

Final Project

RETAIL SUPPLY CHAIN SALES

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March, 2025



1. Introduction

Dataset Title: Retail Supply Chain Sales

Dataset Size: 9,994 rows x 23 columns

Time Extracted: 02/01/2014 – 30/12/2017

Dataset Description: This dataset provides detailed information on retail orders, including sales performance, customer details, and shipment logistics in the United States.

Features:

- Customer: Customer ID, Customer Name, Customer Segment
- Geographic: Region, State, City, Postal Code
- Product: Product ID, Product category, Category, Sub-Category, Product Name, Returned
- Orders: Sales, Quantity, Discount, Profit, Order ID, Order Date, Retail Sales People, Cost(*), Is_Profit(*)
- Shipping: Ship Date, Ship Mode, Shipping Time(*)



Target audience

- Owners
- Sales and Marketing Managers



Objective

- Review overall sales performance.
- Gain insights and identify key factors affecting sales improvement
- Enhance marketing strategy by segmenting customer groups.



Analysis Roadmap

- **Evaluate the business performance**
 - Analyze trends using time-series methods
 - Evaluate profitability metrics
- **Finding root cause**
 - Investigate key factors affecting profit margin
 - Suggest solutions
- **Other methods to improve profitability**
 - Customer behavior analysis
 - Market basket analysis

2. Overview

5,009
No.Orders

793
Total Customers

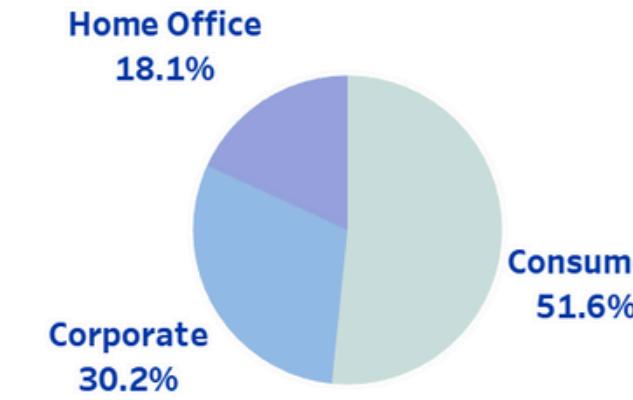
\$2,297K
Total Sales

\$2,047K
Total Cost

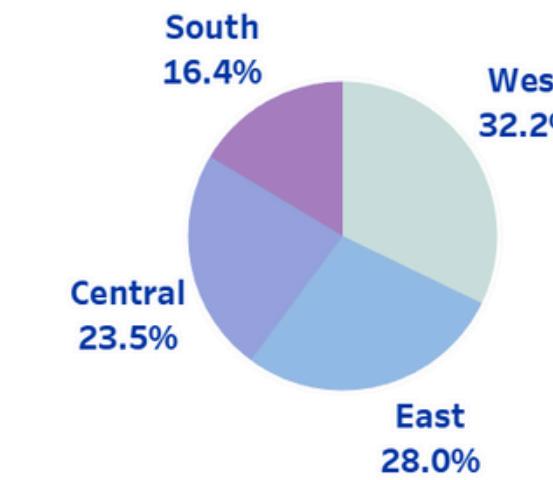
\$251K
Total Profit

10.91%
Profit Margin

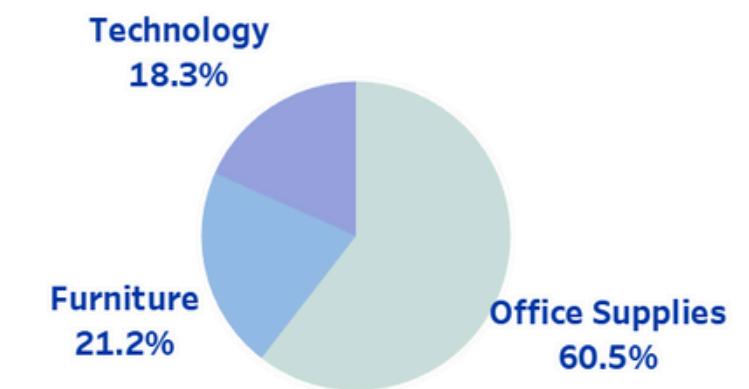
Customer Segment Distribution



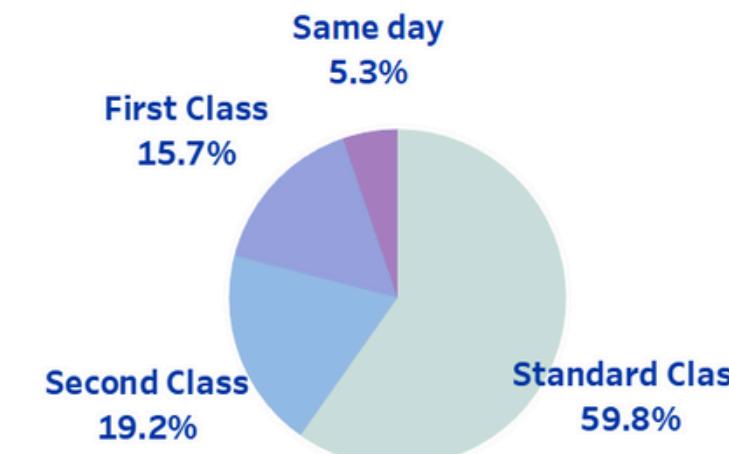
Region Distribution



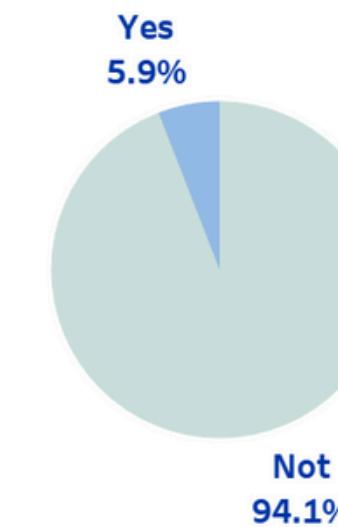
Product Category Distribution



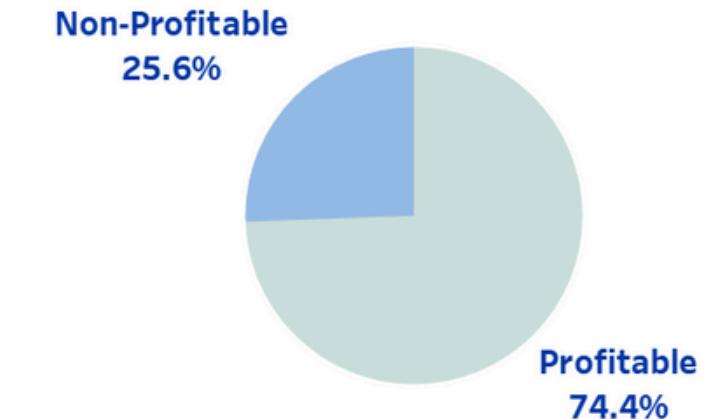
Ship Mode Distribution



Return Rate Distribution of Orders



Order Profitability Distribution





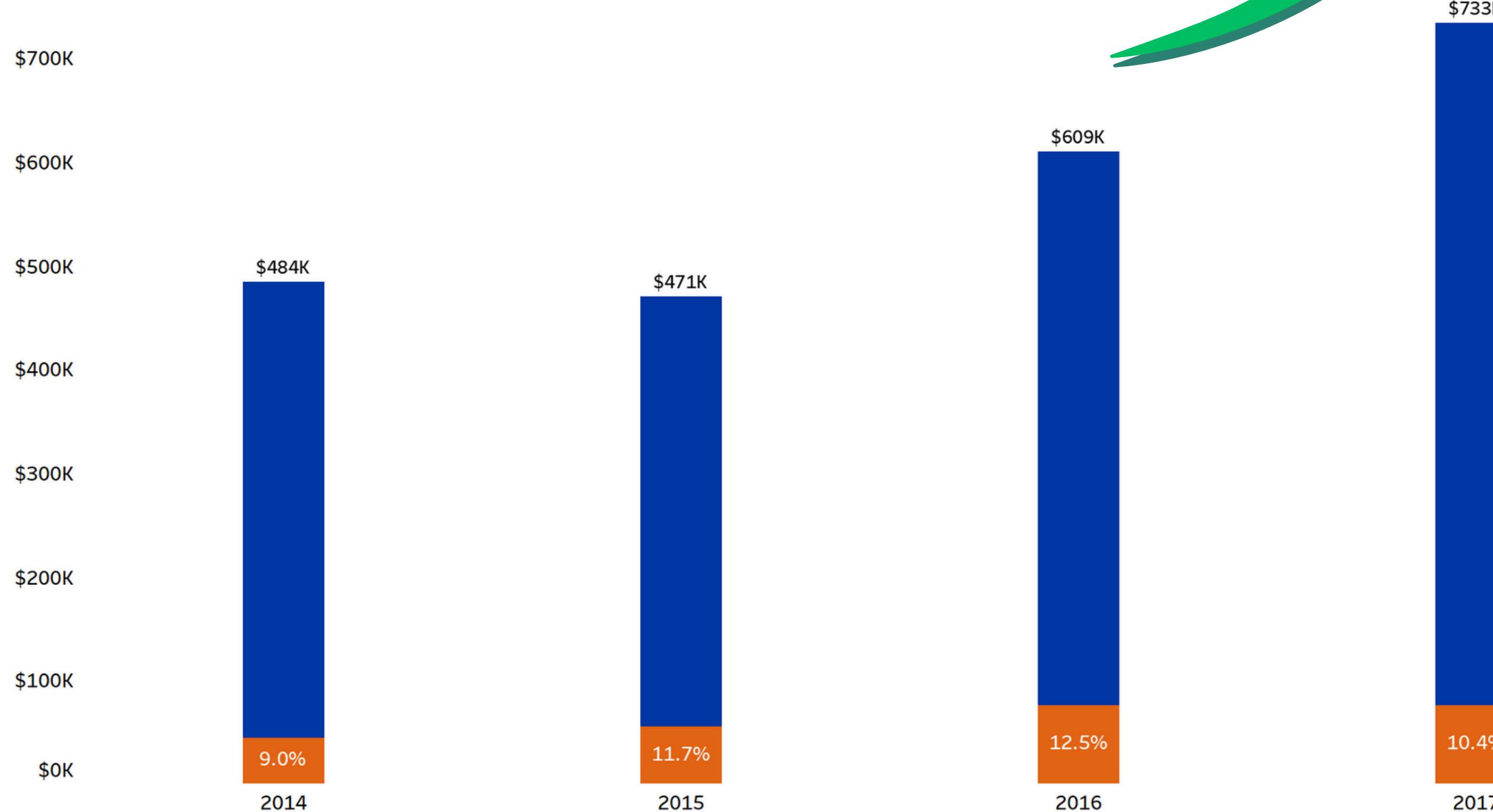
2. Overview

Why is the profit margin declining
despite increasing sales?



