```
import pandas as pd


customers = pd.read_csv("Customers.csv")
products = pd.read_csv("Products.csv")
transactions = pd.read_csv("Transactions.csv")


print(customers.head())
print(products.head())
print(transactions.head())
```

```
  CustomerID        CustomerName         Region  SignupDate
0      C0001    Lawrence Carroll  South America  2022-07-10
1      C0002      Elizabeth Lutz           Asia  2022-02-13
2      C0003      Michael Rivera  South America  2024-03-07
3      C0004  Kathleen Rodriguez  South America  2022-10-09
4      C0005         Laura Weber           Asia  2022-08-15
  ProductID              ProductName     Category   Price
0      P001     ActiveWear Biography        Books  169.30
1      P002    ActiveWear Smartwatch  Electronics  346.30
2      P003  ComfortLiving Biography        Books   44.12
3      P004            BookWorld Rug   Home Decor   95.69
4      P005          TechPro T-Shirt     Clothing  429.31
  TransactionID CustomerID ProductID      TransactionDate  Quantity  \
0        T00001      C0199      P067  2024-08-25 12:38:23         1
1        T00112      C0146      P067  2024-05-27 22:23:54         1
2        T00166      C0127      P067  2024-04-25 07:38:55         1
3        T00272      C0087      P067  2024-03-26 22:55:37         2
4        T00363      C0070      P067  2024-03-21 15:10:10         3

   TotalValue   Price
0      300.68  300.68
1      300.68  300.68
2      300.68  300.68
3      601.36  300.68
4      902.04  300.68
```

```
print(customers.info())
print(products.info())
print(transactions.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   CustomerID    200 non-null    object
 1   CustomerName  200 non-null    object
 2   Region        200 non-null    object
 3   SignupDate    200 non-null    object
dtypes: object(4)
memory usage: 6.4+ KB
None
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 100 entries, 0 to 99
Data columns (total 4 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   ProductID    100 non-null    object
 1   ProductName  100 non-null    object
 2   Category     100 non-null    object
 3   Price        100 non-null    float64
dtypes: float64(1), object(3)
memory usage: 3.3+ KB
None
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 7 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   TransactionID    1000 non-null   object
 1   CustomerID       1000 non-null   object
 2   ProductID        1000 non-null   object
 3   TransactionDate  1000 non-null   object
 4   Quantity         1000 non-null   int64
 5   TotalValue       1000 non-null   float64
 6   Price            1000 non-null   float64
dtypes: float64(2), int64(1), object(4)
memory usage: 54.8+ KB
None
```

```
print(customers.duplicated())
print(products.duplicated())
print(transactions.duplicated())
```

```
0      False
1      False
2      False
3      False
4      False
       ...
195    False
196    False
197    False
198    False
199    False
Length: 200, dtype: bool
0     False
1     False
2     False
3     False
4     False
      ...
95    False
96    False
97    False
98    False
99    False
Length: 100, dtype: bool
0      False
1      False
2      False
3      False
4      False
       ...
