Import Libraries

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings("ignore")
sns.set(style="whitegrid")
```

```
# Load dataset (ensure the file is in your directory)
df = pd.read_csv("/content/synthetic_sales_data.csv", parse_dates=['Purchase_Date'])
df.head()
```

	CustomerID	Age	Gender	Annual_Income	Spending_Score	Region	Purchase_Amount	Purchase_Date
0	1001	56.0	Female	24449.26	2	East	336.65	2023-01-01
1	1002	69.0	Male	49166.78	47	East	274.30	2023-01-02
2	1003	46.0	Male	55760.98	78	West	401.09	2023-01-03
3	1004	32.0	Female	49509.58	84	South	286.95	2023-01-04
4	1005	60.0	Male	18988.37	22	East	239.57	2023-01-05

Next steps: Generate code with df | View recommended plots | New interactive sheet

Basic Info and Missing Data

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 500 entries, 0 to 499
Data columns (total 8 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   CustomerID       500 non-null    int64
 1   Age              475 non-null    float64
 2   Gender           500 non-null    object
 3   Annual_Income    475 non-null    float64
 4   Spending_Score   500 non-null    int64
 5   Region           500 non-null    object
 6   Purchase_Amount  475 non-null    float64
 7   Purchase_Date    500 non-null    datetime64[ns]
dtypes: datetime64[ns](1), float64(3), int64(2), object(2)
memory usage: 31.4+ KB
```

```
df.describe(include='all')
```

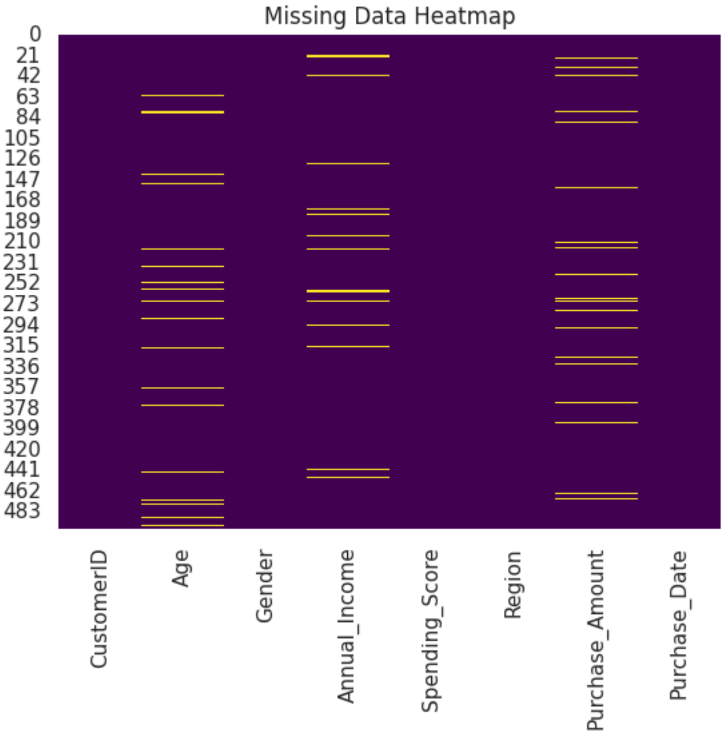
	CustomerID	Age	Gender	Annual_Income	Spending_Score	Region	Purchase_Amount	Purchase_Date
count	500.000000	475.000000	500	475.000000	500.000000	500	475.000000	500
unique	NaN	NaN	2	NaN	NaN	4	NaN	NaN
top	NaN	NaN	Male	NaN	NaN	South	NaN	NaN
freq	NaN	NaN	262	NaN	NaN	135	NaN	NaN
mean	1250.500000	44.077895	NaN	49804.267137	49.274000	NaN	299.115916	2023-09-07 12:00:00
min	1001.000000	18.000000	NaN	9546.700000	1.000000	NaN	-35.160000	2023-01-01 00:00:00
25%	1125.750000	32.000000	NaN	40367.655000	24.000000	NaN	239.680000	2023-05-05 18:00:00
50%	1250.500000	44.000000	NaN	49479.730000	48.000000	NaN	299.090000	2023-09-07 12:00:00
75%	1375.250000	57.000000	NaN	59318.615000	75.000000	NaN	361.810000	2024-01-10 06:00:00
max	1500.000000	69.000000	NaN	96183.210000	99.000000	NaN	554.680000	2024-05-14 00:00:00
std	144.481833	15.130942	NaN	14645.299745	28.707685	NaN	93.373301	NaN

