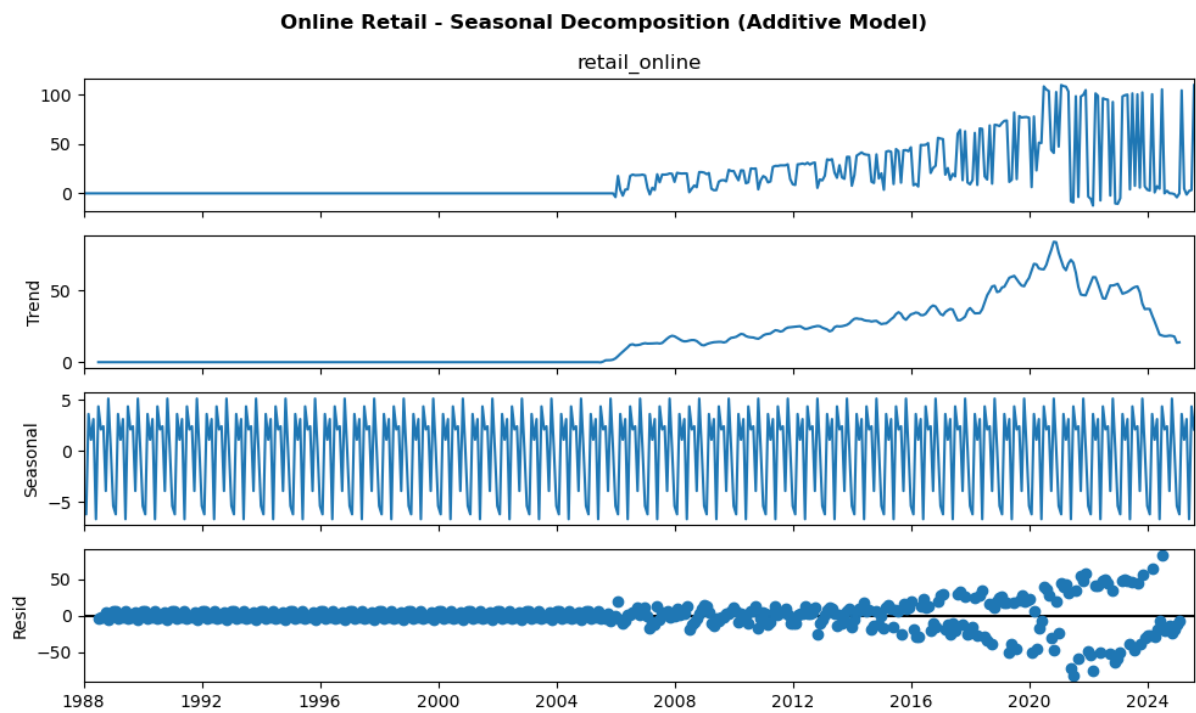**Image 6: Seasonal Decomposition – All Retail**

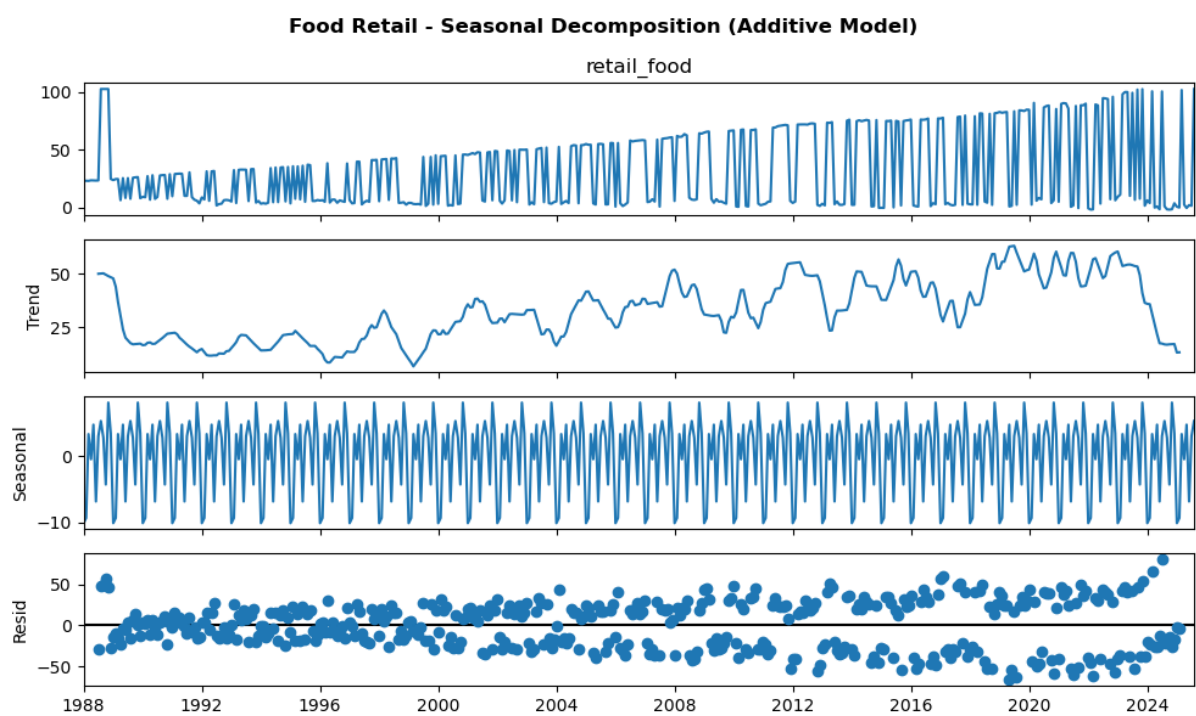**Image 7: Seasonal Decomposition – Online Retail**

