

Smart Inventory Management in Retail and Warehousing: A Data-Driven Approach

Team Data Wranglers:

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Introduction:

In the dynamic world of retail and warehousing, efficient inventory management is crucial for operational effectiveness and customer satisfaction. The complexities associated with inventory management, such as overstocking, stockouts, and resource misallocation, pose significant challenges. This summary outlines a data-driven approach to tackle these issues, leveraging advanced tools and techniques across the data lifecycle.

Generation and Collection of Data:

Data-driven techniques are essential for efficient inventory management in retail and storage. This includes combining data from several sources, including barcoding, RFID, and point-of-sale systems. The deployment of IoT devices makes real-time monitoring possible. Predictive analytics and cooperative efforts with suppliers enable accurate demand forecasts, averting stockouts and overstock. Using cloud-based solutions guarantees efficient operations with enhanced scalability and accessibility. Sensitive information is protected by strict adherence to legislation, security measures, and data quality assurance. A robust and flexible inventory management system is developed by ongoing process monitoring, personnel training programs, and the gradual integration of new technology. This eventually improves overall performance and customer satisfaction.

Data Lifecycle Steps and Tools Used:

1. Data Cleaning and Wrangling with OpenRefine:

- The first step involves using OpenRefine, a powerful tool for data cleaning and preparation.
- This process is essential for ensuring data quality, which includes handling missing values, correcting inconsistencies, and standardizing data formats.

2. Storing Pre-processed Dataset in Google Cloud Platform (GCP) Bucket:

- After cleaning, the data is securely stored in a GCP Bucket.

- This cloud storage solution offers scalability and robustness, essential for handling large datasets typically encountered in retail and warehousing scenarios.

3. Loading Dataset into Hadoop Distributed File System (HDFS):

- For further processing and analysis, the dataset is loaded into HDFS.
- HDFS offers a reliable and distributed storage method, crucial for managing big data in a distributed computing environment.

4. Analysis Using SQL Queries in BigQuery:

- The core analysis is performed through SQL queries in BigQuery, Google's enterprise data warehouse.
- This allows for efficient processing of large datasets and complex analytical queries.

5. Visualizing the Dataset Using Google Data Studio:

- Visualizing data is a critical step for interpreting and presenting the analysis results.
- Google Data Studio provides a versatile platform for creating interactive reports and dashboards, enhancing the understanding and communication of data insights.

6. Interpreting Analysis Results:

- The final step involves interpreting the results of the analysis.
- This step is crucial for drawing actionable insights and making informed decisions.

Use Cases of Dataset:

The processed and analyzed data serves multiple use cases in inventory management:

1. Monthly Sales Summary:
 - Provides an overview of sales performance, highlighting trends and patterns monthly.
2. Supplier Performance Analysis:
 - Assesses the reliability and efficiency of suppliers, influencing procurement strategies.
3. Item Type Sales and Stock Analysis:
 - Offers insights into the sales volume and stock levels of different item categories, aiding in inventory optimization.
4. Identifying Top Selling Items:
 - Helps in recognizing the most popular items, guiding marketing and stock replenishment decisions.
5. Seasonal Sales Analysis:
 - Analyzes sales variations across different seasons, assisting in seasonal stock planning.
6. Yearly Supplier Contribution:
 - Evaluates the annual performance and contribution of suppliers to the business.

Conclusion and Next Steps:

The implementation of this data-driven approach in inventory management represents a significant advancement in addressing the challenges faced by retail and warehousing sectors. The next steps involve continuous monitoring and refinement of the analysis. The data science or analyst teams should focus on integrating real-time data analytics for more dynamic decision-making and exploring advanced analytical techniques like machine learning for predictive analytics. This ongoing process will ensure sustained improvements in inventory management, leading to increased profitability and customer satisfaction.

Supporting Documents:

One of the review's most important findings is how smart warehouse operations management is becoming increasingly important for companies looking to cut costs and increase productivity. The authors emphasize the development and implementation of intelligent warehouse solutions using a variety of technologies, including robots, artificial intelligence, and the Internet of Things (IoT).

ZHEN, L., & LI, H. (2022). A literature review of smart warehouse operations management. *Front. Eng. Manag.* 2022, 9(1): 31–55. <https://doi.org/10.1007/s42524-021-0178-9>

This describes a warehouse inventory management system that combines lot tracking with open-source software. It is scalable and efficient, making it suited to a wide range of sectors. The system is flexible to fit warehouses of different sizes and employs open-source software to create inventory reports and track item movement. It provides flexibility in inventory management and may be used in a variety of industries, including manufacturing, distribution, and retail.

B., S. S. T., & S., N. (2018). Warehouse inventory management system using IoT and open-source framework. *Alexandria Engineering Journal Volume 57, Issue 4, December 2018, Pages 3817-3823.* <https://doi.org/10.1016/j.aej.2018.02.003>

In "Exploring Cyber-Physical Systems in Industry 4.0: A Comprehensive Examination of the Core Technologies in Smart Warehousing," the vital technologies that enable the integration of Cyber-Physical Systems (CPS) in smart warehouses are examined. In line with Industry 4.0 principles, the study explores the revolutionary effect of CPS on warehouse intelligence and operational efficacy.

Liu, X., Cao, J., Yang, Y., & Jiang, S. (2018). CPS-Based Smart Warehouse for Industry 4.0: A Survey of the Underlying Technologies. *Computers* 2018, 7(1), 13. <https://doi.org/10.3390/computers7010013>

Data Cleaning and Data Wrangling using OpenRefine

Using facets and filters

Use facets and filters to select subsets of your data to act on. Choose facet and filter methods from the menus at the top of each data column.