995    False
996    False
997    False
998    False
999    False
Length: 1000, dtype: bool
```

```
print(customers.isnull().sum())
print(products.isnull().sum())
print(transactions.isnull().sum())
```

```
CustomerID      0
CustomerName    0
Region          0
SignupDate      0
dtype: int64
ProductID      0
ProductName    0
Category       0
Price          0
dtype: int64
TransactionID      0
CustomerID         0
ProductID          0
TransactionDate    0
Quantity           0
TotalValue         0
Price              0
dtype: int64
```

```
print(customers.describe())
print(products.describe())
print(transactions.describe())
```

Show hidden output

```
print(customers.dtypes)
print(products.dtypes)
print(transactions.dtypes)
```

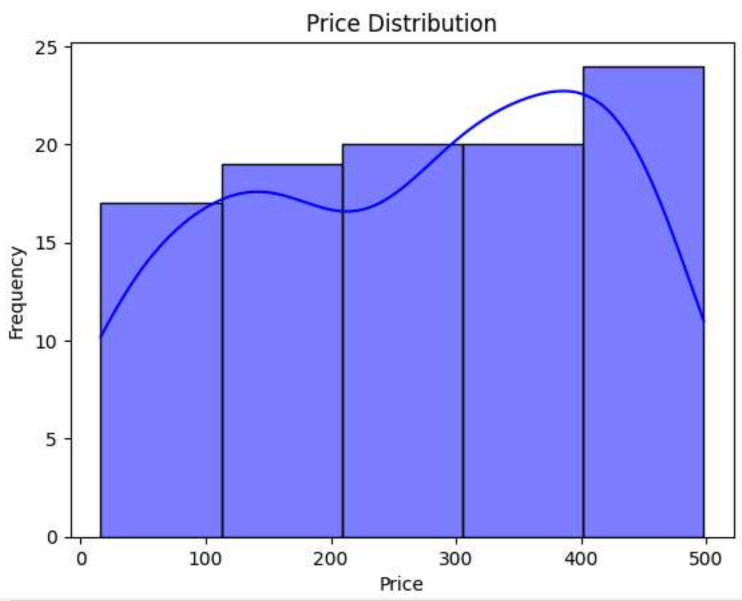
```
CustomerID      object
CustomerName    object
Region          object
SignupDate      object
dtype: object
```

```
ProductID       object
ProductName     object
Category        object
Price          float64
dtype: object
TransactionID       object
CustomerID          object
ProductID           object
TransactionDate     object
Quantity             int64
TotalValue         float64
Price              float64
dtype: object
```

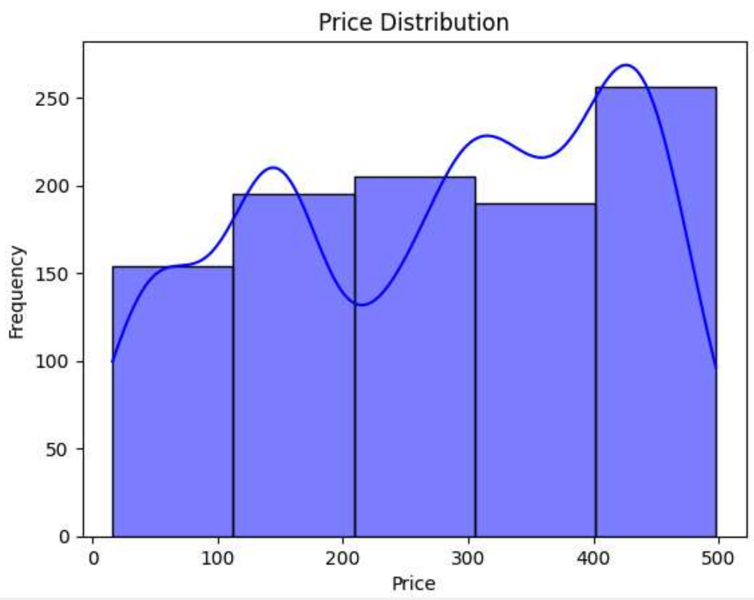
```
print(customers)
print(products)
print(transactions)
```

```
    CustomerID        CustomerName         Region  SignupDate
0        C0001    Lawrence Carroll  South America  2022-07-10
1        C0002      Elizabeth Lutz           Asia  2022-02-13
2        C0003      Michael Rivera  South America  2024-03-07
3        C0004  Kathleen Rodriguez  South America  2022-10-09
4        C0005         Laura Weber           Asia  2022-08-15
..         ...                 ...            ...         ...