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

	0
CustomerID	0
Age	25
Gender	0
Annual_Income	25
Spending_Score	0
Region	0
Purchase_Amount	25
Purchase_Date	0

dtype: int64

```
sns.heatmap(df.isnull(), cbar=False, cmap='viridis')
plt.title("Missing Data Heatmap")
plt.show()
```



Handle Missing Data

```
df['Age'].fillna(df['Age'].mean(), inplace=True)
df['Annual_Income'].fillna(df['Annual_Income'].mean(), inplace=True)
df['Purchase_Amount'].fillna(df['Purchase_Amount'].mean(), inplace=True)
```

Feature Types

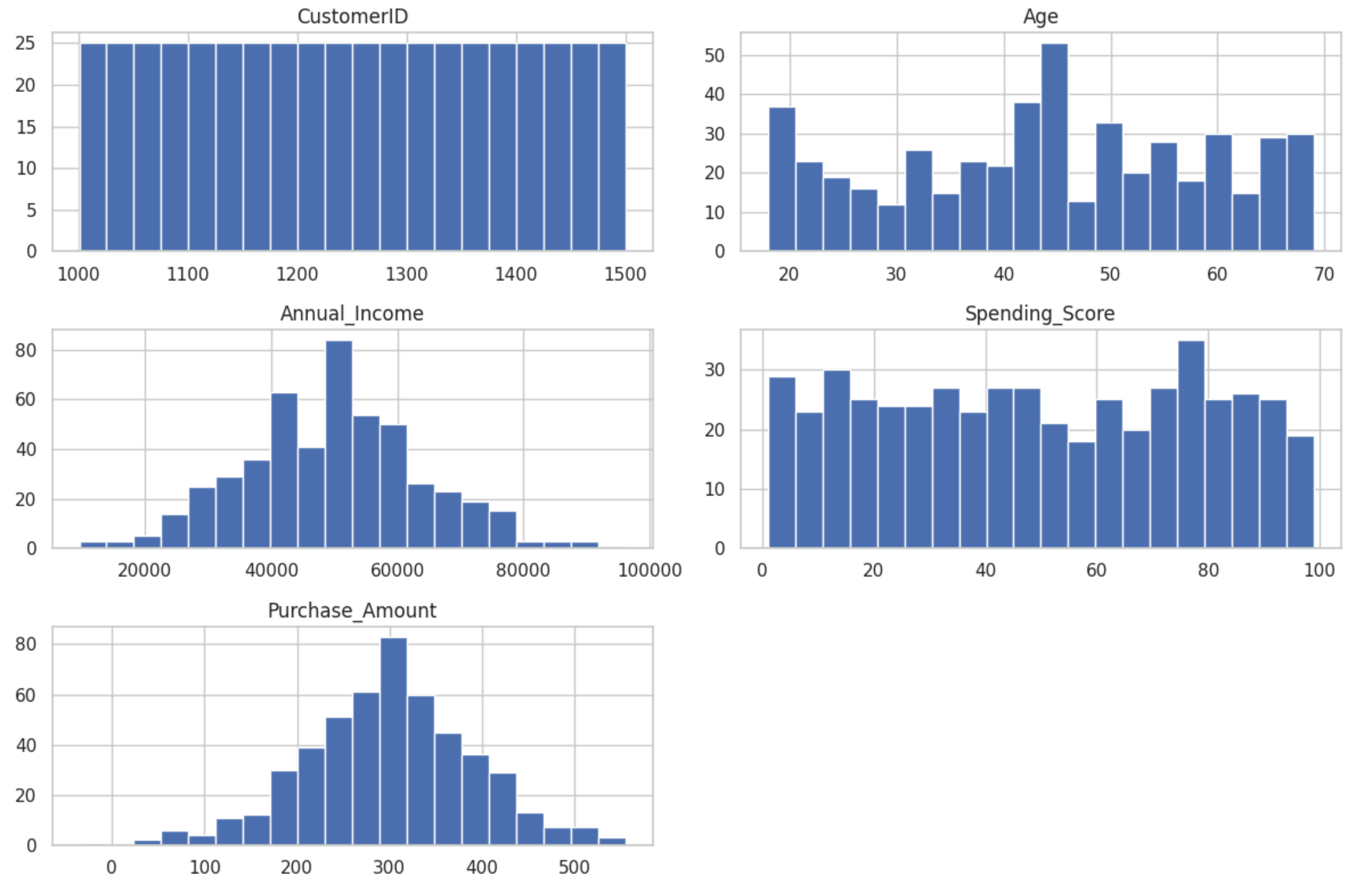
```
numerical = df.select_dtypes(include=['int64', 'float64'])
categorical = df.select_dtypes(include=['object'])

numerical.columns, categorical.columns
```

```
(Index(['CustomerID', 'Age', 'Annual_Income', 'Spending_Score',
        'Purchase_Amount'],
       dtype='object'),
 Index(['Gender', 'Region'], dtype='object'))
```

