Essentials of Data Science(EDS)

Theory Assignment

Submitted by :

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Assignment: *Theory Activity No. 1*

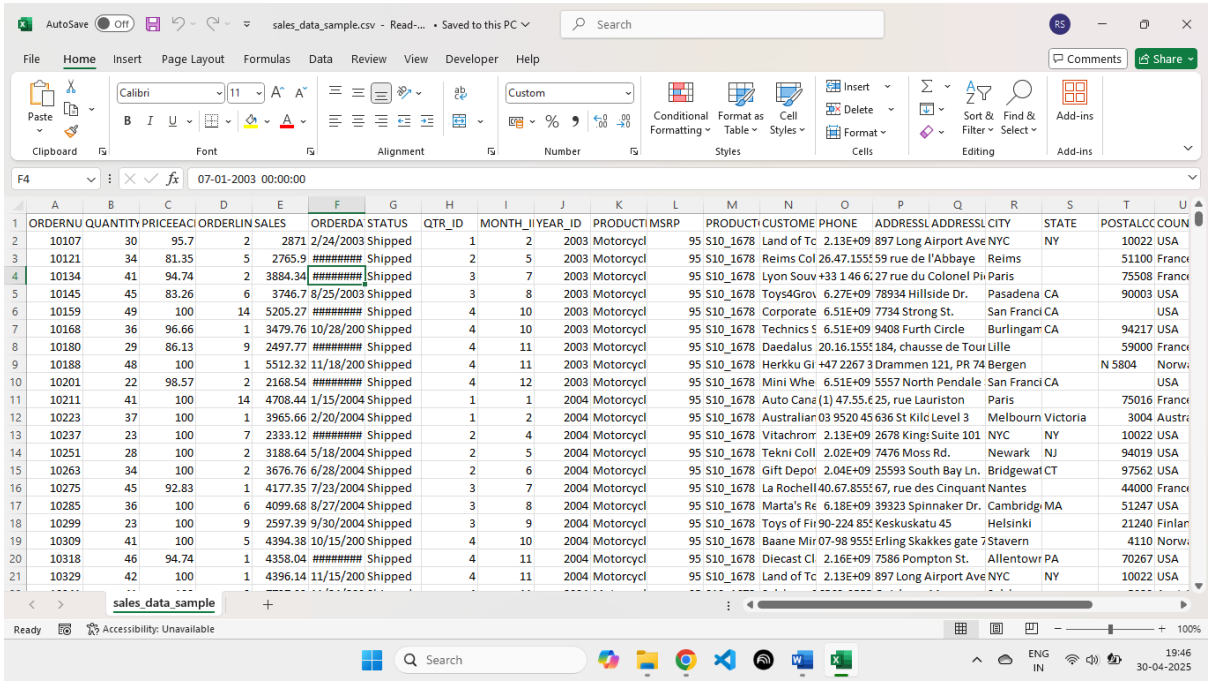
This is for all division students. You have to complete this assignment as per the instructions of your theory teacher.

Formulate 20 problem statements for a given dataset using Numpy and Pandas and Apply Numpy and pandas methods to find the solution for the formulated problem statements.

Each one will take a real-life dataset.

Submission:

Given Dataset : Sales Dataset (Link - C:\Users\user\Downloads\archive (3).zip)



```
import pandas as pd
import numpy as np


df = pd.read_csv('/content/sample_data/sales_data_sample.csv', encoding='latin1')
df
```

	ORDERNUMBER	QUANTITYORDERED	PRICEEACH	ORDERLINENUMBER	SALES	ORDERDATE	STATUS	QTR_ID	MONTH_ID	YEAR_ID	...
0	10107	30	95.70	2	2871.00	2/24/2003 0:00	Shipped	1	2	2003	...
1	10121	34	81.35	5	2765.90	5/7/2003 0:00	Shipped	2	5	2003	...
2	10134	41	94.74	2	3884.34	7/1/2003 0:00	Shipped	3	7	2003	...
3	10145	45	83.26	6	3746.70	8/25/2003 0:00	Shipped	3	8	2003	...
4	10159	49	100.00	14	5205.27	10/10/2003 0:00	Shipped	4	10	2003	...

