

PROJECT REPORT

INVENTORY INSIGHTS AND BREAKAGES TRENDS

SCH-MGMT 663: SUPPLY CHAIN ANALYTICS

ANAND GUPTA

INTRODUCTION

Predictive analytics, a subset of data analytics, leverages historical data, machine learning algorithms, and statistical techniques to predict future outcomes. In the context of supply chain management, predictive analytics can significantly enhance demand forecasting accuracy, allowing businesses to anticipate customer needs more effectively. For instance, by analyzing past sales data, market trends, and external factors such as weather patterns and economic indicators, businesses can predict demand fluctuations and adjust their production schedules accordingly. This not only helps in preventing overproduction, which can lead to waste and increased costs, but also minimizes the risk of stockouts, ensuring that products are available when and where they are needed. Companies like PepsiCo and Unilever have successfully implemented predictive analytics to streamline their inventory management, resulting in improved service levels and reduced operational costs (Harnessing the Power of Data Analytics to Revolutionize the Food and Beverage Supply Chain, 2024).

Accurate insights into inventory levels and product breakages are essential for preserving operational efficiency and minimizing losses in the dynamic world of beverage supply chain management. The objective of my job as a supply chain analyst for a beverage company is to analyze two different datasets and produce useful information so that organizational leaders can make wise decisions. The ABS Store Inventory and Sale Item and Alcohol Beverage Services Breakage Inventory files are among the datasets made available. The former keeps track of inventory damage or waste, providing information about possible areas for operational enhancement. The second dataset, on the other hand, includes inventory items that are part of ABS. It includes store quantities, sale prices, and other relevant information that is necessary to evaluate pricing and inventory management techniques.

The present study aims to tackle many significant goals mentioned in the project prompt. These include figuring out which product category has the most inventory volume, assessing pricing dynamics and discounts across products, and identifying the top products impacted by breakages. They also involve investigating any temporal trends or seasonality related to breakages. Furthermore, the investigation seeks to examine the variety of beverage sizes offered by ABS as well as the range of products that go beyond beverages and the associated costs associated with them. In addition, the viability of combining the inventory and breakage datasets will be assessed, considering both the possible advantages and difficulties of doing so. The report will culminate with an extensive analysis and set of suggestions based on the findings, bolstered by pertinent statistics summaries and visualizations.

This research intends to provide ABS's leadership with the information they need to optimize inventory management strategies, improve product pricing decisions, and eventually increase overall operational efficiency by exploring these statistics and presenting practical insights.

METHODS

This report employed a systematic approach to analyze the provided datasets, namely the **Alcohol Beverage Services Breakage Inventory** and **ABS Store Inventory and Sale Item** datasets, aiming to extract actionable insights relevant to supply chain management in the beverage industry.

1. Data Cleaning and Preprocessing:

1.1. For ABS Store Inventory and Sale Item

- Autofitted the column-widths and changed data types of all the columns.
- Deleted Sales Date as it had very limited information and was not relevant for our analysis.
- Renamed Columns from Size- Product Size, Price- Product Price, Description- Product Description, Code- Product Code, Category- Product Category.
- Filtered Rows.
- Changed datatype for Product Prices to Currency.
- Replaced Units in Product Size as there were many typos; OZ- OZ, Z- OZ, .OZ- OZ, OOOZ- OZ, OOOZ- OZ.
- Deleted Duplicates and Blanks.
- Made four more tables filtering first one with Milliliters- ML, second with Liters- L, third with Ounce- OZ, and fourth with Bags.
- Converted the units for Liters table to Milliliters and Ounce to Milliliters as I wanted a common unit of sizes for analysis.
- Appended all the four tables into one to get a cleaned and formatted dataset.
- Rounded up all the units and Prices to two decimal places.

