```
import pandas as pd
import numpy as np
from sklearn.preprocessing import LabelEncoder
import matplotlib.pyplot as plt
import seaborn as sns
```

```
df = pd.read_csv("train.csv")
```

```
df.head()
```

	User_ID	Product_ID	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Prod
0	1000001	P00069042	F	0-17	10	A	2	0.0	3.0	
1	1000001	P00248942	F	0-17	10	A	2	0.0	1.0	
2	1000001	P00087842	F	0-17	10	A	2	0.0	12.0	

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 383980 entries, 0 to 383979
Data columns (total 12 columns):
 #   Column                      Non-Null Count   Dtype
---  ------                      --------------   -----
 0   User_ID                     383980 non-null  int64
 1   Product_ID                  383980 non-null  object
 2   Gender                      383980 non-null  object
 3   Age                         383980 non-null  object
 4   Occupation                  383980 non-null  int64
 5   City_Category               383980 non-null  object
 6   Stay_In_Current_City_Years  383979 non-null  object
 7   Marital_Status              383979 non-null  float64
 8   Product_Category_1          383979 non-null  float64
 9   Product_Category_2          264893 non-null  float64
 10  Product_Category_3          117520 non-null  float64
 11  Purchase                    383979 non-null  float64
dtypes: float64(5), int64(2), object(5)
memory usage: 35.2+ MB
```

```
print(df.isnull().sum())
```

```
User_ID                           0
Product_ID                        0
Gender                            0
Age                               0
Occupation                        0
City_Category                     0
Stay_In_Current_City_Years        1
Marital_Status                    1
Product_Category_1                1
Product_Category_2           119087
Product_Category_3           266460
Purchase                          1
dtype: int64
```

```
df.fillna(-1, inplace=True)
```

```
print(df.isnull().sum())
```

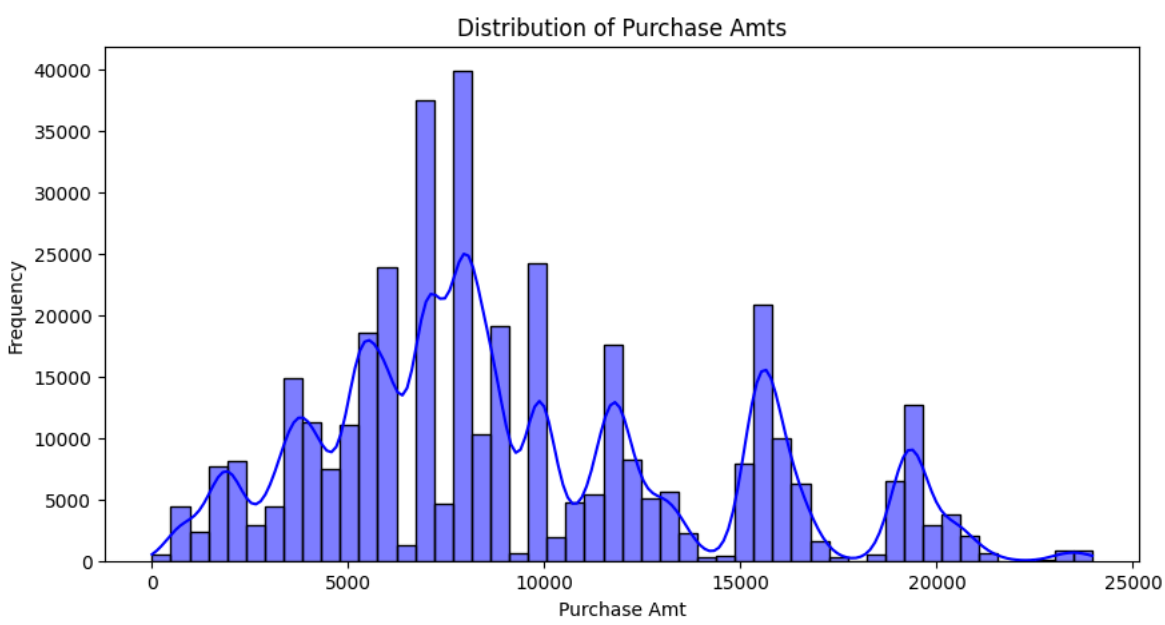
```
User_ID                     0
Product_ID                  0
Gender                      0
Age                         0
Occupation                  0
City_Category               0
Stay_In_Current_City_Years  0
Marital_Status              0
Product_Category_1          0
Product_Category_2          0
Product_Category_3          0
Purchase                    0
dtype: int64
```

