# Retail analytics in power bi

by

Neha Yeramarus Muralidhar

B.E., Visvesvaraya Technological University, 2013

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Computer Science
College of Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2021

Approved by:

Major Professor
Dr. Daniel Andresen

**Copyright**

# Abstract

The retail markets have become extensively competitive and each player in the retail market is striving for the ability to optimize the marketing serving processes, while satisfying the customer expectations. Therefore, it is important for any business/firm to manage and channelize the data to achieve the customer's delight as well as in generating the healthy profits. With regard to big retail players internationally as well as in the USA, data mining or rather big data analytics is now being at every single stage of the retail market/business process, i.e., tracking customer order placements and predicting the forecast sales of the particular product, optimizing the product sales and the offers based on consumer preferences, tracking the emerging products in the market, forecasting and predicting the sales and future demand based on the predictive simulation tools. In parallel to this, recognizing the customers' expectations and interest in specific product types based on their previous purchase actions, and working out the best technique to approach them through targeted marketing efforts and ultimately what to sell them next in what configures the core of data analytics. This project is the outcome of a descriptive research on the past, present, and future of retail industry and the application of business analytics in shaping appropriate marketing strategies with data sources, data structures, and DAX query language through dashboard in Power BI. The project aims to show on how we can use the Power BI with business oriented retail analytics data using DAX query language and its performance on presenting the dashboard to the end users. So in this project, I have created an analytical dashboard to know historic trend and business performance, and also to know which products are sold mostly, which are the top regions and managers/market performance. Additionally, I have created what if analysis for future planning on the basis of historic trend - this dashboard is created for stake holders to know business growth

trend and functional areas and with the visualizations. This project represents the large dataset into visualization form to quickly see the performances of all the commodities.

# Table of Contents

# List of Figures

# List of Tables

# Acknowledgements

First, my sincere gratitude and appreciation goes to my major advisor Dr. Daniel Andresen for all what he has done for me. During these tough COVID times, he not only accepted me as his student but supported me to pursue a project that will help in my career. His kind and warm gesture always inspire confidence within myself and without his advice and encouragement, I wouldn't be where I am today. I am also very grateful to my committee members Dr. Mitch Neilsen and Dr. Torben Amtoft for serving on my M.S. committee. Dr. Neilsen was very supportive right from the beginning of my M.S program and in guiding me with the project in CIS 690 course. I am extremely indebted to Dr. Amtoft for being supportive of my career goals and encouraging me in every way possible.

My special appreciation goes to my family and friends abroad and home. I am extremely grateful my husband Dr. Kaliramesh Siliveru for always inspiring me to follow my dreams and for all the love, encouragement, and emotional support in my life. Finally, I would like to thank my son, Ayushman Siliveru for being my pillar of strength and cheerleader throughout my graduate program.

# 1. Introduction

## 1.1. Power BI

Power BI is a business analytics service provided by Microsoft. It aims to provide interactive visualizations and business intelligence capabilities to create their own reports and dashboards for the end users. Our data may be in an Excel spreadsheet, or a collection of a cloud based .Pbix file which is designed for to use with Power BI desktop. Power BI was initially released in 2014, operating system: Microsoft windows. Power BI provides cloud- based services, along with desktop interface, called Power BI Desktop. The key components of the Power BI are (I have mentioned only 3 which I have used in this project):

- Power BI desktop: designing and publishing reports and dashboards to the service.
- Power BI service: software as a service.
- Power BI mobile apps: iOS, android, and windows phones.

The objective of my project is to analyze the retail sales data of the items sold across multiple countries and stores. I have used visualization and fields tools to create the data sale analysis charts shown in this report and project.

Benefits of Retail analysis: with the help of Power BI, a retailer can even analyze, if there are any issues in its products, transportation, services. Transactions, supply chain, buying behaviors, multi-channel sales, trends and global coverage can also be tracked with this tool to maximize profit. The sales data stored yearly could be used to improvise the business. To store the yearly sales data, products data, and services data, the retailers usually use the excel sheet or SAP tools.

Instead of presenting each and every data in different layouts, I have used Power BI tools and presented all the charts information in five layouts with the complete information for the year 2014 and all the years.

By looking at this retail analysis layout, the audience who are seeing the layout will come to an understanding what profit they have made in multiple countries. For all the charts in the top corner there are 3 symbols i.e., FILTER, HIGHLIGHT, and NONE. We can choose what option we need to demonstrate the charts regarding our requirements. Filter is like filtering the icons to what to present in all the charts and what not to show. Highlight is just like highlighting the requirements mentioned. None is like not to show which is not needed. For visual interaction there is an option called edit interact, using this option we can directly visualize and edit the data. I have created the Power BI tool for the visualization of data for the years 2011-2014. Kindly note that, I am only presenting the data of the year 2014 for few layouts.

### 1.2. Retail analytics

As we are all aware, the retail business sales output is the fulcrum of company's performance. To achieve the best output sales, there are many parameters, to be mastered.

1) Detailed analysis of the particular product in the area, where it must be marketed. The product demand analysis, which must be done practically by interacting with different segment people of that area.
2) Analysis of competitive brands. Evaluation of positives and negatives of our brand product to be marketed. Plan to make improvisation of product and give more emphasis for acceptability of the product by all segment people of society.

3) Quality of product, which is very important parameter of the product sales. To achieve quality, one should look for quality raw materials at most reasonable rate, which will help to sell product at best marketing competitive price.
4) Marketing of finished product. Selection of marketing team is very challenging. The key is to recruit the marketing team. The team efforts, right from sales manager to field salesman gets the best of product sales.
5) Production of product in relative, with demand in market is more important. If demand is more and production is less, because of shortage of raw material or production staff, will give room for competitive brands to dilute the sales curve.
6) After establishing the best sales of product in the market with outstanding co-ordination of above parameters. The company management must give more emphasis for the consistency product sales by research and sales development. The company which has better research and development will perform best in market.

### 1.3. Why should retailers care about retail analytics

There are a million tasks retailers must stick on top of the digital age, and it is not an easy job to conduct all the analysis in a single day. Today's retailers are facing a cluster of new challenges, like declining sales, aggressive competition from online stores, and changing consumer preferences. Despite these challenges, some long established retailers are managing to grow year-over-year, shredding past sales records. The winners are doing something contrasting, something which is not only helps them to survive but also succeed/flourish in this rapidly unfolding retail closure – advanced retail analytics.

According to McKinsey Company, the reason some retailers are winning while others struggle is advanced analytics (Gonzalo et al., 2020). New research says that retailers using advanced

analytics outperform the competition by 68% in earnings — and the disparity is growing exponentially. But what exactly is “advanced analytics,” and how does it differ from regular old Excel analysis? To explain what makes advanced analytics in the retail industry so special, we need to start at the beginning.

### 1.4. What is retail data analytics

Retail data analytics is the process of collection and studying of different datasets in retail data (like sales, inventory, pricing, etc.) to invent trends, future predict results, and make finer business decisions. Data analytics permits retailers to get more understanding into the performance of their customers, stores, products, and dealers and use that insight to grow profits.

Virtually all retailers are doing different form of data analytics even if they are only reviewing sales numbers on Excel. But there is a very big difference between an analyst firing up Excel to shift through spreadsheets and using purpose-built AI to analyze billions of data points at once. One of the reasons to use data analytics to show decision-making is to secure your decisions are based on actual truth (cold, hard numbers), not just others perception of reality.

Analytics help us understand what’s going on with your business with greater detail than you could do otherwise.

*A retailer can use data analytics to:*

- Understand the value and number of products sold in an average order
- Recognize which products sell the most, the least, and everything in-between
- Identify your most valuable customers
- Discover what your true demand was as well as past lost sales
- Determine optimal suggested order quantities and recommend purchase quantities and allocations

- Establish the optimal price point for a specific product at any specific location

It is not a surprise, that there exists an enormous, things in industry for retail analytics solutions. Below, we will discuss some of related applications, how they will work, and what benefits we could see from using them. To productively manage and assemble their data, many businesses choose to turn to Business Intelligence tools. As, BI tools help you to structure and visualize your data.

Many retailers conduct basic BI using native features in their ERP (Enterprise Resource Planning) system, or by importing data directly into Microsoft Excel.

Slightly more advanced retailers are using dedicated BI software like:

- Power BI
- Tableau
- SAP
- QlikView
- Apache Spark

These applications support multiple data sources, appealing visualizations, and some degree of data manipulation. Importantly, all the above mentioned requires a lot of human input and are quite time-consuming to manage. This is especially true for medium to large retailers running hundreds or thousands of stores and products in different segments. Therefore, many retailers have dedicated teams of analysts in most departments to generate reports to get the details of the huge data in a clear form.

### 1.5. System Requirements

**Hardware and Software Requirement:**

**Hardware Requirement:**

Processor : Intel(R) Core (TM) i7-8650U CPU @ Intel(R) Core(TM) i7-8650U CPU @ 1.90GHz 2.11 GHz .

RAM : Minimum16 GB or Greater.

Hard disk : HDD, SDD20 GB (Free Space).

**Software Requirement:**

Software : Power Bi

Operation System : 64-bit operating system, Windows 10 or higher.

**Project Overview:**

Front End : Power Bi Desktop

Back End : Excel, Azure and DAX query language.

# 2. Background

AIM and objective of this project is: The aim of the project is to create an effective software to help the Retail Analytics to maintain the records of a large data sales, handle user details, generate invoice, check, and renew validity and provide a scope of communication between users by using inbuilt messaging system. Retail analytics system deals with the maintenance of Sales and consumables in the Retail industries. This Retail analytics system is user friendly. Having high performance and no time consuming.

## 2.1. Scalability and performance

The scalability of Power BI High quality/elite capacity, and the scalability of backend is Direct Query or Live Connect data sources. The tool is meant to be used in capacity planning and scale evaluation scenarios when admins of Power BI capacities and backend data sources wish to test the ability of their architecture to serve a certain scale. “It has a 1 GB limit per dataset that is imported into Power BI. If you have chosen to keep the Excel experience, instead of importing the data, the limit is 250 MB for the dataset”.

### 3.1.1. DAX queries description:

Syntax

Formula

' ' single quotes indicates to the related table

[ ] related to the table name.

Measures for raw data

Column’s calculations are identified by summation symbol in the fields’

Box with cross lines and calculator symbol is calculated columns.

Measure is identified through calculator symbol from the fields.

All queries are in Dax language with calculated column and measures using formulas and syntax and measure as syntax consumes less space it is visualize, whereas measures contain lot of space and it is not visualize in raw data.

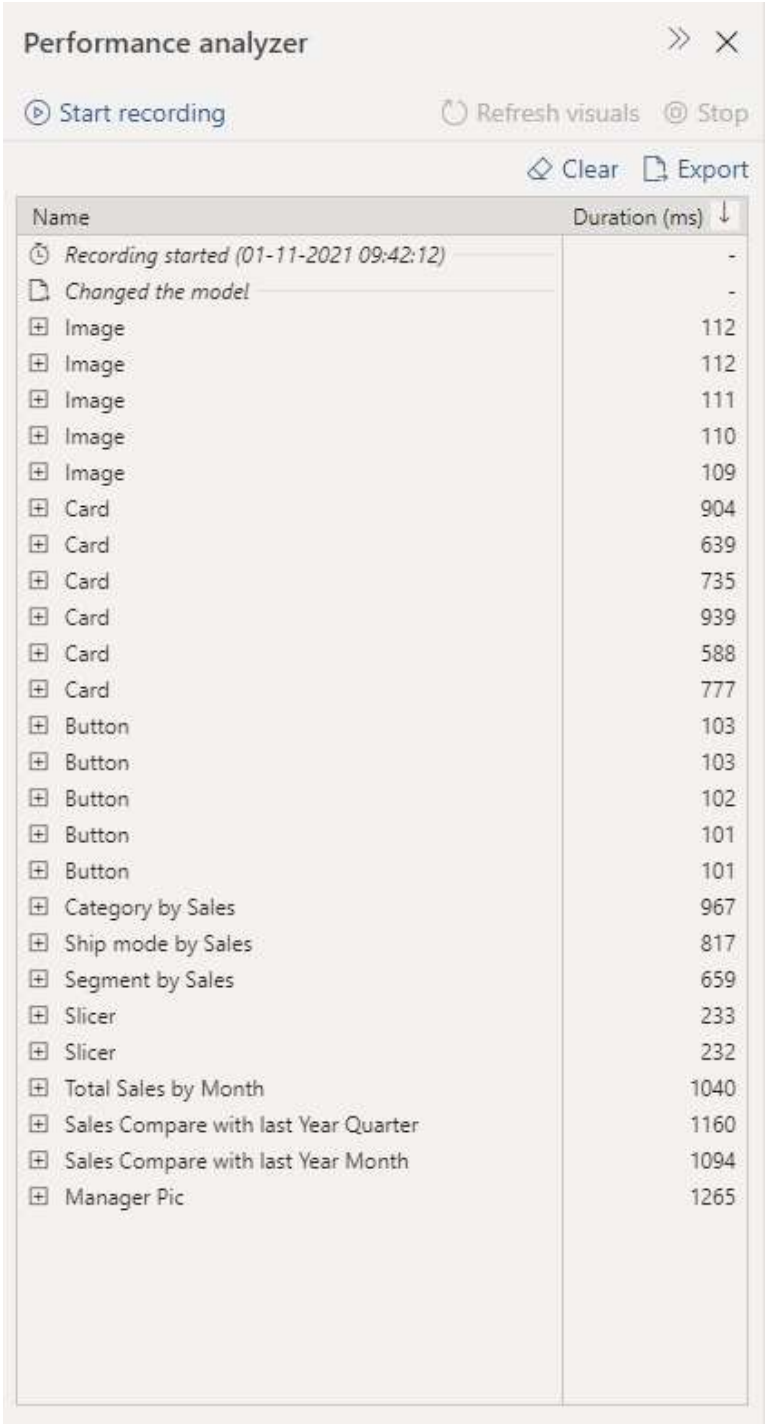



**Figure 1. Performance analyzer**

Referring performance analyzer if I set 10 Lacs records

Duration calculated in microseconds it will take hardly 1 min data and all visualization refreshes.

