

## Project title: Supply Chain Management

**Project description:** This project is for optimizing products manufacturing, and enhancing transportation systems. Also, focus on products and supplier management. Improve Warehouse productivity is mandatory.

### Data preprocessing:

- Import necessary libraries and load dataset on Jupyter notebook
- Checking Data columns and null values. Delete some columns and fill null values with perfect match of those data.
- Then dealing with some duplicates data.

### Analytical part

#### Supplier analysis:

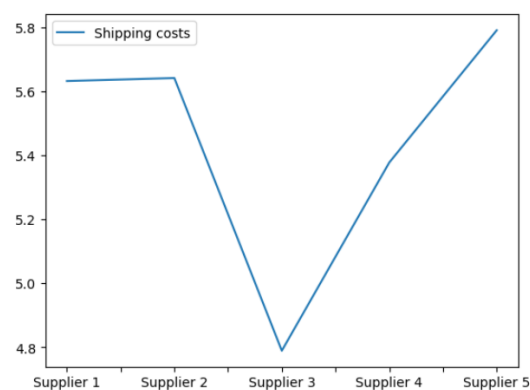
Suppliers with their average lead times:

| Supplier name |       |
|---------------|-------|
| Supplier 1    | 14.81 |
| Supplier 2    | 19.05 |
| Supplier 3    | 19.33 |
| Supplier 4    | 15.30 |
| Supplier 5    | 18.94 |

Insights:

- Supplier 1 has the shortest average lead time. So that, Supplier 1 could be prioritized items for quicker restocking.
- Supplier 3 has the longest lead time. Inventory control may be affected by his longer lead time, especially for items with high demand.
- lead times for other suppliers (2, 4, and 5) range from 15.30 to 19.05 days

Suppliers with their average shipping costs:



Insights:

- Suppliers 1 and 2 have similar shipping costs. They can offer moderate shipping costs. So, they can be economical choices if shipping cost is a priority.
- Supplier 5 has the highest shipping cost, which may impact profitability

Supplier's orders by different transport:

| Transportation modes | Air | Rail | Road | Sea |
|----------------------|-----|------|------|-----|
| Supplier name        |     |      |      |     |
| Supplier 1           | 782 | 177  | 274  | 156 |
| Supplier 2           | 124 | 487  | 157  | 182 |
| Supplier 3           | 20  | 148  | 279  | 185 |
| Supplier 4           | 155 | 221  | 490  | 53  |
| Supplier 5           | 260 | 178  | 322  | 208 |

Insights:

- Supplier 1 supply products maximum by air which is typically faster but more expensive, also used for time-sensitive shipments
- Supplier 3 relies mostly on rail, which could be a cost-effective method for bulk shipments, especially if lead time is not a critical factor.
- Suppliers are less interested to shipping in sea. Because sea shipping is generally slower but economical. For huge no of items.

Supplier Revenue per Order:

|               | Order quantities | Revenue generated | per_order_rev |
|---------------|------------------|-------------------|---------------|
| Supplier name |                  |                   |               |
| Supplier 1    | 1389             | 152086.91         | 109.49        |
| Supplier 2    | 950              | 119962.51         | 126.28        |
| Supplier 3    | 632              | 97795.98          | 154.74        |
| Supplier 4    | 919              | 102875.95         | 111.94        |
| Supplier 5    | 968              | 110343.46         | 113.99        |

Insights:

- Except supplier 3, all suppliers have similar average revenue per order values, indicating they likely handle mid-value products.
- For supplier 3, he may be used for high-margin products.

Products analysis:

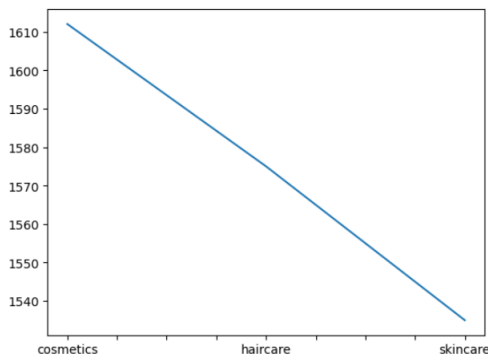
Products by its min and max price range

|              | min      | max       |
|--------------|----------|-----------|
| Product type |          |           |
| cosmetics    | 2.397275 | 97.760086 |
| haircare     | 1.699976 | 97.446947 |
| skincare     | 4.078333 | 99.171329 |

### Insights:

- Skincare items have maximum price range. So, these products expensive from other type products.

### Product stock levels by their type:



### Insights:

- Cosmetics have the highest stock levels by 3857 units, suggest a larger demand or a more extensive product range in this category.
- Skincare has the lowest stock levels by 872 units. The low stock for skincare might be for high turnover or lower demand.

