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


from google.colab import files
uploaded = files.upload()


train = pd.read_csv("train.csv")
test = pd.read_csv("test.csv")
sample_sub = pd.read_csv("sample_submission.csv")


print("Train shape:", train.shape)
print("Test shape:", test.shape)
train.head()
```

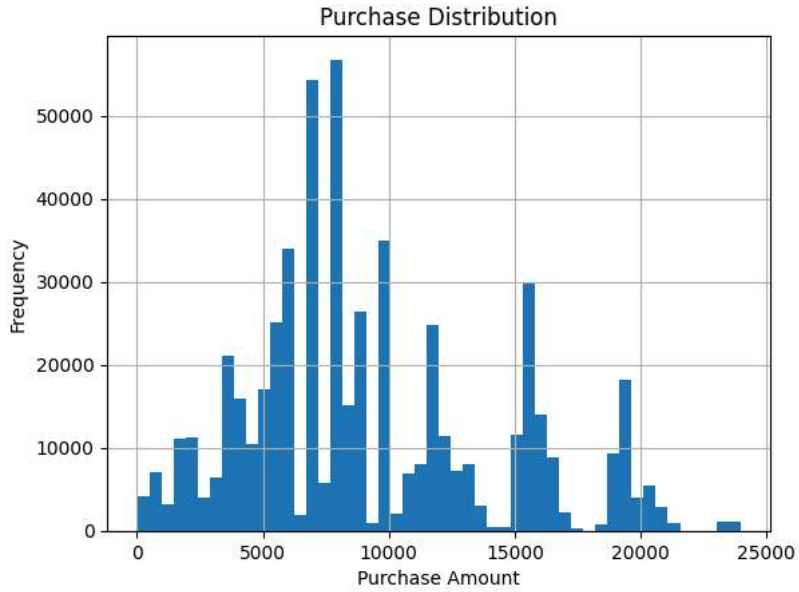
Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving sample_submission.csv to sample_submission (2).csv
Saving test.csv to test (2).csv
Saving train.csv to train (1).csv
Train shape: (550068, 12)
Test shape: (233599, 12)
```

	User_ID	Product_ID	Gender	Age	Occupation	City_Category	Stay_In_Current_City_Years	Marital_Status	Product_Category_1	Product_
0	1000001	P00069042	F	0-17	10	A	2	0	3	
1	1000001	P00248942	F	0-17	10	A	2	0	1	
2	1000001	P00087842	F	0-17	10	A	2	0	12	

```
train.info()


print(train.isnull().sum())


train['Purchase'].hist(bins=50)
plt.xlabel("Purchase Amount")
plt.ylabel("Frequency")
plt.title("Purchase Distribution")
plt.show()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 550068 entries, 0 to 550067
Data columns (total 12 columns):
 #   Column                      Non-Null Count   Dtype  
---  ------                      --------------   -----  
 0   User_ID                     550068 non-null  int64  
 1   Product_ID                  550068 non-null  object 
 2   Gender                      550068 non-null  object 
 3   Age                         550068 non-null  object 
 4   Occupation                  550068 non-null  int64  
 5   City_Category               550068 non-null  object 
 6   Stay_In_Current_City_Years  550068 non-null  object 
 7   Marital_Status              550068 non-null  int64  
 8   Product_Category_1          550068 non-null  int64  
 9   Product_Category_2          376430 non-null  float64
 10  Product_Category_3          166821 non-null  float64
 11  Purchase                    550068 non-null  int64  
dtypes: float64(2), int64(5), object(5)
memory usage: 50.4+ MB
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            173638
Product_Category_3            383247
Purchase                           0
dtype: int64
```




```
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OrdinalEncoder, StandardScaler
from sklearn.impute import SimpleImputer


target = "Purchase"

cat_cols = ["Gender","Age","City_Category","Stay_In_Current_City_Years","Product_ID","User_ID"]
num_cols = ["Occupation","Marital_Status","Product_Category_1","Product_Category_2","Product_Category_3"]


num_pipe = Pipeline([
    ("imputer", SimpleImputer(strategy="median")),
    ("scaler", StandardScaler())
])

cat_pipe = Pipeline([
    ("imputer", SimpleImputer(strategy="most_frequent")),
    ("encoder", OrdinalEncoder(handle_unknown="use_encoded_value", unknown_value=-1))
])
```

```
preprocessor = ColumnTransformer([
    ("num", num_pipe, num_cols),
    ("cat", cat_pipe, cat_cols)
])
```