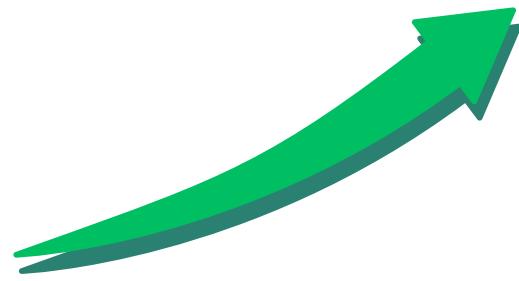
Total Sales by Year

● Cost ● Profit



Sales increase steadily
from 2015 to 2017.

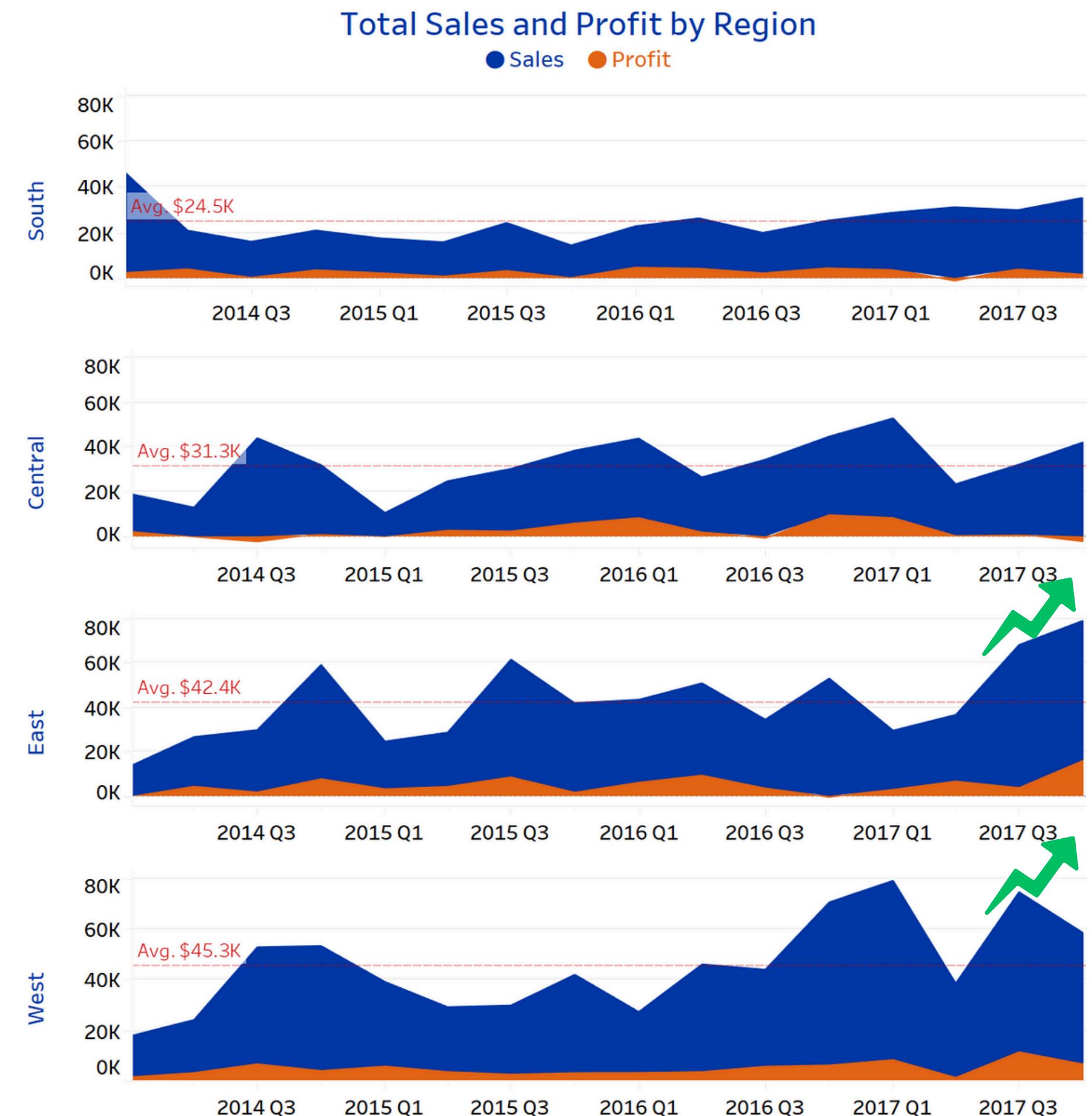
Profit Margin increased
until 2016 but **declined** in
2017.





3. Time-Series

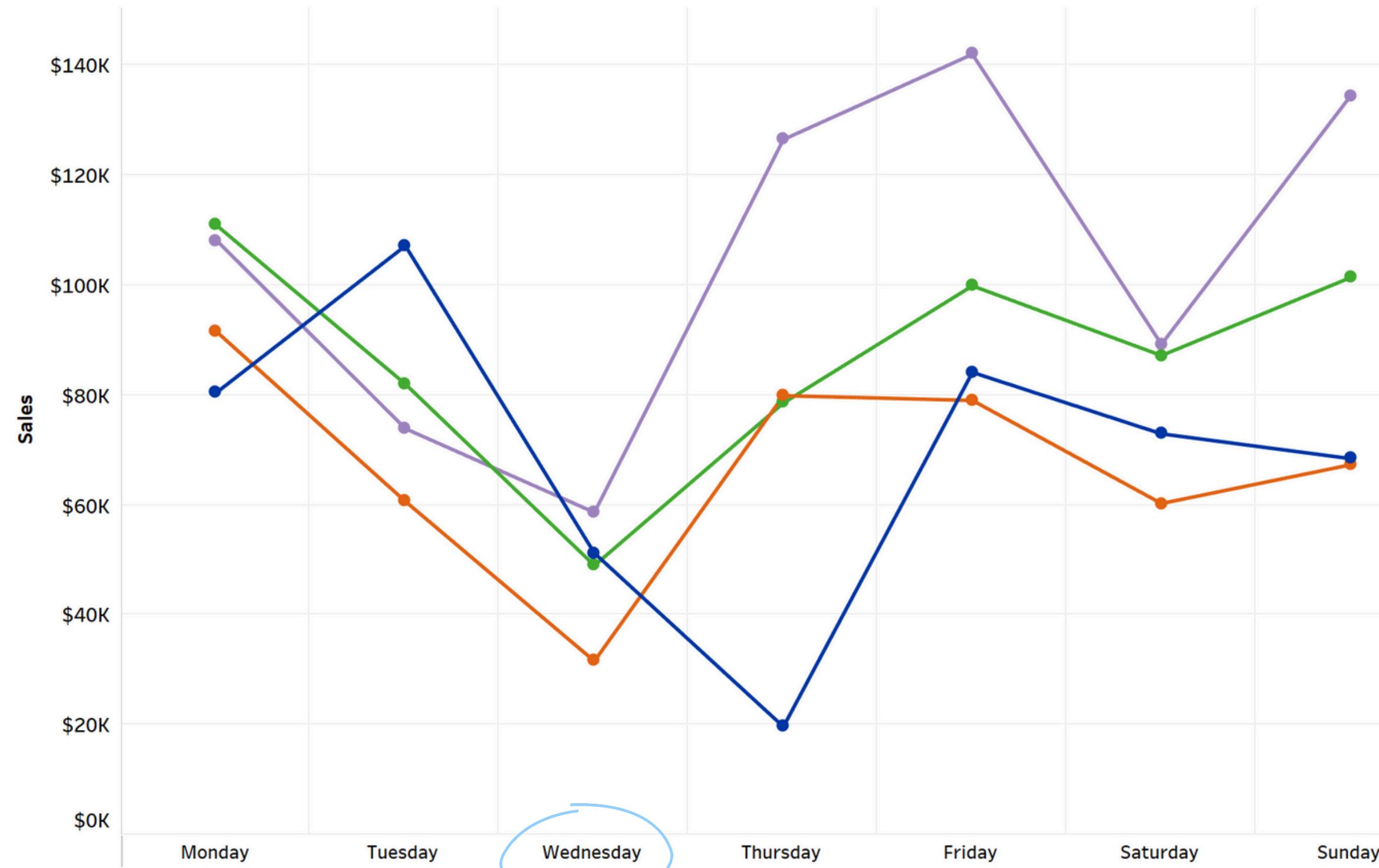
- **East and West:** Strongest areas show a clear upward trend in sales.
 - **South:** Stable sales with minimal fluctuations but limited growth potential.
 - **Central:** More stable than the South, with moderate fluctuations and occasional peaks. It also shows potential for development, ranking behind the East and West.
- Overall, sales growth in 2016 and 2017 was mainly driven by the East and West regions.