195      C0196         Laura Watts         Europe  2022-06-07
196      C0197    Christina Harvey         Europe  2023-03-21
197      C0198         Rebecca Ray         Europe  2022-02-27
198      C0199      Andrea Jenkins         Europe  2022-12-03
199      C0200         Kelly Cross           Asia  2023-06-11

[200 rows x 4 columns]
   ProductID              ProductName     Category   Price
0       P001     ActiveWear Biography        Books  169.30
1       P002    ActiveWear Smartwatch  Electronics  346.30
2       P003  ComfortLiving Biography        Books   44.12
3       P004            BookWorld Rug   Home Decor   95.69
4       P005           TechPro T-Shirt     Clothing  429.31
..       ...                      ...          ...     ...
95      P096     SoundWave Headphones  Electronics  307.47
96      P097       BookWorld Cookbook        Books  319.34
97      P098         SoundWave Laptop  Electronics  299.93
98      P099   SoundWave Mystery Book        Books  354.29
99      P100        HomeSense Sweater     Clothing  126.34

[100 rows x 4 columns]
    TransactionID CustomerID ProductID      TransactionDate  Quantity  \
0          T00001      C0199      P067  2024-08-25 12:38:23         1
1          T00112      C0146      P067  2024-05-27 22:23:54         1
2          T00166      C0127      P067  2024-04-25 07:38:55         1
3          T00272      C0087      P067  2024-03-26 22:55:37         2
4          T00363      C0070      P067  2024-03-21 15:10:10         3
..            ...        ...       ...                  ...       ...
995        T00496      C0118      P037  2024-10-24 08:30:27         1
996        T00759      C0059      P037  2024-06-04 02:15:24         3
997        T00922      C0018      P037  2024-04-05 13:05:32         4
998        T00959      C0115      P037  2024-09-29 10:16:02         2
999        T00992      C0024      P037  2024-04-21 10:52:24         1

     TotalValue   Price
0        300.68  300.68
1        300.68  300.68
2        300.68  300.68
3        601.36  300.68
4        902.04  300.68
..          ...     ...
995      459.86  459.86
996     1379.58  459.86
997     1839.44  459.86
998      919.72  459.86
999      459.86  459.86

[1000 rows x 7 columns]
```

```
import seaborn as sns
import matplotlib.pyplot as plt
# Histogram with Seaborn
sns.histplot(products['Price'], bins=5, kde=True, color='blue')
plt.title('Price Distribution')
plt.xlabel('Price')
plt.ylabel('Frequency')
plt.show()
```



```
import seaborn as sns
import matplotlib.pyplot as plt
# Histogram with Seaborn
sns.histplot(transactions['Price'], bins=5, kde=True, color='blue')
plt.title('Price Distribution')
plt.xlabel('Price')
plt.ylabel('Frequency')
plt.show()
```



```
# Merge datasets for comprehensive EDA
# Step 1: Merge transactions with customers
transactions_customers = pd.merge(transactions, customers, on="CustomerID", how="left")

# Step 2: Merge the result with products
merged_data = pd.merge(transactions_customers, products, on="ProductID", how="left")

# Check the structure of the merged dataset
merged_data.head()
```

	TransactionID	CustomerID	ProductID	TransactionDate	Quantity	TotalValue	Price_x	CustomerName	Region	SignupDate	ProductName
0	T00001	C0199	P067	2024-08-25 12:38:23	1	300.68	300.68	Andrea Jenkins	Europe	2022-12-03	ComfortLiving Bluetooth Speaker