```
df["Gender"] = df["Gender"].map({"M": 1, "F": 0})
```

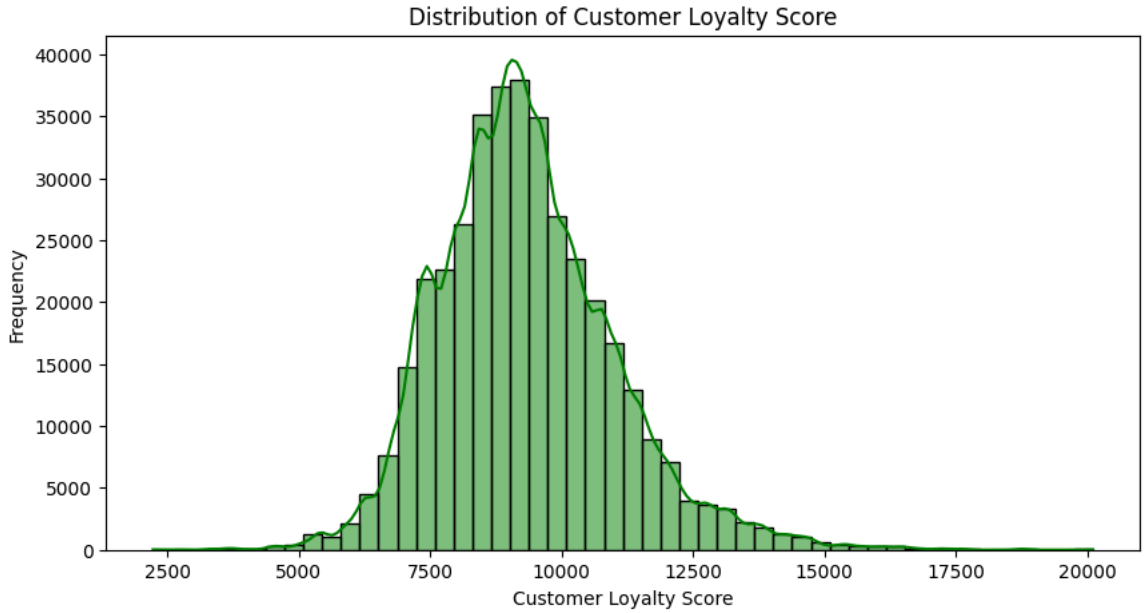
```
df["City_Category"] = df["City_Category"].map({"A": 0, "B": 1, "C": 2})


age_mapping = {'0-17': 0, '18-25': 1, '26-35': 2, '36-45': 3, '46-50': 4, '51-55': 5, '55+': 6}
df["Age"] = df["Age"].map(age_mapping)


df["Stay_In_Current_City_Years"] = df["Stay_In_Current_City_Years"].replace("4+", 4).astype(int)


df.head()
```

	User_ID	Product_ID	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Prod
0	1000001	P00069042	0	0	10	0	2	0.0	3.0	
1	1000001	P00248942	0	0	10	0	2	0.0	1.0	
2	1000001	P00087842	0	0	10	0	2	0.0	12.0	
3	1000001	P00085442	0	0	10	0	2	0.0	12.0	
4	1000002	P00285442	1	6	16	2	4	0.0	8.0	

```
df["Customer_Loyalty_Score"] = df.groupby("User_ID")["Purchase"].transform("sum") / df.groupby("User_ID")["Product_ID"].transform("nunic


df["Product_Popularity_Index"] = df.groupby("Product_ID")["Purchase"].transform("sum")


df["Total_Products_Bought"] = df.groupby("User_ID")["Product_ID"].transform("count")


df.drop(["User_ID", "Product_ID"], axis=1, inplace=True)


