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1. AI and Web Sources

Documentation of all sources used in the production of this report

2. Executive Summary

High level overview of key findings and strategic recommendations for immediate action

3. Summary Report

a) Financial Trends and Forecasting

Analyzing the revenue drop from 2022 to 2023 across all payment types and Linear extrapolation with a zero-floor constraint.

b) Inventory Health and Stock Optimization

Highlighting high-risk categories and calculating the ratio of sales to inventory to identify bestselling products.

c) Warehouse Operational Efficiency

Assessing warehouse performance using a custom efficiency score to the most efficient facility for maximizing output.

d) Seasonal Peaks for Staffing Considerations

Averaging 4 years of data to identify the recurring seasonal peaks for staffing purposes

AI and Web Sources

- To construct this report, the following sources were used:
 - ChatGPT - helped decide what other analyses i could do using information from prior lab assignments.
 - ChatGPT - helped write the executive summary based on all analyses carried out.
 - Gemini - assisted with analyzing visualizations and offering suggestions for what to recommend to management.
 - [Microsoft Office Tutorial on Analyzing Data](#) - gave me some ideas on how to analyze the visualizations.
 - <https://online.sou.edu/degrees/business/mba/information-analysis-and-decision-making/take-small-business-to-the-next-level/> - helped me understand the importance of using data analysis to make business decisions
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Executive Summary

Project Objective:

To analyze the company's operational data across four key pillars: Warehouse Efficiency, Inventory Health, Financial Trends, and Seasonal Demand, in order to identify cost-saving opportunities and optimize resource allocation for the 2024 fiscal year.

Key Findings:

Operational Benchmark: The Toronto Warehouse has emerged as the clear leader in operational efficiency (Score: 0.042). It achieves high shipping throughput while maintaining lean inventory levels, outperforming other locations that are currently slowed down by excess stock.

Financial Trajectory: A linear forecast for 2024 indicates a continued decline in revenue across all payment channels. Specifically, niche payment methods (ApplePay and AMEX) are projected to reach near-zero usage, rendering them obsolete.

Inventory Risks: We have identified a significant "Supply-Demand Gap" in the Technology and Household categories, where stock levels are high but sell-through rates are critical. Conversely, the Media category remains a strong performer that is currently under-prioritized.

Seasonal Volatility: Historical data reveals predictable revenue surges in May and September, with deep slumps in February. Current staffing models are causing inefficiencies during these fluctuations.

Product Performance Trends: The analysis of the top 5 products show that in 2024 they are predicted to continue growing whilst the bottom 5 products were predicted to remain flat or even decline.

Regional Insights: Most provinces are predicted to maintain or slightly reduce in sales however British Columbia shows signs of having a vast increase in sales based on historical data between 2022 and 2023.

Strategic Recommendations:

1. Optimize Warehouse Operations

Standardize the "Toronto Model": Audit Toronto's workflow and implement their staffing and layout procedures at the underperforming Kelowna and Winnipeg locations.

Liquidate Dead Stock: Immediately initiate clearance sales for the stagnant Technology and Household inventory to free up capital and warehouse space.

2. Rationalize Financial Overheads

Phase Out Niche Payments: Remove ApplePay and AMEX support to eliminate unnecessary merchant fees and administrative maintenance.

Focus on Retention: Shift resources from payment optimization to customer retention marketing to address the broader trend of declining order volumes.

3. Implement Dynamic Resourcing

Adopt "Flex" Staffing: Move away from static hiring. onboard temporary staff in April to prepare for the May peak, and reduce hours during the February slump.

Synchronize Inventory: Align bulk ordering schedules to arrive 30 days prior to the May and September peaks, prioritizing the efficient Toronto facility for these high-velocity goods.

4. Increase marketing budget: Due to most of the regions staying the same in sales and even lowering we should adjust the stock levels in order to free up some of the budget for marketing opportunities to all provinces in order to raise sales but especially to BC in order to capitalise on the already increasing growth.

5. Potentially cut products that don't sell: The products that we sell the least don't show any signs of increasing and predictions actually show that the sales will decrease greatly therefore we should focus more on the top 5 products and contemplate whether the bottom 5 are necessary to keep providing to customers.

Summary Report

1. Customers By Region

Overall approach:

First, we use sql to calculate the sales per province per year then these historical sales values are used to predict the sales per province for 2024 via a linear growth method. This is assuming that there are no sudden changes within the customer base within each province including many people leaving the province or the demand for a product changing.

Calculations:

We first wrote an sql statement to calculate the sales per state for each year already in the database:

```
SELECT shiptoState, sum(quantity * price) as total, YEAR(orderDate) as Year
FROM ordersummary, orderproduct
WHERE ordersummary.orderId = orderproduct.orderId
AND YEAR(orderDate) >= '2020' AND YEAR(orderDate) <= '2023'
GROUP BY shiptoState, YEAR(orderDate)
ORDER BY YEAR(orderDate)
```



Province	2020	2021	2022	2023	Total 2020 - 2023
Alberta	\$57,682.18	\$80,828.15	\$ 95,618.36	\$ 71,718.73	\$ 305,847.42
British Columbia	\$73,047.96	\$66,146.74	\$ 33,439.22	\$ 85,596.16	\$ 258,230.08
Manitoba	\$57,405.94	\$49,579.82	\$ 57,642.91	\$ 56,924.16	\$ 221,552.83
New Brunswick	\$74,590.41	\$55,136.33	\$ 58,589.40	\$ 46,020.79	\$ 234,336.93
Niagara Falls, Ontario	\$53,643.10	\$68,872.75	\$ 56,226.82	\$ 52,680.85	\$ 231,423.52
Nova Scotia	\$80,983.15	\$93,465.33	\$ 59,213.64	\$ 64,821.49	\$ 298,483.61
Ontario	\$46,437.37	\$69,278.29	\$ 63,649.29	\$ 45,240.15	\$ 224,605.10
Prince Edward Island	\$69,803.49	\$81,827.71	\$ 63,836.47	\$ 49,397.54	\$ 264,865.21
Quebec	\$61,529.89	\$52,885.92	\$ 86,881.89	\$ 53,667.06	\$ 254,964.76
Saskatchewan	\$42,516.12	\$87,753.46	\$101,210.99	\$ 47,263.78	\$ 278,744.35