1	T00112	C0146	P067	2024-05-27 22:23:54	1	300.68	300.68	Brittany Harvey	Asia	2024-09-04	ComfortLiving Bluetooth Speaker
2	T00166	C0127	P067	2024-04-25 07:38:55	1	300.68	300.68	Kathryn Stevens	Europe	2024-04-04	ComfortLiving Bluetooth Speaker
3	T00272	C0087	P067	2024-03-26 22:55:37	2	601.36	300.68	Travis Campbell	South America	2024-04-11	ComfortLiving Bluetooth Speaker
4	T00363	C0070	P067	2024-03-21 15:10:10	3	902.04	300.68	Timothy Perez	Europe	2022-03-15	ComfortLiving Bluetooth Speaker

```
merged_data = merged_data.drop(columns=["Price_y"])
merged_data = merged_data.rename(columns={"Price_x" : "Price"})
merged_data
```

	TransactionID	CustomerID	ProductID	TransactionDate	Quantity	TotalValue	Price	CustomerName	Region	SignupDate	ProductName
0	T00001	C0199	P067	2024-08-25 12:38:23	1	300.68	300.68	Andrea Jenkins	Europe	2022-12-03	ComfortLiving Bluetooth Speaker
1	T00112	C0146	P067	2024-05-27 22:23:54	1	300.68	300.68	Brittany Harvey	Asia	2024-09-04	ComfortLiving Bluetooth Speaker
2	T00166	C0127	P067	2024-04-25 07:38:55	1	300.68	300.68	Kathryn Stevens	Europe	2024-04-04	ComfortLiving Bluetooth Speaker
3	T00272	C0087	P067	2024-03-26 22:55:37	2	601.36	300.68	Travis Campbell	South America	2024-04-11	ComfortLiving Bluetooth Speaker
4	T00363	C0070	P067	2024-03-21 15:10:10	3	902.04	300.68	Timothy Perez	Europe	2022-03-15	ComfortLiving Bluetooth Speaker
...	...	...	...	...	...	...	...	...	...	...	...
995	T00496	C0118	P037	2024-10-24 08:30:27	1	459.86	459.86	Jacob Holt	South America	2022-01-22	SoundWave Smartwatch
996	T00759	C0059	P037	2024-06-04 02:15:24	3	1379.58	459.86	Mrs. Kimberly Wright	North America	2024-04-07	SoundWave Smartwatch
997	T00922	C0018	P037	2024-04-05 13:05:32	4	1839.44	459.86	Tyler Haynes	North America	2024-09-21	SoundWave Smartwatch
998	T00959	C0115	P037	2024-09-29	2	919.72	459.86	Joshua	Asia	2024-11-11	SoundWave

```
# EDA: Analysis on the merged dataset

# 1. Most popular products by quantity sold
popular_products = merged_data.groupby("ProductName")["Quantity"].sum().sort_values(ascending=False).head(5)

# 2. Revenue generated by product category
category_revenue = merged_data.groupby("Category")["TotalValue"].sum().sort_values(ascending=False)

# 3. High-value customers by total purchase value
high_value_customers = merged_data.groupby(["CustomerID", "CustomerName"])["TotalValue"].sum().sort_values(ascending=False).head(5)

# 4. Transactions by region
transactions_by_region = merged_data["Region"].value_counts()

# 5. Monthly transaction trend
merged_data["TransactionDate"] = pd.to_datetime(merged_data["TransactionDate"])
monthly_trend = merged_data.groupby(merged_data["TransactionDate"].dt.to_period("M"))["TotalValue"].sum()

# Display results
{
    "popular_products": popular_products,
    "category_revenue": category_revenue,
    "high_value_customers": high_value_customers,
    "transactions_by_region": transactions_by_region,
    "monthly_trend": monthly_trend.head()  # Displaying the first few months' trends
}
```

```
{'popular_products': ProductName
 ActiveWear Smartwatch    100
 SoundWave Headphones      97
 HomeSense Desk Lamp       81
 ActiveWear Rug            79
 SoundWave Cookbook        78
 Name: Quantity, dtype: int64,
 'category_revenue': Category
 Books          192147.47
 Electronics    180783.50
 Clothing       166170.66
 Home Decor     150893.93
 Name: TotalValue, dtype: float64,
