

# Case Study: E-commerce Global Sales Optimization

Project Role: Data Analyst

Objective: Analyze 50,000 e-commerce sales transactions to identify trends in customer demographics, product performance, and geographical distribution to deliver actionable business recommendations for revenue growth and operational efficiency.

Technologies: Python (Pandas, NumPy), Data Cleaning, Exploratory Data Analysis (EDA), Time Series Aggregation.

## The Challenge

A leading e-commerce retailer required a deep, data-driven understanding of its sales performance across multiple product categories and international markets. The primary challenges were:

1. Identifying the core drivers of revenue and transaction volume.
2. Pinpointing geographical markets that offer the greatest growth potential.
3. Optimizing inventory and payment infrastructure based on customer behavior.

## Methodology and Data Preparation

The project began with cleaning and structuring the raw dataset of transactions.

### Data Cleaning and Feature Engineering

- **Data Integrity Check:** Verified data completeness across all columns.
- **Date Transformation:** Converted the Transaction\_Date field into a datetime object and engineered new features (Year, Month, Day, YearMonth) to enable time-series analysis.
- **Metric Calculation:** Aggregated data to calculate total revenue, transaction count, and average purchase amount (AOV).

### Key Analytical Questions

1. What are the monthly and annual revenue trends?
2. Which countries generate the highest transaction volume?
3. Which product categories drive the most sales volume?
4. What is the distribution of preferred customer payment methods?

## Key Business Insights & Analysis

The analysis revealed a diversified, yet balanced, sales performance that presents unique optimization opportunities.

## 1. Market Diversity and Opportunity

The analysis of transaction volume across geographical segments showed an unusually balanced distribution, indicating a mature global presence but a lack of hyper-focused market domination.

Rank	Country	Transaction Count
1	Canada	5082
2	Mexico	5059
3	Germany	5047
4	India	4996
5	France	4993

**Insight:** Since customer acquisition cost (CAC) is likely spread evenly, the immediate focus should shift from volume growth to **maximizing Average Order Value (AOV)** within these top-tier, established markets.

## 2. Product Portfolio Stability

The top five product categories contribute equally to the transaction volume, suggesting high demand diversity.

Rank	Product Category	Transaction Count
1	Toys	6392
2	Electronics	6320
3	Sports	6312
4	Books	6253
5	Clothing	6224

**Insight:** No single category shows an outsized risk of failure. This stability allows the business to implement **cross-promotional bundling strategies** between high-volume, complementary categories (e.g., Electronics accessories with Toys).

### 3. Payment Method Optimization

All six payment methods were utilized almost equally, demonstrating successful payment gateway implementation but indicating potential cost inefficiencies. The split was highly uniform (approximately per method).

**Insight:** Cash on Delivery (COD) and PayPal typically incur higher operational costs and fees than direct bank transfers (UPI/Net Banking/Debit Card). A slight majority of transactions use UPI and COD, which are two extremes in processing cost.

### Actionable Recommendations (Focusing on Impact)

Based on these data-driven insights, I formulated three key recommendations aimed at driving profitability and strategic focus:

Recommendation	Rationale	Expected Business Impact
1. Implement AOV-Boosting Campaigns in Q2/Q3	Monthly revenue trend analysis showed revenue peaking in May and July (from to over in the sample). These are high-intent periods.	<b>Target: increase in Average Order Value (AOV)</b> during high-revenue months by introducing tiered discounts (e.g., "Spend and get off").
2. Prioritize High-Margin Cross-Selling	The top five product categories are balanced and robust. Bundling complementary products is low-risk and high-yield.	<b>Target: lift in multi-item orders.</b> Specifically, bundle Toys, Electronics, and Sports items, which cater to broad, high-value demographics.
3. Incentivize Cost-Efficient Payment Methods	Processing fees are higher for methods like COD and PayPal. UPI/Net Banking is the cheapest.	<b>Target: shift from COD/PayPal to UPI/Net Banking.</b> Offer a instant checkout discount for using UPI or Net Banking to reduce processing costs and increase immediate cash flow.

# Business Insights & Recommendations

## 1. Customer Engagement:

- Focus on 20–40 age group with tailored campaigns (loyalty programs, personalized recommendations).

## 2. Product Strategy:

- Promote Electronics & Clothing during festive/peak seasons.
- Use Toys & Books as customer acquisition categories (bundled offers).

## 3. Payment Flexibility:

- Since payment preferences are distributed, continue offering multiple methods.
- Incentivize UPI and digital wallets for faster payments and reduced COD risks.

## 4. Geographic Expansion:

- Strengthen presence in Canada, Mexico, and Germany (top-performing markets).
- Invest in India as an emerging growth driver.

## 5. Revenue Optimization:

- Leverage monthly revenue peaks for sales campaigns (Black Friday, holiday discounts).
- Implement subscription/prime models to ensure repeat purchases.

# Project Conclusion

This analysis provided the e-commerce team with the evidence required to make strategic shifts from generalized growth to **profitability optimization**. By leveraging time-series and segment analysis, we transitioned raw transactional data into a concise, three-point action plan focused on enhancing revenue quality, maximizing existing market strength, and streamlining operational costs associated with payment processing.