3. Time-Series

Weekly Sales Trends Over The Years

● 2014 ● 2015 ● 2016 ● 2017



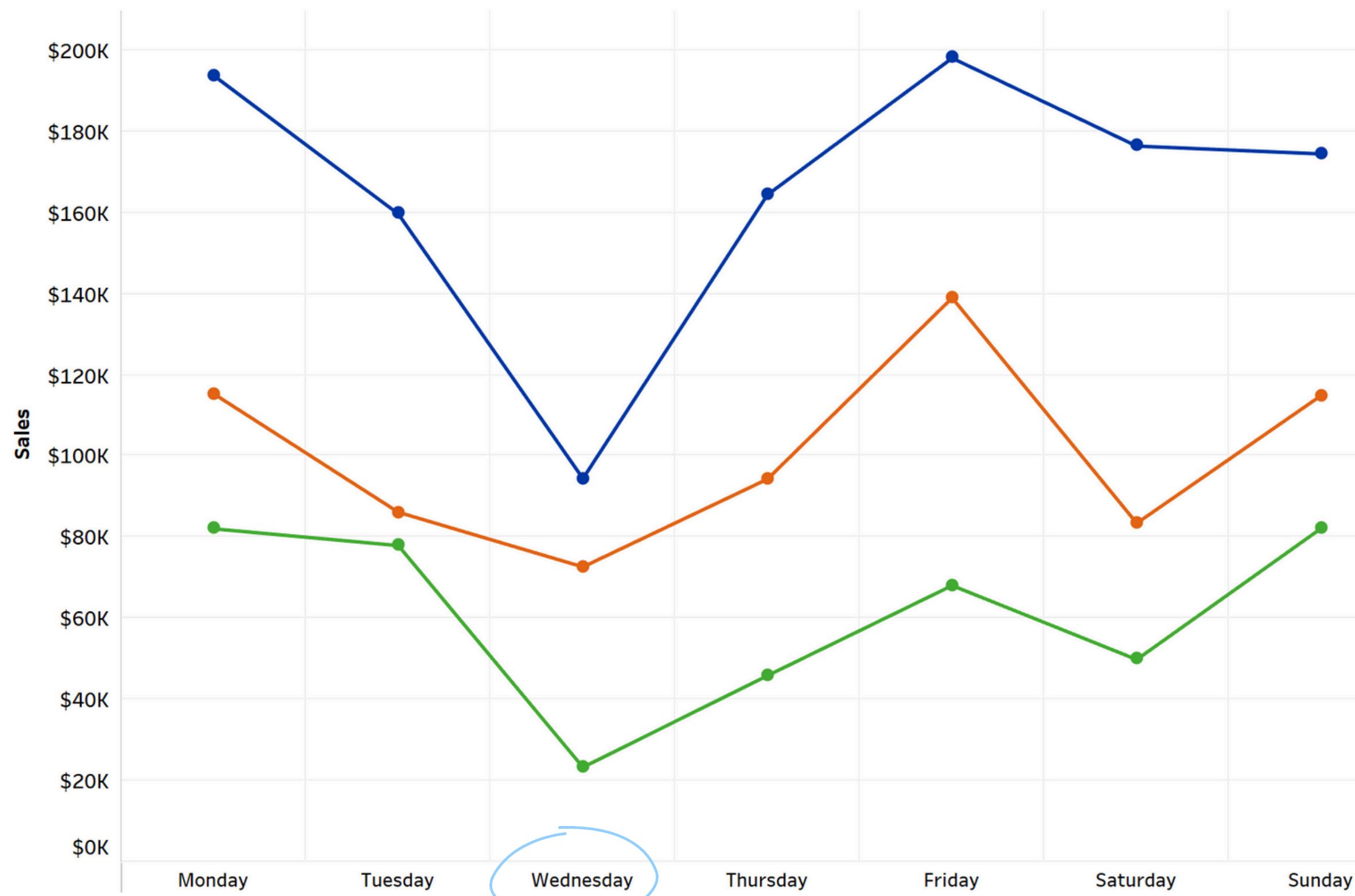
2015 – 2017 Sales Trends

- Sales decline from Monday to Wednesday, indicating weaker demand early in the week.
- Thursday experience increase, consistently reaching a noticeable peak across most years.
- Friday and the highest Friday with

3. Time-Series

Weekly Sales Trends by Customer Segment

● Consumer ● Corporate ● Home Office



- **Consumer Dominance:** The Consumer segment has the highest order volume.
- **Sales decline from Monday to Wednesday** across all customer segments.
- **Thursday and Friday show a strong sales recovery.**
- The Consumer and Home Office segments continue to make purchases over the weekend.
- Corporate sales decline on weekends, as businesses are typically closed.



Correlations Among Key Variables

	Returned	Sales	Quantity	Discount	Shipping time	Profit Adjust	Cost	Profit Margin
Returned	1.000000	-0.002001	0.003537	-0.018258	-0.017147	-0.053925	0.019041	-0.127172
Sales	-0.002001	1.000000	0.200795	-0.028190	-0.002772	0.422303	0.934069	0.006775
Quantity	0.003537	0.200795	1.000000	0.008623	0.002160	0.062140	0.196482	-0.005349
Discount	-0.018258	-0.028190	0.008623	1.000000	0.006536	-0.222700	0.056710	-0.849828
Shipping time	-0.017147	-0.002772	0.002160	0.006536	1.000000	0.011651	-0.007640	-0.004291
Profit Adjust	-0.053925	0.422303	0.062140	-0.222700	0.011651	1.000000	0.070772	0.233755
Cost	0.019041	0.934069	0.196482	0.056710	-0.007640	0.070772	1.000000	-0.084631
Profit Margin	-0.127172	0.006775	-0.005349	-0.849828	-0.004291	0.233755	-0.084631	1.000000

→ Profit margin is **negatively correlated** with two variables: **Discount** and **Return**.



4. Factors affecting profit margin

Product Category	Sales	Sales Trend by Quarter	Profit	Profit Margin	Average Discount	Return Sales Percentage
Furniture	\$742K		\$11.8K	1.6%	17.4%	8.0%
Office Supplies	\$719K		\$110.8K	15.4%	15.7%	6.8%
Technology	\$836K		\$128.0K	15.3%	13.2%	8.7%

Furniture

Has strong sales, but its profit is the lowest. Additionally, the return rate is relatively high.

Office Supplies

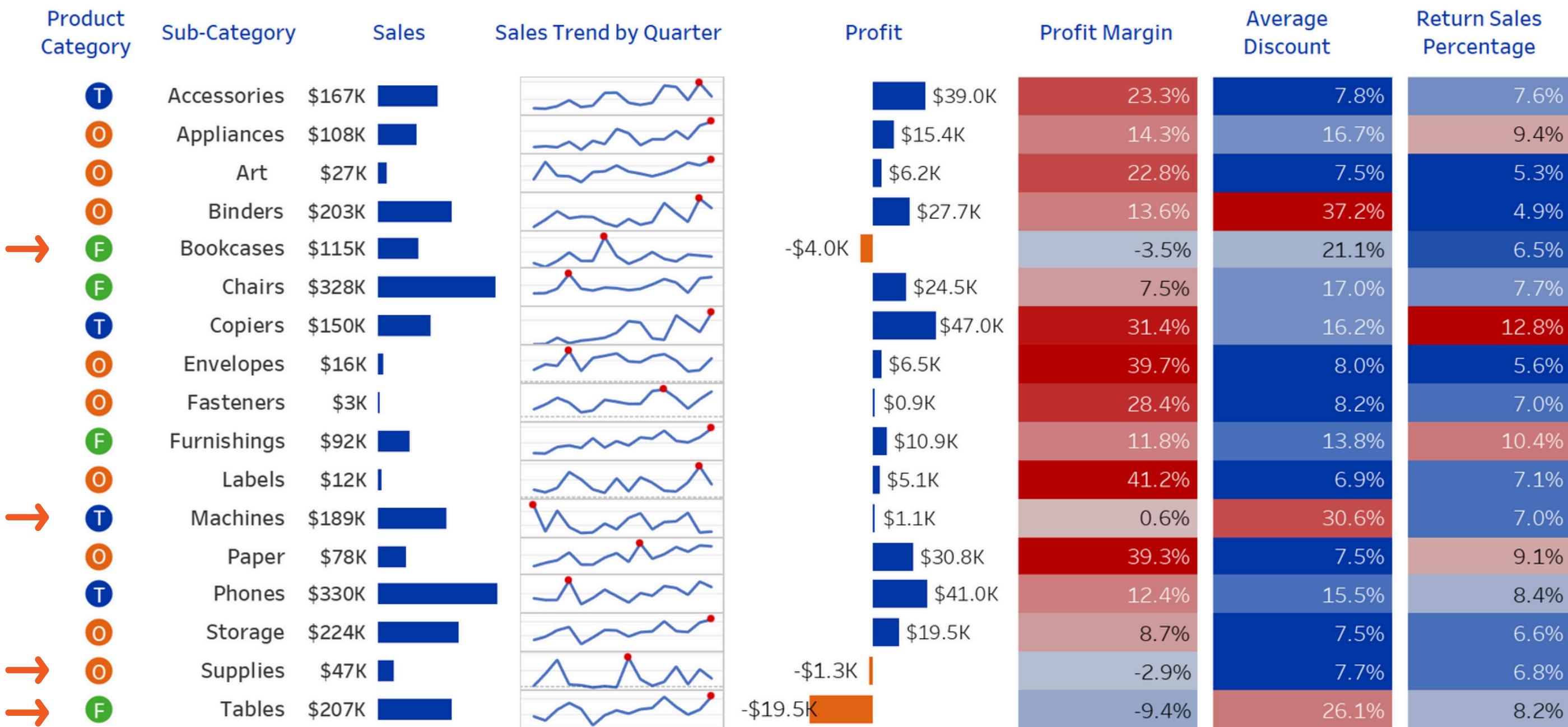
Uses discounting effectively to drive profitability. Moreover, its return rate is the lowest among the three categories

Technology

Leads in Sales & Profit. However, its return sales percentage is the highest.