 'high_value_customers': CustomerID  CustomerName
 C0141       Paul Parsons     10673.87
 C0054       Bruce Rhodes      8040.39
 C0065       Gerald Hines      7663.70
 C0156       William Adams     7634.45
 C0082       Aimee Taylor      7572.91
 Name: TotalValue, dtype: float64,
 'transactions_by_region': Region
 South America    304
 North America    244
 Europe           234
 Asia             218
 Name: count, dtype: int64,
 'monthly_trend': TransactionDate
 2023-12     3769.52
 2024-01    66376.39
 2024-02    51459.27
 2024-03    47828.73
 2024-04    57519.06
 Freq: M, Name: TotalValue, dtype: float64}
```

```
# Merge transactions with products
transactions_data = transactions.merge(products, on='ProductID', how='left')
print(transactions_data)
# Merge transactions with customers
customer_data = transactions.merge(customers, on='CustomerID', how='left')
print(customer_data)
```

```
    TransactionID CustomerID ProductID      TransactionDate  Quantity  \
0          T00001      C0199      P067  2024-08-25 12:38:23         1   
1          T00112      C0146      P067  2024-05-27 22:23:54         1   
2          T00166      C0127      P067  2024-04-25 07:38:55         1   
3          T00272      C0087      P067  2024-03-26 22:55:37         2   
4          T00363      C0070      P067  2024-03-21 15:10:10         3   
..            ...        ...       ...                  ...       ...   
995        T00496      C0118      P037  2024-10-24 08:30:27         1   
996        T00759      C0059      P037  2024-06-04 02:15:24         3   
997        T00922      C0018      P037  2024-04-05 13:05:32         4   
998        T00959      C0115      P037  2024-09-29 10:16:02         2   
999        T00992      C0024      P037  2024-04-21 10:52:24         1   

     TotalValue  Price_x                      ProductName     Category  \
0        300.68   300.68  ComfortLiving Bluetooth Speaker  Electronics   
1        300.68   300.68  ComfortLiving Bluetooth Speaker  Electronics   
2        300.68   300.68  ComfortLiving Bluetooth Speaker  Electronics   
3        601.36   300.68  ComfortLiving Bluetooth Speaker  Electronics   
4        902.04   300.68  ComfortLiving Bluetooth Speaker  Electronics   
..          ...      ...                              ...          ...   
995      459.86   459.86              SoundWave Smartwatch  Electronics   
996     1379.58   459.86              SoundWave Smartwatch  Electronics   
997     1839.44   459.86              SoundWave Smartwatch  Electronics   
998      919.72   459.86              SoundWave Smartwatch  Electronics   
999      459.86   459.86              SoundWave Smartwatch  Electronics   

     Price_y  
0     300.68  
1     300.68  
2     300.68  
3     300.68  
4     300.68  
..       ...  
995   459.86  
```

```
996   459.86
997   459.86
998   459.86
999   459.86

[1000 rows x 10 columns]
    TransactionID CustomerID ProductID      TransactionDate  Quantity  \
0          T00001      C0199      P067  2024-08-25 12:38:23         1
1          T00112      C0146      P067  2024-05-27 22:23:54         1
2          T00166      C0127      P067  2024-04-25 07:38:55         1
3          T00272      C0087      P067  2024-03-26 22:55:37         2
4          T00363      C0070      P067  2024-03-21 15:10:10         3
..            ...        ...       ...                  ...       ...