1.2. For Alcohol Beverage Services Breakage Inventory

- Autofitted the column-width and changed data types of all the columns.
- Replaced Year typos with correct values in the Date Column from 0001- 2001, 0002- 2002.....0023- 2023.
- Changed datatype of the date column to Dates.
- Parsed Date.
- Removed Duplicates.
- Removed Blank Rows.
- Changed Header Names from Code- Product Code, Quantity- Product Quantity, Description- Product Description

2. Tools and Software Used:

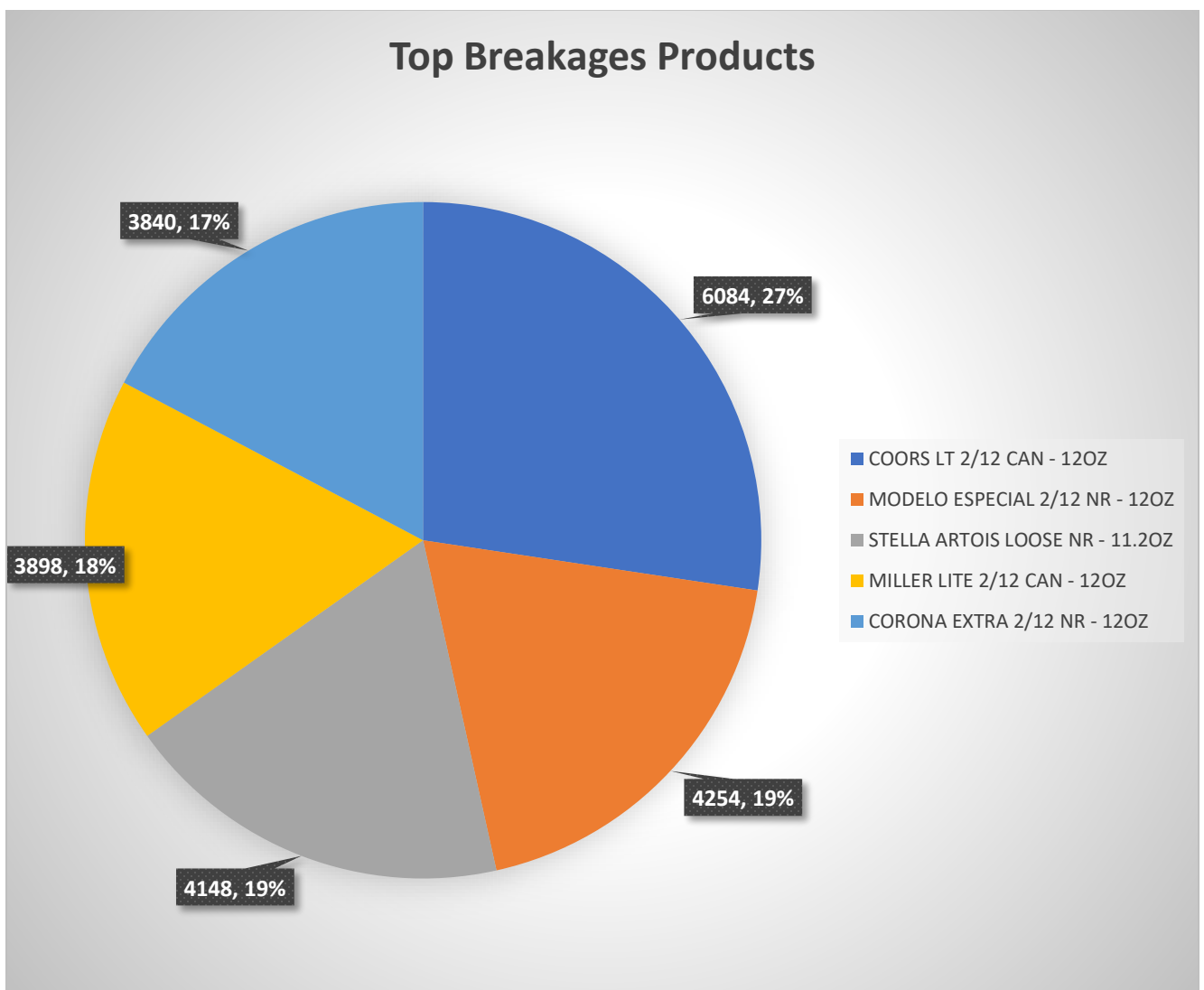
2.1. MS Excel (Cleaning, Preprocessing and Visualization)

