Visualising Data Using Power BI

7th February 2025

OBJECTIVES

The main objective of this project is to gain an in-depth understanding of data visualization techniques and working practice with Microsoft Power BI.

GOALS

1. Using [AdventureWorks company data](#) to construct a dashboard.

2. Develop insights about data and tell a consistent and coherent story.

SPECIFICATIONS

- Write SQL queries to extract needed data. These queries should be well documented, with indentation, and provided as custom queries in a separate file, clearly identifying which datasets in the dashboard they reflect.

- Provide analysis in PowerBI

- Present at least one additional insight that reinforces (or replaces the graphs in the original graph)

NOTES:

Before Starting, set the Power BI Data Load options: uncheck **auto detect relationships**. The purpose of this is to learn how to create relationships between data tables. s

DATA IMPORT

Import (Get Data) from BigQuery with SQL code, choosing the columns needed for analysis.

1. FACT Sales Data

Joined SalesOrderHeader & SalesOrderDetail, to get ProductID and OrderQuantity to the main FACT table. Query:

```sql
SELECT
        salesheader.SalesOrderID,
        salesheader.OrderDate,
        salesheader.ShipDate,
        salesheader.SalesOrderNumber AS OrderNumber,
        salesheader.CustomerID AS CustomerKey,
        salesheader.TerritoryID AS TerritoryKey,
        salesdetail.ProductID AS ProductKey,
        salesdetail.OrderQty AS OrderQuantity,
        salesheader.TotalDue,
        salesheader.SalesPersonID
FROM `tc-da-1.adwentureworks_db.salesorderdetail` AS salesdetail
JOIN `tc-da-1.adwentureworks_db.salesorderheader` AS salesheader
  ON salesdetail.SalesOrderID = salesheader.SalesOrderID
```

Changed Type of:
OrderDate & Shipdate to DATE,
TotalDue to $ FIXED DECIMAL NUMBER

In the View Menu checked **Column quality** and **Column profile**. This action was repeated for all the data inputs to check the quality of the columns.

Finally, for the analysis, needed to add a **Conditional Column** for **Sales Type**:

```
= Table.AddColumn(#"Changed Type", "SalesType", each if [SalesPersonID] = null then "Online" else "Offline")
```

2. DIM Calendar

Created Calendar Dimension Table selecting Distinct OrderDate values from SalesOrderHeader table:

```sql
SELECT
        DISTINCT(OrderDate)
FROM `tc-da-1.adwentureworks_db.salesorderheader`
```

Formatted type to DATE.
Added Date Columns for: Year, Month, MonthName, Start of Year, Star of Quarter, Start of Month, Day

3. DIM Product

Added Product Dimension Table:

```sql
SELECT
        product.ProductID AS ProductKey,
        product.ProductSubcategoryID AS ProductSubcategoryKey,
        product.Name AS ProductName,
        product.ListPrice AS ProductPrice
FROM `tc-da-1.adwentureworks_db.product` AS product
```

Changed Type of ProductPrice to $ FIXED DECIMAL NUMBER

4. DIM Product SubCategory

Added Product SubCategory Dimension Table:

```sql
SELECT
        subcategory.ProductSubcategoryID AS ProductSubcategoryKey,
        subcategory.ProductCategoryID AS ProductCategoryKey,
        subcategory.Name AS SubcategoryName
FROM `tc-da-1.adwentureworks_db.productsubcategory` AS subcategory
```

5. DIM Product Category

Added Product Category Dimension Table:

```sql
SELECT
        category.ProductCategoryID AS ProductCategoryKey,
        category.Name AS CategoryName
FROM `tc-da-1.adwentureworks_db.productcategory` AS category
```

6. DIM Customer

Added Customer Dimension Table:

```sql
SELECT
        customer.ContactId AS CustomerKey,
        customer.Title,
        customer.Firstname,
        customer.LastName
FROM `tc-da-1.adwentureworks_db.contact` AS customer
```