## 2.2. Accessibility

When Power BI Dashboard is built on a specific topic with accessible dashboards and reports, the accessibility can be given to many persons in the world. For accessibility, you must share your report on the Power BI web service so everyone could see it.

**Table 1.** Accessibility checklist.

| **Standard** | **Y/N** | **Comments** |
|---|---|---|
| High Contrast | Y | Available on web service |
| Focus Mode | Y | Available in each visualization |
| Titles & Labels | Y | Available in each visualization |
| Legends | Y | Available in each visualization |
| Filter / Slicer | Y | Adds filters for more drill down |
| Cards | Y | Few cards created for KPI |
| Tabs/Pages | Y | Created different pages/tabs for more clarity of visualization |
| Data Flow | Y | Data visualize in proper way: 1st page – overview of business; 2nd page: product wise 3rd page: market wise; 4th page – geographic wise data |
| Font size & color | Y | We can change font size and color |
| Icons for visualization | Y | Uploaded category wise or graph wise icons to understand easily |
| Wallpaper | Y | Uploaded background with the help of PPT |
| Page Navigation | Y | Created page navigation with the help of button and applied to tabs |
| Theme | Y | Created universal them for all page but layout is different |
| Show Data | Y | we can check raw data |
| Model | Y | we can check and create connection between multiple tables with primary key |
| Sort Option | Y | Sort option is available in each visualization |
| View and Hide | Y | we can hide any visual anytime |
| Measures | Y | Multiple measures created for calculations, we can check by clicking on measures |
| Transform | Y | we can Transform data and modify as per required |
| Format painter | Y | want to apply same format for other visual them by using this we can do |
| Drill down | Y | we can drill down with down arrow in all visualization |
| **Disabilities** | **Y** | **The above options are accessible to disable people through key board** |
| **Color contrast** | **Y** | **With the options published on web, using low, high, yellow, blue colors** |

### 2.2.1. Accessibility in Power BI:

While working with Power BI, I considered the different types of users who may interact with these reports. I created reports that are easily navigated and understood by keywords and button / tabs / filters.

### 2.2.2. Universal Design:

I created Universal design for all pages with background design and colors to make it simple and attractive and user friendly. Created few tabs to separate all pages and applied navigate function to go to directly on that page.

### 2.2.3. To access this reports / dashboard:

To make it accessible I must publish this report from desktop to web service and mentioned users email id so they can access these reports. We can also set the limitations.

### 2.2.4. How to use or access dashboard:

In all pages I have created multiple tabs. If you click on any tabs, you will go directly to that page. Retail analytics dashboard is created to quickly see the performance of all the products that a company sell. This layout relationship calculations are done with DAX query language and then visualizations are created through fields and filters. This dashboard contains 5 layouts that is overview, product wise, market wise, geographic wise and what if analysis. The overview of my dashboard/report includes how the sales are done regarding different products in multiple countries and regions and how many customers are buying the products how it is transported how many managers the best profits and comparisons between quartered and month regarding sales. What if analysis to improve the future business in retail analytics. Our cerebrum attracts more to the colors and visualizations rather than written documents. Accessibility and unit testing performance is done with my dashboard. For accessibility When spotlight option is selected the other are not seen

and there are many options like drill up, drill down, colors, transparency, focus mode, show as a table etc.


**Figure 2. Figure showing overall accessibility of the project.**

There is a filter option available to get only particular year data or any market managers performance:

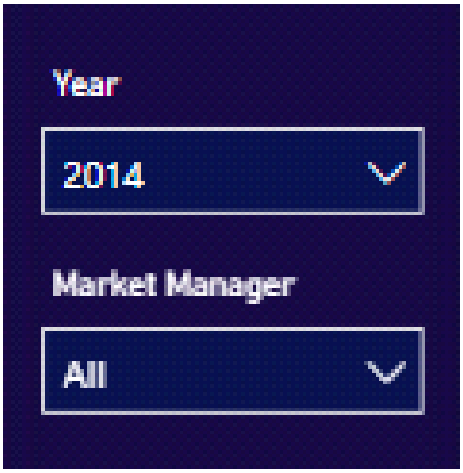



**Figure 3. Figure showing the filter option for the accessibility of the particular year data.**

You can click on highlighted button to for focus mode or you can click on below highlighted area and get data table or you can download data into csv.

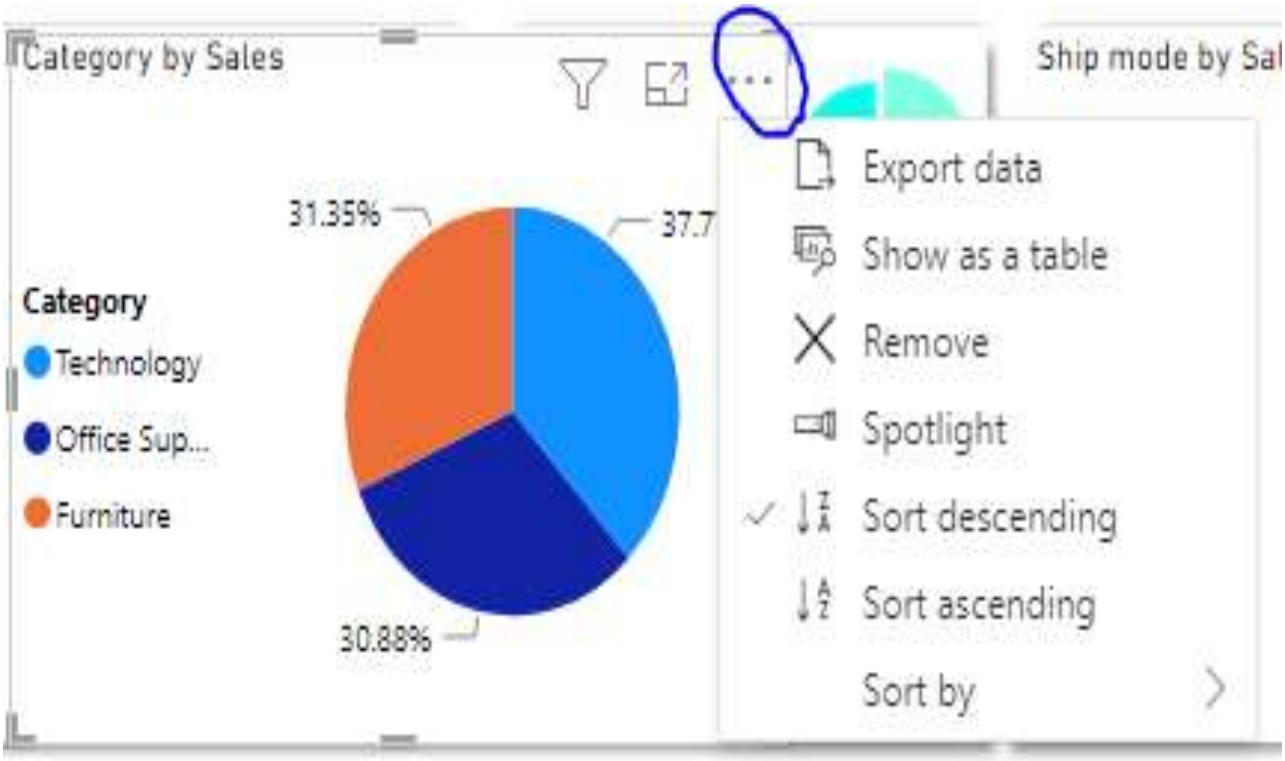



**Figure 4. Figure showing the accessibility of the particular category data.**

### 2.3. GUI

The GUI I have worked on the DAX query Language that is backend program of the application. Power BI interface includes, data source, theme, query language, visualizations, we can manipulate as per our requirement.

Power BI have 2 types of applications:

- Desktop - in Desktop version you can create / modify reports

Web - you can publish your reports from Desktop to web so everyone can access your report or dashboard

# 3. Methodology

The main objective in making this dashboard is that, the reader can directly analyze what we had in last financial year. Which areas are not making sales, or which is our best product etc. I have created what if analysis also to analyze if we increase any parameter like if we increase or decrease quantity by 5% then what will be the total sales and profit. Reader can take decision for business growth, and it is easy to understand business performance.

### 3.2. Data Source

Retail raw data taken from google.com

There are 3 sheets:

- **Sales**

  Below are the Columns with description:

  **Row ID:** Row ID is unique id for each transaction's.

  **Order ID:** Order ID is repeated like if I Purchase product from multiple categories on same time then Order id will be same for both.

