PREPARED BY :

CHIRAG CHAUDHARY - P2023PTLP0018
DAVANG SIKAND - P2023PTLP0039
SAI PRANAV NIDUGONDI - P2023PTLP0017
SAI KRISHNA VAMSHI DEVARASETTY- P2023PTLP0050

TEAM -5

FINAL REPORT

SUPPLY CHAIN
MANAGEMENT

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TECH STACK

The insights and analyses presented in this report were generated using the Python programming language, a versatile and widely-used language for data analysis and manipulation. Python offers a rich ecosystem of libraries and tools that are essential for data analysis tasks.

- **Pandas:** Pandas is a powerful library for data manipulation and analysis in Python. It provides easy-to-use data structures like DataFrames, which allow for efficient data manipulation, cleaning, and aggregation.
- **Matplotlib:** Matplotlib is a comprehensive library for creating static, interactive, and animated visualizations in Python. It offers a wide range of plotting functions and customization options, making it suitable for various data visualization needs.
- **Seaborn:** Seaborn is a statistical data visualization library built on top of Matplotlib. It provides a high-level interface for creating attractive and informative statistical graphics. Seaborn simplifies the process of creating complex visualizations such as heatmaps, pair plots, and regression plots.
- **NumPy:** NumPy is a fundamental library for numerical computing in Python. It provides support for large, multi-dimensional arrays and matrices, along with a collection of mathematical functions to operate on these arrays efficiently. NumPy is essential for performing numerical computations and statistical analysis on data.
- **Cartopy:** Cartopy is a mapping library in Python that provides support for creating geographic maps and visualizations. It allows users to plot data on geographical projections, customize map features, and overlay different data layers such as points, lines, and polygons.
- **Folium:** Folium is a Python library that simplifies the process of creating interactive maps using data from Pandas data frames. It leverages the Leaflet JavaScript library to generate interactive and customizable maps that can be embedded in web applications or exported as standalone HTML files.

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PROBLEM STATEMENT

The report aims to comprehensively address the challenges faced by DataCo, spanning a spectrum of issues within its supply chain management framework as well as optimizing operations and sales metrics. Key challenges include recurring instances of late deliveries, volatile sales trends across regions and product categories, and instances of fraudulent activities. Additionally, the company seeks to optimize sales delivery routes and implement effective delivery strategies to enhance operational efficiency. Through insightful analysis and actionable recommendations, the goal is to provide DataCo with a clear roadmap for improving its supply chain processes and overall business performance.
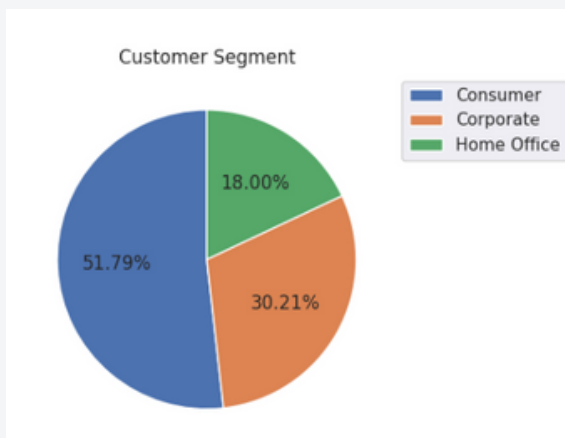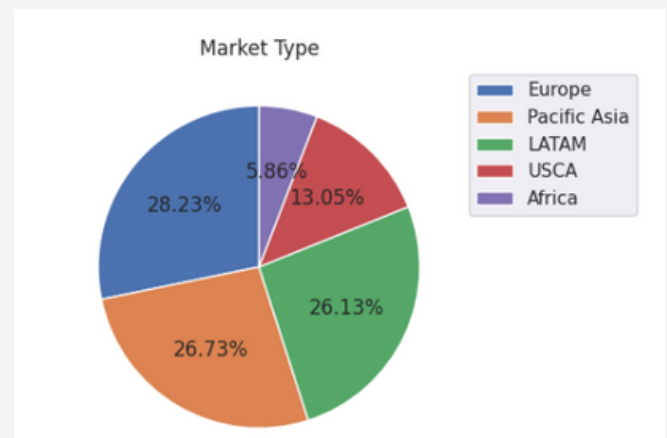
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UNIVARIATE ANALYSIS
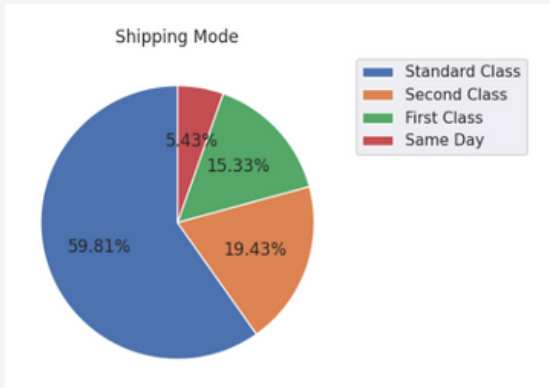
Maximum shipping modes is Standard Class.
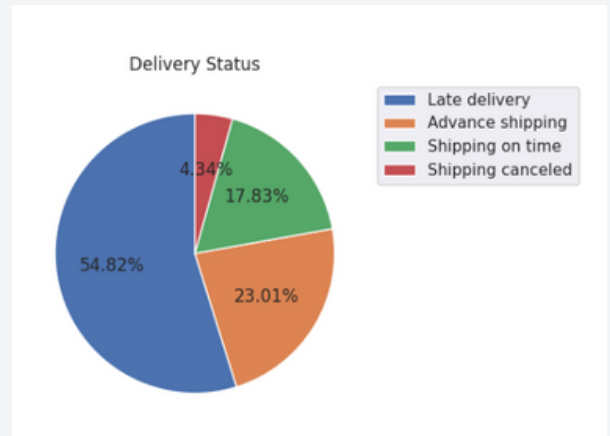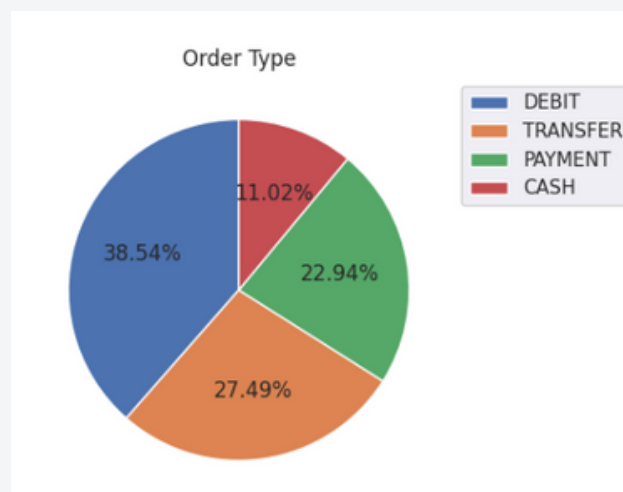

Most Delivery Status are Late Deliveries.
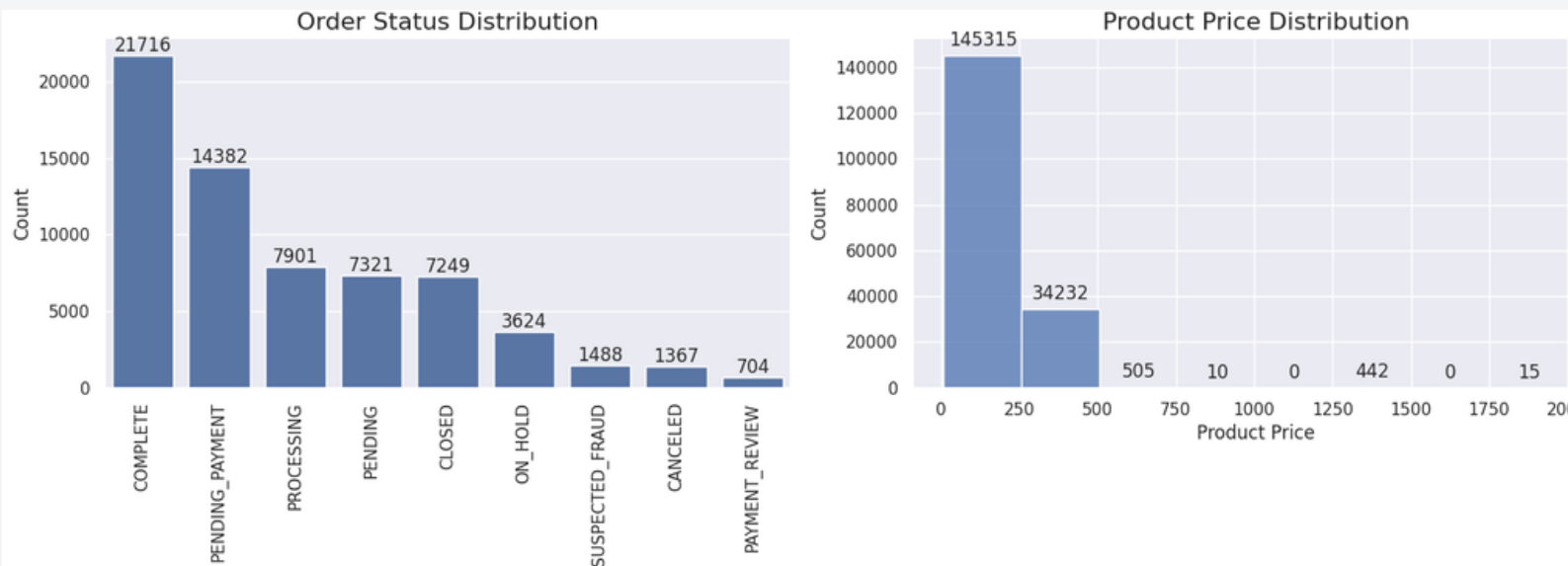

Maximum Customers are from Consumer Segment.