Added a **Merged Column** for a **Full Name**:

```
= Table.AddColumn(Source, "FullName", each Text.Combine({[Firstname], [LastName]}, " "), type text)
```

7. DIM Territory

Added Territory Dimension Table:

```sql
SELECT
        territory.TerritoryID AS TerritoryKey,
        territory.Name AS Region,
        territory.CountryRegionCode,
        country.Name AS Country,
        territory.Group AS Continent
FROM `tc-da-1.adwentureworks_db.salesterritory` AS territory
INNER JOIN `tc-da-1.adwentureworks_db.countryregion` AS country
        ON territory.CountryRegionCode = country.CountryRegionCode
ORDER BY territory.TerritoryID
```

DATA MODEL RELATIONSHIPS

While importing data I already considered that each dimensional table needs to include a **primary key**, that would **correspond to a foreign key** in the FACT Sales Data table. For this I used a naming convention: **ProductKey**, **CustomerKey**, **TerritoryKey** and etc. In properties of each dimension table I set the Key column for better readability of the model. Finally, dragged Primary Keys into the corresponding Foreign Keys in the Fact Table, that way I got **One-to-Many** cardinality. Although my first idea was to create a Star Schema, I found out that, I need to add Product SubCategory and Product Category Dimensions, so in the end result we have a **Snowflake schema**:
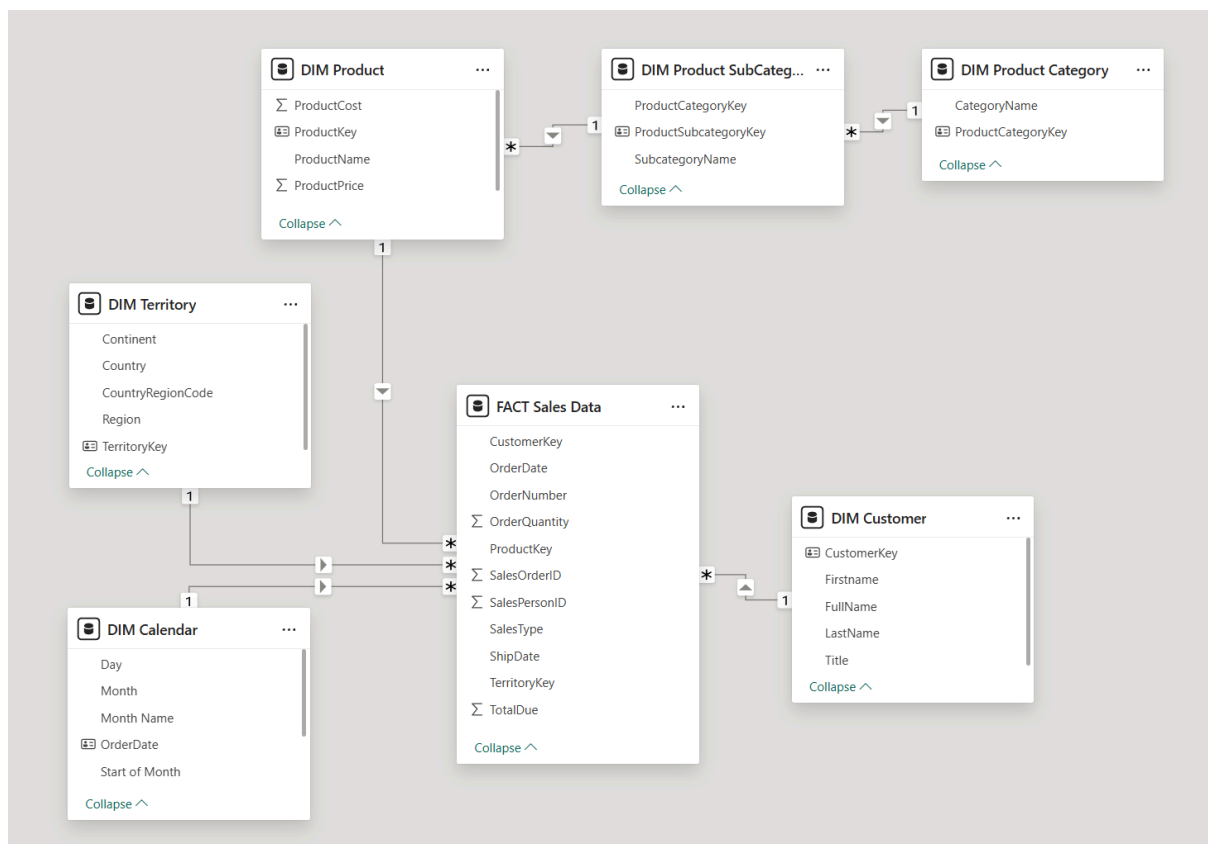
MAIN BUSINESS DASHBOARD