  **Order date**

  **Ship Date**

  **Ship Mode:** we have 4 types of ship mode (First, Second, Standard, Same Day)

  **Customer ID:** which is unique for all customers

  **Customer Name**

  **Segment:** we have 3 types of segments (Consumer, Corporate, Home Office)

  **City**

  **State**

**Country**

**Postal Code**

**Market:** we have 7 Markets

**Region**

**Product ID:** which is unique for each product

**Category:** we have 3 types (Furniture, Office Supplies, Technology)

**Sub-category:** we have 17 sub-categories

**Product name**

**Unite Price**

**Product Profit Margin**

**Quantity**

**Discount**

**Shipping Cost**

**Order Priority**

- **Return**

  Below are the columns with description

  **Row ID:** which is unique id from sales

  **Return Status:** we have yes comment from row id

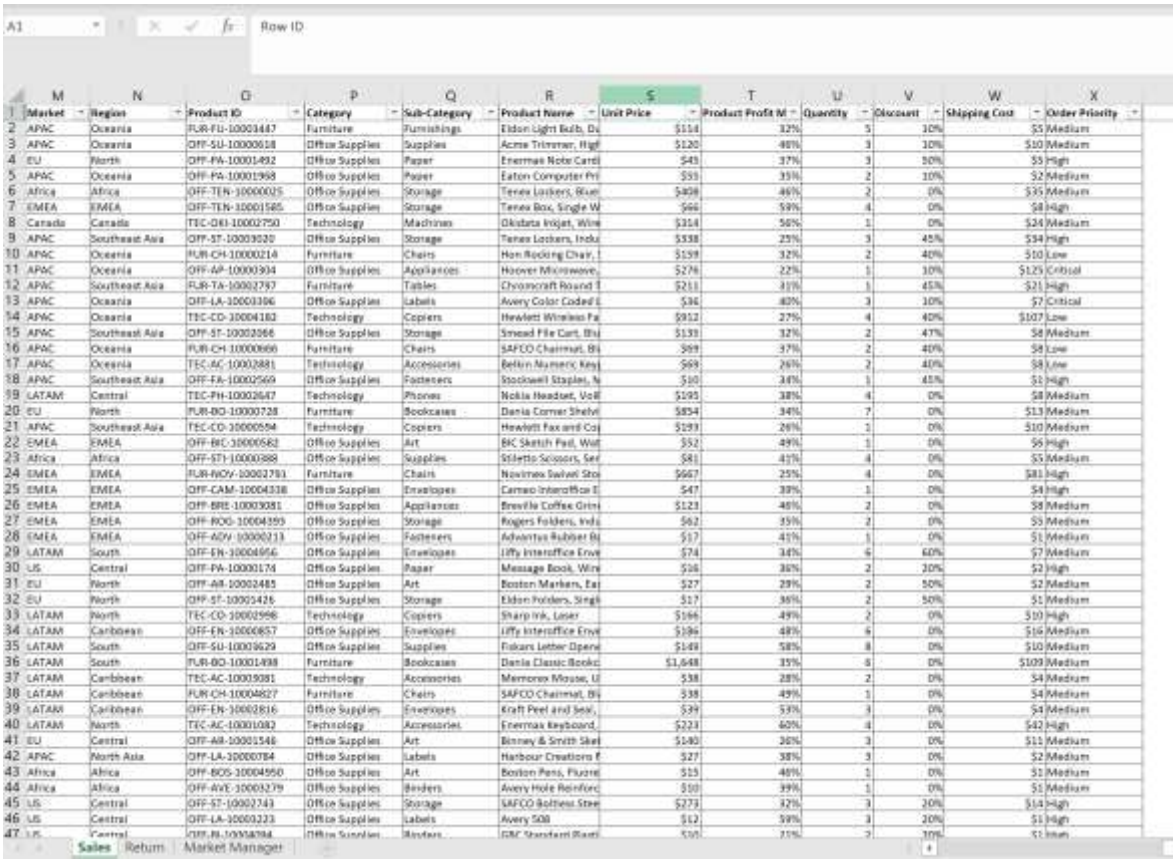
- **Market Manager**

  Below are the columns with description

  **Market:** Unique Market Name

  **Market Manager**

  **Manager Pic**



| | M | N | O | P | Q | R | S | T | U | V | W | X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Market | Region | Product ID | Category | Sub-Category | Product Name | Unit Price | Product Profit M | Quantity | Discount | Shipping Cost | Order Priority |
| 2 | APAC | Oceania | FUR-FU-10003447 | Furniture | Furnishings | Eldon Light Bulb, Du | $114 | 32% | 5 | 10% | $5 | Medium |
| 3 | APAC | Oceania | OFF-SU-10000618 | Office Supplies | Supplies | Acme Trimmer, High | $120 | 48% | 3 | 10% | $10 | Medium |
| 4 | EU | North | OFF-PA-10001492 | Office Supplies | Paper | Enermax Note Card | $45 | 37% | 3 | 50% | $5 | High |
| 5 | APAC | Oceania | OFF-PA-10001968 | Office Supplies | Paper | Eaton Computer Pri | $55 | 35% | 2 | 10% | $2 | Medium |
| 6 | Africa | Africa | OFF-TEN-10000025 | Office Supplies | Storage | Tenex Lockers, Blue | $408 | 46% | 2 | 0% | $35 | Medium |
| 7 | EMEA | EMEA | OFF-TEN-10001585 | Office Supplies | Storage | Tenex Box, Single W | $66 | 59% | 4 | 0% | $8 | High |
| 8 | Canada | Canada | TEC-OKI-10002750 | Technology | Machines | Okidata Inkjet, Wire | $314 | 56% | 1 | 0% | $24 | Medium |
| 9 | APAC | Southeast Asia | OFF-ST-10003020 | Office Supplies | Storage | Tenex Lockers, Indu | $338 | 25% | 3 | 45% | $34 | High |
| 10 | APAC | Oceania | FUR-CH-10000214 | Furniture | Chairs | Hon Rocking Chair, I | $199 | 32% | 2 | 40% | $10 | Low |
| 11 | APAC | Oceania | OFF-AP-10000304 | Office Supplies | Appliances | Hoover Microwave, | $276 | 22% | 1 | 10% | $125 | Critical |
| 12 | APAC | Southeast Asia | FUR-TA-10002797 | Furniture | Tables | Chromcraft Round T | $211 | 31% | 1 | 45% | $21 | High |
| 13 | APAC | Oceania | OFF-LA-10003306 | Office Supplies | Labels | Avery Color Coded L | $36 | 40% | 3 | 10% | $7 | Critical |
| 14 | APAC | Oceania | TEC-CO-10004183 | Technology | Copiers | Hewlett Wireless Fa | $912 | 27% | 4 | 40% | $107 | Low |
| 15 | APAC | Southeast Asia | OFF-ST-10002066 | Office Supplies | Storage | Smead File Cart, Blu | $133 | 32% | 2 | 47% | $8 | Medium |
| 16 | APAC | Oceania | FUR-CH-10000666 | Furniture | Chairs | SAFCO Chairmat, Bl | $69 | 37% | 2 | 40% | $8 | Low |
| 17 | APAC | Oceania | TEC-AC-10002881 | Technology | Accessories | Belkin Numeric Key | $69 | 26% | 2 | 40% | $8 | Low |
| 18 | APAC | Southeast Asia | OFF-FA-10002569 | Office Supplies | Fasteners | Stockwell Staples, N | $10 | 34% | 1 | 45% | $1 | High |
| 19 | LATAM | Central | TEC-PH-10002647 | Technology | Phones | Nokia Headset, Voi | $195 | 38% | 4 | 0% | $8 | Medium |
| 20 | EU | North | FUR-BO-10000728 | Furniture | Bookcases | Dania Corner Shelv | $854 | 34% | 7 | 0% | $13 | Medium |
| 21 | APAC | Southeast Asia | TEC-CO-10000594 | Technology | Copiers | Hewlett Fax and Co | $193 | 26% | 1 | 0% | $10 | Medium |
| 22 | EMEA | EMEA | OFF-BIC-10000682 | Office Supplies | Art | BIC Sketch Pad, Wid | $52 | 49% | 1 | 0% | $6 | High |
| 23 | Africa | Africa | OFF-STI-10000888 | Office Supplies | Supplies | Stiletto Scissors, Ser | $81 | 41% | 4 | 0% | $5 | Medium |
| 24 | EMEA | EMEA | FUR-ROY-10002781 | Furniture | Chairs | Novimex Swivel Sto | $667 | 25% | 4 | 0% | $81 | High |
| 25 | EMEA | EMEA | OFF-CAM-10004338 | Office Supplies | Envelopes | Cameo Interoffice E | $47 | 39% | 1 | 0% | $4 | High |
| 26 | EMEA | EMEA | OFF-BRE-10003081 | Office Supplies | Appliances | Breville Coffee Grin | $123 | 46% | 2 | 0% | $8 | Medium |
| 27 | EMEA | EMEA | OFF-ROG-10004395 | Office Supplies | Storage | Rogers Folders, Indu | $62 | 35% | 2 | 0% | $5 | Medium |
| 28 | EMEA | EMEA | OFF-ADV-10000213 | Office Supplies | Fasteners | Advantus Rubber Bi | $17 | 41% | 1 | 0% | $1 | Medium |
| 29 | LATAM | South | OFF-EN-10004956 | Office Supplies | Envelopes | Jiffy Interoffice Enve | $74 | 34% | 6 | 60% | $7 | Medium |
| 30 | US | Central | OFF-PA-10000174 | Office Supplies | Paper | Message Book, Wire | $16 | 36% | 2 | 20% | $2 | High |
| 31 | EU | North | OFF-AR-10002485 | Office Supplies | Art | Boston Markers, Eas | $27 | 29% | 2 | 50% | $2 | Medium |
| 32 | EU | North | OFF-ST-10001426 | Office Supplies | Storage | Eldon Folders, Singl | $17 | 36% | 2 | 50% | $1 | Medium |
| 33 | LATAM | North | TEC-CO-10002998 | Technology | Copiers | Sharp Ink, Laser | $166 | 49% | 2 | 0% | $10 | High |
| 34 | LATAM | Caribbean | OFF-EN-10000857 | Office Supplies | Envelopes | Jiffy Interoffice Enve | $196 | 48% | 6 | 0% | $16 | Medium |
| 35 | LATAM | South | OFF-SU-10003629 | Office Supplies | Supplies | Fiskars Letter Opene | $149 | 58% | 8 | 0% | $10 | Medium |
| 36 | LATAM | South | FUR-BO-10001498 | Furniture | Bookcases | Dania Classic Bookc | $1,648 | 35% | 6 | 0% | $109 | Medium |
| 37 | LATAM | Caribbean | TEC-AC-10003081 | Technology | Accessories | Memorex Mouse, U | $38 | 28% | 2 | 0% | $4 | Medium |
| 38 | LATAM | Caribbean | FUR-CH-10004827 | Furniture | Chairs | SAFCO Chairmat, Bl | $38 | 49% | 1 | 0% | $4 | Medium |
| 39 | LATAM | Caribbean | OFF-EN-10002816 | Office Supplies | Envelopes | Kraft Peel and Seal, | $39 | 53% | 3 | 0% | $4 | Medium |
| 40 | LATAM | North | TEC-AC-10001082 | Technology | Accessories | Enermax Keyboard, | $223 | 60% | 4 | 0% | $42 | High |
| 41 | EU | Central | OFF-AR-10001546 | Office Supplies | Art | Binney & Smith Ske | $140 | 36% | 3 | 0% | $11 | Medium |
| 42 | APAC | North Asia | OFF-LA-10000784 | Office Supplies | Labels | Harbour Creations F | $27 | 38% | 3 | 0% | $2 | Medium |
| 43 | Africa | Africa | OFF-BOS-10004950 | Office Supplies | Art | Boston Pens, Fluore | $15 | 46% | 1 | 0% | $1 | Medium |
| 44 | Africa | Africa | OFF-AVE-10003279 | Office Supplies | Binders | Avery Hole Reinforc | $10 | 39% | 1 | 0% | $1 | Medium |
| 45 | US | Central | OFF-ST-10002743 | Office Supplies | Storage | SAFCO Boltless Stee | $273 | 42% | 3 | 20% | $14 | High |
| 46 | US | Central | OFF-LA-10003223 | Office Supplies | Labels | Avery 508 | $12 | 59% | 3 | 20% | $1 | High |
| 47 | US | Central | OFF-BI-10003784 | Office Supplies | Binders | GBC Standard Plastic | $10 | 21% | 2 | 10% | $1 | High |

Sales | Return | Market Manager

**Figure 5. Excel raw data**

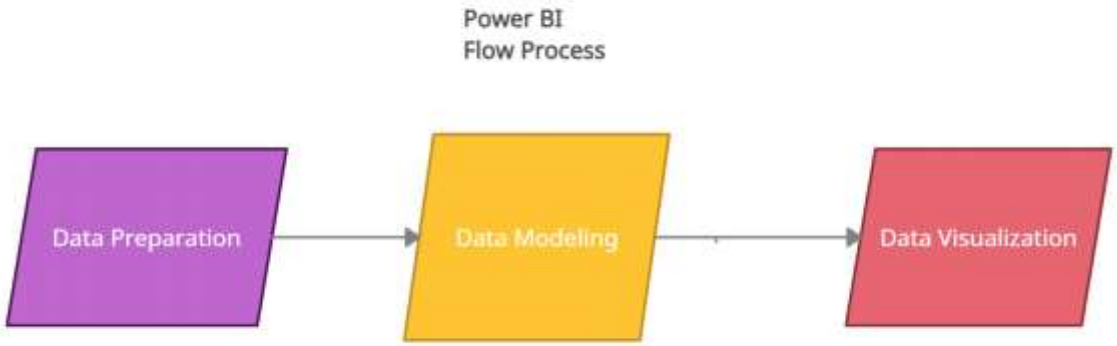



**Figure 6. Data flow process**

1. Data preparation – organizing the data in a flat table.

2. Data modeling – It is used to connect multiple data sources in BI tool using a relationship.
3. Data Visualization – It is the process of transforming huge data sets into graphs charts and other visualizations**.**

### 3.3. How to upload raw data into Power BI

To Create Power BI, visualize dashboard, you need to download Power bi desktop and install. Once you have installed, then we need to follow below process (Microsoft Power BI documentation, 2021):

Click on Get Data => Excel workbook = > browse your raw file = > select required sheets and then click on transform => Power Query editor window will be open => then from each table you have to check all data types, then you have to click on close & apply.

Now your base data is ready!