plt.figure(figsize=(10, 5))
sns.histplot(df["Purchase"], bins=50, kde=True, color="blue")
plt.title("Distribution of Purchase Amts")
plt.xlabel("Purchase Amt")
plt.ylabel("Frequency")
plt.show()
```

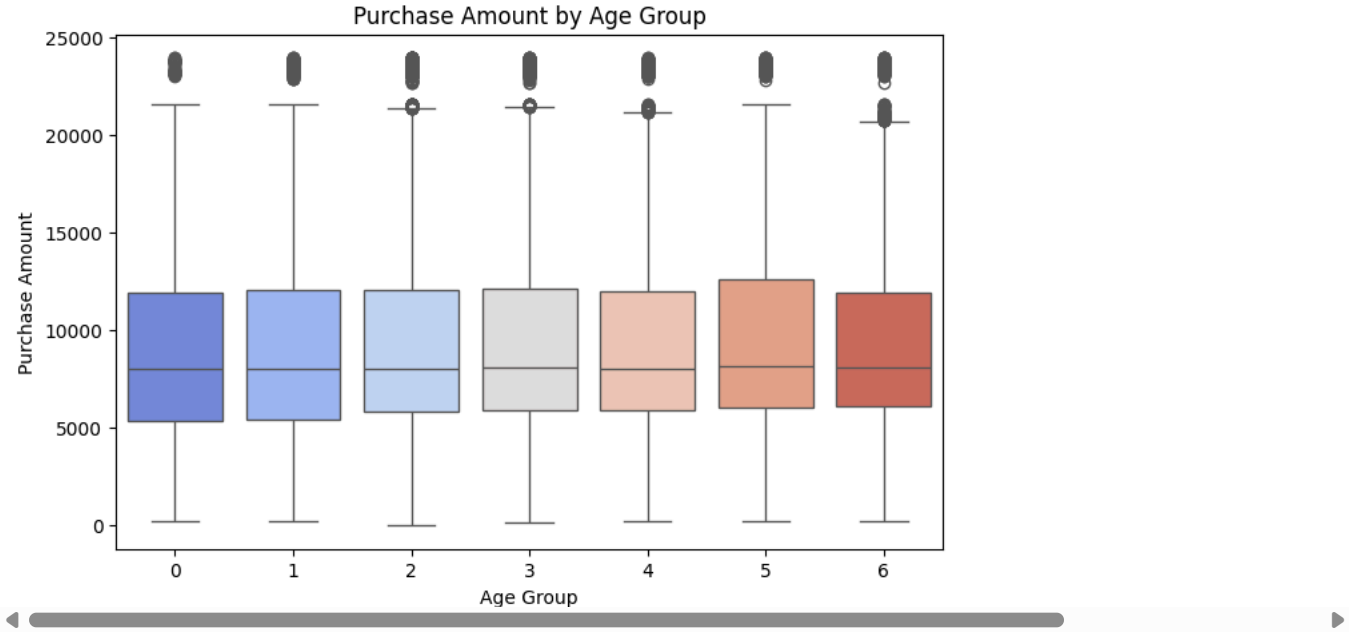



```
plt.figure(figsize=(10, 5))
sns.histplot(df["Customer_Loyalty_Score"], bins=50, kde=True, color="green")
plt.title("Distribution of Customer Loyalty Score")
plt.xlabel("Customer Loyalty Score")
plt.ylabel("Frequency")
plt.show()
```

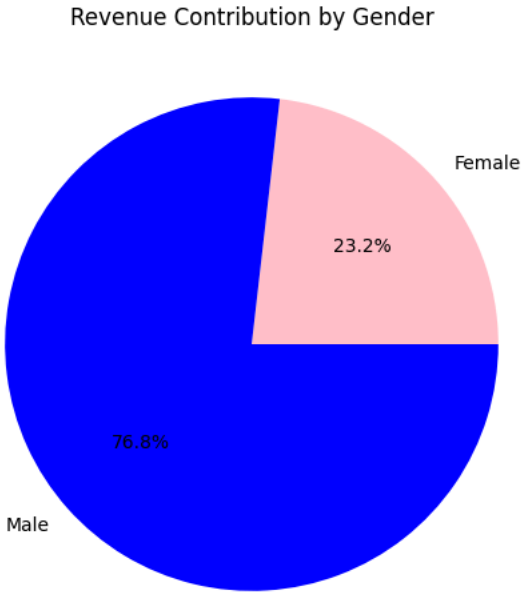



```
plt.figure(figsize=(8, 5))
sns.boxplot(x="Age", y="Purchase", data=df, palette="coolwarm")
plt.title("Purchase Amount by Age Group")
plt.xlabel("Age Group")
plt.ylabel("Purchase Amount")
plt.show()
```

```
<ipython-input-19-bdcee78464ef>:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `le

  sns.boxplot(x="Age", y="Purchase", data=df, palette="coolwarm")
```




```
gender_revenue = df.groupby("Gender")["Purchase"].sum().reset_index()

plt.figure(figsize=(6, 6))
plt.pie(gender_revenue["Purchase"], labels=["Female", "Male"], autopct="%1.1f%%", colors=["pink", "blue"])
plt.title("Revenue Contribution by Gender")
plt.show()
```