1. I started my dashboard from the main introduction to the business. Presenting the most important KPI's. For that I used **Card (New)** Visual.

For the values represented in KPI's created a respected Measures with DAX :

```
Total Orders =                                – KPI ORDERS
DISTINCTCOUNT(
    'FACT Sales Data'[OrderNumber]
)
```

```
Total Revenue =                               – KPI REVENUE
SUMX(
    VALUES('FACT Sales Data'[OrderNumber]),    – VALUES returns a single column table of
    CALCULATE(MAX('FACT Sales Data'[TotalDue]))   unique OrderNumber column values
)
```

```
Total Customers =                             – KPI CUSTOMERS
 DISTINCTCOUNT(
    'FACT Sales Data'[CustomerKey]
 )
```

```
Avg. Days To Ship =                           – KPI AVG. DAYS TO SHIP
AVERAGEX(
    'FACT Sales Data',
    DATEDIFF(
        'FACT Sales Data'[OrderDate],
        'FACT Sales Data'[ShipDate],
        DAY
    )
)
```

```
AOV =                                         – KPI AOV (Average Order Value)
DIVIDE(
    [Total Revenue],
    [Total Orders]
)
```

KPI Cards Result:

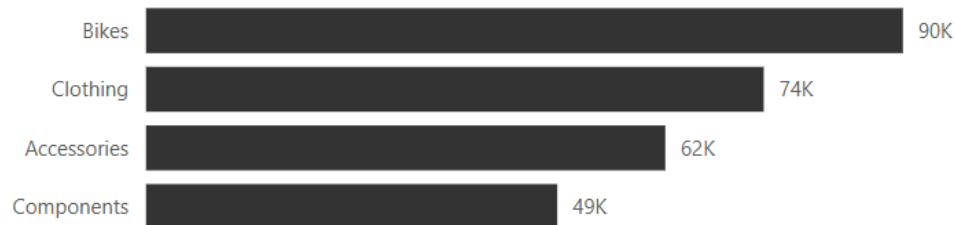| **31.5K**	**$140.7M**	**19.1K**	**7**	**$4.47K**
ORDERS	REVENUE	CUSTOMERS	AVG. DAYS TO SHIP	AOV

2. To display a **Monthly Revenue** used Line Chart. X-axis OrderDate: Year, Month. Y-axis Total Revenue. Added a Filter to exclude the last month, since it looks like that is not complete and can make it difficult to identify genuine patterns.