995        T00496      C0118      P037  2024-10-24 08:30:27         1
996        T00759      C0059      P037  2024-06-04 02:15:24         3
997        T00922      C0018      P037  2024-04-05 13:05:32         4
998        T00959      C0115      P037  2024-09-29 10:16:02         2
999        T00992      C0024      P037  2024-04-21 10:52:24         1

     TotalValue   Price          CustomerName         Region  SignupDate
0        300.68  300.68        Andrea Jenkins         Europe  2022-12-03
1        300.68  300.68       Brittany Harvey           Asia  2024-09-04
2        300.68  300.68       Kathryn Stevens         Europe  2024-04-04
3        601.36  300.68       Travis Campbell  South America  2024-04-11
```

```
transactions_data = transactions_data.drop(columns=["Price_y"])
transactions_data = transactions_data.rename(columns={"Price_x" : "Amount"})
transactions_data
```

	TransactionID	CustomerID	ProductID	TransactionDate	Quantity	TotalValue	Amount	ProductName	Category
0	T00001	C0199	P067	2024-08-25 12:38:23	1	300.68	300.68	ComfortLiving Bluetooth Speaker	Electronics
1	T00112	C0146	P067	2024-05-27 22:23:54	1	300.68	300.68	ComfortLiving Bluetooth Speaker	Electronics
2	T00166	C0127	P067	2024-04-25 07:38:55	1	300.68	300.68	ComfortLiving Bluetooth Speaker	Electronics
3	T00272	C0087	P067	2024-03-26 22:55:37	2	601.36	300.68	ComfortLiving Bluetooth Speaker	Electronics
4	T00363	C0070	P067	2024-03-21 15:10:10	3	902.04	300.68	ComfortLiving Bluetooth Speaker	Electronics
...	...	...	...	...	...	...	...	...	...
995	T00496	C0118	P037	2024-10-24 08:30:27	1	459.86	459.86	SoundWave Smartwatch	Electronics
996	T00759	C0059	P037	2024-06-04 02:15:24	3	1379.58	459.86	SoundWave Smartwatch	Electronics
997	T00922	C0018	P037	2024-04-05 13:05:32	4	1839.44	459.86	SoundWave Smartwatch	Electronics
998	T00959	C0115	P037	2024-09-29 10:16:02	2	919.72	459.86	SoundWave Smartwatch	Electronics
999	T00992	C0024	P037	2024-04-21 10:52:24	1	459.86	459.86	SoundWave Smartwatch	Electronics

1000 rows × 9 columns

```
# Step 3: Feature Engineering
# Aggregate transaction data to customer level
customer_features = customer_data.groupby('CustomerID').agg({
    'Price': 'sum',  # Total spending
    'Quantity': 'sum',  # Total quantity purchased
    'ProductID': 'nunique',  # Number of unique products purchased
    #'Category': lambda x: x.mode()[0] if not x.mode().empty else None,  # Most common product category
}).reset_index()

# Encode categorical features (e.g., Category)
#customer_features = pd.get_dummies(customer_features, columns=['Category'], drop_first=True)

# Merge with customer demographics
customer_features = customer_features.merge(customers, on='CustomerID', how='left')

# Step 4: Normalize Features
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
numeric_columns = customer_features.select_dtypes(include=['float64', 'int64']).columns
customer_features[numeric_columns] = scaler.fit_transform(customer_features[numeric_columns])
```

```
import pandas as pd
from sklearn.metrics.pairwise import cosine_similarity

# Load the Customers CSV
customers = pd.read_csv('Customers.csv')
```

```
# Check the data types of the columns to ensure we have numeric columns
print("Data types of columns:")
print(customers.dtypes)

# Select only the numeric columns (e.g., exclude customer names, categorical columns)
numeric_columns = customers.select_dtypes(include=['float64', 'int64']).columns

# Debug: Check which numeric columns are selected
print("\nNumeric columns selected:")
print(numeric_columns)

# If no numeric columns are found, print the first few rows of the data to inspect
if len(numeric_columns) == 0:
    print("\nInspecting the first few rows of the data:")
    print(customers.head())

# If there are numeric columns, proceed with feature extraction
if len(numeric_columns) > 0:
    # Extract the features (first 20 customers) based on the numeric columns
    features = customers.loc[0:19, numeric_columns].values
    customer_ids = customers.loc[0:19, 'CustomerID'].values

    # Calculate cosine similarity matrix
    similarity_matrix = cosine_similarity(features)

    # Ensure that the similarity matrix has the expected size (20, 20)
    print("\nShape of the similarity matrix:", similarity_matrix.shape)
```

```
Data types of columns:
CustomerID      object
CustomerName    object