Most of orders are from Europe, Pacific Asia, and Latin America.

Almost 66% consumer mode of payment is Debit and Transfer.

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UNIVARIATE ANALYSIS

Order Status Distribution

Product Price Distribution

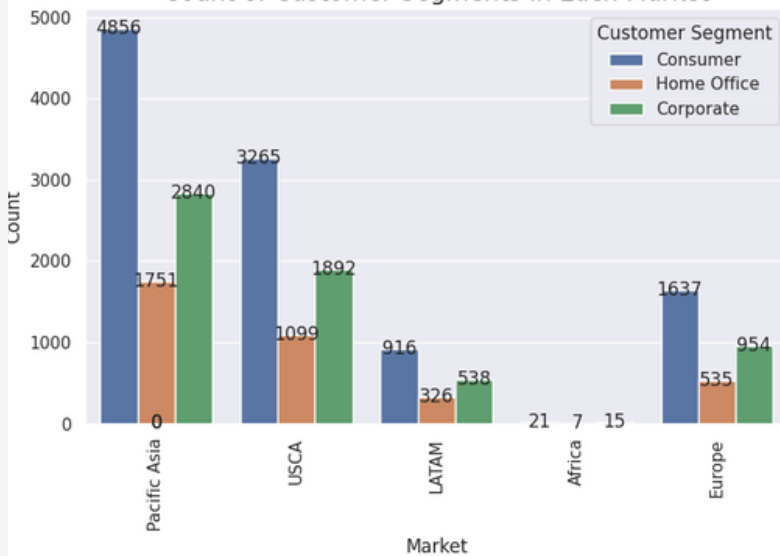
No. of Products in an Order

Most order status is Complete.
Most products price lie between 0 to 250.
Maximum number of products in an order is 1.

BIVARIATE ANALYSIS
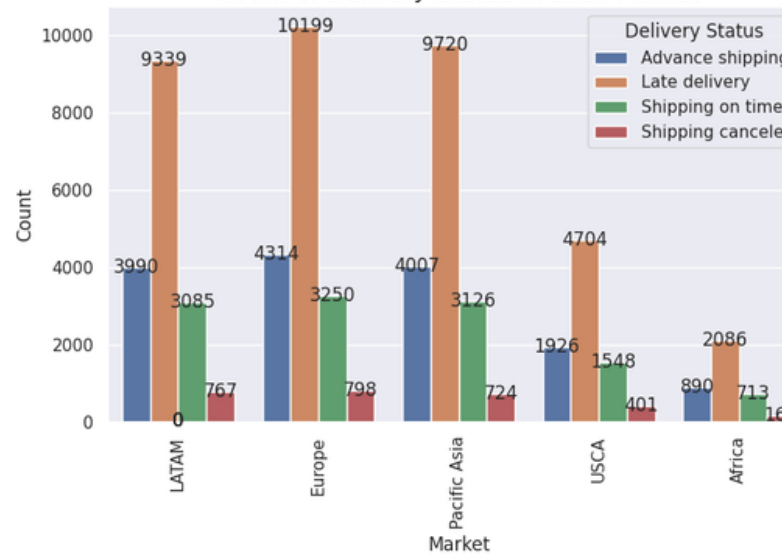
Despite only 43 unique customers from Africa, a significant total of 3705 orders have been placed.

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Global Distribution of Orders by Country: A World Map Analysis
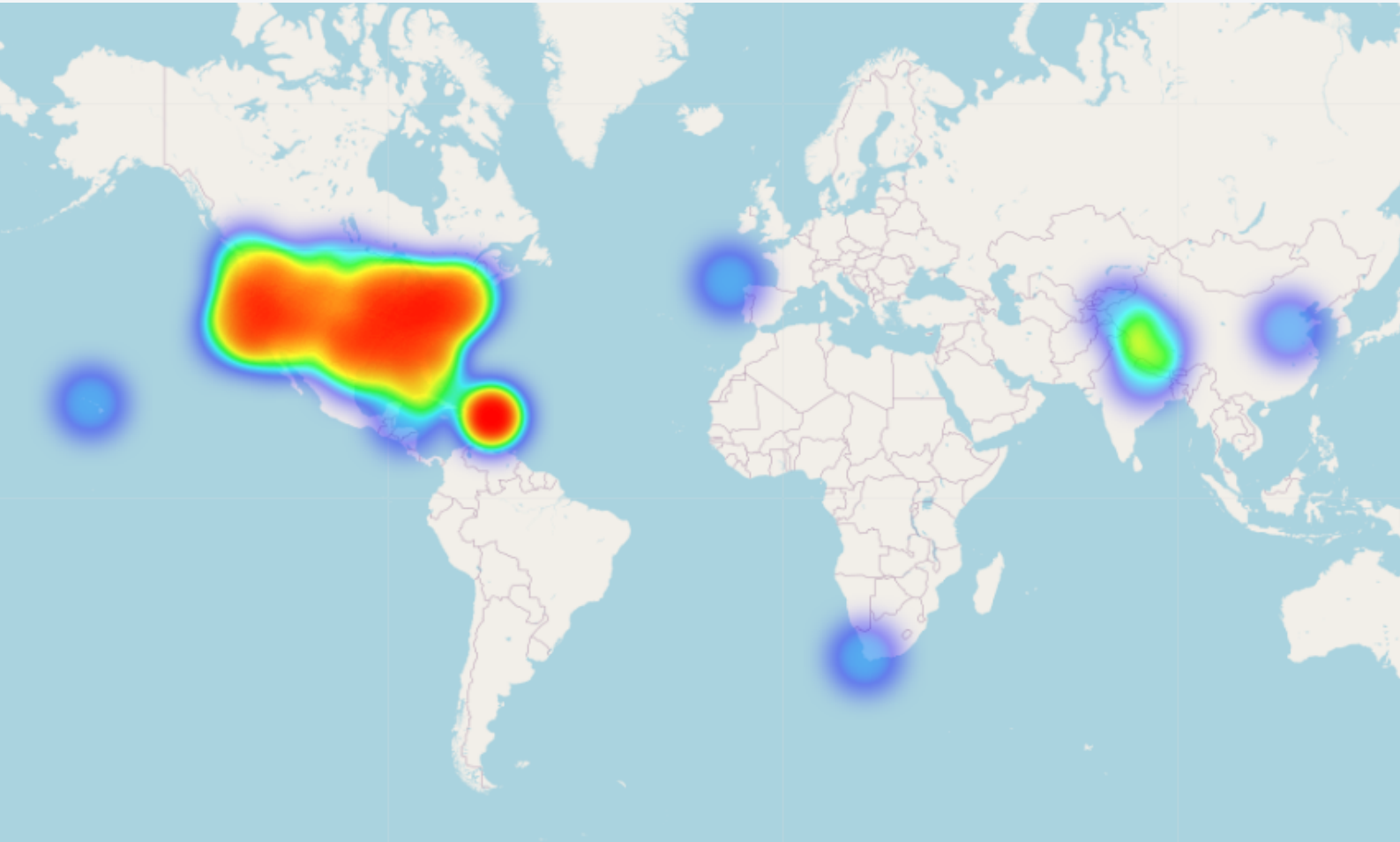
INSIGHT

The analysis reveals that the majority of orders originate from the United States and Puerto Rico, indicating a significant portion of the company's customer base resides in this region.

