ACME Company
Analysis & Forecast Report for 2023 and 2024

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Group 58

COSC 304: Intro to Databases

Lab 10 Final Submission

Dec 6, 2024

Executive Summary

ACME Company sells a variety of products to consumers all across Canada. As the company continues to grow, it is important to take a quantifiable and analytical assessment of many factors - what is working, and what isn't?

This analysis and forecast report will consider previous years sales at ACME, and use several forecasting techniques to display trends and possibilities for 2023 and 2024. The report is broken into five main sections of analysis:

- Customers by Region
- Payment Methods
- Reviews and Sales Trends
- Highest and Lowest Revenue Products
- Inventory Management

With a final general recommendations section, informed by the prior analysis.

The goal of this report is to inform and recommend actions for the benefit of ACME Company and subsequently ACME product consumers. Recommendations fall under the category of data improvements, or product management.

One of the largest weaknesses in the ACME database is the lack of spatial integration. This limits analysis capabilities and, if addressed, could open up avenues for much more substantial and informative geographic analysis. Increased data infrastructure around spatial information can locate and help improve elements such as the shipping process, warehouse stocking, and marketing.

Our analysis also reveals that there are products within the ACME inventory that are no longer (if they ever were) beneficial to continue to supply. We encourage ACME to review low rated and low selling products, clean out this stock, and pivot to products of higher quality and demand.

Summary Report

Section 1: Customers by Region

Overview of Approach

1. Gather historical data from 2020-2023 for all sales, focusing on total revenue and grouping by province, year, and month
2. Use the historical data (SQL Query) to create a table and an exponential smoothing forecast in Excel for each province
3. Identify the top and bottom provinces based forecasted total sales
4. Create a choropleth map/chart of the performance by sales of each province. Assess trendlines of overall and targeted provinces

Analysis Assumptions

- Sales will be predicted using an exponential smoothing forecast from historical data. It does not take any other factors into account.
- No price changes or inflationary adjustments will occur.
- Shipping to a province will be assumed to be a sale for that province.

Analysis Methods, Results, and Visualizations

SQL Query:

```
SELECT shiptoState AS 'Province', YEAR(orderDate) AS 'Year',
MONTH(orderDate) AS 'Month', SUM(totalamount) AS 'Total Sales'
FROM ordersummary
WHERE YEAR(orderDate) != '2019'
GROUP BY shiptoState, YEAR(orderDate), MONTH(orderDate)
ORDER BY shiptoState ASC, YEAR(orderDate) ASC, MONTH(orderDate)
ASC;
```

// for total sales by province per month from 2020 - October 2023 (end of records in database)

Data was used to forecast the final two months of 2023 sales, and the entirety of 2024 sales with the exponential smoothing forecast method in Microsoft Excel.

Province	Total Sales Historic + Forecast (2023)	Total Sales Forecast (2024)	Total Sales Historic + Forecast (2020 to 2024)
AB	$ 97,579.37	$ 100,166.53	$ 323,773.07

BC	$ 97,482.87	$ 71,204.04	$ 251,777.66
MB	$ 71,604.39	$ 80,110.75	$ 246,506.12
NB	$ 50,182.97	$ 44,606.84	$ 143,558.83
NF	$ 57,874.15	$ 70,639.60	$ 204,346.65
NS	$ 73,327.63	$ 82,110.84	$ 246,055.46
ON	$ 66,582.51	$ 124,721.25	$ 337,367.38
PE	$ 67,465.02	$ 104,461.92	$ 294,456.34
QC	$ 71,385.17	$ 74,904.46	$ 238,912.21
SK	$ 59,908.61	$ 118,792.71	$ 310,138.85

Table 1.1: Each province and corresponding forecasted sales for 2023, 2024, and the total sales (2020, 2021, 2022, 2023 historic, 2023 forecasted, and 2024 forecasted).