Figure 1: Total sales per province between 2020 and 2023

Province	2020	2021	2022	2023	Total 2020 - 2023	2024 prediction
Alberta	\$57,682.18	\$80,828.15	\$ 95,618.36	\$ 71,718.73	\$ 305,847.42	\$ 90,686.82
British Columbia	\$73,047.96	\$66,146.74	\$ 33,439.22	\$ 85,596.16	\$ 258,230.08	\$ 65,791.79
Manitoba	\$57,405.94	\$49,579.82	\$ 57,642.91	\$ 56,924.16	\$ 221,552.83	\$ 57,042.65
New Brunswick	\$74,590.41	\$55,136.33	\$ 58,589.40	\$ 46,020.79	\$ 234,336.93	\$ 38,020.29
Niagara Falls, Ontario	\$53,643.10	\$68,872.75	\$ 56,226.82	\$ 52,680.85	\$ 231,423.52	\$ 53,972.71
Nova Scotia	\$80,983.15	\$93,465.33	\$ 59,213.64	\$ 64,821.49	\$ 298,483.61	\$ 53,936.74
Ontario	\$46,437.37	\$69,278.29	\$ 63,649.29	\$ 45,240.15	\$ 224,605.10	\$ 53,846.11
Prince Edward Island	\$69,803.49	\$81,827.71	\$ 63,836.47	\$ 49,397.54	\$ 264,865.21	\$ 46,414.03
Quebec	\$61,529.89	\$52,885.92	\$ 86,881.89	\$ 53,667.06	\$ 254,964.76	\$ 66,343.06
Saskatchewan	\$42,516.12	\$87,753.46	\$101,210.99	\$ 47,263.78	\$ 278,744.35	\$ 76,611.21

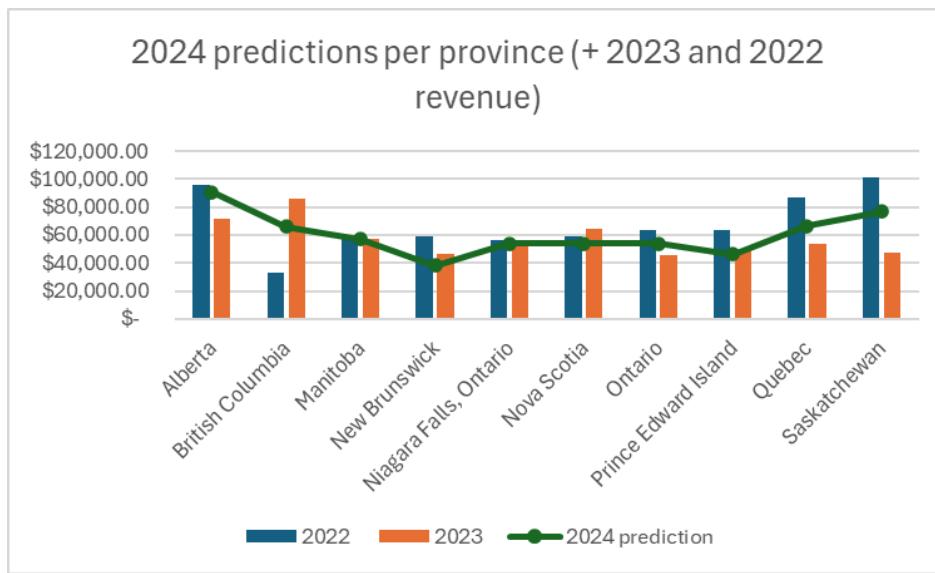


Figure 2: 2024 prediction for sales per province

Recommendations to management:

1. Most of the provinces are predicted to stay the same if not reduce therefore it would be smart to increase our advertising in order to gain more traction and boost sales. This would be especially effective in Ontario and Saskatchewan as they had the lowest profit in 2023.
2. Almost all provinces are predicted to reduce in sales therefore we should reduce stock meaning we could push some more of the budget towards advertising.
3. British Columbia has a spike between 2022 and 2023 therefore we should push a lot of our marketing towards there in order to capitalise on the growing demand.

2. Best and Worst Products

Overall Approach:

Using SQL queries we calculated the top and bottom 5 products overall. Once we got the IDs of those products then we used another sql query to get the yearly revenue for each of the top and bottom 5 products. After that we then calculated the predictions using excel's built in function: =FORECAST.LINEAR(2024, B2:F2, {2019,2020,2021,2022,2023}).

This method assumes that any trends that cause spikes and falls between 2019 and 2023 will remain the same in 2024 as we are directly using that data to make our prediction and that there would be no sudden changes in 2024 that will make our assumptions untrustworthy.

Calculations:

Sql query for top 5 products (modified from desc to asc for top/bottom but the query remains essentially the same for all charts)

```
SELECT TOP 5 p.productId, p.productName, SUM(op.quantity * op.price) AS totalRevenue
FROM product p
JOIN orderproduct op ON p.productId = op.productId
JOIN ordersummary os ON op.orderId = os.orderId
GROUP BY p.productId, p.productName
ORDER BY totalRevenue DESC
```

productId	productName	totalRevenue
81	Aerodynamic Copper Bag	\$ 32,684.89
70	Heavy Duty Plastic Knife	\$ 29,536.23
72	Ergonomic Iron Lamp	\$ 25,879.65
160	Practical Cotton Wallet	\$ 25,731.17
150	Incredible Wool Plate	\$ 23,343.69