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MULTIVARIATE ANALYSIS

Heatmap - Plot of Correlations
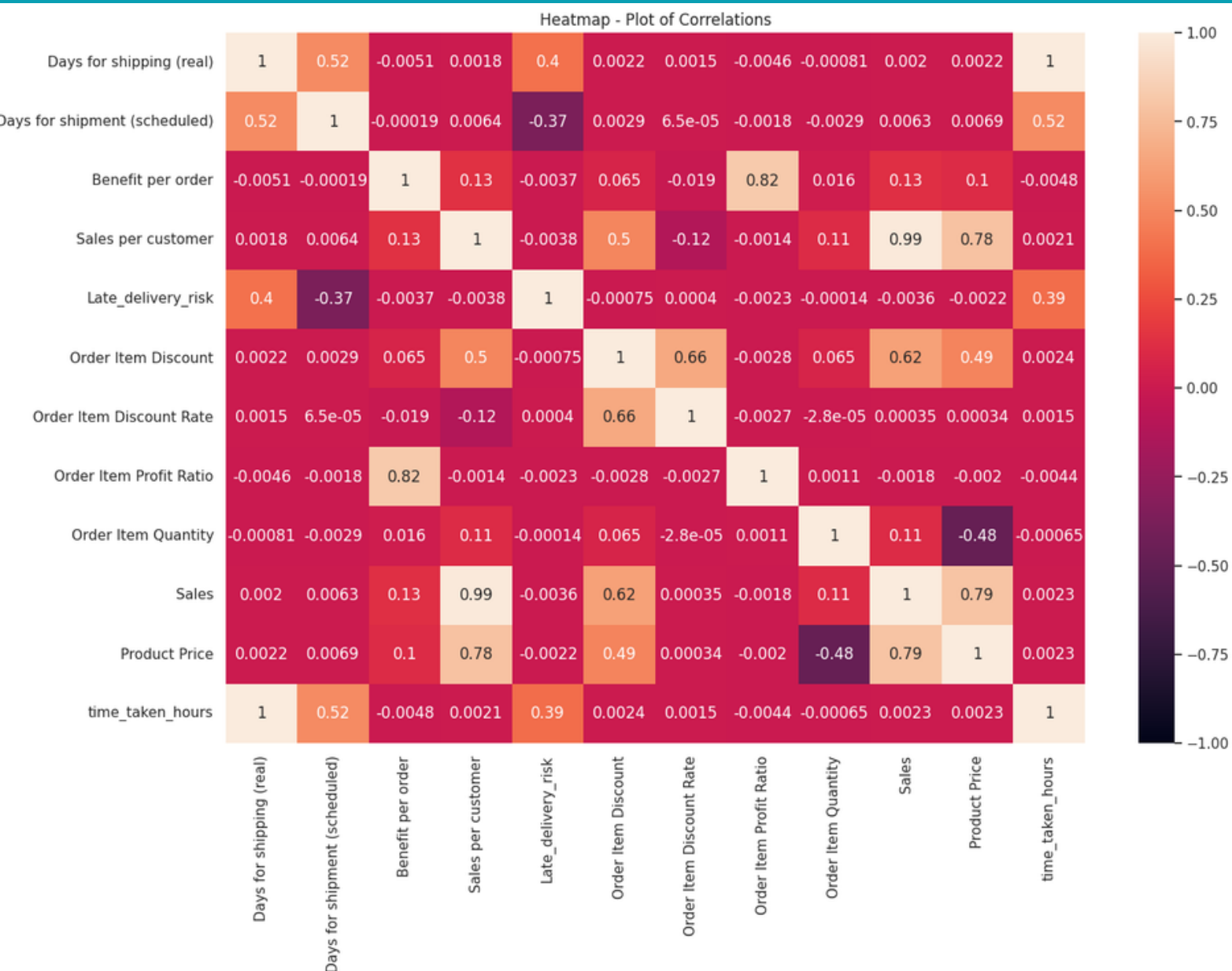
OBSERVATIONS

Strong -ve or ve Correlation between:
Sales per customer vs Product Price
Sales vs Order Item Discount
Order Item Quantity vs Order Item Discount
Order Item Discount vs sales per customer

Strong Correlation due to Multicollinearity:
Benefit per order vs Order Item Profit Ratio
Sales per customer and Sales
Days for shipping (real) and Days for shipment(schedul
Order Item Profit Ratio vs Benefit per order

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Yearly Sales Distribution Across Departments

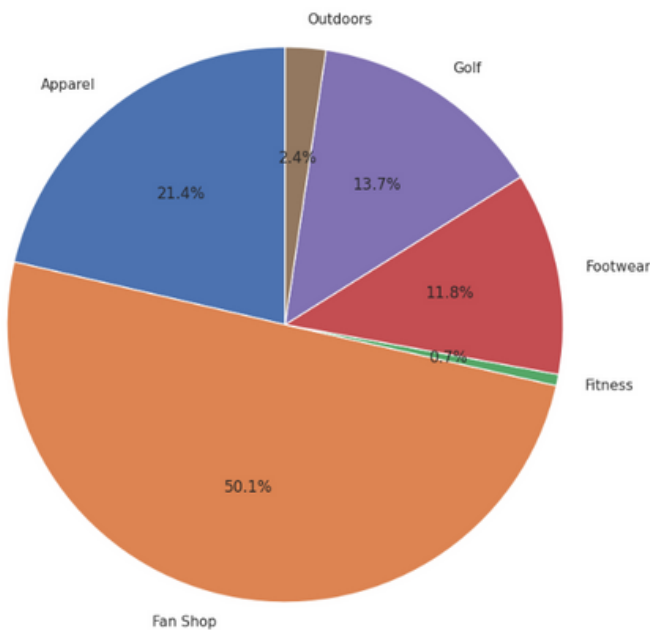Distribution of Total Sales by Department - 2015
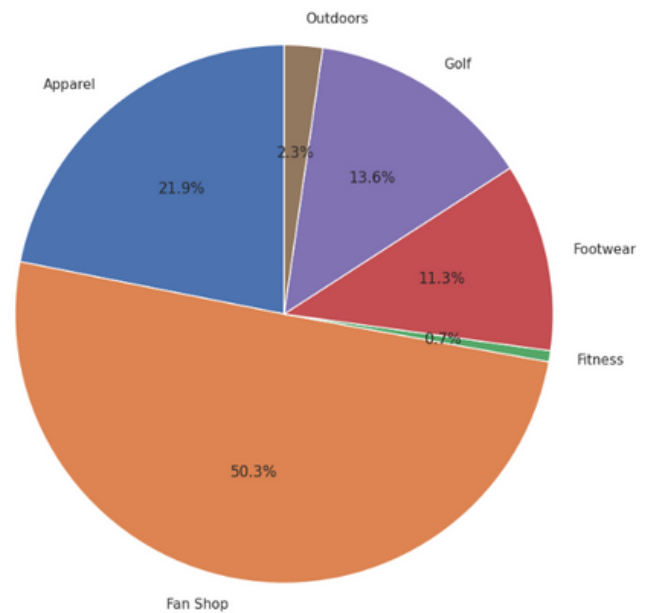
- Outdoors 2.4%
- Golf 13.7%
- Apparel 21.4%
- Footwear 11.8%
- Fitness 0.7%
- Fan Shop 50.1%

Distribution of Total Sales by Department - 2016

- Outdoors 2.3%
- Golf 13.6%
- Apparel 21.9%
- Footwear 11.3%
- Fitness 0.7%
- Fan Shop 50.3%

Distribution of Total Sales by Department - 2017

- Technology
- Pet Shop
- Outdoors
- Health and Beauty
- Apparel 21.7%
- 8.8%
- 0.2%
- 5.3%
- 0.6%
- Golf 10.6%
- Book Shop / Discs Shop 0.1% 1.4%
- Footwear 9.8%
- Fitness 1.4%
- Fan Shop 40.1%

Distribution of Total Sales by Department - 2018

- Pet Shop 6.3%
- Outdoors 15.4%
- Apparel 26.6%
- Health and Beauty 10.9%
- Discs Shop 19.0%
- Fan Shop 1.0%
- Fitness 21.0%
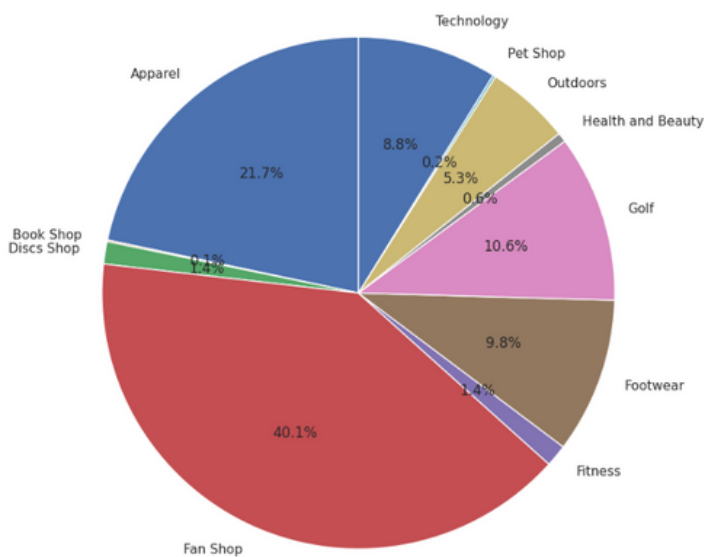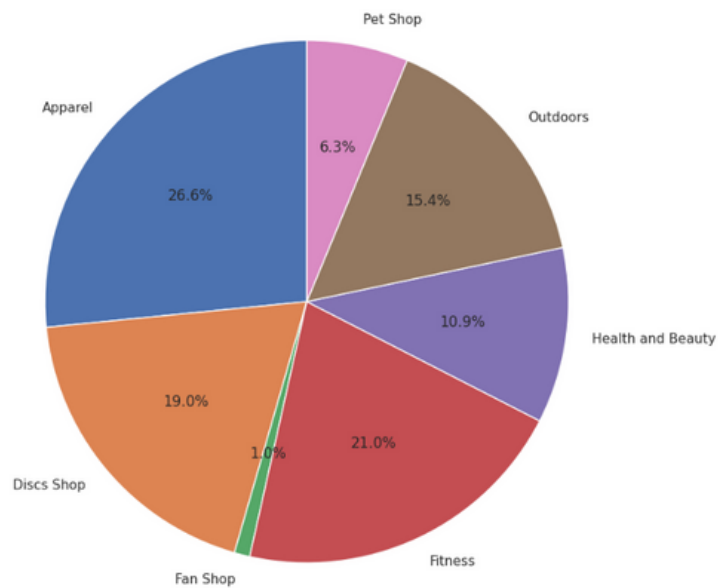
INSIGHT