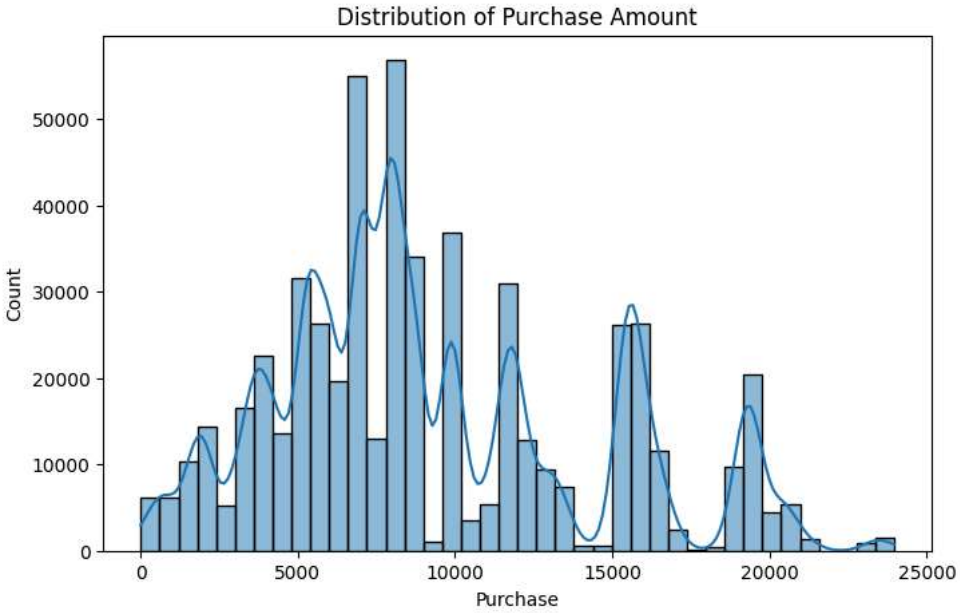
```
duplicates = train.duplicated().sum()
print("Number of exact duplicate rows in train:", duplicates)
```

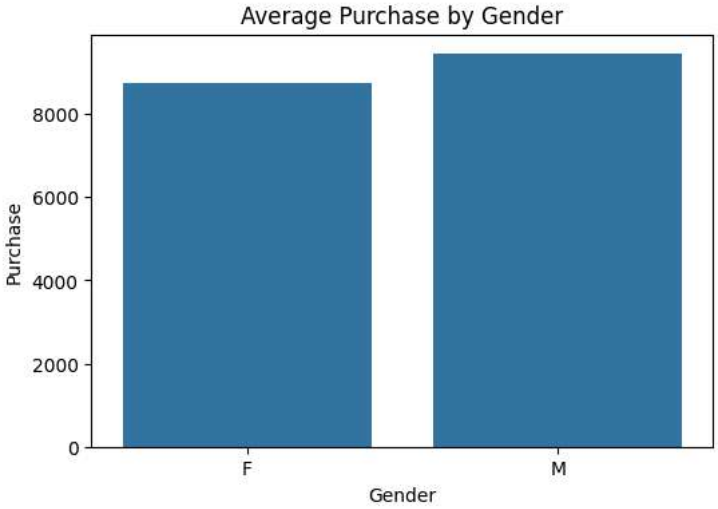
```
Number of exact duplicate rows in train: 0
```

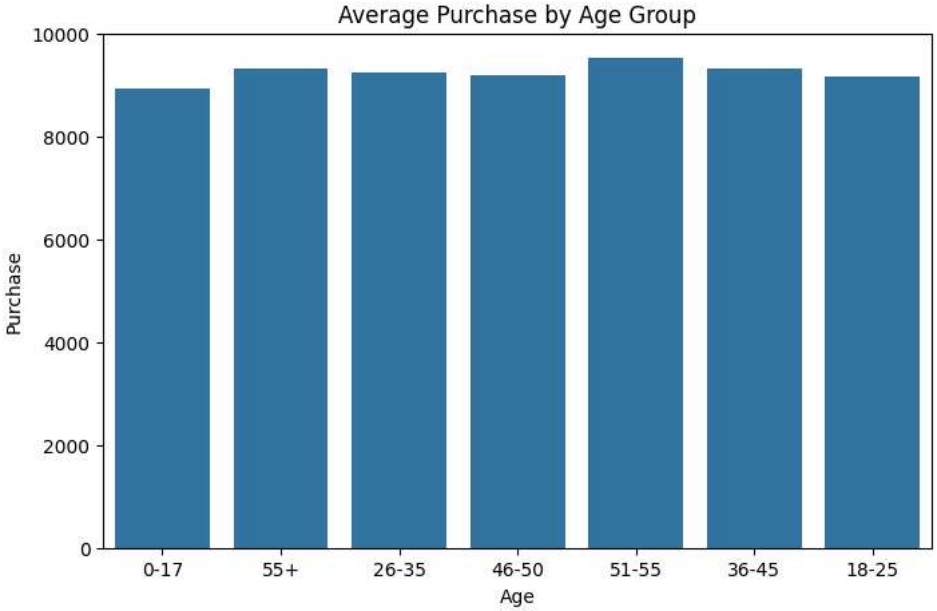
```
duplicates = test.duplicated().sum()
print("Number of exact duplicate rows in test:", duplicates)
```

