Supply Chain Performance Analytics – SQL-Driven KPI Insights

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1. Project Introduction

Title:
Supply Chain Performance Analytics – SQL-Driven KPI Insights

Objective:
The goal of this project is to analyse key supply chain performance indicators using SQL and Excel. The project uncovers insights into delivery performance, fulfilment efficiency, product profitability, and order priority effectiveness by extracting, transforming, and analysing data. These insights can help a retail company optimize its supply chain operations and make data-driven decisions.

Dataset:
A synthetic Global Superstore dataset (2,500 records) was created to mimic real-world supply chain data. The dataset includes the following fields:

- Order and shipping dates (order_id, order_date, ship_date)
- Shipping details (ship_mode, shipping_cost, order_priority)
- Customer and geographic information (customer_id, segment, country, city, state, region)
- Product information (product_id, category, sub_category, product_name)
- Financial metrics (sales, quantity, discount, profit)
- A precomputed shipping_delay (days between order and ship dates)

The dataset was carefully validated to ensure accuracy, with particular attention to verifying that all date fields were valid and that the precomputed shipping delay matched the expected values.

2. Database and Data Preparation

Database Creation

A MySQL database named **SupplyChainDB** was created. Within this database, the following table was defined:

```
[SQL]

CREATE TABLE Synthetic_Global_Superstore (

    order_id VARCHAR(50) PRIMARY KEY,

    order_date DATE,
```

```
    ship_date DATE,
    ship_mode VARCHAR(50),
    shipping_cost DECIMAL(10,2),
    order_priority VARCHAR(20),
    customer_id VARCHAR(50),
    segment VARCHAR(50),
    country VARCHAR(50),
    city VARCHAR(50),
    state VARCHAR(50),
    region VARCHAR(50),
    product_id VARCHAR(50),
    category VARCHAR(50),
    sub_category VARCHAR(50),
    product_name VARCHAR(100),
    sales DECIMAL(10,2),
    quantity INT,
    discount DECIMAL(5,2),
    profit DECIMAL(10,2),
    shipping_delay INT
);
```

Data Import Process

The dataset was imported using MySQL Workbench's Table Data Import Wizard:

- Mapping Columns: Each column from the CSV file was manually mapped to the corresponding table column.
- Data Verification: A sample query was run: `SELECT * FROM Synthetic_Global_Superstore LIMIT 10;`

Data Cleaning

- **Validation:** A query verified that no orders had missing dates.
- **Shipping Delay:** Pre-Validated from the CSV and retained,

3. SQL Analysis

3.1 Delivery Performance by Region

```
[SQL]
SELECT region,
       AVG(shipping_delay) AS avg_shipping_delay,
       COUNT(order_id) AS total_orders
FROM Synthetic_Global_Superstore
GROUP BY region
ORDER BY avg_shipping_delay;
```

Key insight: Highlights regions with slower or faster delivery.

3.2 Fulfillment Efficiency by Shipping Mode

```
[SQL]
SELECT ship_mode,
       AVG(shipping_delay) AS avg_delivery_time,
       COUNT(order_id) AS order_count
FROM Synthetic_Global_Superstore
GROUP BY ship_mode
ORDER BY avg_delivery_time;
```

Key Insights: Identifies the fastest and most common shipping modes

3.3 Product Profitability

[SQL]

```
SELECT product_id,
       product_name,
       SUM(sales) AS total_sales,
       SUM(profit) AS total_profit,
       (SUM(profit) / SUM(sales)) * 100 AS profit_margin
FROM Synthetic_Global_Superstore
GROUP BY product_id, product_name
ORDER BY total_profit DESC;
```

Key Insights: Reveals top-performing products by profit and Margin.

3.4 Delivery Time by Order Priority (Optional KPI)

[SQL]

```
SELECT order_priority,
       AVG(shipping_delay) AS avg_shipping_delay,
       COUNT(order_id) AS total_orders
FROM Synthetic_Global_Superstore
GROUP BY order_priority
ORDER BY avg_shipping_delay;
```

Key Insights: Measures whether priority orders are fulfilled faster.

4. Exporting and Visualizing the Data

Exported CSVs: delivery_performance_by_region.csv, fulfillment_efficiency_by_ship_mode.csv, product_profitability.csv, delivery_by_order_priority.csv

Charts:

Creating Visualizations in Excel

A separate Dashboard sheet was created in Excel to consolidate the visualizations. Dynamic links were set up by copying charts from their source sheets and pasting them into the Dashboard sheet so that any updates to the underlying data automatically refresh the visualizations

1. Delivery performance by Region (Combo Charts)
2. Fulfilment Efficiency by shipping mode (combo or side by side charts)
3. Product profitability (Top 10 by Profit)
4. Delivery time by order priority (Pie + Column charts)

5. Conclusion

Key Insights:

- **Delivery Performance:**
  Delivery delays vary by region; some perform far better.
- **Fulfilment Efficiency:**
  Certain shipping modes (e.g., "First Class" or "Same Day") may balance between speed and volume, informing potential logistics improvements.
- **Product Profitability:**
  The analysis identifies the top products by profit and profit margin, guiding targeted marketing and inventory focus.
- **Order Priority:**
  The order distribution and shipping delay analysis by order priority offer insights into whether high-priority orders are fulfilled more quickly than lower-priority ones.

Recommendations

- Improve slow-performing regions.
- Expand high-efficiency shipping methods.
- Focus on high-margin products.
- Ensure high-priority orders are expedited

Future Work

- **Integrate Inventory Data:**
  Incorporate metrics such as stock levels and stockout rates for a more comprehensive supply chain analysis.
- **Include Supplier Performance:**
  Add supplier data to analyse on-time delivery and overall supplier efficiency.
- **Expand Delivery Metrics:**
  Track end-to-end delivery times (from order placement to final delivery) for an even more detailed analysis.