

Exploratory Data Analysis (EDA) on Customers Dataset

This notebook performs step-by-step EDA on the `customers.csv` dataset. We will explore distributions, correlations, outliers, and customer segmentation.

1. Import Libraries

```
In [1]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
sns.set(style="whitegrid")
```

2. Load the Dataset

We load the dataset and preview the first few rows.

```
In [2]: df = pd.read_csv("customers.csv")
df.head()
```

```
Out[2]:
```

	Channel	Region	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicatessen
0	2	3	12669	9656	7561	214	2674	1338
1	2	3	7057	9810	9568	1762	3293	1776
2	2	3	6353	8808	7684	2405	3516	1784
3	1	3	13265	1196	4221	6404	507	1788
4	2	3	22615	5410	7198	3915	1777	5185

3. Basic Info & Summary Statistics

Checking data types, missing values, and descriptive statistics.

```
In [3]: df.info()
df.describe()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 440 entries, 0 to 439
Data columns (total 8 columns):
 #   Column              Non-Null Count  Dtype
---  --
 0   Channel             440 non-null    int64
 1   Region              440 non-null    int64
 2   Fresh               440 non-null    int64
 3   Milk                440 non-null    int64
 4   Grocery             440 non-null    int64
 5   Frozen              440 non-null    int64
 6   Detergents_Paper    440 non-null    int64
 7   Delicatessen        440 non-null    int64
dtypes: int64(8)
memory usage: 27.6 KB
```

```
Out[3]:
```

	Channel	Region	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicatessen
count	440.000000	440.000000	440.000000	440.000000	440.000000	440.000000	440.000000	440.000000
mean	1.322727	2.543182	12000.297727	5796.265909	7951.277273	3071.931818	2881.493182	1524.870455
std	0.468052	0.774272	12647.328865	7380.377175	9503.162829	4854.673333	4767.854448	2820.105937
min	1.000000	1.000000	3.000000	55.000000	3.000000	25.000000	3.000000	3.000000
25%	1.000000	2.000000	3127.750000	1533.000000	2153.000000	742.250000	256.750000	408.250000
50%	1.000000	3.000000	8504.000000	3627.000000	4755.500000	1526.000000	816.500000	965.500000
75%	2.000000	3.000000	16933.750000	7190.250000	10655.750000	3554.250000	3922.000000	1820.250000
max	2.000000	3.000000	112151.000000	73498.000000	92780.000000	60869.000000	40827.000000	47943.000000

Interpretation:

- All columns are numeric except `Channel` and `Region` which are categorical.
- Spending values vary widely — some customers spend very little, while others spend tens of thousands.

4. Data Quality Checks

Checking for missing values and duplicates.

```
In [4]: print("Missing values:\n", df.isnull().sum())
print("Duplicate rows:", df.duplicated().sum())
```

Missing values:

Channel	0
Region	0
Fresh	0
Milk	0
Grocery	0
Frozen	0
Detergents_Paper	0
Delicatessen	0

dtype: int64
Duplicate rows: 0

Interpretation:

- No missing values → dataset is clean.
- If duplicates exist, they should be removed to avoid bias.

5. Distribution Analysis

Plotted histograms to see spending distributions.

```
In [5]: df.hist(bins=30, figsize=(15,10))
plt.tight_layout()
plt.show()
```

Interpretation:

- Most features are right-skewed (many small spenders, few very large spenders).
- Categories like `Fresh` and `Grocery` have extreme outliers.

6. Outlier Detection

Used boxplots to visualize outliers in spending categories.

```
In [6]: plt.figure(figsize=(12,6))
sns.boxplot(data=df.drop(columns=['Channel','Region']))
plt.xticks(rotation=45)
plt.show()
```

Interpretation:

- Boxplots confirm extreme outliers in `Fresh`, `Grocery`, and `Frozen`.
- These outliers represent very high-spending customers.

7. Correlation Analysis

Checking relationships between product categories.

```
In [7]: plt.figure(figsize=(10,8))
sns.heatmap(df.corr(), annot=True, cmap="coolwarm")
plt.show()
```

Interpretation:

- Strong correlation between `Grocery`, `Milk`, and `Detergents_Paper` → retail-oriented customers.
- `Fresh` and `Frozen` are less correlated → Horeca (hotels/restaurants/catering).

8. Channel & Region Analysis

Comparing average spending by Channel and Region.

```
In [8]: print("Average spend by Channel:\n", df.groupby("Channel").mean())
print("\nAverage spend by Region:\n", df.groupby("Region").mean())
```

Average spend by Channel:

	Region	Fresh	Milk	Grocery	Frozen
Channel					
1	2.510067	13475.560403	3451.724832	3962.137584	3748.251678
2	2.612676	8904.323944	10716.500000	16322.852113	1652.612676

Average spend by Region:

	Channel	Fresh	Milk	Grocery	Frozen
Region					
1	1.233766	11101.727273	5486.415584	7403.077922	3000.337662
2	1.404255	9887.680851	5088.170213	9218.595745	4045.361702
3	1.332278	12533.471519	5977.085443	7896.363924	2944.594937

Interpretation:

- Channel 1 (Horeca) → higher spending on `Fresh` and `Frozen`.
- Channel 2 (Retail) → higher spending on `Grocery`, `Milk`, and `Detergents_Paper`.

9. Pairplot

Visualizing relationships between features.

```
In [9]: sns.pairplot(df.drop(columns=['Region']))
plt.show()
```

Interpretation:

- Scatter plots show clusters forming naturally.
- Retail customers cluster around `Grocery` and `Detergents_Paper`.

10. PCA (Dimensionality Reduction)

Reduced dimensions to 2 principal components for visualization.

```
In [10]: from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA

X = df.drop(columns=['Channel','Region'])
X_scaled = StandardScaler().fit_transform(X)

pca = PCA(n_components=2)
X_pca = pca.fit_transform(X_scaled)

plt.figure(figsize=(8,6))
plt.scatter(X_pca[:,0], X_pca[:,1], c=df['Channel'], cmap='viridis')
plt.xlabel("PC1")
plt.ylabel("PC2")
plt.title("PCA Projection by Channel")
plt.show()
```

Interpretation:

- PCA reduces the dataset to 2D.
- Clear separation between Channel 1 and Channel 2 customers.

11. K-Means Clustering

Clustered customers into segments and visualize.

```
In [11]: from sklearn.cluster import KMeans

kmeans = KMeans(n_clusters=4, random_state=42)
df['Cluster'] = kmeans.fit_predict(X_scaled)

sns.scatterplot(x=X_pca[:,0], y=X_pca[:,1], hue=df['Cluster'], palette='Set2')
plt.title("Customer Segments (KMeans)")
plt.show()
```

Interpretation:

- K-Means groups customers into 4 clusters.
- Each cluster represents a different spending pattern (e.g., Horeca-heavy, Retail-heavy, balanced, or outlier spenders).

Insights

- Spending distributions are skewed with many small spenders and few large ones.
- Retail customers (Channel 2) spend more on `Grocery`, `Milk`, `Detergents`.
- Horeca customers (Channel 1) spend more on `Fresh` and `Frozen`.
- PCA and clustering reveal natural customer segments.