Monthly Revenue
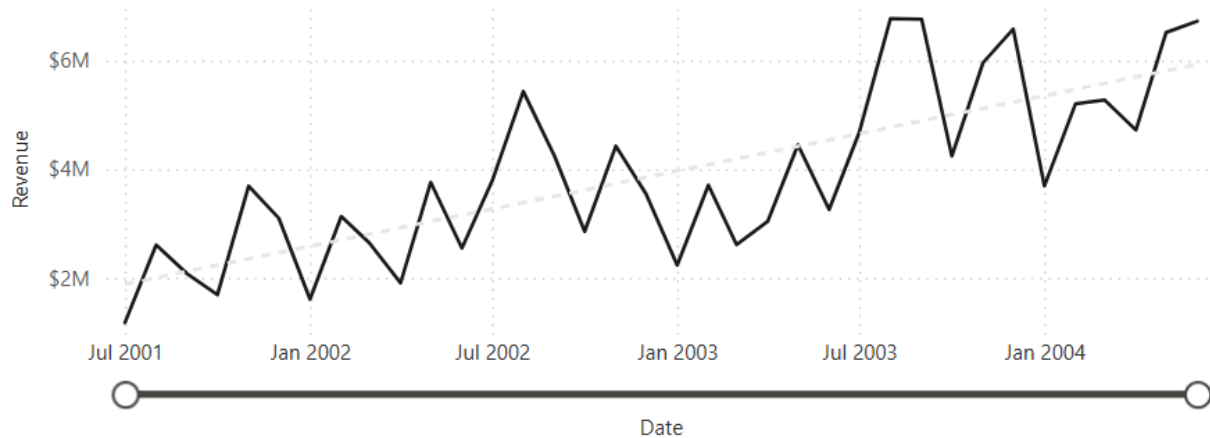
3. Bar chart representing Orders by Category:

For visual purposes excluded Components. (By filtering TOP 3 Categories) Although they take a good amount of orders, they do not represent well what kind of Products business is selling.

4. KPI Cards indicating the monthly Revenue, Orders and a last two years Online Revenue comparison.

DAX Measures:

```
Previous Month Revenue =
 CALCULATE(
    [Total Revenue],
    DATEADD(
        'DIM Calendar'[OrderDate],
        -1,
        MONTH
    )
 )
```

```
Previous Month Orders =
 CALCULATE(
    [Total Orders],
    DATEADD(
        'DIM Calendar'[OrderDate],
```

```
        -1,
        MONTH
    )
)
```

For Year To Date Revenue Value created a new Calendar, which takes Fiscal Year from June:

```
Fiscal Year Table =
ADDCOLUMNS(
    CALENDAR(DATE(2001, 6, 1), DATE(2004, 6, 31)),
    "Year", YEAR([Date]),
    "Month", MONTH([Date])
)
```

```
Fiscal Year =
IF(
    MONTH([Date]) >= 7,
    YEAR([Date]),
    YEAR([Date]) - 1
)
```

```
Fiscal Month =
SWITCH(
    TRUE(),
    MONTH([Date]) >= 7, MONTH([Date]) - 6,
    MONTH([Date]) < 7, MONTH([Date]) + 6
)
```

Monthly Revenue	Monthly Orders	Yearly Online Revenue
$6.73M	**2374**	**$18.2M**
Prev. Month: $6.52M (+3.21%)	Prev. Month: 2386 (-0.5%)	Prev. Year: $6.37M (+185.89%)

5. A Table representing Top 10 Selling Products, Amount of Orders, Revenue and the percentage of how much of them were purchased Online.

```
Product Order Total Count =
 SUMX(
    VALUES('FACT Sales Data'[ProductKey]),
    CALCULATE(SUM('FACT Sales Data'[OrderQuantity]))
 )
```

```
Product Order Revenue =
 SUMX(
    'FACT Sales Data',
    'FACT Sales Data'[OrderQuantity] *
    RELATED('DIM Product'[ProductPrice]
    )
 )
```

```
Online Product Sales % =
```

```
DIVIDE(
    [Online Purchased Product Count],
    [Total Orders],
    0
)

//For this needed to create an additional measure to find the Online Purchased Product
Count:
```

```
Online Purchased Product Count =
 CALCULATE(
    SUM('FACT Sales Data'[OrderQuantity]),
    'FACT Sales Data'[SalesType] = "Online"
)
```