Histograms and Value Counts

```
numerical.hist(figsize=(12, 8), bins=20)
plt.tight_layout()
plt.show()
```



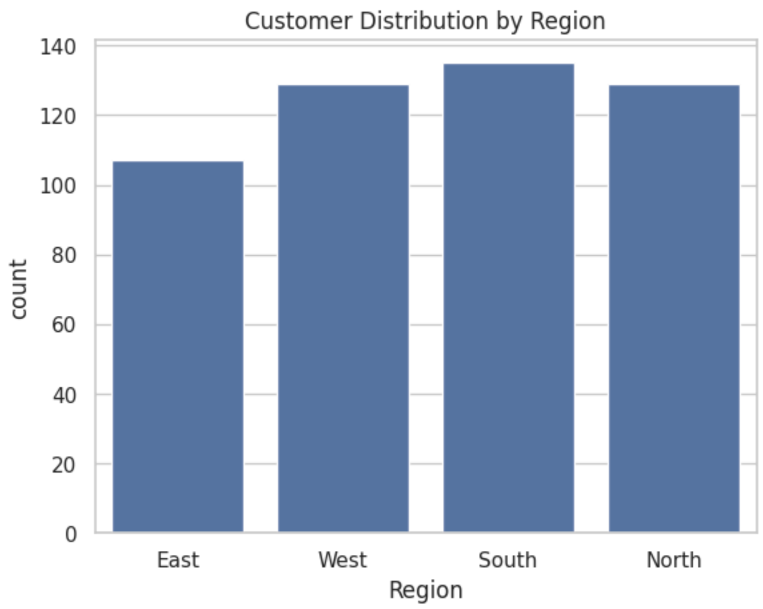
```
for col in categorical.columns:
    print(f"\n{col} value counts:\n", df[col].value_counts())
```

```
Gender value counts:
 Gender
Male      262
Female    238
Name: count, dtype: int64

Region value counts:
 Region
South    135
West     129
North    129
East     107
Name: count, dtype: int64
```

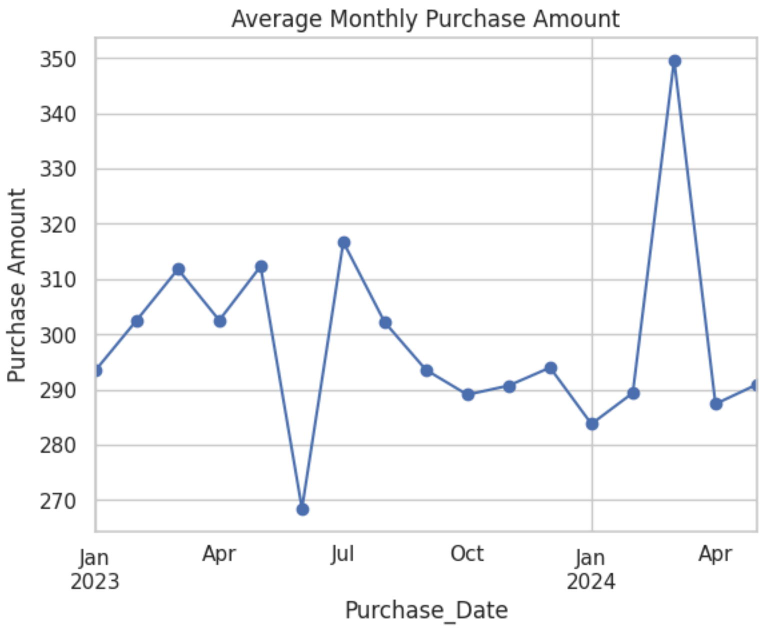
Bar Plot

```
sns.countplot(x='Region', data=df)
plt.title("Customer Distribution by Region")
plt.show()
```