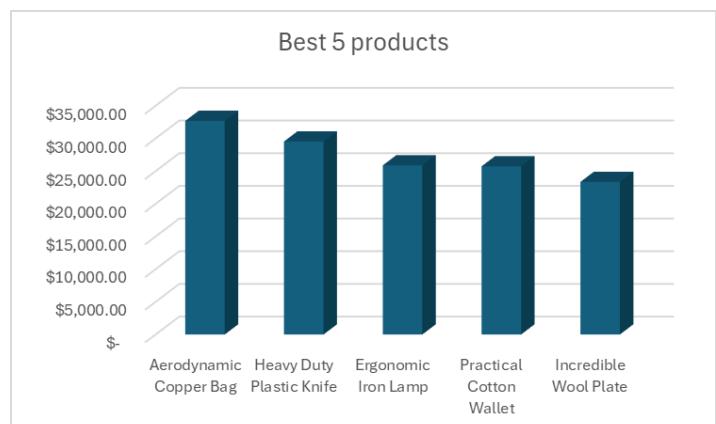


Figure 1: Best selling products overall

productId	productName	totalRevenue
174	Sleek Bronze Keyboard	\$ 2,404.30
48	Lightweight Aluminum Gloves	\$ 3,502.07
162	Enormous Wool Wallet	\$ 4,156.69
61	Synergistic Iron Car	\$ 4,290.21
40	Fantastic Silk Knife	\$ 4,515.65

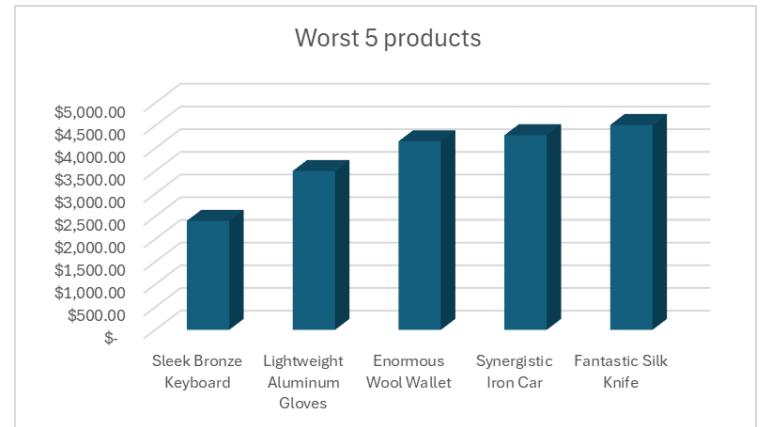


Figure 2: Worst selling products overall

Sql for the yearly revenue of the bottom 5 products(same sql used for top 5 but different productIds in the brackets):

```

SELECT
    p.productId,
    p.productName,
    YEAR(os.orderDate) AS year,
    SUM(op.quantity * op.price) AS totalRevenue
FROM product p
JOIN orderproduct op ON p.productId = op.productId
JOIN ordersummary os ON op.orderId = os.orderId
WHERE p.productId IN (174, 48, 162, 61, 40)
GROUP BY
    p.productId,
    p.productName,
    YEAR(os.orderDate)
ORDER BY
    p.productId,
    year;

```

Product Name	2019	2020	2021	2022	2023	2024 prediction
Enormous Wool Wallet	\$ 376.67	\$ 881.44	\$ 1,461.66	\$ 919.52	\$ 517.40	\$ 927.20
Lightweight Aluminum Gloves		\$ 794.99	\$ 1,782.68		\$ 924.40	\$ 1,102.47
Fantastic Silk Knife	\$ 571.28	\$ 100.96	\$ 323.85	\$ 2,517.56	\$ 1,002.00	\$ 1,886.54
Synergistic Iron Car		\$ 2,427.49		\$ 76.60	\$ 1,786.12	\$ 610.68
Sleek Bronze Keyboard			\$ 1,334.95	\$ 1,069.35		\$ 538.15

