

BI Report Part A

INF30004-Business Intelligence and Data Visualisation

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1. Introduction

As ACME Bikes Emporium, a renowned retailer of bicycles, advances in a highly competitive international market, it is positioned to grow its market share by optimising its inventory management practices to satisfy customer demands. Our team - Zenith Advisory, will assist ACME Bikes Emporium in navigating the challenges of global expansion. Utilising our BI and data analysis service, this will guarantee a successful track for ACME Bikes Emporium as it seeks to establish itself as a prominent global bicycle retailer. In this report, which I have compiled with the assistance of our analyst team at Zenith Advisory, a proper documentation of our team's service is provided, from data quality assessment process to an in-depth analysis of both historical and forecast inventory data for ACME, aiming to improve inventory decision-making process across its global warehouses. Additionally, this report also includes insightful recommendations and suggestions. It will facilitate ACME in formulating informed decisions that foster sustained expansion and market flexibility.

2. Data Quality Assessment

Data cleaning is one of the most important steps in the data analytics process. This is due to the fact that organisations are increasingly reliant on data for effective business operations and decision-making in order to improve performance and obtain competitive advantage over their competitors. If data is not properly cleansed, records and other company data assets may be inaccurate, and analytics systems may produce misleading results and analysis. This can result in operational issues, missed opportunities, inaccurate business decisions, and missed revenue and profit opportunities, all of which may ultimately contribute to cost increases and revenue declines (Stedman, 2022).

To appropriately transform the inventory data, Tableau Prep Builder is utilised for this process, which involves generating a flow with multiple cleaning steps. Firstly, the initial step is to identify duplicate data entries. After generating a calculated field which serves as a duplication indicator, it is discovered that all of the records are unique, indicating that the data is ready to proceed to the second stage: addressing invalid and missing data. There are 20 records in the data with missing Outflow Quantity and Unit Value from approximately 13000 records, accounting for less than 1% of the total records. Those 20 rows will be eliminated from the dataset, with no influence on the overall analysis and display of data in the subsequent visualisation process. Finally, the issue of inconsistent and irrelevant data is addressed, such as inconsistent Item Code, Warehouse and Category, ensuring that the inventory data is more appropriate for analysis and insight extraction.

3. Analysis and Insights

In order to extract valuable insights from the inventory data, Tableau Desktop, a powerful business intelligence application, is employed for data visualisation and analysis.

3.1. Demand Analysis

3.1.1. Top 10 Most Popular Bicycles (Actual)

Top 10 Items Ranked By Outflow Quantity Sorted By Outflow Quantity (Actual Scenario)