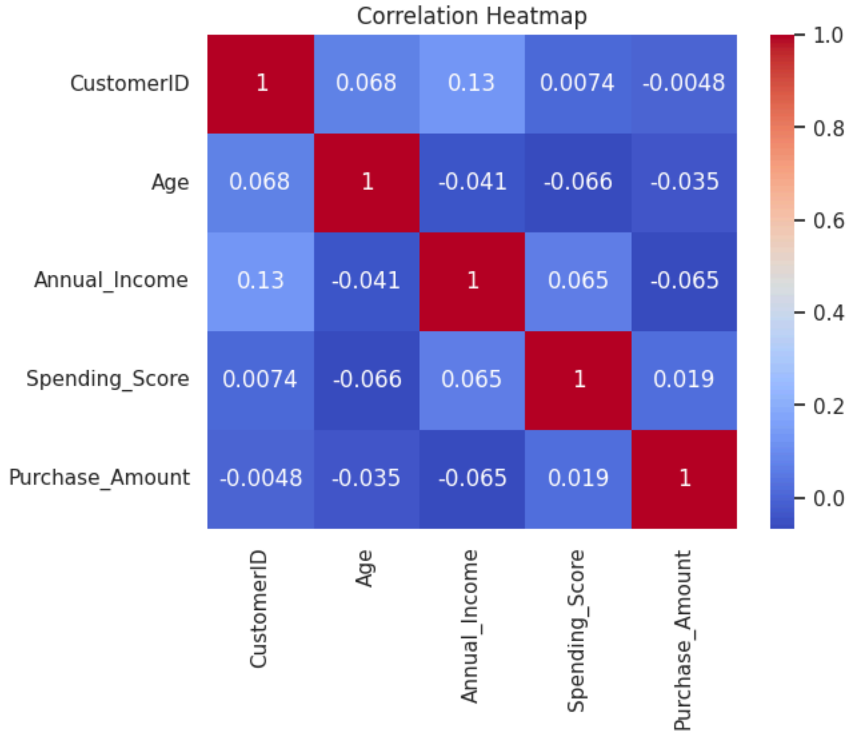
Line Plot

```
df.set_index("Purchase_Date").resample("M")['Purchase_Amount'].mean().plot(marker='o')
plt.title("Average Monthly Purchase Amount")
plt.ylabel("Purchase Amount")
plt.show()
```



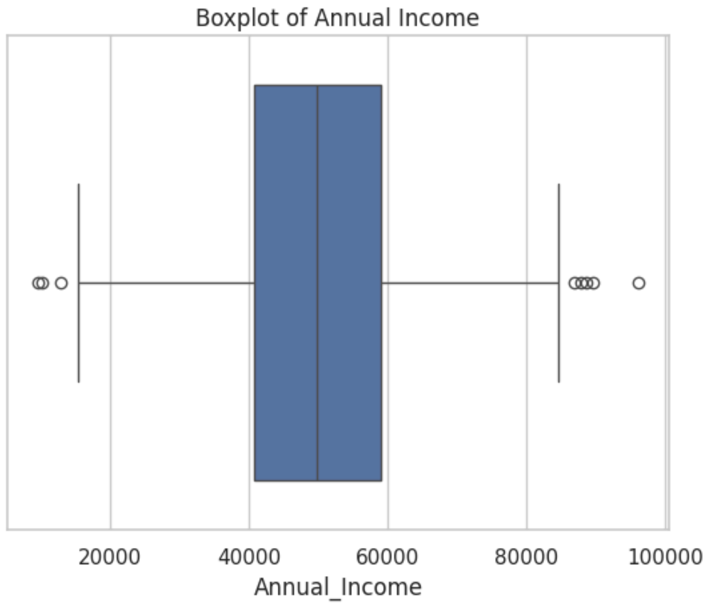
Correlation Heatmap

```
sns.heatmap(df.corr(numeric_only=True), annot=True, cmap="coolwarm")
plt.title("Correlation Heatmap")
plt.show()
```



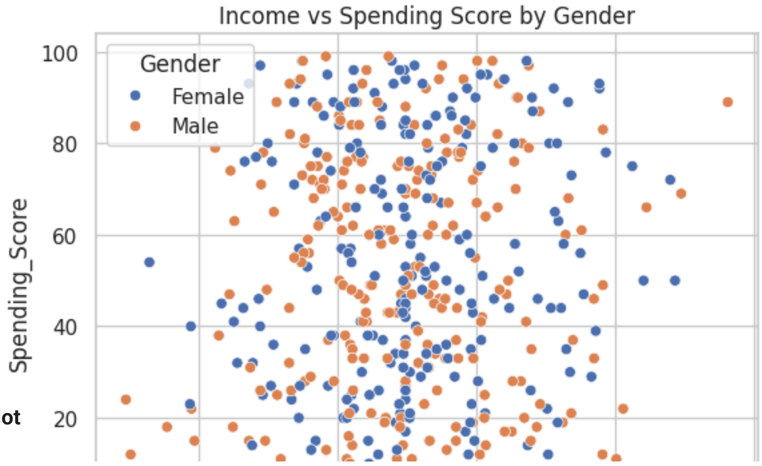
Boxplot for Outliers

```
sns.boxplot(x=df['Annual_Income'])
plt.title("Boxplot of Annual Income")
plt.show()
```



