Supply Chain Analysis

The supply Chain is the network of production and logistics involved in producing and delivering goods to customers. And Supply Chain Analysis means analyzing various components of a Supply Chain to understand how to improve the effectiveness of the Supply Chain to create more value for customers.

In [ ]:

```
# importing python libraries

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

Column name and details about that columns.

Product type: The category of the product (e.g., haircare, skincare).

SKU: Stock Keeping Unit, a unique identifier for each product.

Price: The price of the product.

Availability: The current availability of the product (in units).

Number of products sold: Total number of units sold for the product.

Revenue generated: The revenue generated from the sale of the product.

Customer demographics: Demographic information about the customer (e.g., gender or unspecified).

Stock levels: The number of units currently in stock.

Lead times: The time taken (in days) to fulfill an order.

Order quantities: The quantity of products ordered.

Location: The geographical location where the product is stored or shipped from.

Lead time: A repeat of the earlier lead time information, but specific to the location.

Production volumes: The number of units produced.

Manufacturing lead time: The time taken (in days) to manufacture the product.

Manufacturing costs: The cost of manufacturing the product.

Inspection results: Outcome of product inspection (e.g., Pass, Fail, Pending).

Defect rates: The percentage of products that were found defective.

Transportation modes: The mode of transportation used to deliver the product (e.g., Road, Air, Rail).

Routes: The specific transportation route used for the product delivery.

Costs: The transportation cost associated with the product shipment.

In [ ]:

```
# read csv file

df = pd.read_csv('/content/supply_chain_data.csv')
```

In [ ]:

```
# top 5 rows

df.head()
```

Out[ ]:

	Product type	SKU	Price	Availability	Number of products sold	Revenue generated	Customer demographics	Stock levels	Lead times	qu
0	haircare	SKU0	69.808006	55	802	8661.996792	Non-binary	58	7	
1	skincare	SKU1	14.843523	95	736	7460.900065	Female	53	30	
2	haircare	SKU2	11.319683	34	8	9577.749626	Unknown	1	10	
3	skincare	SKU3	61.163343	68	83	7766.836426	Non-binary	23	13	
4	skincare	SKU4	4.805496	26	871	2686.505152	Non-binary	5	3	

5 rows × 24 columns

In [ ]:

```
# Transposing column to row that we can see all the columns

df.head().T
```

Out[ ]:

	0	1	2	3	4
Product type	haircare	skincare	haircare	skincare	skincare
SKU	SKU0	SKU1	SKU2	SKU3	SKU4
Price	69.808006	14.843523	11.319683	61.163343	4.805496
Availability	55	95	34	68	26
Number of products sold	802	736	8	83	871
Revenue generated	8661.996792	7460.900065	9577.749626	7766.836426	2686.505152
Customer demographics	Non-binary	Female	Unknown	Non-binary	Non-binary
Stock levels	58	53	1	23	5
Lead times	7	30	10	13	3
Order quantities	96	37	88	59	56
Shipping times	4	2	2	6	8
Shipping carriers	Carrier B	Carrier A	Carrier B	Carrier C	Carrier A
Shipping costs	2.956572	9.716575	8.054479	1.729569	3.890548
Supplier name	Supplier 3	Supplier 3	Supplier 1	Supplier 5	Supplier 1
Location	Mumbai	Mumbai	Mumbai	Kolkata	Delhi
Lead time	29	23	12	24	5
Production volumes	215	517	971	937	414
Manufacturing lead time	29	30	27	18	3
Manufacturing costs	46.279879	33.616769	30.688019	35.624741	92.065161
Inspection results	Pending	Pending	Pending	Fail	Fail
Defect rates	0.22641	4.854068	4.580593	4.746649	3.14558
Transportation modes	Road	Road	Air	Rail	Air
Routes	Route B	Route B	Route C	Route A	Route A
Costs	187.752075	503.065579	141.920282	254.776159	923.440632

In [ ]:

```
# Shape of the data /  Total rows and columns

df.shape
```

Out[ ]:

```
(100, 24)
```

In [ ]:

```
# Checking datatype and null columns

df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 100 entries, 0 to 99
Data columns (total 24 columns):
 #   Column                   Non-Null Count  Dtype  
---  ------                   --------------  -----  
 0   Product type             100 non-null    object 
 1   SKU                      100 non-null    object 
 2   Price                    100 non-null    float64
 3   Availability             100 non-null    int64  
 4   Number of products sold  100 non-null    int64  
 5   Revenue generated        100 non-null    float64
 6   Customer demographics    100 non-null    object 
 7   Stock levels             100 non-null    int64  
 8   Lead times               100 non-null    int64  
 9   Order quantities         100 non-null    int64  
 10  Shipping times           100 non-null    int64  
 11  Shipping carriers        100 non-null    object 
 12  Shipping costs           100 non-null    float64
 13  Supplier name            100 non-null    object 
 14  Location                 100 non-null    object 
 15  Lead time                100 non-null    int64  
 16  Production volumes       100 non-null    int64  
 17  Manufacturing lead time  100 non-null    int64  
 18  Manufacturing costs      100 non-null    float64
 19  Inspection results       100 non-null    object 
 20  Defect rates             100 non-null    float64
 21  Transportation modes     100 non-null    object 
 22  Routes                   100 non-null    object 
 23  Costs                    100 non-null    float64
dtypes: float64(6), int64(9), object(9)
memory usage: 18.9+ KB
```

In [ ]:

