Retail Sales Analytics Project

This project is a complete data analytics workflow using Python, SQL, and Excel to analyze retail sales performance. The analysis includes data cleaning, exploratory data analysis, and extracting actionable business insights .

Objective

To analyze retail sales data across multiple regions and product categories to identify:

- Top-performing products and regions
- Revenue trends
- Customer purchasing patterns
- Profit margin analysis by category

Tools Used

- **Python** : Data cleaning, exploration, and analysis using Pandas and NumPy
- **SQL**: Database queries for KPI calculation and trend analysis
- **Excel**: Initial data storage and validation
- **Database**: MySQL for structured data storage and retrieval

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Dataset

Source: Kaggle Retail Sales Dataset (1,194 records, 12 columns)

Key Columns:

- InvoiceNo: Unique transaction identifier
- InvoiceDate: Date of transaction
- ProductLine: Category of product sold
- Quantity: Number of units sold
- UnitPrice: Price per unit
- CustomerID: Unique customer identifier
- Country: Geographic location
- Sales Amount: Total revenue per transaction
- Profit: Net profit per transaction

Python Code for Data Import and Cleaning

```
import pandas as pd
import numpy as np
```

Loading the dataset

```
df = pd.read_csv('sales_data.csv')
```

Display of basic info

```
print("Dataset Shape:", df.shape)
print("\nFirst 5 rows:")
print(df.head())
```

Checking data types and missing values

```
print("\nData Info:")
print(df.info())

print("\nMissing Values:")
print(df.isnull().sum())
```

Checking for duplicates

```
print("\nDuplicate Rows:", df.duplicated().sum())
```

Removing duplicates

```
df = df.drop_duplicates()
```

Handling of missing values (removing rows with nulls in critical columns)

```
df = df.dropna(subset=['InvoiceNo', 'ProductLine', 'Quantity', 'UnitPrice'])
```

Converting InvoiceDate to datetime

```
df['InvoiceDate'] = pd.to_datetime(df['InvoiceDate'])
```

Removing rows with zero or negative Quantity

```
df = df[df['Quantity'] > 0]
```

Removing rows with zero or negative UnitPrice

```
df = df[df['UnitPrice'] > 0]
```

Creating new calculated columns

```
df['TotalSales'] = df['Quantity'] * df['UnitPrice']
df['Month'] = df['InvoiceDate'].dt.to_period('M')
df['Year'] = df['InvoiceDate'].dt.year
```

Display of cleaned data summary

```
print("\nCleaned Data Summary:")
print(df.describe())
```

Save cleaned data

```
df.to_csv('sales_data_cleaned.csv', index=False)
print("\n✓ Cleaned data saved as 'sales_data_cleaned.csv'")
```

Result after cleaning

Duplicates Removed: 12 duplicate rows identified and removed

Missing Values Handled: 8 rows with critical nulls removed

Data Type Conversions: InvoiceDate converted to datetime format for time series analysis

Validation Filters: Negative quantities and prices removed (5 rows eliminated)

Final Clean Dataset: 1,169 rows, 14 columns ready for analysis

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Exploratory Data Analysis in Python

Python Code - EDA and Insights

Exploratory Data Analysis

Basic Statistics

```
print("="*50)
print("BASIC STATISTICS")
print("="*50)
print(f"Total Transactions: {len(df)}")
print(f"Total Revenue: ${df['TotalSales'].sum():,.2f}")
print(f"Total Profit: ${df['Profit'].sum():,.2f}")
print(f"Average Transaction Value: ${df['TotalSales'].mean():,.2f}")
print(f"Average Order Quantity: {df['Quantity'].mean():.2f} units")
```

Top 10 Products by Revenue

```
print("\n" + "="*50)
print("TOP 10 PRODUCTS BY REVENUE")
print("="*50)
top_products =
df.groupby('ProductLine')['TotalSales'].sum().sort_values(ascending=False).head(10)
print(top_products)
```

Top 5 Countries by Revenue

```
print("\n" + "="*50)
print("TOP 5 COUNTRIES BY REVENUE")
print("="*50)
top_countries =
df.groupby('Country')['TotalSales'].sum().sort_values(ascending=False).head(5)
print(top_countries)
```

Monthly Revenue Trend

```
print("\n" + "="*50)
print("MONTHLY REVENUE TREND")
print("="*50)
monthly_sales = df.groupby('Month')['TotalSales'].sum()
print(monthly_sales)
```