4. Factors affecting profit margin

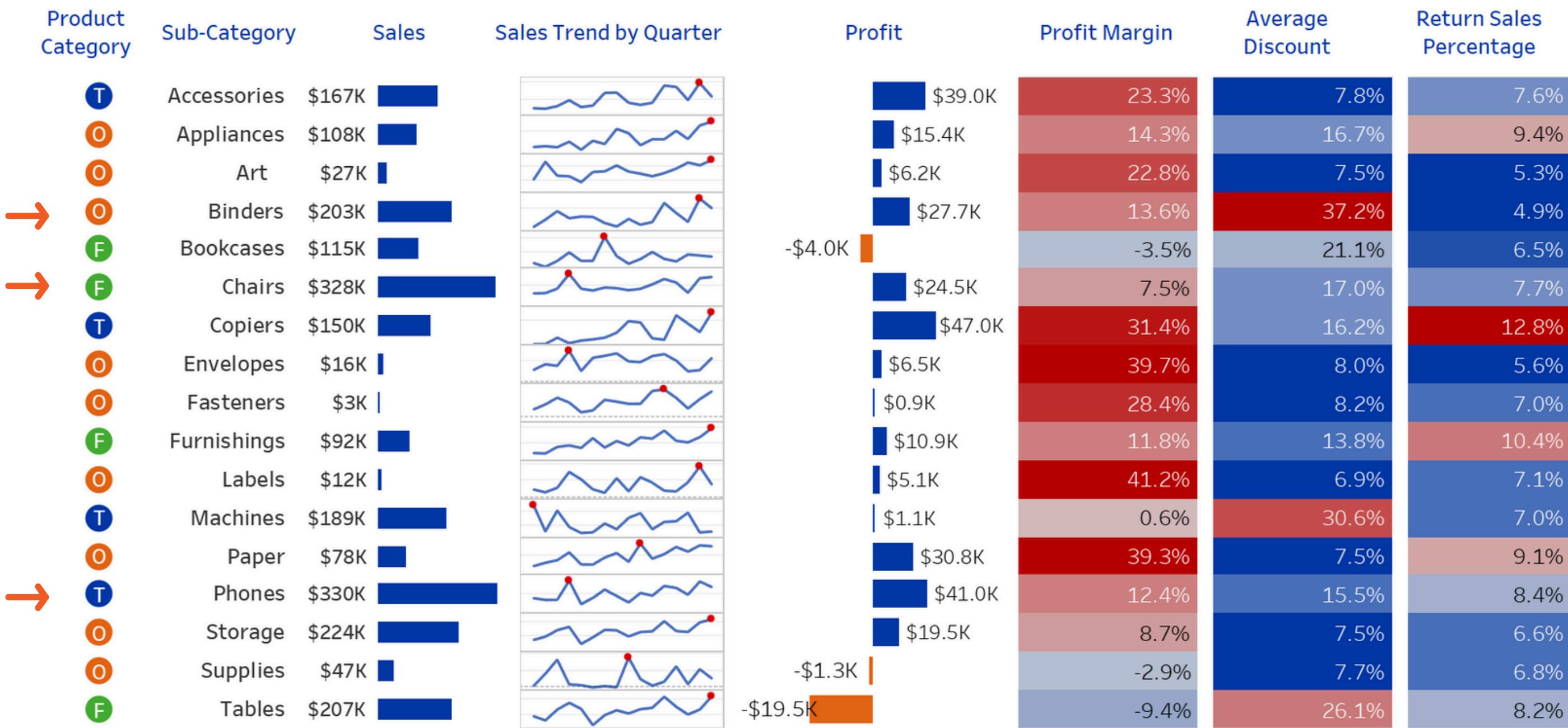


Group 1

Low Profit Margin or Discount > 20%

Tables, Supplies, Bookcases, Machines

4. Factors affecting profit margin



Group 1

Low Profit Margin or Discount > 20%

Tables, Supplies, Bookcases, Machines

Group 2

Good Sales and high Discount 15–30%

Phones, Chairs, Binders

Group 3

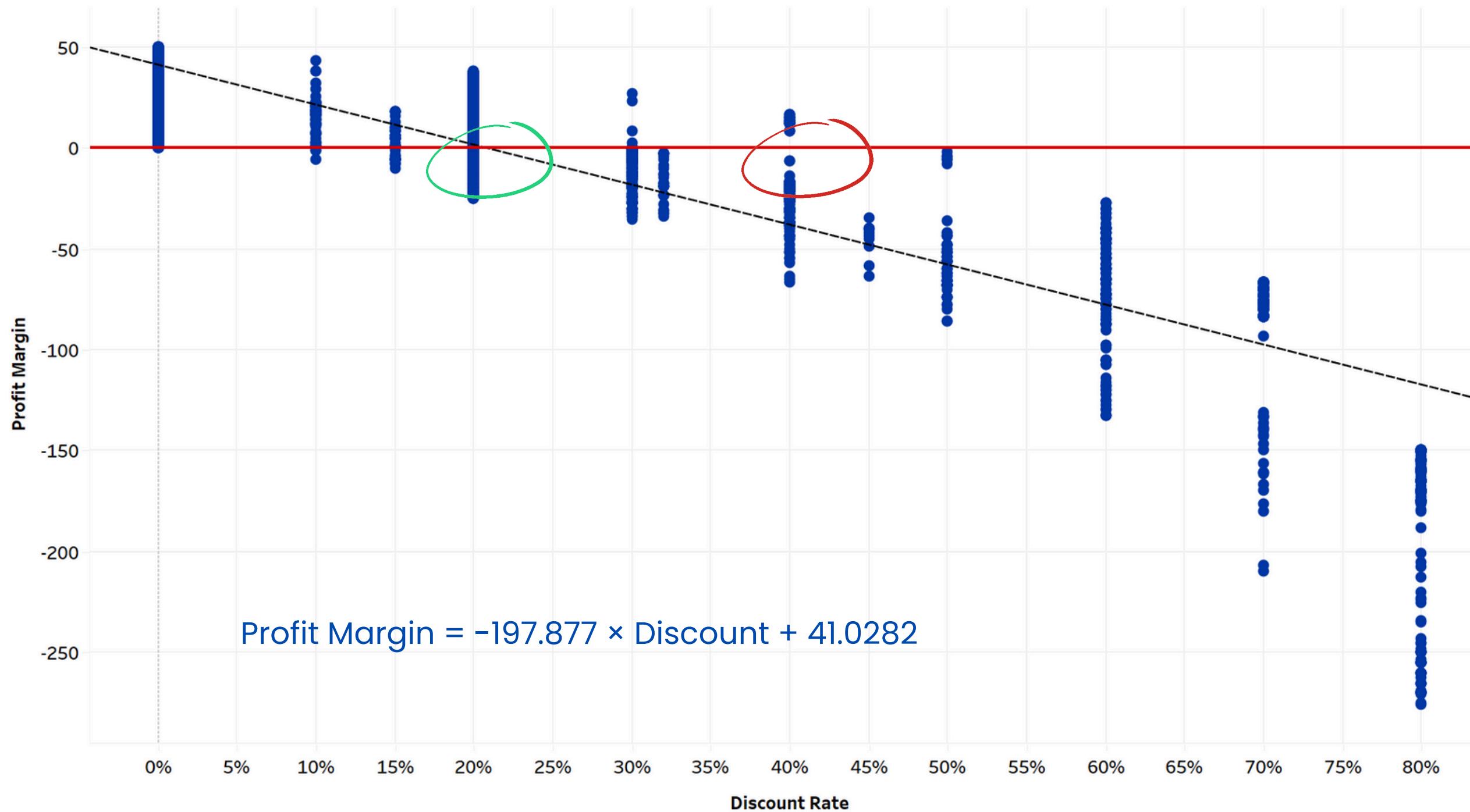
Remaining Products



4. Factors affecting profit margin

Discount Rate

Correlation between Profit Margin and Discount Rate



- Profit Margin and Discount are in an **Inverse relationship**.
- **P-value < 0.0001** confirms strong statistical significance.
- **R-Squared (0.756)** indicates that discount is a dominant factor affecting profit margin.
- **20% Discount → Safe Boundary**
- **40% Discount → Risky Threshold**



