DSA 3050A — Business Intelligence & Data Visualization

Mid-Semester Practical Examination (Power BI)

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Course Code: DSA 3050A

Assessment Type: Individual Practical Examination

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1. Introduction

1.1 Project Overview

This project presents an end-to-end Business Intelligence (BI) solution developed using Microsoft Power BI as part of the DSA 3050A mid-semester practical examination. The objective of the project is to demonstrate the full BI workflow, including dataset sourcing, data preparation using Power Query, analytical data modelling, dashboard development, and publishing of insights through the Power BI Service.

The project is designed to simulate a real-world organizational analytics engagement, where data-driven insights are used to support managerial and operational decision-making.

1.2 Business Problem Statement

Many organizations collect large volumes of transactional data but lack effective tools to transform this data into actionable insights. Without proper data preparation, modelling, and visualization, decision-makers are unable to identify performance trends, profitability drivers, and operational inefficiencies.

This project addresses the need for an interactive business intelligence dashboard that enables stakeholders to monitor sales performance, analyze profitability, evaluate customer and product performance, and identify trends across regions and time periods.

1.3 Stakeholders

The primary stakeholders for this Business Intelligence solution include:

- Executive Management
- Regional Sales Managers

- Operations and Strategy Teams

These stakeholders require timely, accurate, and interactive reports to support strategic planning and operational optimization.

1.4 Tools and Technologies Used

The project was developed using the following tools and technologies:

- Microsoft Power BI Desktop for data preparation, modelling, and dashboard development
- Power BI Service for report publishing and sharing
- Google Docs for documentation and evidence compilation
- GitHub for project version control and artifact organization

1.5 Project Workflow

The project follows a structured Business Intelligence workflow consisting of:

1. Dataset selection and sourcing
2. Data preparation using Power Query
3. Data modelling using a star schema
4. Dashboard design and development
5. Publishing and deployment of insights

2. Section 1 — Process Evidence

2.1 Dataset Sourcing Evidence

I selected the **Sample Superstore Dataset** from Kaggle because it is a real-world dataset that meets the exam requirements. The dataset contains more than 7,000 rows and includes important analytical attributes such as dates (Order Date, Ship Date), categories (Segment, Category, Sub-Category), numerical values (Sales, Quantity, Profit), and locations (Country, Region, State, City, Postal Code).

Although the dataset is provided as a single CSV file, I can logically separate it into multiple tables for modelling: a fact table for orders and dimension tables for customers, products, and shipping. This dataset provides the foundation for analytical storytelling, including sales performance across segments, regions, product categories, and time periods.

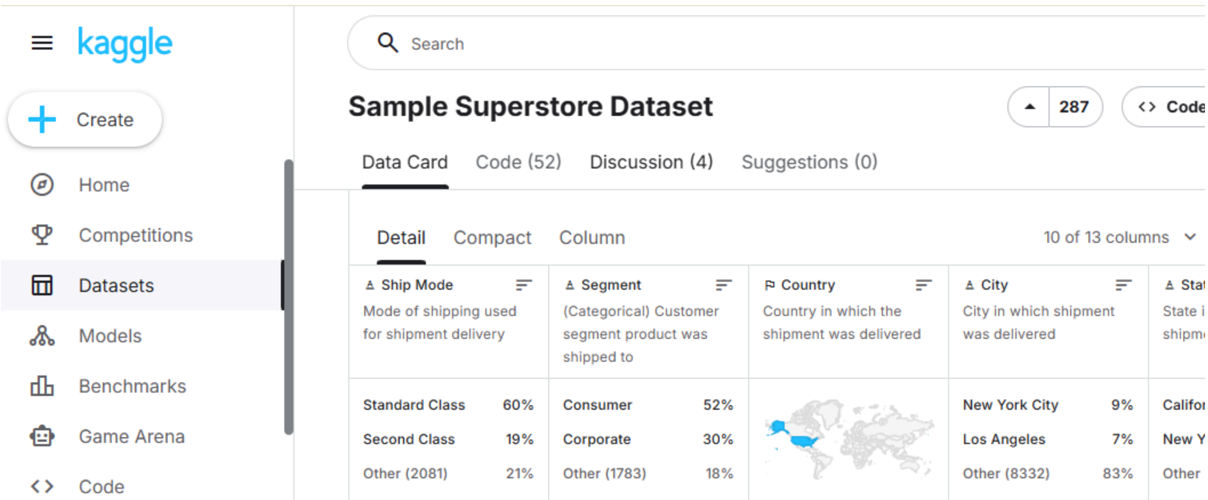


Figure 1: Raw Online Retail dataset sourced from Kaggle open data platform

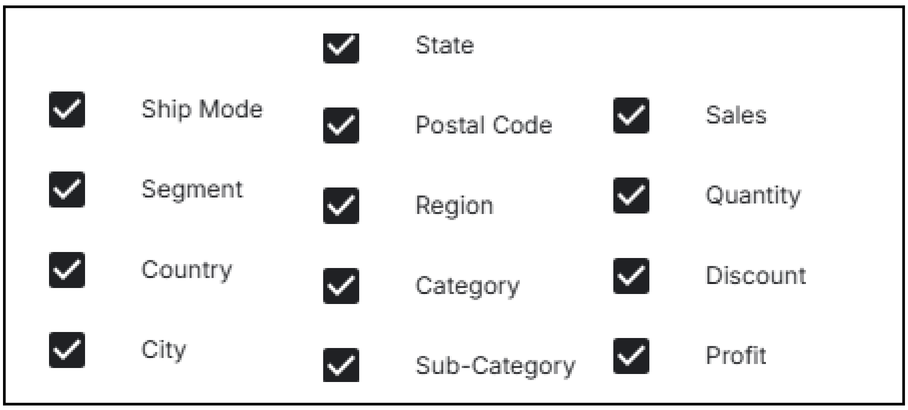


Figure 2: Overview of columns in the Sample Superstore dataset.

2.2 Power Query Transformations

Step 1 : Import and Initial Review

I imported the Superstore_Data .csv dataset into Power BI and opened Power Query Editor. I first reviewed the column profile and distributions to understand the data types, null values, and unique entries for each column. This step helps identify potential issues and plan transformations.

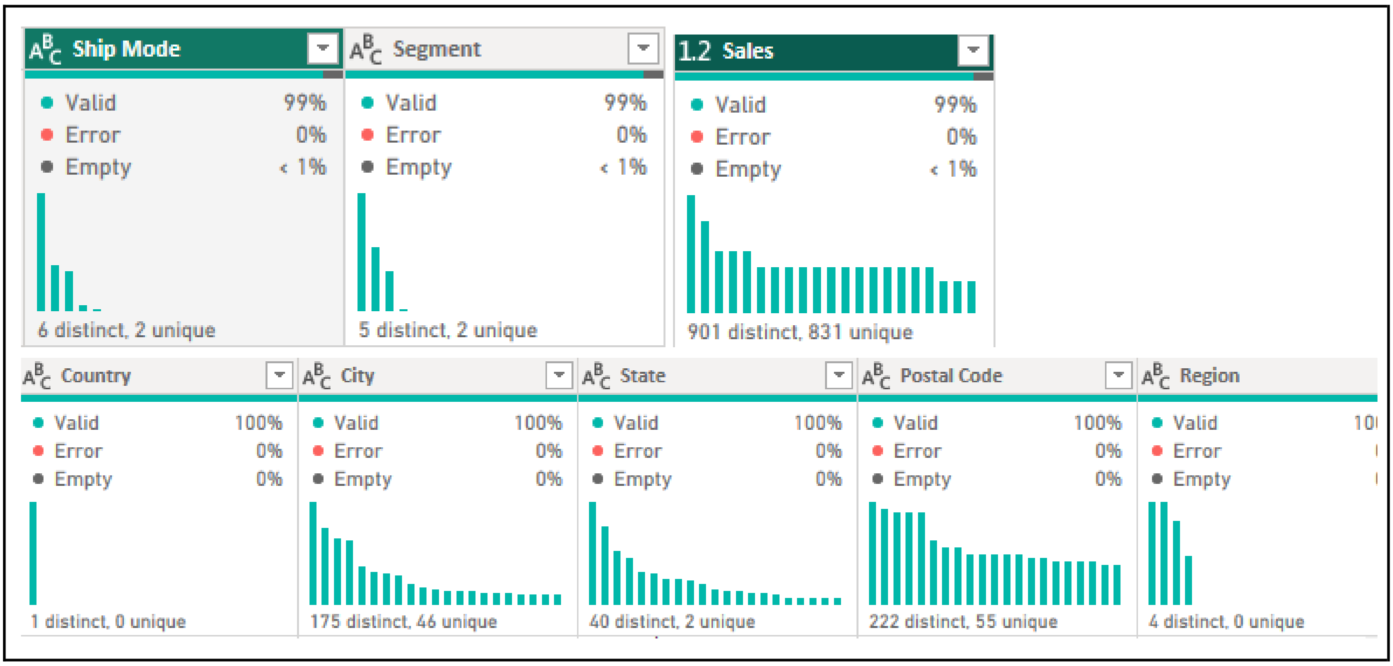


Figure 3: Sample Column statistics and distribution in Power Query to assess data quality and prepare for transformations.

Step 2 : Remove Duplicates

I first checked the dataset for duplicate rows. Using Power Query, I applied the **Remove Duplicates** function on all columns.Performing this step ensures that each transaction is unique and maintains the accuracy of aggregated metrics like total Sales and number of orders.