Problem Statements and solutions :

1. Calculate the total revenue generated from all sales.

```
df['Revenue'] = df['QUANTITYORDERED'] * df['PRICEEACH']
total_revenue = df['Revenue'].sum()
print(f"Total Revenue: ${total_revenue}")
```

```
Total Revenue: $8290886.789999999
```

2. Determine the average revenue per order.

```
df['Revenue'] = df['QUANTITYORDERED'] * df['PRICEEACH']
```

3. Identify the top 5 products that generated the highest revenue.

```
product_revenue = df.groupby('PRODUCTLINE')['Revenue'].sum()
top_5_products = product_revenue.sort_values(ascending=False).head(5)
print("Top 5 Products by Revenue:")
print(top_5_products)
```

```
Top 5 Products by Revenue:
PRODUCTLINE
Classic Cars        2968546.40
Vintage Cars        1644212.05
Motorcycles          971086.29
Trucks and Buses     947355.18
Planes               877942.21
Name: Revenue, dtype: float64
```

4. Analyze the total revenue generated each month.

```
df['ORDERDATE'] = pd.to_datetime(df['ORDERDATE'])
df['Month'] = df['ORDERDATE'].dt.month
monthly_revenue = df.groupby('Month')['Revenue'].sum()
print("Total Revenue Generated Each Month:")
print(monthly_revenue)
```

```
Total Revenue Generated Each Month:
Month
1      659582.29
2      668328.15
3      626186.73
4      560334.46
5      756812.91
6      384743.59
7      420973.34
8      552132.91
9      474900.12
10     919036.70
11    1744682.45
12     523173.14
Name: Revenue, dtype: float64
```

5. Determine which month had the highest sales revenue.

```
highest_revenue_month = monthly_revenue.idxmax()
highest_revenue = monthly_revenue.max()

print(f"The month with the highest sales revenue was {highest_revenue_month}, with a total revenue of ${highest_revenue:.2f}")
```

```
The month with the highest sales revenue was 11, with a total revenue of $1744682.45
```

6. Identify the day of the week with the highest average sales revenue.

```
df['ORDERDATE'] = pd.to_datetime(df['ORDERDATE'])

df['Revenue'] = df['QUANTITYORDERED'] * df['PRICEEACH']

df['DayOfWeek'] = df['ORDERDATE'].dt.day_name()

average_revenue_by_day = df.groupby('DayOfWeek')['Revenue'].mean()

highest_revenue_day = average_revenue_by_day.idxmax()

print(f"The day of the week with the highest average sales revenue is {highest_revenue_day}.")
```

```
The day of the week with the highest average sales revenue is Tuesday.
```

7. Identify the hour of the day when most orders are placed.

```
df['ORDERDATE'] = pd.to_datetime(df['ORDERDATE'])
df['Hour'] = df['ORDERDATE'].dt.hour
orders_by_hour = df.groupby('Hour')['ORDERNUMBER'].count()
most_orders_hour = orders_by_hour.idxmax()
print(f"The hour with the most orders is: {most_orders_hour}")
```

```
The hour with the most orders is: 0
```

8. Find the product with the highest quantity sold.

```
product_quantities = df.groupby('PRODUCTCODE')['QUANTITYORDERED'].sum()
highest_quantity_product = product_quantities.idxmax()
print(f"The product with the highest quantity sold is: {highest_quantity_product}")
```

```
The product with the highest quantity sold is: S18_3232
```