**Let's identify the optimal
discount for Group 1 and 2.**



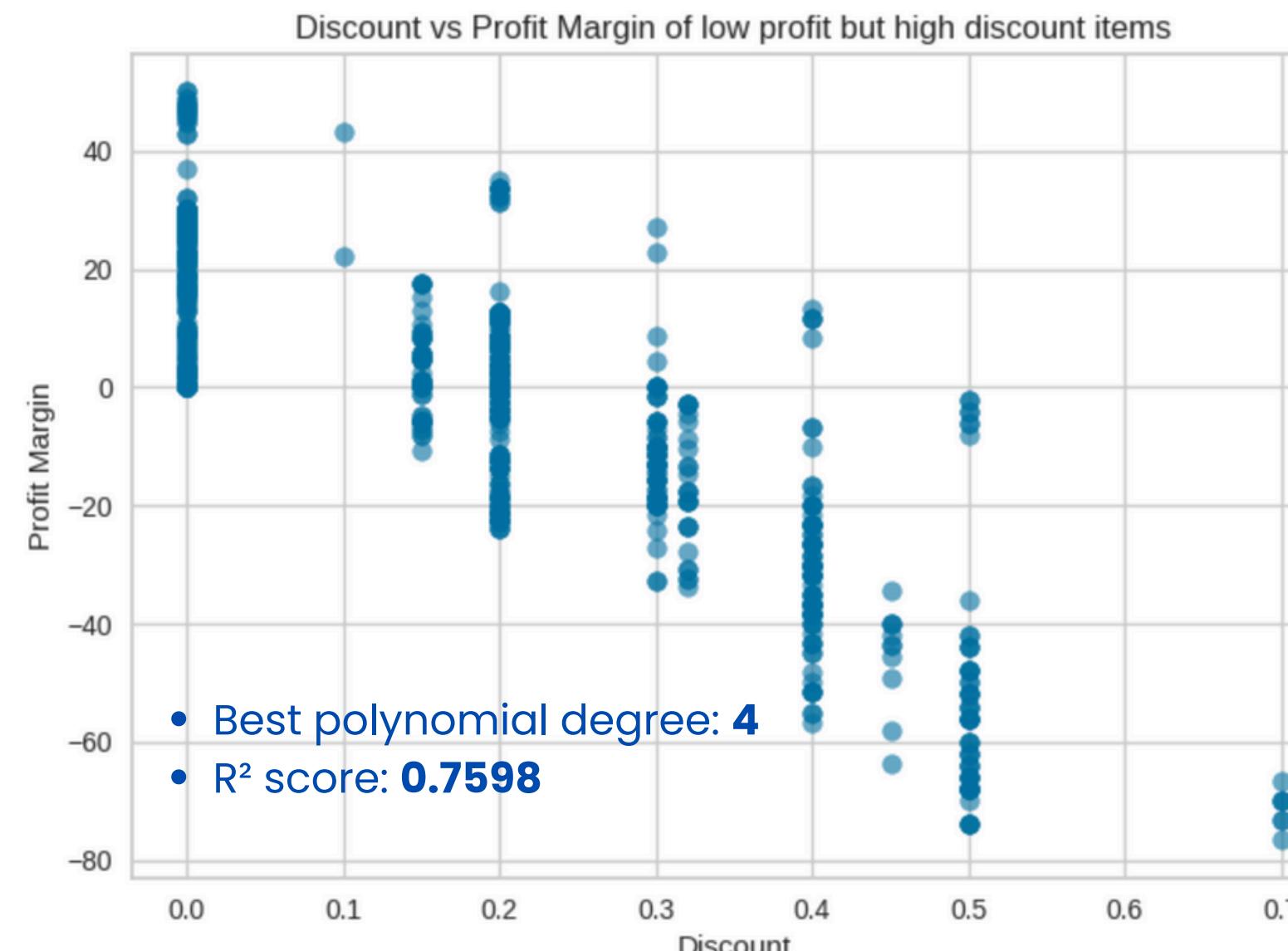
4. Factors affecting Profit Margin

Discount Rate

Solution

Group 1: Low Profit Margin or
Discount greater than 20%

Product	Sub-Category	Sales	Sales Trend by Quarter	Profit	Profit Margin	Average Discount	Return Sales Percentage
F	Bookcases	\$115K		-\$4.0K	-3.5%	21.1%	6.5%
T	Machines	\$189K		\$1.1K	0.6%	30.6%	7.0%
O	Supplies	\$47K		-\$1.3K	-2.9%	7.7%	6.8%
F	Tables	\$207K		-\$19.5K	-9.4%	26.1%	8.2%



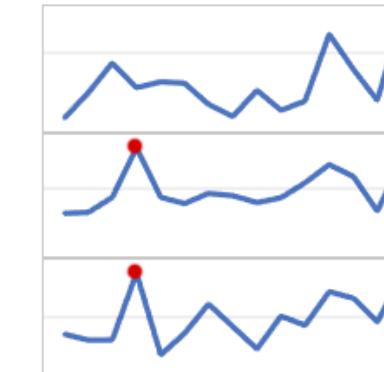
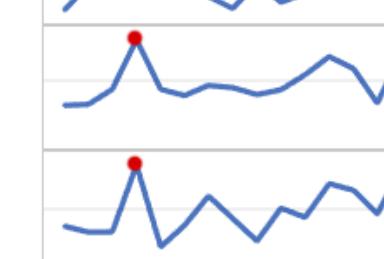
- The optimal discount rate for maximizing profit is 5.00%.
- At this discount rate, the optimal profit margin is 13.21.

4. Factors affecting Profit Margin

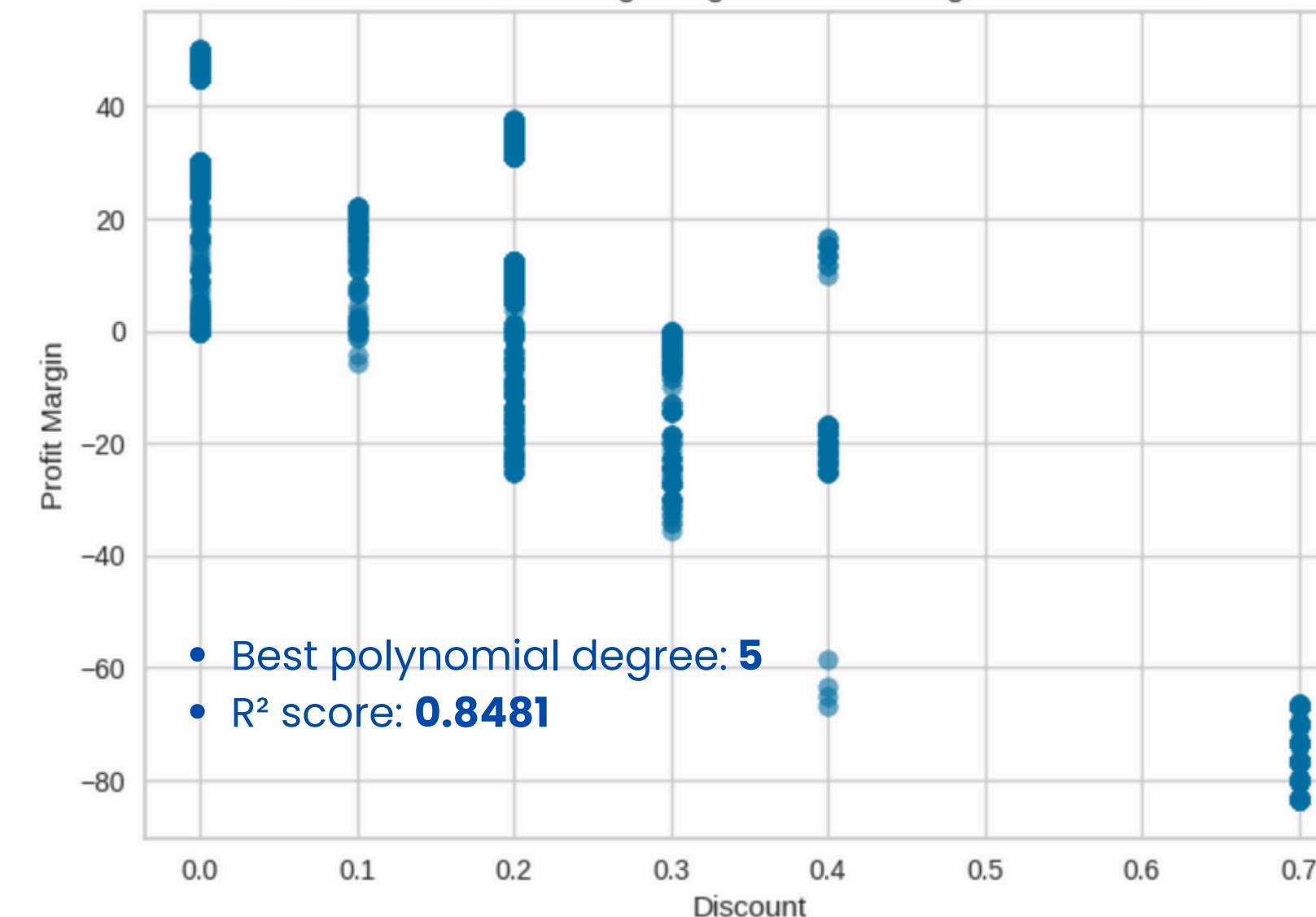
Discount Rate

Solution

Group 2: Good Sales and High Discount 15-30%

Product	Sub-Category	Sales	Sales Trend by Quarter	Profit	Profit Margin	Average Discount	Return Sales Percentage
O	Binders	\$203K		\$27.7K	13.6%	37.2%	4.9%
F	Chairs	\$328K		\$24.5K	7.5%	17.0%	7.7%
T	Phones	\$330K		\$41.0K	12.4%	15.5%	8.4%

Discount vs Profit Margin of good sale and high discount items



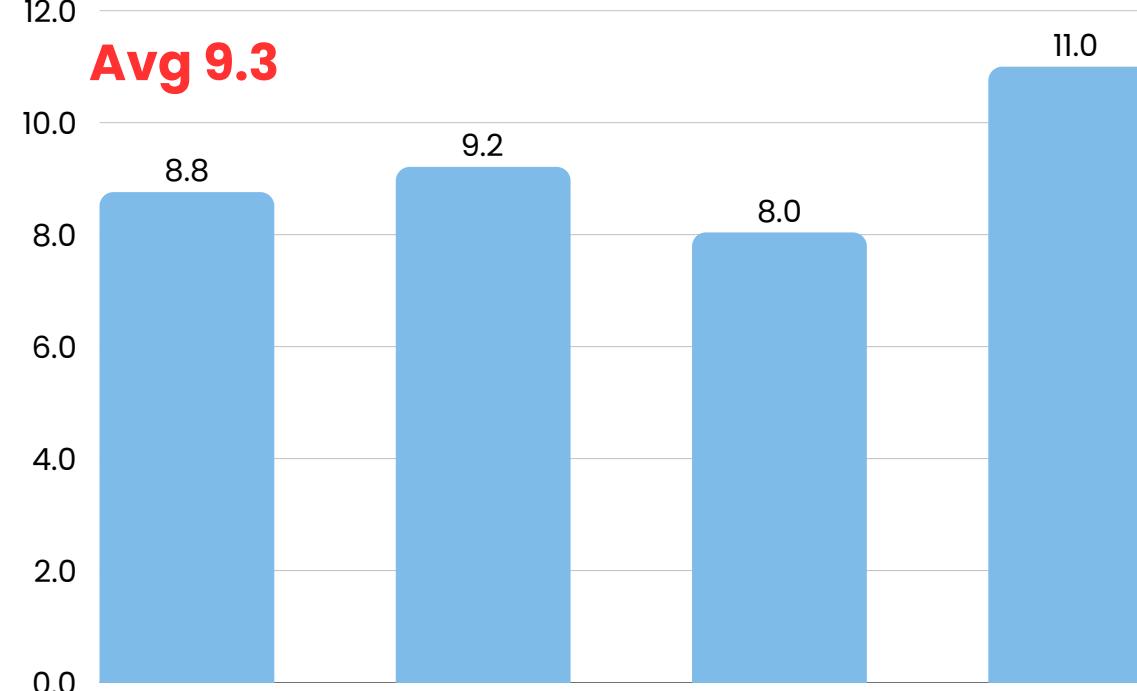
- The optimal discount rate for maximizing profit is 16.53%.
- At this discount rate, the optimal profit margin is 19.14.