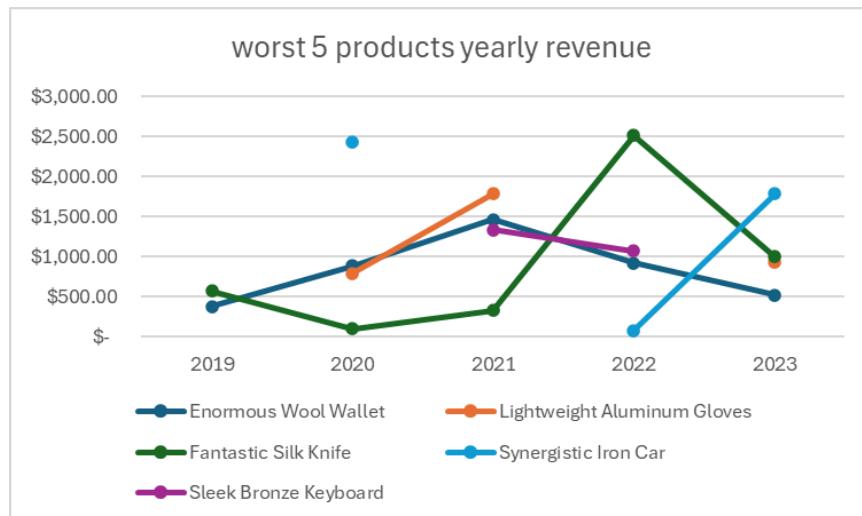


Figure 3: Yearly revenue of the overall worst selling products

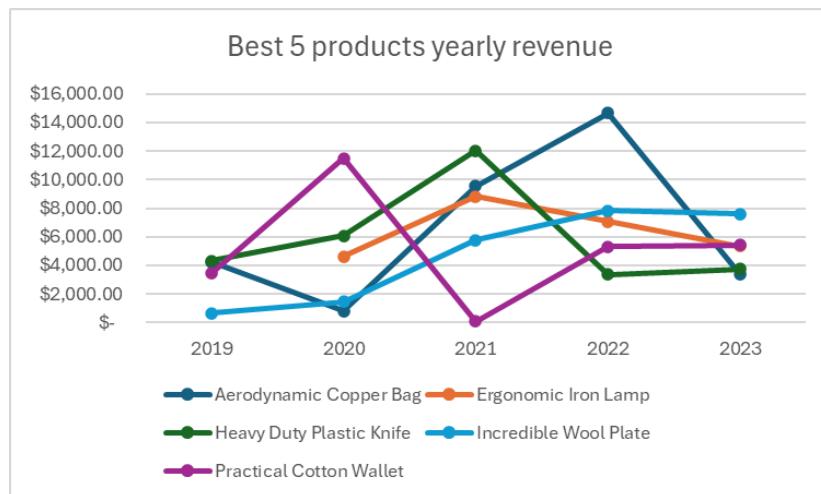
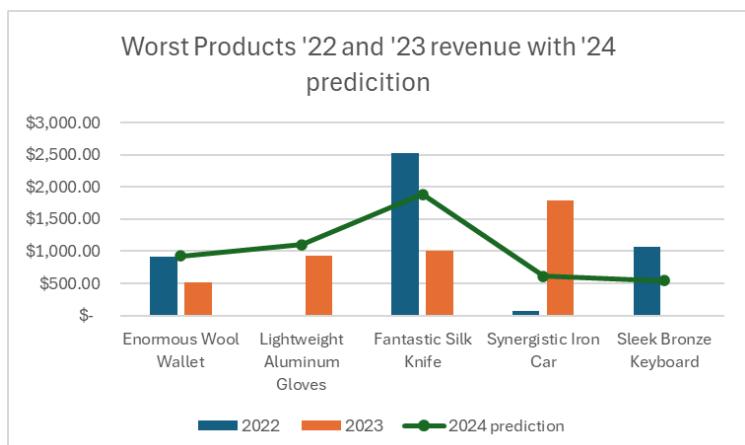
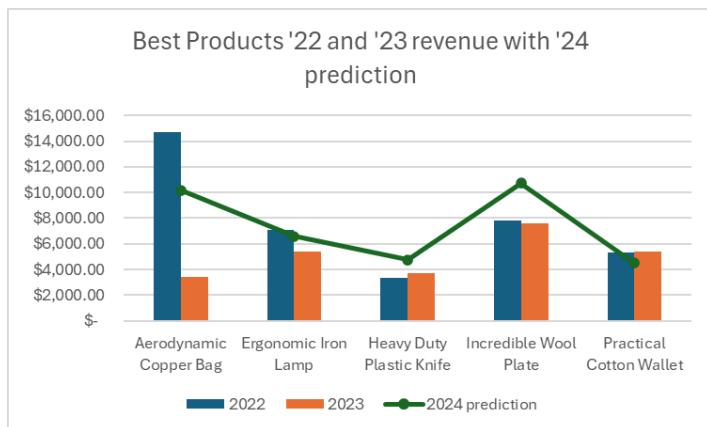


Figure 4: Yearly revenue of the best selling products overall

The 2024 predication was calculated via: =FORECAST.LINEAR(2024, B2:F2, {2019,2020,2021,2022,2023}) and plotted as a line on the bar chart containing 2023 and 2024 revenue





Recommendations to management:

1. Predicted sales for 2024 for the top 5 products either increased from 2023 or stayed the same therefore we should think about increasing some of the stock of the products.
2. Predicted sales for 2024 for the bottom 5 products either stay around the same or decrease therefore we should reduce the stock of these products.

3. Payment Methods

Overall Approach:

Methodology: Linear Extrapolation - To predict 2024 revenue, we utilized a linear trend model based on the absolute year-over-year performance change between 2022 and 2023. This method assumes that the specific growth or decline observed in the previous period will remain constant for the next year.

SQL Queries:

Payment Methods in 2022 and 2023 (WHERE clause YEAR modified for 2023 but otherwise the same query for both)

```
= Sql.Database("cosc304.ok.ubc.ca", "analysis", [Query="SELECT
    pm.paymentType,
    SUM(o.totalAmount) AS totalPaymentAmount
FROM orderSummary o
JOIN shipment s ON o.shipmentId = s.shipmentId
JOIN (
    SELECT customerId, MIN(paymentMethodId) as defaultPaymentId
    FROM paymentMethod
    GROUP BY customerId
    ) pm ON pm.customerId = o.customerId
    WHERE YEAR(o.orderDate) = 2022
    GROUP BY pm.paymentType"])
```

```

) customer_card ON o.customerId = customer_card.customerId
JOIN paymentMethod pm ON customer_card.defaultPaymentId = pm.paymentMethodId
WHERE
YEAR(o.orderDate) = 2022
AND s.shipmentDate IS NOT NULL
GROUP BY
pm.paymentType
ORDER BY
totalPaymentAmount DESC")]

```

We calculated the forecast by applying the 2022–2023 difference to the 2023 totals:

$$\text{2024 Forecast} = \text{2023 Revenue} + (\text{2023 Revenue} - \text{2022 Revenue})$$

Adjustments: We added a rule to ensure the prediction didn't show numbers below zero.

- Because ApplePay and AMEX dropped so fast last year, the math predicted they would make negative money in 2024, which is impossible.
- We changed any negative result to \$0. This simply means we predict nobody will use those payment methods next year.

Assumption: This model assumes market conditions and consumer payment preferences will continue their current downward trajectory without change.