Not sure how to get started?
Watch these screencasts

All	YEAR	MONTH	SUPPLIER	ITEM CODE	ITEM DESCRIPTION	ITEM TYPE	Retail Sales	Retail Transfers	Warehouse Sales
1.	2020	1	REPUBLIC NATIONAL DISTRIBUTING CO	100009	BOOTLEG RED - 750ML	WINE	0.00	0.00	2.00
2.	2020	1	PWSWN INC	100024	MOMENT DE PLAISIR - 750ML	WINE	0.00	1.00	4.00
3.	2020	1	RELIABLE CHURCHILL LLC	1001	S SMITH ORGANIC PEAR CIDER - 18.70Z	BEER	0.00	0.00	1.00
4.	2020	1	LANTERNA DISTRIBUTORS INC	100145	SCHLINK HAUS KABINETT - 750ML	WINE	0.00	0.00	1.00
5.	2020	1	DIONYSOS IMPORTS INC	100293	SANTORINI GAVALA WHITE - 750ML	WINE	0.82	0.00	0.00
6.	2020	1	KYSELA PERE ET FILS LTD LTD	100641	CORTENOVA VENETO P/GRIG - 750ML	WINE	2.76	0.00	6.00
7.	2020	1	SANTA MARGHERITA USA INC	100749	SANTA MARGHERITA P/GRIG ALTO - 375ML	WINE	0.08	1.00	1.00
8.	2020	1	BROWN-FORMAN BEVERAGES WORLDWIDE	1008	JACK DANIELS COUNTRY COCKTAIL SOUTHERN PEACH - 10.OZ-NR	BEER	0.00	0.00	2.00
9.	2020	1	JIM BEAM BRANDS CO	10103	KNOB CREEK BOURBON 9YR - 100P - 375ML	LIQUOR	6.41	4.00	0.00
10.	2020	1	INTERNATIONAL CELLARS LLC	101117	KSARA CAB - 750ML	WINE	0.33	1.00	2.00

Text Facet for Item Code

34056 choices total, too many to display
Set choice count limit

Facet by choice counts

All	YEAR	MONTH	SUPPLIER	ITEM CODE	ITEM DESCRIPTION	ITEM TYPE	Retail Sales	Retail Transfers	Warehouse Sales
1.	2020	1	REPUBLIC NATIONAL DISTRIBUTING CO	100009	BOOTLEG RED - 750ML	WINE	0.00	0.00	2.00
2.	2020	1	PWSWN INC	100024	MOMENT DE PLAISIR - 750ML	WINE	0.00	1.00	4.00
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9.	2020	1	JIM BEAM BRANDS CO	10103	KNOB CREEK BOURBON 9YR - 100P - 375ML	LIQUOR	6.41	4.00	0.00
10.	2020	1	INTERNATIONAL CELLARS LLC	101117	KSARA CAB - 750ML	WINE	0.33	1.00	2.00
11.	2020	1	HEAVEN HILL DISTILLERIES INC	10120	J W DANT BOURBON 100P - 1.75L	LIQUOR	1.70	1.00	0.00
12.	2020	1	BACCHUS IMPORTERS LTD	10123	NOTEWORTHY SMALL BATCH BOURBON - 750ML	LIQUOR	1.02	0.00	0.00
13.	2020	1	BACCHUS IMPORTERS LTD	10124	NOTEWORTHY SMALL BATCH RYE 750ML	LIQUOR	0.68	0.00	0.00
14.	2020	1	BACCHUS IMPORTERS LTD	10125	NOTEWORTHY SMALL BATCH HONEY BBN 750	LIQUOR	0.34	0.00	0.00
15.	2020	1	MONSIEUR TOUTON SELECTION	101346	ALSACE WILLIAM GEW - 750ML	WINE	0.00	0.00	2.00
16.	2020	1	THE COUNTRY VINTNER, LLC DBA WINEBOW	101486	POLIZIANO ROSSO MONTEPUL - 750ML	WINE	0.00	0.00	1.00
17.	2020	1	THE COUNTRY VINTNER, LLC DBA WINEBOW	101532	HATSUMAGO SAKE JUN MAI SHU - 720ML	WINE	0.34	1.00	1.00
18.	2020	1	ROYAL WINE CORP	101664	RAMON CORDOVA RIOJA - 750ML	WINE	0.16	0.00	2.00
19.	2020	1	REPUBLIC NATIONAL DISTRIBUTING CO	101702	MANISCHEWITZ CREAM RED CONCORD - 1.5L	WINE	0.00	0.00	1.00
20.	2020	1	ROYAL WINE CORP	101753	BARKAN CLASSIC PET SYR - 750ML	WINE	0.00	0.00	3.00
21.	2020	1	ROYAL WINE CORP	101915	WEINSTOCK CAB - 750ML	WINE	0.00	0.00	1.00
22.	2020	1	ROYAL WINE CORP	101923	WEINSTOCK CHARD - 750ML	WINE	0.00	0.00	1.00
23.	2020	1	JIM BEAM BRANDS CO	10197	KNOB CREEK BOURBON 9YR - 100P - 1.75L	LIQUOR	12.72	11.84	0.00

Numeric Facet for Item Code

OpenRefine Warehouse and Retail Sales Permalink

Facet / Filter Undo / Redo 0 / 0

307645 rows

Show as: rows records Show: 5 10 25 50 100 500 1000 rows

Extensions Wikibase

	ITEM CODE	YEAR	MONTH	SUPPLIER	ITEM CODE	ITEM DESCRIPTION	ITEM TYPE	RETAIL SALES	RETAIL TRANSFERS	WAREHOUSE SALES
1.	2020	1		REPUBLIC NATIONAL DISTRIBUTING CO	100009	BOOTLEG RED - 750ML	WINE	0.00	0.00	2.00
2.	2020	1		PWSWN INC	100024	MOMENT DE PLAISIR - 750ML	WINE	0.00	1.00	4.00
3.	2020	1		RELIABLE CHURCHILL LLLP	1001	S SMITH ORGANIC PEAR CIDER - 18.7OZ	BEER	0.00	0.00	1.00
4.	2020	1		LANTERNA DISTRIBUTORS INC	100145	SCHLINK HAUS KABINETT - 750ML	WINE	0.00	0.00	1.00
5.	2020	1		DIONYSOS IMPORTS INC	100293	SANTORINI GAVALA WHITE - 750ML	WINE	0.82	0.00	0.00
6.	2020	1		KYSELAPERE ET FILS LTD	100641	CORTENOVA VENETO P/GIGR - 750ML	WINE	2.76	0.00	6.00
7.	2020	1		SANTA MARGHERITA USA INC	100749	SANTA MARGHERITA P/GIGR ALTO - 375ML	WINE	0.08	1.00	1.00
8.	2020	1		BROWN-FORMAN BEVERAGES WORLDWIDE	1008	JACK DANIELS COUNTRY COCKTAIL SOUTHERN PEACH - 10.02-NR	BEER	0.00	0.00	2.00
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17.	2020	1		THE COUNTRY VINTNER, LLC DBA WINEBOW	101532	HATSUMAGO SAKE JUN MAI SHU - 720ML	WINE	0.34	1.00	1.00
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Transform from Text to Numeric (Wrangling Data)