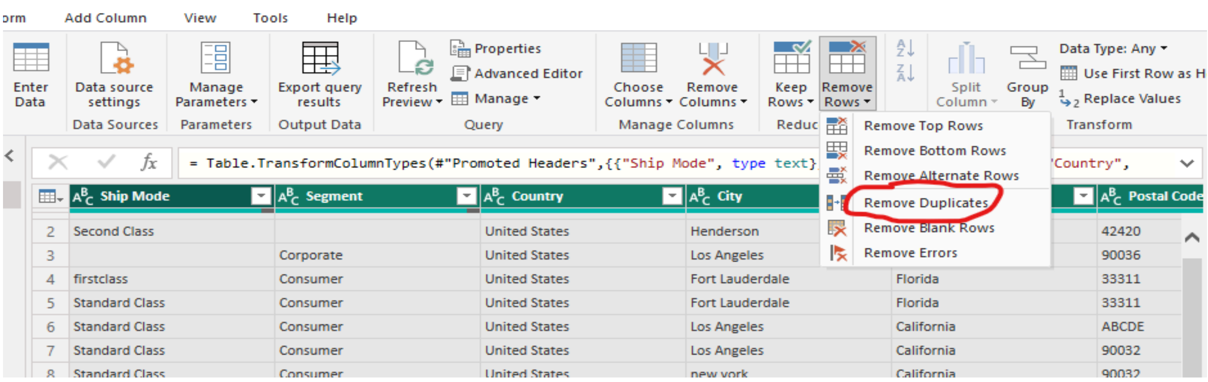


Figure 5: Removing duplicate rows in Power Query to ensure data uniqueness.

I counted the rows before and after removing duplicates. The dataset had **9,994 rows initially**. After applying the Remove Duplicates function the dataset has **9977 rows** now indicating that 17 duplicate transactions were removed

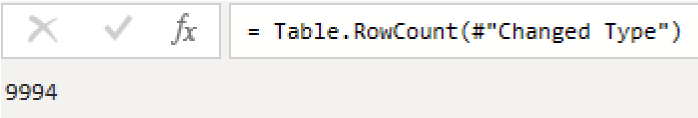


Figure 5a: Total number of rows in the dataset before removing duplicates (9,994 rows)

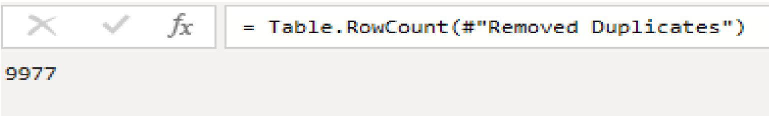


Figure 5b: Total number of rows in the dataset after removing duplicates (9,977 rows) showing that duplicates were removed.

Step 3 : Handle Missing / Null Values

I analyzed the dataset for missing or null values using the Column **Profile** in Power Query. I observed that some entries in Ship Mode and Segment were empty strings, and a few values in Sales were null.

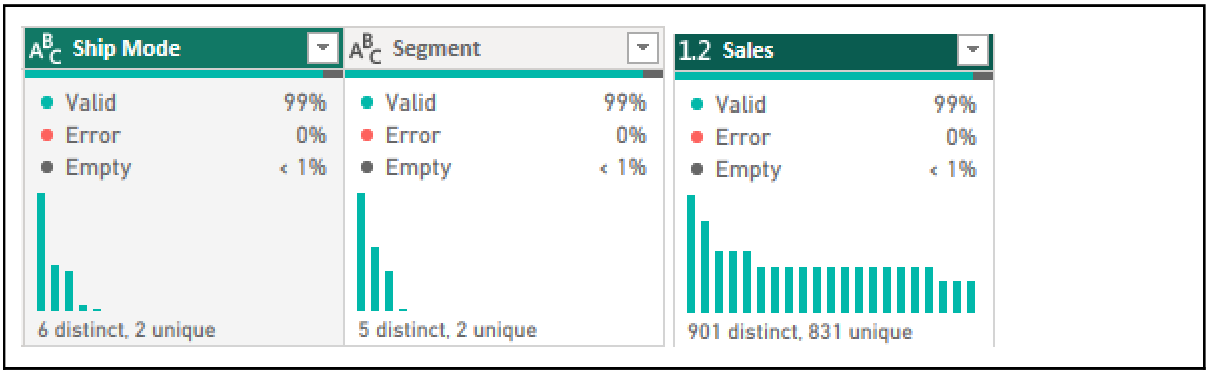


Figure 6a: Initial Column profile in Power Query highlighting empty strings in Ship Mode and Segment, and nulls in Sales.

I applied transformations to correct these: replacing nulls in Sales with 0, empty strings in Segment with “Unknown”, and empty strings in Ship Mode with the Standard Class as it is the mode

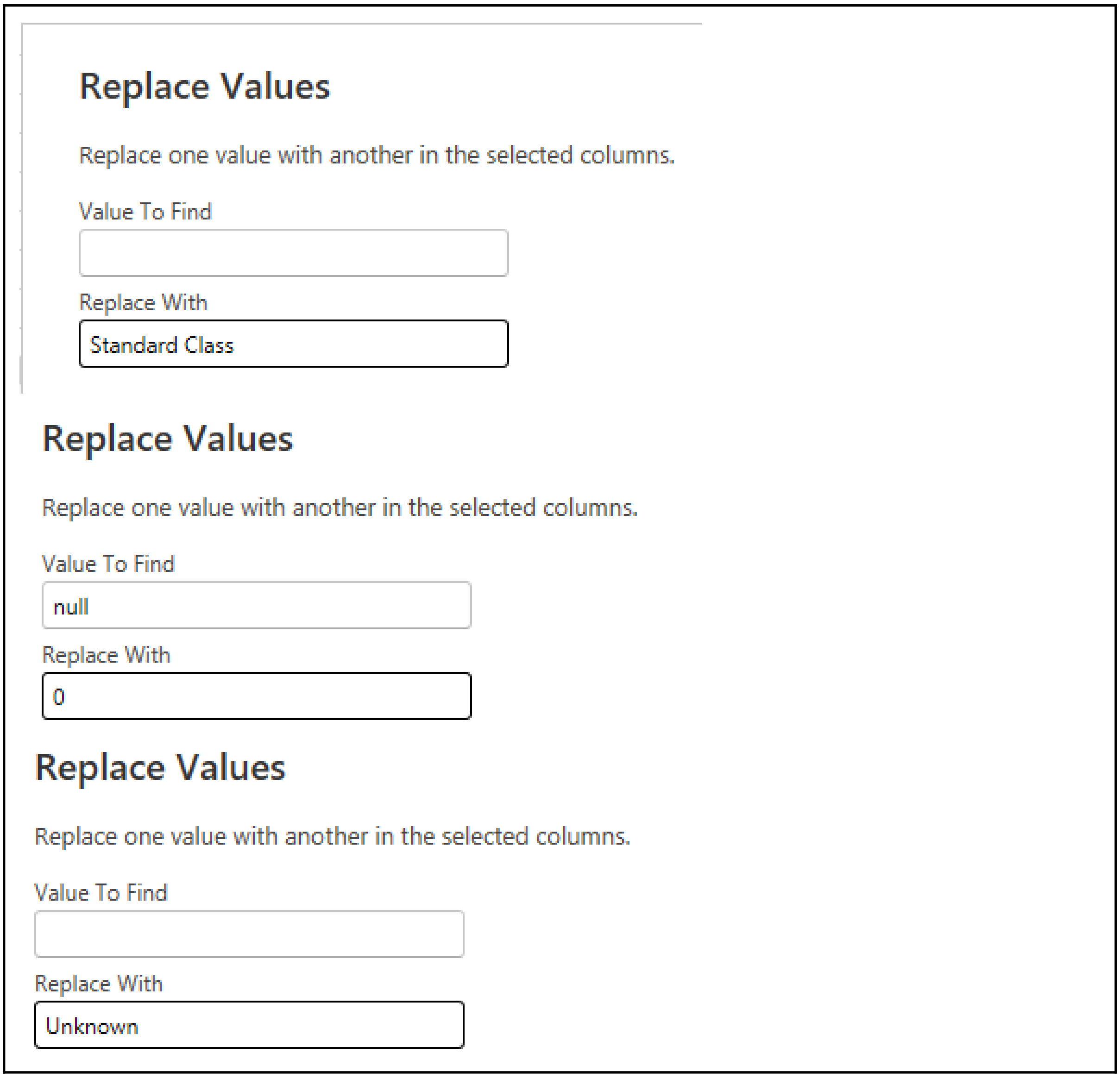


Figure 6b: Power Query Applied Steps showing replacement of nulls and empty strings.

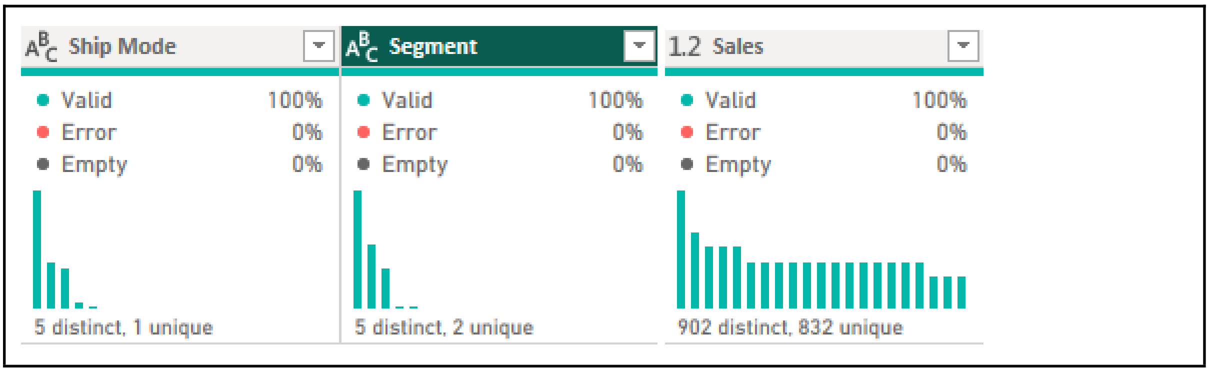


Figure 6c: Updated column profile showing that all missing and empty values were corrected.