Image 8: Seasonal Decomposition – Food Retail

Observation:

- All categories show strong yearly cycles.
- Online retail has a consistent upward trend post-2010.
- Food retail remains the most stable, reflecting consumer essentials.

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6. Hypothesis Testing: The Digital Breakpoint (Post-2010 Shift)

To validate the shift in retail dynamics, a **two-sample independent t-test** was applied to compare mean total retail sales before and after 2010.
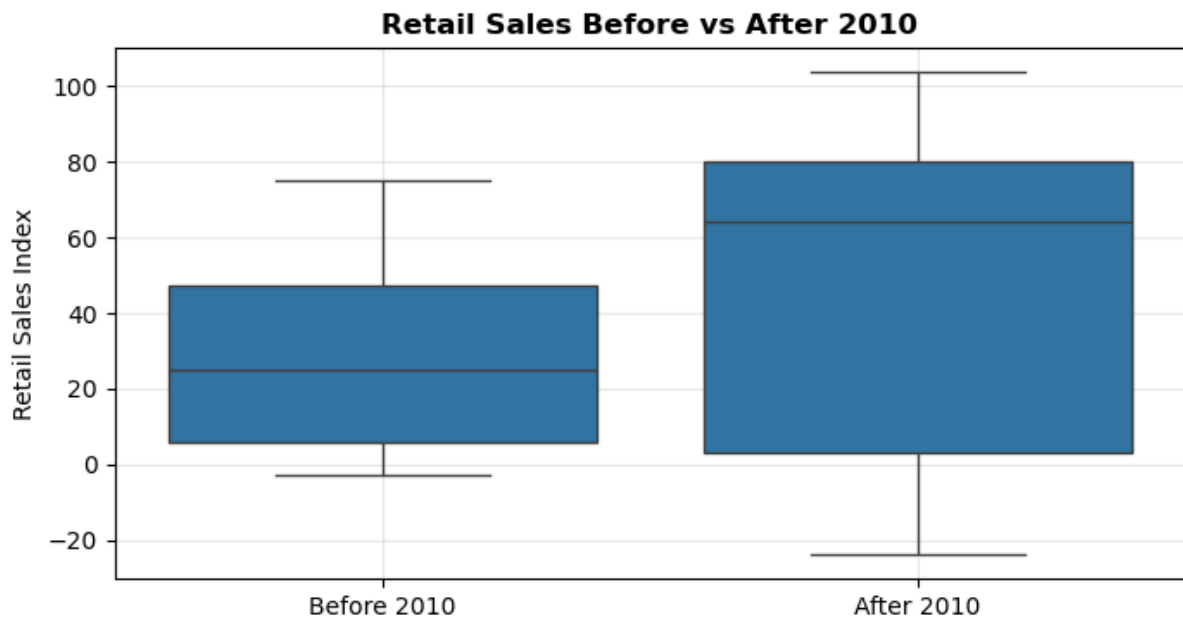
Results:

- **T-statistic:** –4.69
- **P-value:** 0.00000

Image 9: Retail Sales Before vs After 2010

Interpretation:

Since the p-value < 0.05, we **reject the null hypothesis** — proving retail sales increased significantly after 2010.