Region          object
SignupDate      object
dtype: object

Numeric columns selected:
Index([], dtype='object')

Inspecting the first few rows of the data:
  CustomerID        CustomerName         Region  SignupDate
0      C0001    Lawrence Carroll  South America  2022-07-10
1      C0002      Elizabeth Lutz           Asia  2022-02-13
2      C0003      Michael Rivera  South America  2024-03-07
3      C0004  Kathleen Rodriguez  South America  2022-10-09
4      C0005         Laura Weber           Asia  2022-08-15
```

```
customer_ids=['C0001','C0002','C0003','C0004','C0005','C0006','C0007','C0008','C0009','C0010','C0011','C0012','C0013','C0014','C0015','C001
for i in customer_ids:
       target_customer_id = i  # Replace with a valid CustomerID
       recommendations = recommend_similar_customers(target_customer_id, top_n=3)
       print("Recommendations for Customer", target_customer_id)
       print(recommendations)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-33-ba58db71364f> in <cell line: 0>()
      2 for i in customer_ids:
      3        target_customer_id = i  # Replace with a valid CustomerID
----> 4        recommendations = recommend_similar_customers(target_customer_id, top_n=3)
      5        print("Recommendations for Customer", target_customer_id)
      6        print(recommendations)

<ipython-input-31-93275609bcfd> in recommend_similar_customers(target_customer_id, top_n)
     13
     14         # Get similarity scores for the target customer
---> 15         similarity_scores = similarity_matrix[target_index]
     16
     17         # Get the indices of the top N similar customers (excluding the target itself)

NameError: name 'similarity_matrix' is not defined
```

Next steps: Explain error

```
import pandas as pd
from sklearn.metrics.pairwise import cosine_similarity
```

```python
def recommend_similar_customers(customer_id, top_n=3):
    """
    Recommends similar customers based on cosine similarity.

    Args:
        customer_id (str): The ID of the target customer.
        top_n (int): The number of similar customers to recommend.

    Returns:
        list: A list of CustomerIDs of the most similar customers.
    """

    # Load the Customers CSV
    customers = pd.read_csv('Customers.csv')

    # Select only the numeric columns
    numeric_columns = customers.select_dtypes(include=['float64', 'int64']).columns

    # If no numeric columns are found, return an empty list
    if len(numeric_columns) == 0:
        print("No numeric columns found for similarity calculation.")
        return []

    # Extract the features
    features = customers[numeric_columns].values
    customer_ids = customers['CustomerID'].values

    # Find the index of the target customer
    target_index = customers[customers['CustomerID'] == customer_id].index[0]

    # Calculate cosine similarity matrix
    similarity_matrix = cosine_similarity(features)

    # Get similarity scores for the target customer
    similarity_scores = similarity_matrix[target_index]

    # Exclude the customer itself and get top similar customers
    similarity_scores[target_index] = -1  # Set self-similarity to -1
    sorted_indices = similarity_scores.argsort()[::-1][:top_n]

    # Return the CustomerIDs of the most similar customers
    return [customer_ids[i] for i in sorted_indices]

# Your existing code for generating recommendations...
customer_ids=['C0001','C0002','C0003','C0004','C0005','C0006','C0007','C0008','C0009','C0010','C0011','C0012','C0013','C0014','C0015','C0016'
for i in customer_ids:
       target_customer_id = i  # Replace with a valid CustomerID
       recommendations = recommend_similar_customers(target_customer_id, top_n=3)
       print("Recommendations for Customer", target_customer_id)
       print(recommendations)
```

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No numeric columns found for similarity calculation.
Recommendations for Customer C0002
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Recommendations for Customer C0003
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Recommendations for Customer C0019
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Recommendations for Customer C0020
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```

Start coding or generate with AI.

Start coding or generate with AI.