2.2. Power Query (Cleaning and Preprocessing)

Results

1. Top five Products with Breakages

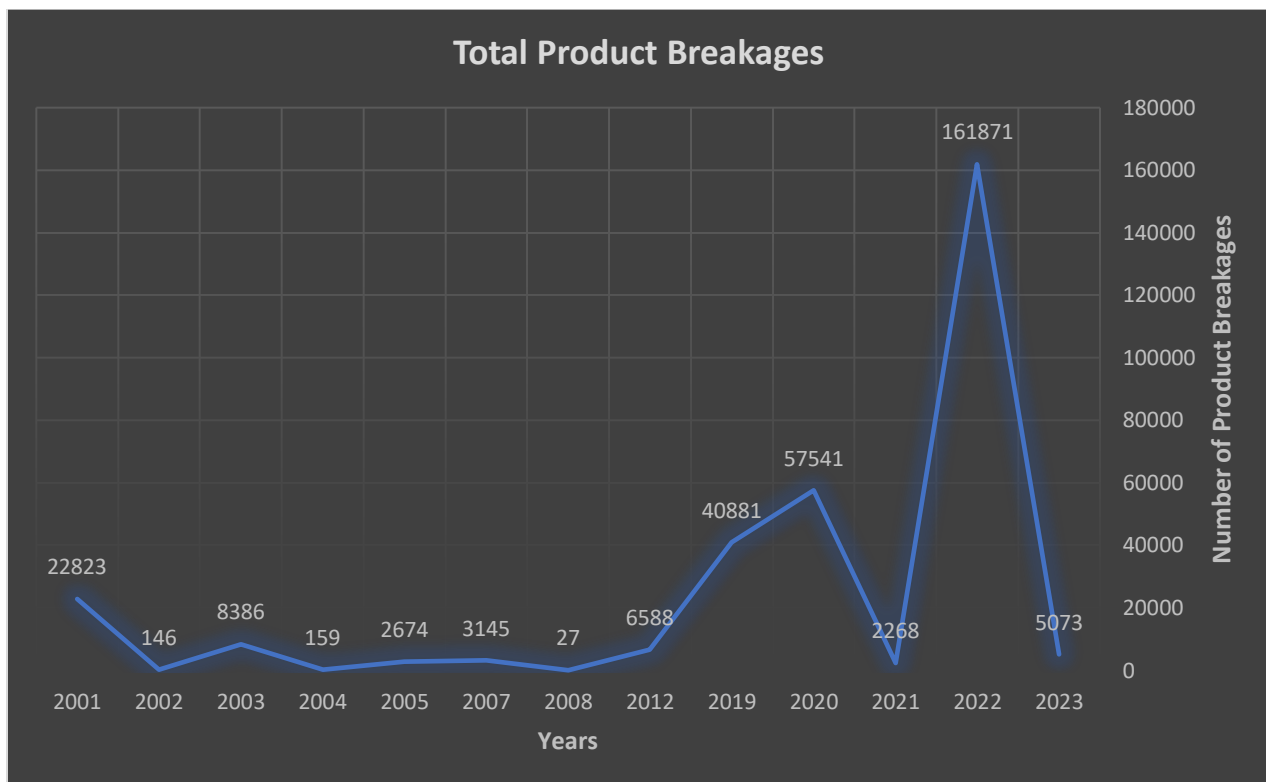
Date	Product Code	Product Description	Product Quantity	Unit Of Measure
7/1/2022	91138	COORS LT 2/12 CAN - 12OZ	6084	BTL
7/1/2022	99198	MODELO ESPECIAL 2/12 NR - 12OZ	4254	BTL
7/1/2022	26187	STELLA ARTOIS LOOSE NR - 11.2OZ	4148	BTL
7/1/2022	91669	MILLER LITE 2/12 CAN - 12OZ	3898	BTL
10/24/2001	96750	CORONA EXTRA 2/12 NR - 12OZ	3840	BTL



The significant occurrence of breakages in popular beer brands like Coors Light, Modelo Especial, and Stella Artois highlights potential vulnerabilities in packaging or handling processes. These products, often packaged in 12-ounce bottles or loose units, may benefit from enhanced protective measures during transportation and storage to reduce the frequency of breakages. Additionally, the concentration of breakages on specific dates, such as July 1, 2022, suggests a need for targeted investigation into operational practices or external factors influencing these incidents.

2. Seasonality and Time Relationship with Breakages

Years	Total Product Breakages
2023	5073
2022	161871
2021	2268
2020	57541
2019	40881
2012	6588
2008	27
2007	3145
2005	2674
2004	159
2003	8386
2002	146
2001	22823



Early Years (2001-2008):

- Initial high in 2001 followed by a sharp drop in 2002.

- Minor fluctuations from 2003 to 2007, with breakages remaining below 10,000 annually.

Mid-period (2009-2018):

- There is a notable dip in 2008 (only 27 breakages).
- Gradual increase towards 2012 (6,588 breakages), followed by a relatively low but increasing trend until 2019.