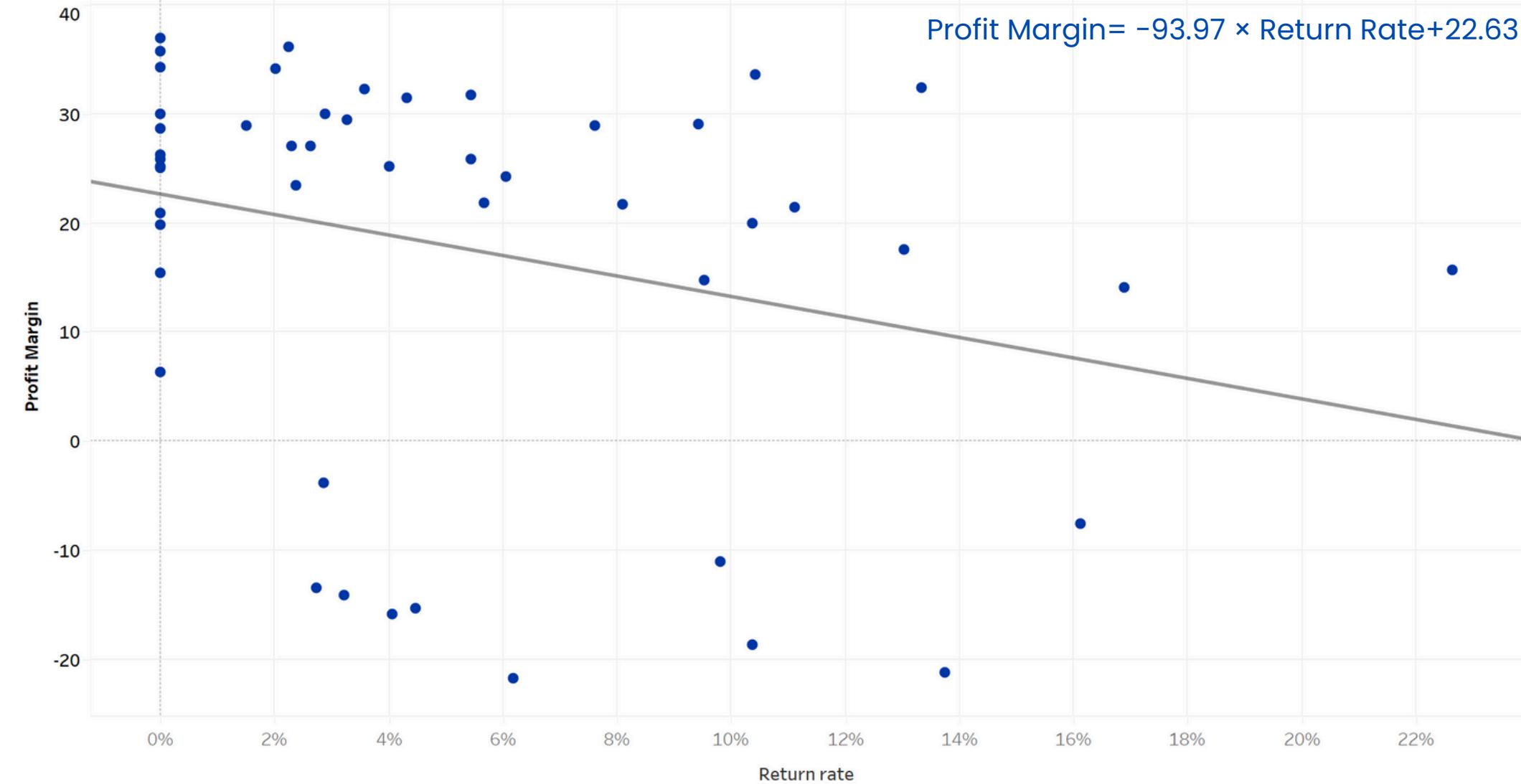
4. Factors affecting Profit Margin

Return Rate

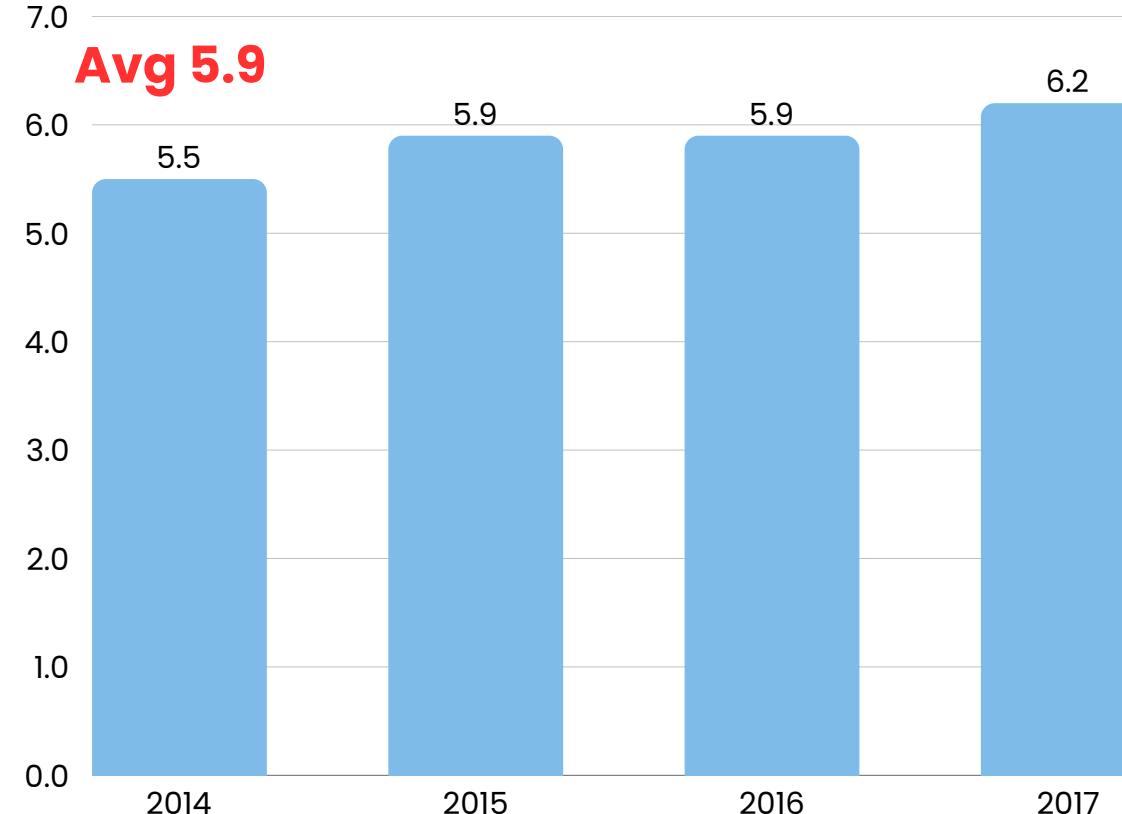
Merchandise returned as a percentage of total retail sales in the United States



Correlation between Profit Margin and Return Rate



Annual Return Sales Percentage by Year



- Profit Margin and Return Rate have an **inverse relationship**.
- **P-value (0.046)** confirms statistical significance, but the return rate alone is not a strong predictor.
- **R-Squared (0.0818)** indicates that the return rate has a weak impact on profit margin.