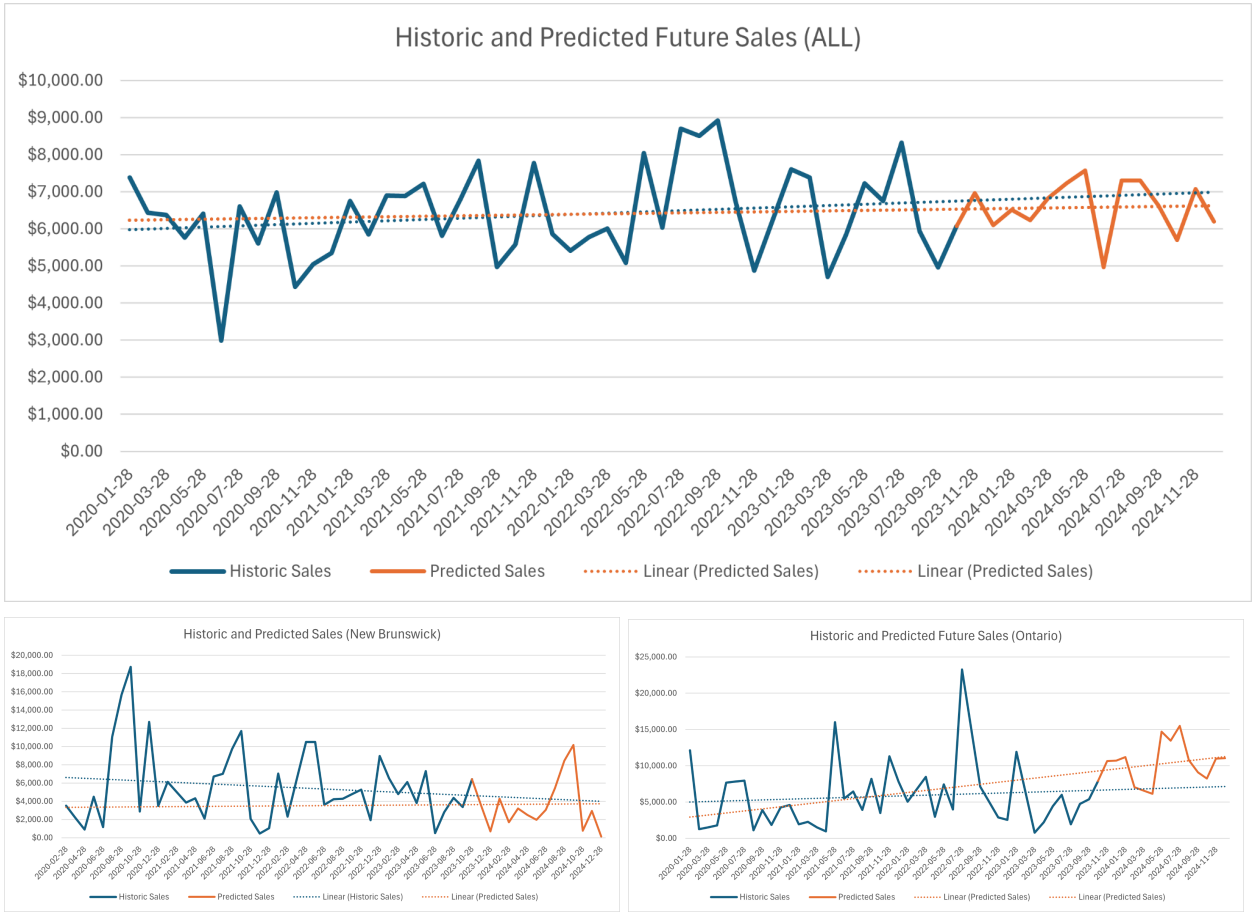

Figure 1.1: Historic and predicted future sales, as seen with the exponential smoothing forecast - beginning in January 2020, ending in December 2024. Top graph overall (all provinces),

bottom left New Brunswick (lowest sales 2023, 2024), bottom right Ontario (highest sales 2024, overall)