```
# Checking null values

df.isna().sum()
```

Out[ ]:

	0
Product type	0
SKU	0
Price	0
Availability	0
Number of products sold	0
Revenue generated	0
Customer demographics	0
Stock levels	0
Lead times	0
Order quantities	0
Shipping times	0
Shipping carriers	0
Shipping costs	0
Supplier name	0
Location	0
Lead time	0
Production volumes	0
Manufacturing lead time	0
Manufacturing costs	0
Inspection results	0
Defect rates	0
Transportation modes	0
Routes	0
Costs	0

dtype: int64

In [ ]:

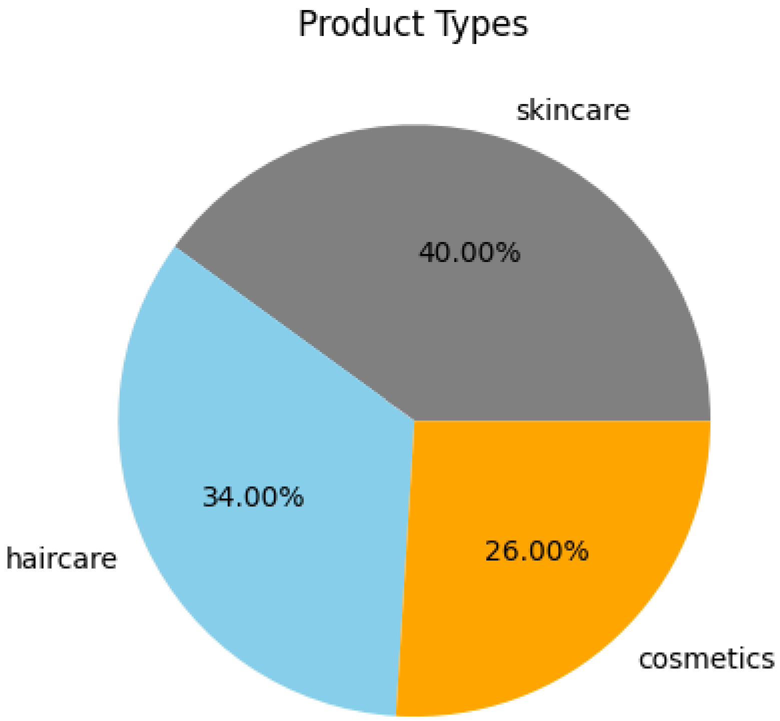
```
#  Statistical deviation of dataset

df.describe()
```

Out[ ]:

	Price	Availability	Number of products sold	Revenue generated	Stock levels	Lead times	Order quantities	Shi
count	100.000000	100.000000	100.000000	100.000000	100.000000	100.000000	100.000000	100.0
mean	49.462461	48.400000	460.990000	5776.048187	47.770000	15.960000	49.220000	5.7
std	31.168193	30.743317	303.780074	2732.841744	31.369372	8.785801	26.784429	2.7
min	1.699976	1.000000	8.000000	1061.618523	0.000000	1.000000	1.000000	1.0
25%	19.597823	22.750000	184.250000	2812.847151	16.750000	8.000000	26.000000	3.7
50%	51.239831	43.500000	392.500000	6006.352023	47.500000	17.000000	52.000000	6.0
75%	77.198228	75.000000	704.250000	8253.976921	73.000000	24.000000	71.250000	8.0
max	99.171329	100.000000	996.000000	9866.465458	100.000000	30.000000	96.000000	10.0

In [42]:

```
# Products types total stocks in given data

df['Product type'].value_counts().plot(kind='pie',autopct = '%1.2f%%',colors=['grey
plt.title('Product Types')
plt.ylabel('')
plt.show()
```



In [ ]:

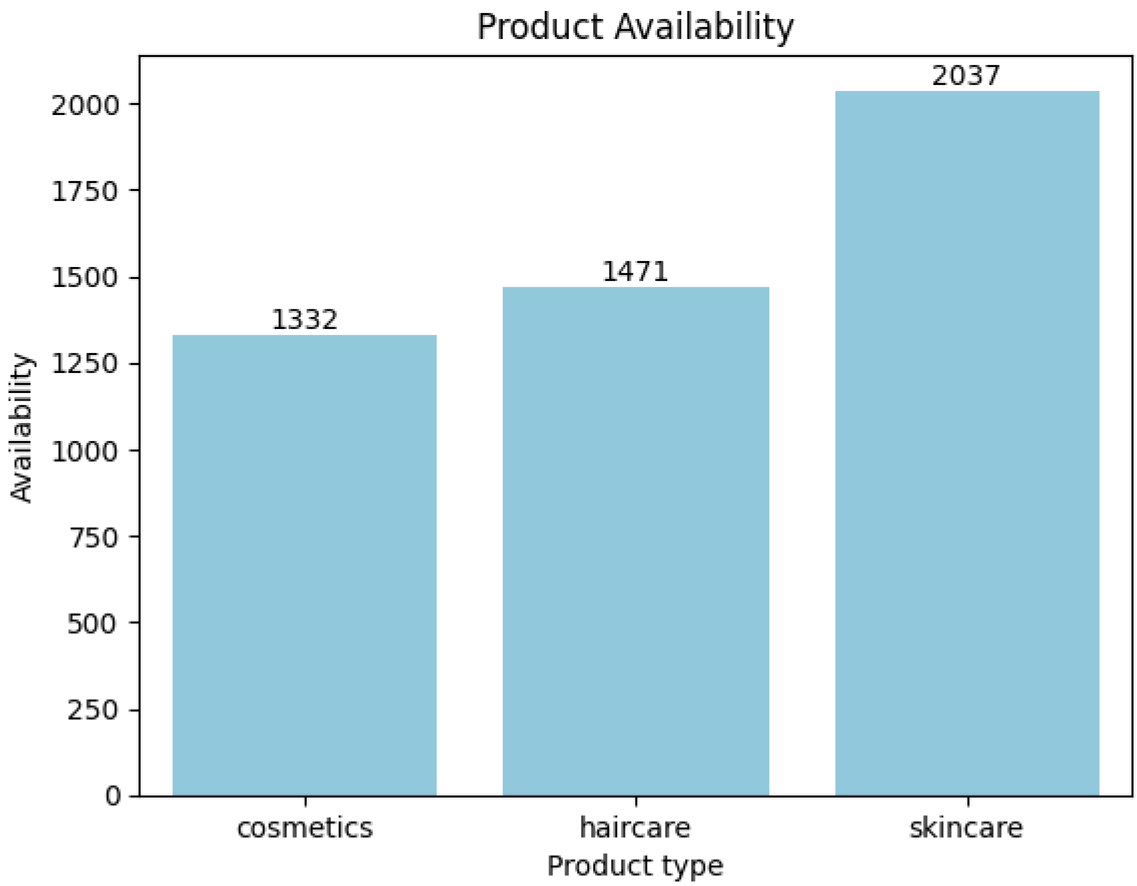
```
# Availability of product by their product type

Availability_of_products = df.groupby('Product type')['Availability'].sum().reset_i