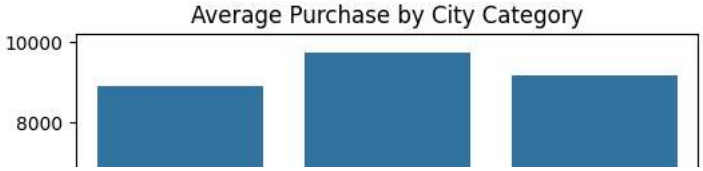
```
Number of exact duplicate rows in test: 0
```

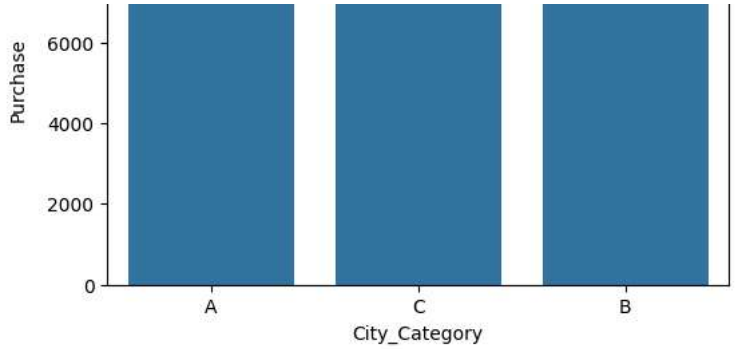
```
import matplotlib.pyplot as plt
import seaborn as sns

# Copy the train dataset for EDA
eda_df = train.copy()

# 1. Distribution of Target Variable (Purchase Amount)
plt.figure(figsize=(8,5))
sns.histplot(eda_df["Purchase"], bins=40, kde=True)
plt.title("Distribution of Purchase Amount")
plt.show()

# 2. Purchase vs Gender
plt.figure(figsize=(6,4))
sns.barplot(data=eda_df, x="Gender", y="Purchase", estimator="mean", errorbar=None)
plt.title("Average Purchase by Gender")
plt.show()

# 3. Purchase vs Age
plt.figure(figsize=(8,5))
sns.barplot(data=eda_df, x="Age", y="Purchase", estimator="mean", errorbar=None)
plt.title("Average Purchase by Age Group")
plt.show()

# 4. Purchase vs City Category
plt.figure(figsize=(6,4))
sns.barplot(data=eda_df, x="City_Category", y="Purchase", estimator="mean", errorbar=None)
plt.title("Average Purchase by City Category")
plt.show()

# 5. Purchase vs Marital Status
plt.figure(figsize=(6,4))
sns.barplot(data=eda_df, x="Marital_Status", y="Purchase", estimator="mean", errorbar=None)
plt.title("Average Purchase by Marital Status")
plt.show()

# 6. Correlation Heatmap (numerical features)
plt.figure(figsize=(10,6))
sns.heatmap(eda_df.corr(numeric_only=True), annot=True, cmap="coolwarm")
plt.title("Correlation Heatmap")
plt.show()
```