OpenRefine Warehouse and Retail Sales Permalink

Facet / Filter Undo / Redo 1 / 1

307645 rows

Show as: rows records Show: 5 10 25 50 100 500 1000 rows

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23.	2020	1		JIM BEAM BRANDS CO	10197	KNOB CREEK BOURBON 9YR - 100P - 1.75L	LIQUOR	12.72	11.84	0.00

0 — 3,500,000

Numeric Non-numeric Blank Error

307591 54 0 0

Storage of Dataset in GCP Bucket

The screenshot shows the Google Cloud Storage 'Bucket details' page for 'datawrangler5'. The bucket is located in 'us-east1 (South Carolina)' with a 'Standard' storage class, 'Not public' public access, and 'None' protection. A single object, 'WarehouseandRetailSales.csv', is listed, which is 26.2 MB in size, a text/csv type, created on Nov 29, 2023, at 11:53:00 PM, and has a 'Standard' storage class. A success message at the bottom indicates '1 file successfully uploaded'.

Exploring Hadoop & Spark Cluster

The screenshot shows an SSH session on a Google Compute Engine instance. The user is running a series of commands to explore the Hadoop and Spark cluster. The commands include:

- `ps -ef | grep -i hadoop`: Shows processes related to Hadoop.
- `hive`: Starts the Hive shell.
- `dfs -Xmx400m -Dproc metastore -Dlog4j.formatMsgs=trus -Dlog4j.configurationfile=hive-log4j.properties -Djava.util.logging.config.file=/usr/lib/hive/conf/parquet-logging.properties -Dyarn.log.dir=/usr/lib/hadoop/logs -Dyarn.root.logger=INFO,console -Djava.library.path=/usr/lib/hadoop/lib/native -Dhadoop.log.dir=/usr/lib/hadoop/logs -Dhadoop.log.file=hadoop.log -Dhadoop.home.dir=/usr/lib/hadoop -Dhadoop.id.str=hive -Dhadoop.root.logger=INFO,console -Dhadoop.policy.file=hadoop-policy.xml -Dhadoop.security.logger=INFO,NullAppender org.apache.hadoop.util.RunJar /usr/lib/hive/lib/hive-service-3.1.3.jar org.apache.hive.service.server.HiveServer2`: Starts the Hive server.
- `hdfs`: Starts the HDFS NameNode.
- `mapred`: Starts the MapReduce JobHistory Server.
- `yarn`: Starts the YARN Resource Manager.
- `root`: Starts the HDFS NameNode.
- `spark`: Starts the Spark History Server.
- `narenrdrathreddy@338:~/datawranglers-cluster-m:~$`: The user's prompt.

The output of these commands includes logs for Hive, HDFS, MapReduce, and YARN, as well as configuration details for each service.

Loading of Dataset into Hadoop Distributed File System (HDFS)

The screenshot shows an SSH session in a browser window titled "SSH-in-browser". The URL is `ssh.cloud.google.com/v2/ssh/projects/adta5240datawranglers/zones/us-central1-a/instances/datawranglers-cluster-m?authuser=0&hl=en_US&projectNumber=8..`. The session output shows the following command sequence:

```
Linux datawranglers-cluster-m 5.10.0-0.deb10.16-cloud-amd64 #1 SMP Debian 5.10.127-2-bpo10+1 (2022-07-28) x86_64
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Thu Nov 30 06:22:25 2023 from 35.235.244.32
narendranathreddy@339:~$ ls -l
total 0
narendranathreddy@339:~$ mkdir DATA
narendranathreddy@339:~$ cd DATA
narendranathreddy@339:~/DATA$ gsutil cp gs://datawrangler5/data/WarehouseandRetailSales.csv WarehouseandRetailSales.csv
Copying gs://datawrangler5/data/WarehouseandRetailSales.csv...
- [1 files] 26.2 MiB / 26.2 MiB
Operation completed over 1 objects/26.2 MiB.
narendranathreddy@339:~/DATA$
```

Analysis:

The screenshot shows the Google Cloud BigQuery interface. The left sidebar includes sections for Analysis, BigQuery Studio, Data transfers, Scheduled queries, Analytics Hub, Dataform, Partner Center, Migration, Assessment, SQL translation, Administration, Monitoring, Capacity management, BI Engine, Policy tags, and Release Notes. The main area displays the "WarehouseandRetailSales" dataset in the "WarehouseandRetailSales" table. The "PREVIEW" tab is selected, showing the following data:

Row	YEAR	MONTH	SUPPLIER	ITEM_DESCRIPTION	ITEM_TYPE	RETA
1	2020	1	null	EMPTY WINE KEG - KEGS	DUNNAGE	
2	2020	1	null	BEER CREDIT	REF	
3	2020	1	null	WINE CREDIT	REF	
4	2020	7	null	EMPTY WINE KEG - KEGS	DUNNAGE	
5	2020	7	null	BEER CREDIT	REF	
6	2020	7	null	WINE CREDIT	REF	
7	2020	3	null	EMPTY WINE KEG - KEGS	DUNNAGE	
8	2020	3	null	BEER CREDIT	REF	
9	2020	3	null	WINE CREDIT	REF	
10	2017	6	null	EMPTY WINE KEG - KEGS	DUNNAGE	
11	2017	6	null	BEER CREDIT	REF	
12	2017	6	null	WINE CREDIT	REF	
13	2017	7	null	EMPTY WINE KEG - KEGS	DUNNAGE	
14	2017	7	null	BEER CREDIT	REF	
15	2017	7	null	WINE CREDIT	REF	
16	2017	8	null	EMPTY WINE KEG - KEGS	DUNNAGE	
17	2017	8	null	BEER CREDIT	REF	
18	2017	8	null	WINE CREDIT	REF	
19	2017	9	null	EMPTY WINE KEG - KEGS	DUNNAGE	
20	2017	9	null	BEER CREDIT	REF	

At the bottom, there are navigation buttons for "Job history" and "REFRESH".