Top 10 Products	Orders ▼	Revenue	Online Sales %
AWC Logo Cap	8311	$74,715.89	65%
Water Bottle - 30 oz.	6815	$34,006.85	91%
Sport-100 Helmet, Blue	6743	$235,937.57	69%
Sport-100 Helmet, Black	6532	$228,554.68	69%
Sport-100 Helmet, Red	6266	$219,247.34	72%
Patch Kit/8 Patches	3865	$8,850.85	95%
Mountain Tire Tube	3095	$15,444.05	100%
Road Tire Tube	2376	$9,480.24	100%
Fender Set - Mountain	2121	$46,619.58	100%
Mountain Bottle Cage	2025	$20,229.75	100%

Additionally highlighted Cell elements:

- Order Column - **Data Bars** displaying the difference of amount between order amount of these 10 products,
- Online Sales - **Background Color**, Highlighting the sales mostly made online.

Final Result of the main Business Dashboard:

SALES OVERVIEW

31.5K	$140.7M	19.1K	7	$4.47K
ORDERS	REVENUE	CUSTOMERS	AVG. DAYS TO SHIP	AOV

Monthly Revenue
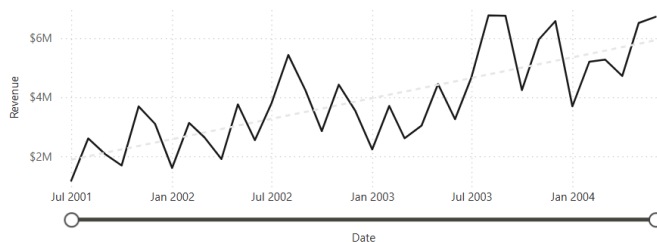
Sold Products by Category

Bikes — 90K
Clothing — 74K
Accessories — 62K

Monthly Revenue	Monthly Orders	Yearly Online Revenue
$6.73M✓	2374 !	$18.2M✓
Prev. Month: $6.52M (+3.21%)	Prev. Month: 2386 (-0.5%)	Prev. Year: $6.37M (+185.89%)

Top 10 Selling Products	Orders ▼	Revenue	Online %
AWC Logo Cap	8311	$74,716	65%
Water Bottle - 30 oz.	6815	$34,007	91%
Sport-100 Helmet, Blue	6743	$235,938	69%
Sport-100 Helmet, Black	6532	$228,555	69%
Sport-100 Helmet, Red	6266	$219,247	72%
Patch Kit/8 Patches	3865	$8,851	95%
Mountain Tire Tube	3095	$15,444	100%
Road Tire Tube	2376	$9,480	100%
Fender Set - Mountain	2121	$46,620	100%
Mountain Bottle Cage	2025	$20,230	100%

INSIGHTS:

- **Total Revenue** trended up resulting a 474% increase between July 2001 and June 2004
- **Steady Growth**: The monthly revenue shows a general upward trend, indicating healthy business growth
- Product Performance: Bikes are the top selling category
- **Online Sales Growth**: A significant increase in Online Sales Revenue, from 19% to 32% YoY.
- Top selling items have a high percentage of sales made Online.

CUMULATIVE SALES

Pareto Chart from Hand-on-Task:

```
Pareto Table =
 SUMMARIZE(
    'FACT Sales Data',
    'FACT Sales Data'[Sales Person New],
    "Sum Sales",
    SUMX(
        VALUES('FACT Sales Data'[OrderNumber]),
        CALCULATE(MAX('FACT Sales Data'[TotalDue]))
    )
 )
```

```
Ranking =
RANKX(
    'Pareto Table',
    'Pareto Table'[Sum Sales]
)
```

```
Total Sales =
CALCULATE(
    SUM('Pareto Table'[Sum Sales]),
    ALLSELECTED('Pareto Table')
 )
```

```
Cumulative Total =
CALCULATE(
    SUM(
        'Pareto Table'[Sum Sales]),
        FILTER(
            ALLSELECTED('Pareto Table'),
            'Pareto Table'[Ranking] <= MAX( 'Pareto Table'[Ranking] )
    )
)
```

```
Cumulative Percent =
[Cumulative Total] / [Total Sales]
```