Recent Years (2019-2023):

- Significant increase starting from 2019, peaking in 2022.
- A sudden and dramatic decrease in 2021, an unexplained anomaly considering the neighboring years' data.
- After peaking in 2022, there is a sharp decline in 2023 but still higher than the pre-2019 levels.

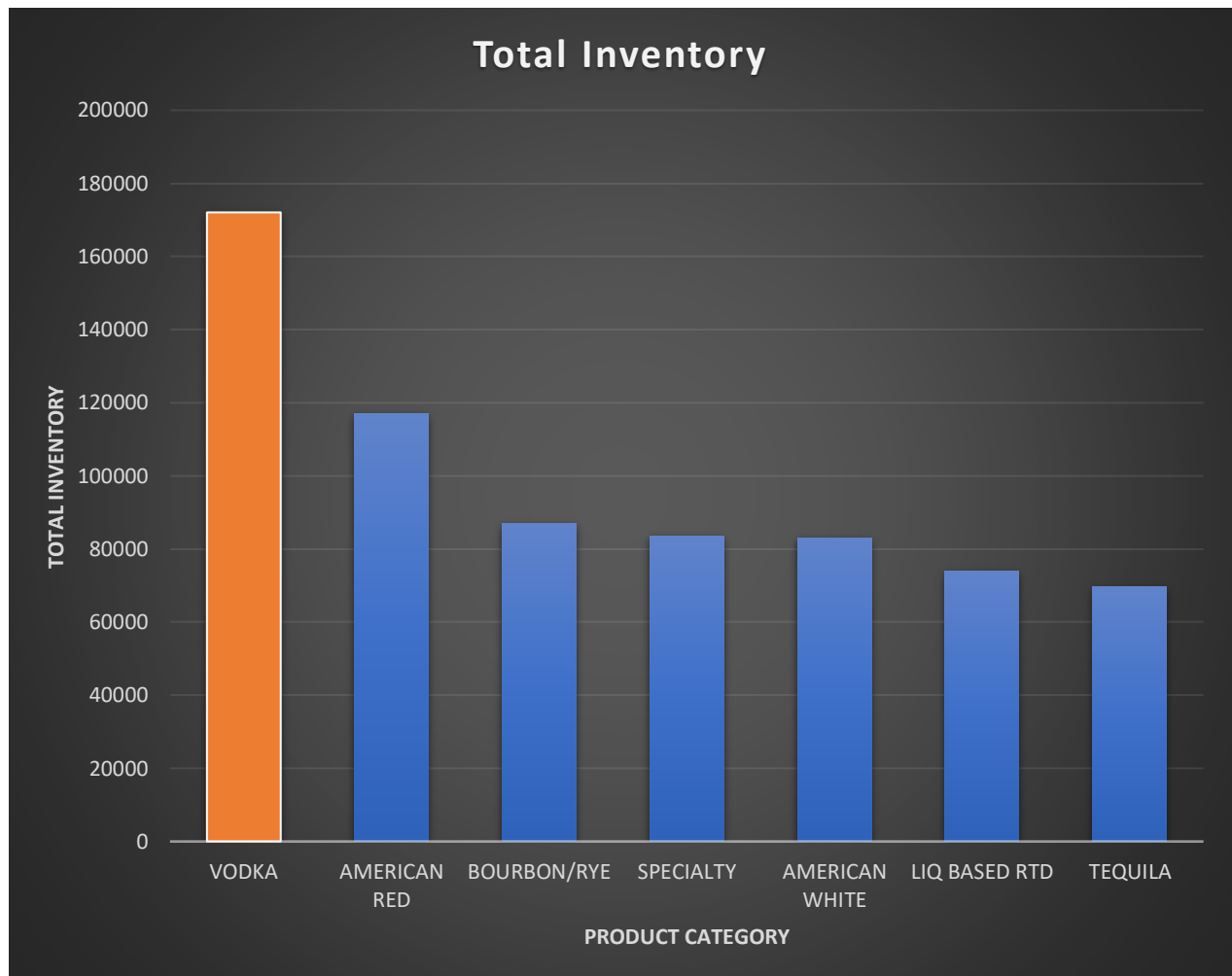
The COVID-19 pandemic significantly impacted product breakages from 2019 to 2023. Key observations include:

1. **2020 Spike:** Breakages increased to 57,541, likely due to supply chain disruptions, operational challenges, and shifts in consumer behavior.
2. **2021 Dip:** Sharp drop to 2,268, possibly due to improved adjustments and quality control measures by companies.
3. **2022 Surge:** Record high breakages at 161,871, potentially from accumulated pandemic effects and increased demand as economies reopened.
4. **2023 Decline:** Drop to 5,073, indicating stabilization as businesses adapted to post-pandemic conditions.