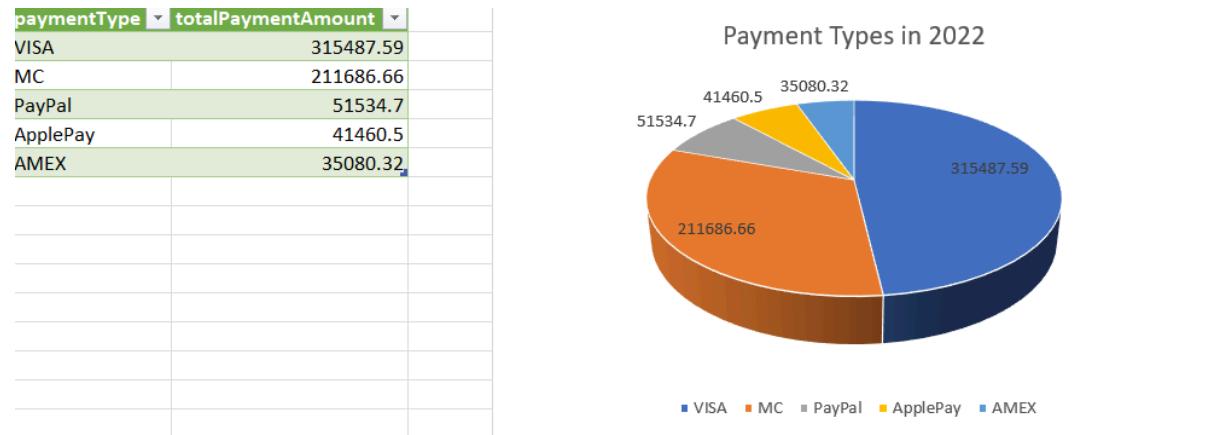


Figure 1: Payment Types in 2022 showing AMEX as the most used payment method

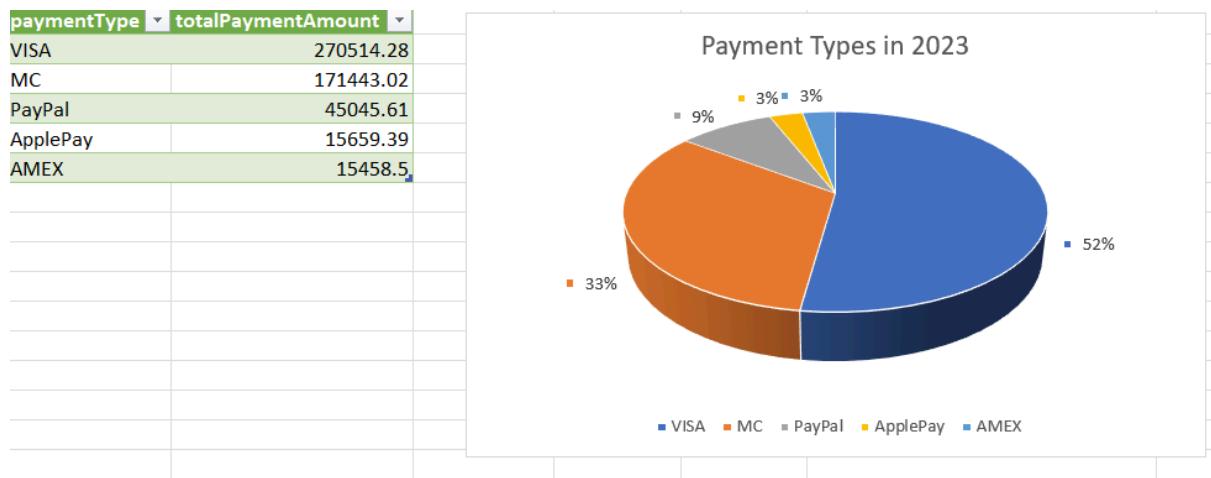


Figure 2: Payment Types in 2023 showing AMEX as the most used payment method.

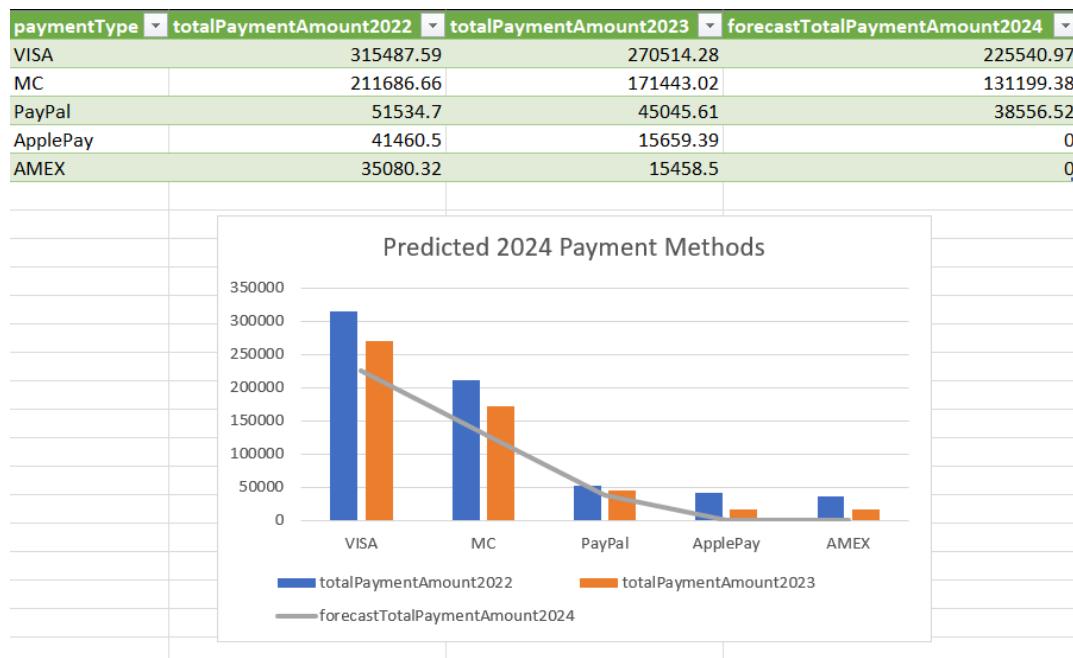


Figure 3: Forecasted payment types in 2024 based on years 2022 and 2023.

Recommendations to Management:

1. Consider Removing ApplePay and AMEX: Since our data predicts nobody will use these next year, we should check if they cost us extra money or fees to keep active. If they do, we should remove them to save costs.
2. Focus on Why Sales are Dropping: The charts show that every payment method went down in 2023, even the popular ones like Visa. This means the problem isn't the payment options, it's that we have fewer customers overall. We need to focus on marketing to get sales back up.
3. Keep the Checkout Simple: Most of our money comes from Visa and MasterCard. We should make sure our website makes it very easy to pay with those cards, rather than cluttering the screen with options nobody uses.

4. Inventory Management

Overall Approach:

Objective: To identify where the company is wasting money on unsold goods and to find out which products are actually driving revenue.