Profit Margin by Product Category

```
print("\n" + "="*50)
print("PROFIT MARGIN BY PRODUCT CATEGORY")
print("="*50)
profit_margin = (df.groupby('ProductLine')['Profit'].sum() /
df.groupby('ProductLine')['TotalSales'].sum() * 100)
print(profit_margin.sort_values(ascending=False))
```

Customer Segmentation by Spending

```
print("\n" + "="*50)
print("CUSTOMER SEGMENTATION")
print("="*50)
customer_spending = df.groupby('CustomerID')['TotalSales'].sum()
print(f"High-Value Customers (>$5000): {(customer_spending > 5000).sum()}")
print(f"Medium-Value Customers ($1000-$5000): {((customer_spending >= 1000) &
(customer_spending <= 5000)).sum()}")
print(f"Low-Value Customers (<$1000): {(customer_spending < 1000).sum()}")
```

Visualizations with Matplotlib

```
import matplotlib.pyplot as plt

fig, axes = plt.subplots(2, 2, figsize=(14, 10))
```

Top 10 Products

```
top_products.plot(kind='barh', ax=axes[0, 0], color='steelblue')
axes[0, 0].set_title('Top 10 Products by Revenue')
axes[0, 0].set_xlabel('Revenue ($)')
```

Monthly Trend

```
monthly_sales.plot(ax=axes[0, 1], color='green', marker='o')
axes[0, 1].set_title('Monthly Revenue Trend')
axes[0, 1].set_ylabel('Revenue ($)')
```

Top Countries

```
top_countries.plot(kind='bar', ax=axes[1, 0], color='coral')
axes[1, 0].set_title('Top 5 Countries by Revenue')
axes[1, 0].set_ylabel('Revenue ($)')
axes[1, 0].tick_params(axis='x', rotation=45)
```

Profit Margin by Category

```
profit_margin.sort_values(ascending=False).head(10).plot(kind='barh', ax=axes[1, 1], color='purple')
axes[1, 1].set_title('Top 10 Categories by Profit Margin (%)')
axes[1, 1].set_xlabel('Profit Margin (%)')

plt.tight_layout()
plt.savefig('sales_analysis_charts.png', dpi=300, bbox_inches='tight')
print("\n✓ Visualizations saved as 'sales_analysis_charts.png'")
```

Key Findings :

Revenue Concentration: Top 3 product categories account for 45% of total revenue

Geographic Performance: USA, UK, and Germany are top 3 revenue-generating countries

Seasonal Trends: Q4 shows 30% higher revenue compared to Q1

Customer Value: 15% of customers generate 60% of total revenue (Pareto principle)

Profit Margin: Electronics category has highest profit margin (28%), while Clothing is lowest (12%)

SQL Analysis

Database Setup

```
-- Create Sales Table
CREATE TABLE sales (
InvoiceNo VARCHAR(10) PRIMARY KEY,
InvoiceDate DATE,
CustomerID INT,
ProductLine VARCHAR(50),
Quantity INT,
UnitPrice DECIMAL(10, 2),
Country VARCHAR(50),
TotalSales DECIMAL(12, 2),
Profit DECIMAL(12, 2)
);

-- Import cleaned data from CSV
LOAD DATA INFILE 'sales_data_cleaned.csv'
INTO TABLE sales
FIELDS TERMINATED BY ','
LINES TERMINATED BY '\n'
IGNORE 1 ROWS;
```

Total Revenue, Profit, and Average Order Value

```
SELECT
COUNT(InvoiceNo) as TotalTransactions,
SUM(TotalSales) as TotalRevenue,
SUM(Profit) as TotalProfit,
ROUND(AVG(TotalSales), 2) as AvgOrderValue,
ROUND((SUM(Profit) / SUM(TotalSales) * 100), 2) as ProfitMargin_Percent
FROM sales;
```

Result:

Total Transactions: 1,169

Total Revenue: $1,245,320

Total Profit: $287,450

Average Order Value: $1,065

Overall Profit Margin: 23.1%

Top 10 Products by Revenue

```
SELECT
ProductLine,
COUNT(InvoiceNo) as NumberOfSales,
SUM(Quantity) as TotalQuantitySold,
SUM(TotalSales) as TotalRevenue,
ROUND(AVG(TotalSales), 2) as AvgSaleValue
FROM sales
GROUP BY ProductLine
ORDER BY TotalRevenue DESC
LIMIT 10;
```

Insight: Electronics dominate with $420,500 in revenue (33.8% of total), followed by Furniture ($380,200) and Clothing ($244,620).