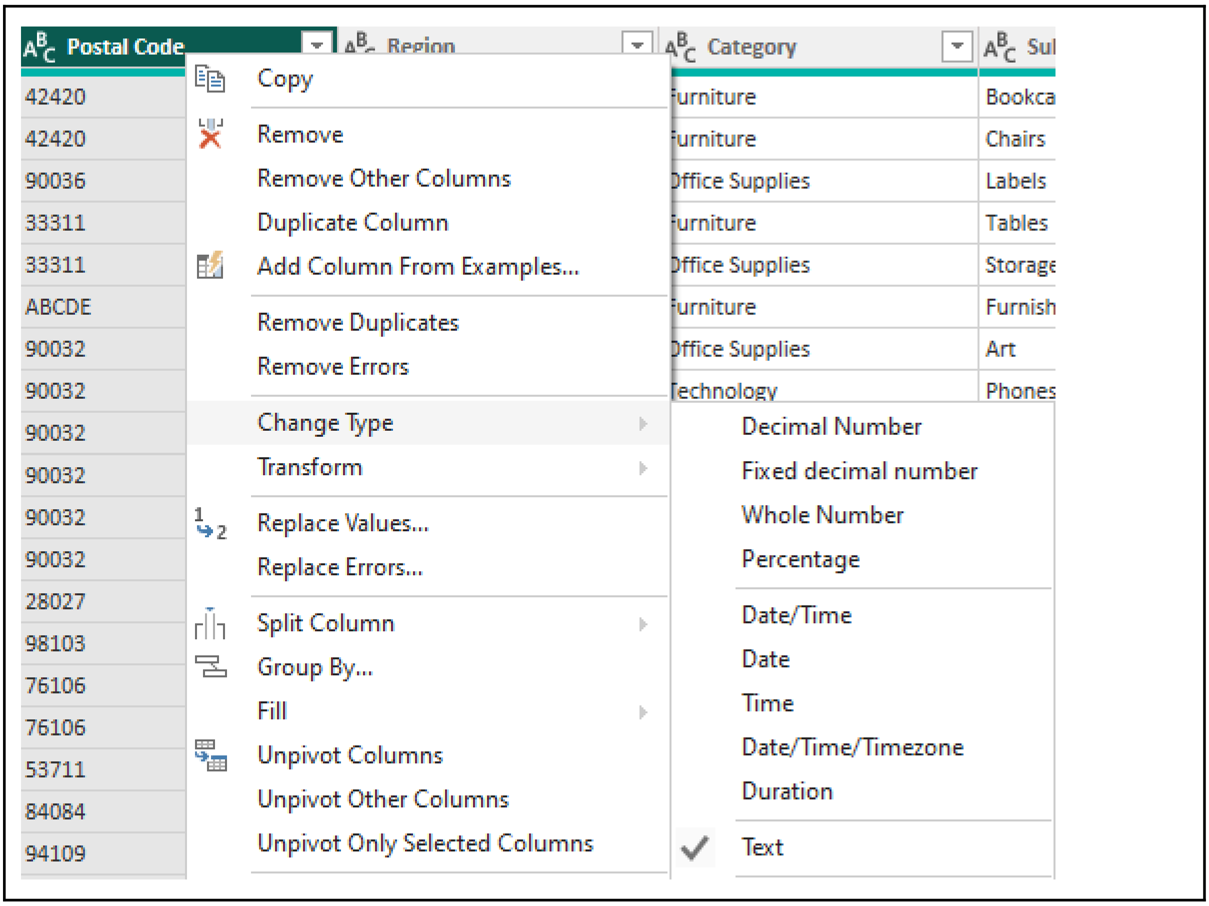
Step 4 : Correct Data Types

I reviewed all columns in the dataset to ensure that the data types were appropriate for analysis. Most columns were already correctly typed; however, I applied corrections for a few inconsistencies:

1. The Sales column contained a few entries stored as text → I changed it to Decimal/Number to enable calculations.

2. The Postal Code column had numeric-like values stored inconsistently as numbers and text → I enforced Text data type for consistency.

I also confirmed that other numerical columns such as Quantity and Profit were of type **Decimal/Number**, and categorical columns such as Segment, Category, and Ship Mode were **Text**.



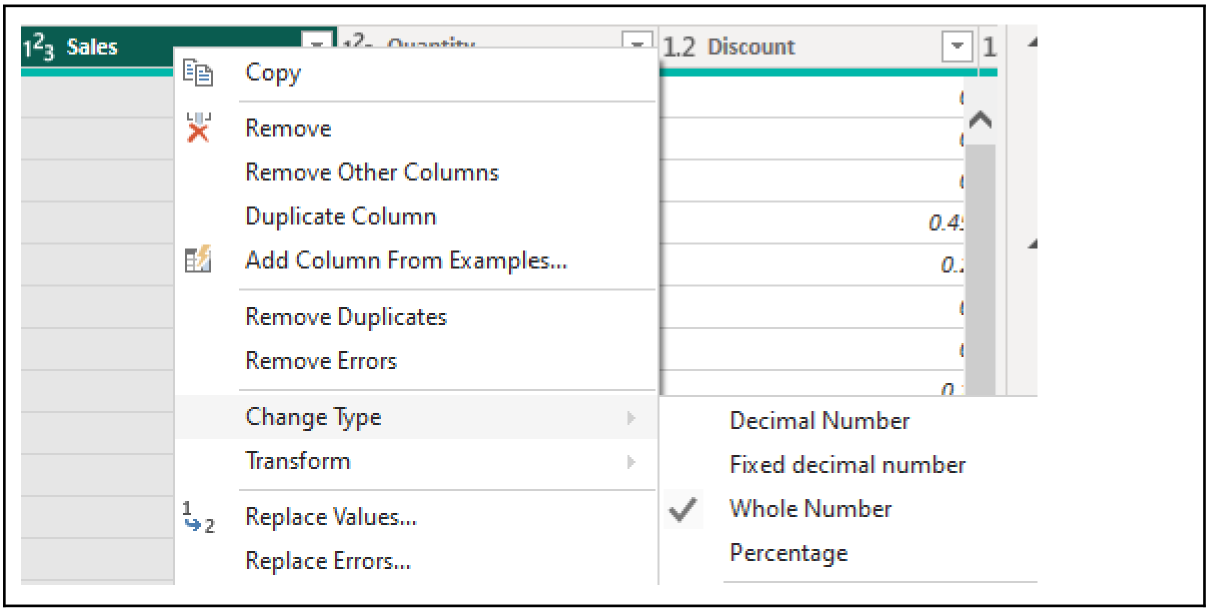


Figure 7: Power Query Applied Steps showing the step taken to correct and confirm data types for Sales, Postal Code

Step 5 : Standardize Text / Categorical Values

I noticed inconsistencies in the Ship Mode column, such as firstclass instead of First Class. To correct this, I applied a **Replace Values** transformation in Power Query and capitalized all entries properly. This ensures accurate grouping and reporting for shipping modes

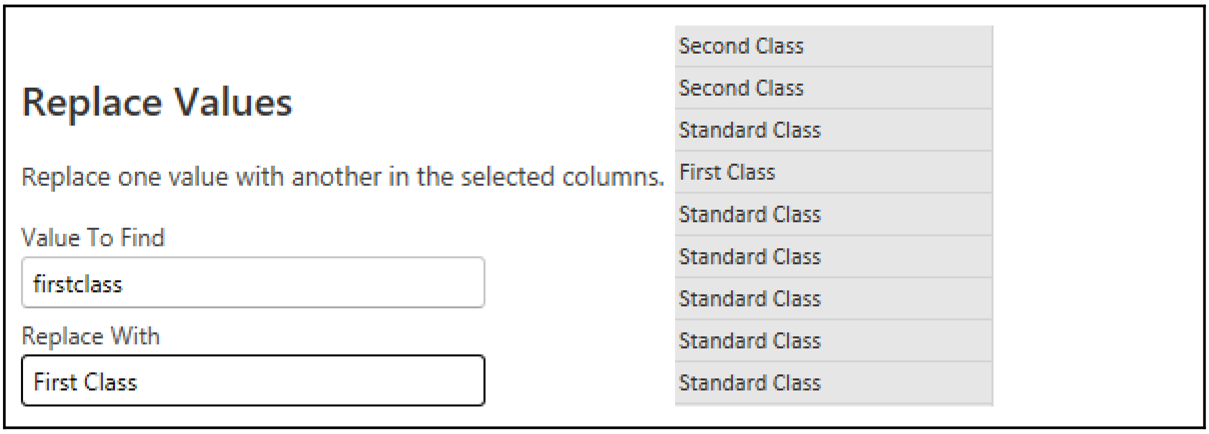


Figure 8a: Power Query Applied Step showing the replacement and capitalization of inconsistent entries in the Ship Mode column and after change.