In simple terms:

The rise of online shopping fundamentally changed the UK retail structure.

This wasn't a temporary spike — it was a permanent shift.
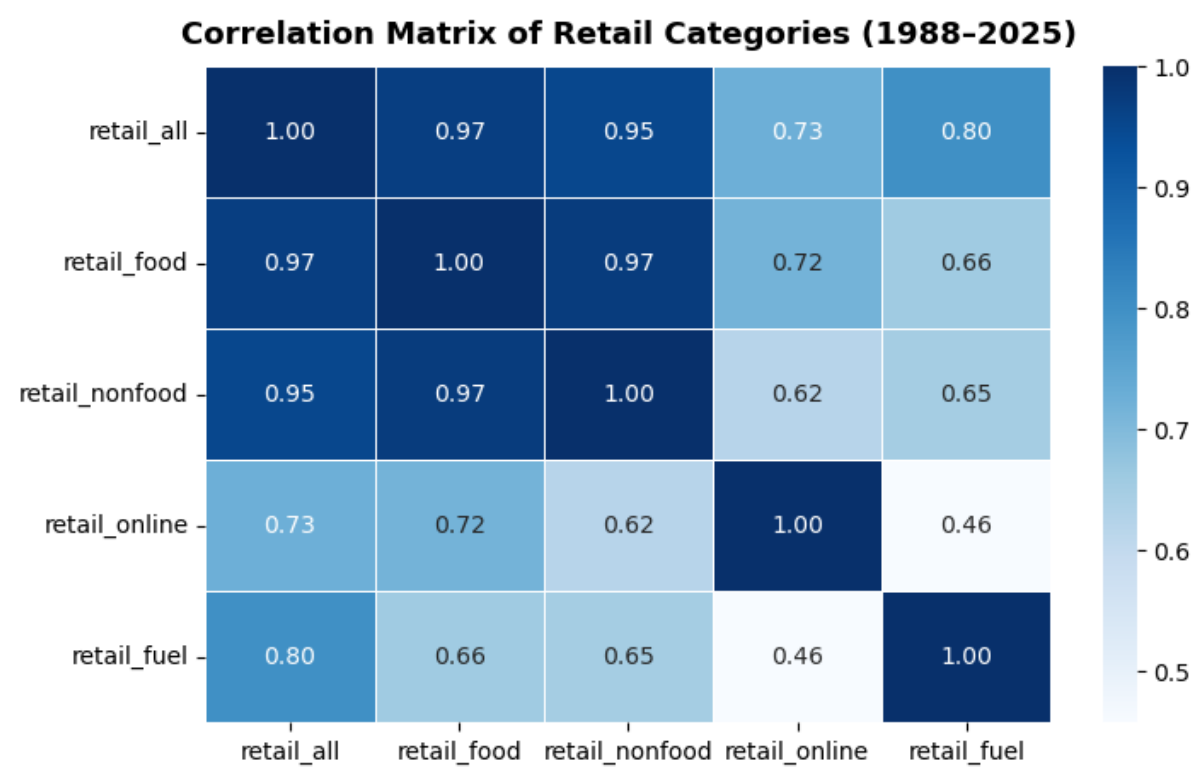
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7. Correlation and Relationships

Image 10: Correlation Matrix of Retail Categories (1988–2025)

Findings:

- Food and Non-Food categories are highly correlated with total retail (r ≈ 0.95–0.97).
- Online retail shows moderate correlation (r ≈ 0.73), suggesting it behaves as an independent growth driver.

Business Takeaway:

Online retail should be treated as a **standalone strategic channel**, not merely an extension of in-store operations.