```
plt.figure(figsize=(8, 5))
sns.boxplot(x="City_Category", y="Purchase", data=df, palette="Set2")
plt.title("Purchase Trends Across Cities")
plt.xlabel("City Category (A: Metro, B: Tier 2, C: Tier 3)")
plt.ylabel("Purchase Amount")
plt.show()
```

```
<ipython-input-21-fec2ce1f3b8a>:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `le

  sns.boxplot(x="City_Category", y="Purchase", data=df, palette="Set2")
```


```
from sklearn.model_selection import train_test_split


X = df.drop("Purchase", axis=1)
y = df["Purchase"]

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score
import math
```

```
lr_model = LinearRegression()
lr_model.fit(X_train, y_train)
```

```
y_pred_lr = lr_model.predict(X_test)
```

```
mae_lr = mean_absolute_error(y_test, y_pred_lr)
rmse_lr = math.sqrt(mean_squared_error(y_test, y_pred_lr))
r2_lr = r2_score(y_test, y_pred_lr)

print("Linear Regression Performance:")
print(f"MAE: {mae_lr:.4f}")
print(f"RMSE: {rmse_lr:.4f}")
print(f"R2 Score: {r2_lr:.4f}")
```

```
Linear Regression Performance:
MAE: 2959.9453
RMSE: 3889.1440
R2 Score: 0.3902
```

```
import pandas as pd
```

```
comparison_df = pd.DataFrame({
    'Actual': y_test,
    'Predicted': y_pred_lr
})
```

```
print(comparison_df.tail(10))
```

```
          Actual     Predicted
209096   6033.0   5917.931109
44791   11961.0   9412.522603
298974  19008.0  11059.827371
257433   5258.0   5814.386634
348555  20158.0  10945.729336
301262   3677.0   6887.784883
168533   8822.0  11425.420344
243302  19155.0  15087.268346
73592   19175.0  15358.140413
254399   2078.0   7219.667331
```

```
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score
import math
```

```
rf_model = RandomForestRegressor(n_estimators=100, random_state=42)
```

```
rf_model.fit(X_train, y_train)
```

```
y_pred_rf = rf_model.predict(X_test)
```

```
mae_rf = mean_absolute_error(y_test, y_pred_rf)
rmse_rf = math.sqrt(mean_squared_error(y_test, y_pred_rf))
r2_rf = r2_score(y_test, y_pred_rf)

print("Random Forest Performance:")
print(f"MAE: {mae_rf:.4f}")
print(f"RMSE: {rmse_rf:.4f}")
print(f"R2 Score: {r2_rf:.4f}")
```

```
Random Forest Performance:
MAE: 1934.6645
RMSE: 2619.6267
R2 Score: 0.7234
```

```
import pandas as pd
```

```
comparison_df = pd.DataFrame({
    'Actual': y_test,
    'Predicted': y_pred_rf
})
```

```
print(comparison_df.tail(10))
```

```
          Actual  Predicted
209096   6033.0    6850.37
44791   11961.0   13311.99
298974  19008.0   11624.30
257433   5258.0    5131.46
348555  20158.0   17456.87
301262   3677.0    3782.34
168533   8822.0    6903.43
243302  19155.0   16436.67
73592   19175.0   16767.92
254399   2078.0    6993.27
```

```
import xgboost as xgb
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score
import math


xgb_model = xgb.XGBRegressor(objective='reg:squarederror', random_state=42)


xgb_model.fit(X_train, y_train)


y_pred_xgb = xgb_model.predict(X_test)


mae_xgb = mean_absolute_error(y_test, y_pred_xgb)
rmse_xgb = math.sqrt(mean_squared_error(y_test, y_pred_xgb))
r2_xgb = r2_score(y_test, y_pred_xgb)

print("Basic XGBoost Performance:")
print(f"MAE: {mae_xgb:.4f}")
print(f"RMSE: {rmse_xgb:.4f}")
print(f"R2 Score: {r2_xgb:.4f}")
```

```
Basic XGBoost Performance:
MAE: 1892.8309
RMSE: 2550.0058
R2 Score: 0.7379
```

```
import pandas as pd


comparison_df = pd.DataFrame({
    'Actual': y_test,
    'Predicted': y_pred_xgb
})


print(comparison_df.tail(10))
```

```
          Actual     Predicted
209096   6033.0   7038.531738
44791   11961.0  12416.989258
298974  19008.0  12940.225586
257433   5258.0   4973.995605
348555  20158.0  16805.087891
301262   3677.0   6362.686523
168533   8822.0   7270.750000
243302  19155.0  16966.843750
73592   19175.0  16197.197266
254399   2078.0   7471.643066
```

Start coding or generate with AI.