Emerging Revenue Sources from 2017:-
- Pet Shop
- Health and Beauty
- Technology
- Books Shop
- Discs Shop

Fan Shop Department Sales Analysis

Year-wise Sales for Fan Shop Department
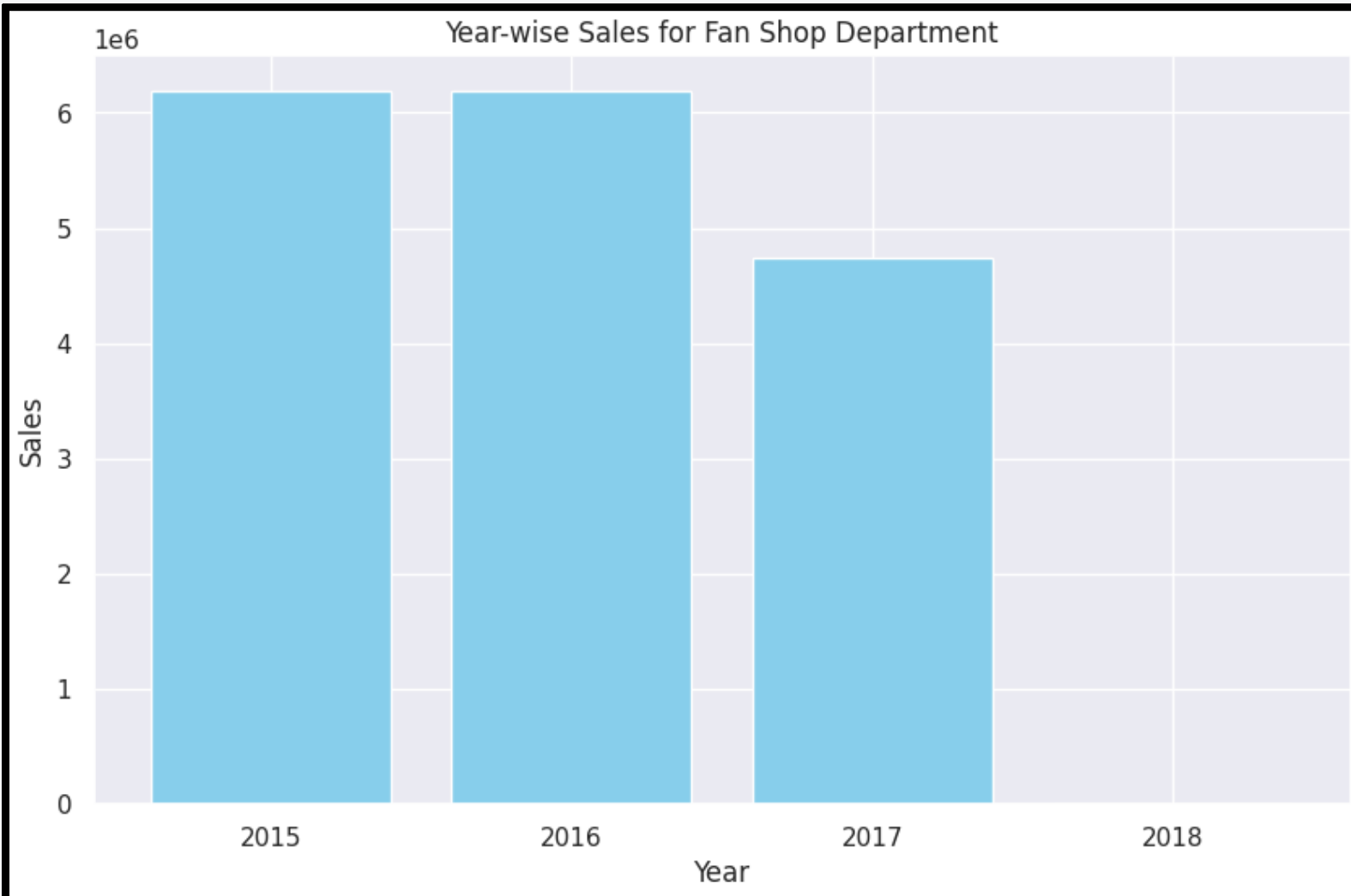
INSIGHT

Fan Shop Decline: Fan Shop, while historically significant, has shown a decrease in contribution from 2017.

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Monthly Sales Comparison Over Years

Sales vs Month for Each Year
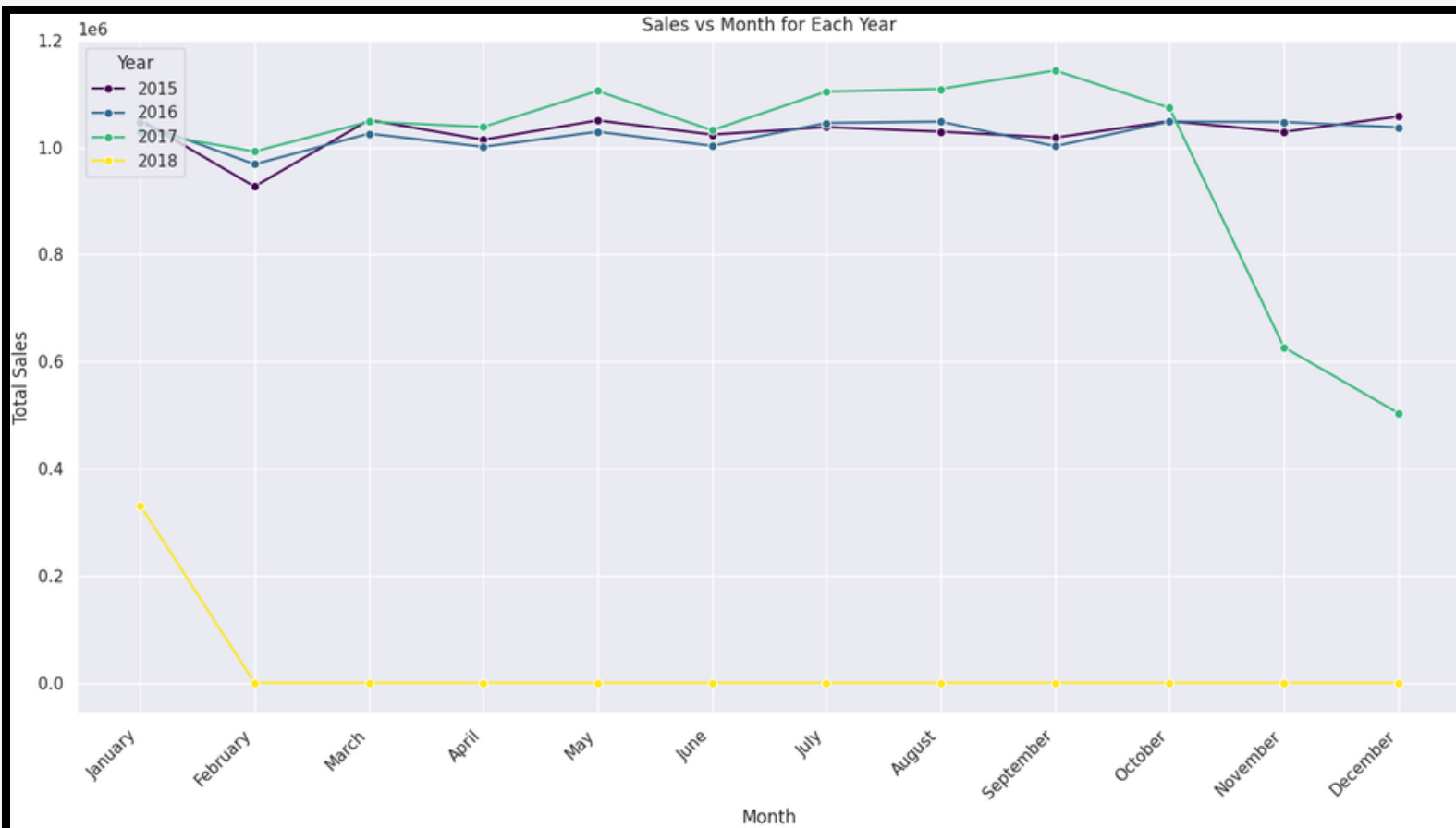
INSIGHT

By analyzing Monthly Sales Comparison Over the Years, we found that there has been a decline in sales post October 2017.