The fluctuations align with pandemic phases, highlighting its profound impact on operations and product quality.

3. Product Category with Highest Inventory

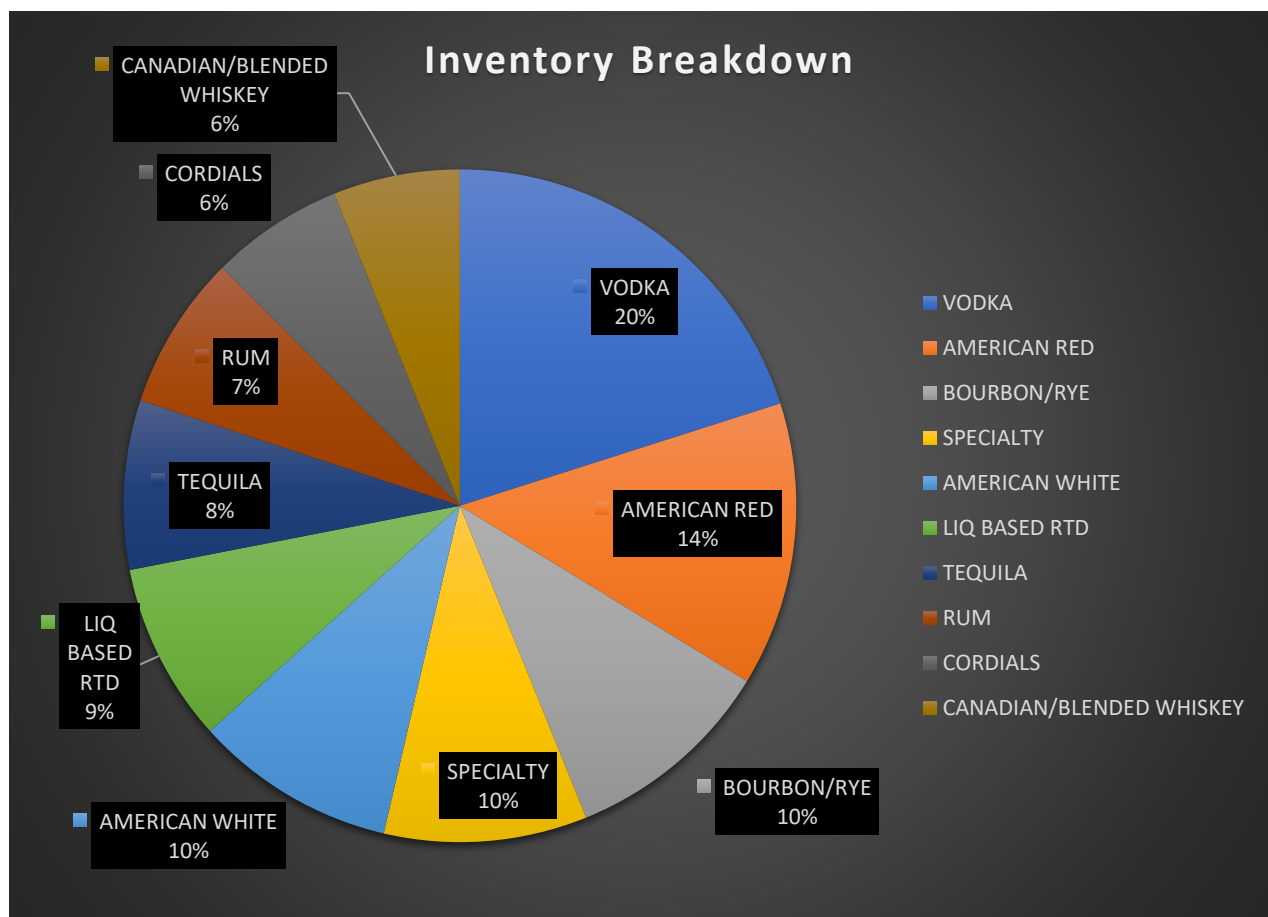
Product Category	Total Inventory
VODKA	172087
AMERICAN RED	117013
BOURBON/RYE	86962
SPECIALTY	83648
AMERICAN WHITE	83021



VODKA holds the highest inventory at 172,087 units, significantly surpassing other categories. AMERICAN RED follows with 117,013 units, while BOURBON/RYE, SPECIALTY, and AMERICAN WHITE each have inventories around 83,000 to 87,000 units. This indicates a strategic focus or higher demand for VODKA compared to other product categories.

