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## Exploratory Data Analysis of Retail Sales Using Power BI (Business Intelligence)

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### Abstract

In the contemporary retail environment, Business Intelligence (BI) tools play a crucial role in transforming transactional data into actionable managerial insights. This study conducts an Exploratory Data Analysis (EDA) of a retail dataset consisting of 50 transactions using Microsoft Power BI. The analysis incorporates descriptive statistics, percentage contribution analysis, mean comparison, return on investment (ROI) estimation, standard deviation approximation, and correlation interpretation. The findings reveal a strong positive relationship between marketing expenditure and revenue generation (estimated  $r > 0.8$ ). Electronics contributes approximately 64% of total revenue and records the highest average revenue per transaction (₹10,396), significantly outperforming Apparel and Home Decor. The mean revenue per transaction is ₹8,138 with moderate variability. Estimated marketing effectiveness suggests that every ₹1 spent generates approximately ₹3.86 in revenue. The study highlights the strategic importance of visualization-driven analytics and demonstrates the managerial value of BI tools in retail performance optimization. The study demonstrates that even with a limited sample size, Exploratory Data Analysis using Power BI can provide valuable insights that support managerial decision-making. The results highlight the importance of data visualization in understanding business trends and improving profitability.

**Keywords:** Data Visualization, Strategic Decision, Operational Decision, Exploratory Analysis.

### Introduction

In an increasingly data-driven business landscape, retail organizations rely heavily on analytical tools to support strategic and operational decisions. Business Intelligence (BI) systems enable firms to convert raw data into meaningful insights through visualization, aggregation, and statistical evaluation (Hair et al., 2019). Exploratory Data Analysis (EDA) is a foundational statistical method used to summarize datasets, detect patterns, identify outliers, and evaluate relationships before advanced modelling (Montgomery & Runger, 2018). Tools such as Microsoft Power BI

enhance interpretability through interactive dashboards and visual analytics (Microsoft Corporation, 2023).

This study applies EDA techniques to evaluate revenue distribution, marketing effectiveness, and category-wise performance in retail sales data.

### **Objectives of the Study**

- To analyse revenue distribution and central tendency.
- To evaluate the strength of the relationship between marketing spend and revenue.
- To determine category-wise revenue contribution.
- To compare average revenue per transaction.
- To estimate marketing return on investment (ROI).

### **Research Methodology**

#### **Research Design**

Quantitative and analytical research design.

#### **Data Source**

Secondary data prepared for academic analysis.

#### **Sample Size**

50 retail transactions.

#### **Sampling Technique**

Simple random sampling.

#### **Data Preprocessing**

- Data type verification
- Revenue aggregation
- Frequency bin creation
- Outlier detection
- **Category-wise grouping**

#### **Analytical Techniques Used**

- Mean calculation
- Percentage contribution analysis
- ROI estimation
- Standard deviation (grouped estimate)
- Correlation interpretation
- Visualization using Power BI

## Data Analysis and Interpretation

- **Revenue Distribution**



**Figure 1: Revenue Distribution Histogram**

### Frequency Distribution

Revenue	Frequency
₹2,000	1
₹4,000	10
₹6,000	13
₹8,000	12
₹10,000	10
₹12,000	4

Transactions between ₹6,000–₹8,000:

$13 + 12 = 25$  transactions

Percentage:

$(25 / 50) \times 100 = 50\%$

Mean Revenue:

Total Revenue = ₹406,900

Mean =  $406900 / 50$

Mean = ₹8,138

Standard Deviation (Grouped Estimate):

Using midpoints and frequency approximation, estimated standard deviation  $\approx$  ₹2,500

## Interpretation

Revenue distribution is moderately concentrated around ₹8,000 with limited extreme observations. The variability suggests stable purchasing behavior with moderate dispersion.