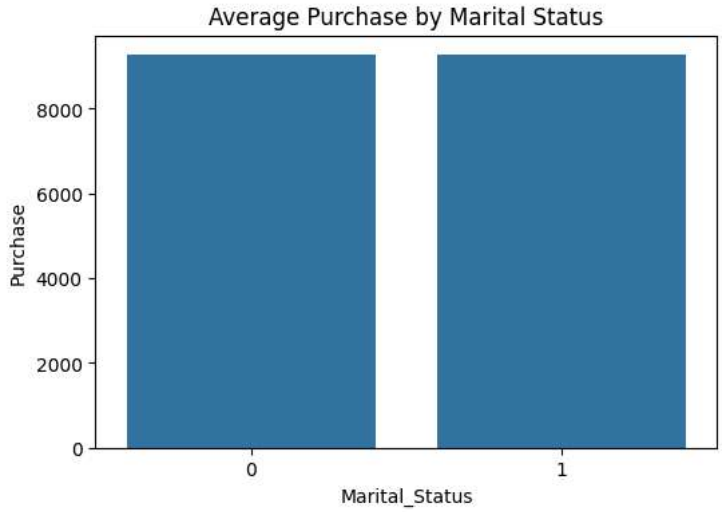

Distribution of Purchase Amount
Count
Purchase
0
10000
20000
30000
40000
50000
0
5000
10000
15000
20000
25000

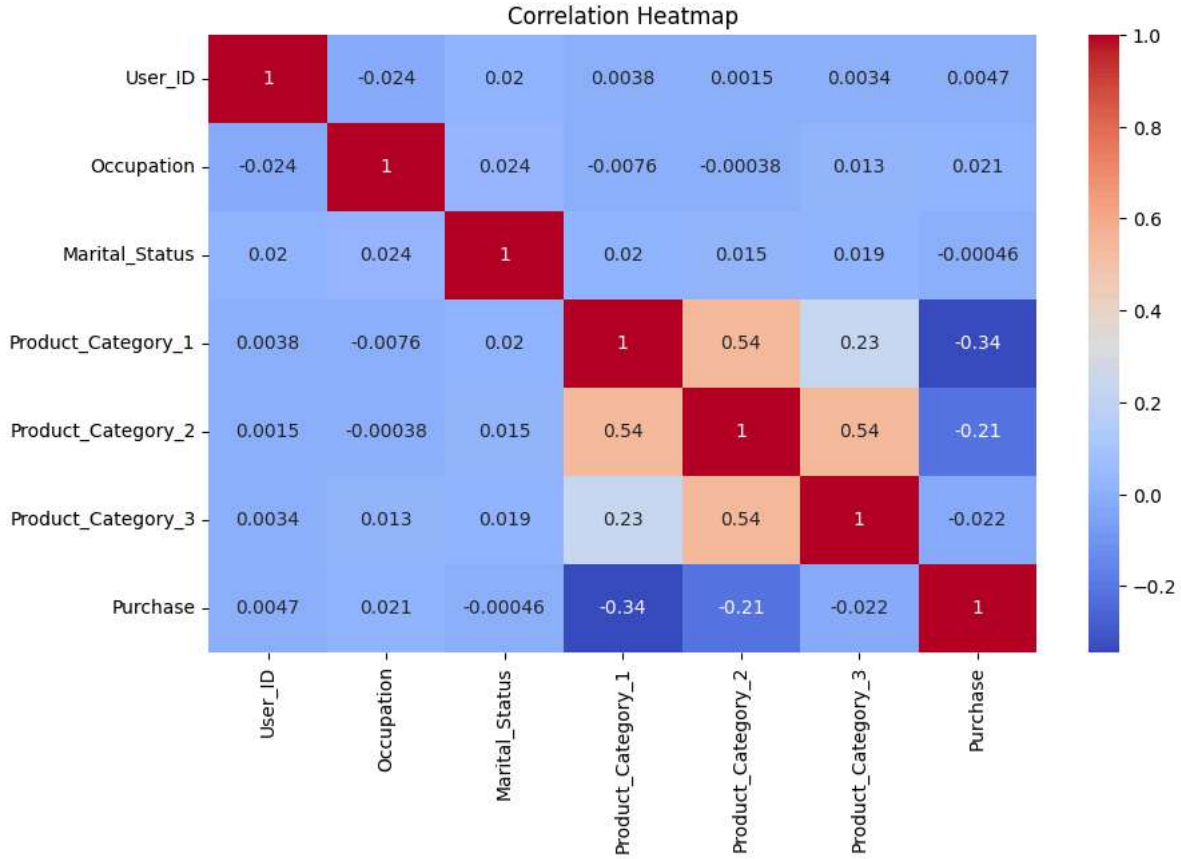

Average Purchase by Gender
Purchase
Gender
F
M
0
2000
4000
6000
8000


Average Purchase by Age Group
Purchase
Age
0-17
55+
26-35
46-50
51-55
36-45
18-25
0
2000
4000
6000
8000
10000