Cumulative Sales by Sales Rep & Online

● Revenue ● Cumulative Percent
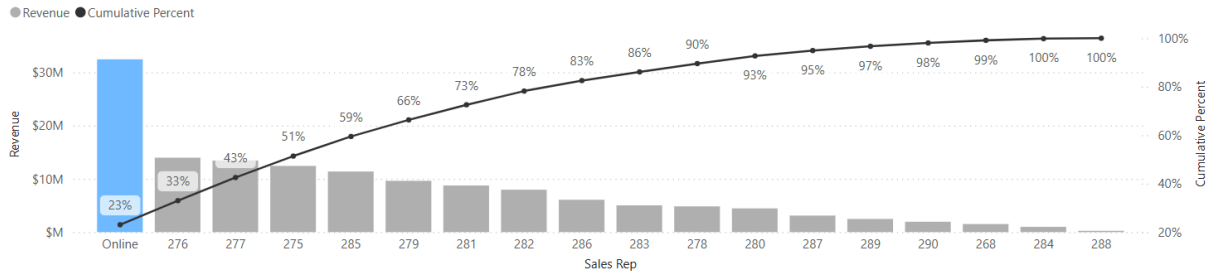
INSIGHTS:

- **Dominance of Online Sales:** Online sales are the highest contributor, generating $32,4M. This represents 23% of the cumulative total sales.
- The sales rep with ID 276 is the top performer among the sales representatives, with revenue of $13,98M. This accounts for 33% of the cumulative sales.
- Online sales play a crucial role in the overall revenue, highlighting the importance of maintaining and possibly expanding online sales strategies.

SALES REASON

Another chart created for hands-on task, required an additional table to input from BigQuery:

```
WITH sales_per_reason AS (
 SELECT
  DATE_TRUNC(OrderDate, MONTH) AS year_month,
  sales_reason.SalesReasonID,
  SUM(sales.TotalDue) AS sales_amount
 FROM
  `tc-da-1.adwentureworks_db.salesorderheader` AS sales
 INNER JOIN
  `tc-da-1.adwentureworks_db.salesorderheadersalesreason` AS sales_reason
 ON
  sales.SalesOrderID = sales_reason.salesOrderID
 GROUP BY 1,2
)
SELECT
 sales_per_reason.year_month,
 reason.Name AS sales_reason,
 sales_per_reason.sales_amount
FROM
 sales_per_reason
LEFT JOIN
 `tc-da-1.adwentureworks_db.salesreason` AS reason
ON
 sales_per_reason.SalesReasonID = reason.SalesReasonID
```

Monthly Online Sales Reason

● Manufacturer ● On Promotion ● Other ● Price ● Quality ● Review ● Television Advertisement
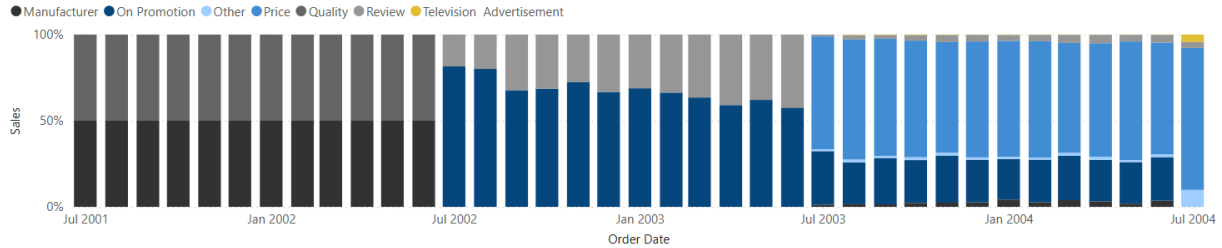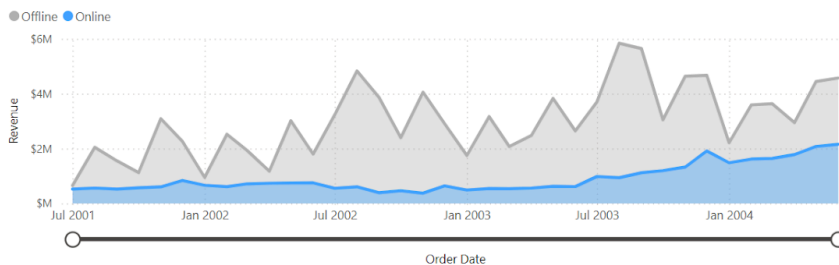