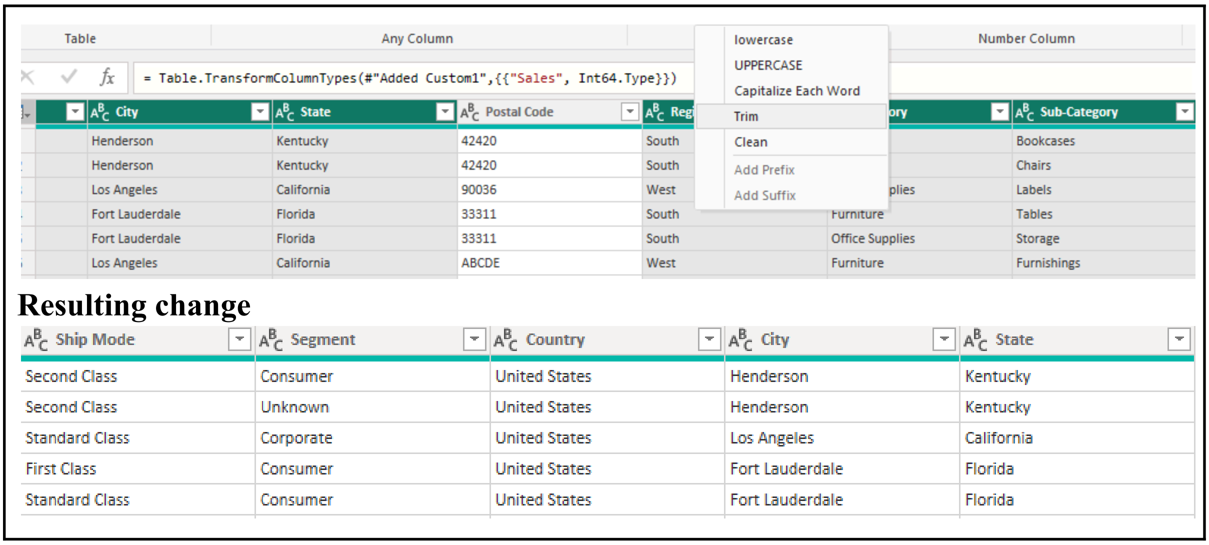


Figure 8b: Applied Steps showing trimming and capitalization transformations forCity,State, Segment, Category, and Sub-Category

Step 6 : Generate Dates and Extract Year, Month, Quarter

I generated an Order Date column in Power Query to meet the requirement for time-based analysis. The dates are randomly assigned between 1-Jan-2022 and 31-Dec-2022. I also generated a Ship Date column with 1–7 days added to Order Date to simulate realistic shipping delays.

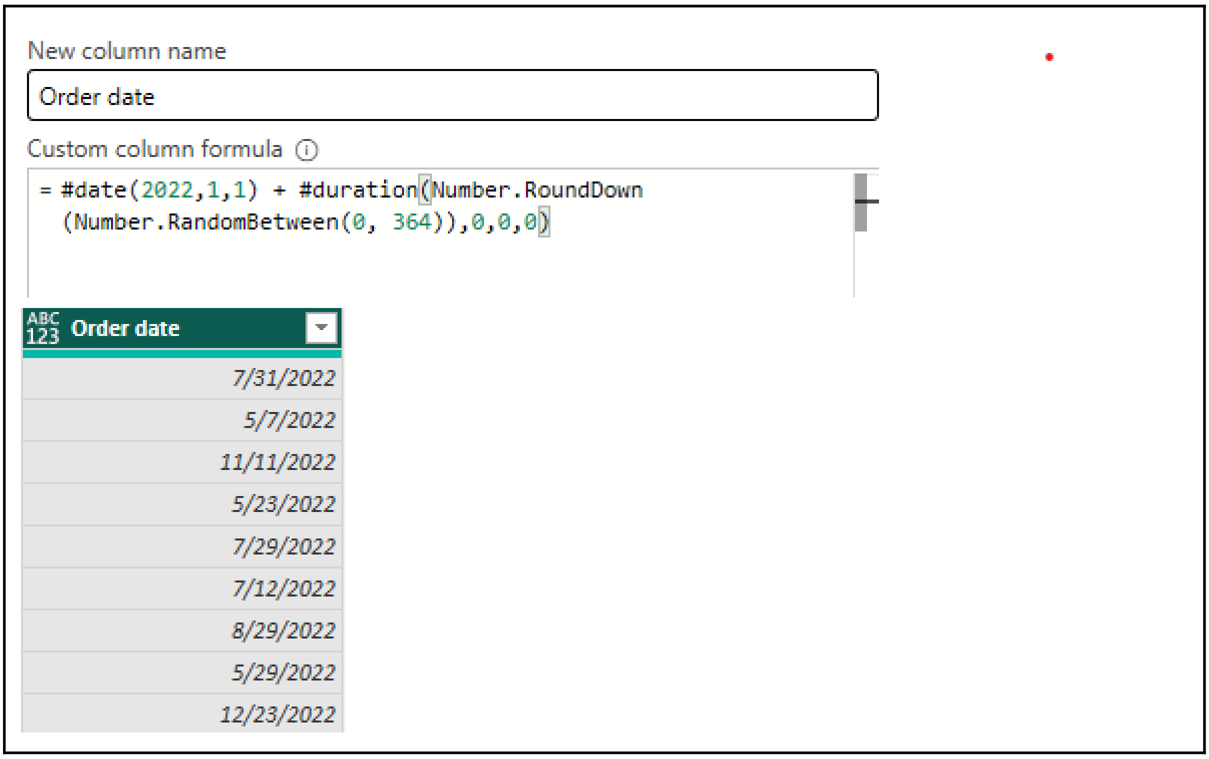


Figure 9a: Power Query Custom Column formula to generate random Order Date for each transaction and the results.

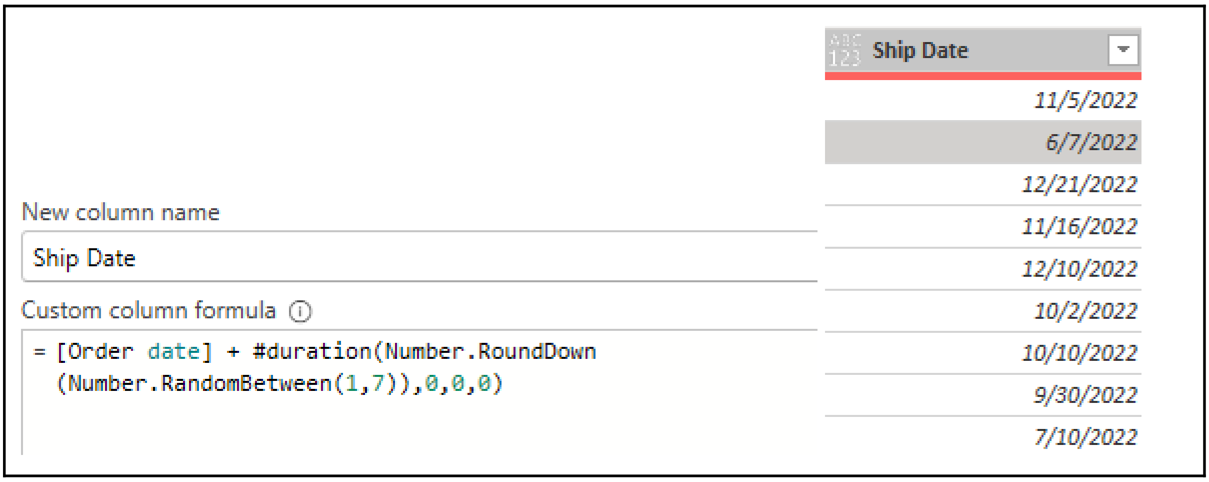
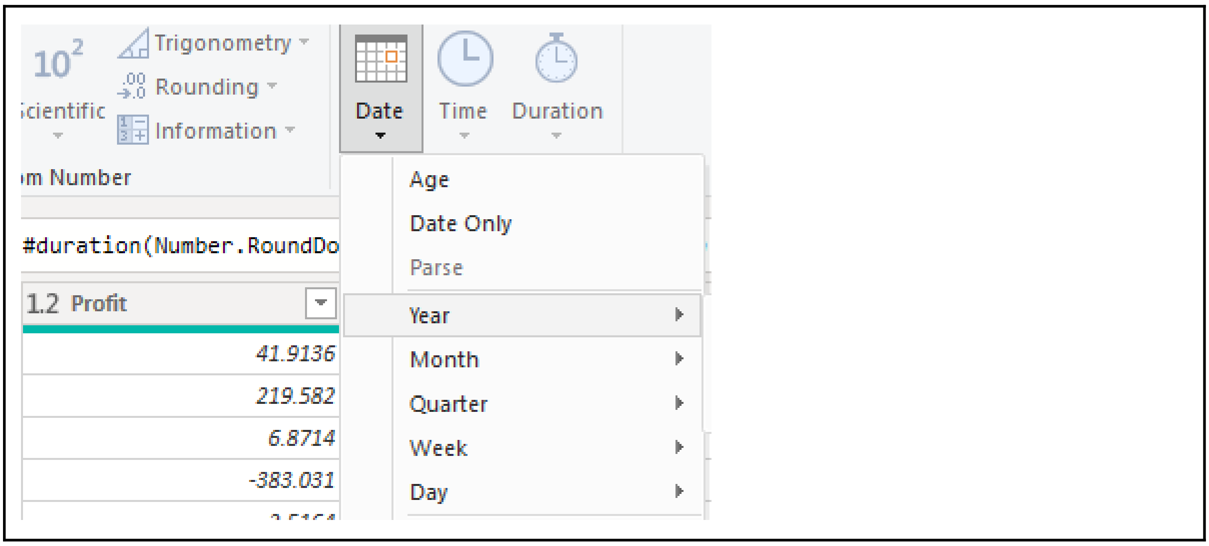


Figure 9b: Power Query Custom Column formula adding 1–7 days to Order Date to create Ship Date.