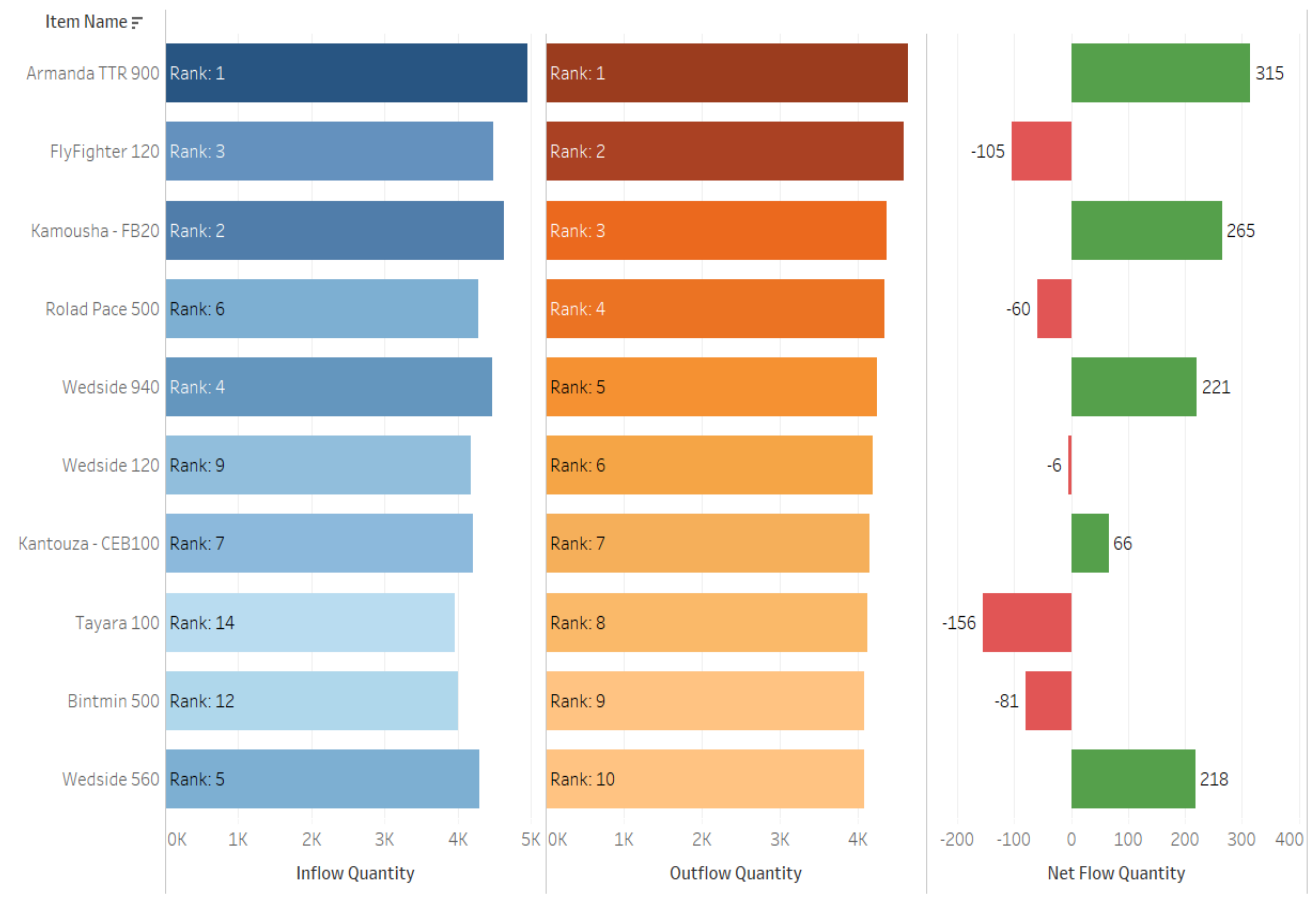


Figure 1: Top 10 Most Popular Bicycles (Actual)

The bar chart delivers an overview of current performance of the top ten bicycles with the highest outflow quantity. The visualisation shows that Armand TTR 900, FlyFighter 120, and Kamousha-FB20 have dominated the bicycle sales of ACME, with the ranking from first to third in the outflow and inflow quantity respectively. However, when examining the net flow quantity of the FlyFighter, the rank 2 type of bicycle, the negative netflow quantity indicates an insufficient inventory amount of this type of bicycle. Several other bicycle products in the top ten, including the Rolad Pace 500, Wedside 120, Tayara 100, and Bintmin 500, also encounter the identical issue. This is the problem that ACME must address in order to meet the extremely high demand for its most popular bicycles models, which are the retailer's primary source of sales.