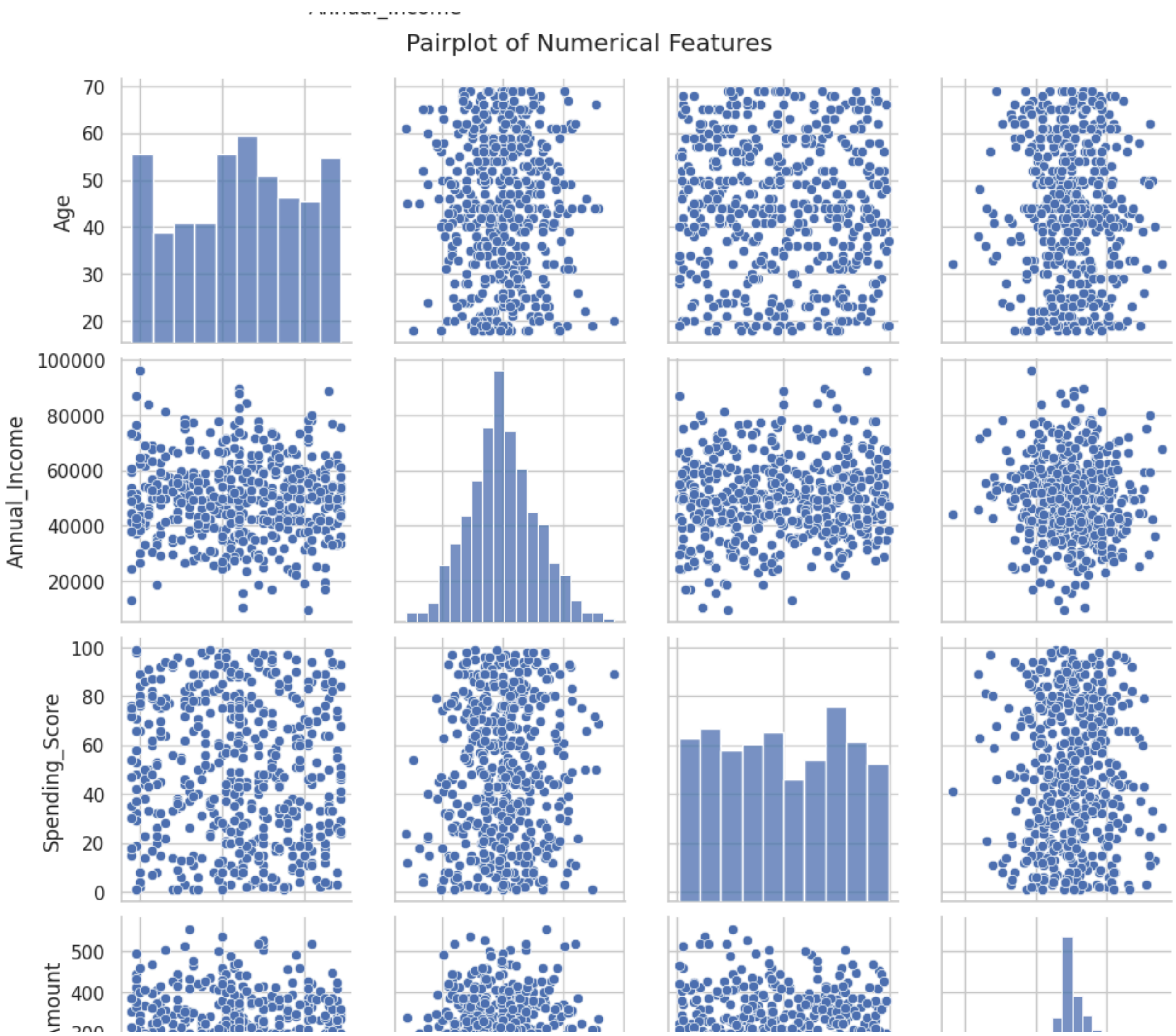
Scatter Plot

```
sns.scatterplot(x='Annual_Income', y='Spending_Score', hue='Gender', data=df)
plt.title("Income vs Spending Score by Gender")
plt.show()
```



Pairplot

```
sns.pairplot(df[['Age', 'Annual_Income', 'Spending_Score', 'Purchase_Amount']])
plt.suptitle("Pairplot of Numerical Features", y=1.02)
plt.show()
```


Annual_Income
Pairplot of Numerical Features
Age
Annual_Income
Spending_Score
mount