I extracted the Year, Month, and Quarter from the Order Date column in Power Query to enable time-based analysis and trend reporting. These new columns allow aggregation of sales, profit, and other metrics by year, month, or quarter, which supports analytical storytelling in the dashboard



Year	Month	Quarter
2022	11	4
2022	1	1
2022	7	3
2022	8	3
2022	7	3
2022	6	2

Figure 9c: Power Query table showing the newly created Order Year, Order Month, and Order Quarter columns extracted from the Order Date for time-based analysis

Step 7 : Split / Merge Columns (Country Codes)

I created a derived column in Power Query to standardize state names into official US state abbreviations using conditional logic. This improves consistency and supports geographic analysis and modelling.

New column name

State Code

	Column Name	Operator	Value		Output
If	State	equals	Alabama	Then	AL
Else If	State	equals	Alaska	Then	AK
Else If	State	equals	Arizona	Then	AZ
Else If	State	equals	Arkansas	Then	AR
Else If	State	equals	California	Then	CA

Results

State Code
KY
KY
CA
FL
FL
CA
CA
CA
CA

Figure 10: Creation of a State Code column using conditional logic in Power Query to standardize state values and results.

Step 8 : Derived Columns

I created a Sales Band derived column using conditional logic based on the statistical distribution of the Sales variable.The band thresholds were defined using the mean sales value (≈ 242), observed distribution spread, and presence of high-value outliers to ensure meaningful categorization.

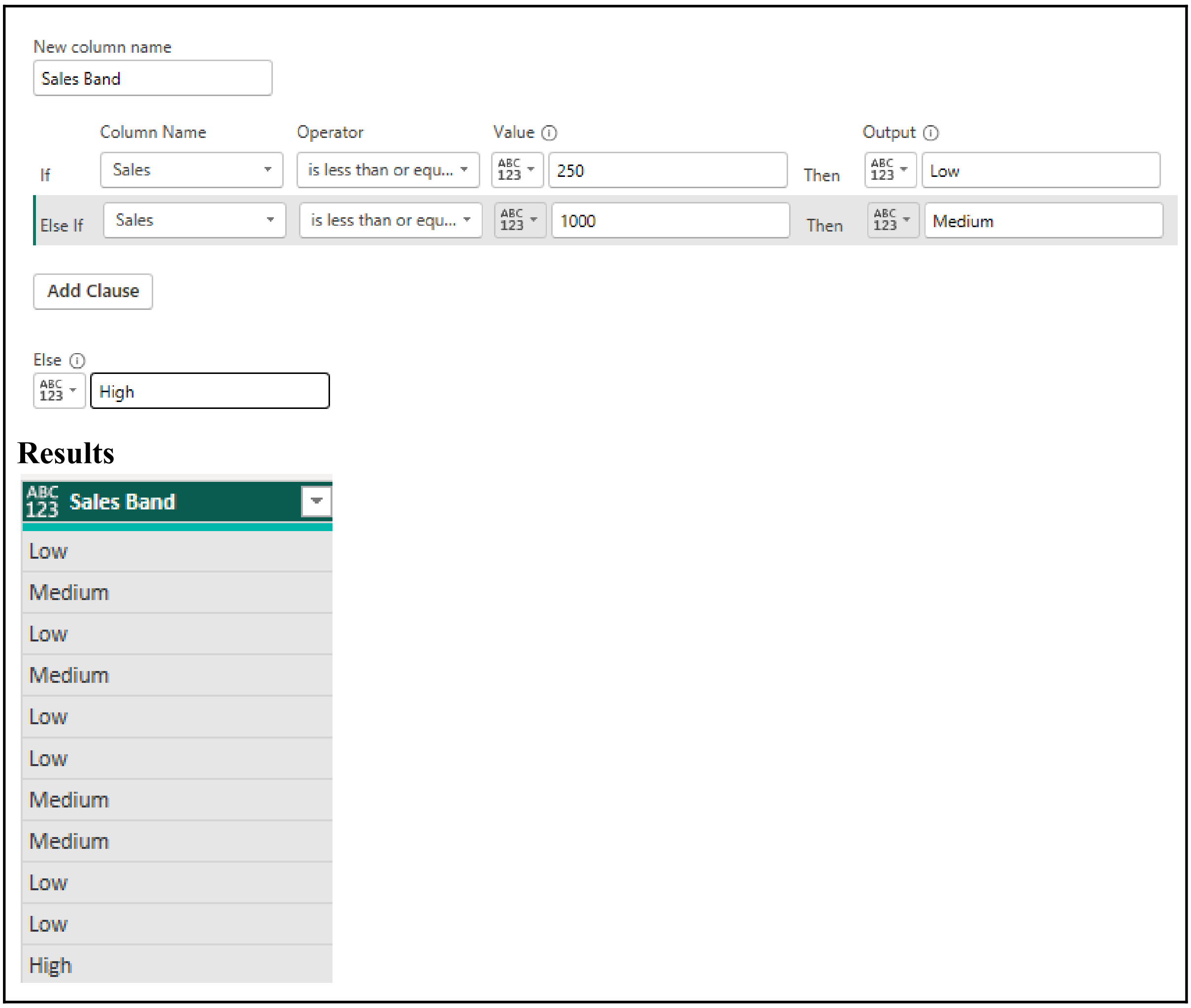


Figure 11: shows the creation of a Sales Band column using data-driven thresholds informed by the sales distribution statistics.

Step 9 : Remove Unnecessary Columns & Rename Queries

I removed columns that were not required for analysis, such as Postal Code,the country column because it is the same throughout, and the original State column, to simplify the dataset and reduce clutter in the data model.
The remaining columns contain all necessary information for relationships, derived metrics, and dashboard visuals.

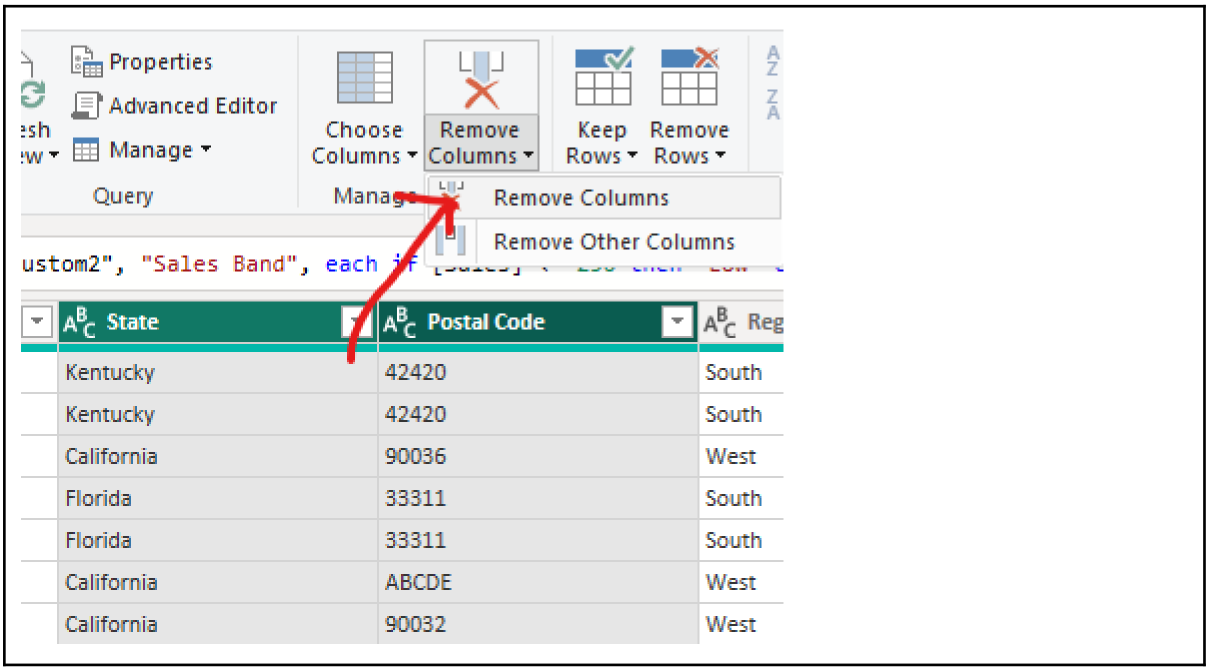


Figure 12: shows the removal of unnecessary columns in Power Query to create a clean dataset ready for modelling.

Step 10 :Create More Derived Columns

I created additional derived columns to enable deeper analytical insights:

1. Profit Margin % — measures profit as a percentage of sales
2. Shipping Delay (Days) — calculates the time between order and shipment
3. Profit / Loss Flag — identifies unprofitable transactions
4. Region_Category — concatenates region and category for cross-dimensional analysis

New column name

Shipping Delay

Custom column formula ⓘ

```
= [Ship Date]-[Order date]
```

New column name

Profit Margin

Custom column formula ⓘ

```
= [Profit] / [Sales] * 100
```

New column name

Region

Custom column formula ⓘ

```
= [Region] & "_" & [Category]
```

New column name

Profit / Loss Flag

Custom column formula ⓘ

```
= if [Profit] < 0 then "Loss" else "Profit"
```

Results

Shipping Delay	Profit Margin	Region.1	Profit / Loss Flag
5	Infinity	South_Furniture	Profit
4	29.99754098	South_Furniture	Profit
6	45.80933333	West_Office Supplies	Profit
6	-39.98235908	South_Furniture	Loss
2	11.43818182	South_Office Supplies	Profit

Figure 13 : Shows the derived columns created in Power Query including Sales Band, Profit Margin %, Shipping Delay, Profit/Loss Flag, and Region_Category.