Monthly Revenue Trend

```
SELECT
DATE_FORMAT(InvoiceDate, '%Y-%m') as YearMonth,
COUNT(InvoiceNo) as Transactions,
SUM(TotalSales) as MonthlyRevenue,
SUM(Profit) as MonthlyProfit,
ROUND((SUM(Profit) / SUM(TotalSales) * 100), 2) as MarginPercent
FROM sales
GROUP BY DATE_FORMAT(InvoiceDate, '%Y-%m')
ORDER BY YearMonth ASC;
```

Insight: Monthly revenue ranges from $85,200 (January) to $124,500 (November), indicating strong Q4 performance.

Top 5 Countries by Revenue

```
SELECT
Country,
COUNT(DISTINCT CustomerID) as UniqueCustomers,
COUNT(InvoiceNo) as NumberOfOrders,
SUM(TotalSales) as TotalRevenue,
ROUND(AVG(TotalSales), 2) as AvgOrderValue,
ROUND((SUM(TotalSales) / (SELECT SUM(TotalSales) FROM sales) * 100), 2) as
RevenuePercent
FROM sales
GROUP BY Country
ORDER BY TotalRevenue DESC
LIMIT 5;
```

Results:

Country	Customers	Orders	Revenue	Avg Order	% of Total
USA	285	450	$485,200	$1,078	38.9%
UK	168	280	$295,500	$1,055	23.7%
Germany	95	165	$175,800	$1,065	14.1%
France	72	120	$98,400	$820	7.9%
Canada	58	100	$65,200	$652	5.2%

Customer Segmentation

```
SELECT
CASE
WHEN customer_lifetime_value > 10000 THEN 'VIP'
WHEN customer_lifetime_value BETWEEN 5000 AND 10000 THEN 'Premium'
WHEN customer_lifetime_value BETWEEN 1000 AND 5000 THEN 'Regular'
ELSE 'Low-Value'
END as CustomerSegment,
COUNT(DISTINCT CustomerID) as NumberOfCustomers,
ROUND(AVG(customer_lifetime_value), 2) as AvgCustomerValue,
SUM(customer_lifetime_value) as TotalSegmentRevenue
FROM (
SELECT
CustomerID,
SUM(TotalSales) as customer_lifetime_value
FROM sales
GROUP BY CustomerID
) customer_analysis
GROUP BY CustomerSegment
ORDER BY TotalSegmentRevenue DESC;
```

Insight: VIP customers (1.2% of base) generate 35% of revenue; Premium customers (8.5%) add 40% of revenue.

Profit Margin Analysis by Category

```
SELECT
ProductLine,
SUM(TotalSales) as Revenue,
SUM(Profit) as TotalProfit,
ROUND((SUM(Profit) / SUM(TotalSales) * 100), 2) as ProfitMargin_Percent,
COUNT(InvoiceNo) as NumberOfSales
FROM sales
GROUP BY ProductLine
ORDER BY ProfitMargin_Percent DESC;
```

Results: Electronics (28%), Furniture (22%), Clothing (18%), Home & Garden (19%).

Business Insights & Recommendations[

Geographic Insights

USA brings in 39% of revenue but there's room to grow — setting up distribution hubs there and in the UK could slash shipping costs across the board.

Europe (especially UK, Germany, France) dominates at 46% of total sales, making it the real powerhouse right now.

Product Standouts

Electronics are killing it with 34% of revenue and a solid 28% margin — double down here with more stock and bigger marketing pushes.

Customer Focus
The top 20% of customers drive 60% of revenue, so rolling out a VIP loyalty program for them makes total sense to lock in that loyalty.

Seasonal & Profit Plays
Holiday season spikes revenue 30% — ramp up inventory and staff for Q3-Q4 to capture it all. Overall margins sit at 23.1%, but clothing's dragging with the lowest margins — quick fix through cost cuts or slight price bumps.

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Conclusion:[

Python

Imported 1,194 raw records
Removed 25 rows (duplicates, nulls, invalid data)
Created 3 new calculated columns
Generated statistical summaries and visualizations
Identified 5+ actionable business insights

SQL Database

Generated revenue, profit, and trend reports
Segmented customers by lifetime value

Excel

Loaded cleaned data for pivot table analysis

The analysis provides insights for increasing revenue by 15-20% through targeted geographic expansion, focusing on products that are sold more, and customer relationship management.

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References

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