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Product Portfolio - Number of Products (SKUs) in Each Department

Number of Products in Each Department
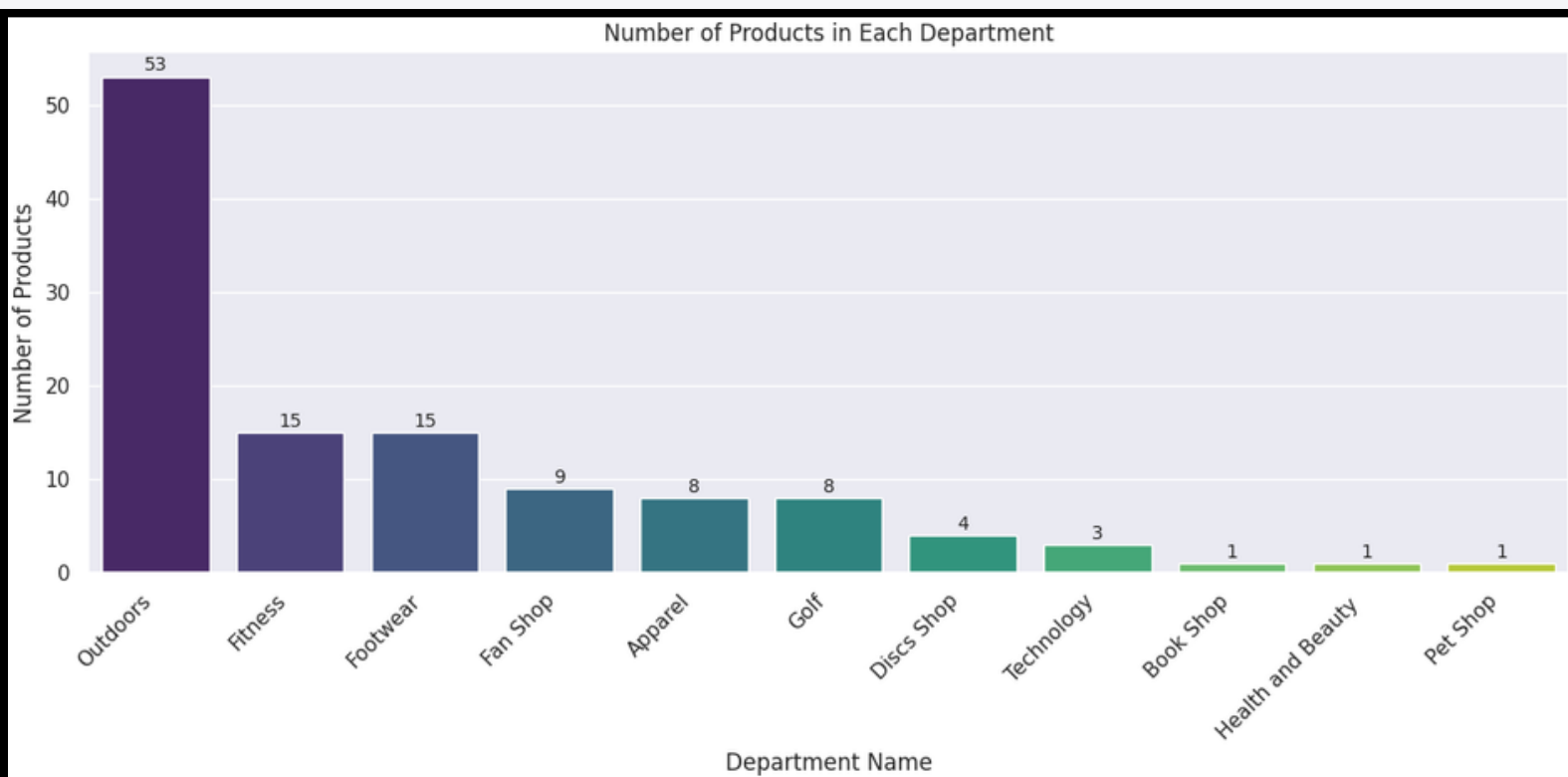
INSIGHT

Very High SKU's
1. Outdoors: 53 SKUs (Very High)

Low SKU's
Emerging Departments:
1. Technology: 3 SKUs
2. Book Shop: 1 SKU
3. Health and Beauty: 1 SKU
4. Pet Shop: 1 SKU
5. Discs Shop: 4 SKU

Contribution of Top 15 Products in Outdoor Department to Total Sales

Contribution of Top 15 Products in Outdoor Department vs Total Sales
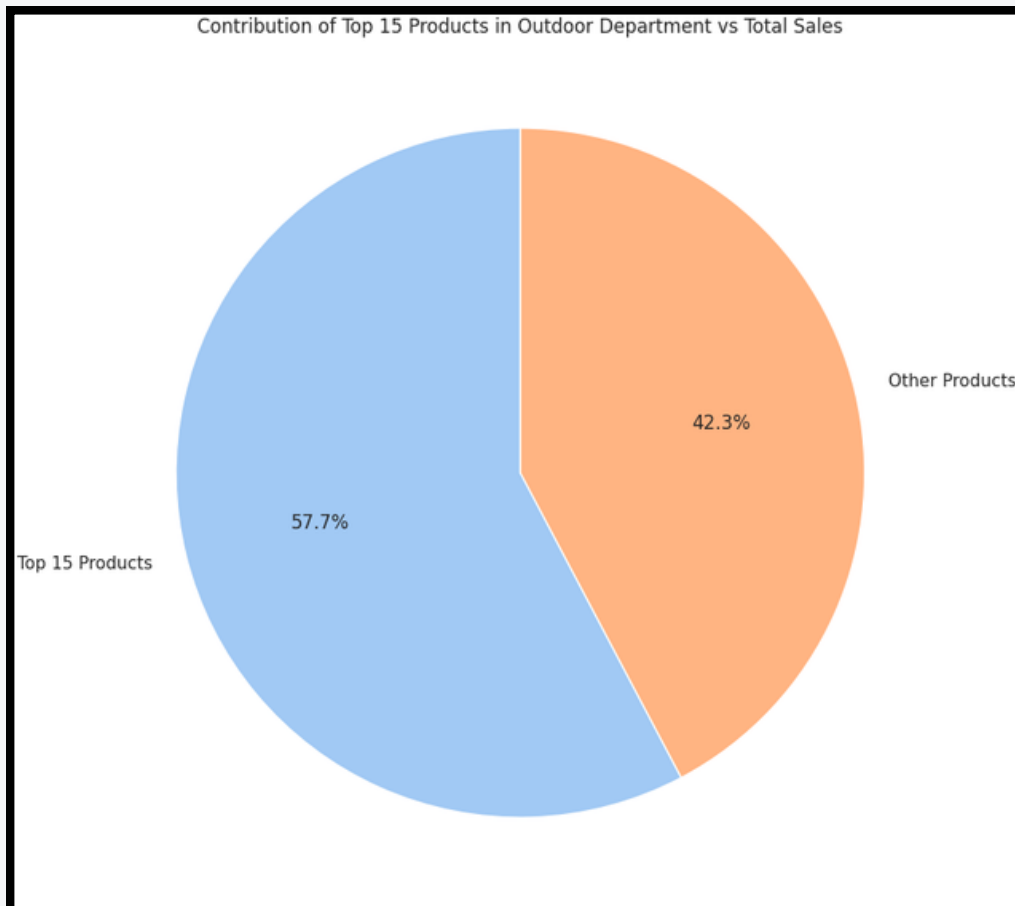
INSIGHT

Only top 15 products contribute to 57.7% percent of revenue and Outdoors Department has 53 SKU's.