Date Table:

I have created date table for measures and apply into charts. Below is DAX query:

```
Date = CALENDAR(MIN(Sales[Order Date]),MAX(Sales[Order Date]))
```

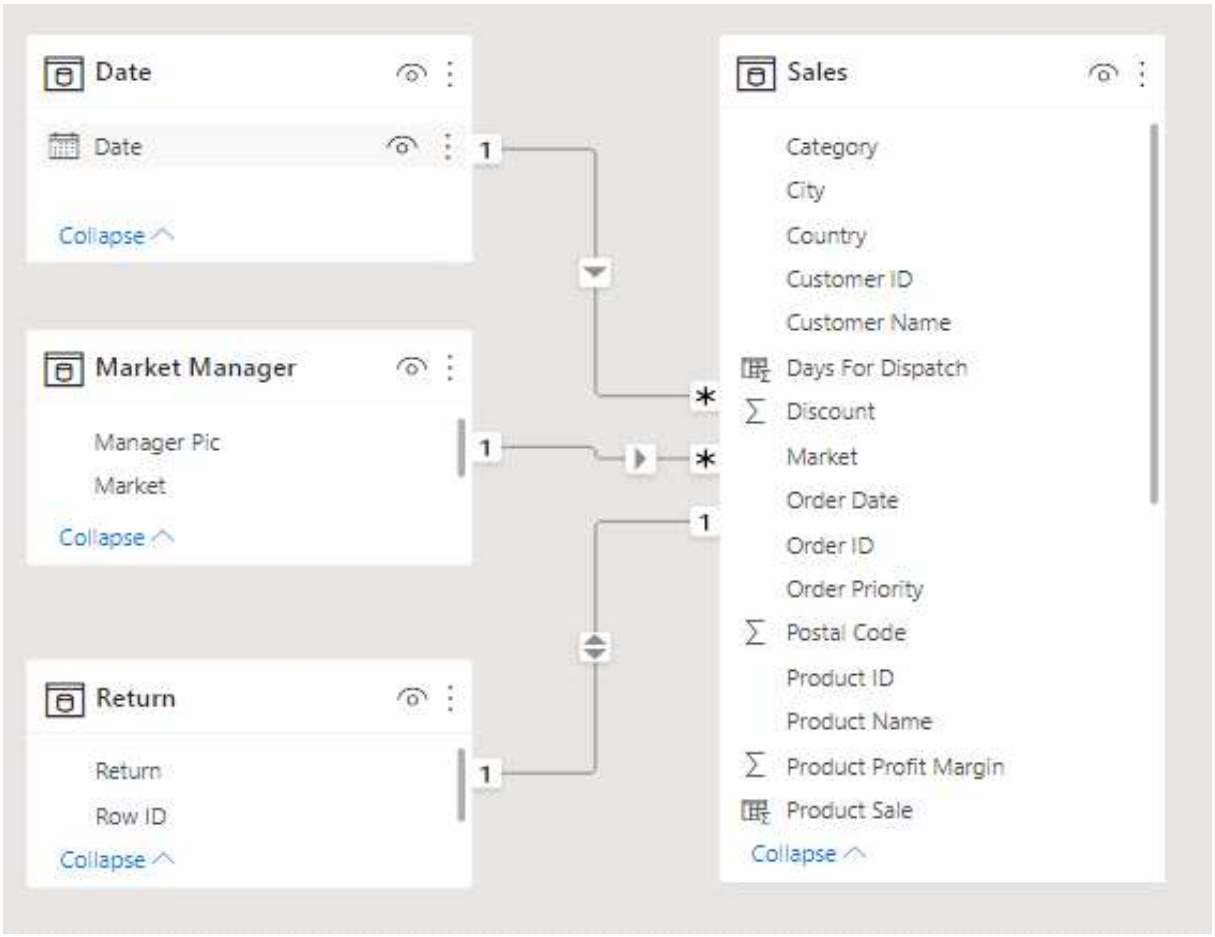



**Figure 7. Connection between multiple tables for calculations**

### 3.4. Data Analysis Expressions (DAX)

Data Analysis Expressions (DAX) is a query programming language that is used throughout Microsoft Power BI for creating calculated columns, measures, and custom tables. It is a collection of functions, operators, and constants that can be used in a formula, or expression, to calculate and return one or more values.

### 3.5. DAX Queries

I have created multiple measures with DAX query:

**1) Days for dispatch:** to calculate days difference between order date and ship date & below is the DAX query.

*Days For Dispatch = DATEDIFF(Sales[Order Date],Sales[Ship Date],DAY)*

**2) Product Sale:** to calculate product sale & below is the DAX query.

*Product Sale = (Sales[Unit Price]*Sales[Product Profit Margin])+Sales[Unit Price]*

**3) Profit:** to calculate profit & below is the DAX query.

*Profit = (Sales[Total Sales]) - (Sales[Unit Price]*Sales[Quantity])*

**4) Product Return Status:** applied lookup into sales table from return table & below is the DAX query.

*Return Status = LOOKUPVALUE('Return'[Return],'Return'[Row ID], Sales [Row ID])*

**5) Total Sales (Sales Table):** to calculate total sales & below is the DAX query.

*Total Sales = (((Sales [Product Sale] *Sales[Quantity]) + Sales[Shipping Cost]) - ((Sales[Product Sale]*Sales[Quantity])*Sales[Discount]))*

**6) Return%:** to calculate percentage of return product out of total transactions & below the DAX query.

*Return % = "(" & " " & FORMAT (KPIs [Return Products]/COUNT(Sales[Row ID]),"0.00%") & " " & ")"*

**7) Return Product:** to calculate return product count & below is the DAX query

*Return Products = COUNTA ('Return'[Row ID])*

**8) Sales LY:** to calculate last year total sales & below is the DAX query.

*Sales LY = CALCULATE ([Total Sales], SAMEPERIODLASTYEAR('Date'[Date]))*

**9) Sales YoY:** to calculate YoY difference between current year sales and last year sales amount & below is the DAX query

*Sales YoY = 'KPIs'[Total Sales]- [Sales LY]*

**10) Discount%:** Created discount range for what if analysis & below is the DAX query

*Discount% = GENERATESERIES (-100, 100, 1)*

**11) IF Discount Change:** this measure created for what if analysis.(it will capture this % if I change Discount % in what if analysis)

*IF Discount Change =*

*IF(HASONEVALUE('Discount%'[Discount%]),MIN('Discount%'[Discount%]),0)*

**12) Sales YoY% :** to calculate YoY difference percentage between current year sales and last year sales amount & below is the DAX query

*Sales YoY% = DIVIDE ([Sales YoY] , [Sales LY])*

**13) Total Sales (KPI table):** to calculate total sales for dashboard cards & below is the DAX query.

*Total Sales = SUM(Sales[Total Sales])*

**14) What if Profit:** to calculate what is profit, if I increase or decrease any parameter in what if analysis & below is the DAX query.

*What IF Profit = [What IF Total Sale] - SUMX(Sales,Sales[Unit Price]*Sales[Quantity])*

**15) What if Sales LY:** to calculate last year sales, if I increase or decrease any parameter in what if analysis & below is the DAX query.

*What IF Sales LY = CALCULATE([What IF Total Sale],*

*SAMEPERIODLASTYEAR('Date'[Date]))*

**16) What if Sales YoY:** to calculate difference between current year sales and last year sales, if I increase or decrease any parameter in what if analysis & below is the DAX query.

*What IF Sales YoY = [What IF Total Sale]-[What IF Sales LY]*

**17) What if Sales YoY%:** to calculate difference percentage between current year sales and last year sales, if I increase or decrease any parameter in what if analysis & below is the DAX query.

*What IF Sales YoY% = DIVIDE([What IF Sales YoY] , [What IF Sales LY])*

**18) What if Total Sales:** to calculate total sales if I increase or decrease any parameter in what if analysis & below is the DAX query.

```
What IF Total Sale =
SUMX(Sales,
(((((Sales[Unit Price] * (1 + 'Unit Price Change%'[IF Unit Price])) * (Sales[Product Profit Margin] * ( 1 + 'Profit Margin%'[IF Profit Margin Change]))) + (Sales[Unit Price] * (1 + 'Unit Price Change%'[IF Unit Price]))) * (Sales[Quantity] * (1 + 'Quantity Change%'[IF Quantity Change]))) + Sales[Shipping Cost]) -
((((Sales[Unit Price] * (1 + 'Unit Price Change%'[IF Unit Price])) * (Sales[Product Profit Margin] * ( 1 + 'Profit Margin%'[IF Profit Margin Change]))) + (Sales[Unit Price] * (1 + 'Unit Price Change%'[IF Unit Price]))) * (Sales[Quantity] * (1 + 'Quantity Change%'[IF Quantity Change]))) * (Sales[Discount] * (1 + 'Discount%'[IF Discount Change])))
```

**19) Profit Margin:** Created Profit margin Percentage range for what if analysis & below is the DAX query

*Profit Margin% = GENERATESERIES(-100, 100, 1)*

**20) IF Profit Margin Change:** this measure created for what if analysis. (it will capture this % if I change Profit margin % in what if analysis)

*IF Profit Margin Change = IF(HASONEVALUE('Profit Margin%'[Profit Margin%]),MIN('Profit Margin%'[Profit Margin%]),0)*

**21) Quantity Change% :** Created Quantity Percentage range for what if analysis & below is the DAX query

*Quantity Change% = GENERATESERIES(-100, 100, 1)*

**22) IF Quantity Change:** this measure created for what if analysis.(it will capture this % if I change Quantity % in what if analysis)

IF Quantity Change = IF(HASONEVALUE('Quantity Change%'[Quantity Change%]),MIN('Quantity Change%'[Quantity Change%]),0)

**23) Unit Price Change% :** Created Unit Price change Percentage range for what if analysis & below is the DAX query

*Unit Price Change% = GENERATESERIES(-100, 100, 1)*

**24) IF Unit Price Change% :** this measure created for what if analysis.(it will capture this % if I change Quantity % in what if analysis)

*IF Unit Price = IF(HASONEVALUE('Unit Price Change%'[Unit Price Change%]),MIN('Unit Price Change%'[Unit Price Change%]),0)*

# 4. Results

## 4.1. Power BI Pages


**Figure 8. Overview of the Power BI dashboard**


**Figure 9. Multiple cards to represent key performance like: Total Sales | Total Orders | Unique Customers | Return Products with percentage | Total**

We can go to that page with the help of direct click on mentioned tab. I have given year filer and market manager filter to check year wise visualization and manager wise.


**Figure 10. Tabs for multiple pages- As in the above picture we are seeing multiple tabs, Overview, product wise, market wise, geographic wise, what if analysis with the year 2014 and market manager with seven market managers pictures. When we click on these tabs and pictures it directly navigates to the wanted pages to find the information within seconds.**

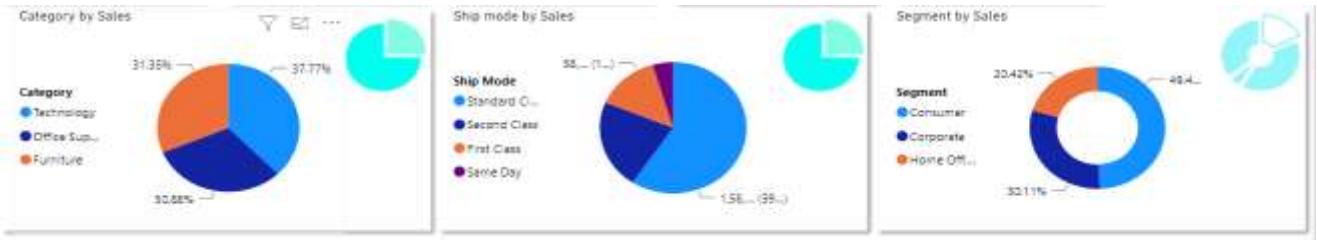



**Figure 11. Visualization showing the category wise sales, Ship mode wise sale, Segment mode wise sale - Category by sales have three categories that is Technology, office supplies,**

**furniture from the selected year 2014 this pie chart shows in which category the sales are more done. Technology category is the highest sales with 37.77%, Furniture with 31.35% and the least is Office supplies with 30.88%.**

Ship mode by sales: Number of days of transportation by country and ship mode contains: 1) Economy means normal courier 2) Economy plus means courier within 2-3 days delivery time. 3) Immediate means courier reached within a day. 4) Priority means importance of the services (i.e) fast, normal or immediate.