3.1.2. Top 10 Most Popular Bicycles (Forecast)

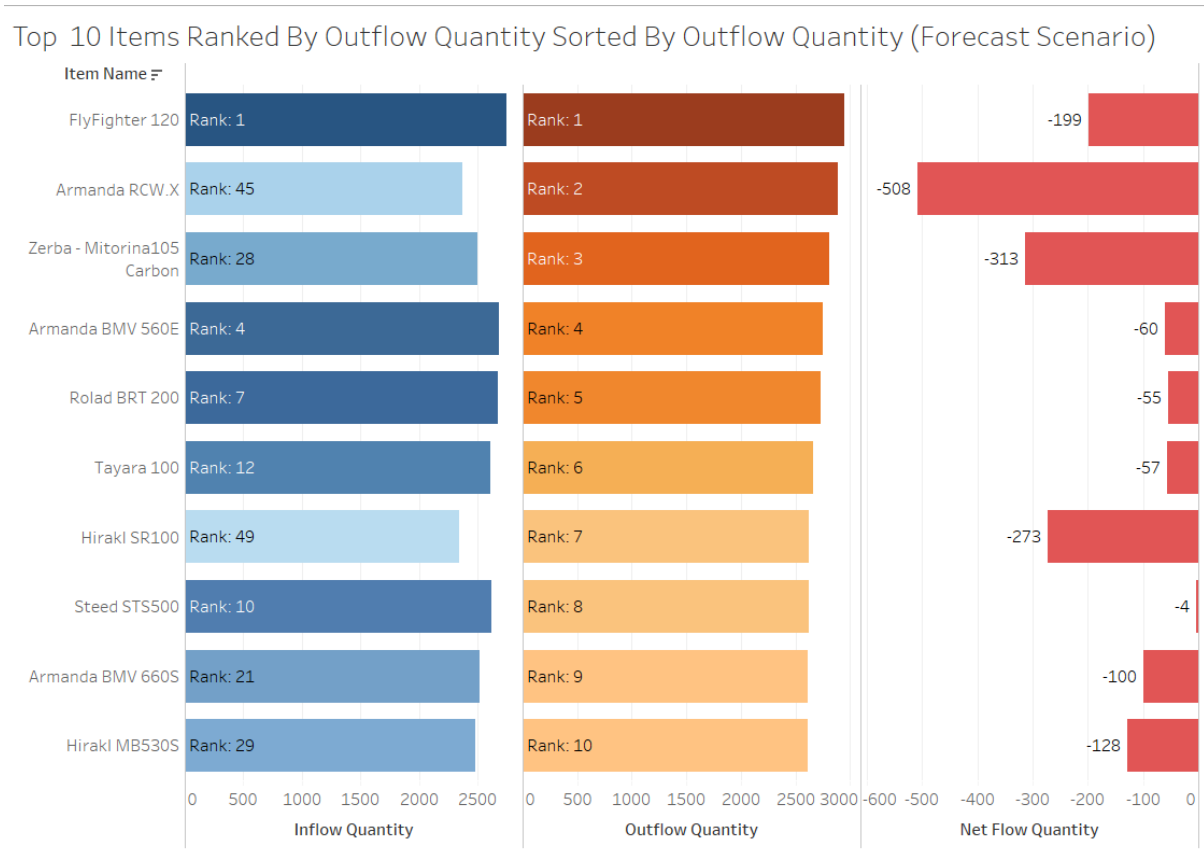


Figure 2: Top 10 Most Popular Bicycles (Forecast)

When making future forecasts for the top ten products, some interesting insights can be identified. First of all, FlyFighter 120 is forecasted to move from second to first place in terms of outflow demand, while the current best-selling bicycle, the Armanda TTR 900, is no longer among the top ten. Additionally, new bicycle models are projected to displace the current top ten bicycles, with the FlyFighter 120 being the only model to remain in the top ten. This finding demonstrates the consistent and extraordinary performance of this product. However, on the other hand, the top ten bicycles all expect a negative net flow quantity, indicating insufficient inventory levels to meet demand. Addressing this issue will help boost inventory efficiency and demand satisfaction in the long run, ensuring ACME's reach to its consumers.

3.1.3. Bicycle Category Demand

Outflow Quantity By Product Category and Month (Actual Scenario)

Product Category	January	February	March	April	May	Inventory Date		August	September	October	November	December
						June	July					
Electric Bikes	713	843	1,085	1,090	1,557	1,395	1,223	1,233	1,082	1,379	1,404	409
Folding Bikes	800	954	1,905	1,576	1,911	1,950	1,951	1,897	1,766	1,700	1,772	1,063
Hybrid Bikes	901	1,031	1,795	2,006	1,622	1,725	1,642	1,804	1,820	1,731	1,672	888
Kids Bikes	1,218	1,133	2,136	2,008	1,861	1,950	1,899	1,950	2,160	2,103	2,298	899
Mountain Bikes	1,034	972	2,332	2,275	2,242	2,451	1,811	2,179	2,037	1,970	1,767	1,169
Road & Gravel Bikes	1,781	1,727	3,477	3,007	3,591	3,848	3,686	3,599	3,881	3,751	3,661	1,593
Urban Bikes	1,181	1,030	2,440	2,255	2,584	2,635	2,611	2,411	1,991	2,514	2,313	1,261

Figure 3: Outflow Quantity By Product Category and Month Heatmap

The visualisation consists of a heatmap that depicts the outflow quantity of bicycles by month and product category. From the visualisation, the first insight that can be derived is that the Road and Gravel Bike Category has the best performance with the highest outflow level throughout all months, while the Electric Bike Category is the least popular. Consequently, in order to satisfy the annual demand for Road and Gravel Bikes, it is necessary to maintain a higher level of inventory at all times. Meanwhile, The low level of outflow quantities for electric bikes could be attributed to the bicycles' expensive cost as compared to other types of bikes (see Figure 4). Hence, in order to increase turnover, ACME might consider implementing strategic promotions and offers during periods of high purchase volume.

Average Unit Price For Each Bicycle Category (Actual Scenario)