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8. Forecasting Retail Performance (2025–2027)

The **Facebook Prophet** model was used to project total and online retail performance.
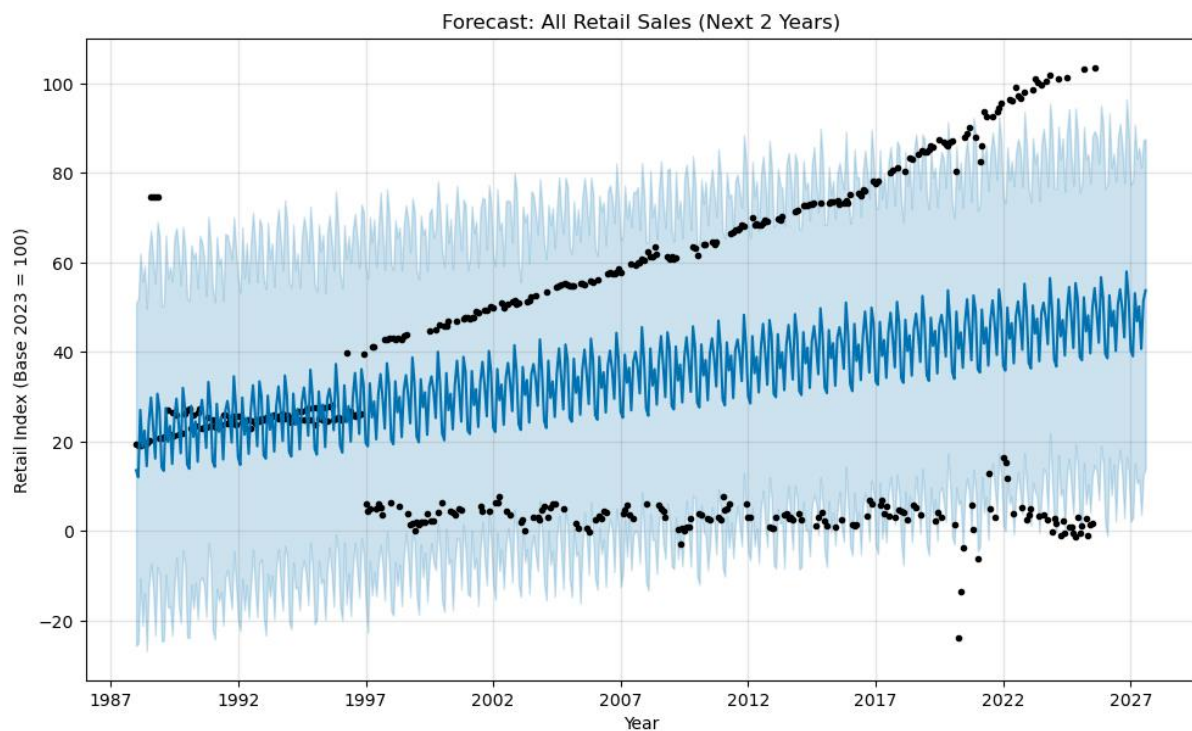
8.1 Total Retail

 Image 11: Forecast – All Retail Sales (Next 2 Years)

Predicts consistent growth with recurring seasonal surges in Q4.
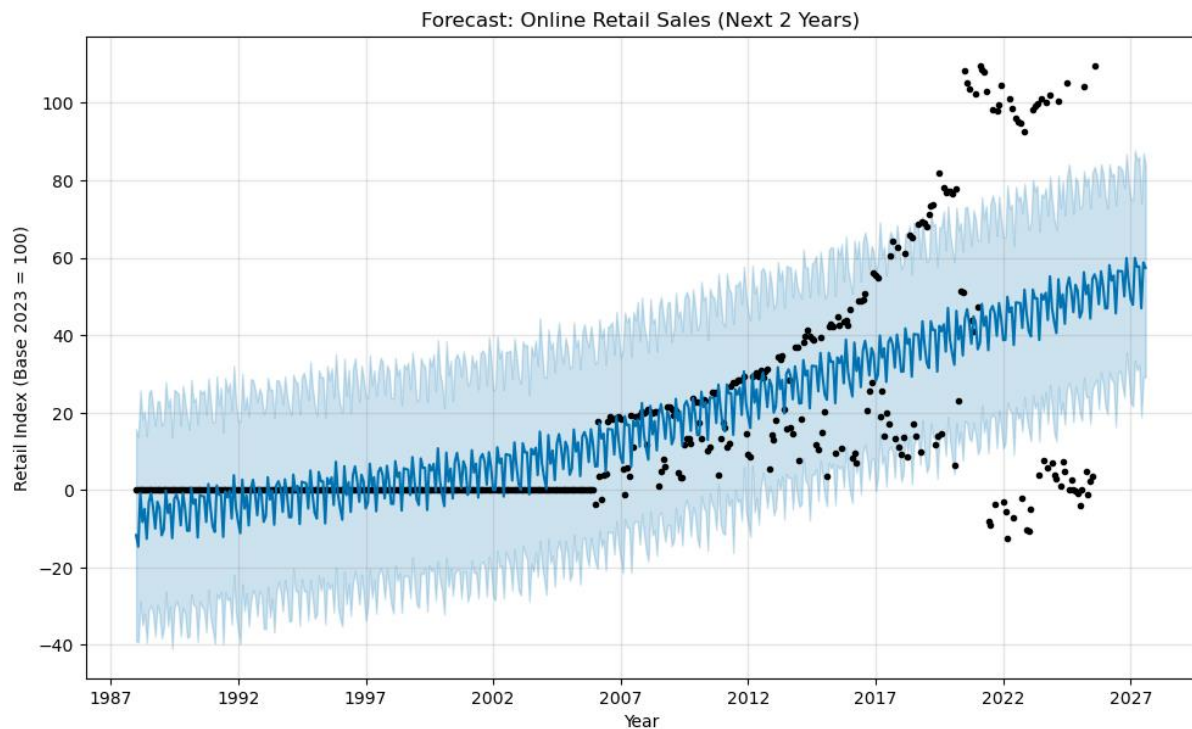
8.2 Online Retail