Use cases:

The purpose of this query is to provide a clear overview of sales trends over time, differentiating between retail and warehouse sales.

The screenshot shows the Google Cloud BigQuery interface. On the left, the sidebar includes sections for Analysis, Migration, Administration, and Partner Center. The main area displays a query titled "Untitled 2" which retrieves monthly sales data from the "WarehouseandRetailSales" dataset. The results table shows data for years 2017 and 2018, with columns for Year, Month, Total_Retail_Sales, and Total_Warehouse_Sales. The total number of rows is 24.

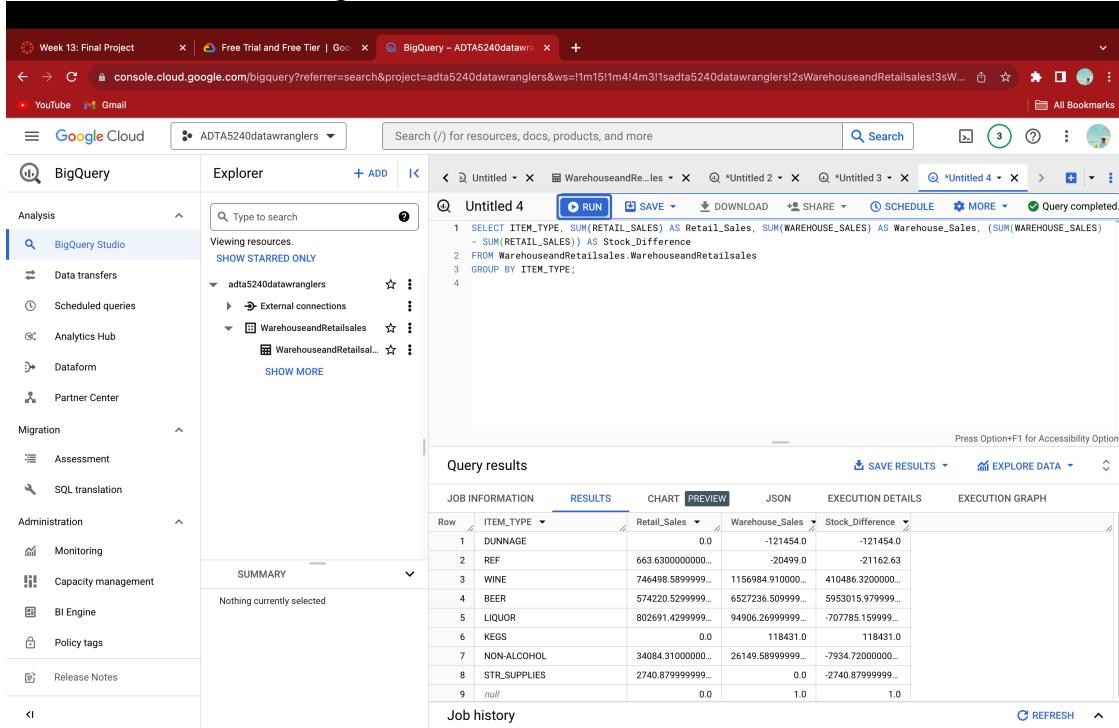
Row	YEAR	MONTH	Total_Retail_Sales	Total_Warehouse_Sales
1	2017		97357.26000000...	379390.83000000...
2	2017		92625.29000000...	316853.88999999...
3	2017		87111.78000000...	382186.68999999...
4	2017		90452.64000000...	305440.53000000...
5	2017		89236.96000000...	303714.91000000...
6	2017		98316.010000002	339305.66
7	2017		131634.49000000...	306957.22000000...
8	2018		76791.77000000...	254517.47000000...

The purpose of this query to provide a summary of total retail sales and transfers for each supplier.

The screenshot shows the Google Cloud BigQuery interface. The sidebar is identical to the previous screenshot. The main area displays a query titled "Untitled 3" which retrieves data for each supplier, summing up total retail sales and transfers. The results table shows data for various suppliers, with columns for Supplier and Total_Retail_Sales. The total number of rows is 397.

Row	SUPPLIER	Total_Retail_Sales
1	null	7439.97999999...
2	WI INC	433.0
3	BBL INC	33.6500000000...
4	MHW LTD	5691.72999999...
5	DOPS INC	1984.32000000...
6	RVWC LLC	2.9699999999...
7	TAPWINES	0.0
R	GAMBRINUS	1789.75

The purpose of this query is to provide an item-type-wise breakdown of sales across retail and warehouse channels, along with a calculation of stock differences.