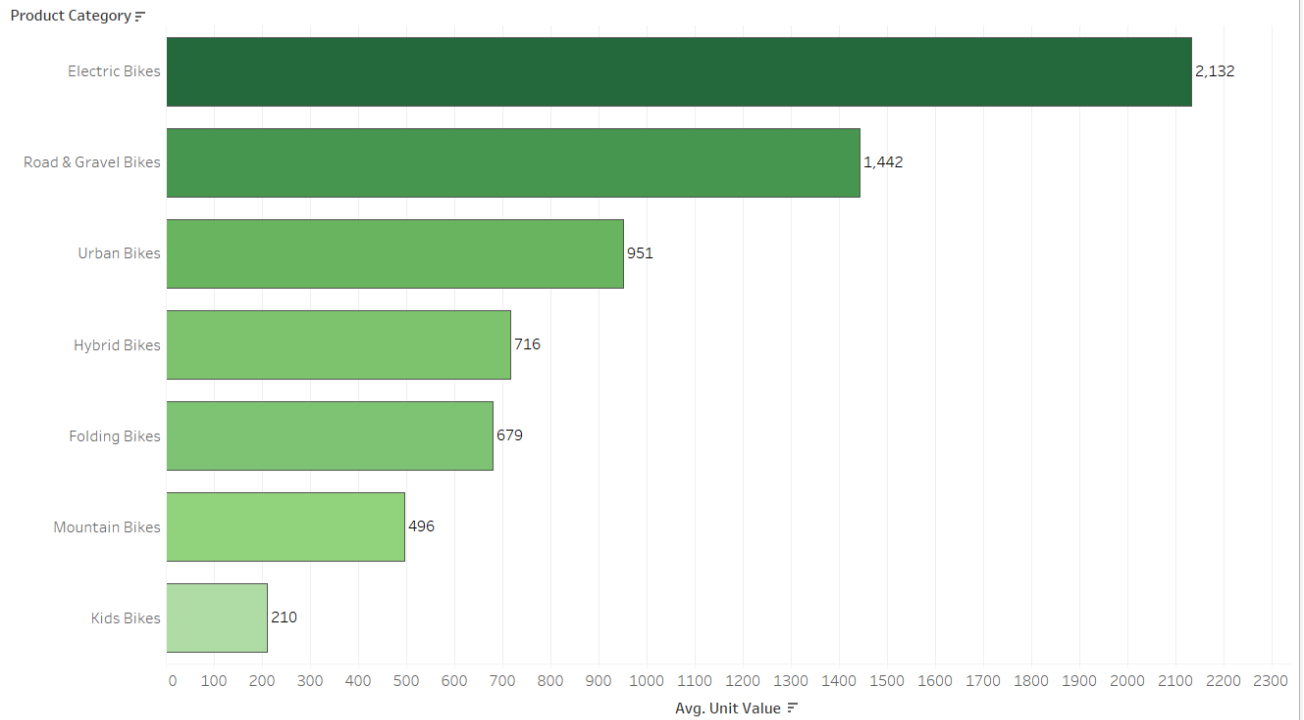


Figure 4: Average Unit Price By Product Category

3.1.4. Seasonality Demand

Furthermore, the aforementioned heat map depicts the demand behaviour of consumers with the biggest outflow of bicycles throughout the summer months of May, June, and April (see Figure 3). This rise corresponds to the arrival of warmer weather, which promotes outdoor activities and aligns with the summer vacation season. On the other hand, certain months, such as November, December, and January, have a smaller bicycle outflow quantity (see Figure 3). This is due to the winter season in many of ACME's markets, where colder temperatures and severe weather discourage outdoor activity. As a result, according to the insights offered, ACME management team should ensure that inventory levels across all categories are optimised during the high season of May to July in order to satisfy customer demands and maximise inventory turnover.

3.2. Warehouse Performance

3.2.1. Warehouse Stocking Condition

Warehouse Stocking Condition (Actual Scenario)



Figure 5: Warehouse Stocking Condition

This set of pie charts depicts the current stocking condition at each ACME warehouse. Overall, the stocking conditions in the five warehouses all have to deal with a lot of serious problems, with an extremely high percentage of understock records. WH-IN-01 warehouse in New Delhi exhibits the lowest performance among all the warehouses, with an alarming understock rate of 57.76%. This poor understock rate not only leads to failure to meet consumer demands but also gives rise to missed sales opportunities and potentially detrimental effects on customer satisfaction and brand reputation. On the other hand, warehouse WH-TK-01 in Istanbul has the greatest overstock rate (23.07%). While having a high percentage of overstock records may help to mitigate the unpredictability of supply chain interruptions and lower the risk of demand shortage, it also raises inventory holding costs, potentially leading to profit margin reduction (Leonard, 2019). As a result, several solutions such as regular stock reviews and balanced inventory management can be used to address these challenges, assuring an effective stock condition to satisfy consumer demand and lowering the inventory management costs.