Segment by sales

1) Consumers 2) Corporate 3) Home office. I have chosen pie chart visualization for the chart. Here it shows Consumers are the top sales makers with 49.44%, next corporate with 30.11% sales, then Home office with 20.42% sales. These all sales are done in the year 2014 in different countries on these 3 segments. If we click on the consumers/corporate/home office, the icons and remaining charts are changed and presents us with a clear information.

We can drill down with arrow keys for yearly, monthly, quarterly etc. I have used line chart visualization to show the total sales by month, year, date and quarter from the year 2014. The highest sales makers are in the month November with 34,36,964.

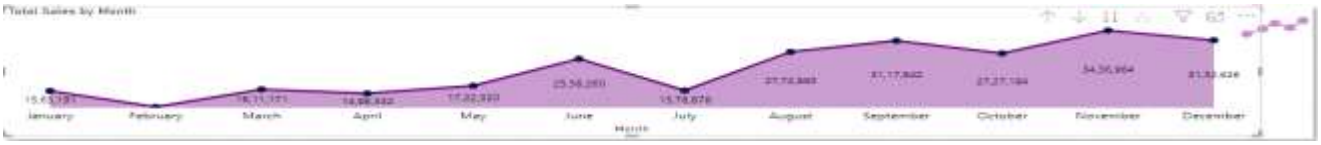



**Figure 12. Visualization showing the yearly, quarterly, monthly and date wise sales.**

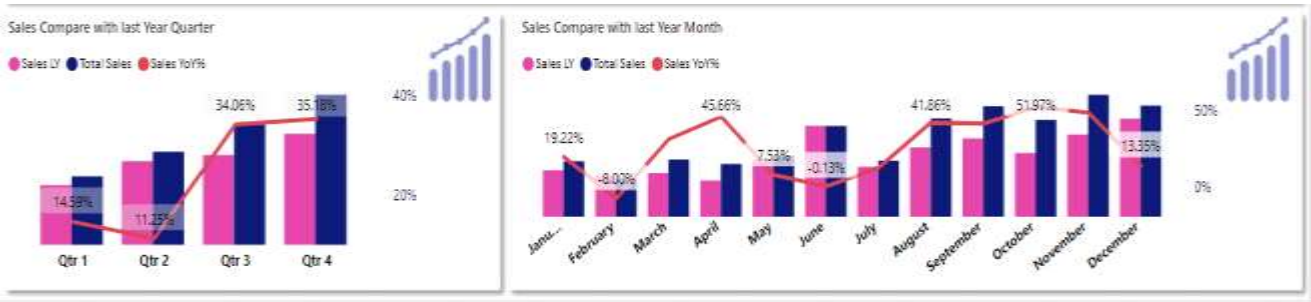



**Figure 133. Visualization showing the quarter wise and month wise and date wise sales (comparing years 2013 and 2014)**

I have used stacked bar chart visualization for the comparison of sales with last year and present year with quarter wise. The pink color indicates last year sales, the blue color indicates present year sales and red color indicates sales year in year. If we click on the any icons remaining charts are changed and presents us with a clear information.


**Figure 144. Visualization showing the product wise sales**

Second layout is the product wise sales from selected year 2014 – three types of products and the sales connected with top products wise and comparison between last year and present by quarter wise, year in year, by last year month in sales.

Technology products- topmost product is cisco smart phone full size with the count- 2,07,644

**Furniture products- in top ten the topmost is Hon executive leather Armchair with the count- 2,03,798.**

**Office supplies- in top ten products is Hoover stove, Red with the count – 1,55,652.**

**If we click on any icon to know the specific detail the other charts are changed and give us a clear information.**


**Figure 155. Different cards showing the category wise total Sales, total orders, total return product count and percentage, and total profits**

The above cards are related to the second layout of the product wise,

The pictures are from the image visualization showing the differences of three different products (Technology, Furniture, office supplies products) regarding the total sales ,profit, total orders and product return with percentage.

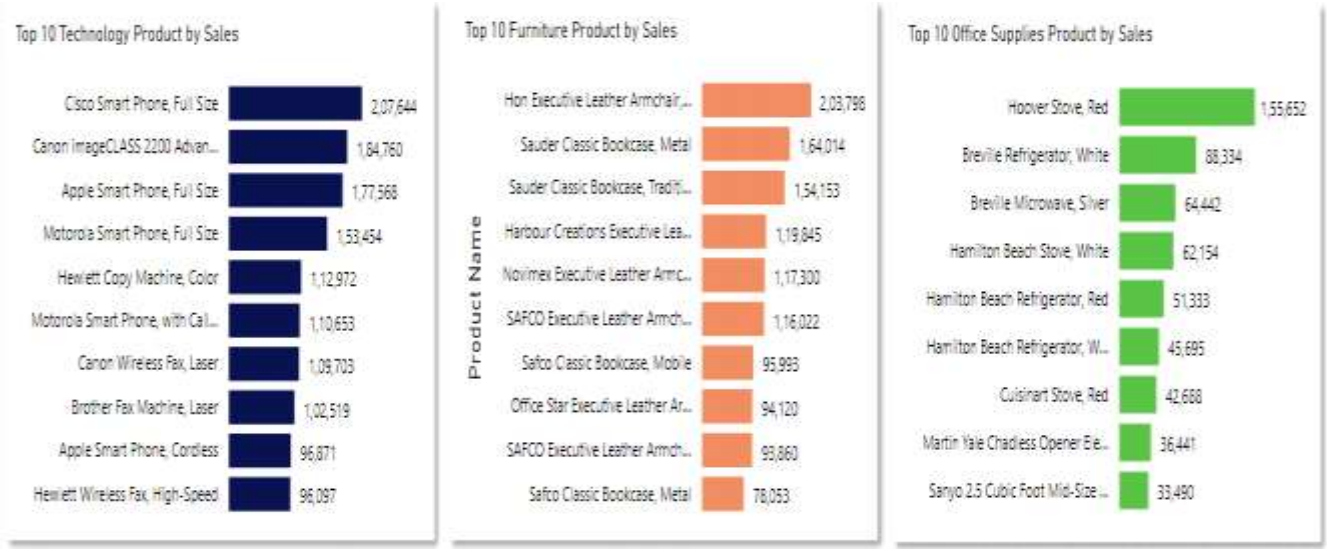



**Figure 16. Visualization showing the top 10 products by category wise**

Above figure is the second layout of the product wise, these top 10 products are connected to the cards of the three products to give a clear information regarding topmost sold products, sales and profit in all this three categories technology products, furniture products and office supplies products from the year 2014. If we need a information in specific we can select and click any icon to get the perfect information. As we click one icon the remaining charts are changed.

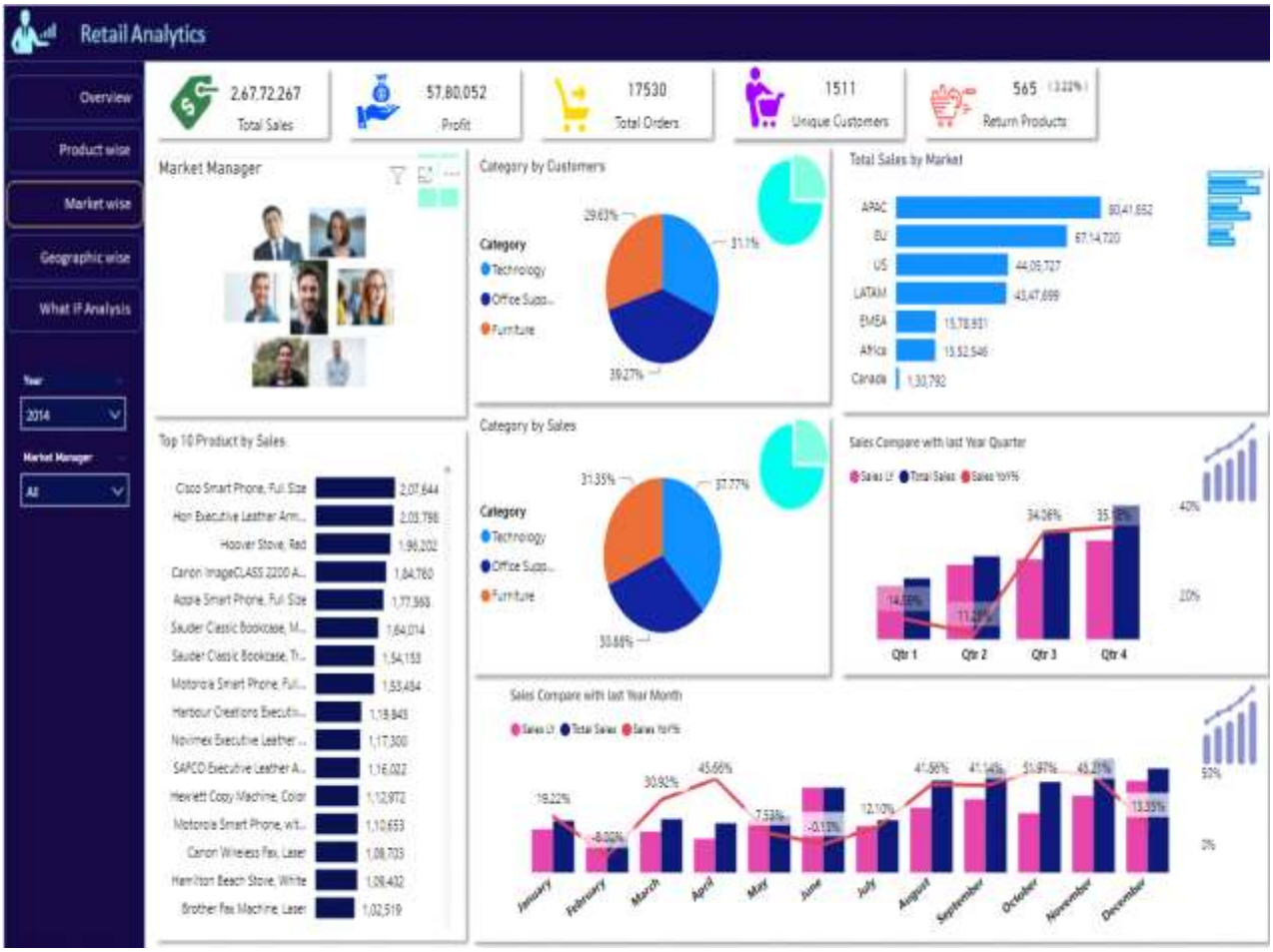



**Figure 17. Visualization showing the market wise data**

The above figure is about the third layout market wise – This layout indicates from the selected year 2014 how the market manager has used their designing strategies with regarding market customers, top ten products, sales, profit, total orders, return products and categories. Therefore, there is a comparison with last year quarter, last year month with present year and year in year. Can select any market manger icon to find the clear information.

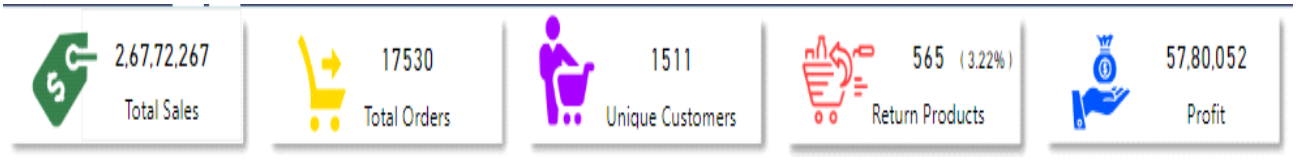



**Figure 18. Visualization showing the key performance indices.**

The above figure is from the market wise layout the key performances listings are about from the 2014 all the market managers total sales, total orders, unique customers, return products and profits.