Availability_of_products
```

Out[ ]:

	Product type	Availability
0	cosmetics	1332
1	haircare	1471
2	skincare	2037

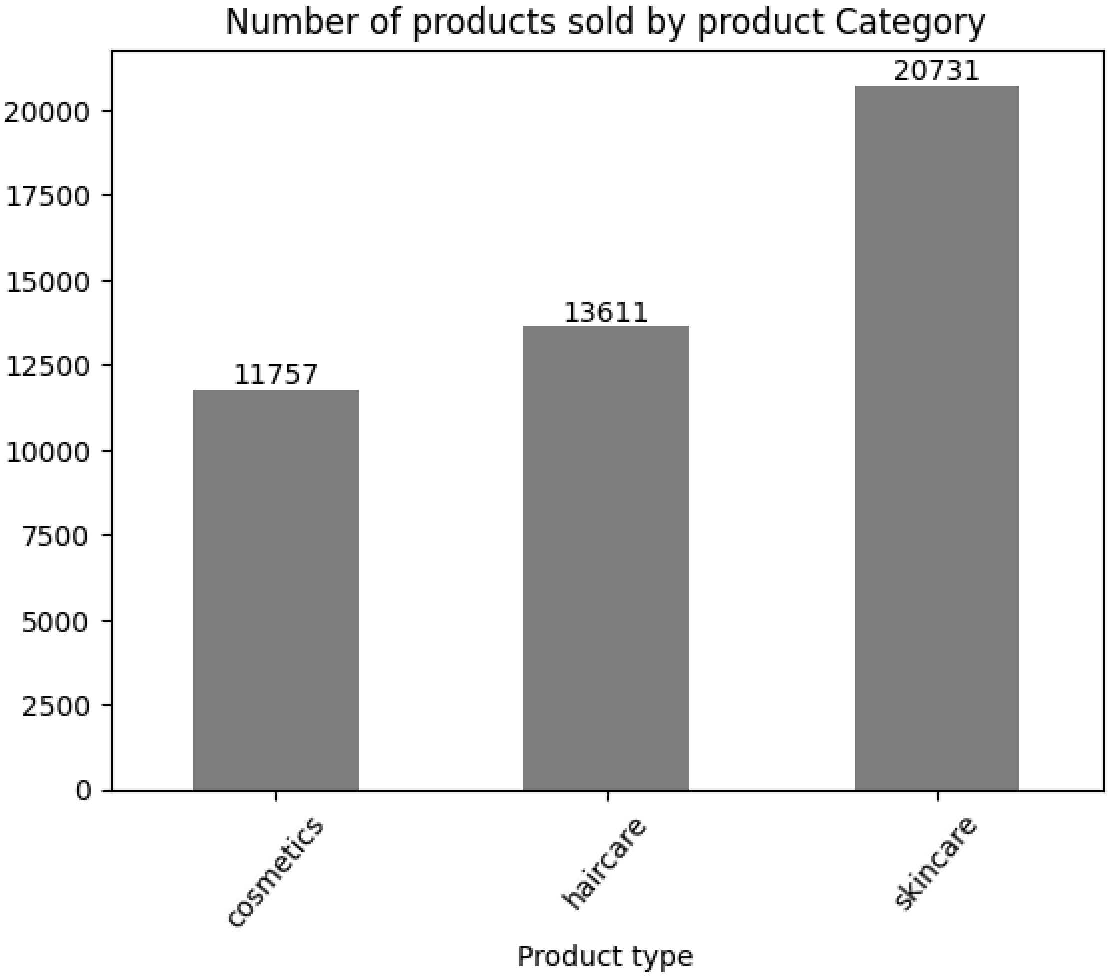
In [ ]:

```
xz = sns.barplot(data = Availability_of_products,x='Product type',y='Availability',
plt.title('Product Availability')
for i in xz.containers:
  xz.bar_label(i)
plt.show()
```

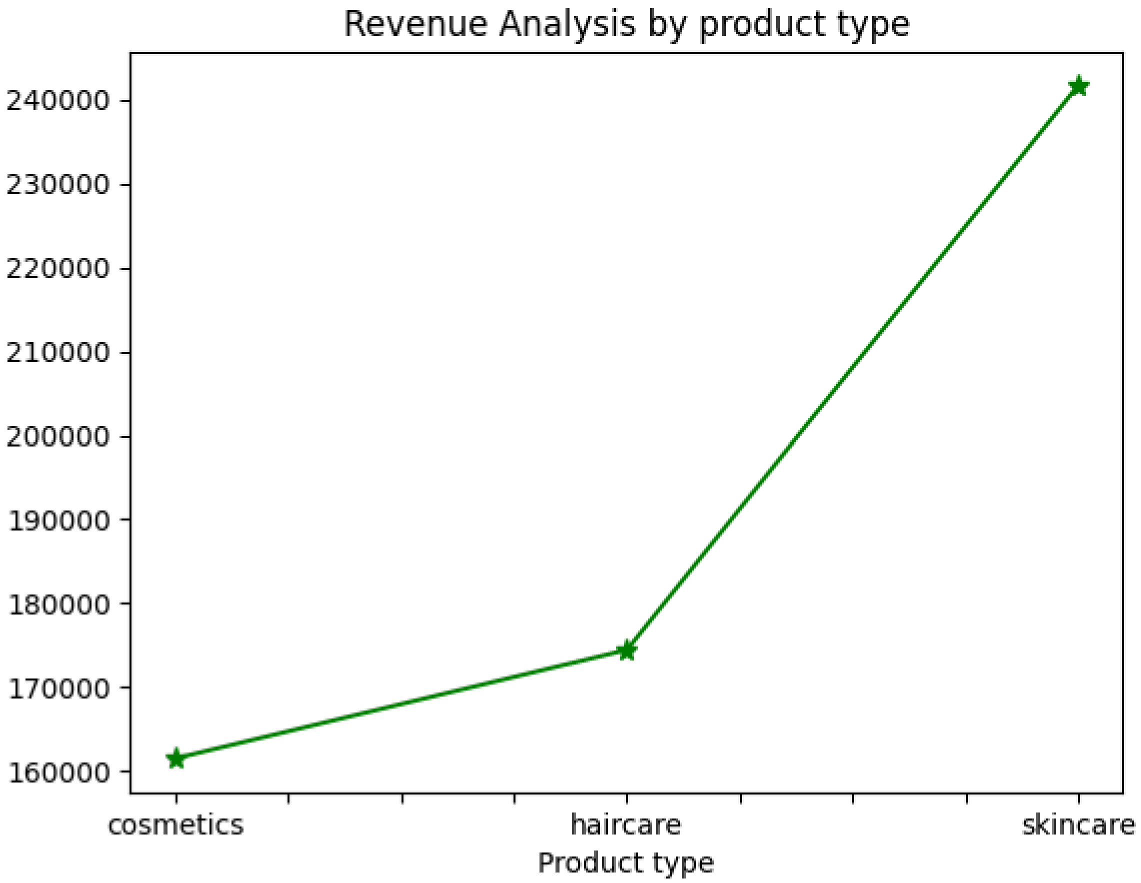


In [ ]:

```
# Number of products sold by product type

xz = df.groupby('Product type')['Number of products sold'].sum().plot(kind='bar',x=
plt.title('Number of products sold by product Category')
for i in xz.containers:
  xz.bar_label(i)
plt.xticks(rotation=50)
plt.show()
```