3.2.2. Warehouse's Minimum Inventory Level By Month

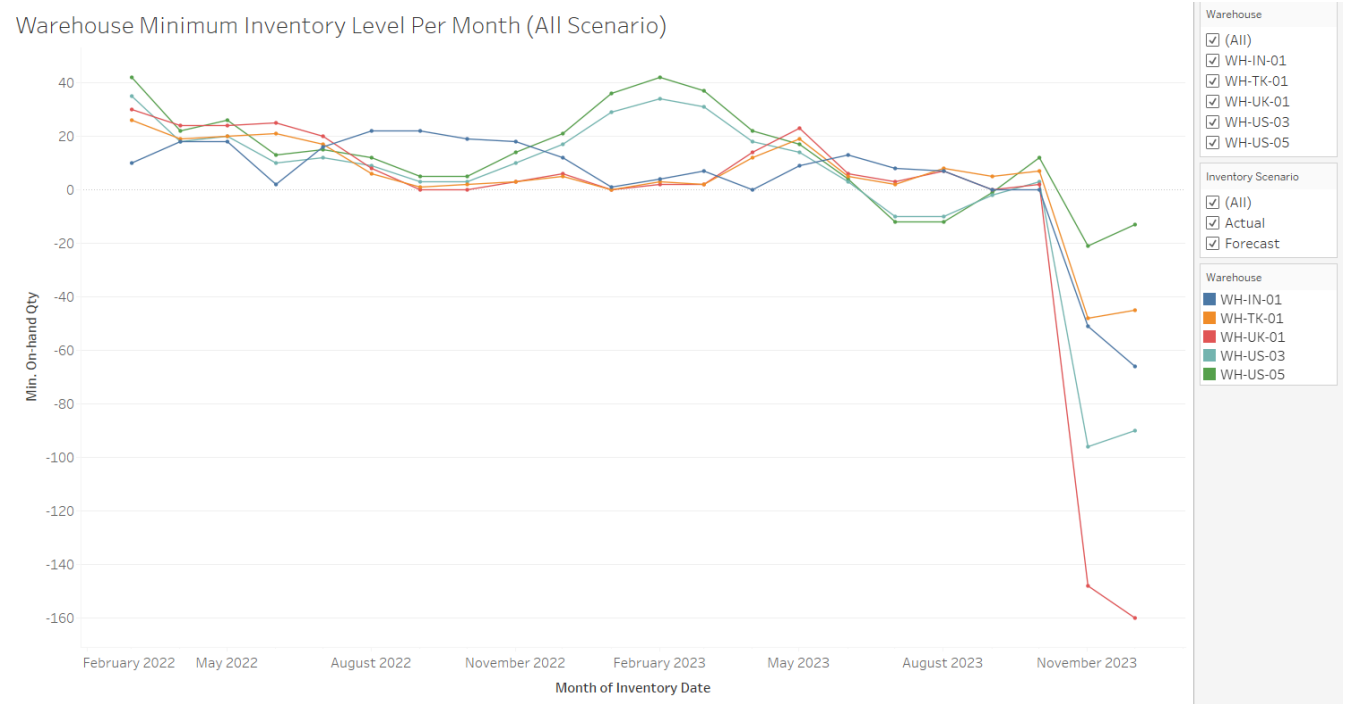


Figure 6: Warehouse's minimum inventory level by month

The line chart illustrates the warehouse's minimum on-hand quantity for each month. From the visualisation, it is indicated that the lowest level of inventory fluctuates significantly over both the historical and forecast periods in all the warehouses. With regard to the historical data, WH-US-03 and WH-US-05, two warehouses located in the United States, did encounter a minimum level of inventory with a negative on-hand value in July, August, and September. A closer examination of the forecast data reveals that beginning in November 2023, negative on-hand values will occur in every warehouse of ACME. Obviously, an item cannot have any quantity less than zero. These negative numbers occur as a result of poor inventory management processes, and it can lead to numerous drawbacks for the warehouse, including the inability to fulfil orders and backorders, which may cause lost sales and loss of consumer trust (TRANQUIL, 2022). As a result, certain approaches are proposed to resolve this, such as root cause analysis and real-time inventory tracking, to ensure an effective inventory management operation.

4. Recommendation

4.1. Integration of External Market Data

ACME can enhance its data analytics process by integrating with third-party market data sources. These sources may contain information specific to some of the ACME markets, such as demographic trends, economic indicators, and consumer spending behaviour. By

doing so, ACME may enrich its inventory data and hence generate more valuable insights and analysis