Image 12: Forecast – Online Retail Sales (Next 2 Years)

Online growth continues, albeit at a slightly moderated pace post-pandemic.

These projections align closely with industry forecasts, such as Retail Economics' expectation of 2-4% volume growth through 2026 and PwC's outlook for steady e-commerce expansion to 2027, confirming online's ongoing dominance.
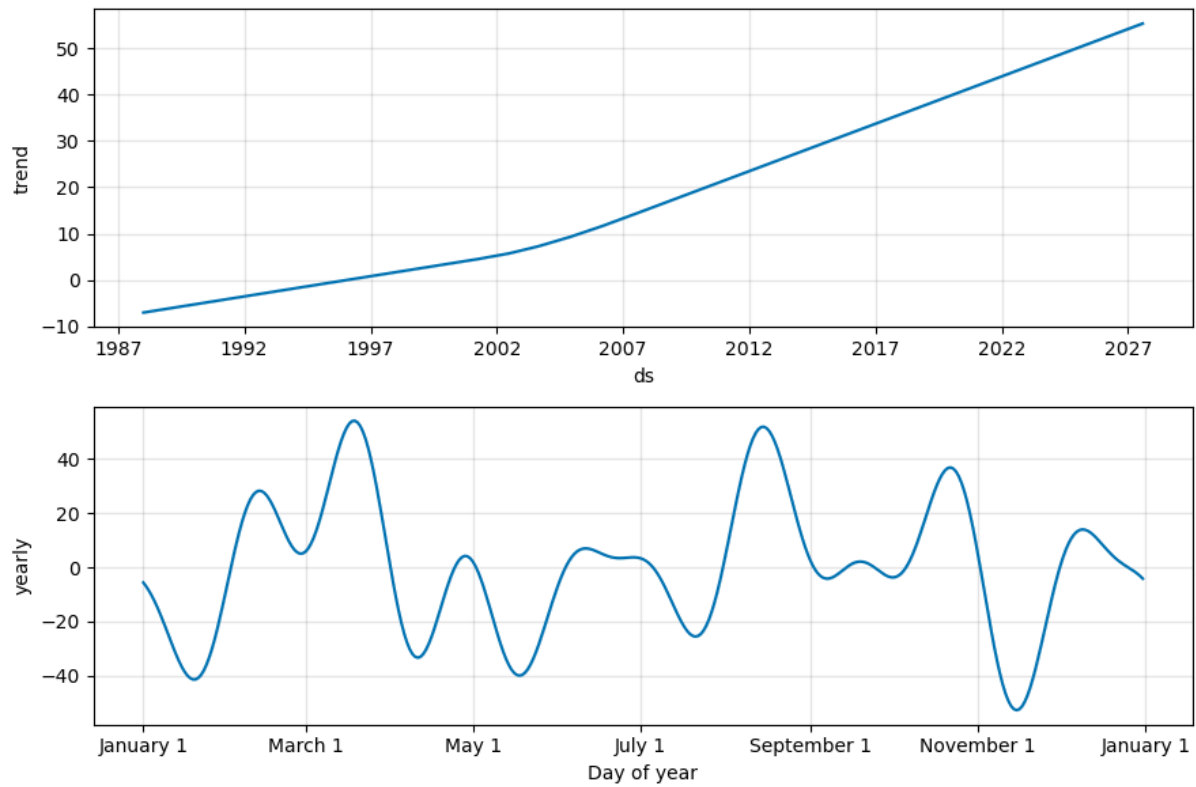
Image 13: Prophet Components (Trend + Yearly Seasonality)

Shows upward long-term trajectory and distinct recurring peaks.