SQL Queries:

Query showing the orders per month every month from 2019-2023

```
SELECT  
    FORMAT(orderDate, 'yyyy-MM') AS salesMonth,  
    COUNT(orderId) AS totalOrders,  
    SUM(totalAmount) AS totalRevenue  
FROM orderSummary  
GROUP BY FORMAT(orderDate, 'yyyy-MM')  
ORDER BY salesMonth;
```

Changed the query to display categories instead of individual products as there are way too many products

```
= Sql.Database("cosc304.ok.ubc.ca", "analysis", [Query="SELECT  
    c.categoryName,  
    SUM(pi.quantity) AS totalInStock,  
    COALESCE(SUM(op.quantity), 0) AS totalSold  
FROM product p  
JOIN category c ON p.categoryId = c.categoryId  
JOIN productInventory pi ON p.productId = pi.productId  
LEFT JOIN orderProduct op ON p.productId = op.productId  
GROUP BY c.categoryName  
ORDER BY totalInStock DESC"])
```

Step 1: Simplifying the Data: Instead of looking at 197 individual products (which is too messy), we grouped them by Category. This allowed us to spot the big trends immediately.

Step 2: Supply vs. Demand: We compared the total amount of stock sitting in the warehouse against the actual sales numbers.

- What we looked for: Big gaps where we have thousands of items in stock but only a few sales. This identified our dead stock

Step 3: Calculating Efficiency (Sell-Through Rate) We didn't just look at volume; we calculated a Sell-Through Score (Sales divided by Stock).

- It allows us to fairly compare a small category against a big one. It highlights which products turn inventory into cash the fastest.

Outcome: By combining these methods, we were able to separate our inventory into High Risk items (to be liquidated) and "Bestsellers" (to be restocked).

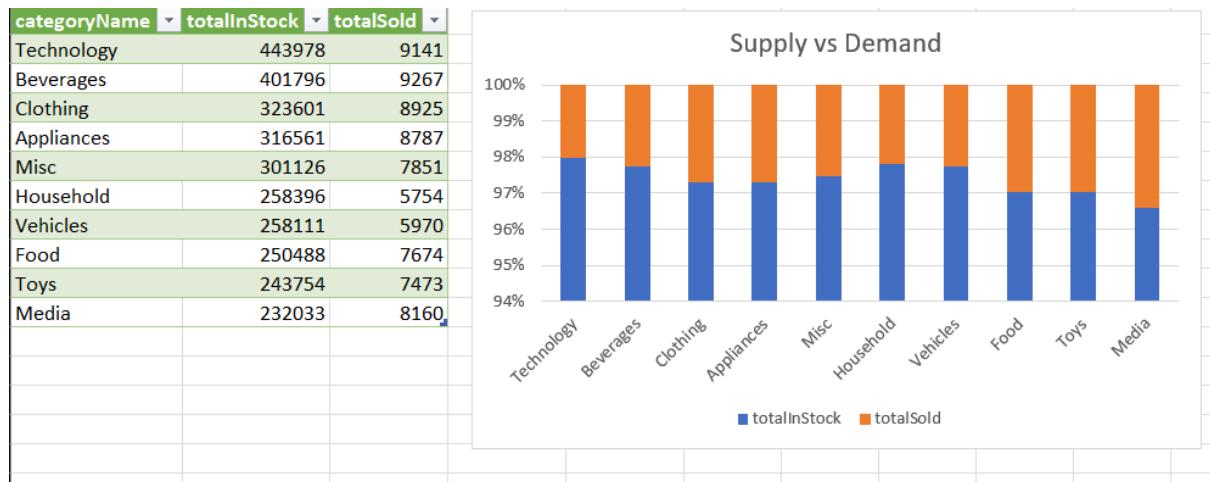


Figure 1: A “Supply vs Demand” bar chart showing the products in stock vs the products sold in each category



Figure 2: A line graph showing the most popular category is Media according to its sell-through rate

Recommendations to Management:

1. Run a Clearance Sale for Low-Performing Categories: our charts show that certain categories (like Technology and household) have huge blue bars (stock) but smaller orange bars (sales). It is better to get some cash back now and free up warehouse space than to let the items sit there costing us storage fees forever.
2. Stop Re-Ordering the Dead Stock: We need to fix the buying process so this doesn't happen again.Put a hold on ordering new stock for any category with a low Sell-Through Rate. Don't buy more of what isn't selling.
3. Double Down on the Bestsellers: Increase the budget for these popular items and stock them primarily in the efficient Toronto warehouse. These items fund the business. We need to make sure we never run out of them.

5. Warehouse Efficiency

Overall Approach:

Objective: To evaluate which warehouses contribute most effectively to product distribution.

Methodology: We developed a Warehouse Efficiency Score to quantify performance by balancing three key metrics: shipping volume, operational frequency, and inventory holding.

We defined efficiency as the daily shipping rate relative to the total stock held:

$$\text{Efficiency} = (\text{Total Shipped} / \text{Shipping Days}) / \text{Total Inventory}$$

Execution Steps:

1. Data Extraction: We utilized SQL to aggregate three distinct datasets per warehouse:
 - Total quantity shipped.
 - Total current inventory.
 - Total distinct shipping days.

SQL Queries:

Total Inventory query

```
= Sql.Database("sql04.ok.ubc.ca", "analysis", [Query="

SELECT
    pi.warehouseId,
    w.warehouseName,
    SUM(pi.quantity) AS totalInventory
FROM productinventory pi
JOIN warehouse w ON w.warehouseId = pi.warehouseId
GROUP BY pi.warehouseId, w.warehouseName"])
```

```
        ORDER BY totalInventory DESC  
    "])
```

Total shipping days query

```
= Sql.Database("sql04.ok.ubc.ca", "analysis", [Query=  
    SELECT  
        s.warehouseId,  
        w.warehouseName,  
        COUNT(DISTINCT CAST(s.shipmentDate AS DATE)) AS shippingDays  
    FROM shipment s  
    JOIN warehouse w ON w.warehouseId = s.warehouseId  
    GROUP BY s.warehouseId, w.warehouseName  
    "])
```

Total shipped inventory query

```
= Sql.Database("sql04.ok.ubc.ca", "analysis", [Query=  
    SELECT  
        s.warehouseId,  
        w.warehouseName,  
        SUM(op.quantity) AS totalShipped  
    FROM shipment s  
    JOIN warehouse w ON w.warehouseId = s.warehouseId  
    JOIN ordersummary os ON os.shipmentId = s.shipmentId  
    JOIN orderproduct op ON op.orderId = os.orderId  
    GROUP BY s.warehouseId, w.warehouseName  
    ORDER BY totalShipped DESC  
    "])
```

2. Consolidation: We merged these results into a single unified table.
3. Calculation: We applied the efficiency formula to rank the locations.