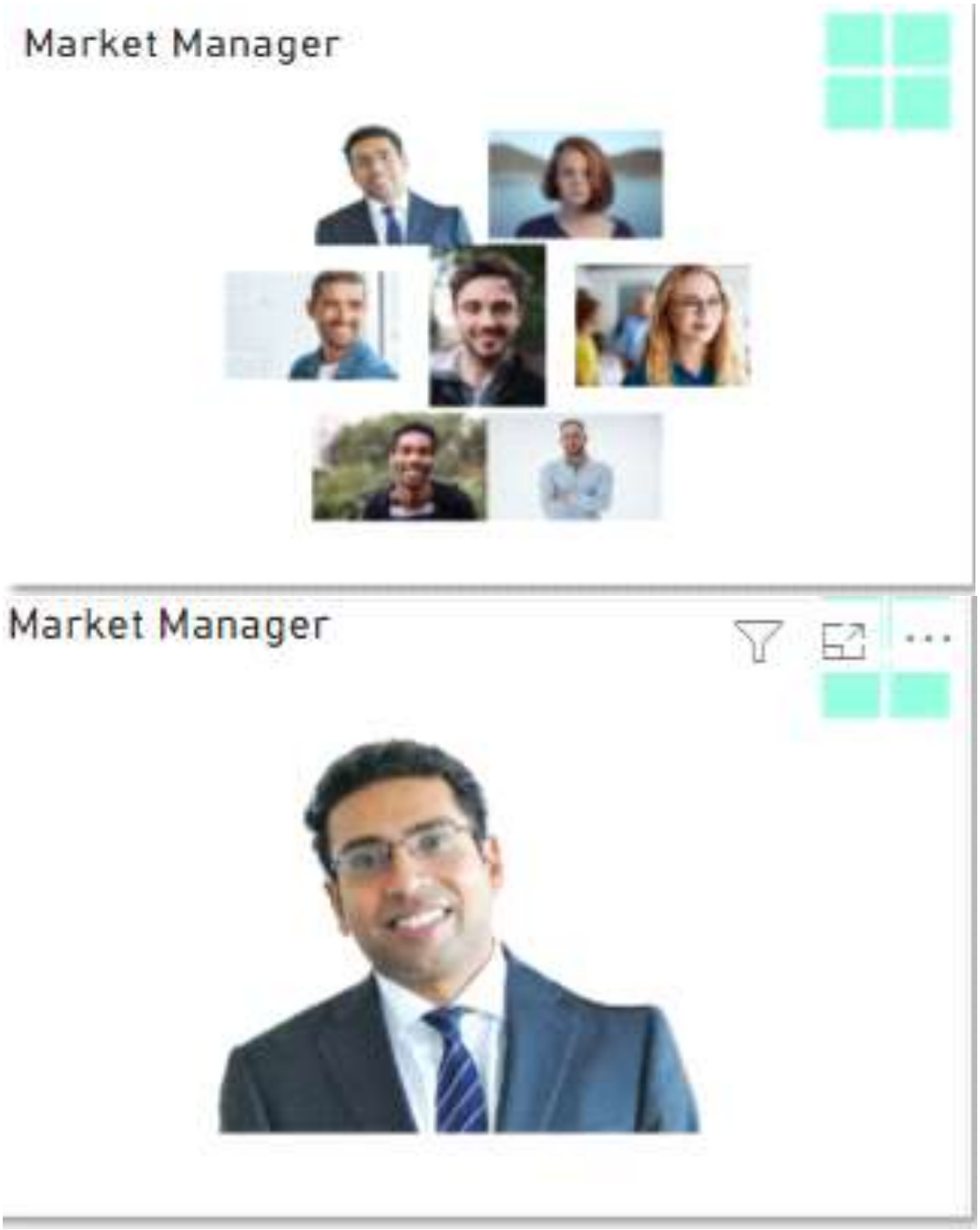



**Figure 19. Image grid visualization to see the picture of market manager**

The above figure is from market wise this is the market manger picture when we select this picture, we do get the information about this market manger regarding on his sales, products, categories, customers and profit. The same applies to all the market managers images.

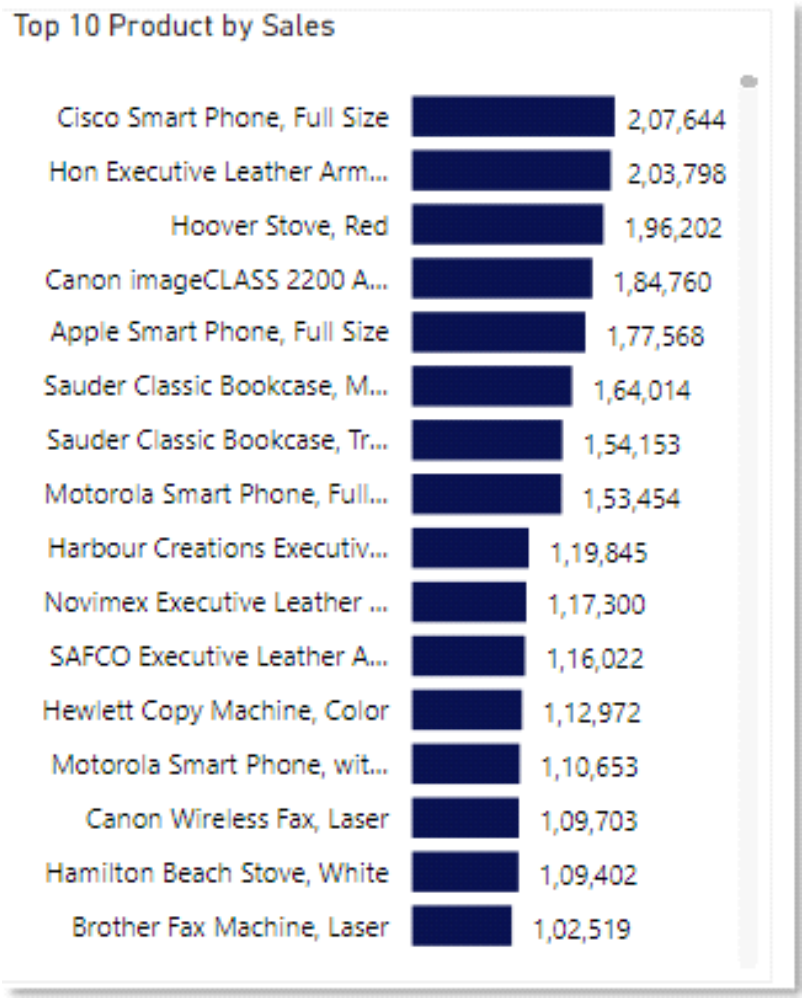



**Figure 20. Visualization showing the to identify top 10 products**

The above figure is about identifying top ten products by sales from all the market managers from the selected year 2014.

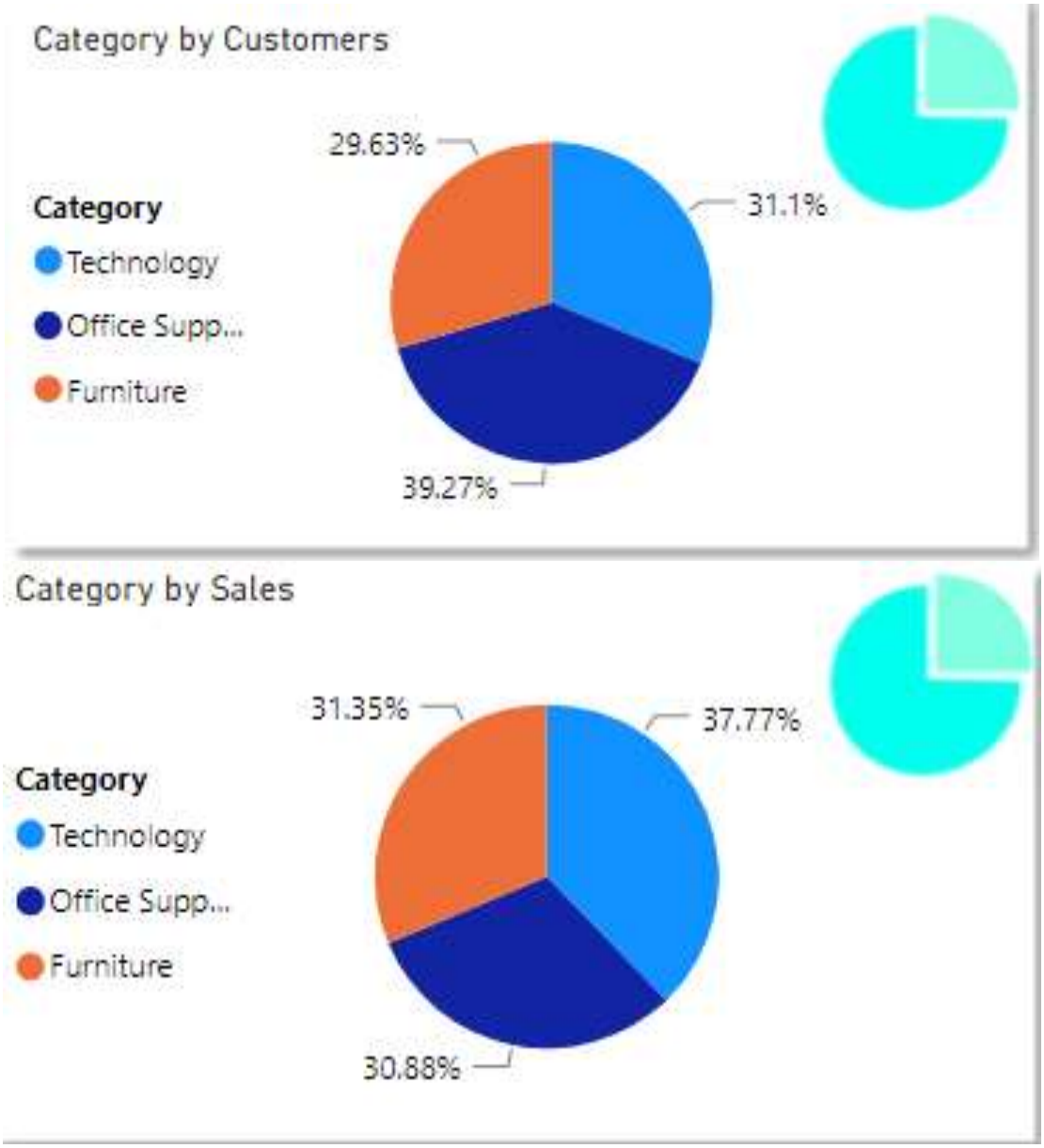



**Figure 21. Visualization showing the category by sales and customers**

The above figure is related to market wise layout with selected year 2014 from all the market managers to show the differences between category by customers and category by sales from the products they sold in three different categories. If we select the required icon like technology the other charts are changed and gives the clear information regarding sales, products etc.


**Figure 22. Visualization showing the geographic wise sales and profit**

Fourth layout is geographic from the selected year 2014 - in this layout the chart name itself indicates how many customers are there in specified countries, how many goods are being sold, how much profit they are gaining, how many products they are receiving, and in which segments they are well sold.

In this layout there is comparison between last year and present year, year in year by quarter wise and month wise of the retail analytics.


**Figure 23. Visualization showing the key performance indices**

The above figure is from the geographic wise layout the key performances listings are from the year 2014 all these indices are related to total sales, total orders, unique customers, return products and profits from all the layouts related to top 10 countries.