4. Product Category Breakdown

Product Category	Total Inventory
VODKA	172087
AMERICAN RED	117013
BOURBON/RYE	86962
SPECIALTY	83648
AMERICAN WHITE	83021
LIQ BASED RTD	73836
TEQUILA	69699
RUM	63819
CORDIALS	54740
CANADIAN/BLENDED WHISKEY	52229



VODKA leads with the highest inventory at 172,087 units, followed by **AMERICAN RED** with 117,013 units. The categories **BOURBON/RYE**, **SPECIALTY**, and **AMERICAN WHITE** have inventories ranging from approximately 83,000 to 87,000 units. **CANADIAN/BLENDED WHISKEY** has the lowest inventory at 52,229 units. This distribution suggests a strategic focus on stocking higher quantities of VODKA and AMERICAN RED.

5. Inventory Level for Product Code: 92452

Product Description	Product Code	Total Inventory
Samuel Adams Hops cape Wheat Ale - 6 Pack	92452	-48

The negative inventory level for Product Code 92452, Samuel Adams Hops cape Wheat Ale - 6 Pack, indicates that there is an issue that needs to be addressed.

A negative inventory level generally means that the recorded inventory count in the system shows a negative number, indicating that **more units of the product have been sold or removed from inventory than were recorded as being in stock**. This situation is typically a sign of an error or discrepancy in inventory management. Here are some of the common implications and potential causes of negative inventory:

Implications of Negative Inventory

- ❖ **Stock-Out Situations:**
 - It indicates that the product is not physically available for sale, despite what the system might show.
- ❖ **Financial Discrepancies:**
 - Negative inventory can affect financial reports, as it may lead to inaccuracies in cost of goods sold (COGS) and profit margins.
- ❖ **Customer Service Issues:**
 - It can result in unfulfilled customer orders, leading to dissatisfaction and potential loss of business.
- ❖ **Supply Chain Disruptions:**
 - It can disrupt supply chain operations, making it difficult to plan restocking and manage supplier relationships.

Potential Causes of Negative Inventory

- ❖ **Sales Transactions Exceeding Stock:**
 - Sales recorded in the system exceed the actual inventory available, possibly due to overselling or backordering errors.
- ❖ **Data Entry Errors:**
 - Mistakes in entering inventory data, such as incorrect quantities during stock updates, sales, or returns.
- ❖ **Unrecorded Receipts or Returns:**
 - Inventory received or returned not being properly recorded in the system.
- ❖ **Theft, Loss, or Damage:**
 - Physical inventory loss due to theft, loss, or damage that has not been accounted for in the system.
- ❖ **Miscounts During Physical Inventory:**
 - Errors during physical inventory counts can result in discrepancies between actual and recorded stock levels.

Steps to Resolve Negative Inventory

- ❖ **Conduct a Physical Inventory Count:**
 - Verify the actual physical stock to identify and correct discrepancies.
- ❖ **Review and Audit Transactions:**
 - Audit recent sales, returns, and restocking transactions to identify and correct errors.
- ❖ **Adjust Inventory Records:**
 - Make necessary corrections in the inventory management system to reflect the accurate stock levels.
- ❖ **Implement Strong Inventory Controls:**
 - Establish procedures for accurate inventory tracking, regular audits, and staff training to prevent future discrepancies.
- ❖ **Use Inventory Management Software:**
 - Utilize advanced inventory management software with real-time tracking to minimize errors and ensure accurate inventory levels.

Addressing the root causes of negative inventory and implementing robust inventory management practices can help prevent such issues in the future and ensure smooth business operations.