```
In [ ]: # Revenue analysis by product types

        df.groupby('Product type')['Revenue generated'].sum().plot(kind='line',marker='*',m
        plt.title('Revenue Analysis by product type')
        plt.show()
```



In [ ]:

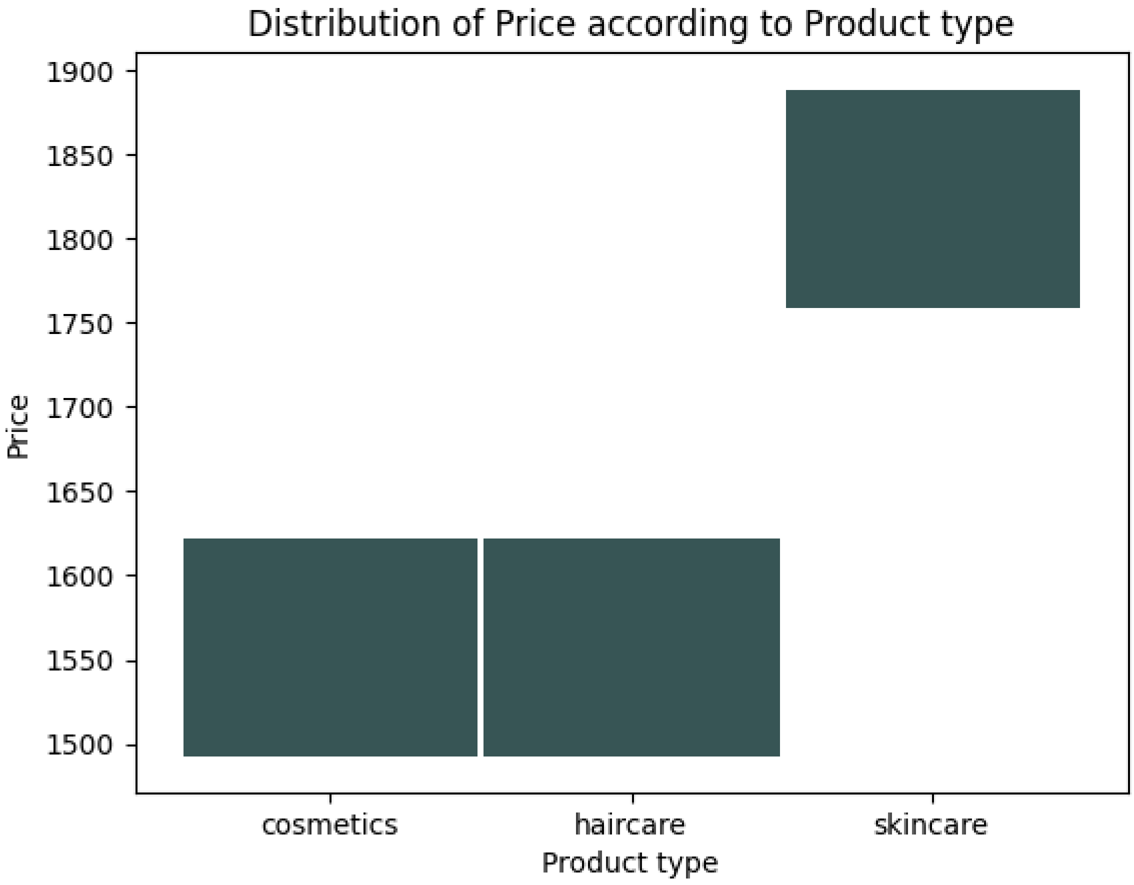
```
# Price distribution according to the product types

product_prices = df.groupby('Product type')['Price'].sum().reset_index()
product_prices
```

Out[ ]:

	Product type	Price
0	cosmetics	1491.387498
1	haircare	1564.485482
2	skincare	1890.373155

In [ ]:

```
sns.histplot(data=product_prices,x='Product type',y='Price',color='cyan',edgecolor=
plt.title('Distribution of Price according to Product type')
plt.show()
```



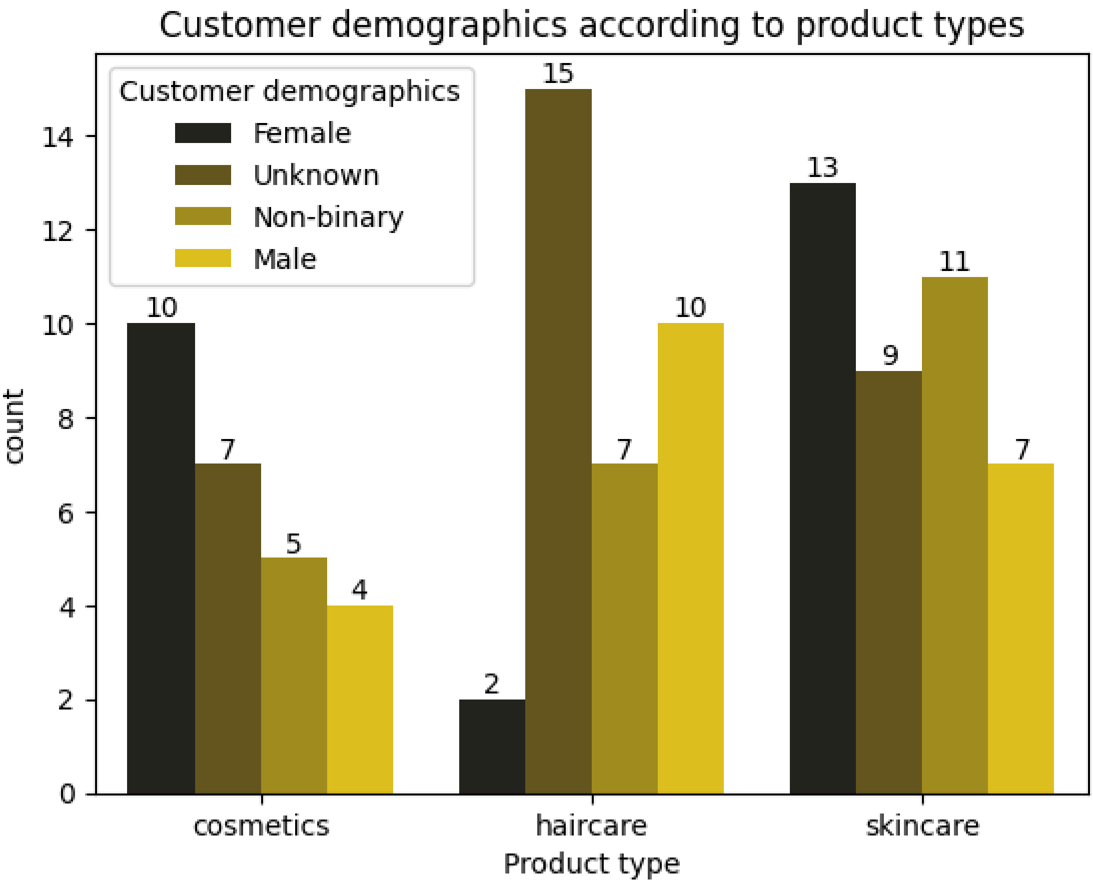
In [ ]:
```
# counting Customer demographics according to product types