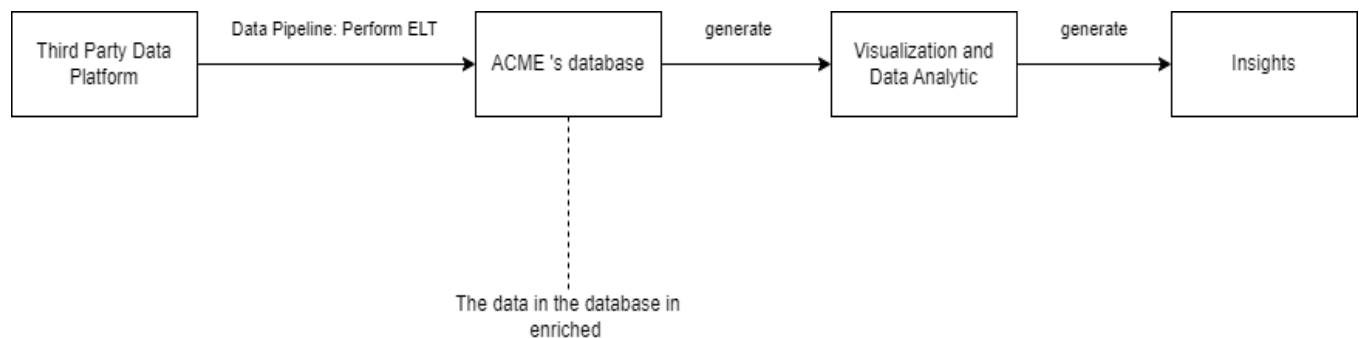


Figure 7: Integration of External Market Data

4.2. Inventory Data Categorization

Inventory data can be subdivided into groups and categories, which helps increase the effective storage, retrieval, and analysis of information (Joshi, 2023) . This data enrichment technique aids in data organisation, classification,enhancing the data analytic process of ACME, providing it with long term ample benefits in inventory management operation.

5. Reference

TRANQUIL. (2022, January 18). What is Negative Inventory and How Can You Prevent it? TRANQUIL.

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Joshi, S. (2023, November 6). Data Enrichment Guide: Types, Tools & Techniques to Enhance Data. Www.hitechbpo.com.

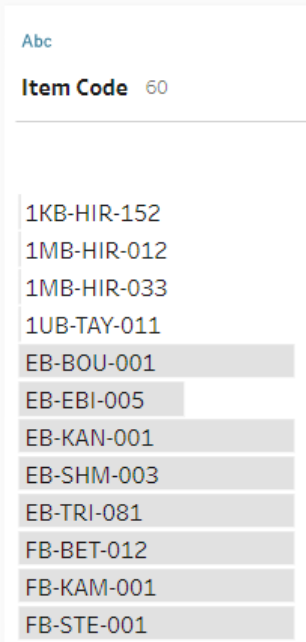
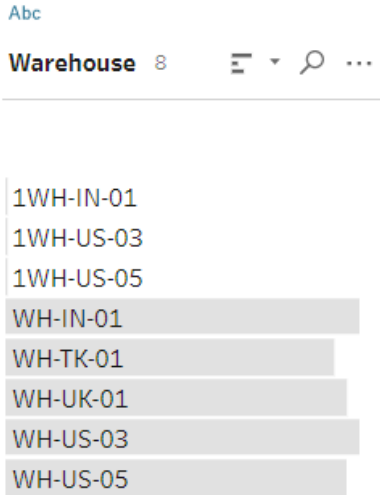
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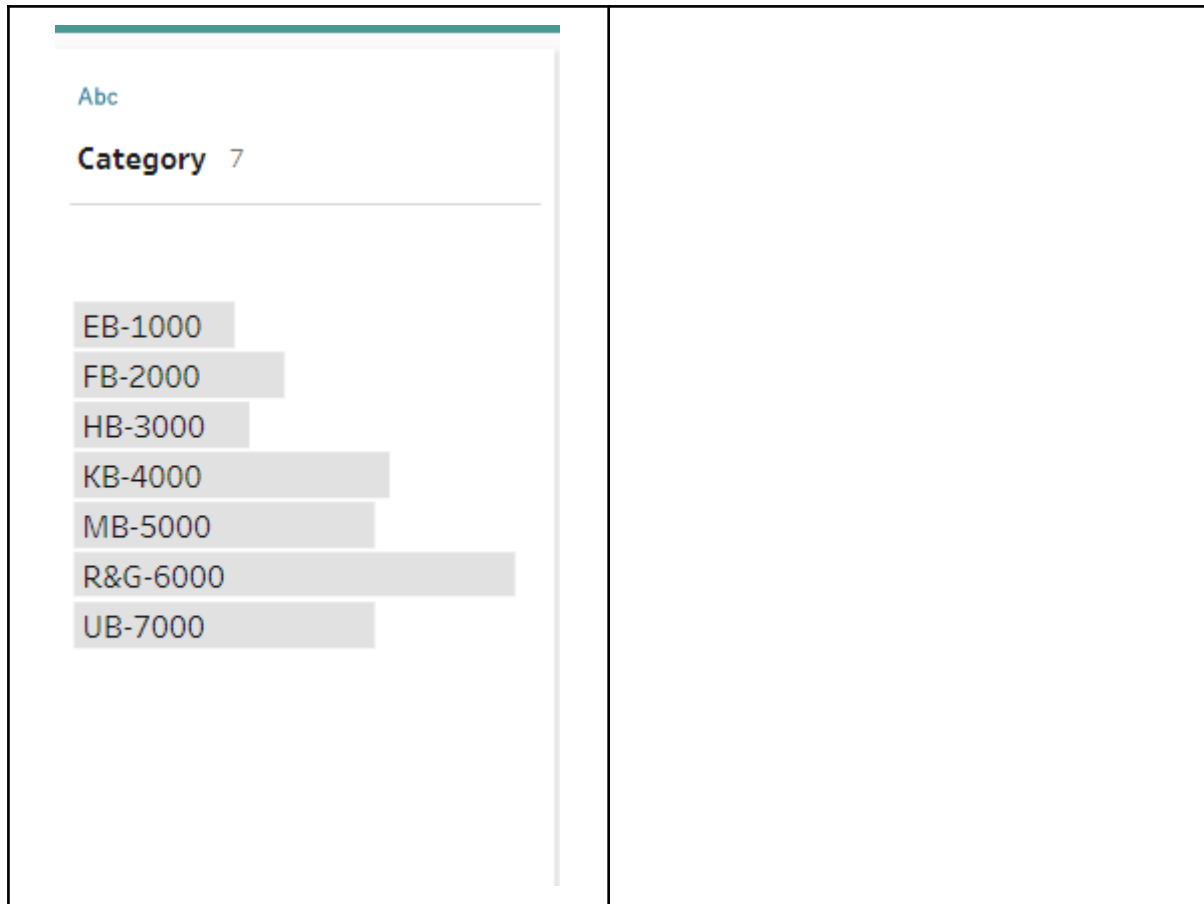
<https://www.techtarget.com/searchdatamanagement/definition/data-scrubbing>