9. Analyze the relationship between product price and quantity sold.

```
product_quantities = df.groupby('PRODUCTCODE')['QUANTITYORDERED'].sum().reset_index()
product_data = pd.merge(product_quantities, df[['PRODUCTCODE', 'PRICEEACH']], on='PRODUCTCODE', how='left')
product_data = product_data.drop_duplicates(subset=['PRODUCTCODE'])
correlation = product_data['PRICEEACH'].corr(product_data['QUANTITYORDERED'])
print(f"Correlation coefficient: {correlation}")
```

```
Correlation coefficient: 0.10636620722949874
```

10. Identify which products have the most consistent revenue generation over time.

```
[15] df['ORDERDATE'] = pd.to_datetime(df['ORDERDATE'])
     df['Month'] = df['ORDERDATE'].dt.month
     df['Revenue'] = df['QUANTITYORDERED'] * df['PRICEEACH']
     product_monthly_revenue = df.groupby(['PRODUCTCODE', 'Month'])['Revenue'].sum().reset_index()
```

11. Identify the top 5 cities with the highest number of orders.

```
city_orders = df.groupby('CITY')['ORDERNUMBER'].nunique().reset_index()
top_5_cities = city_orders.sort_values(by=['ORDERNUMBER'], ascending=False).head(5)
print(top_5_cities)
```

```
          CITY  ORDERNUMBER
34      Madrid           31
61  San Rafael           17
42         NYC           16
63   Singapore            9
52       Paris            9
```

12. Calculate the average quantity ordered for each product.

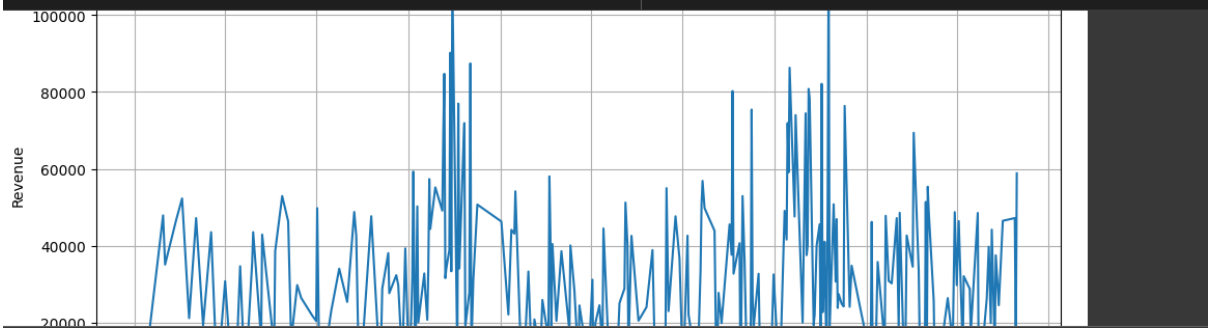
```
average_quantity_by_product = df.groupby('PRODUCTCODE')['QUANTITYORDERED'].mean().reset_index()
print(average_quantity_by_product)
```