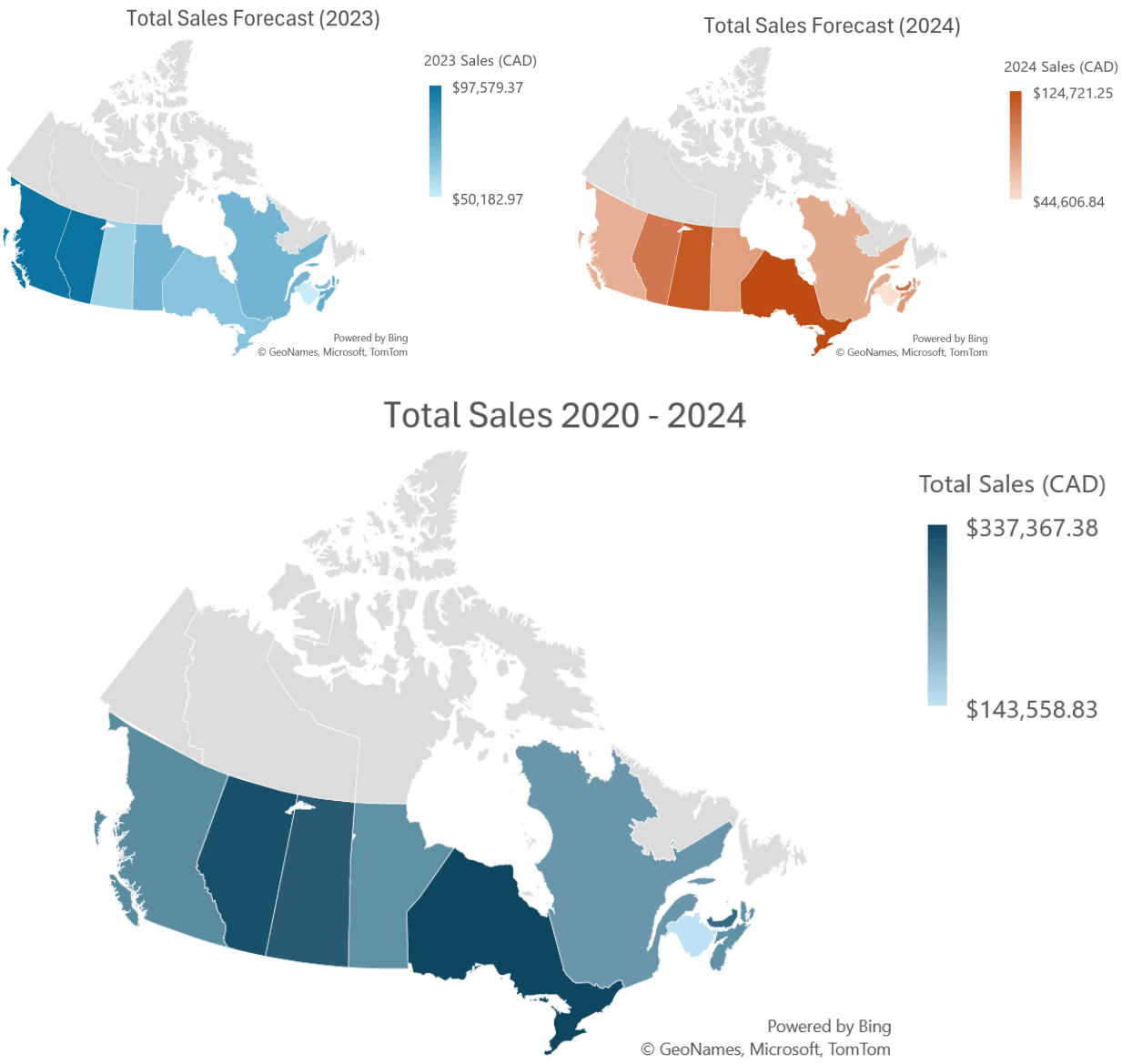

Figure 1.2: Total Sales Forecast 2023, Total Sales Forecast 2024, and Total Sales Forecast from 2020, 2021, 2022, 2023 historic, 2023 forecasted, and 2024 forecasted. Divided by province to see which region's contribute most significantly to ACME sales.

Recommendations

Overall, sales are trending upward in the long-term, regardless of the province where sales are being made (Figure 1.1). New Brunswick is an outlier, projected to reduce total sales in the end of 2023 and 2024 (Figure 1.1, Figure 1.2). As such, it is advisable to consider the marketing strategy particularly in this region, and how it may be possible to

increase demand in the province.

As sales continue to grow, it may be beneficial to consider integrating a way to cross-reference city data with geolocations. This would allow for a more substantial and potentially beneficial spatial analysis, as opposed to the current system only being capable of aggregating by province. Being able to perform analysis at the city level would allow for more insight as to if ACME fulfills orders to the predominant population hotspots, or if you are servicing any rural communities across Canada.

Section 2: Highest and Lowest Revenue Products

Overview of Approach

1. Gather historical data from 2020-2022 for all products, mainly focusing on total revenue and the revenue trend
2. Use the historical data (SQL Query) to create a table and a linear forecast in Excel
3. Identify the top 5 and bottom 5 products based on linear trends
4. Create linear trendline charts for the top 5 and bottom 5 products

Assumptions

- Sales will be predicted using a linear trend from historical data. It does not take any other factors into account.
- No price changes or inflationary adjustments will occur.

Analysis Methods, Results, and Visualizations

SQL Query

```
SELECT p.productID, p.productName, y.year, COALESCE(SUM(CASE WHEN
YEAR(os.orderDate) = y.year
THEN quantity * price ELSE 0 END), 0) AS totalSales
FROM product p CROSS JOIN
   (SELECT 2020 AS year UNION ALL
   SELECT 2021 UNION ALL
   SELECT 2022) y
LEFT JOIN orderproduct op ON p.productId = op.productId
LEFT JOIN ordersummary os ON op.orderId = os.orderId AND
YEAR(os.orderDate) = y.year
GROUP BY p.productID, p.productName, y.year
ORDER BY p.productId, y.year ASC;
```

// for products and their total sales per year from 2020 - 2022

Data was used to forecast 2023 and 2024 sales of each product with the linear forecast method in Microsoft Excel.

Product	Forecasted Sales (2023)	Product	Forecasted Sales (2024)
Aerodynamic Copper Bag	$ 22,201.15	Aerodynamic Copper Bag	$ 29,131.65
Intelligent Concrete Wallet	$ 17,559.13	Intelligent Concrete Wallet	$ 23,030.67
Mediocre Plastic Pants	$ 12,590.45	Mediocre Plastic Pants	$ 16,565.64
Sleek Plastic Computer	$ 11,720.38	Sleek Plastic Computer	$ 15,426.62
Incredible Wool Plate	$ 11,376.08	Incredible Wool Plate	$ 14,551.02

Table 2.1: Forecasted top 5 highest revenue-generating products in 2023 and 2024.

Product	Forecasted Sales (2023)	Product	Forecasted Sales (2023)
Gorgeous Wooden Pants	$ -7,752.21	Gorgeous Wooden Pants	$ -13,613.53
Lightweight Wooden Table	$ -4,976.30	Lightweight Wooden Table	$ -9,163.01
Small Plastic Bottle	$ -3,154.72	Heavy Duty Rubber Keyboard	$ -6,748.84
Sleek Steel Pants	$ -2,984.72	Sleek Steel Pants	$ -6,475.00
Mediocre Plastic Table	$ 2,606.34	Small Plastic Bottle	$ -5,696.90

Table 2.2: Forecasted top 5 lowest revenue-generating products in 2023 and 2024. Linear forecasting bounds were not set to disclude negative numbers; despite being unable to have “negative sales”, forecasting is still indicative as to the sales trends products have been experiencing.