6. Appendix

6.1. Data Cleaning Process

Problem	Solution
<p>Cleaning the Item Code field in the dataset</p> 	<p>Remove the “1” at the beginning of the record</p>
<p>Cleaning the Warehouse field in the dataset</p> 	<p>Remove the “1” at the beginning of the record</p>
<p>Null Values appear in the dataset</p>	<p>Remove the record with the null values</p>

 <p>The image displays four horizontal bar charts, each representing a different data category. The first chart, 'Outflow Qty', has a y-axis ranging from null to 95. The second, 'Over Stock Th Qty', ranges from 80 to 160. The third, 'Safety Stock Th Qty', ranges from 65 to 140. The fourth, 'Unit Value', ranges from null to 5,000. Each chart contains multiple blue horizontal bars of varying lengths, representing data points for different items or categories.</p>	
<p>Inconsistent Record United State and USA</p>  <p>The screenshot shows a software interface with a search bar at the top containing 'Abc' and a magnifying glass icon. Below the search bar is a label 'Country' followed by the number '5'. A dropdown menu is open, displaying a list of countries: India, Turkey, United Kingdom, United States, and USA. Each country name is on a separate line within the dropdown list.</p>	<p>Changing the field United State to USA</p>
<p>Inconsistent Category Code</p>	<p>Change the record from R%G-6000 to RG-6000, to make the code more consistent to the other product category</p>



6.2. Field Description

This is the description of the fields in the final dataset

Field	Description
Inventory Date	The date the inventory data was recorded.
Inventory Scenario	This refers to a specific inventory situation being analysed ("Actual" or "Forecast").
Item Code	A unique identifier for each bicycle product in the inventory system.
Warehouse	The warehouse for bicycle stock.
Inflow Qty	The number of bicycles received by the warehouse on the inventory date.
On-hand Qty	The total number of bicycles physically available in the warehouse on the inventory date.
Outflow Qty	The number of bicycles that left the

	warehouse on the inventory date. This could represent sales or transfers to other locations.
Over Stock Th Qty	The threshold quantity for considering a bicycle to be in overstock.
Safety Stock Th Qty	The minimum quantity of a bicycle that should be maintained in the warehouse to avoid stockouts.
Unit Value	The cost price or wholesale value of a single bicycle.
Item Name	The name of the bicycle product.
Unit of Measure	The unit used to quantify the bicycle.
Category	A unique identifier for each product category.
Product Category	The name of the product category for the bicycles.
City	The city where the warehouse is located.
Country	The country where the warehouse is located.
Wh_Long	The warehouse's longitude coordinate.
Wh_Lat	The warehouse's latitude coordinate.

6.3. Visualisation User Guide

This is the user guide for the “Top N/Bottom N Bicycles Items” in the Tableau Workbook.