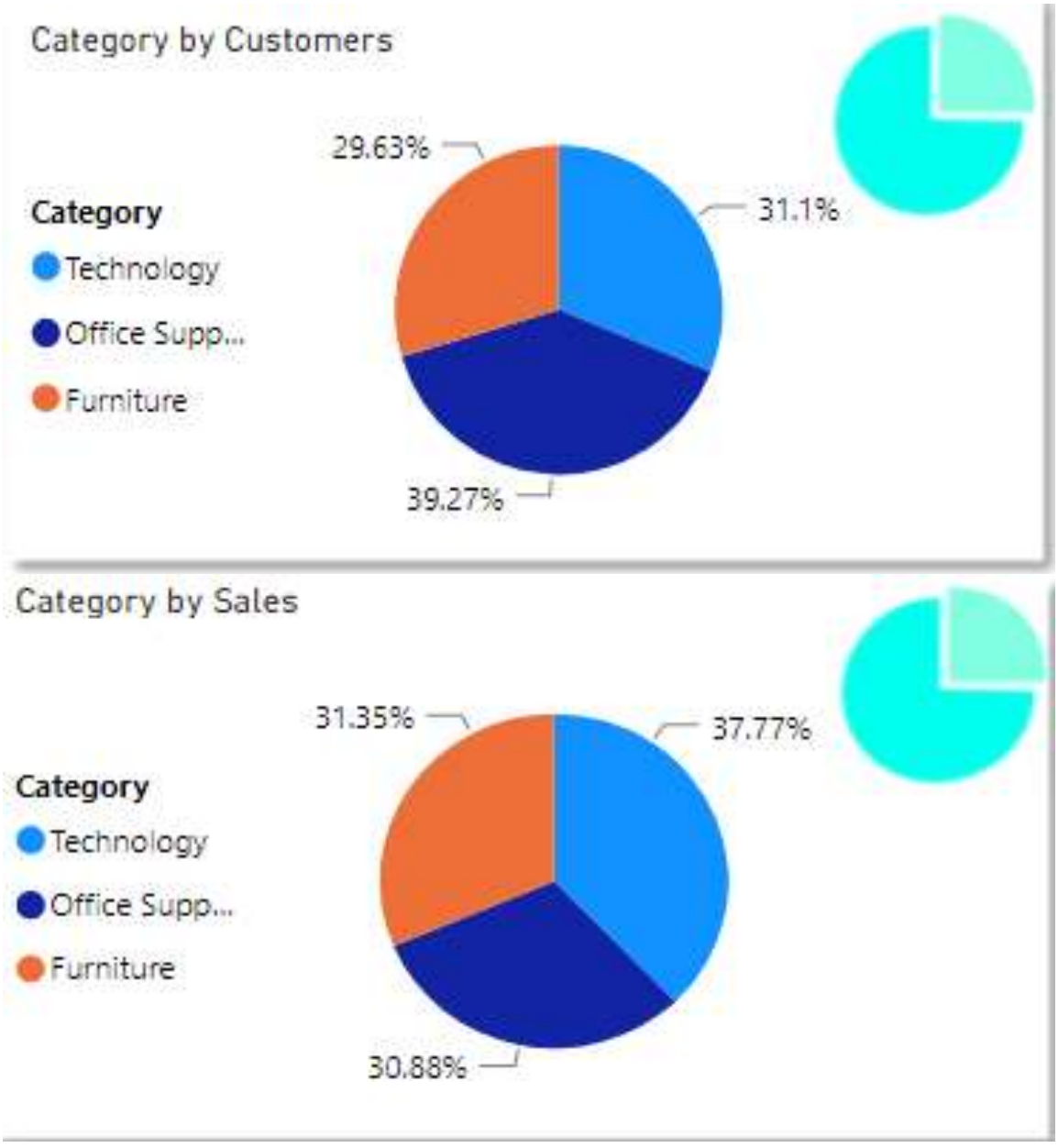



**Figure 24. Visualization showing the category by sales and customers**

The above figure is related to geographic wise layout with selected year 2014 from all the top ten countries to show the differences between category by customers and category by sales from the

products they sold in three different categories. If we select the required icon like technology the other charts are changed and gives the clear information regarding sales, products etc. Navigates to the particular country.

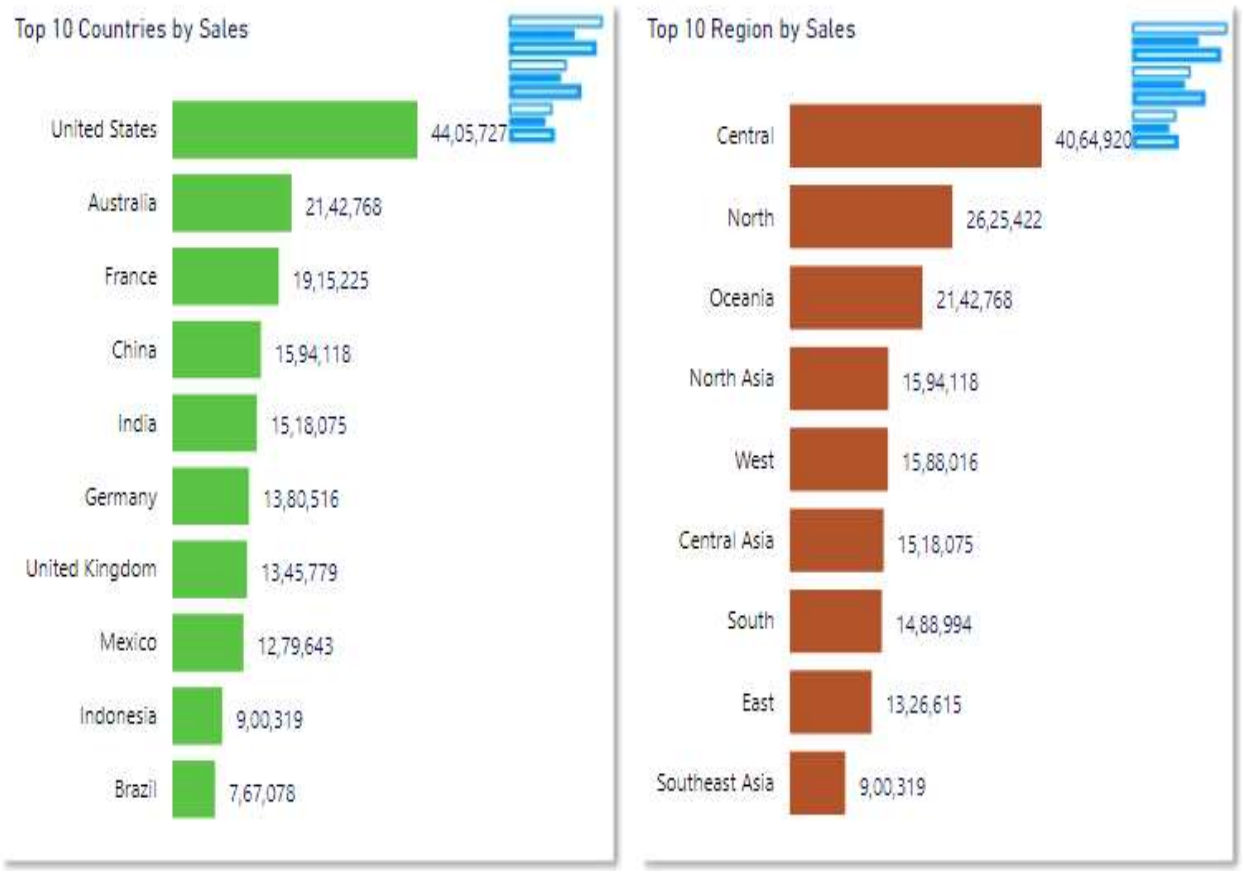



**Figure 25. Visualization showing the top 10 countries and region by sales**

The above figure gives clear visualization from top ten countries and top regions showing sales and profit of the products. The leading country in top 10 is united states with 44,05,727.

The leading region by sales is central with 40,64,920.

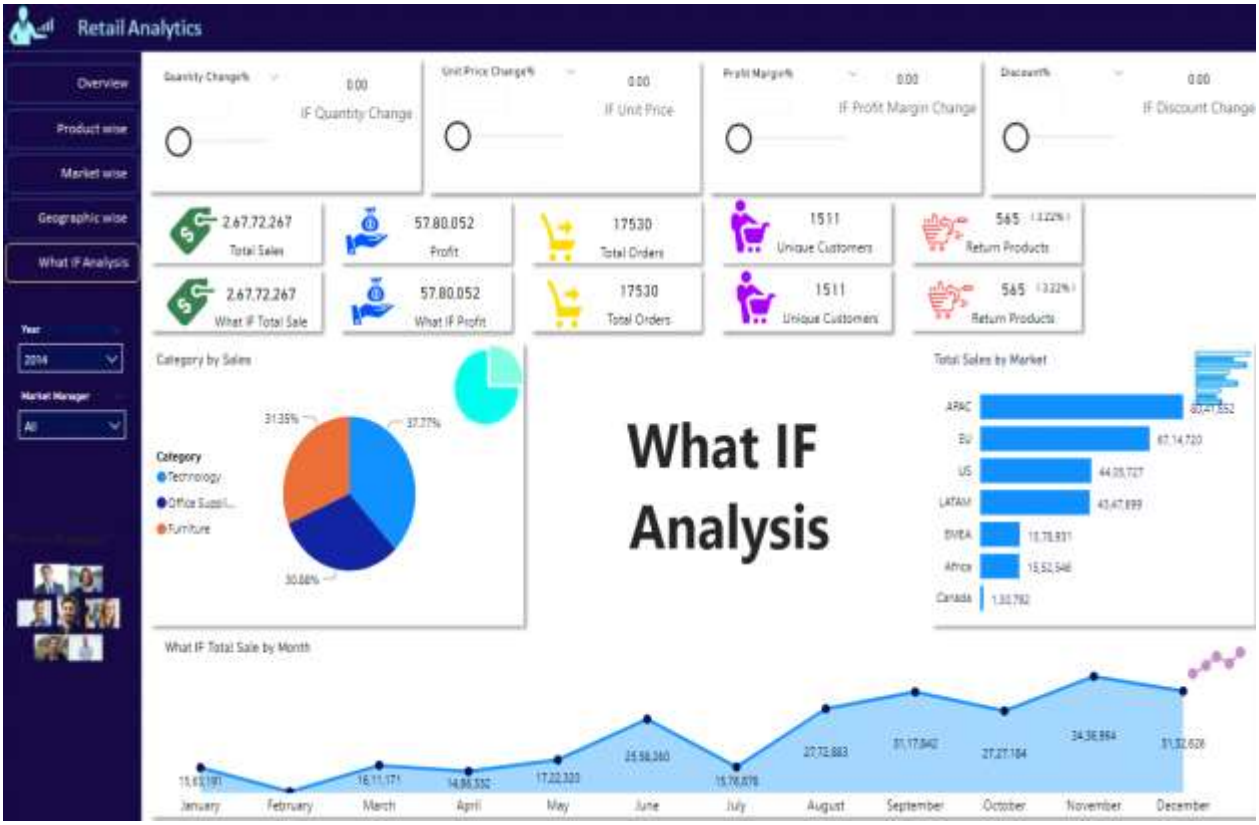



**Figure 26. Visualization showing the What-IF-Analysis**

**The above figure is the fifth layout what if analysis**

This page is created to analyze the overall impact if we change any parameter like, therefore we change quantity (increased by 10%) then what will be the impact on sales and profit, or if we increase or decrease profit margin percentage then what will be the impact on sales and profit etc.

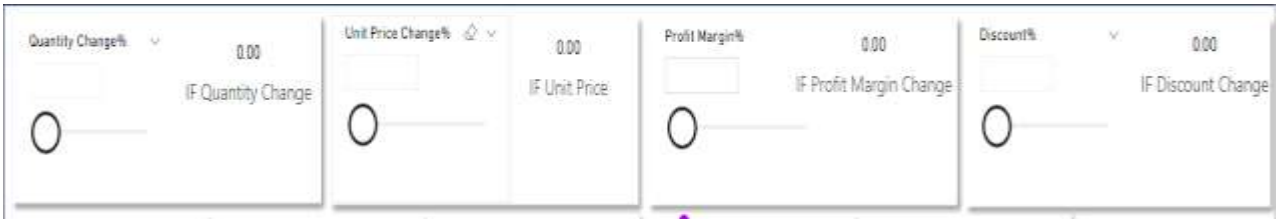



**Figure 27. Slicer to change parameters**

The above figure indicates if we change any numbers in the slicers to check our future marketing of the products and profits. The other charts changes and shows the information this is the future predicts of retail analytics.


**Figure 28. Visualization showing the cards of what-if-analysis**

In the above figure all values in the indices are same but if we change in the slicer to check our future predicts in sales then the related indices and layout charts change and give us the right information.

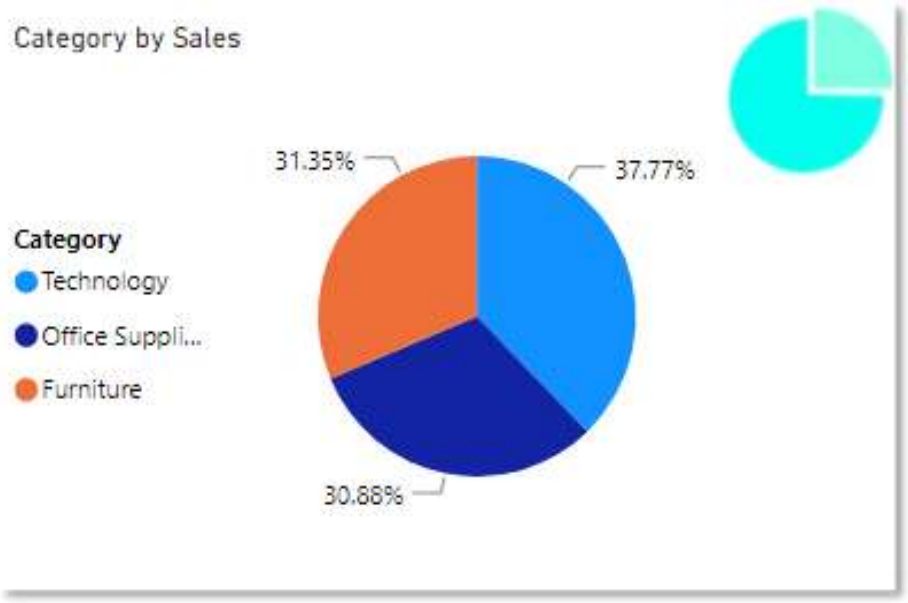



**Figure 29. Category by sales**

The above figure is the present data from the year 2014 of the category by sales in what if analysis layout. If we increase the discount to check our future profit then these values will change automatically in three different categories.