Figure 2.1: Clustered column chart of the forecasted top 5 highest revenue-generating products in 2023 and 2024.

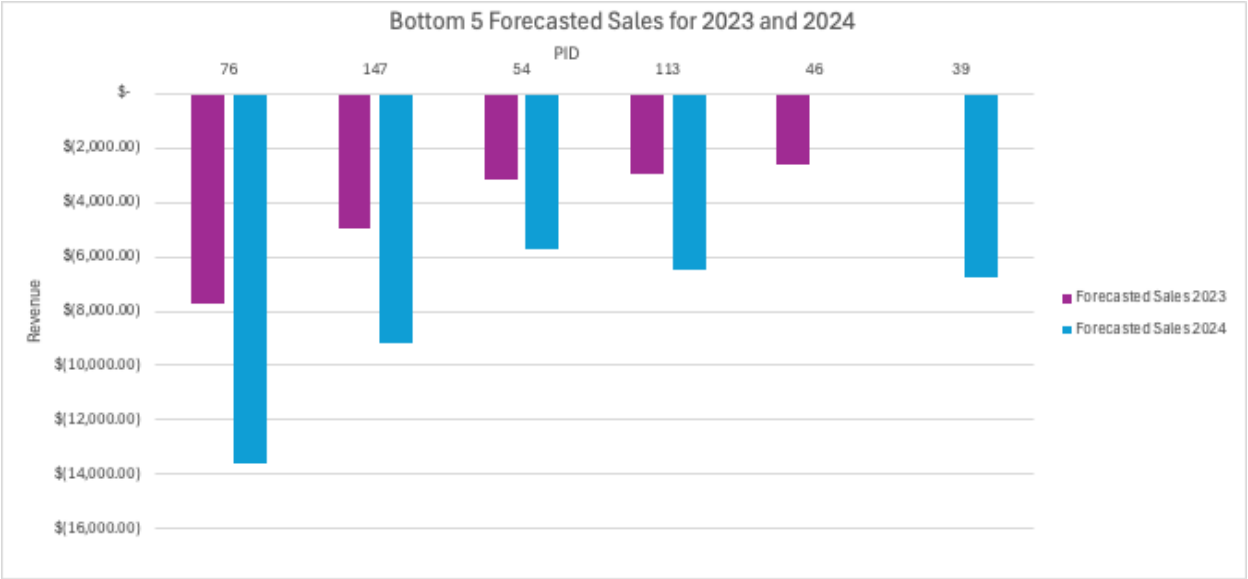

Figure 2.2: Clustered column chart of the forecasted top 5 lowest revenue-generating products in 2023 and 2024.

Recommendations

The top 5 products have consistent and high sales historically, with an upward trend for both 2023 and 2024 (Table 2.1, Figure 2.1). The marketing budget and inventory for these products, specifically the “Aerodynamic Copper Bag”, should be increased. You should consider expanding preexisting marketing channels or introducing the product and marketing to new areas altogether.

The bottom 5 products show a forecasted loss for 2023 and 2024, with a downward forward trend into the negative. While products cannot actually generate “negative revenue”, the behaviour indicated by the linear trend is that these products have been, and will continue to be, poor performers for sales at ACME. These products should be analyzed and revamped, or discontinued if revamping isn’t possible. Consider targeted discounts or promotions to clear out these products’ current inventory, most notably the “Gorgeous Wooden Pants.”

These actions should maximize revenue from the high performers while mitigating risk from the products that are losing the company money.

Section 3: Payment Methods

Overview of Approach

For payment methods used in 2022:

1. Querying the payment methods that were used in 2022
2. Create a chart that shows the payment methods used in 2022

For the prediction of payment methods used in 2024:

1. Query and use historical data from 2020-2023
2. Create a graph and add a linear forecast for the year 2024, as well as a linear trendline for 2024.

Assumptions

- 2023 data will be increased by 20% as there are still 2 months left in the year.
- The trends from the data from 2020-2023 follow a linear pattern, making it reasonable to use a linear trendline for 2024.
- Market and economic conditions will be stable.

Analysis Methods, Results, and Visualizations

SQL Query

```
SELECT paymentType, SUM(totalAmount) AS totalAmount
FROM ordersummary os
JOIN paymentmethod pm ON os.customerId = pm.customerId
WHERE YEAR(os.orderDate) = 2022
GROUP BY paymentType
ORDER BY totalAmount DESC;
```

// for payment methods used in 2022

Figure 3.1: (left) Pie chart showing the distribution of the payment methods used for ACME orders in 2022.

Figure 3.2: (right) Column chart showing the distribution of the payment methods used for ACME orders in 2022.