demographics = df.groupby('Product type')['Customer demographics'].value_counts().t
demographics
```

Out[ ]:

		count
Product type	**Customer demographics**	
cosmetics	**Female**	10
	Unknown	7
	Non-binary	5
	Male	4
haircare	**Unknown**	15
	Male	10
	Non-binary	7
	Female	2
skincare	**Female**	13
	Non-binary	11
	Unknown	9
	Male	7

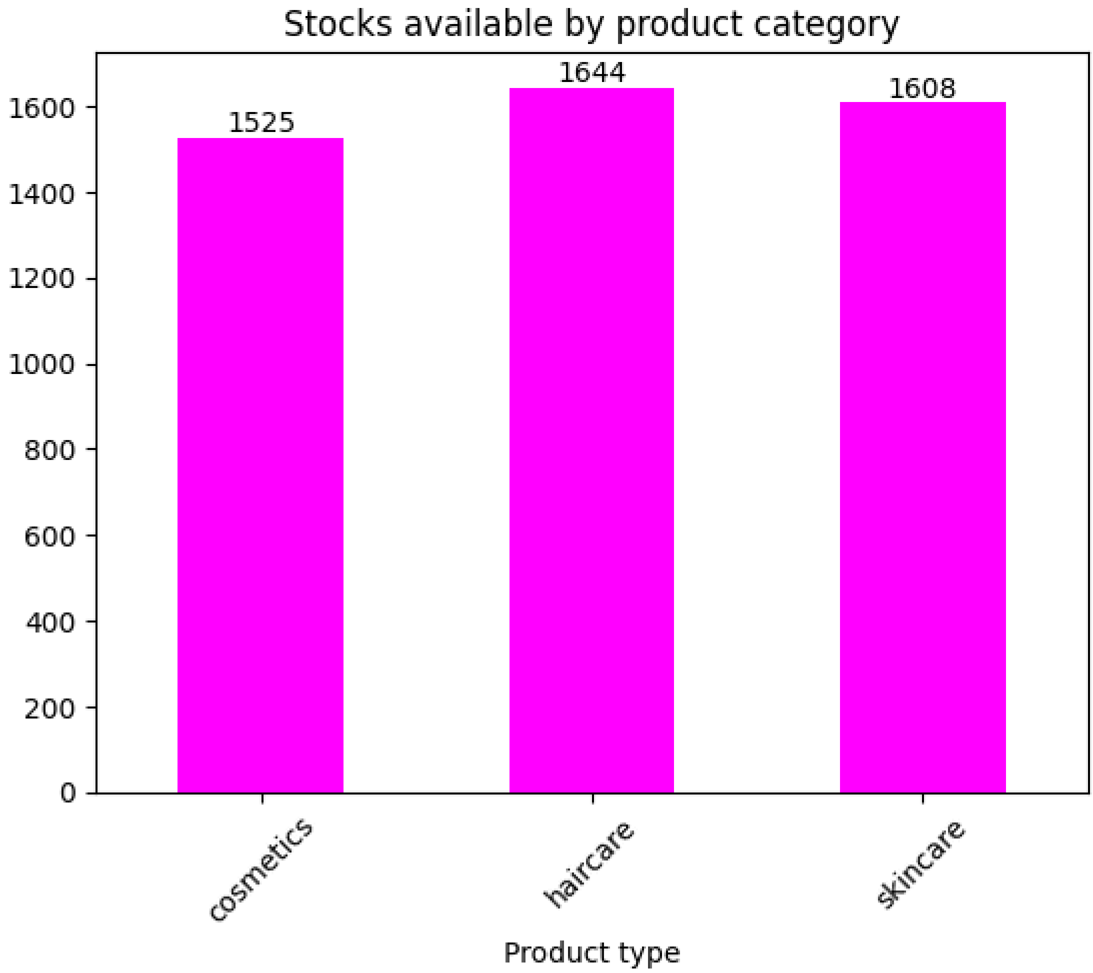
In [ ]:
```
xz = sns.barplot(data=demographics,x='Product type',y='count',hue='Customer demogra
plt.title('Customer demographics according to product types')
for i in xz.containers:
  xz.bar_label(i)
plt.show()
```

```
<ipython-input-26-f05f6a94fe21>:1: FutureWarning:

Setting a gradient palette using color= is deprecated and will be removed in v0.1
4.0. Set `palette='dark:gold'` for the same effect.

  xz = sns.barplot(data=demographics,x='Product type',y='count',hue='Customer demo
graphics',color='gold')
```



In [ ]:

```
# Total stock levels by their product category

xz = df.groupby('Product type')['Stock levels'].sum().plot(kind='bar',color='magent
plt.title('Stocks available by product category')
for i in xz.containers:
  xz.bar_label(i)
plt.xticks(rotation=45)
plt.show()
```



In [ ]:

```
# Total Shipping Costs by Carrier and Location

cost_by_location = round(df.groupby(['Shipping carriers','Location'])['Shipping cos
cost_by_location
```

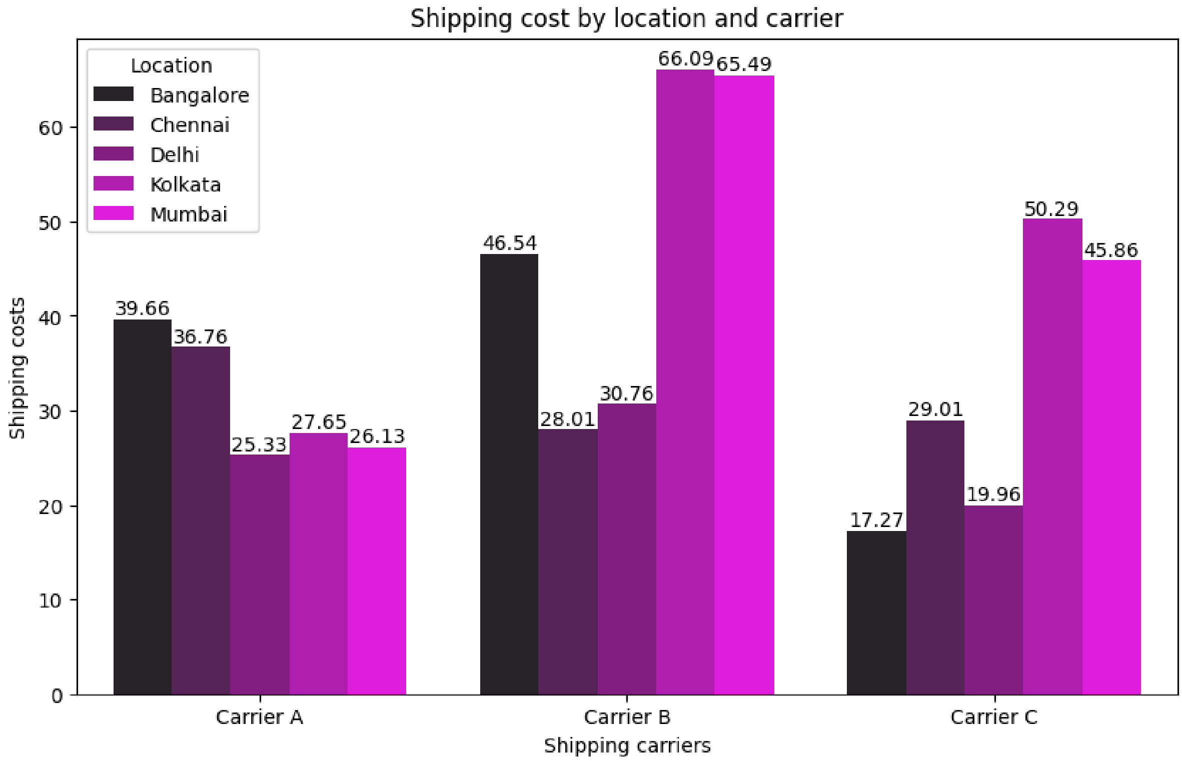
Out[ ]:

		Shipping costs
Shipping carriers	**Location**	
Carrier A	**Bangalore**	39.66
	Chennai	36.76
	Delhi	25.33
	Kolkata	27.65
	Mumbai	26.13
Carrier B	**Bangalore**	46.54
	Chennai	28.01
	Delhi	30.76
	Kolkata	66.09
	Mumbai	65.49
Carrier C	**Bangalore**	17.27
	Chennai	29.01
	Delhi	19.96
	Kolkata	50.29
	Mumbai	45.86

In [ ]:

```
plt.figure(figsize=(10,6))
xz = sns.barplot(data=cost_by_location,x='Shipping carriers',y='Shipping costs',hue
plt.title('Shipping cost by location and carrier')
for i in xz.containers:
  xz.bar_label(i)
plt.show()
```

```
<ipython-input-20-9129ecaee863>:2: FutureWarning:

Setting a gradient palette using color= is deprecated and will be removed in v0.1
4.0. Set `palette='dark:magenta'` for the same effect.

  xz = sns.barplot(data=cost_by_location,x='Shipping carriers',y='Shipping costs',
hue='Location',color='magenta')
```



In [ ]:

```
# Total Count of inspection results by product type

Inspection_by_product = df.groupby('Product type')['Inspection results'].value_cour
Inspection_by_product
```

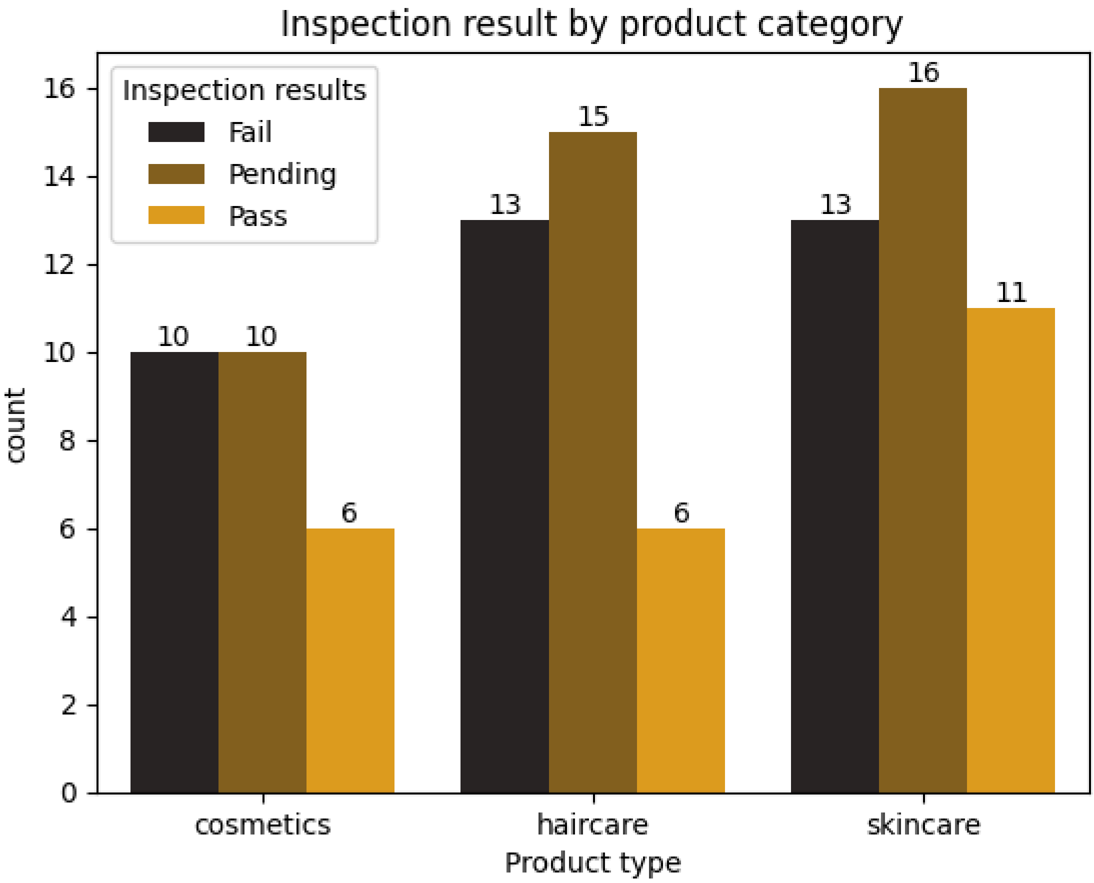
Out[ ]:

Product type	Inspection results	count
cosmetics	Fail	10
	Pending	10
	Pass	6
haircare	Pending	15
	Fail	13
	Pass	6
skincare	Pending	16
	Fail	13
	Pass	11

In [ ]:

```
xz = sns.barplot(data=Inspection_by_product,x='Product type',y='count',hue='Inspect
plt.title('Inspection result by product category')
for i in xz.containers:
  xz.bar_label(i)
plt.show()
```

```
<ipython-input-22-4cad4388e065>:1: FutureWarning:

Setting a gradient palette using color= is deprecated and will be removed in v0.1
4.0. Set `palette='dark:orange'` for the same effect.

  xz = sns.barplot(data=Inspection_by_product,x='Product type',y='count',hue='Insp
ection results',color='orange')
```



In [ ]:

```
# Correlation Matrix for Lead Time, Order Quantities, and Manufacturing Costs

df_corr = df[['Lead time','Order quantities','Manufacturing costs']]
cor_col = df_corr.corr()
cor_col
```

Out[ ]:

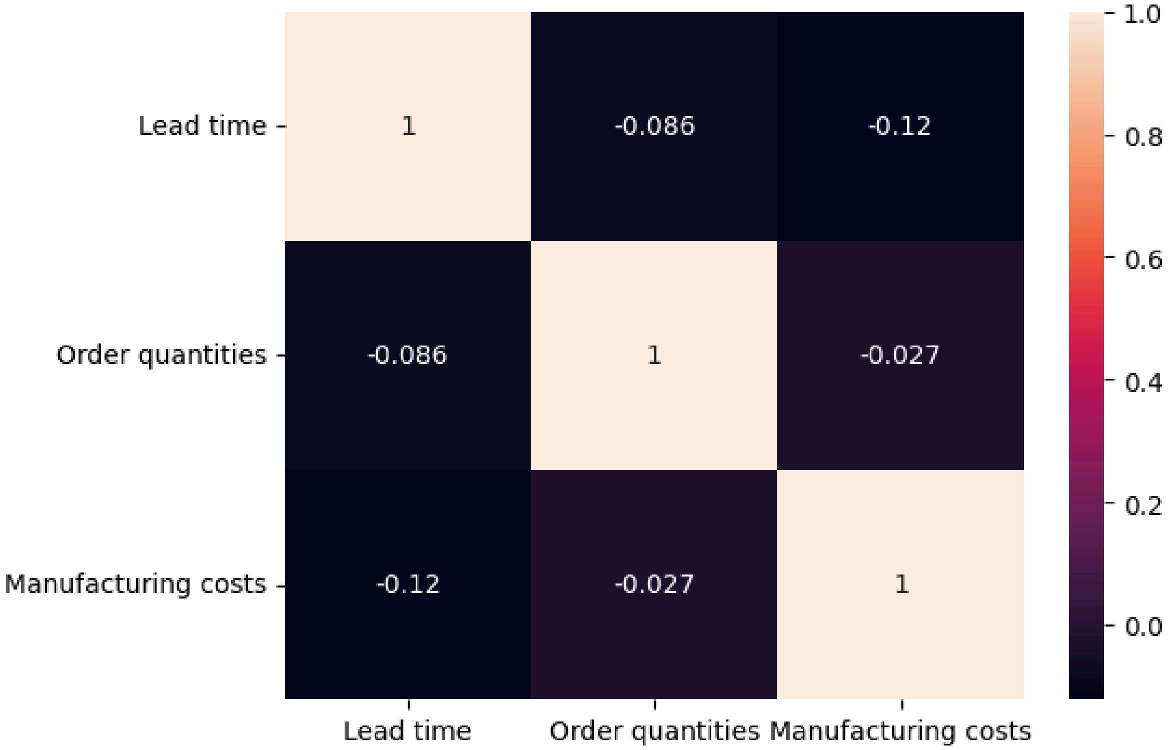
	Lead time	Order quantities	Manufacturing costs
Lead time	1.000000	-0.086189	-0.121999
Order quantities	-0.086189	1.000000	-0.026784
Manufacturing costs	-0.121999	-0.026784	1.000000

In [ ]:

```
sns.heatmap(data= cor_col,annot = True)
```

Out[ ]:

```
<Axes: >
```



In [ ]:

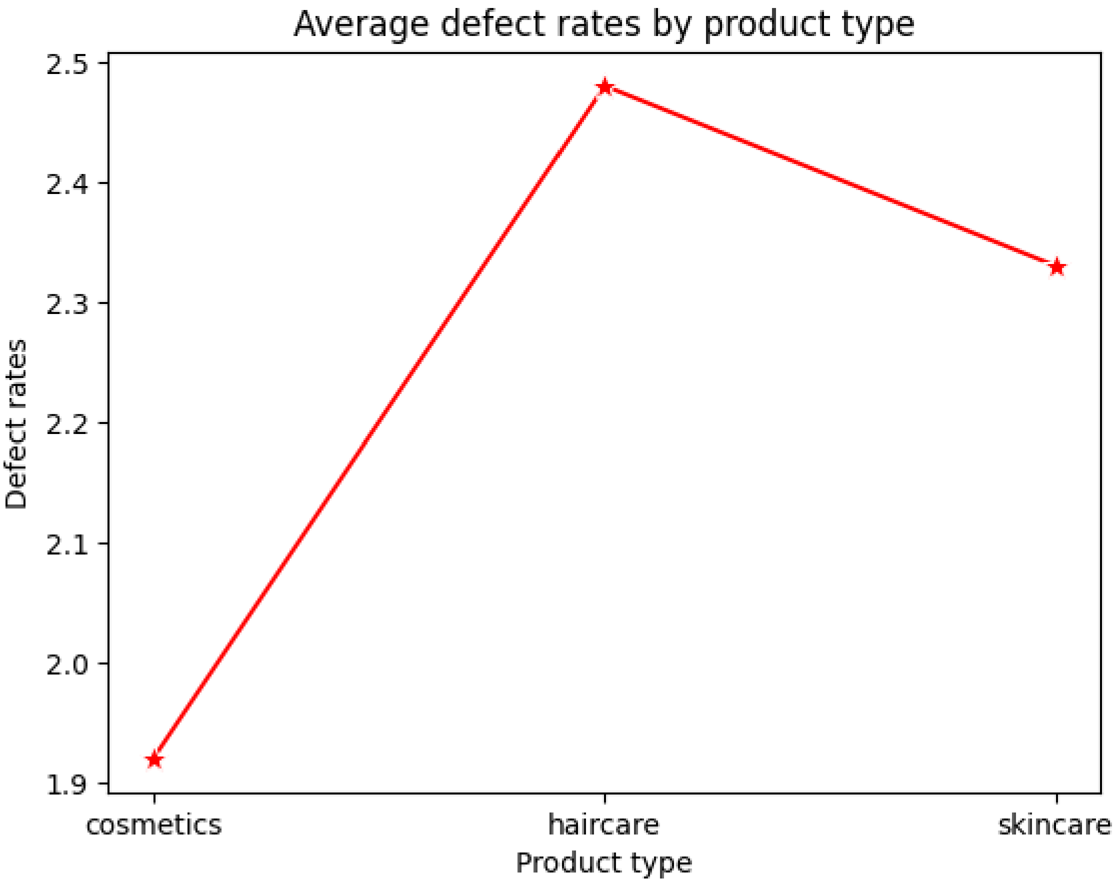
```
# Average Defect Rates by Product Type