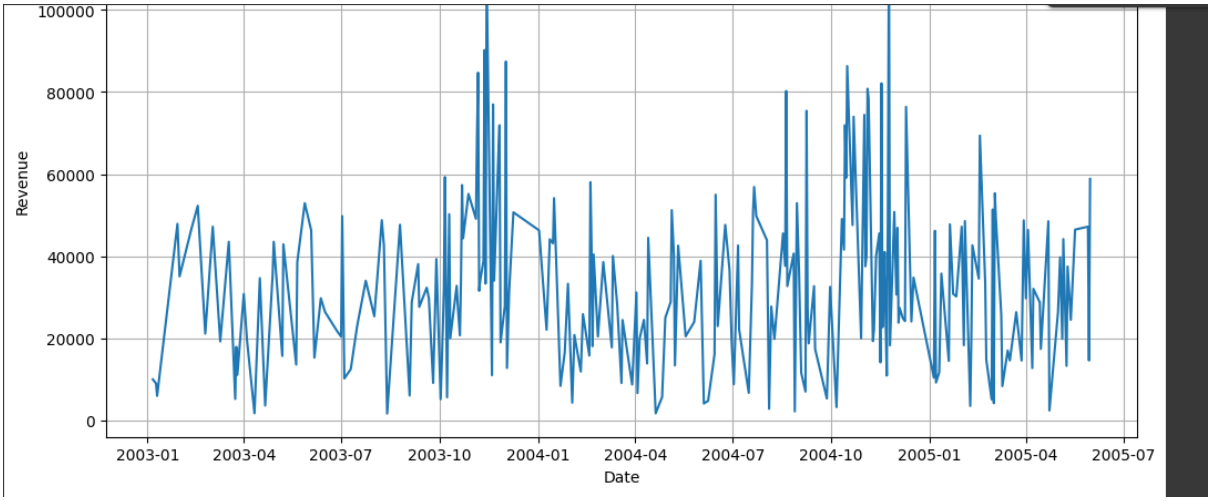
```
    PRODUCTCODE  QUANTITYORDERED
0      S10_1678        36.307692
1      S10_1949        34.321429
2      S10_2016        35.692308
3      S10_4698        35.423077
4      S10_4757        35.259259
..          ...              ...
104    S700_3505        35.269231
105    S700_3962        32.769231
106    S700_4002        38.111111
107     S72_1253        34.074074
108     S72_3212        35.653846
```

13.Analyze daily sales revenue to identify trends.

```
import matplotlib.pyplot as plt


df['ORDERDATE'] = pd.to_datetime(df['ORDERDATE'])


df['Date'] = df['ORDERDATE'].dt.date

daily_revenue = df.groupby('Date')['Revenue'].sum().reset_index()

plt.figure(figsize=(12, 6))
plt.plot(daily_revenue['Date'], daily_revenue['Revenue'])
plt.title('Daily Sales Revenue Trend')
plt.xlabel('Date')
plt.ylabel('Revenue')
plt.grid(True)
plt.show()

daily_revenue['MovingAverage'] = daily_revenue['Revenue'].rolling(window=7).mean()  # 7-day moving average
plt.figure(figsize=(12, 6))
plt.plot(daily_revenue['Date'], daily_revenue['Revenue'], label='Daily Revenue')
plt.plot(daily_revenue['Date'], daily_revenue['MovingAverage'], label='7-Day Moving Average', color='red')
plt.title('Daily Sales Revenue Trend with Moving Average')
plt.show()('Date')
```

```
daily_revenue['MovingAverage'] = daily_revenue['Revenue'].rolling(window=7).mean()  # 7-day moving average
plt.figure(figsize=(12, 6))
plt.plot(daily_revenue['Date'], daily_revenue['Revenue'], label='Daily Revenue')
plt.plot(daily_revenue['Date'], daily_revenue['MovingAverage'], label='7-Day Moving Average', color='red')
plt.title('Daily Sales Revenue Trend with Moving Average')
plt.xlabel('Date')
plt.ylabel('Revenue')
plt.grid(True)
plt.legend()
plt.show()
```





14.Find the most frequent purchase address.

```
address_counts = df['ADDRESSLINE1'].value_counts()
most_frequent_address = address_counts.index[0]

print(f"The most frequent purchase address is: {most_frequent_address}")
```

```
The most frequent purchase address is: C/ Moralzarzal, 86
```

15.Calculate the total number of units sold across all products.

```
total_units_sold = df['QUANTITYORDERED'].sum()
print(f"Total units sold across all products: {total_units_sold}")
```

```
Total units sold across all products: 99067
```

16.Determine the average price for each product.

```
average_price_by_product = df.groupby('PRODUCTCODE')['PRICEEACH'].mean()
print(average_price_by_product)
```

```
PRODUCTCODE
S10_1678      92.607692
S10_1949     100.000000
S10_2016      94.365769
S10_4698      98.593846
S10_4757      94.190000
                ...
S700_3505     92.877308
S700_3962     91.812308
S700_4002     73.621111
S72_1253      55.897037
S72_3212      63.865769
Name: PRICEEACH, Length: 109, dtype: float64
```