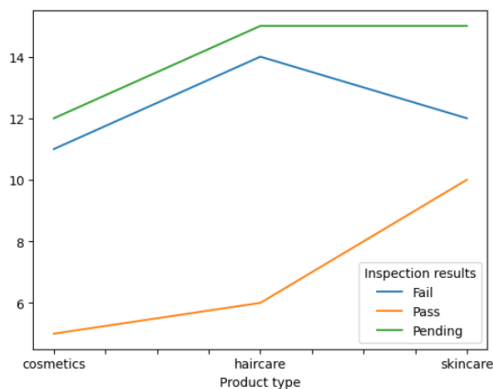
### Products with its manufacturing processes:

|              | Manufacturing costs | Manufacturing lead time | Production volumes |
|--------------|---------------------|-------------------------|--------------------|
| Product type |                     |                         |                    |
| cosmetics    | 43.76               | 12.39                   | 474.89             |
| haircare     | 48.93               | 16.83                   | 575.46             |
| skincare     | 48.04               | 14.24                   | 611.78             |

### Insights:

- Cosmetics have the shortest manufacturing lead time of 43.56 days and the highest production volume of 4170 units. which is suggest that its high demand.
- Skincare has the longest manufacturing lead time at 48.79 days and the lowest production volume of 871 units. The longer manufacturing lead time for skincare could be a factor in its lower stock levels which is remind in previous.

### Inspection Results by Product Type

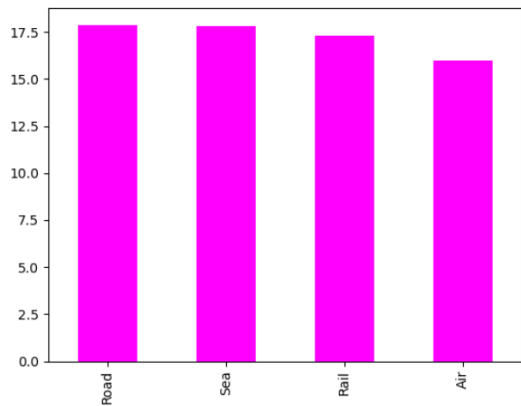


#### Insights:

- Cosmetics and skincare products have relatively high pass rates, while haircare products have a lower pass rate.
- As seen in the first plot, haircare products have the highest failure rate, which may be a factor in their decreasing availability.

#### Transportation analysis:

Transports by its average lead time



#### Insights:

- The bar graph shows Air is more costly than other kinds of transport, but it is good for urgent shipments because it has the lowest lead time.
- Road, Rail, and Sea may suggest potential optimization opportunities, especially if the goal is to reduce transit times.

Transports success rate and defect rates:

|                      | Defect rates | success_rate |
|----------------------|--------------|--------------|
| Transportation modes |              |              |
| Air                  | 1.743216     | 98.256784    |
| Rail                 | 2.427583     | 97.572417    |
| Road                 | 2.542874     | 97.457126    |
| Sea                  | 2.318461     | 97.681539    |

#### Insights:

- Air has the highest success rate (98.26%) and lowest defect rate (1.74%), making it the most secure way for transporting goods with minimal issues, especially for fragile or high-value items.
- The higher defect rates (2.54%) on roads suggest that there is a greater chance of problems with the items being delivered by these modes.

Order quantities by transportation mode in different locations:

| Transportation modes | Location  |     |
|----------------------|-----------|-----|
| Air                  | Bangalore | 100 |
|                      | Chennai   | 362 |
|                      | Delhi     | 213 |
|                      | Kolkata   | 261 |
|                      | Mumbai    | 405 |
| Rail                 | Bangalore | 301 |
|                      | Chennai   | 206 |
|                      | Delhi     | 308 |
|                      | Kolkata   | 283 |
|                      | Mumbai    | 113 |
| Road                 | Bangalore | 300 |
|                      | Chennai   | 378 |
|                      | Delhi     | 44  |
|                      | Kolkata   | 559 |
|                      | Mumbai    | 241 |
| Sea                  | Bangalore | 10  |
|                      | Chennai   | 229 |
|                      | Delhi     | 96  |
|                      | Kolkata   | 125 |
|                      | Mumbai    | 324 |

Insights:

- Locations in Bangalore, Delhi, and Mumbai are the most frequently used air routes, suggesting that these can be high-priority or high-demand locations.
- Less urgent deliveries are indicated by the common use of rail and sea for a range of places.
- In Delhi, where rail and air travel are most common, road usage is lower.

## Conclusion:

In this supply chain management project, Air transport is suggested for urgent, high-value shipments because of its low failure rate, while Supplier 1 is best for faster restocking because of its lowest lead time. Cosmetics have high demand and stock levels, while skincare faces challenges with longer lead times and lower stock. For high-demand locations like Bangalore, Delhi, and Mumbai, air transport is prioritized, with rail and sea serving less time-sensitive deliveries.

All resources are given in this link: [https://github.com/sakib007q/supply\\_chain\\_management.git](https://github.com/sakib007q/supply_chain_management.git)