- From July 2001 to around mid-2002, the primary reason for online sales was **Manufacturer** and **Quality** indicating that brand reputation and manufacturer-driven promotions played a significant role during this period.
- Starting mid-2002, **On Promotion** became a significant driver for online sales and maintained a substantial portion until mid-2003. This suggests that promotional campaigns were highly effective in attracting online customers during this time.
- Growth in Price-Driven Sales: The **Price** becoming a major contributor from mid-2003 onwards. This indicates that competitive pricing strategies played a crucial role in driving online sales.

SALES TYPE

Here we can see the comparison between two sales types: Online and Offline.
Monthly Revenue and Orders by each channel, Revenue and Orders per Continent.
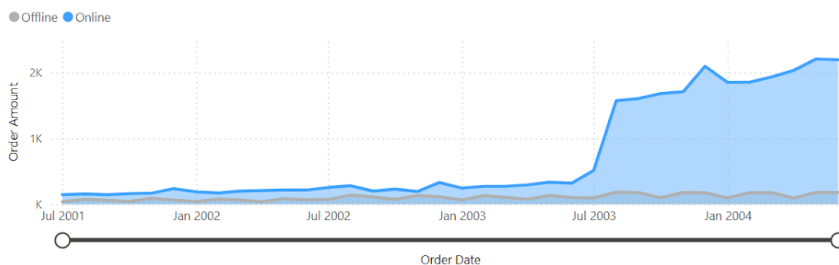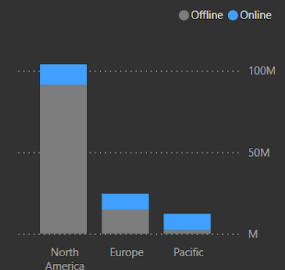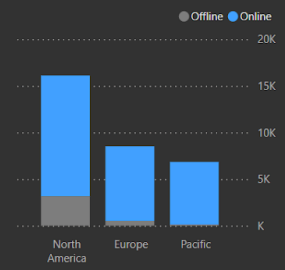
INSIGHTS:

- **Offline sales** consistently outperform online sales in terms of revenue, particularly in North America.
- **Offline Orders:** Offline orders remain relatively stable with minor fluctuations.
- **Online sales** are showing a promising growth trend, especially in terms of the number of orders, indicating a shift towards online purchasing.
- Given the promising growth in online sales, it's crucial to continue refining and investing in online sales channels to capitalize on this trend.

ONLINE SALES

DAX Measures for KPI Cards:

```
Online Customer Count =
 CALCULATE(
    DISTINCTCOUNT('FACT Sales Data'[CustomerKey]),
    'FACT Sales Data'[SalesType] = "Online"
 )
```

```
Average Revenue per Online Customer =
 DIVIDE(
    [Online Revenue],
    [Online Customer Count]
 )

// For this added two measures:
```

```
Online Revenue =
 SUMX(
    FILTER(
        VALUES('FACT Sales Data'[OrderNumber]),
        CALCULATE(MAX('FACT Sales Data'[SalesType]) = "Online")
    ),
    CALCULATE(MAX('FACT Sales Data'[TotalDue]))
 )
```

```
Online Customer Count =
 CALCULATE(
    DISTINCTCOUNT('FACT Sales Data'[CustomerKey]),
    'FACT Sales Data'[SalesType] = "Online"
 )
```

To visualise Customer Purchasing Behaviour Trend added a Line Chart with two Y-axis. First one counting the amount of Online Customers, second for the Average Revenue per Customer.