6. Highest Priced Product

Row Labels	Sum of Sale Price (\$)
Patron Silver Tequila	104.99
Maestro Dobel Anejo Tequila	63.99
Camarena Reposado Tequila	53.98
Camarena Silver Tequila	53.98
Casa Noble Reposado Tequila	48.99
Stags' Leap Winery Cabernet Sauvignon	47.99
Don Julio Blanco Tequila	46.99
D'usse VSOP Cognac	41.99
Jagermeister Herbal Liqueur	40.99
Brother's Bond Hand Selected Batch Straight Bourbon Whiskey	38.99
Maestro Dobel Diamante Tequila	38.99
The Botanist Islay Dry Gin	38.99



The highest priced product is **Patron Silver Tequila** at **\$104.99**.

7. Best Discounted Product



Product Description	Sale Price (\$)	Product Price (\$)	Discount (\$)
Woodford Reserve Distiller's Select Kentucky Straight Bourbon Whiskey	31.99	214.55	-182.56
Maker's Mark Kentucky Straight Bourbon Whisky	20.99	139.95	-118.96
Patron Silver Tequila	104.99	213.76	-108.77
La Crema Pinot Noir	22.99	130.95	-107.96
Don Julio Blanco Tequila	46.99	139.98	-92.99
Disaronno Originale Amaretto Liqueur	25.99	103.96	-77.97
Jose Cuervo Especial Silver Tequila	35.99	111.94	-75.95
Mount Gay Eclipse Rum	18.99	92.97	-73.98
Jim Beam Kentucky Straight Bourbon Whiskey	30.99	102.34	-71.35
Jose Cuervo Gold Especial Oro Tequila	35.99	104.95	-68.96



The best discounted product is **Woodford Reserve Distiller's Select Kentucky Straight Bourbon Whiskey**, which has a sale price of **\$31.99** and an original product price of **\$214.55**, resulting in a discount of **\$182.56**.

This substantial discount makes Woodford Reserve Distiller's Select Kentucky Straight Bourbon Whiskey the best deal among the listed products, offering significant savings compared to its original price.

8. Range of Product Sizes

Product Size (IN ML)											 
50	100	187	200	207	250	296	325	330	331	355	375
376	425	441	473	500	503	553	562	568	651	656	673
710	750	751	760	800	828	831	850	937	950	1000	1065
1081	1105	1106	1124	1125	1126	1175	1183	1302	1312	1375	1500
1501	1538	1687	1750	1800	1875	2000	2125	2151	2175	2250	2251
2437	2500	2550	2582	2625	2700	2750	2812	2875	2925	2937	3000
3125	3175	3325	3375	3500	3550	3625	3750	3751	3875	3925	3975
4000	4075	4125	4175	4225	4300	4500	4550	4625	4687	5000	5250
5437	5500	5651	5875	5937	6000	6500	(bl...				

The slicer for product sizes in milliliters (ml) shows the range of beverage sizes ABS sells, from **50 ml** to **6500 ml**. The slicer includes a comprehensive selection of intermediate sizes, such as 100 ml, 500 ml, 1000 ml, 2000 ml, and 5000 ml. The other units such as Liters- L and Ounces- OZ are converted into milliliters for better readability. This interactive tool allows users to filter and view products based on their sizes easily, enhancing inventory and sales analysis.

9. Products sold by ABS other than Beverages

Product Code	Product Description	Product Size	Total Inventory	Product Price (\$)
122	WHISKEY ROCKS T SHIRT	BAG	0	14.99

Yes, ABS sells product other than Beverages. One such product is **BAG** of **WHISKEY ROCKS T SHIRT** priced at **\$14.99** with **Product Code 122**. Its currently **out of stock** as Inventory shows **0 items** available.

10. Combining Breakage and Inventory Datasets

Yes, the two data sets can be combined based on the Product Code as the Foreign Key. I have merged the two dataset queries and made a connection between both based on the Product code. I have displayed Product Description from the ABS Inventory dataset and Product Quantity from the Breakages dataset.

Product Description	Product Quantity
1000 Stories Bourbon Barrel Aged Zinfandel	6
1000 Stories Gold Rush Red Bourbon Barrel Aged Red Blend	1
14 Hands Cabernet Sauvignon	2
14 Hands Hot to Trot Red Can Merlot	12
1623 DRY IRISH STOUT 4/6 CANS - 6 Pack	24
1623 PILSNER 4/6 CANS - 6 Pack	24
1800 Anejo Reserva Tequila	1
1800 Coconut Reserva Tequila	2
1800 Reposado Reserva Tequila	1
1800 Silver Reserva Tequila	23

Combining Breakage and Inventory Datasets:

In this analysis, I merged two datasets—ABS Inventory and Breakages—using Product Code as the common identifier or Foreign Key. This approach enabled me to integrate information on inventory levels from the ABS Inventory dataset with instances of product breakage recorded in the Breakages dataset.