Step 11 : Renaming Queries & Splitting Tables

The dataset did not include a Customer ID. I created a unique CustomerId by removing duplicates in Segment + City + State Code and adding an Index column

Segment	City	State Code	CustomerId
Consumer	Henderson	KY	1
Unknown	Henderson	KY	2
Corporate	Los Angeles	CA	3
Consumer	Fort Lauderdale	FL	4
Consumer	Los Angeles	CA	5
Consumer	New York	CA	6
Consumer	Concord	NC	7
Consumer	Seattle	WA	8
Home Office	Fort Worth	TX	9
Consumer	Madison	WI	10

Figure 14: shows the generated Customer Key for the Customer dimension table, created from Segment, City, and State Code.

The dataset did not include Product IDs. I created a **Product Id** by removing duplicates on Category + Sub-Category and adding an Index column.

Category	Sub-Category	ProductId
Furniture	Bookcases	1
Furniture	Chairs	2
Office Supplies	Labels	3
Furniture	Tables	4
Office Supplies	Storage	5
Furniture	Furnishings	6
Office Supplies	Art	7
Technology	Phones	8

Figure 11: Shows the Product dimension table with unique Product Keys derived from Category and Sub-Category.

I created a Date dimension table from distinct `Order Date` values and extracted Year, Month, and Quarter. A Date Key was added for proper relationships with the Orders fact table.

Order date	Year	Month	Quarter
4/23/2022	2022	4	2
7/28/2022	2022	7	3
10/31/2022	2022	10	4
5/25/2022	2022	5	2
9/25/2022	2022	9	3
11/6/2022	2022	11	4
2/20/2022	2022	2	1

Figure 12: shows the Date dimension table with Year, Month, Quarter, and Date Key derived from Order Date.

I created a Location dimension table to uniquely identify geographic locations for analysis.

- Columns kept: State Code, City, Region
- Added Location Key as primary key

City	Region	State Code	LocationId
Henderson	South	KY	1
Los Angeles	West	CA	2
Fort Lauderdale	South	FL	3
New York	West	CA	4
Concord	South	NC	5
Seattle	West	WA	6
Fort Worth	Central	TX	7
Madison	Central	WI	8
West Jordan	West	UT	9

Figure 13: shows the Location dimension table with unique Location Keys derived from State Code, City, and Region.

"Orders fact table merged with Customers, Products, and Location dimension tables using text keys. After merging, numeric keys were extracted for relationships in the Star Schema."

```
= Table.AddColumn(#"Expanded Dim_Location", "Product Merge Key", each Text.Trim([Category]) & "_" & Text.Trim(
    [#"Sub-Category"]))

 = Table.AddColumn(#"Expanded Dim_Customer", "Location Merge Key", each Text.Trim([State Code]) & "_" & Text.Trim(
    [City]) & "_" & Text.Trim([Region]))

 = Table.NestedJoin(Merge2, {"Order date"}, Dim_Date, {"Order date"}, "Dim_Date", JoinKind.LeftOuter)
```

Figure 14: Merging Fact and Dimension Tables

I then removed the merge keys as they have already served their purpose and we need a clear dataset

CustomerId	LocationId	ProductId
1	1	1
1	1	10
1	1	2
2	1	2
3	2	2
3	2	3
1	1	13

Figure 14: Merging Fact and Dimension Tables Results

2.3 Applied Steps Evidence

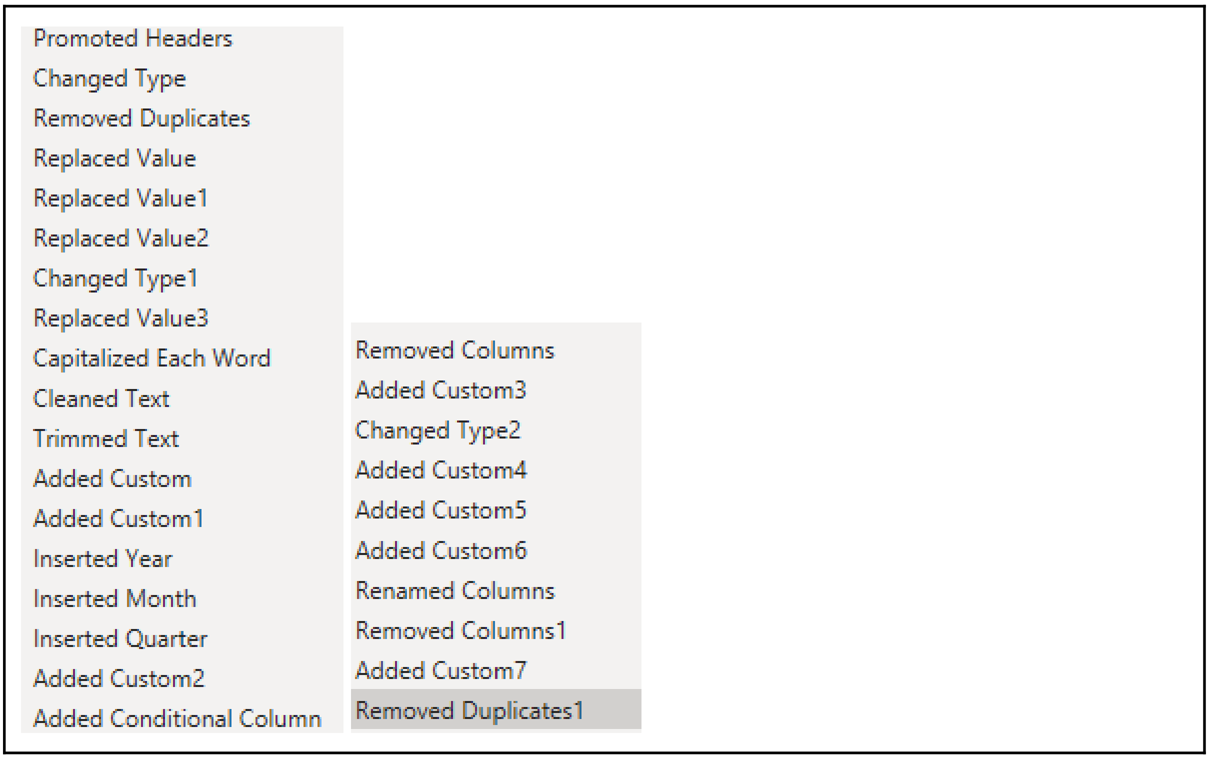


Figure 15: shows all transformations applied to the original Sales Table

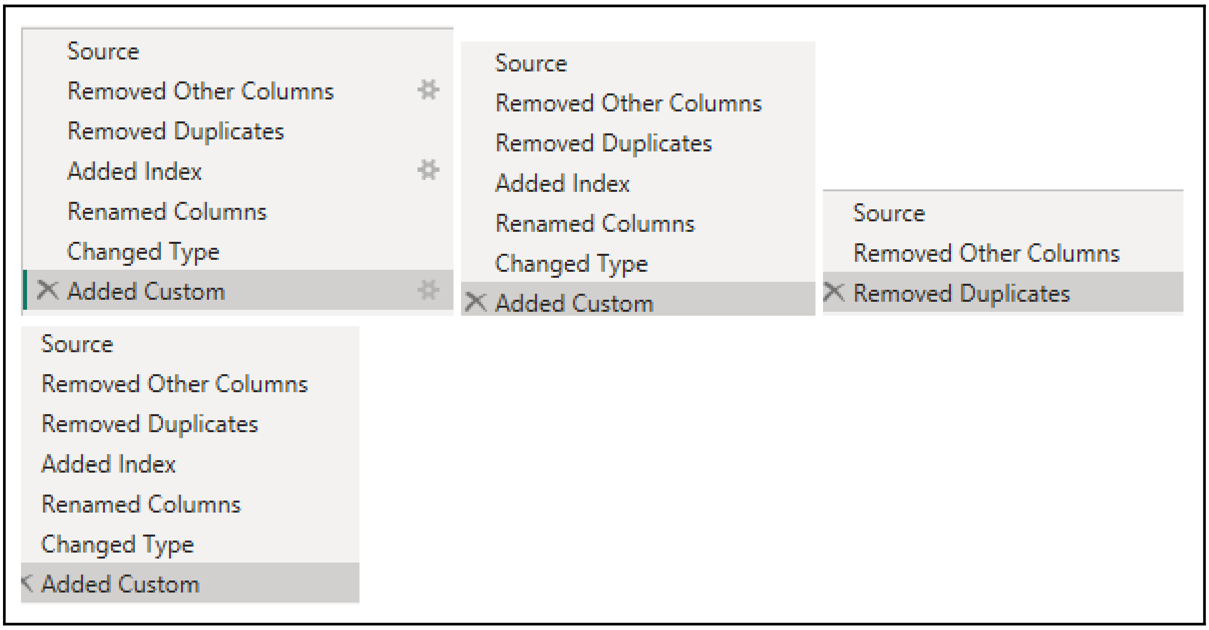


Figure 16: shows all transformations applied to the Customers,Product,Date,and Location dimension tables respectively in Power Query, including removing duplicates, adding Primary Key, and standardizing text.

2.4 Data Model Relationships

The data model in Power BI links the Orders fact table with the dimension tables to form a **Star Schema**, enabling efficient analysis. The relationships are as follows:

- **Orders.Customer Key → Customers.Customer Key** (1:N)
- **Orders.Product Key → Products.Product Key** (1:N)
- **Orders.Location Key → Location.Location Key** (1:N)
- **Orders.Order Date → Date.Date Key** (1:N)

The fact table contains all transactions, while each dimension table contains unique entities. These relationships allow us to slice, filter, and aggregate data across customers, products, locations, and time.