4. Factors affecting Profit Margin > Return Rate

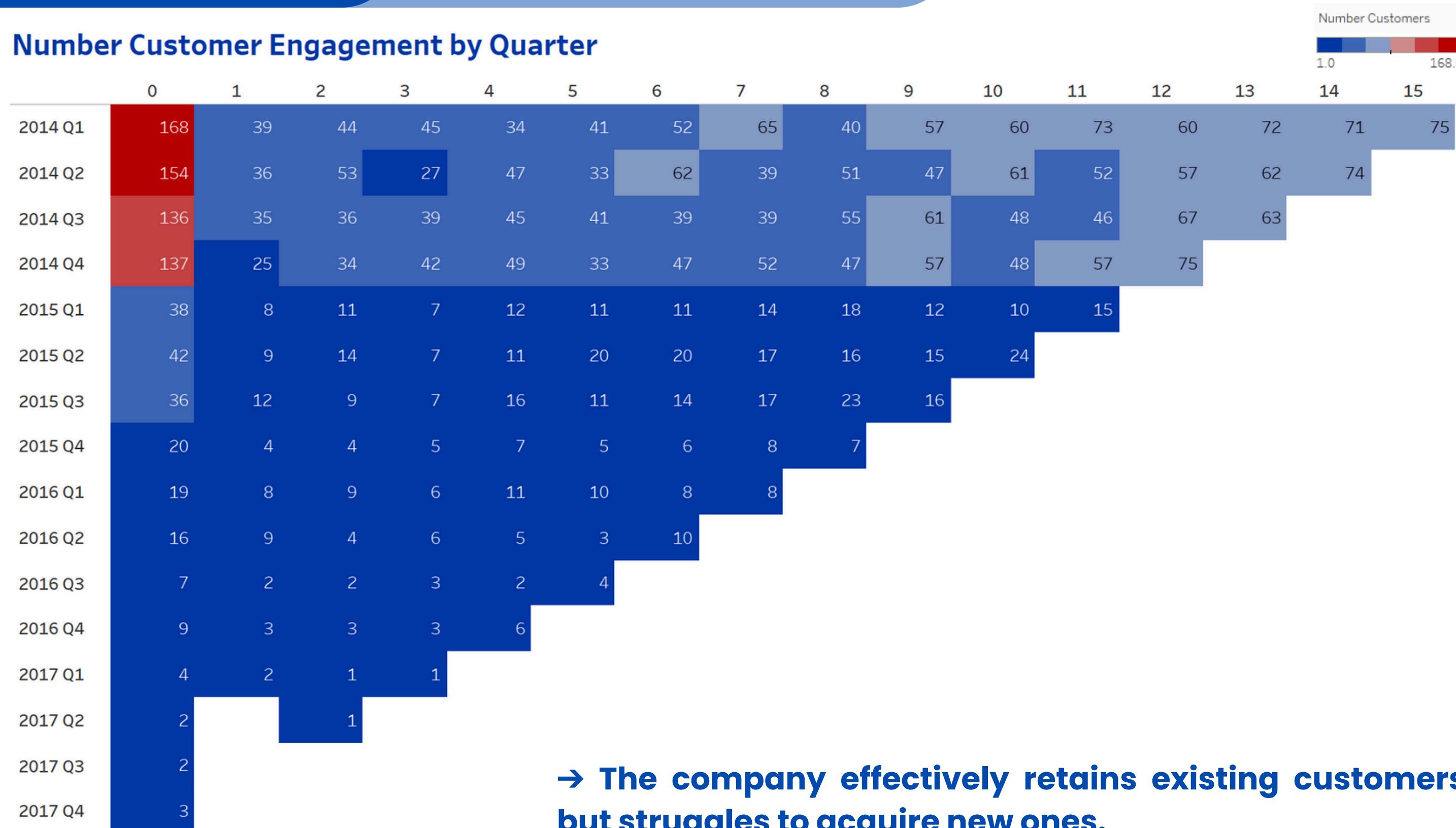
Product Category	Sub-Category	Sales	Sales Trend by Quarter	Profit	Profit Margin	Average Discount	Return Sales Percentage
T	Accessories	\$167K		\$39.0K	23.3%	7.8%	7.6%
O	Appliances	\$108K		\$15.4K	14.3%	16.7%	9.4%
O	Art	\$27K		\$6.2K	22.8%	7.5%	5.3%
O	Binders	\$203K		\$27.7K	13.6%	37.2%	4.9%
F	Bookcases	\$115K		-\$4.0K	-3.5%	21.1%	6.5%
F	Chairs	\$328K		\$24.5K	7.5%	17.0%	7.7%
T	Copiers	\$150K		\$47.0K	31.4%	16.2%	12.8%
O	Envelopes	\$16K		\$6.5K	39.7%	8.0%	5.6%
O	Fasteners	\$3K		\$0.9K	28.4%	8.2%	7.0%
F	Furnishings	\$92K		\$10.9K	11.8%	13.8%	10.4%
O	Labels	\$12K		\$5.1K	41.2%	6.9%	7.1%
T	Machines	\$189K		\$1.1K	0.6%	30.6%	7.0%
O	Paper	\$78K		\$30.8K	39.3%	7.5%	9.1%
T	Phones	\$330K		\$41.0K	12.4%	15.5%	8.4%
O	Storage	\$224K		\$19.5K	8.7%	7.5%	6.6%
O	Supplies	\$47K		-\$1.3K	-2.9%	7.7%	6.8%
F	Tables	\$207K		-\$19.5K	-9.4%	26.1%	8.2%

Copiers, Furnishings, Paper, and Appliances have the highest return rates.



5. Customer Behaviour

Customer Retention





5. Customer Behaviour

Customer Segment

Cluster	RECENCY				FREQUENCY				MONETARY				
	Mean	Median	Min	Max	Mean	Median	Min	Max	Mean	Median	Min	Max	Count
0	138	80	0	1024	14	14	2	32	2692	2649	1822	3794	272
1	145	54	2	835	20	20	6	34	8279	8026	6608	11165	47
2	123	72	1	1092	17	15	3	37	4927	4794	3806	6528	135
3	114	45	9	399	18	17	10	32	14342	13508	11471	25043	14
4	206	117	0	1165	9	8	1	22	954	971	5	1804	32

Recent Customer

0

Moderate-frequency customers, but don't spend much per order.

Potential Loyalists

1

Recent customers with relatively high spending and frequency who have potential to become Champions

Loyal Customers

2

Moderate-frequency customers with average spending.

Champions

3

The best customers who have purchased recently with both high frequency and high-value spending

Hibernating

4

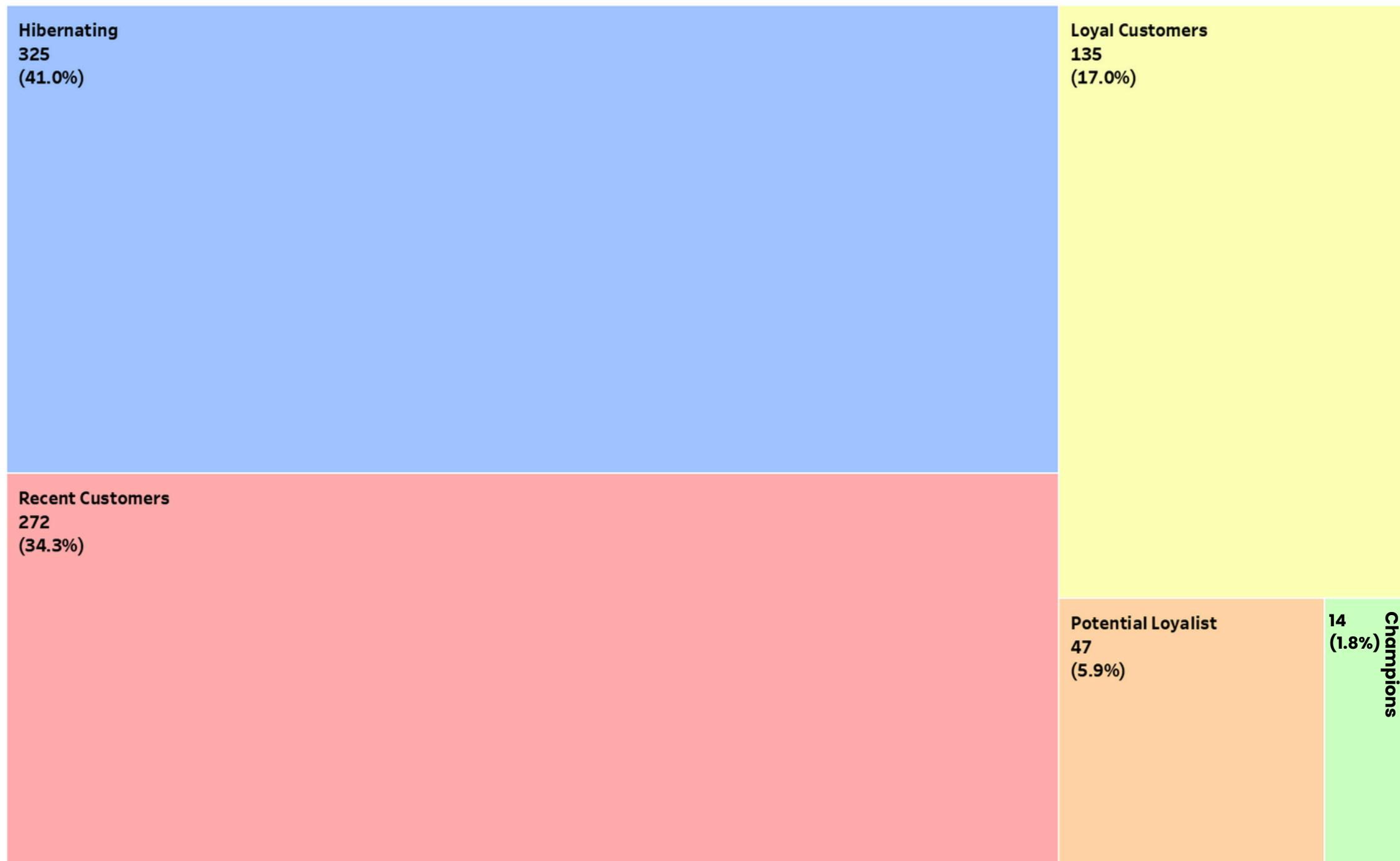
Low-frequency customers who spend little.