Outcome: The analysis identified the Toronto Warehouse as the most efficient facility, successfully moving a high volume of inventory in the fewest operational days.

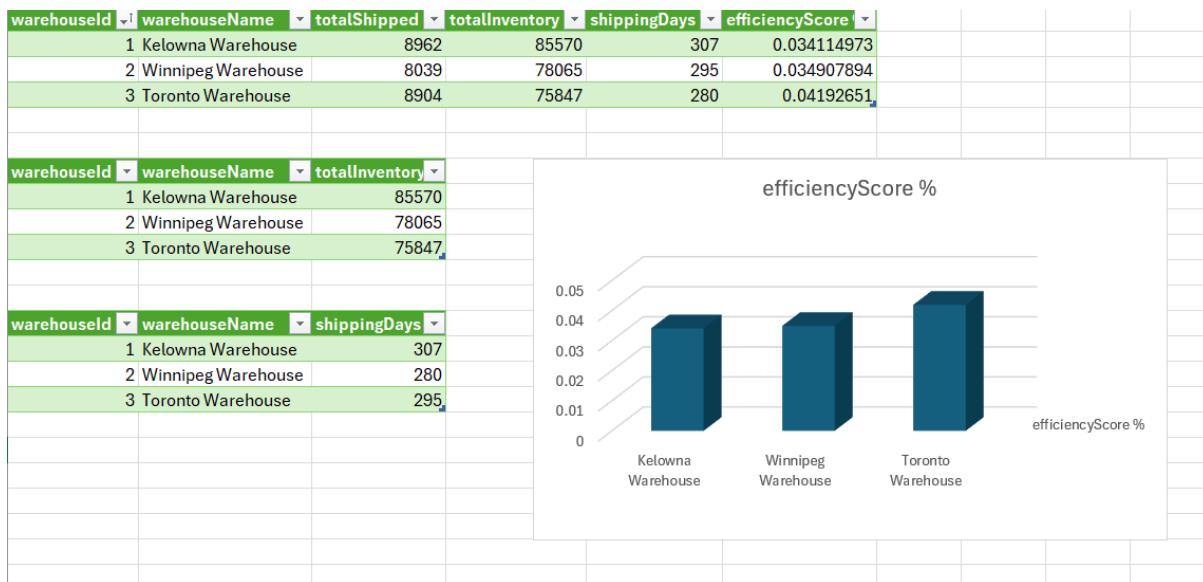


Figure 1: A comparison of final efficiency scores shows Toronto outperforming the other warehouses with a top rating of 0.042.

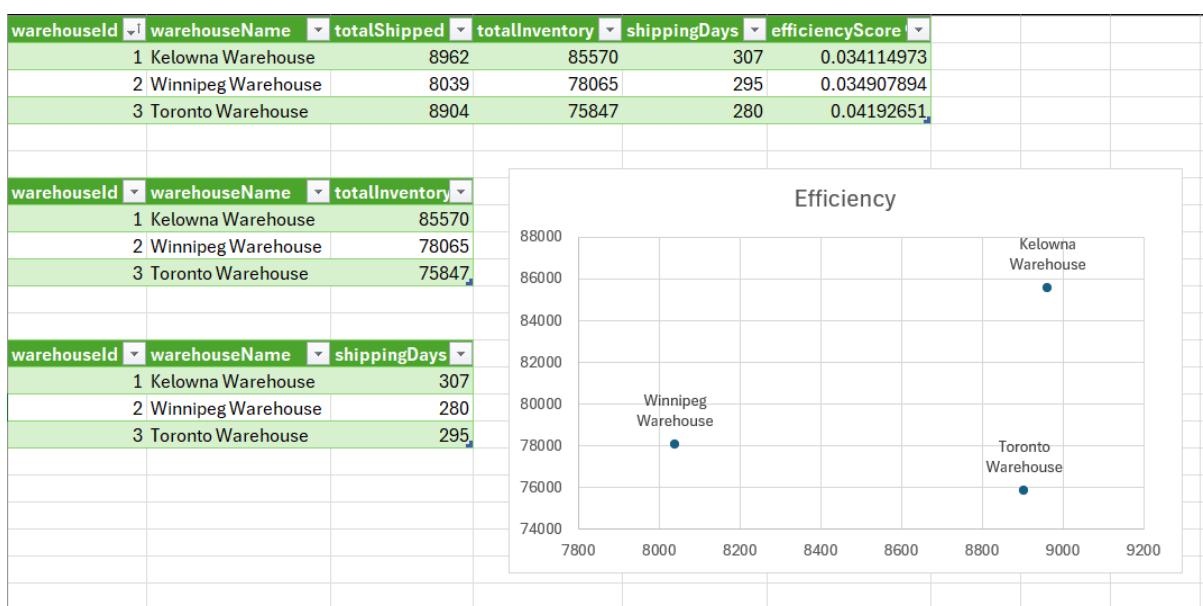


Figure 2: This comparison reveals that while Kelowna ships slightly more volume, Toronto is the superior performer because it achieves similar results with significantly less stock.

Recommendations to Management:

1. Standardize Best Practices: Investigate Toronto's workflow to understand why they are faster. Apply their methods (staffing, packing, layout) to the other warehouses to improve company-wide performance.
2. Reduce Excess Inventory: The other warehouses are holding too much stock that isn't moving. We should reduce their inventory levels to lower holding costs and improve their efficiency scores.
3. Prioritize Toronto for Top Sellers: Since Toronto ships the fastest, we should route our most popular, high-demand products through that facility to ensure customers get them quickly.