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Analyzing Benefit per Order Across Region

Sum of Benefit per Order by Year and Region
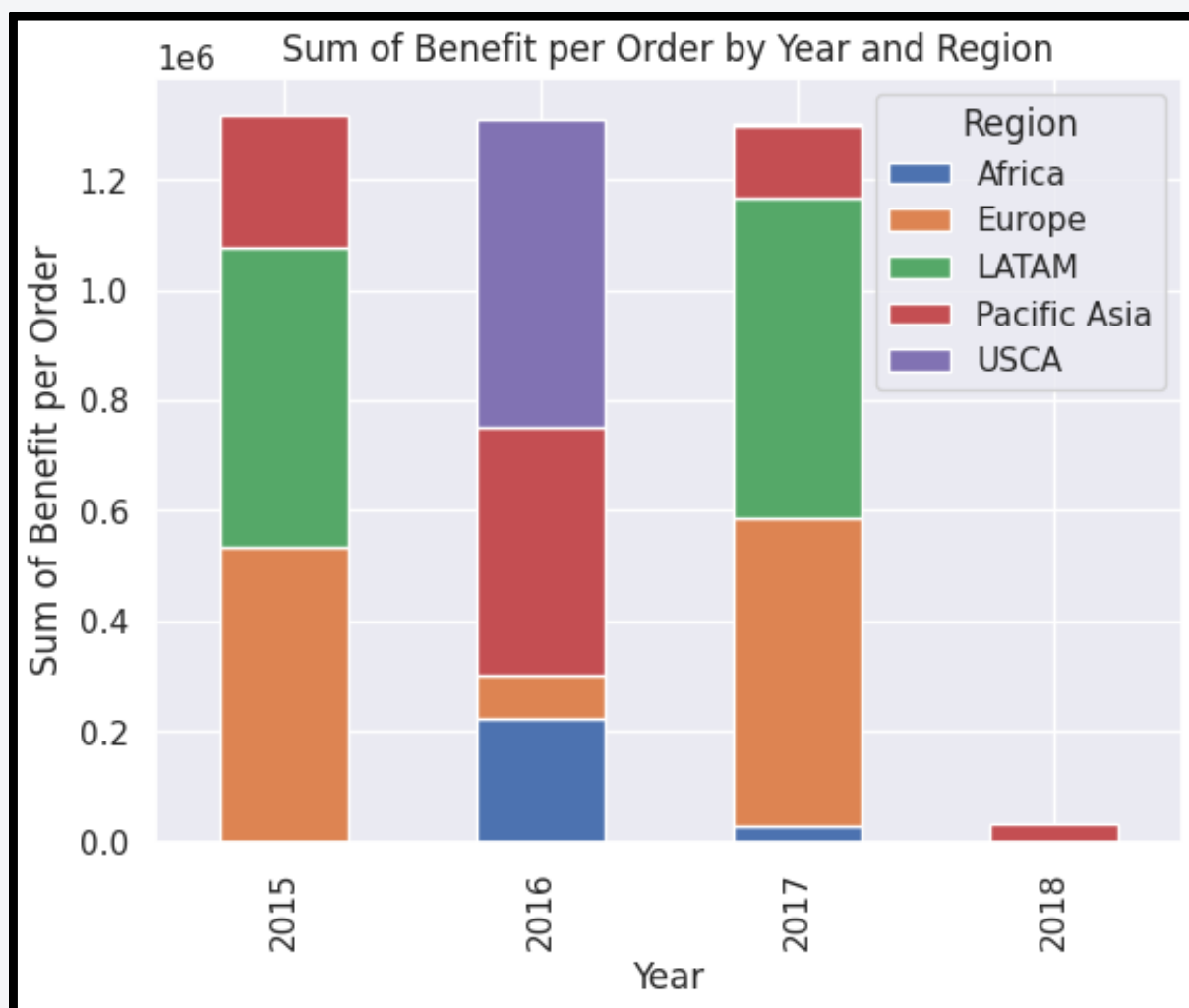
Max Sales
2015 - Europe
2016 - US and Canada
2017 - Europe

INSIGHT
In 2016, Latin America showed no sales activity, while the US and Canada emerged as top sales markets despite not being present in 2015 or 2016 prior.

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Top 10 Profitable Categories and Departments

Top 10 Categories by Profit%

Top 10 Departments by Profit%
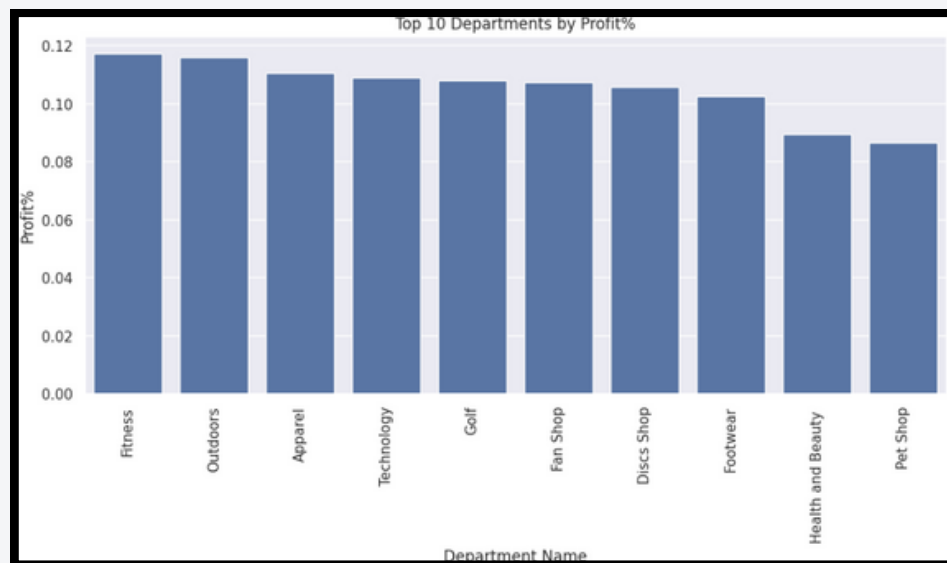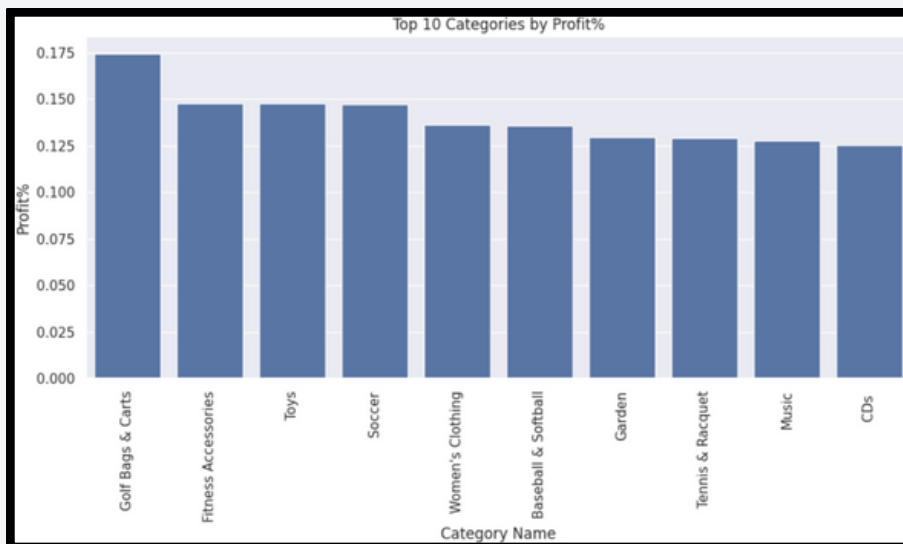
INSIGHT
The analysis identifies "Golf Bags and Carts" as the most profitable category and the "Fitness" department as the most profitable overall.

Percentage Increase in Quantity sold based on Discount

Product Name	2015_Loss_Quantity	2015_Total_Quantity	% Discounted Products 2015 ▼	2017_Total_Quantity	% Inc. in Quantity Sold
Glove It Women's Mod Oval 3-Zip Carry All Gol	106	384	0.2760416666666667	134	-0.6510416666666667
Under Armour Men's Compression EV SL Slide	106	412	0.25728155339805825	87	-0.7888349514563107
Columbia Men's PFG Anchor Tough T-Shirt	92	393	0.2340966921119593	129	-0.6717557251908397
adidas Youth Germany Black/Red Away Match Soc	101	435	0.23218390804597702	123	-0.7172413793103448
Under Armour Women's Ignite PIP VI Slide	89	391	0.22762148337595908	92	-0.7647058823529411
ENO Atlas Hammock Straps	95	431	0.22041763341067286	146	-0.6612529002320185
Hirzl Women's Soffft Flex Golf Glove	92	427	0.2154566744730679	111	-0.7400468384074941
Nike Men's Deutschland Weltmeister Winners Bl	76	358	0.2122905027932961	93	-0.7402234636871509
LIJA Women's Eyelet Sleeveless Golf Polo	94	444	0.21171171171171171	117	-0.7364864864864865

INSIGHT

DataCo's intentional selling of products at a loss, initially thought to be a promotional tactic, is revealed as a strategic inventory clearance. The significant drop in product sales from 2015 to 2017, coupled with department discontinuations, supports the conclusion that the company was systematically reducing inventory during this period.

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Days of Shipment and Shipping Duration

Days for shipment (scheduled)	0	1	2	4
Days for shipping (real)				
0	52.172127	0.0	0.000000	0.000000
1	47.827873	0.0	0.000000	0.000000
2	0.000000	100.0	20.269196	20.107283
3	0.000000	0.0	20.061904	20.138837
4	0.000000	0.0	19.814857	19.985708
5	0.000000	0.0	20.024989	19.592212
6	0.000000	0.0	19.829055	20.175960

INSIGHT

The pivot table analysis between scheduled and real delivery days reveals that the entries below the diagonal primarily correspond to instances of late deliveries.