Average Purchase by City Category
10000
8000


Purchase
6000
4000
2000
0
A
C
B
City_Category


Average Purchase by Marital Status
Purchase
8000
6000
4000
2000
0
0
1
Marital_Status


Correlation Heatmap
User_ID 1 -0.024 0.02 0.0038 0.0015 0.0034 0.0047
Occupation -0.024 1 0.024 -0.0076 -0.00038 0.013 0.021
Marital_Status 0.02 0.024 1 0.02 0.015 0.019 -0.00046
Product_Category_1 0.0038 -0.0076 0.02 1 0.54 0.23 -0.34
Product_Category_2 0.0015 -0.00038 0.015 0.54 1 0.54 -0.21
Product_Category_3 0.0034 0.013 0.019 0.23 0.54 1 -0.022
Purchase 0.0047 0.021 -0.00046 -0.34 -0.21 -0.022 1
User_ID
Occupation
Marital_Status
Product_Category_1
Product_Category_2
Product_Category_3
Purchase
1.0
0.8
0.6
0.4
0.2
0.0
−0.2

```
#decisiontreeregressor
from sklearn.tree import DecisionTreeRegressor
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
import numpy as np


X = train[cat_cols + num_cols]
y = train[target]


X_train, X_valid, y_train, y_valid = train_test_split(
    X, y, test_size=0.2, random_state=42
)


dt_model = Pipeline([
    ("preprocess", preprocessor),
    ("model", DecisionTreeRegressor(
        max_depth=10,
        random_state=42
    ))
])


dt_model.fit(X_train, y_train)


dt_preds = dt_model.predict(X_valid)


dt_rmse = np.sqrt(mean_squared_error(y_valid, dt_preds))
print("Decision Tree RMSE:", dt_rmse)
```

```
Decision Tree RMSE: 2850.7836065238166
```

```
# Random Forest Regressor


from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline

X = train[cat_cols + num_cols]
y = train[target]

X_train, X_valid, y_train, y_valid = train_test_split(
    X, y, test_size=0.2, random_state=42
)

rf_model = Pipeline([
    ("preprocess", preprocessor),
    ("model", RandomForestRegressor(
        n_estimators=100,
        max_depth=15,
        n_jobs=-1,
        random_state=42
    ))
])

rf_model.fit(X_train, y_train)

rf_preds = rf_model.predict(X_valid)

rf_rmse = np.sqrt(mean_squared_error(y_valid, rf_preds))
print("Random Forest RMSE:", rf_rmse)
```

```
Random Forest RMSE: 2719.4869127676334
```

```
# XGBoost Regressor


from xgboost import XGBRegressor
```

```
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
import numpy as np

X = train[cat_cols + num_cols]
y = train[target]

X_train, X_valid, y_train, y_valid = train_test_split(
    X, y, test_size=0.2, random_state=42
)

xgb_model = Pipeline([
    ("preprocess", preprocessor),
    ("model", XGBRegressor(
        n_estimators=300,
        learning_rate=0.1,
        max_depth=8,
        subsample=0.8,
        colsample_bytree=0.8,
        random_state=42,
        n_jobs=-1
    ))
])

xgb_model.fit(X_train, y_train)

xgb_preds = xgb_model.predict(X_valid)

xgb_rmse = np.sqrt(mean_squared_error(y_valid, xgb_preds))
print("XGBoost RMSE:", xgb_rmse)
```

```
XGBoost RMSE: 2587.0555656962606
```

```
# Submission: Decision Tree

dt_final = Pipeline([
    ("preprocess", preprocessor),
    ("model", DecisionTreeRegressor(
        max_depth=10,
        random_state=42
    ))
])

dt_final.fit(train[cat_cols + num_cols], train[target])


dt_test_preds = dt_final.predict(test[cat_cols + num_cols])


submission_dt = sample_sub.copy()
submission_dt["Purchase"] = dt_test_preds

submission_dt.to_csv("submission_decisiontree.csv", index=False)
print("✅ Decision Tree submission file created!")
```

```
✅ Decision Tree submission file created!
```

```
# Submission: Random Forest


rf_final = Pipeline([
    ("preprocess", preprocessor),
    ("model", RandomForestRegressor(
        n_estimators=100,
        max_depth=15,
        n_jobs=-1,
        random_state=42
    ))
])

rf_final.fit(train[cat_cols + num_cols], train[target])

rf_test_preds = rf_final.predict(test[cat_cols + num_cols])

submission_rf = sample_sub.copy()
```