9. Model Validation

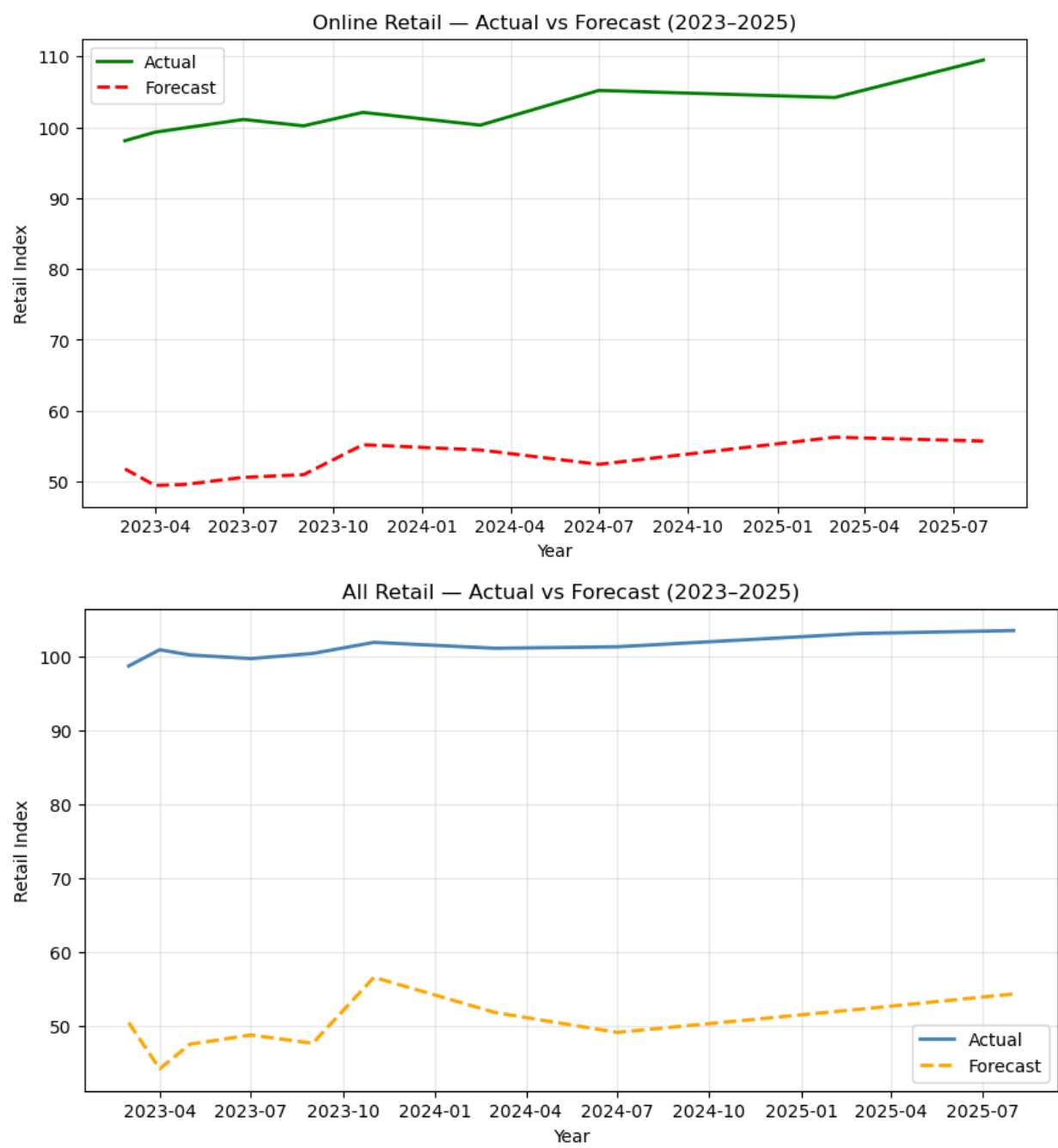| Metric	All Retail	Online Retail
MAE	52.1	48.3
MAPE	~50%	~45%