Top 10 Items Ranked By Outflow Quantity Sorted By Outflow Quantity (All Scenario)

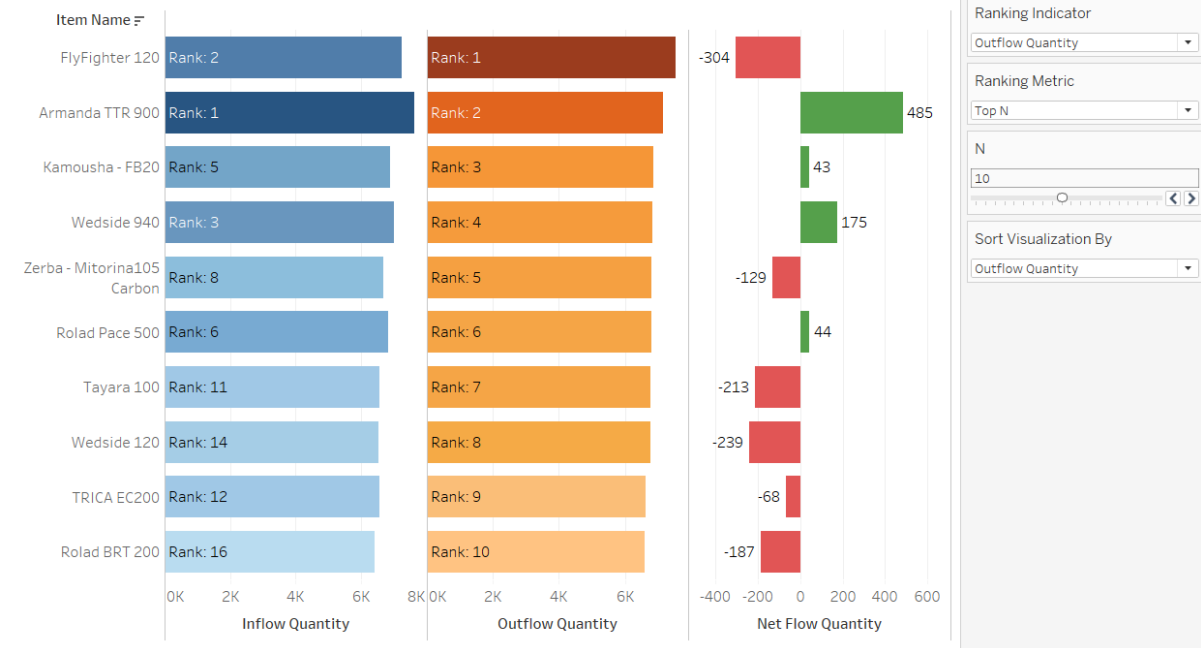


Figure 8: Top N/Bottom N Bicycles Item visualisation

Users can choose how they want to rank the bicycles items (rank by outflow quantity or inflow quantity)

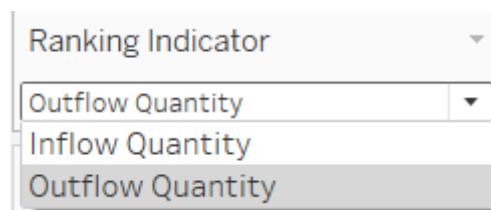


Figure 9: Ranking Indicator parameter

Additionally, the users can be able to choose the ranking metric they want to utilise (top N, bottom N or display all the bicycle items)

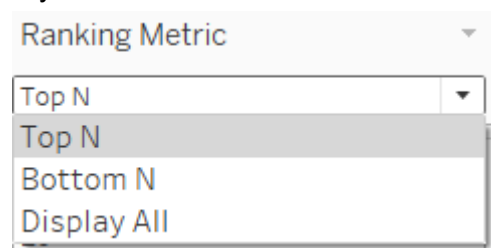


Figure 10: Ranking Metric parameter

The users can also be able to choose the number of top/bottom bicycles items they want to see (top 3, top 5, bottom 10), however the N number is limited from 1 to 20

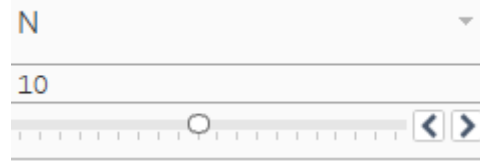
A UI control for the 'N' parameter. It features a label 'N' with a dropdown arrow, a text input field containing the value '10', and a horizontal slider below it. The slider has a circular knob positioned at approximately the 10th mark on a scale of 20. Navigation arrows are located at the right end of the slider.

Figure 11: N number parameter

Finally, the bars in the visualisation can be sorted (by Outflow Quantity or Inflow Quantity)

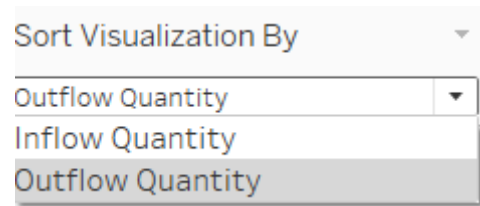
A dropdown menu titled 'Sort Visualization By'. The menu is open, showing three options: 'Outflow Quantity', 'Inflow Quantity', and 'Outflow Quantity'. The bottom 'Outflow Quantity' option is highlighted with a grey background.

Figure 12: Sort Visualisation parameter