average_defect = round(df.groupby('Product type')['Defect rates'].mean().to_frame()
average_defect
```

Out[ ]:

	Defect rates
Product type	
cosmetics	1.92
haircare	2.48
skincare	2.33

In [ ]:

```
sns.lineplot(data=average_defect,x='Product type',y='Defect rates',color='red',mark
plt.title('Average defect rates by product type')
plt.show()
```



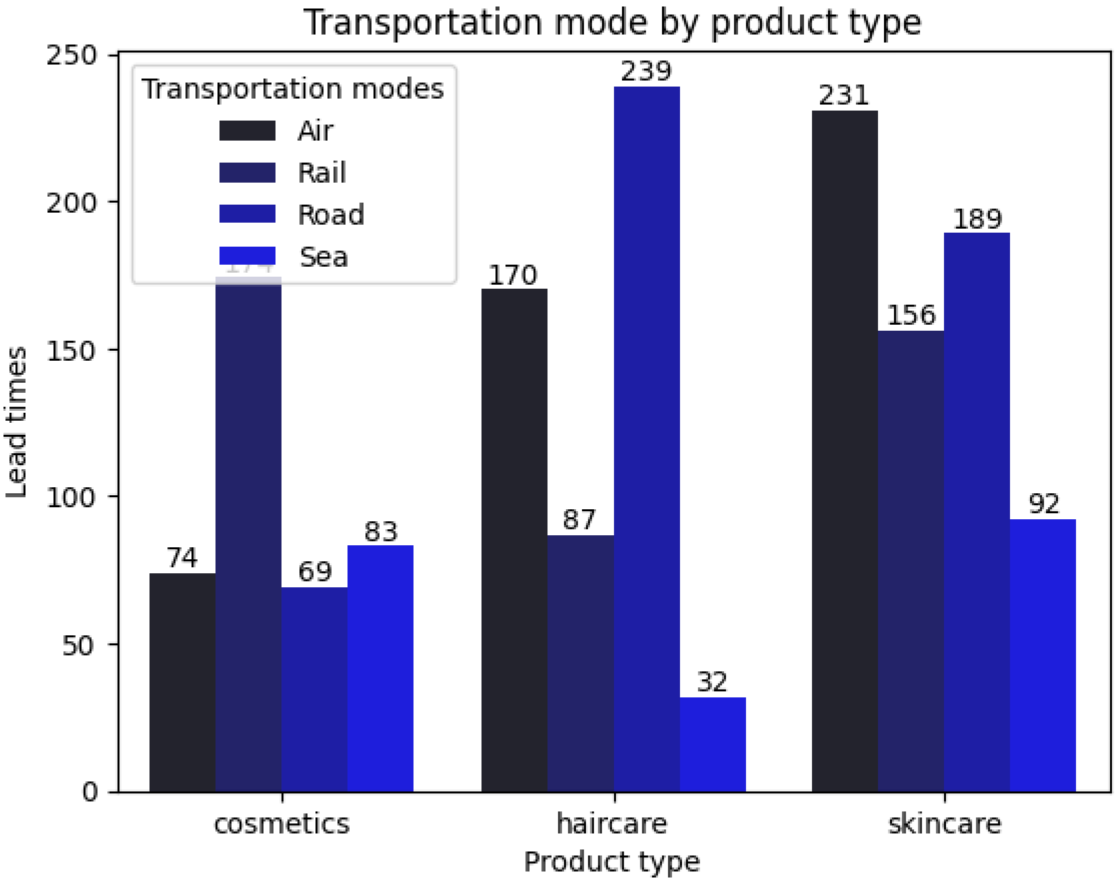
In [45]:
```
transportation_mode_by_prod =  df.groupby(['Product type','Transportation modes'])[
transportation_mode_by_prod
```

Out[45]:

		Lead times
Product type	**Transportation modes**	
cosmetics	**Air**	74
	Rail	174
	Road	69
	Sea	83
haircare	**Air**	170
	Rail	87
	Road	239
	Sea	32
skincare	**Air**	231
	Rail	156
	Road	189
	Sea	92

In [48]:
```
xz = sns.barplot(data=transportation_mode_by_prod,x='Product type',y='Lead times',h
plt.title('Transportation mode by product type')
for i in xz.containers:
  xz.bar_label(i)
plt.show()
```

```
<ipython-input-48-093c6cc85d18>:1: FutureWarning:

Setting a gradient palette using color= is deprecated and will be removed in v0.1
4.0. Set `palette='dark:blue'` for the same effect.

  xz = sns.barplot(data=transportation_mode_by_prod,x='Product type',y='Lead time
s',hue='Transportation modes',color='blue')
```



Key Insights:

Product Performance: Haircare and skincare products show notable differences in availability, sales, and revenue.

Stock and Availability: Higher stock levels generally improve product availability and sales performance.

Lead Times: Longer lead times tend to decrease the number of products sold.

Revenue Drivers: Certain products generate more revenue despite lower sales, indicating potential price influence.

Transportation Modes: Air and rail transportation are costlier but could offer faster delivery times.

Quality Control: High defect rates and failed inspections impact several products, affecting customer satisfaction.

Conclusion:

Optimize Stock Levels: Ensuring adequate stock can prevent product shortages and improve sales.

Minimize Lead Times: Reducing lead times will likely boost product availability and customer satisfaction.

Control Transportation Costs: Managing air and rail transport costs can enhance overall profitability.

Improve Quality Control: Addressing high defect rates and inspection failures will lead to better product quality and reduced returns.

Focus on Efficiency: Streamlining inventory management, transportation, and quality control can significantly improve supply chain performance and profitability.

```
In [ ]:
```