6. Peak Seasons

Overall Approach:

Objective: To understand when business is busiest. We wanted to find out if our sales are steady all year round or if we have specific rush months that we need to prepare for.

Execution Steps:

Step 1:Trend Analysis - We looked at every single month of sales from 2019 to 2023 (48 months total).

Step 2: Finding the Pattern (Typical Month Analysis) We averaged the data to see what a typical year looks like. We grouped all the "Januaries" together, all the "Februaries" together etc. This removed the noise and proved that our business has a predictable busy season rather than just random luck.

SQL Queries:

Query calculating the total revenue for every month from 2019-2023 and showing each month

```
SELECT
    FORMAT(orderDate, 'yyyy-MM') AS salesMonth,
    COUNT(orderId) AS totalOrders,
    SUM(totalAmount) AS totalRevenue
FROM orderSummary
GROUP BY FORMAT(orderDate, 'yyyy-MM')
ORDER BY salesMonth;
```

Query averaging total revenue for each month from 2019-2023

```
= Sql.Database("cosc304.ok.ubc.ca", "analysis", [Query="SELECT
    MONTH(orderDate) AS MonthNum,
    DATENAME(month, orderDate) AS MonthName,
    AVG(totalAmount) AS AvgRevenue
FROM orderSummary
GROUP BY MONTH(orderDate), DATENAME(month, orderDate)
ORDER BY MonthNum;"])
```

Outcome: We now know exactly when demand surges, meaning we can stop guessing and start planning our staffing and inventory based on the calendar.

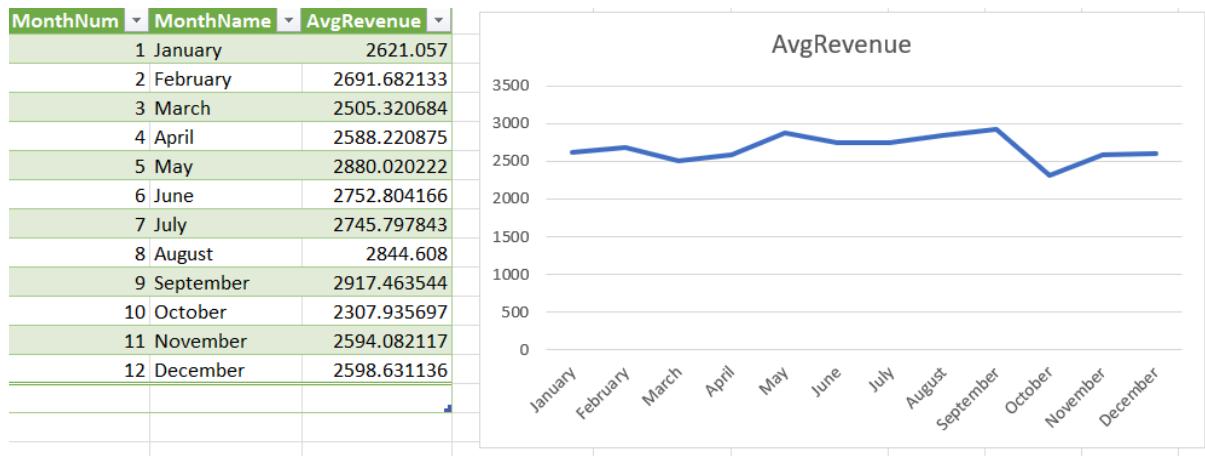


Figure 1: A line chart showing the average revenue per month from years 2019-2023.

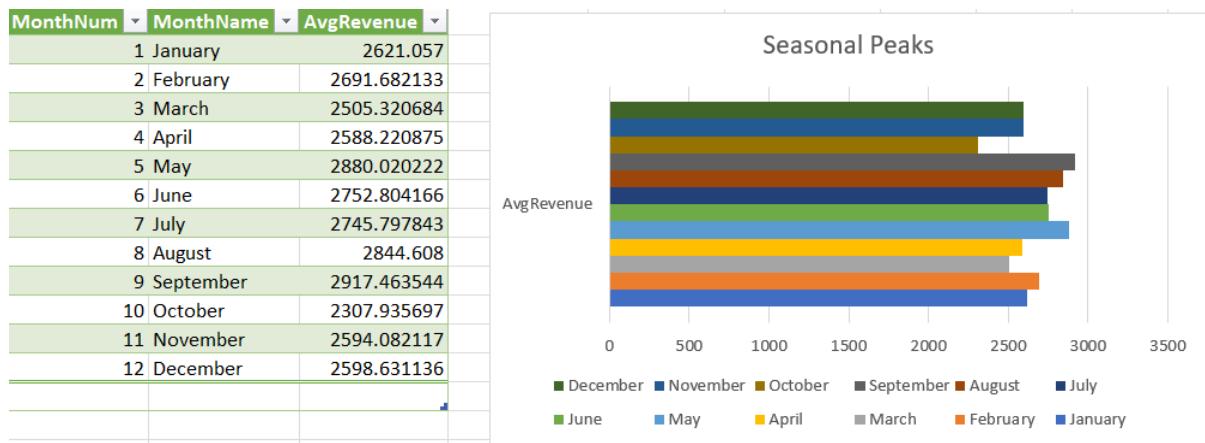


Figure 2: An accompanying bar chart that shows the busiest seasons of the year.

Recommendations to Management:

1. Implement Extra Staffing for Peak Months: Since we know May and September are our busiest times, we shouldn't keep the same number of staff all year. Hire temporary warehouse workers starting in April to handle the rush, and reduce staff hours during the slow months (like February) to save money.
2. Adjust Inventory Ordering Schedules: We cannot order stock at the same speed every month. Place large bulk orders 30 days before our predicted peak (e.g., in May) so the efficient Toronto warehouse is full when the orders start flooding in. Do not restock heavy items right after the peak ends.
3. Run Promotions During Slow Months: Our charts show big dips in revenue during the off-season. Marketing needs to run special sales or discounts specifically during our quietest months. This helps smooth out our cash flow so we aren't relying entirely on the summer rush.

**Analysis Report Collated by
Gamuchirai Mhere and Somto Azubuike**