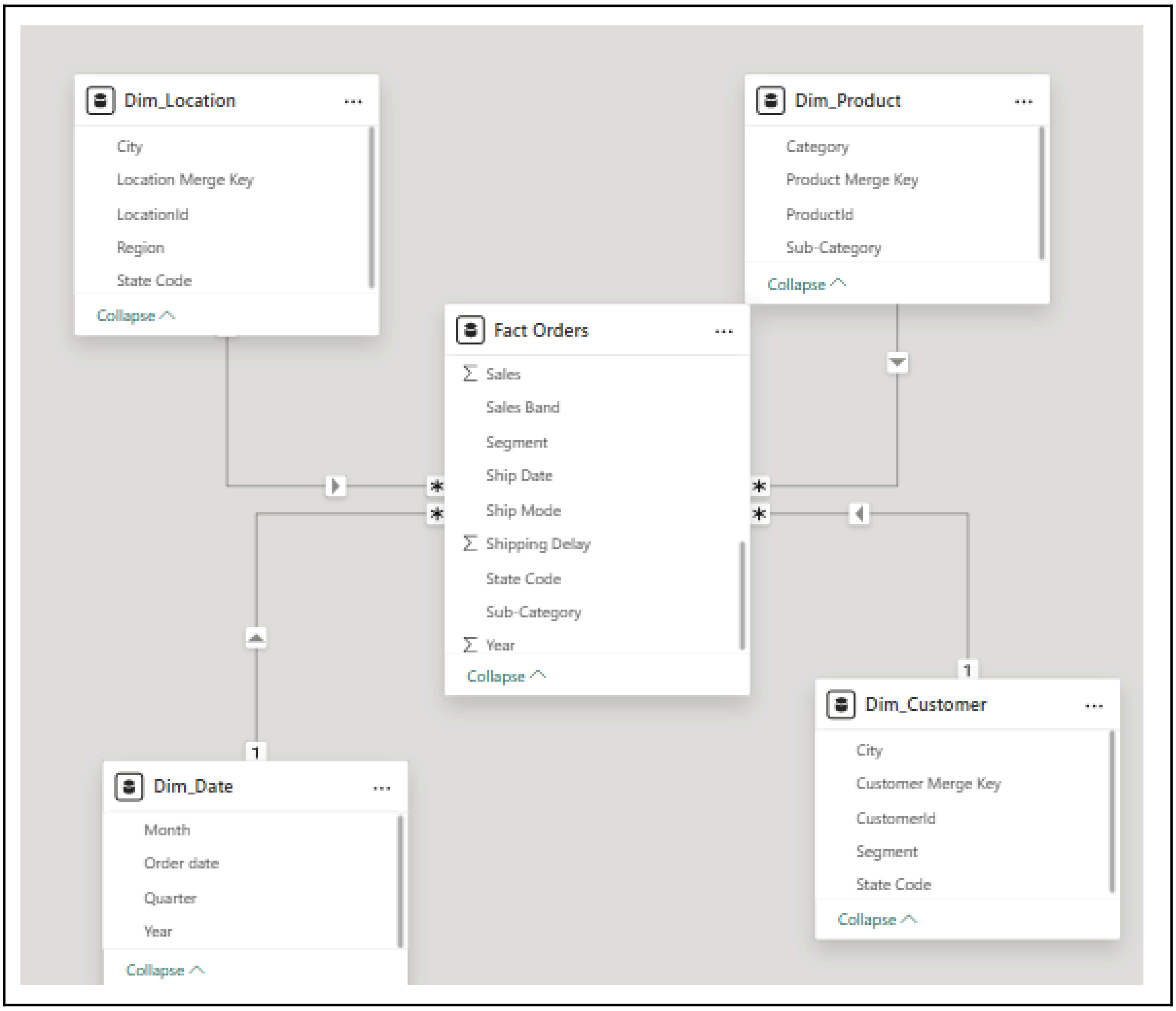


Figure 17: shows the data model relationships in Power BI. The Orders fact table is linked to Customers, Products, Location, and Date dimension tables via their respective keys, forming a Star Schema.

From: table (column) ↑	Relationship	To: table (column)
Fact Orders (CustomerId)	*—◄—1	Dim_Customer (CustomerId)
Fact Orders (LocationId)	*—◄—1	Dim_Location (LocationId)
Fact Orders (Order date)	*—◄—1	Dim_Date (Order date)
Fact Orders (Sub-Category)	*—◄—1	Dim_Product (Sub-Category)

*Figure 18: Relationship configuration showing one-to-many (1:) cardinality between a dimension table and the fact table.**

- All relationships were configured as one-to-many, avoiding many-to-many relationships to prevent ambiguity and incorrect aggregations.
- Single-direction filtering was applied from dimension tables to the fact table to maintain correct aggregation behavior and improve model performance.

After creating the required relationships, technical merge key columns were hidden from the Report View to improve usability and prevent confusion for end users.

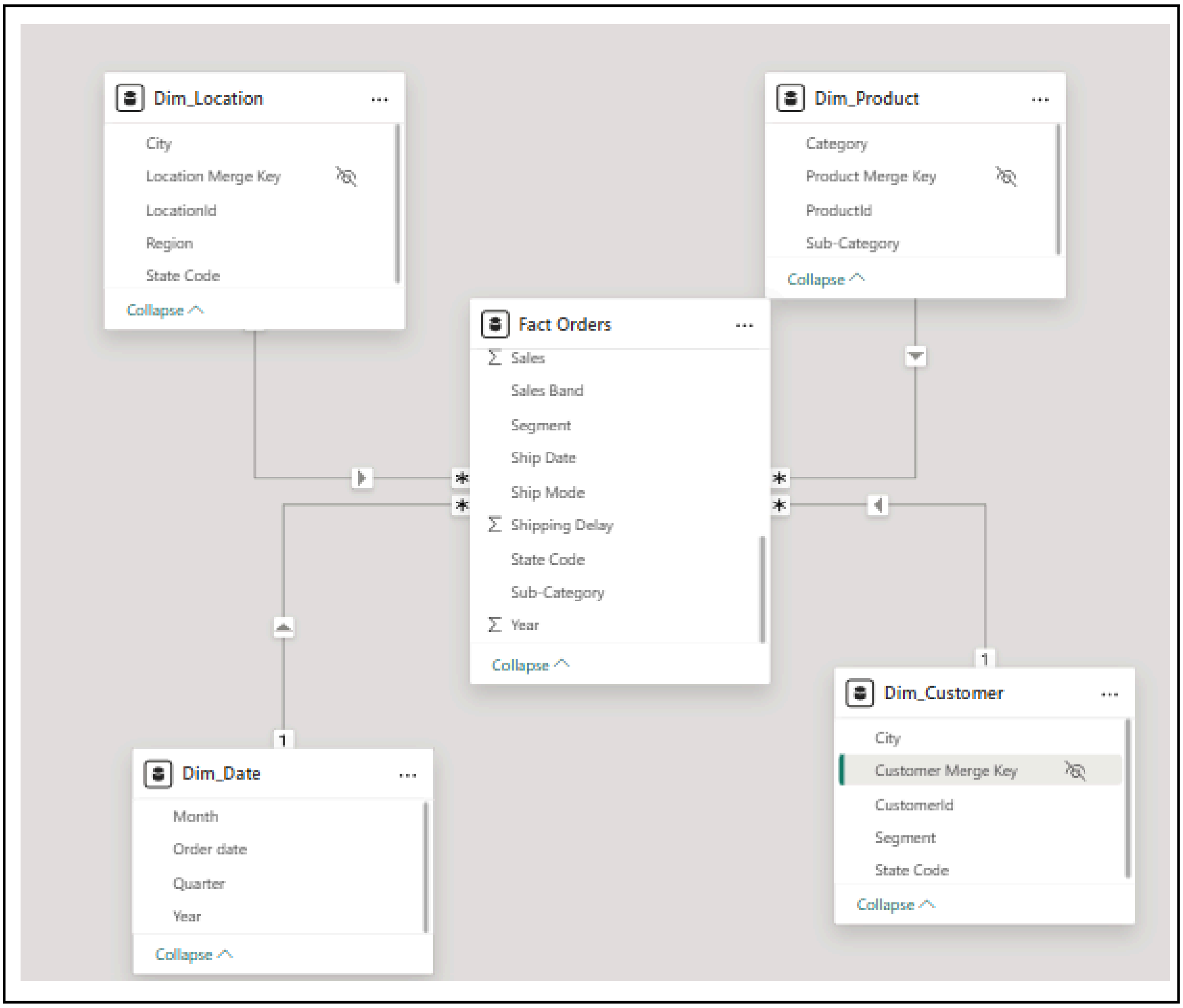


Figure 19: Merge key columns hidden from Report View after relationship creation.

2.5 Dashboard Pages

The Sales Analysis dashboard provides a **comprehensive overview of Superstore's sales and profit performance for 2022**, combining KPIs, trend analysis, comparative charts, and distribution visualizations. It is designed to support **data-driven decision-making**, enabling stakeholders to quickly interpret metrics and identify actionable insights.

2.5.1 Overall Performance

- **Total Sales:** $2,000,000
- **Total Profit:** $287,000
- **Quantity Sold:** 38,000 units

The KPI cards summarize the overall health of the Superstore business in 2022, providing a quick snapshot of revenue, profitability, and sales volume.

2.5.2 Regional Analysis

- **West Region:** $726,000 – highest sales
- **East Region:** $681,000
- **Central Region:** $501,000
- **South Region:** $391,000 – lowest sales

The West region is the top revenue contributor, while the South region underperforms. This highlights potential **regional focus areas** for sales, marketing, and operational improvements.