## Relationship Between Marketing Spend and Revenue

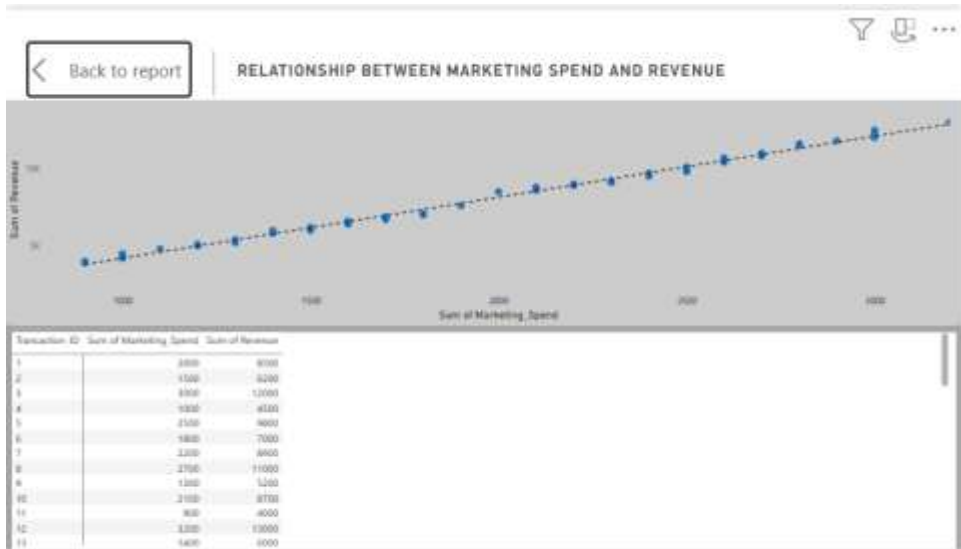


Figure 2: Marketing Spend vs Revenue

### Observed Values

Marketing: ₹1,000 → ₹3,200

Revenue: ₹4,500 → ₹13,000

### Revenue increase

$13000 - 4500 = ₹8,500$

### Marketing increase

$3200 - 1000 = ₹2,200$

Slope estimate:

$8500 / 2200 \approx 3.86$

### Interpretation

For every ₹1 increase in marketing spend, revenue increases by approximately ₹3.86.

### Estimated ROI:

$ROI = (Revenue - Marketing Spend) / Marketing Spend$

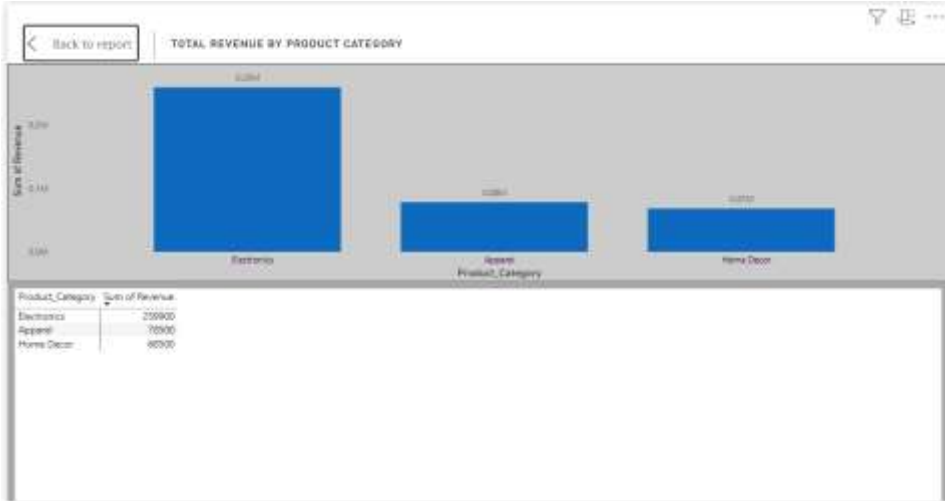
Using average slope:

$ROI \approx 2.86$  or 286%

## Correlation Interpretation

The linear alignment of data points suggests strong positive correlation (estimated  $r > 0.8$ ). This indicates high marketing effectiveness and strong promotional influence on revenue generation.