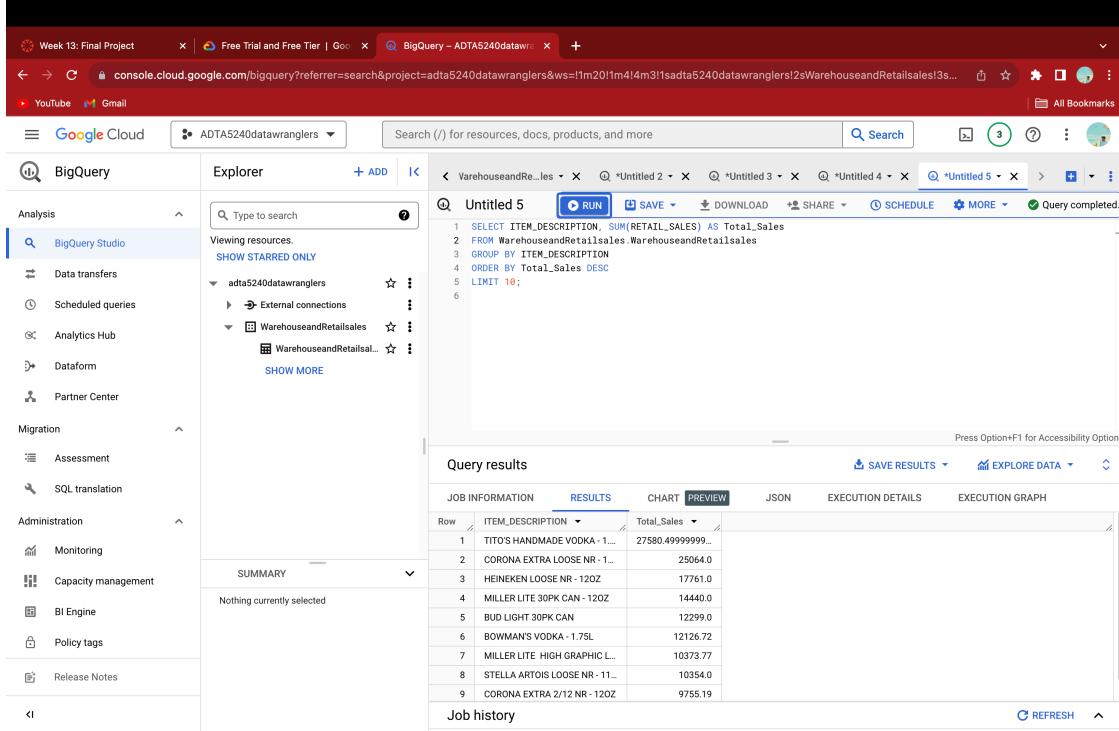
```

SELECT ITEM_TYPE, SUM(RETAIL_SALES) AS Retail_Sales, SUM(WAREHOUSE_SALES) AS Warehouse_Sales, (SUM(WAREHOUSE_SALES) - SUM(RETAIL_SALES)) AS Stock_Difference
FROM WarehouseandRetailsales.WarehouseandRetailsales
GROUP BY ITEM_TYPE;

```

ITEM_TYPE	Retail_Sales	Warehouse_Sales	Stock_Difference
DUNNAGE	0.0	-121454.0	-121454.0
REF	663.6300000000...	-20499.0	-21162.63
WINE	746498.5899999...	1156984.910000...	410486.320000...
BEER	574220.529999...	6527236.509999...	5953015.979999...
LIQUOR	802691.429999...	94906.2699999...	-70778.159999...
KEGS	0.0	118431.0	118431.0
NON-ALCOHOL	34084.3100000...	26149.5899999...	-7934.7200000...
STR_SUPPLIES	2740.87999999...	0.0	-2740.87999999...
null	0.0	1.0	1.0

The purpose of this query is to identify the top 10 best-selling items in terms of retail sales.



```

SELECT ITEM_DESCRIPTION, SUM(RETAIL_SALES) AS Total_Sales
FROM WarehouseandRetailsales.WarehouseandRetailsales
GROUP BY ITEM_DESCRIPTION
ORDER BY Total_Sales DESC
LIMIT 10;

```

ITEM_DESCRIPTION	Total_Sales
TITO'S HANDMADE VODKA - 1.75L	27580.4999999...
CORONA EXTRA LOOSE NR - 1...	25064.0
HEINEKEN LOOSE NR - 12OZ	17761.0
MILLER LITE 30PK CAN - 12OZ	14440.0
BUD LIGHT 30PK CAN	12299.0
BOWMAN'S VODKA - 1.75L	12126.72
MILLER LITE HIGH GRAPHIC...	10373.77
STELLA ARTOIS LOOSE NR - 11...	10354.0
CORONA EXTRA 2/12 NR - 12OZ	9755.19

The purpose of this query is to provide a detailed overview of sales performance for different item types across various months.

The screenshot shows the Google Cloud BigQuery interface. On the left, the sidebar includes sections for Analysis, Migration, Administration, and Partner Center. The main area displays a query titled "Untitled 6" which has completed. The query results are shown in a table:

```

1 SELECT MONTH, ITEM_TYPE, SUM(RETAIL_SALES) AS Total_Sales
2 FROM WarehouseandRetailSales.WarehouseandRetailSales
3 GROUP BY MONTH, ITEM_TYPE
4 ORDER BY MONTH, Total_Sales DESC;
5

```

Month	Item Type	Total Sales
1	LIQUOR	87152.3199999...
2	WINE	83629.0000000...
3	BEER	51965.1200000...
4	NON-ALCOHOL	3093.88
5	STR_SUPPLIES	300.319999999...
6	REF	70.43
7	DUNNAGE	0.0
8	KEGS	0.0

The purpose of this query is to provide a yearly comparison of supplier performance based on retail sales.

The screenshot shows the Google Cloud BigQuery interface. The sidebar includes sections for Analysis, Migration, Administration, and Partner Center. The main area displays a query titled "Untitled 7" which has completed. The query results are shown in a table:

```

1 SELECT YEAR, SUPPLIER, SUM(RETAIL_SALES) AS Total_Sales
2 FROM WarehouseandRetailSales.WarehouseandRetailSales
3 GROUP BY YEAR, SUPPLIER
4 ORDER BY YEAR, Total_Sales DESC;
5

```

Year	Supplier	Total Sales
2017	E & J GALLO WINERY	55030.3899999...
2017	DIAGEO NORTH AMERICA INC	47326.0200000...
2017	CONSTELLATION BRANDS	42457.3600000...
2017	ANHEUSER BUSCH INC	36062.2800000...
2017	JIM BEAM BRANDS CO	31725.2399999...
2017	MILLER BREWING COMPANY	29913.5200000...
2017	CROWN IMPORTS	23140.57
2017	RACERONI USA INC	22988.8000000...