Integration Process:

1. **Data Merging:** I utilized Excel queries to merge the datasets based on the Product Code. This connection allowed me to align records from both datasets into a unified dataset for analysis.
2. **Data Elements:** From the merged dataset, I extracted and correlated specific attributes:

- **Product Description:** Retrieved from the ABS Inventory dataset, providing contextual information about each product.
- **Product Quantity:** Extracted from the Breakages dataset, indicating the quantity of products that were reported as damaged or broken.

Insights and Reporting:

This integration facilitated a deeper understanding of the relationship between inventory management and incidences of breakage. By examining product quantities alongside their descriptions, we gained insights into:

- **Impact of Breakages:** Understanding how incidents affect specific products within the inventory.
- **Inventory Management:** Assessing potential implications for inventory control and forecasting based on historical breakage data.
- **Operational Efficiency:** Identifying opportunities to optimize processes and reduce instances of product damage.

Conclusion

The analysis of ABS Store Inventory and Sale Item, along with Alcohol Beverage Services Breakage Inventory datasets, has provided comprehensive insights into inventory management and product breakages within the beverage supply chain. Through systematic data cleaning, preprocessing, and analysis, this report addressed key objectives outlined in the project prompt, offering actionable recommendations for operational improvements.

Through a thorough analysis of the ABS Store Inventory and Sale Item, as well as the Alcohol Beverage Services Breakage Inventory datasets, this report has illuminated critical insights into inventory management and breakage trends within the beverage supply chain. Key findings include:

- **Breakage Insights:** Identified top products like Coors Light and Modelo Especial most affected by breakages, highlighting opportunities for improved packaging and handling practices to minimize losses.
- **Seasonal Trends:** Analyzed seasonal variations in breakage incidents, suggesting potential correlations with operational practices or external factors that influence inventory handling efficiencies.
- **Inventory Dynamics:** Vodka emerged as the category with the highest inventory volume, underscoring the need for targeted strategies to optimize stock levels and enhance inventory turnover.
- **Pricing and Discounts:** Identified high-priced products like Patron Silver Tequila and products offering significant discounts, providing insights into effective pricing strategies to maximize profitability and manage inventory effectively.
- **Product Range and Diversification:** Explored the variety of beverage sizes and identified non-beverage products such as the Whiskey Rocks T-shirt, indicating potential avenues for product line expansion and market diversification.
- **Data Integration Feasibility:** Successfully integrated breakage and inventory datasets, demonstrating the potential for comprehensive analysis to enhance decision-making processes across supply chain management.

Recommendations

Based on the analysis of ABS Store Inventory and Sale Item, as well as Alcohol Beverage Services Breakage Inventory datasets, the following strategic recommendations are proposed to enhance inventory management and operational efficiency:

1. **Enhanced Packaging and Handling Protocols:** Implement customized packaging solutions and rigorous handling protocols for high-risk products like Coors Light and Modelo Especial to minimize breakages and improve supply chain reliability.
2. **Agile Seasonal Inventory Strategies:** Develop adaptive inventory management strategies to align with seasonal demand fluctuations observed. Continuous monitoring and swift adjustments in inventory levels will optimize stock allocation and reduce carrying costs.
3. **Optimized Pricing Tactics:** Strategically adjust pricing strategies based on insights gathered. Introduce targeted discounts on products with significant price variations to stimulate sales and improve inventory turnover rates.
4. **Diversification into Non-Beverage Categories:** Explore opportunities to diversify product offerings beyond beverages, leveraging insights into consumer preferences. Consider expanding into categories such as identified non-beverage products like the Whiskey Rocks T-shirt to broaden market appeal and reduce dependency on seasonal beverage demand.
5. **Establishment of Continuous Monitoring Systems:** Implement robust monitoring mechanisms to track inventory trends and consumer behaviors continuously. This proactive approach will facilitate timely adjustments in supply chain strategies, ensuring responsiveness to market dynamics.

References

Harnessing the Power of Data Analytics to Revolutionize the Food and Beverage Supply Chain.
(2024). IMAM A. [Optimizing Food & Beverage Supply Chains with Data Analytics \(linkedin.com\)](#)