BUSINESS INSIGHTS

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Market Basket Analysis: Identifying Top Product Combinations

Products Bought Together	Number of Times
Nike Mens CJ Elite 2 TD Football Cleat, Perfect Fitness Perfect Rip Deck	3808
Nike Mens CJ Elite 2 TD Football Cleat, Nike Mens Dri-FIT Victory Golf Polo	3638
Nike Mens CJ Elite 2 TD Football Cleat, Field & Stream Sportsman 16 Gun Fire Safe	2997
Perfect Fitness Perfect Rip Deck, OBrien Mens Neoprene Life Vest	2983
Nike Mens CJ Elite 2 TD Football Cleat, OBrien Mens Neoprene Life Vest	2833
Nike Mens Dri-FIT Victory Golf Polo, OBrien Mens Neoprene Life Vest	2825
Perfect Fitness Perfect Rip Deck, Nike Mens Dri-FIT Victory Golf Polo	2750
Nike Mens CJ Elite 2 TD Football Cleat, Nike Mens Dri-FIT Victory Golf Polo	2692
Perfect Fitness Perfect Rip Deck, Perfect Fitness Perfect Rip Deck	2682
Nike Mens CJ Elite 2 TD Football Cleat, Perfect Fitness Perfect Rip Deck	2651

INSIGHT

Through market basket analysis, we have identified a considerable number of top product combinations that are frequently purchased together, indicating strong patterns of consumer behavior.

ACTIONABLE SOLUTION:

To capitalize on these insights, the company should strategically group these frequently co-purchased products together in physical stores or on their website. This bundling can streamline the shopping experience for customers, making it easier for them to find complementary items and potentially increasing sales. Additionally, leveraging these product associations can enhance recommendation algorithms.

Understanding Late Deliveries: Exploring the Distribution of Number of Items in Orders with Late Delivery

Number of Items in Orders with Late Delivery
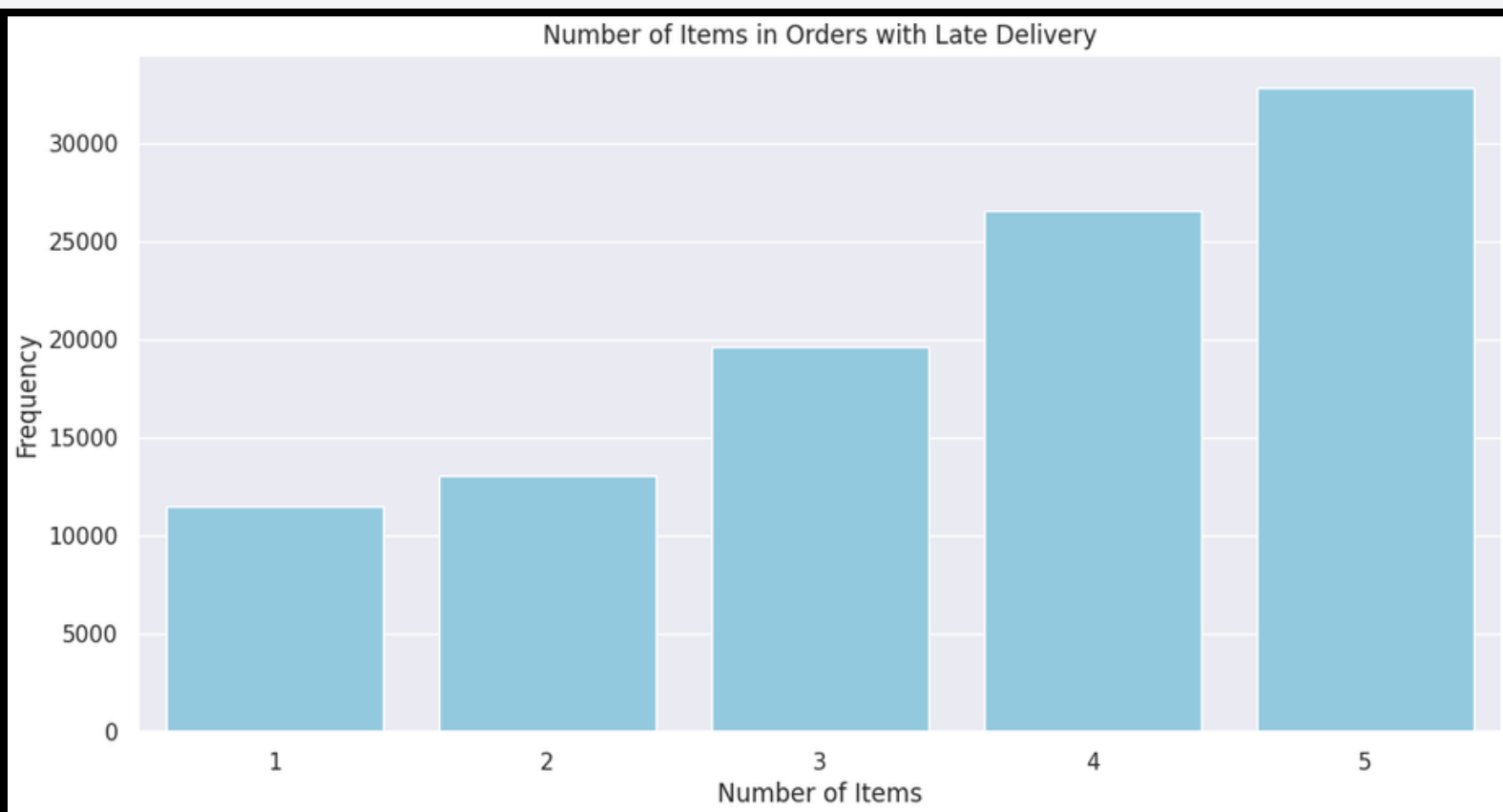
INSIGHT

Analysis indicates a correlation between the number of items in orders and late deliveries, suggesting that larger orders tend to experience more delays.

ACTIONABLE SOLUTION:

To mitigate late deliveries, the company could provide customers with the option to have each product delivered individually rather than bundled together in a single order. This personalized delivery approach may reduce the complexity of orders, streamline the delivery process, and ultimately decrease the occurrence of late deliveries.

Enhancing On-Time Delivery

Late Delivery Improvement by Customer State for Selected Countries
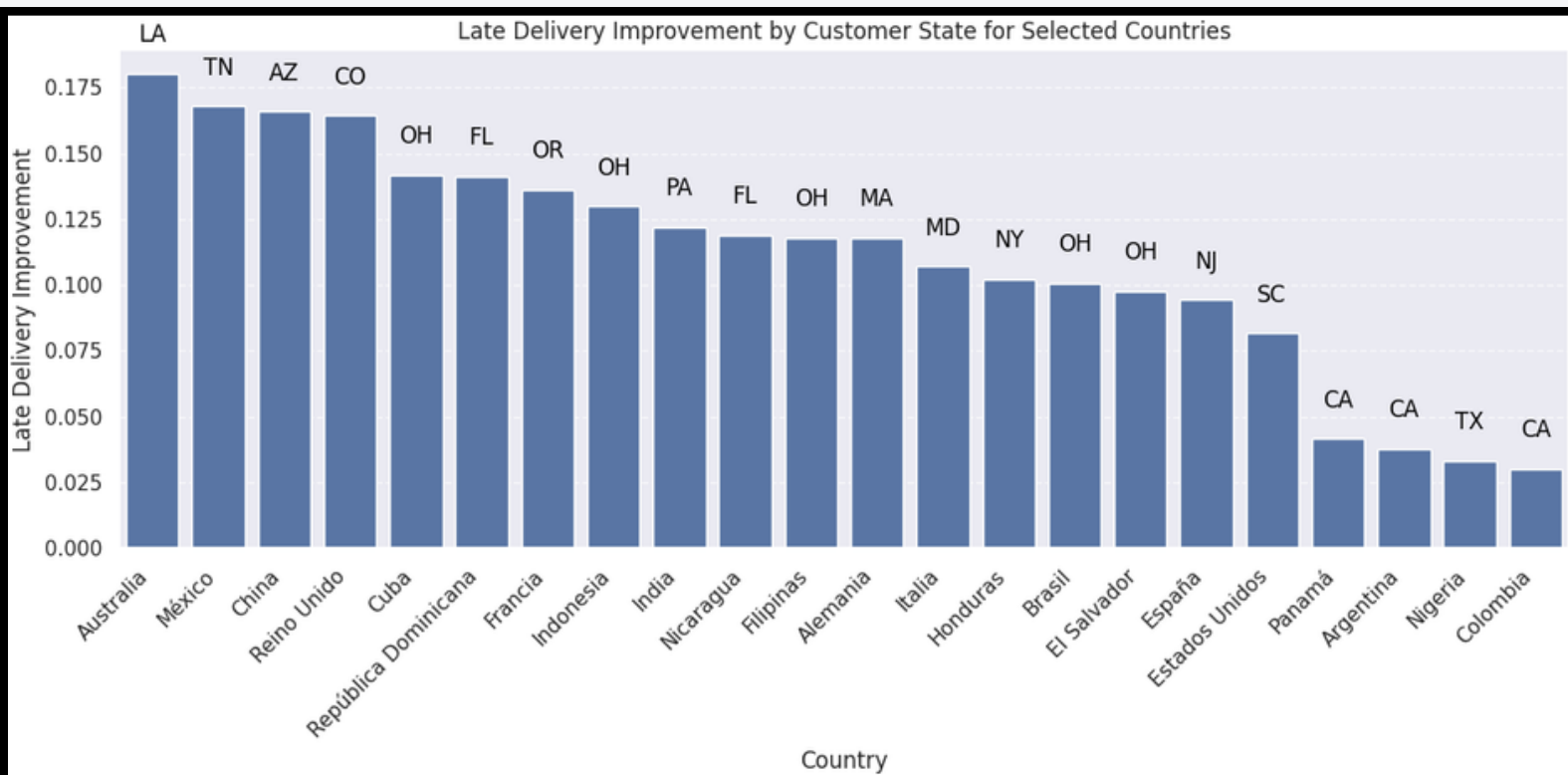
INSIGHT