SQL Queries:

```
SELECT YEAR, MONTH, SUM('RETAIL_SALES') AS Total_Retail_Sales,  
SUM('WAREHOUSE_SALES') AS Total_Warehouse_Sales  
FROM WarehouseandRetailsales.WarehouseandRetailsales  
GROUP BY YEAR, MONTH  
ORDER BY YEAR, MONTH;
```

```
SELECT SUPPLIER, SUM(RETAIL_SALES) AS Total_Retail_Sales,  
SUM(RETAIL_TRANSFERS) AS Total_Retail_Transfers  
FROM WarehouseandRetailsales.WarehouseandRetailsales  
GROUP BY SUPPLIER;
```

```
SELECT ITEM_TYPE, SUM(RETAIL_SALES) AS Retail_Sales,  
SUM(WAREHOUSE_SALES) AS Warehouse_Sales, (SUM(WAREHOUSE_SALES) -  
SUM(RETAIL_SALES)) AS Stock_Difference  
FROM WarehouseandRetailsales.WarehouseandRetailsales  
GROUP BY ITEM_TYPE;
```

```
SELECT ITEM_DESCRIPTION, SUM(RETAIL_SALES) AS Total_Sales  
FROM WarehouseandRetailsales.WarehouseandRetailsales  
GROUP BY ITEM_DESCRIPTION  
ORDER BY Total_Sales DESC  
LIMIT 10;
```

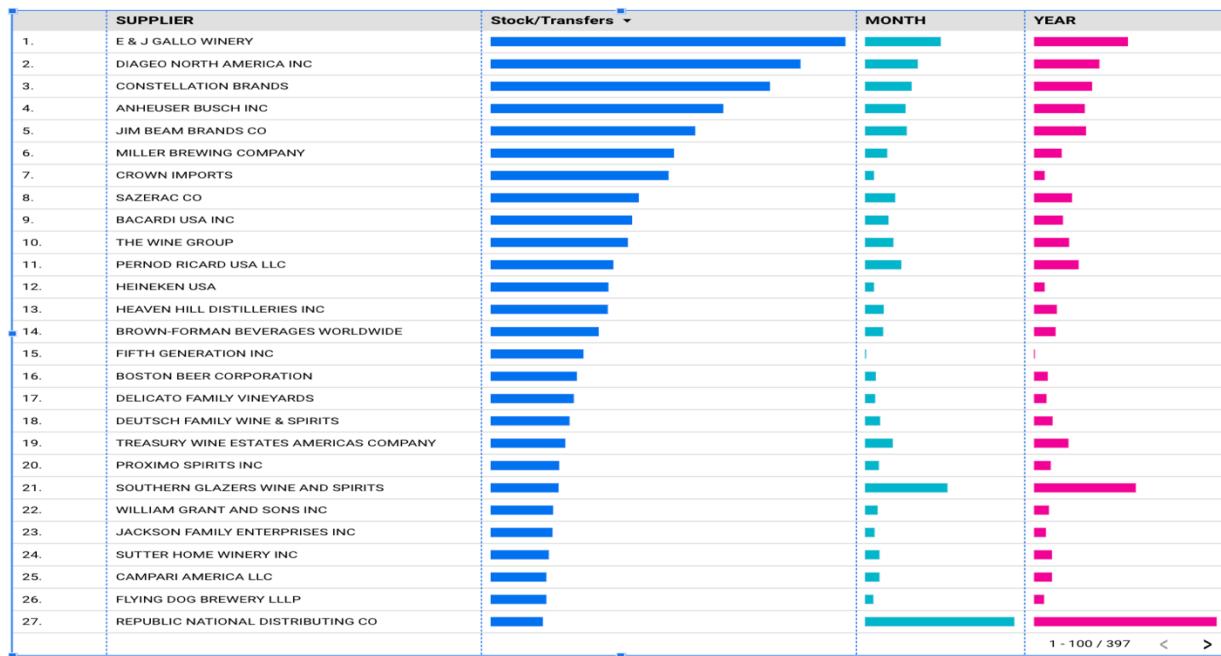
```
SELECT MONTH, ITEM_TYPE, SUM(RETAIL_SALES) AS Total_Sales  
FROM WarehouseandRetailsales.WarehouseandRetailsales  
GROUP BY MONTH, ITEM_TYPE  
ORDER BY MONTH, Total_Sales DESC;
```

```
SELECT YEAR, SUPPLIER, SUM(RETAIL_SALES) AS Total_Sales  
FROM WarehouseandRetailsales.WarehouseandRetailsales  
GROUP BY YEAR, SUPPLIER  
ORDER BY YEAR, Total_Sales DESC;
```

Visualization (Use Cases)