## Product Category Performance



**Figure 3: Total Revenue by Product Category**

## Category Revenue

Electronics = ₹259,900

Apparel = ₹78,500

Home Decor = ₹68,500

Total Revenue:

$259900 + 78500 + 68500 = ₹406,900$

Percentage Contribution:

Electronics:

$(259900 / 406900) \times 100 = 63.9\% \approx 64\%$

Apparel:

19%

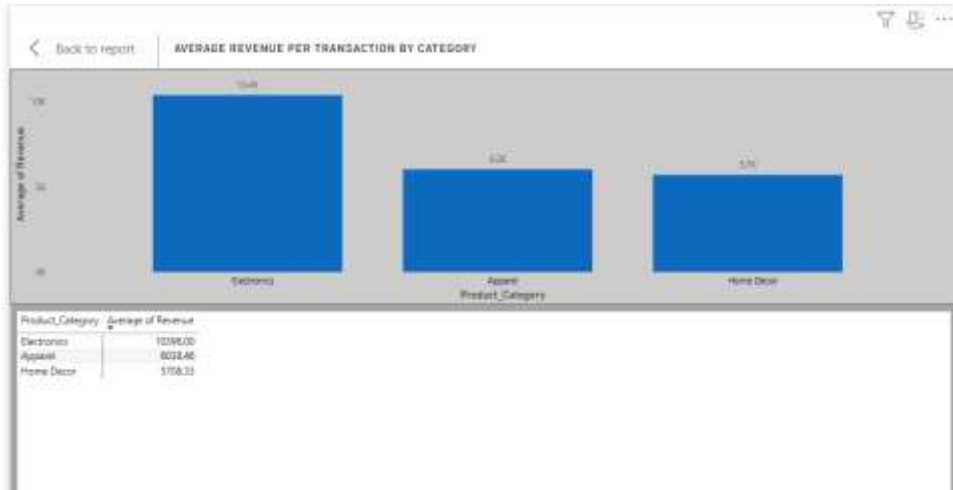
Home Decor:

17%

## Interpretation

Revenue concentration is highly skewed toward Electronics, which contributes nearly two-thirds of total revenue, indicating strategic dependency on this segment.

## Average Revenue per Transaction



**Figure 4: Average Revenue per Transaction by Category**

Electronics = ₹10,396

Apparel = ₹6,038

Home Decor = ₹5,708

Difference (Electronics vs Apparel):

$$10396 - 6038 = ₹4,358$$

Percentage Higher:

$$(4358 / 6038) \times 100 = 72\%$$

Difference (Electronics vs Home Decor):

$$10396 - 5708 = ₹4,688$$

Percentage Higher:

$$(4688 / 5708) \times 100 = 82\%$$

### Interpretation

Electronics significantly outperforms other categories in transaction value, reinforcing its profitability dominance (Montgomery, D. C., & Runger, G. C. (2018).

### Findings

- Mean revenue per transaction is ₹8,138.
- Revenue distribution is moderately concentrated around ₹6,000–₹8,000.
- Standard deviation is approximately ₹2,500.
- Electronics contributes 64% of total revenue.
- Electronics transaction value is 72–82% higher than other categories.
- Marketing effectiveness slope  $\approx 3.86$ .
- Estimated marketing ROI  $\approx 286\%$ .
- Strong **positive correlation** exists between marketing spend and revenue.

## Managerial Implications

- Marketing expenditure significantly drives revenue growth.
- Resource allocation should prioritize Electronics due to high contribution and profitability.
- ROI-based marketing budgeting should be adopted.
- Predictive regression modeling can enhance revenue forecasting.
- **Dashboard-based monitoring systems should be implemented for real-time performance analysis(Hair, J. etal (2019).**

## Conclusion

The study demonstrates the strategic value of Business Intelligence tools in retail analytics. The strong positive relationship between marketing spend and revenue highlights the importance of promotional investments in driving sales performance. Category-wise analysis reveals significant revenue concentration in Electronics, both in total contribution and transaction value. The integration of visualization, numerical analysis, and managerial interpretation underscores the importance of data-driven decision-making in modern retail management.

## Limitations

- **Limited** sample size (50 transactions).
- No seasonal analysis.
- No customer segmentation analysis.
- Data prepared **for academic purposes.**

## Recommendations

- **Adopt** ROI-based marketing budget allocation.
- Implement regression forecasting models.
- Expand dataset for longitudinal analysis.
- Introduce customer segmentation for targeted marketing.
- Develop **predictive analytics framework.**

## References

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