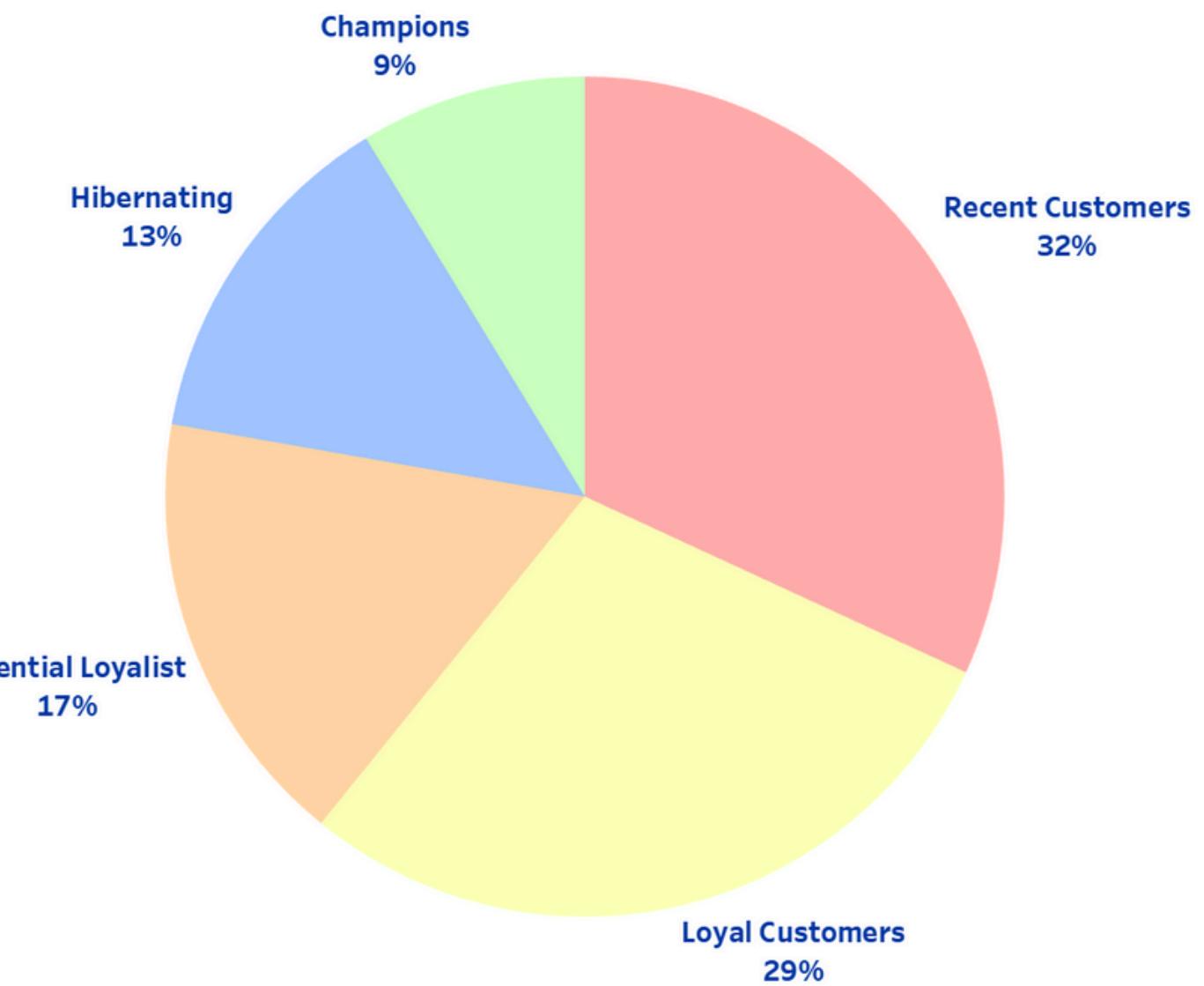
5. Customer Behaviour

Customer Segment

Customer Segment based on RFM Analysis



Sales Percentage by Customer Segment





5. Customer Behaviour

Customer Segment

Key Characteristics	Recent Customers	Potential Loyalist	Loyal Customers	Champions	Hibernating
Top Purchased Category	Furniture (38,3%)	Technology (38,5%)	Technology (37,5%)	Technology (64,2%)	Office Supplies (39%)
Top Purchasing Region	West (34,3%)	East (31,9%)	West (33,7%)	<ul style="list-style-type: none"> Central (31,5%) East (31,5%) 	<ul style="list-style-type: none"> West (30,9%) East (30,5%)



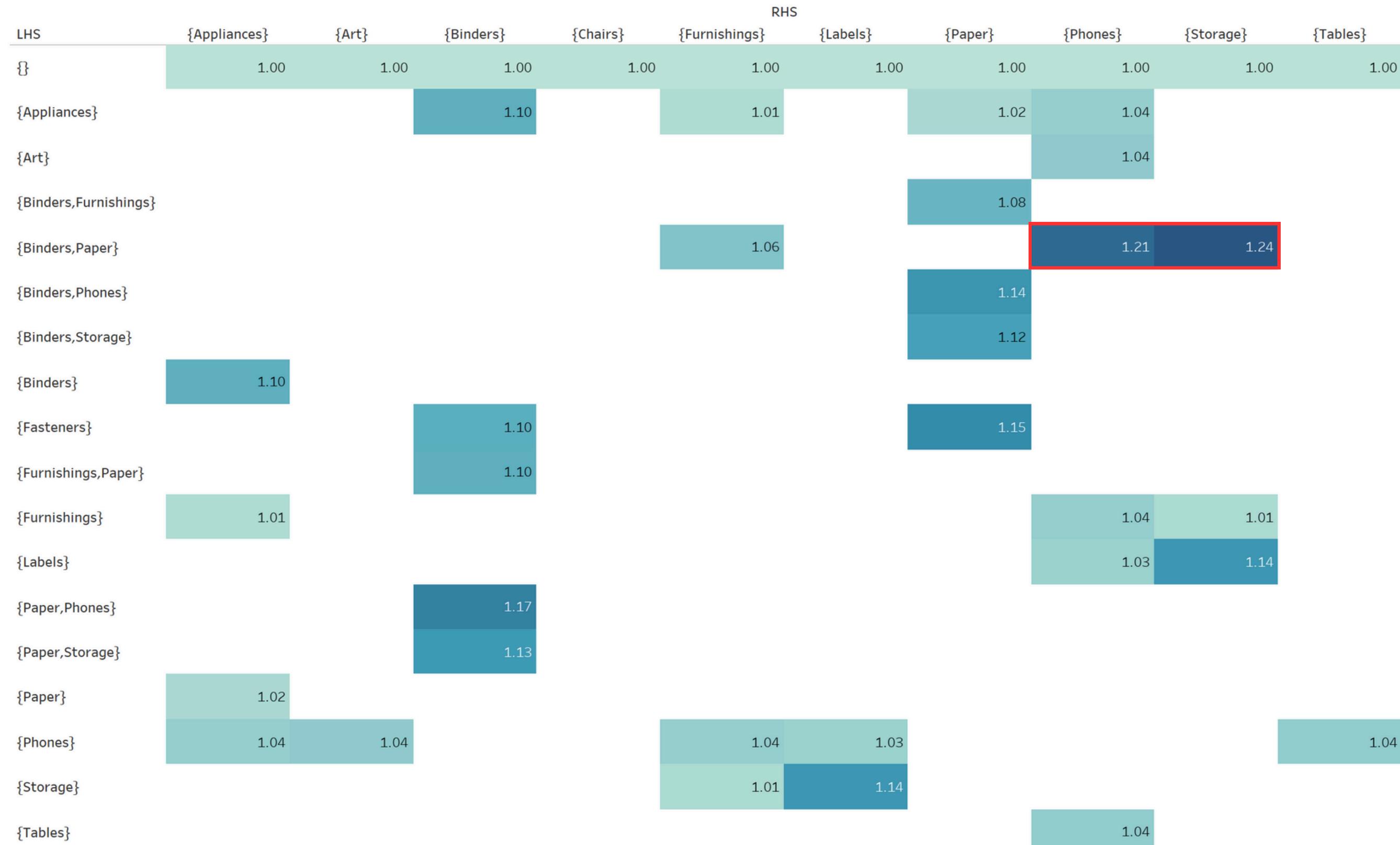
Technology is the dominant category for most clusters.



5. Customer Behaviour

Basket Market Analysis

Market Basket Analysis: Lift Coefficient Heatmap



- Min-Support: 0.01
- Min-Confidence: 0.05
- Min-Lift: 1

Top Product Associations

- **Binders and Paper** are strongly associated with **Phones**
- **Binders and Paper** products often pair with **Storage**

Insight Summary

Time - Series

- The East and West regions drive sales growth, while the Central region shows potential. The South remains stable but has limited growth opportunities.
- Sales decline from Monday to Wednesday and peak on Friday across years and segments.
- Consumers lead sales, whereas corporate sales decline on weekends.

Factors affecting Profit Margin

- The discount rate is a dominant factor affecting profit margin.
 - 20% Discount → Safe Boundary
 - 40% Discount → Risky Threshold
- Products requiring discount rate adjustment:
 - Low Profit Margin or High Discount (>20%): Tables, Supplies, Bookcases, and Machines.
 - High Sales and High Discount (15-30%): Phones, Chairs, and Binders.
- The return rate does not strongly influence profit margin.
- Products with a high return rate include Copiers, Furnishings, Paper, and Appliances.

Customer Behaviour

- The company effectively retains existing customers but struggles to acquire new ones.
- 60% of revenue comes from the Recent Customers and Loyal Customers segments.
- Technology is the dominant product category across most customer segments, especially among Champions.
- Popular product combinations: Binders & Paper - Phones, Binders & Paper - Storage.

Recommendations

Optimal Discount Rate Adjustments

- ✓ Low profit margin or discount > 20%: Reduce the discount rate to 5.00% to improve profit margin.
- ✓ Good sales and high discount 15–30%: Optimize discount at 16.53% to balance sales volume and profit margin.

Time-Series Strategies

- ✓ Boost early-week sales by offering discounts and promotions for business clients.
- ✓ Leverage high demand on Thursdays & Fridays by offering exclusive deals and targeted marketing.

Retention Improvement

- ✓ Enhance marketing efforts to attract new customers.
- ✓ Use promotions and targeted campaigns to drive customer acquisition.

Product Strategies

- ✓ Bundle Strategy: Offer pre-packaged deals such as Binders – Paper – Phones and Binders – Paper – Storage.
- ✓ Cross-Sell Tactics: Promote Binders & Paper when customers purchase Phones or Storage.
- ✓ Discount Optimization: Offer bundle savings instead of individual discounts to increase cart value.

THANK YOU