SQL Query

```
SELECT YEAR(os.orderDate) AS year,pm.paymentType, SUM(
       CASE
           WHEN YEAR(os.orderDate) = 2023 THEN os.totalAmount *
1.20
           ELSE os.totalAmount
       END
   ) AS totalAmount
FROM ordersummary os
   JOIN paymentmethod pm ON os.customerId = pm.customerId
WHERE YEAR(os.orderDate) BETWEEN 2020 AND 2023
GROUP BY YEAR(os.orderDate), pm.paymentType
ORDER BY pm.paymentType ASC, year ASC;
```

// for prediction of payment methods used in 2024

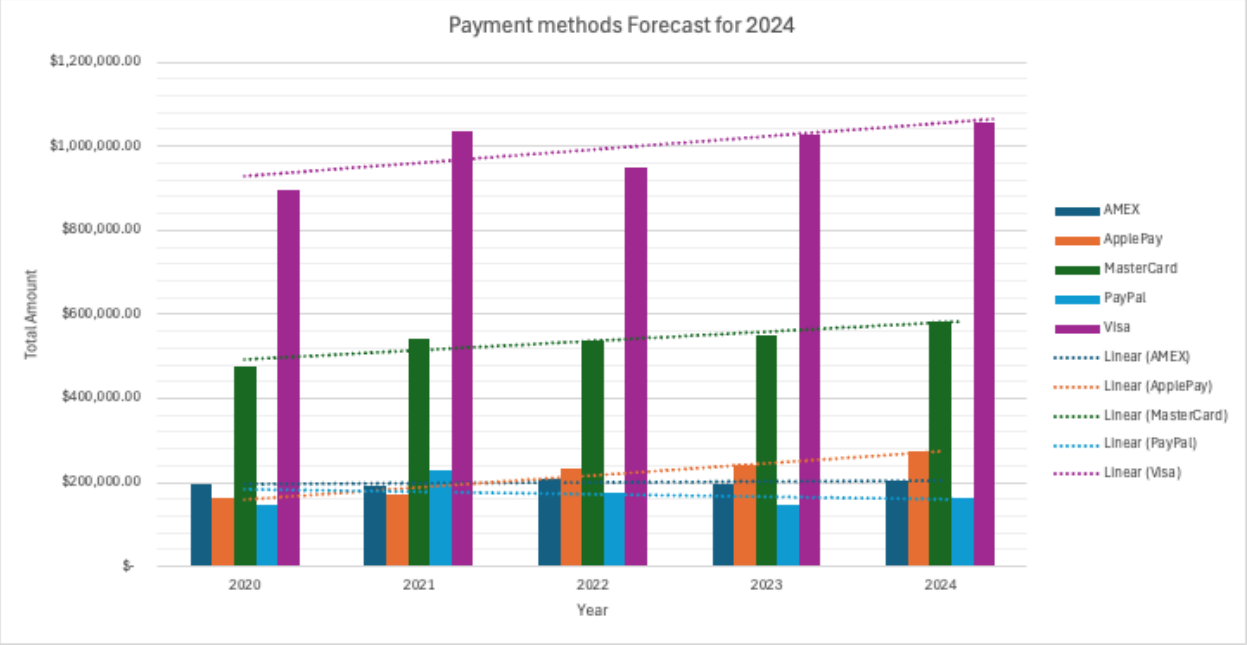

Figure 3.3: Grouped column chart of payment method linear forecasts for 2024.

Section 4: Inventory Management

Overview of Approach

1. Query to find current stock levels of all products

2. Query to find out each product's monthly sales throughout 2020-2023
3. If the inventory of the warehouse > 24x average monthly sales, determine inventory is too high
4. If the inventory of the warehouse < 1.5x average monthly sales, determine inventory is too low
5. If stock levels are too low or too high, then either order more, redistribute to other warehouses for even inventory, or put on a sale

Assumptions

- > 24x average monthly sales is "too high" inventory, < 1.5x average monthly sales is "too low" inventory
- Demand for products is relatively stable or follows a trend of increasing or decreasing; no erratic shifts in demand that could alter the assessment of inventory being "too high" or "too low"

Analysis Methods, Results, and Visualizations

Query for inventory levels, with average monthly sales, inventory, and stock status (if inventory > 24x monthly sales, stock status is "Too High", if inventory < 1.5x monthly sales, stock status is "Too Low", if in between, stock status is "Normal":

SQL Query

```
WITH SalesVelocity AS (
   SELECT op.productId, SUM(op.quantity) AS total_quantity_sold,
SUM(op.quantity) / COUNT(DISTINCT YEAR(os.orderDate) * 12 +
MONTH(os.orderDate)) AS avg_monthly_sales
   FROM OrderProduct op
   JOIN ordersummary os ON op.orderId = os.orderId
   WHERE os.orderDate BETWEEN '2020-01-01' AND '2023-12-31'
   GROUP BY op.productId
),
InventoryLevels AS (
   SELECT productId, SUM(quantity) AS inventory
   FROM ProductInventory
   GROUP BY productId
)
SELECT pi.productId, pi.warehouseId, p.productName, pi.quantity,
sv.avg_monthly_sales,
   CASE
       WHEN pi.quantity < sv.avg_monthly_sales * 1.5 THEN 'Too Low'
       WHEN pi.quantity > sv.avg_monthly_sales * 24 THEN 'Too High'
       ELSE 'Normal'
   END AS stock_status
```

```
FROM productinventory pi
JOIN SalesVelocity sv ON pi.productId = sv.productId
JOIN Product p ON pi.productId = p.productId
ORDER BY productId
```

// for each product, each warehouse and average monthly sales. Shows which warehouses have abundant stock and which have scarce stock.