2.5.3 Category Analysis

- **Technology:** $838,000 – highest sales
- **Furniture:** $724,000 – mid-level sales
- **Office Supplies:** $720,000 – lowest sales

Technology is driving the majority of revenue, indicating strong customer demand. Office Supplies may require **promotional strategies or bundling** to boost sales performance.

2.5.4 Sales Band Distribution

- **Low band:** 7,793 transactions
- **Medium band:** 1,726 transactions
- **High band:** 468 transactions

Most sales fall into the **low band**, indicating smaller transactions dominate. High-value sales are limited, suggesting opportunities for **upselling or premium offerings** to increase revenue.

2.5.5 Shipping Mode Insights

- **Standard Class Ship Mode:** Generates the most revenue at $1,000,000

Customers clearly prefer standard shipping. Operational focus on this mode can help maintain efficiency and satisfaction while exploring ways to optimize alternative shipping options.

2.5.6 Decision-Making Insights

- Prioritize **high-performing regions and categories** to sustain revenue
- Address **underperforming segments** (South region, Office Supplies) with targeted initiatives
- Explore strategies to increase **high-band sales** through promotions or upselling
- Leverage **Standard Class shipping trends** to optimize delivery operations

2.5.7 Dashboard Visuals

This visual provides a **single-page interactive view** of KPIs, trends, comparative charts, and distribution, allowing stakeholders to filter by **Region, Category, Segment, Ship Mode, and Year**, with cross-filtering across all visuals.

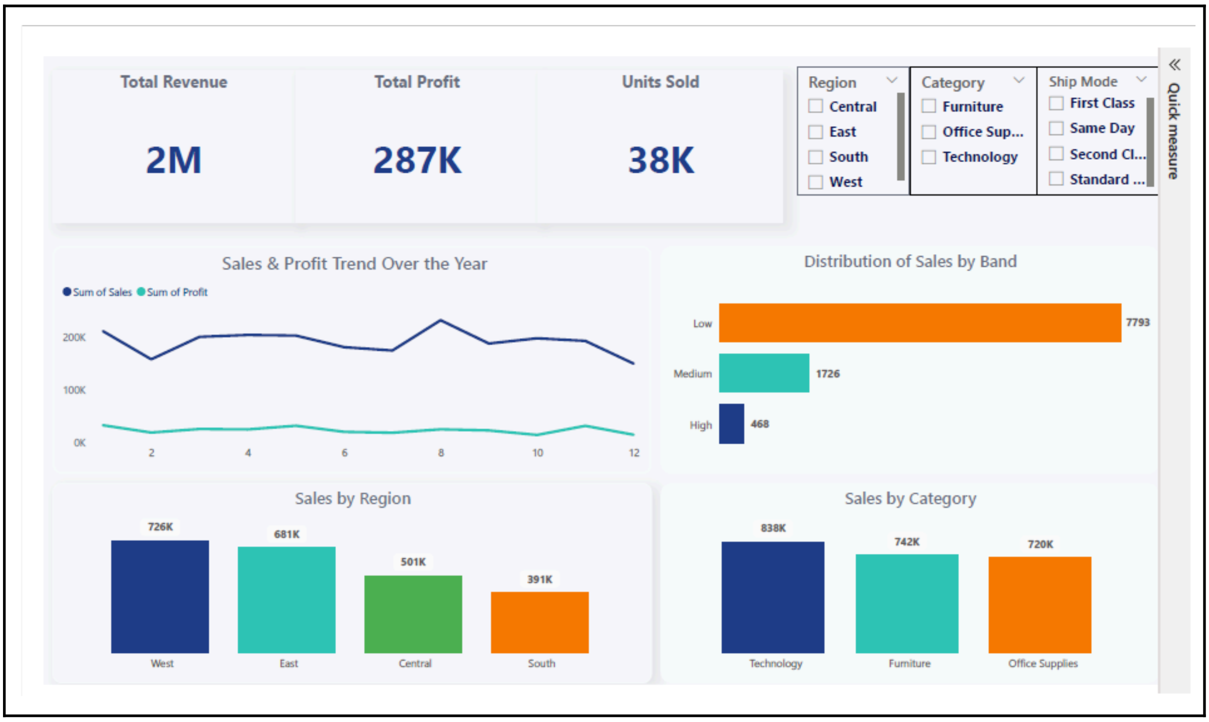
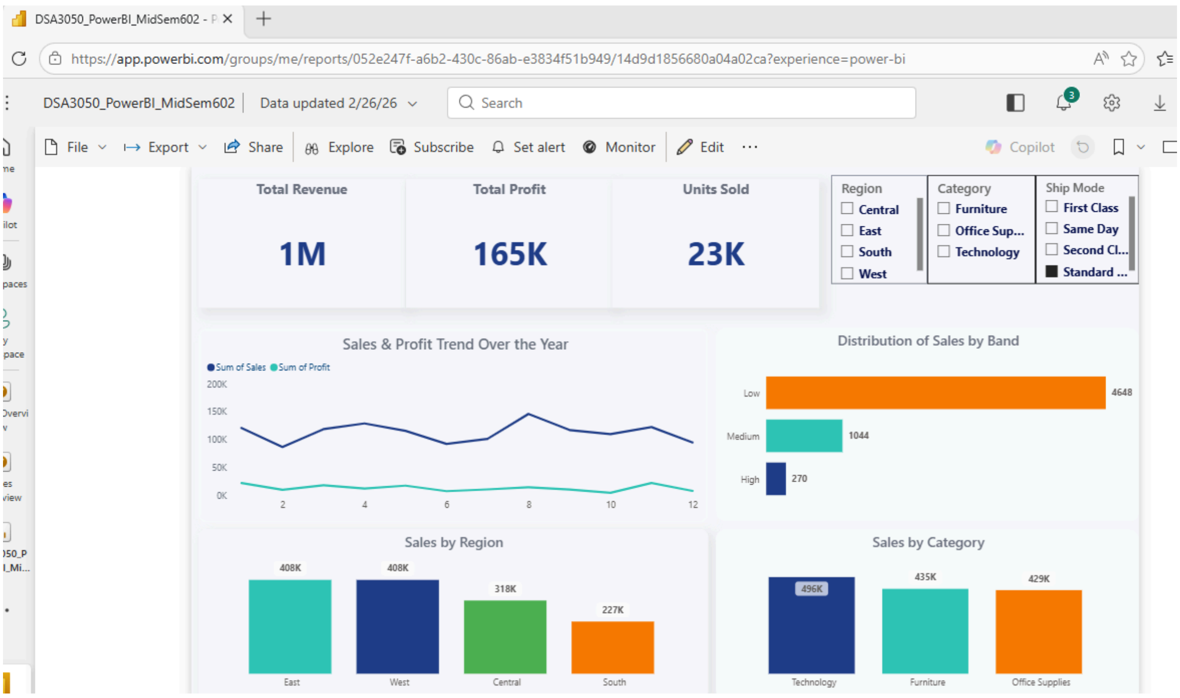


Figure 20 : Dashboard successfully created

2.6 Publishing Confirmation

After publishing the dashboard ,I pinned the sales visuals just to get an overview of the sales attribute



Sales_Overview(Pinned visuals)

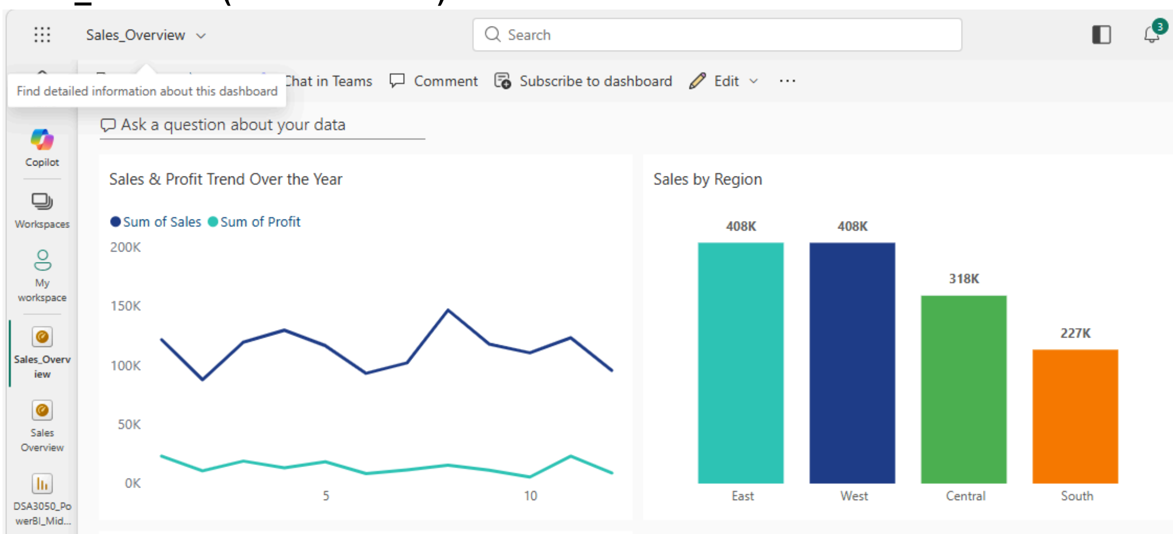


Figure 21: Power BI report successfully published to Power BI Service.

3.Section 2 — Dashboard Link (Public Link)

The interactive Power BI dashboard was successfully published to the Power BI Service and made publicly accessible using the *Publish to Web* feature.

Public Dashboard Link:

- https://app.powerbi.com/groups/me/reports/052e247f-a6b2-430c-86ab-e3834f51b949/14d9d1856680a04a02ca?experience=power-bi

This link allows users to view and interact with the dashboard, including slicers, cross-filtering, and visual insights.