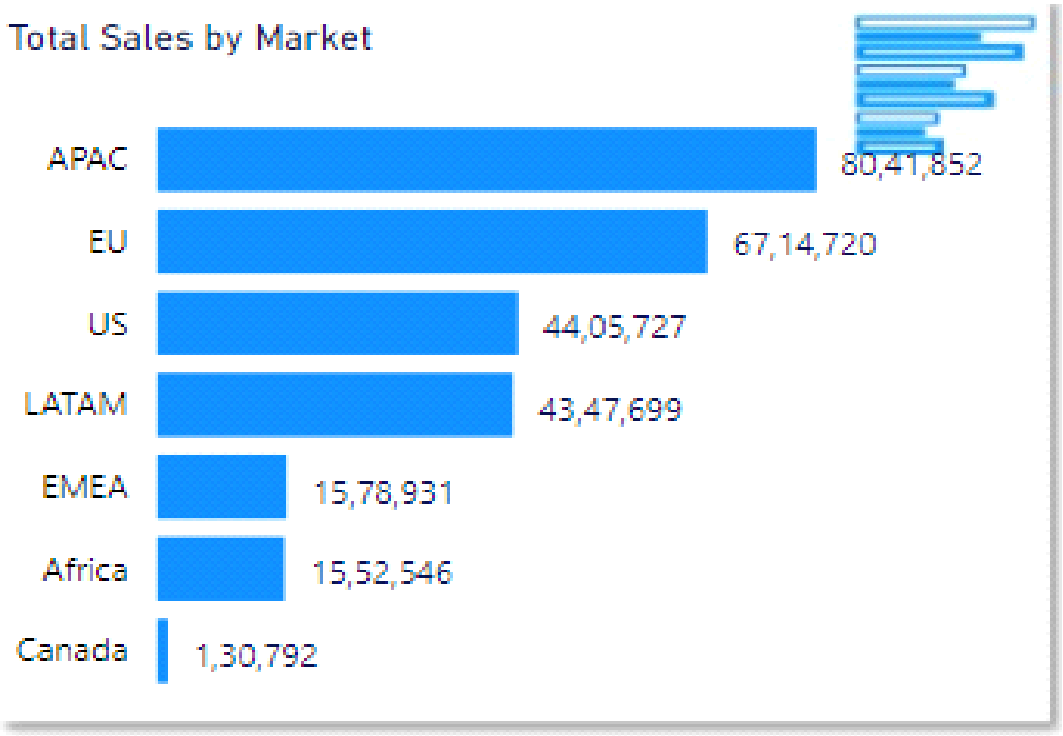



**Figure 30. Total sales by market**

The above figure is from what if analysis from the year 2014 marketed by all the managers on different market sectors and how many sales are done.


**Figure 31. Total sales by month**

The above figure is from what if analysis from the year 2014 these are the sales by month if we change any number from the slicer like discount, unit price, etc. these values change according to months and remaining charts change in the layout to give the perfect information.

### 4.2. Testing and correctness of DAX queries

The testing and correctness of DAX queries are mentioned below:

Product Sale:

```
/* START QUERY BUILDER */
DEFINE
MEASURE Sales[Product Sale] = (SUM(Sales[Unit Price])*SUM(Sales[Product Profit Margin]))+SUM(Sales[Unit Price])
EVALUATE
SUMMARIZECOLUMNS(
    Sales[Row ID],
    Sales[Unit Price],
    Sales[Product Profit Margin],
    "Product Sale", [Product Sale]
)
ORDER BY
    Sales[Row ID] ASC,
    Sales[Unit Price] ASC,
    Sales[Product Profit Margin] ASC
/* END QUERY BUILDER */
```

```
/* START QUERY BUILDER */
DEFINE
MEASURE Sales[Product Sale] = (SUM(Sales[Unit Price])*SUM(Sales[Product Profit Margin]))+SUM(Sales[Unit Price])
EVALUATE
SUMMARIZECOLUMNS(
    Sales[Row ID],
    Sales[Unit Price],
    Sales[Product Profit Margin],
    "Product Sale", [Product Sale]
)
ORDER BY
    Sales[Row ID] ASC,
    Sales[Unit Price] ASC,
    Sales[Product Profit Margin] ASC
/* END QUERY BUILDER */
```

100 %

Results

| Row ID | Unit Price | Product Profit Margin | Product Sale |
|---|---|---|---|
| 1 | 113.67 | 32.00% | 150.0444 |
| 2 | 120.366 | 46.00% | 175.73436 |
| 3 | 44.865 | 37.00% | 61.46505 |
| 4 | 55.242 | 35.00% | 74.5767 |
| 5 | 408.3 | 46.00% | 596.118 |
| 6 | 66.12 | 59.00% | 105.1308 |
| 7 | 314.22 | 56.00% | 490.1832 |
| 8 | 337.6395 | 25.00% | 422.049375 |
| 9 | 159.444 | 32.00% | 210.46608 |
| 10 | 276.102 | 22.00% | 336.84444 |

**Total Sale:**

```
/* START QUERY BUILDER */
DEFINE
MEASURE Sales[Total Sale] = (((SUM(Sales[Product Sale])*SUM(Sales[Quantity])) +
SUM(Sales[Shipping Cost])) - ((SUM(Sales[Product
Sale])*SUM(Sales[Quantity]))*SUM(Sales[Discount])))
EVALUATE
SUMMARIZECOLUMNS(
    Sales[Row ID],
    Sales[Unit Price],
    Sales[Shipping Cost],
    Sales[Quantity],
    Sales[Product Profit Margin],
  "Total Sale", [Total Sale]
)
ORDER BY
    Sales[Row ID] ASC,
```

```
    Sales[Unit Price] ASC,
    Sales[Shipping Cost] ASC,
    Sales[Quantity] ASC,
    Sales[Product Profit Margin] ASC
/* END QUERY BUILDER */
```

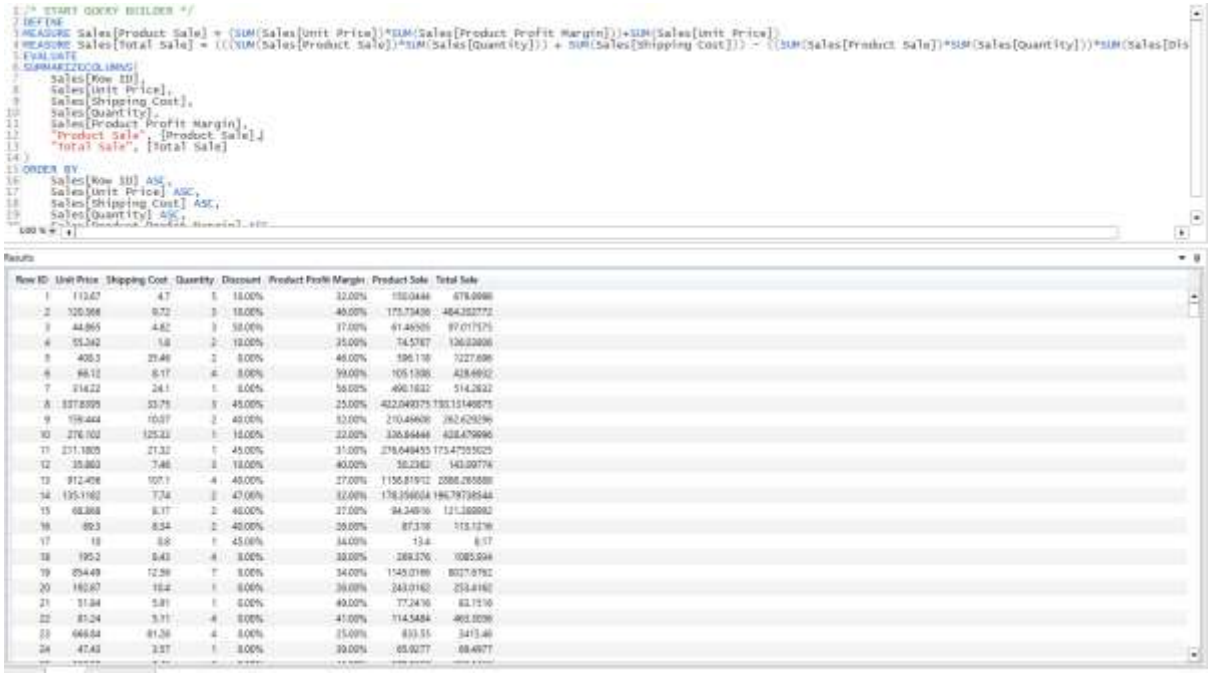


**Table 2.** Table showing the verified DAX queries.

| **Testing DAX Queries** | **Verified** |
|---|---|
| Days for dispatch | yes |
| Product Sale | yes |
| Profit | yes |
| Product Return Status | yes |
| Total Sales (Sales Table): | yes |
| Return%: | yes |
| Return Product | yes |
| Sales LY | yes |
| Sales YoY | yes |
| Discount%: | yes |
| IF Discount Change | yes |
| Sales YoY% | yes |
| Total Sales (KPI table): | yes |
| What if Profit | yes |
| What if Sales LY | yes |
| What if Sales YoY | yes |
| What if Sales YoY%: | yes |
| What if Total Sales | yes |
| Profit Margin | yes |
| Quantity Change% | yes |
| IF Quantity Change | yes |
| Unit Price Change% | yes |
| IF Unit Price Change% | yes |

# 5. Discussion

Power Bi tool is a business-oriented tool, when I have started the basic things to learn regarding this tool, I was just following as it was taught to me, as doing research regarding Power BI like reading different papers and journals of it. I got an idea that how it is useful to computers field. At that time this business intelligence tool with an inbuilt application will work with queries and programming language to sort out the data. So, I have picked DAX query language for this retail analytics project and to Analyze and present with a beautiful dashboard. Still learning deeply into the subject to gain more knowledge regarding Power BI.

# 6. Conclusions

This project gave me an opportunity to learn the new platform Power BI. I have done data visualization project previously. In this report, I have done accessibility and unit testing of the DAX query language as I have only reported the data for the year 2014. The project data and the Power BI tool through which we can visualize the data for the years 2011, 2012, and 2013. The Power BI platform not only gave me an opportunity to analyze the data and present in meaningful way, but also gave me an opportunity to think about the key indicators that are essential for the success of the sales in various countries. I am planning on pursuing my career in Power BI.

# 7. References


Gonzalo, A., Harreis, H., Altable C.S., and Villepelet, C. 2020. Fashion's digital transformation: now or never. https://www.mckinsey.com/industries/retail/our-insights/fashions-digital-transformation-now-or-never (Accessed on September 05, 2021).

Hamilton, T. 2021. Business intelligence (BI) testing: sample test cases. https://www.guru99.com/business-intelligence-testing-sample-test-cases.html (Accessed on November 07, 2021).

Microsoft Power BI documentation. 2021. Create a report from an Excel file in the Power BI service. https://docs.microsoft.com/en-us/power-bi/create-reports/service-report-create-new (Accessed on September 20, 2021).

Microsoft Power BI documentation. 2021. Manage data storage in Power BI workspaces. https://docs.microsoft.com/en-us/power-bi/admin/service-admin-manage-your-data-storage-in-power-bi (Accessed on September 20, 2021).

Microsoft Power BI documentation. 2021. Apply DAX basics in Power BI desktop. https://docs.microsoft.com/en-us/power-bi/transform-model/desktop-quickstart-learn-dax-basics (Accessed on September 15, 2021).

Microsoft Power BI documentation. 2021. Design Power BI reports for accessibility. https://docs.microsoft.com/en-us/power-bi/create-reports/desktop-accessibility-creating-reports (Accessed on November 07, 2021).