Stock Status	Count (PID)
Normal	110
Too High	346
Too Low	144
Grand Total	**600**

Table 4.1: Stock Status and Count of all products in the ACME catalogue.

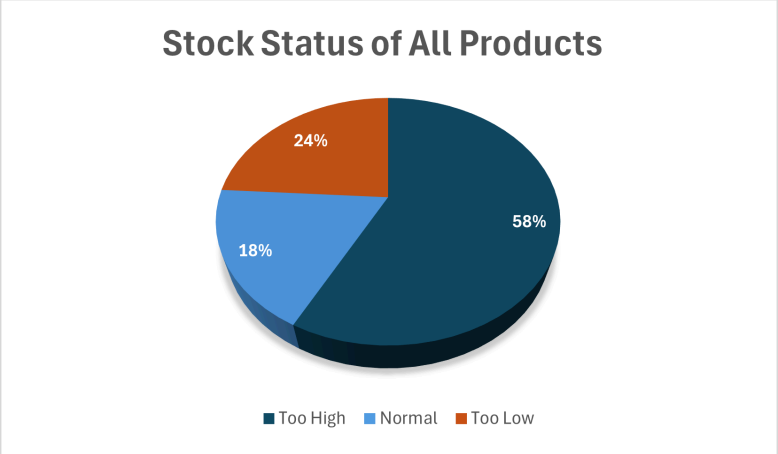

Figure 4.1: Pie chart of the stock status and count of all products in the ACME catalogue.

Recommendations

We have found a significant portion of the inventory is overstocked or understocked. The “Too High” value is set to 24x the monthly sales, meaning over half of the products in ACME warehouses are stocked to last 2+ years of their average monthly sales (Table 4.1, Figure 4.1). For the overstocked products, we recommend re-distributing them to the warehouses that are understocked in the same product, or putting the product on sale to bring those numbers down. For the understocked product, it is recommended to check the same product among other warehouses. If it is overstocked in the other warehouses, ship it to the understocked warehouse. If the product is understocked in all warehouses, prioritize getting a shipment of that product to keep up with demand. Focus on the high-demand products first, ensuring inventory levels are sufficient at all warehouses as these will have the largest impact on revenue and overall profit for the company.

For the long term, evaluate whether the “Too Low” and “Too High” thresholds are appropriate for the business goals and adjust them when needed. Implement ongoing inventory management and monitoring of sales trends to maintain optimal inventory levels.

Section 5: Reviews and Sales Trends

Overview of Approach

1. Identify the 10 highest-rated products based on their average ratings and analyze their sales trends from 2020–2022, only take into account products with > 10 reviews
2. Identify the 10 lowest-rated products based on their average ratings and analyze their sales trends from 2020–2022, only take into account products with > 10 reviews
3. Visualize and compare sales trends for the highest-rated and lowest-rated products using charts to identify correlations between review ratings and sales trends

Assumptions

- Stable market conditions, with external factors such as market trends, and extenuating circumstances (COVID, etc.), etc. are accounted for.
- The review reflects the product quality accurately.
- Only products with more than 10 reviews have a reputable rating.

Analysis Methods, Results, and Visualizations

SQL Query

```
WITH Top10Products AS (
   SELECT TOP 10 r.productId, p.productName, COUNT(r.reviewRating)
AS
       total_reviews,CAST(AVG(CAST(r.reviewRating AS
DECIMAL(10,2)))
       AS DECIMAL(10,2)) AS avg_rating
   FROM review r
   JOIN product p ON r.productId = p.productId
   JOIN orderproduct op ON p.productId = op.productId
   JOIN ordersummary os ON op.orderId = os.orderId
   WHERE os.orderDate BETWEEN '2020-01-01' AND '2022-12-31'
   GROUP BY r.productId, p.productName
   HAVING COUNT(r.reviewRating) > 10
   ORDER BY avg_rating DESC, total_reviews DESC
)
SELECT
   t.productId,
   t.productName,
```

```
   YEAR(os.orderDate) AS sales_year,
   SUM(op.quantity * op.price) AS yearly_sales
FROM Top10Products t
JOIN orderproduct op ON t.productId = op.productId
JOIN ordersummary os ON op.orderId = os.orderId
WHERE os.orderDate BETWEEN '2020-01-01' AND '2022-12-31'
GROUP BY t.productId, t.productName, YEAR(os.orderDate)
ORDER BY t.productId, sales_year;
```

// for the sales trends from 2020 - 2022 for the 10 highest average-rated products from 2020 - 2022