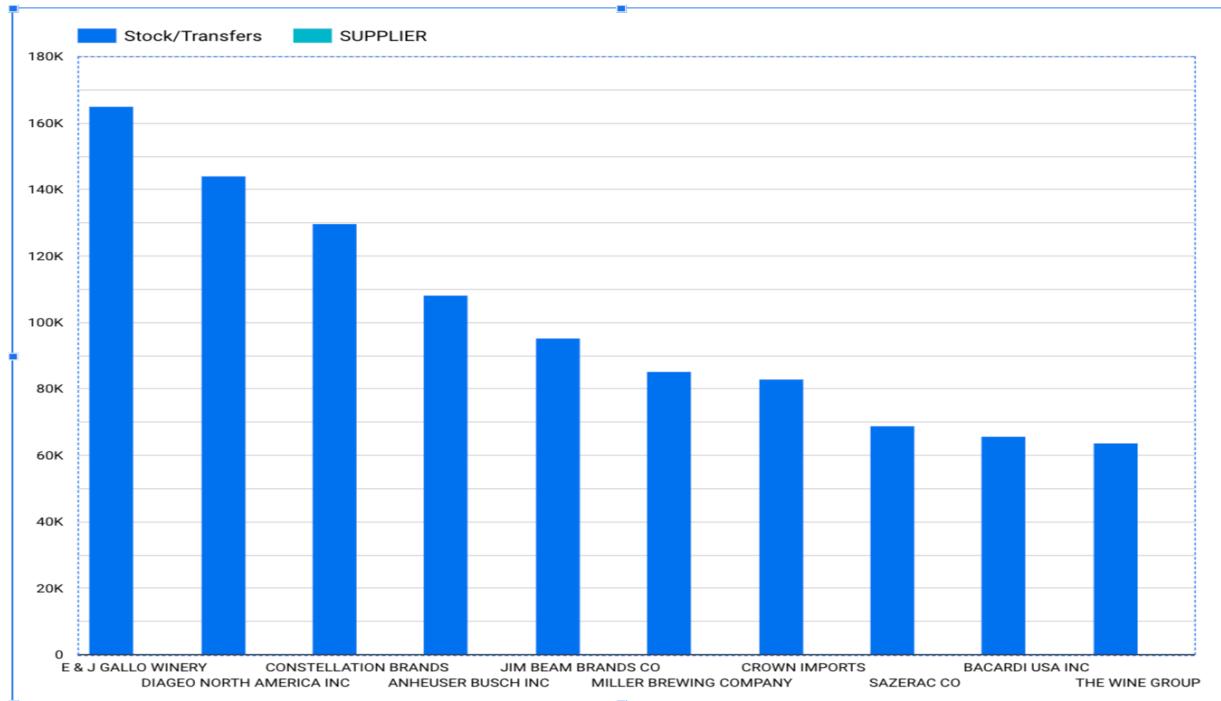
Monthly Sales Summary

The objective of the Monthly Sales Summary is to provide a comprehensive overview of sales for each month across different years.



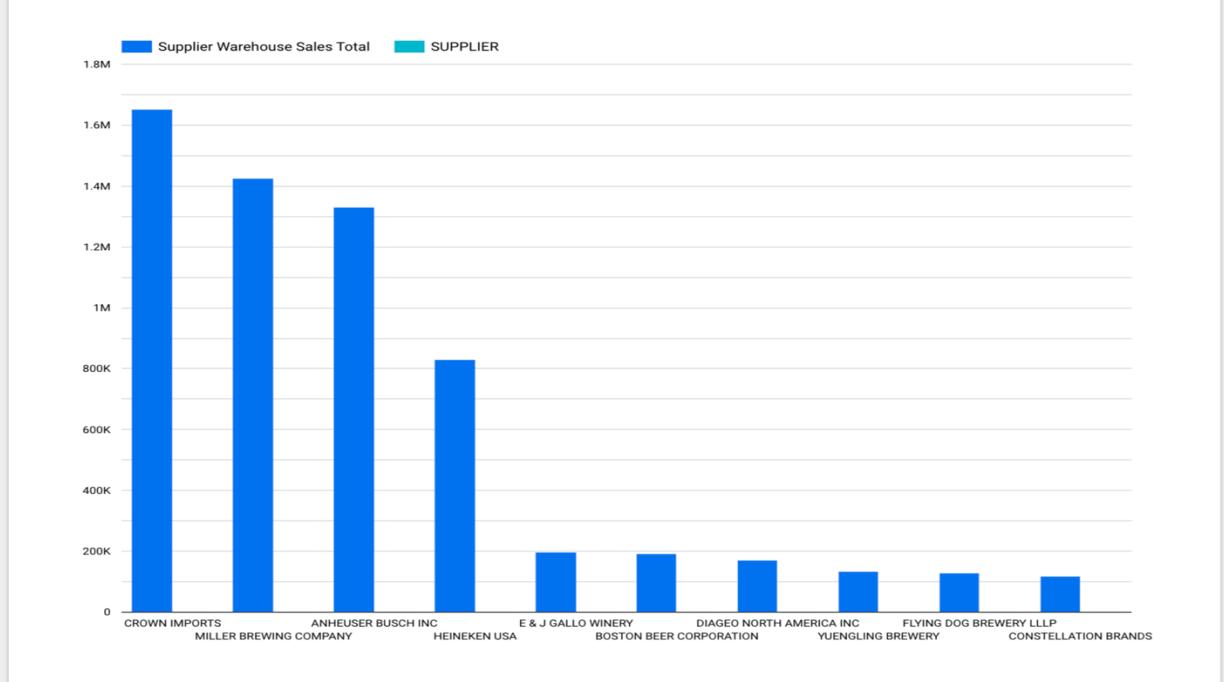
Supplier Performance Analysis

The objective of the Supplier Performance Analysis is to assess the performance of each supplier by calculating their average retail sales.



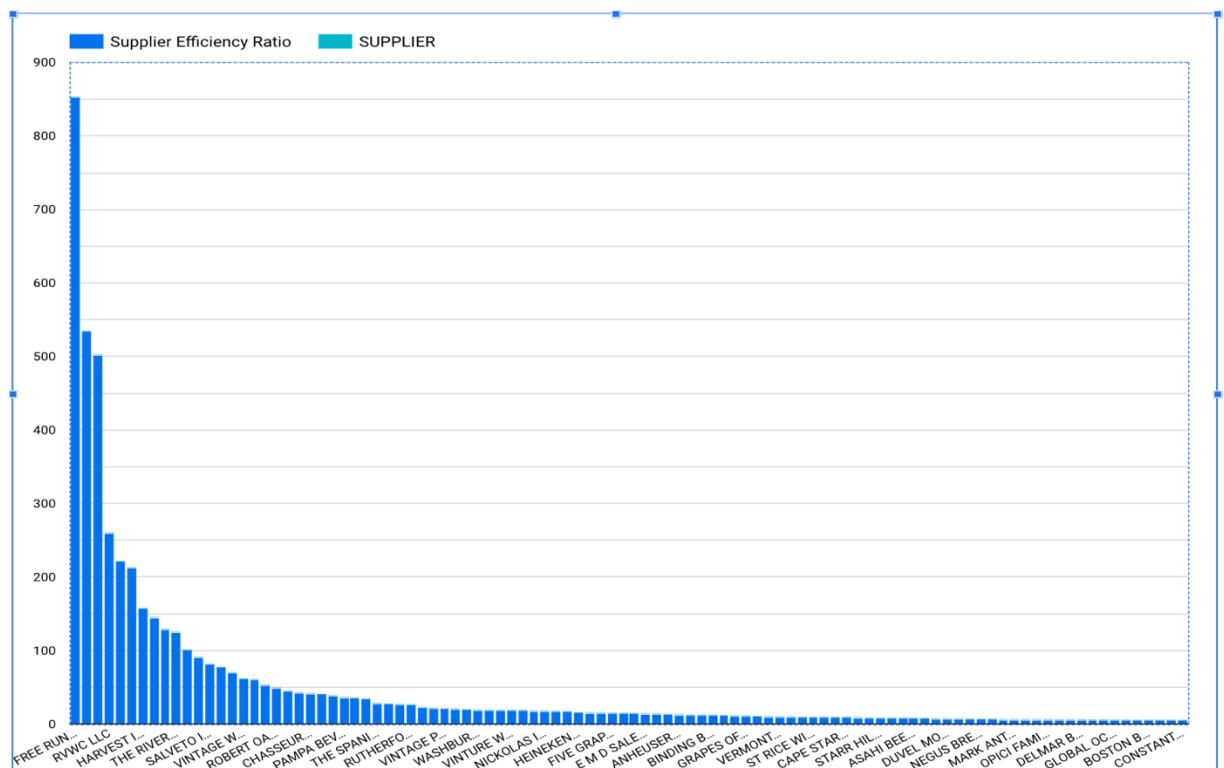
Supplier Warehouse Sales Total:

The objective of the Supplier Warehouse Sales Total analysis is to ascertain the total sales generated in the warehouse that are attributed to each supplier.



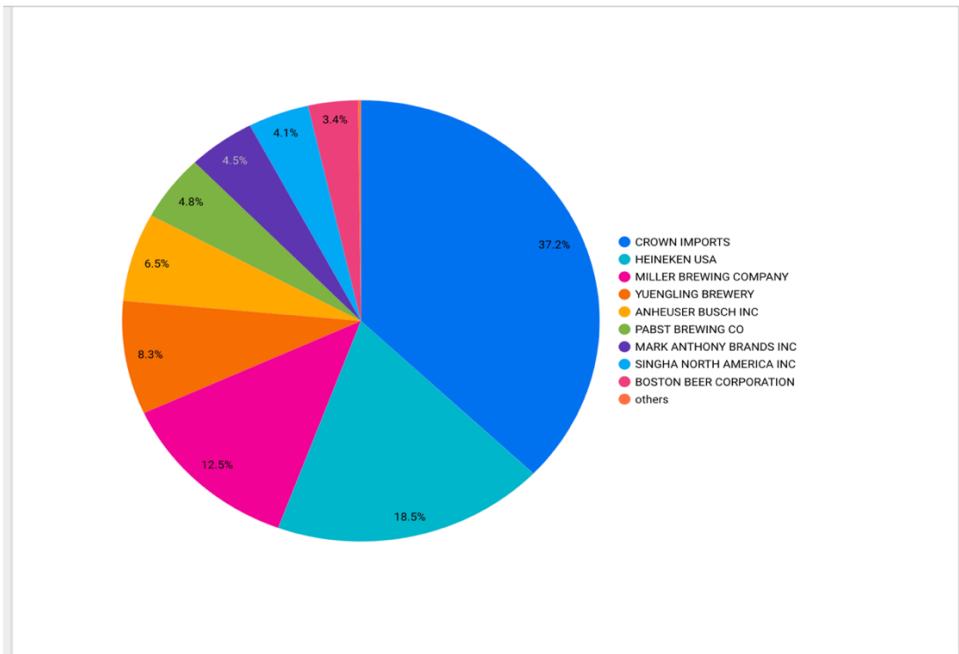
Supplier Efficiency Ratio:

The objective of the Monthly Sales Summary is to provide a comprehensive overview of sales for each month across different years.



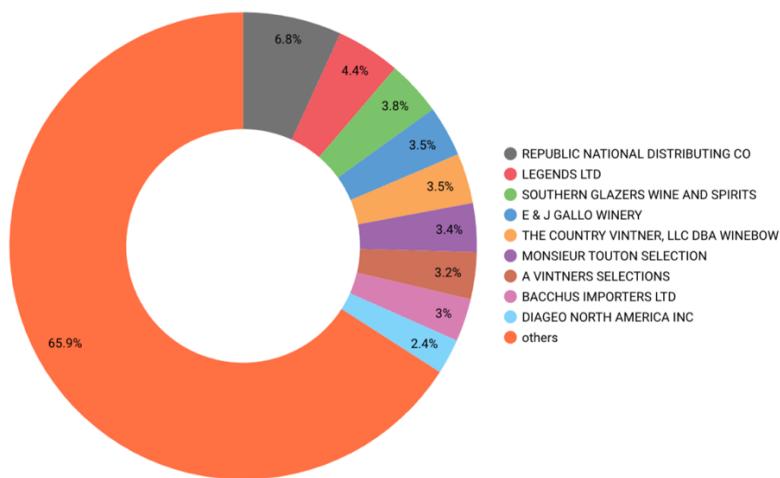
Average Warehouse Sales per Supplier:

The objective of calculating the "Average Warehouse Sales per Supplier" is to assess and compare the performance of suppliers by computing the average sales each supplier contributes to the warehouse.



Average Monthly Transfers

The objective of the "Average Monthly Transfers" analysis is to determine the average number of items transferred to retail outlets each month.



Interpretation of analysis:

Understanding Data Patterns: By studying the data visualization outputs, such as those from Google Data Studio, the team identifies patterns and trends in sales, stock levels, and supplier performance.

Identifying Key Insights: This includes recognizing top-selling items, understanding seasonal sales variations, and assessing monthly sales summaries. These insights are critical for strategic planning and operational adjustments.

Evaluating Supplier Performance: The data helps in assessing the reliability and efficiency of suppliers. This evaluation influences procurement strategies, ensuring better inventory control and cost management.

Analyzing Sales and Stock for Different Item Types: The analysis provides a detailed view of how different items perform in terms of sales and stock levels, aiding in optimal stock management and marketing strategies.

Actionable Decision-Making: Based on these insights, the report likely suggests specific actions to improve inventory management. This might include recommendations for stock replenishment, identifying potential areas for cost reduction, and strategies for improving sales and customer satisfaction.

Future Planning: The insights derived from the analysis also inform long-term strategic decisions, like exploring new market opportunities, adjusting inventory levels based on seasonal trends, and enhancing supplier relationships.