Route Optimization for Improved Late Delivery%

ACTIONABLE SOLUTION:

DataCo has a significant opportunity to enhance its delivery performance by strategically optimizing delivery routes. Analysis of the first bar reveals that by routing deliveries to Australia from Los Angeles (LA), DataCo could potentially achieve a remarkable 17.5% reduction in the Late Delivery%.

Late Delivery Risk vs. Order Month

Late Delivery Risk vs Order Month
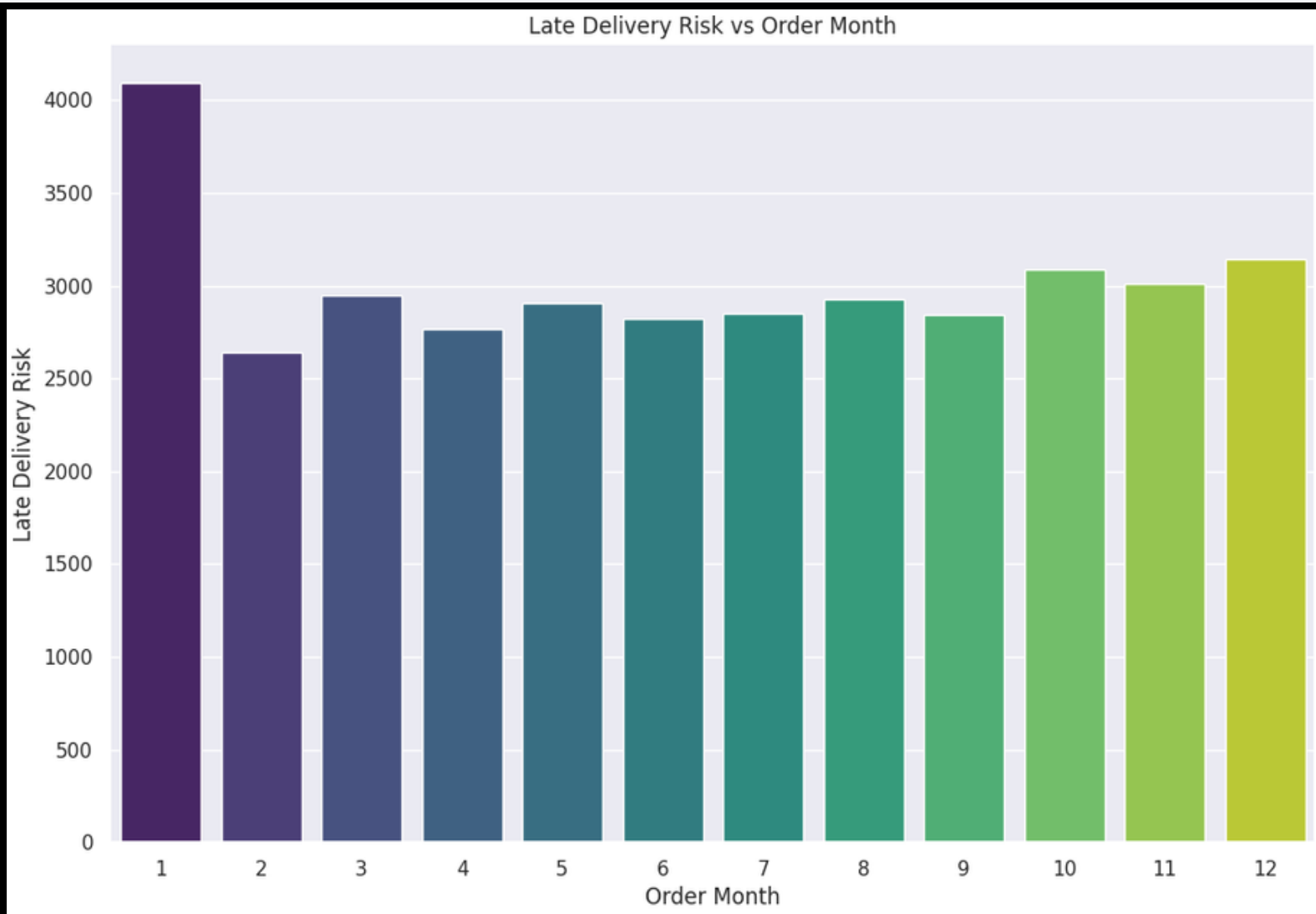
INSIGHT
The analysis highlights a notable surge in late orders during January.

ACTIONABLE SOLUTION:
To address the issue, the company should consider augmenting its delivery staff to accommodate the increased demand during peak periods like January.

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Average Profit by Different Countries of Shipment

	Benefit per order	
Customer Country	EE. UU.	Puerto Rico
Order Region		
Western Europe	25.713551	25.259952
Central America	21.388379	22.483531
South America	21.632865	23.251966
Southeast Asia	24.314621	25.533300
Oceania	20.571376	19.957991
Northern Europe	28.248281	24.927609
Southern Europe	25.593885	27.832178
Eastern Asia	23.162904	20.457025
South Asia	21.776782	23.844696
West of USA	20.026129	19.995930
Caribbean	23.925849	19.323774
East of USA	22.764770	21.519507
US Center	23.417313	25.900859
West Asia	20.398565	21.027258
South of USA	21.511980	23.407369
West Africa	20.061204	24.539842
Eastern Europe	20.345429	23.175012
North Africa	20.072596	18.676589
East Africa	23.836701	25.435541
Central Africa	19.637143	19.162577
Southern Africa	28.121749	24.883586
Canada	25.907678	26.183895
Central Asia	26.429695	19.658527

INSIGHT:

Our analysis indicates that orders are being shipped from two distinct countries, and we have computed the average profits associated with each country of shipment.

ACTIONABLE SOLUTION:

Leveraging this insight, the company can optimize its shipping strategies by potentially focusing more resources on the country yielding higher average profits per shipment. For instance, in the last row in the above data shows that, shipping products from the United States to Central Asia results in significantly higher profits compared to shipping from Puerto Rico.

Number of Repeat Customers After Suspected Fraud

Order Item Id	Customer Id	Order Status
101052	2784	SUSPECTED_FRAUD
81596	3800	SUSPECTED_FRAUD
81595	3800	SUSPECTED_FRAUD
94445	3222	SUSPECTED_FRAUD
131310	9002	SUSPECTED_FRAUD
....	...	....
72257	9231	SUSPECTED_FRAUD
71017	6637	SUSPECTED_FRAUD
70939	482	SUSPECTED_FRAUD
69391	6138	SUSPECTED_FRAUD
67826	9010	SUSPECTED_FRAUD

349 rows × 2 columns

INSIGHT
There are 349 customer IDs that have been involved in repeated instances of fraud.

ACTIONABLE SOLUTION:
As a proactive business action, these customer IDs should be immediately flagged and blocked to mitigate further fraudulent activities.

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SUMMARY OF ACTIONABLE SOLUTIONS:

Enhancing Operational Preparedness: During peak periods such as January DataCo can enhance operational preparedness.

Market Basket Analysis: Strategically group frequently co-purchased products together to enhance the shopping experience and potentially increase sales.

Late Deliveries Mitigation: Consider personalized delivery options to mitigate late deliveries. To mitigate late deliveries, the company could provide customers with the option to have each product delivered individually rather than bundled together in a single order. This personalized delivery approach may reduce the complexity of orders, streamline the delivery process, and ultimately decrease the occurrence of late deliveries.

Optimizing On Time Delivery: DataCo has a significant opportunity to enhance its delivery performance by strategically optimizing delivery routes. Analysis of the first bar reveals that by routing deliveries to Australia from Los Angeles (LA), DataCo could potentially achieve a remarkable 17.5% reduction in the Late Delivery%.

Route Optimization: Implement route optimization techniques to improve on-time delivery rates and reduce late delivery percentages.

Shipping Strategy Optimization: Optimize shipping strategies based on average profits per shipment from different countries.

Fraud Prevention: Proactively identify and block customer IDs involved in repeated instances of fraud to mitigate further fraudulent activities.