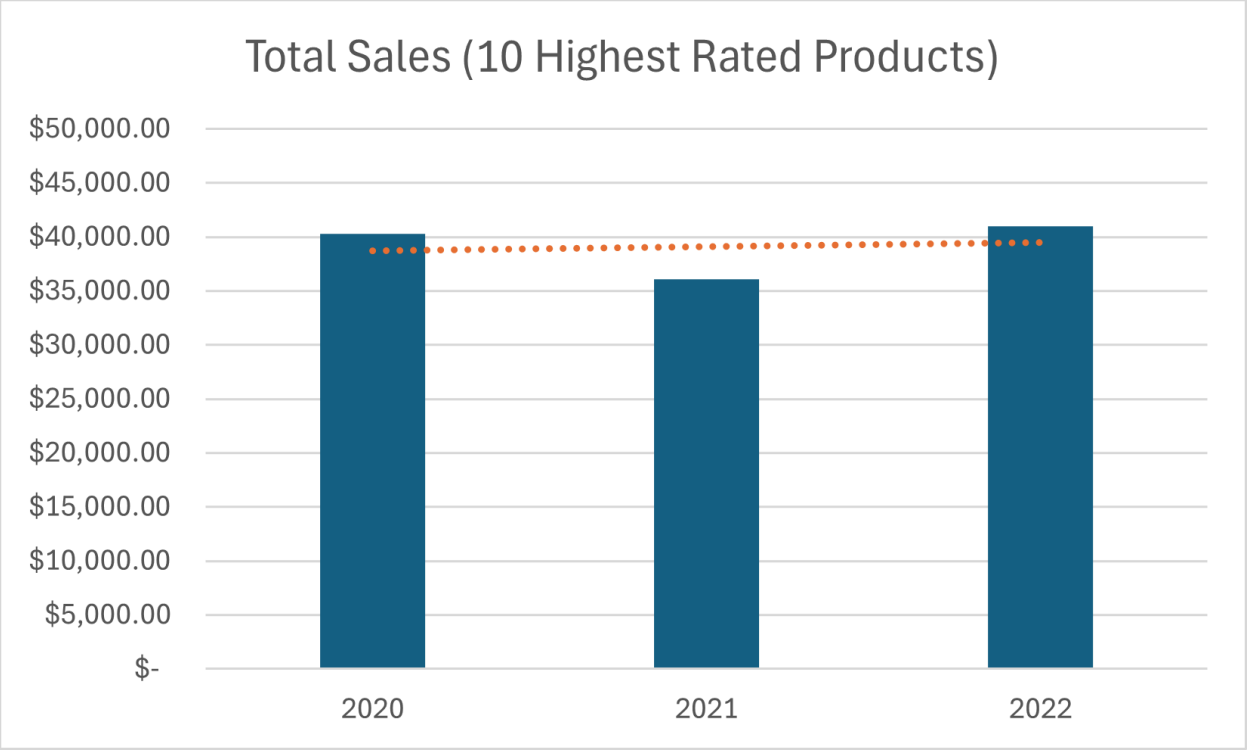

Figure 5.1: Total sales for the top 10 highest rated products, sorted by year from 2020 - 2022.

SQL Query

```
WITH Bottom10Products AS (
   SELECT TOP 10 r.productId, p.productName, COUNT(r.reviewRating)
AS
       total_reviews, CAST(AVG(CAST(r.reviewRating AS
DECIMAL(10,2)))
       AS DECIMAL(10,2)) AS avg_rating
   FROM review r
   JOIN product p ON r.productId = p.productId
   JOIN orderproduct op ON p.productId = op.productId
```

```
    JOIN ordersummary os ON op.orderId = os.orderId
    WHERE os.orderDate BETWEEN '2020-01-01' AND '2022-12-31'
    GROUP BY r.productId, p.productName
    HAVING COUNT(r.reviewRating) > 10
    ORDER BY avg_rating ASC, total_reviews DESC
)
SELECT
    b.productId,
    b.productName,
    YEAR(os.orderDate) AS sales_year,
    SUM(op.quantity * op.price) AS yearly_sales
FROM Bottom10Products b
JOIN orderproduct op ON b.productId = op.productId
JOIN ordersummary os ON op.orderId = os.orderId
WHERE os.orderDate BETWEEN '2020-01-01' AND '2022-12-31'
GROUP BY b.productId, b.productName, YEAR(os.orderDate)
ORDER BY b.productId, sales_year;
```

// for the sales trends from 2020 - 2022 for the 10 lowest average-rated products from 2020 - 2022