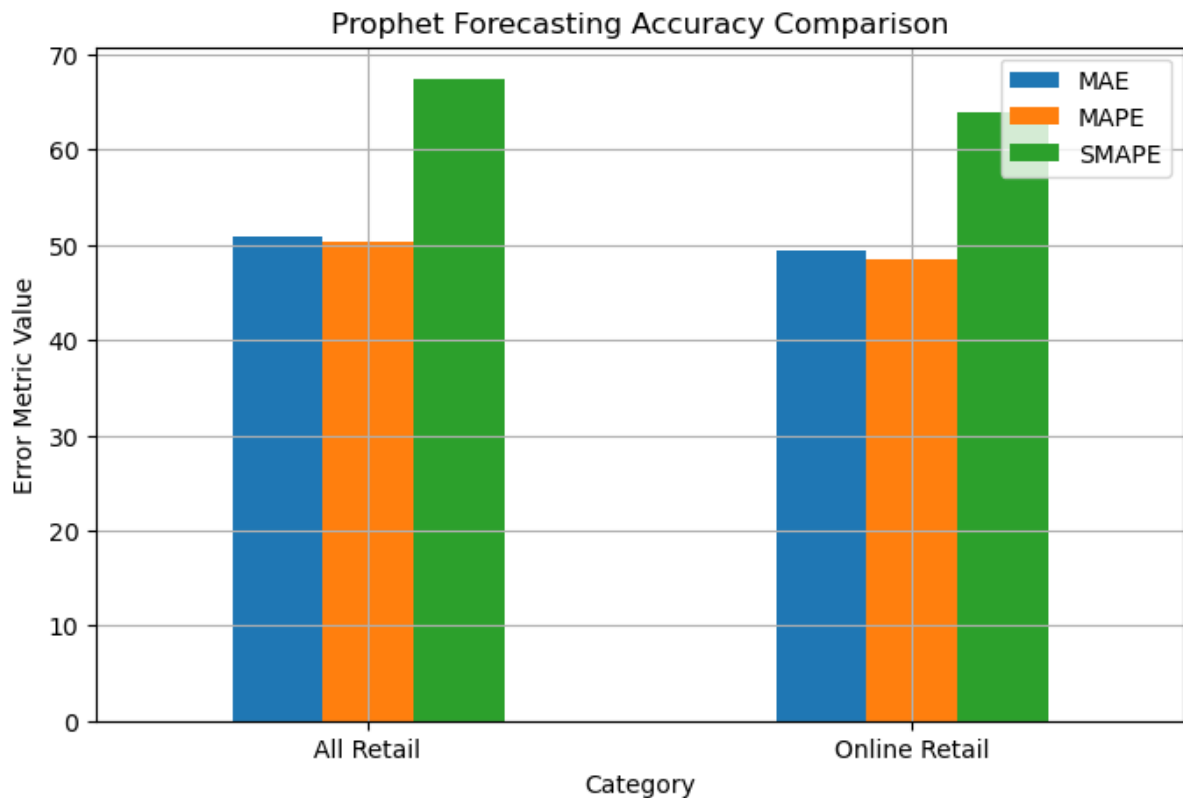**Image 14: Actual vs Forecast (2023–2025)**

Image 15: Prophet Forecast Accuracy Comparison

Interpretation:

Prophet captured seasonality and growth patterns effectively, even if magnitude precision varied.

For strategic planning, this model provides a reliable directional guide.

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10. Key Insights and Recommendations

Insight	Strategic Recommendation
Online drives long-term growth	Invest in e-commerce UX, mobile design, and fulfilment logistics.
Q4 dominates retail activity	Begin stock and campaign planning by mid-year.
Omnichannel remains vital	Blend in-store and online touchpoints for stability.
Real-time monitoring	Integrate ONS updates into live Power BI dashboards.

11. Conclusion

The UK retail market has not simply grown — it has **structurally evolved**.

The post-2010 digital revolution represents a turning point that permanently redefined consumer behaviour and business models.

This project demonstrates not only data manipulation and statistical analysis skills but also an understanding of how to translate those findings into actionable insights for businesses.

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12. Technical Summary

Tools Used:

Python (Pandas, Seaborn, SciPy, Prophet, Matplotlib), T-SQL

Power BI | Jupyter Notebook

References

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