Online Customer Amount & Average Revenue per Customer
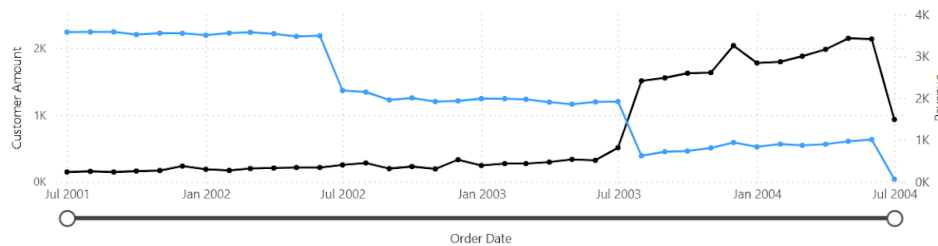
18.5K
ONLINE CUSTOMERS

1.76K
REVENUE PER ONLINE CUSTOMER

Now the question occurred, what leads the Revenue per Online Customer to decrease?

For this I analysed the product Category and Subcategory:

Created A new Field parameter 'Online Orders Metric Selection' with slicer to see Orders by category/ Orders by SubCategory.

```
Online Orders Metric Selection = {
    ("Category", NAMEOF('DIM Product Category'[CategoryName]), 0),
    ("Subcategory", NAMEOF('DIM Product SubCategory'[SubcategoryName]), 1)
}
```

Online Orders by

Online Orders by
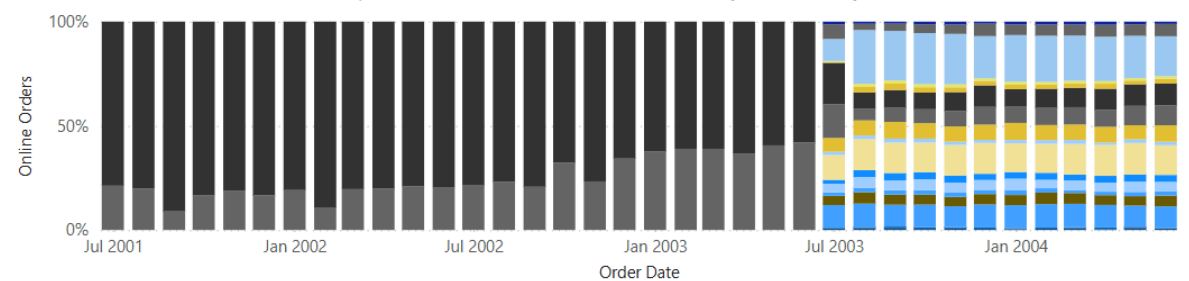

In addition to those graphs, added:

- Relevant KPI cards: **Total Online Customer Count** and **Average Revenue per online Customer.**
- **Year Slider** for User Interaction
- Cards showing **Top Customer** (by Revenue), his/her **Order Amount** and **Revenue.** For this needed additional DAX Measures:

```
Top Online Customer =
 IF(
     HASONEVALUE(                            — Needed to check if there might be not only one
         'DIM Customer'[CustomerKey]               customer with a highest Revenue amount
     ),
     MAX(
         'DIM Customer'[FullName]
     ),
     "Multiple Customers"
 )
```

Added Filter Top N value for all these cards.

Final Report:

- The sharp rise in the number of online customers around July 2003 suggests successful marketing efforts or product launches that attracted new customers.
- The average revenue per customer drops significantly around mid-2002 and again around July 2003.
- These declines indicate that while more customers were acquired, they either spent less per purchase or the company offered lower-priced products/promotions to attract them.
- Online Orders by Category reveals that customer purchasing behavior has shifted from high-value items, such as bikes, to lower-value products like accessories. This transition accounts for the observed decrease in revenue per customer over the past year.

SALES TERRITORY

Map added to provide the Count of Sales in each country. User can filter Countries and Online/Offline Orders per country:

SALES TERRITORY

| Select all | Europe | North America | Pacific |

| Offline | Online |