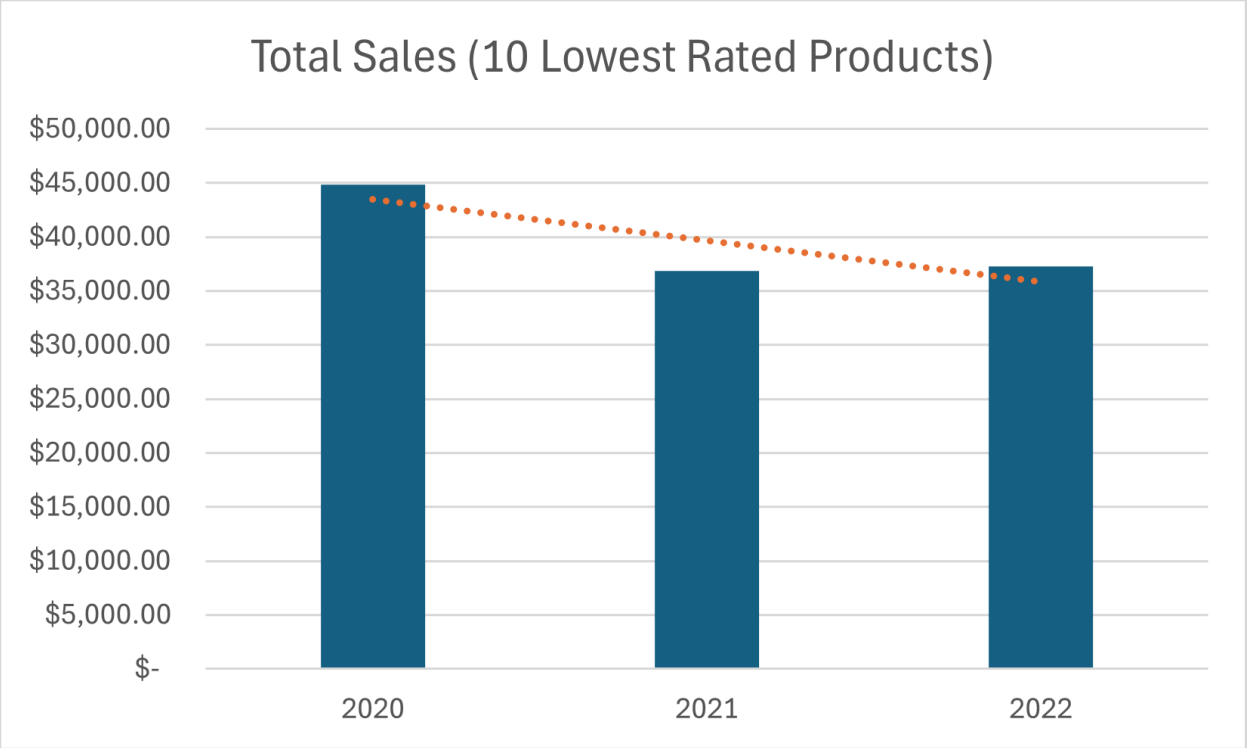

Figure 5.2: Total sales for the top 10 lowest rated products, sorted by year from 2020 - 2022.

Recommendations

Our analysis indicates that positive or negative reviews do influence the sales and total revenue generated by ACME products, particularly in the case of a negative rating reducing revenue (Figure 5.1, Figure 5.2). We recommend that ACME individually assesses low rated products in your inventory, and either improve upon or discontinue these products. This will raise the floor of quality at your company and eliminate many items that have a trend of reduced sales, which can free space in inventory to provide newer products that are more likely to be well received by consumers.

Section 6: General Recommendations

As discussed in Section 1, the spatial analysis capabilities with the ACME Company database is quite limited. Provincial analysis is possible, however querying any further means that information is unable to be projected in a spatial quality. We recommend either creating a table within the ACME database that contains point locations for cities, or utilize another (possibly independently created) database to cross-reference city names in the ACME database with point locations. This would allow for more significant spatial analysis, and perhaps provide some insight into the distribution and potential needs of ACME product consumers - are they predominantly in population hotspots, or are certain products being shipped to rural communities? This information could help with marketing, and increase sales at the company.

With the integration of better spatial information, other mapping programs such as ArcGIS could be utilized to assist in data analysis, visualization, and manipulation. Creating the foundation for this kind of program use will be easier to implement sooner than later, and could have extremely beneficial events and discoveries in analysis further down the road.

Shown in Section 4, overall product inventory is very high at the three ACME warehouses, with 58% of products being stocked to supply over 2 years of average demand (Figure 4.1). We recommend that you review ACME's high level approach to inventory management, and reduce the level of stock sitting in warehouses for extended periods of time. This will allow ACME to remain maneuverable in what products are supplied, and reduce risk of becoming tied down by a high-stock, slow-selling product.

Feature List

Customers by Region, Best and Worst Products, Payment Methods, Inventory Management, Reviews and Sales Trends, Suggested Database Improvements/Other

Analysis Features	PPoints	EPoints	Comments
Documentation (MANDATORY)	15		
Executive Summary (up to 1 page)	2		
Feature List	2		
List of Web and AI sources used	3		
Summary Report (up to 15 pages)	8		
Analysis: Customers by Region	10		
Overview of approach with assumptions	3		
Predicted sales for 2023+2024 for each province and at least two charts or visualizations	4		
Recommendation/summary paragraph for management	3		
Analysis: Best and Worst Products	10		
Overview of approach with assumptions	3		
Predicted sales for 2023+2024 for top 5 and bottom 5 products with at least two charts or visualizations	4		
Recommendation/summary paragraph for management	3		
Analysis: Payment Methods	5		
Overview of approach with assumptions	1		
Visualization of payment methods used in 2022	2		
Visualization/prediction of payment methods for 2024	2		
Analysis: Inventory Management	10		
Overview of approach with assumptions	3		
Perform analysis with at least two charts or visualizations	4		
Recommendation paragraph to management	3		

Analysis Features	PPoints	EPoints	Comments
Analysis: Reviews and Sales Trends	10		
Overview of approach with assumptions	3		
Perform analysis with at least two charts or visualizations	4		
Recommendation paragraph to management	3		
General and Open Category	20		
Suggest database improvements	3		
Other (suggestions using tools beside Excel)	17/20		
Total: /50 + 10 mark bonus, /60			

Sources Used

OpenAI. (2024). *ChatGPT* (December 6th version) [Large language model].https://chat.openai.com/chat

Microsoft. (n.d.). *Microsoft support.* Microsoft. https://support.microsoft.com/en-us

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