17.Identify pairs of products that are frequently sold together.

```
unique_orders = df['ORDERNUMBER'].unique()


pair_counts = {}

# 3. Iterate through each order
for order in unique_orders:
    # Get the products in the current order
    products_in_order = df.loc[df['ORDERNUMBER'] == order, 'PRODUCTCODE'].tolist()

    # If there's more than one product in the order
    if len(products_in_order) > 1:
        # Create all possible pairs of products within the order
        for i in range(len(products_in_order)):
            for j in range(i + 1, len(products_in_order)):
                pair = tuple(sorted([products_in_order[i], products_in_order[j]]))

                # Update the pair count in the dictionary
                pair_counts[pair] = pair_counts.get(pair, 0) + 1

# 4. Convert the dictionary to a Pandas DataFrame for easier handling
pair_counts_df = pd.DataFrame(list(pair_counts.items()), columns=['Product Pair', 'Count'])

# 5. Sort the DataFrame by count in descending order
frequent_pairs = pair_counts_df.sort_values(by=['Count'], ascending=False)
```

```
# 4. Convert the dictionary to a Pandas DataFrame for easier handling
pair_counts_df = pd.DataFrame(list(pair_counts.items()), columns=['Product Pair', 'Count'])

# 5. Sort the DataFrame by count in descending order
frequent_pairs = pair_counts_df.sort_values(by=['Count'], ascending=False)

# 6. Display the top frequently sold together pairs (e.g., top 10)
print(frequent_pairs.head(10))
```

```
              Product Pair  Count
428   (S700_2047, S72_1253)     26
792    (S24_2841, S24_3420)     26
1126   (S18_2319, S18_3232)     26
292   (S24_3949, S700_4002)     26
311   (S50_1341, S700_1691)     26
530    (S18_2957, S18_3136)     26
457    (S10_1949, S18_1097)     25
924   (S700_3962, S72_3212)     25
477    (S10_4962, S18_4600)     25
1147   (S24_2840, S32_2509)     25
```

18. Calculate each product's contribution to total revenue as a percentage.

```
df['Revenue'] = df['QUANTITYORDERED'] * df['PRICEEACH']
total_revenue = df['Revenue'].sum()
print(f"Total Revenue: ${total_revenue}")
product_revenue = df.groupby('PRODUCTCODE')['Revenue'].sum()
product_contribution = (product_revenue / total_revenue) * 100
print("Product Contribution to Total Revenue (%):")
print(product_contribution)
```

```
Total Revenue: $8290886.789999999
Product Contribution to Total Revenue (%):
PRODUCTCODE
S10_1678     1.069133
S10_1949     1.159104
S10_2016     1.050801
S10_4698     1.096533
S10_4757     1.078773
               ...
S700_3505    1.025599
S700_3962    0.936506
S700_4002    0.909412
S72_1253     0.623116
S72_3212     0.707085
Name: Revenue, Length: 109, dtype: float64
```

19. Determine the total number of orders placed.

```
total_orders = len(df['ORDERNUMBER'].unique())
print(f"Total number of orders placed: {total_orders}")
```

```
Total number of orders placed: 307
```

20. Calculate average revenue generated per city.

```
city_revenue = df.groupby('CITY')['Revenue'].sum()
city_orders = df.groupby('CITY')['ORDERNUMBER'].nunique()
average_revenue_per_city = city_revenue / city_orders
print("Average Revenue per City:")
print(average_revenue_per_city)
```

```
Average Revenue per City:
CITY
Aaarhus          38739.395000
Allentown        24094.567500
Barcelona        24642.333333
Bergamo          42381.213333
Bergen           28779.703333
                      ...
Toulouse         19628.426667
Tsawassen        35746.165000
Vancouver        30298.955000
Versailles       26682.485000
White Plains     36825.240000
Length: 73, dtype: float64
```