

▼ Import libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from mlxtend.plotting import plot_confusion_matrix
from sklearn.metrics import confusion_matrix, classification_report, accuracy_score, precision_score, recall_score, f1_score
import warnings
warnings.filterwarnings('ignore')
%matplotlib inline
```

▼ Load data

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

```
df.head()
```

	User ID	Gender	Age	EstimatedSalary	Purchased	grid icon
0	15624510	Male	19	19000	0	play icon
1	15810944	Male	35	20000	0	play icon
2	15668575	Female	26	43000	0	play icon
3	15603246	Female	27	57000	0	play icon
4	15804002	Male	19	76000	0	play icon

Next steps: [Generate code with df](#) [View recommended plots](#) [New interactive sheet](#)

▼ Basic stats

```
df.shape
```

```
(400, 5)
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 5 columns):
 #   Column           Non-Null Count  Dtype  
 ---  -- 
 0   User ID          400 non-null    int64  
 1   Gender            400 non-null    object  
 2   Age               400 non-null    int64  
 3   EstimatedSalary  400 non-null    int64  
 4   Purchased         400 non-null    int64  
dtypes: int64(4), object(1)
memory usage: 15.8+ KB
```

```
df.describe()
```

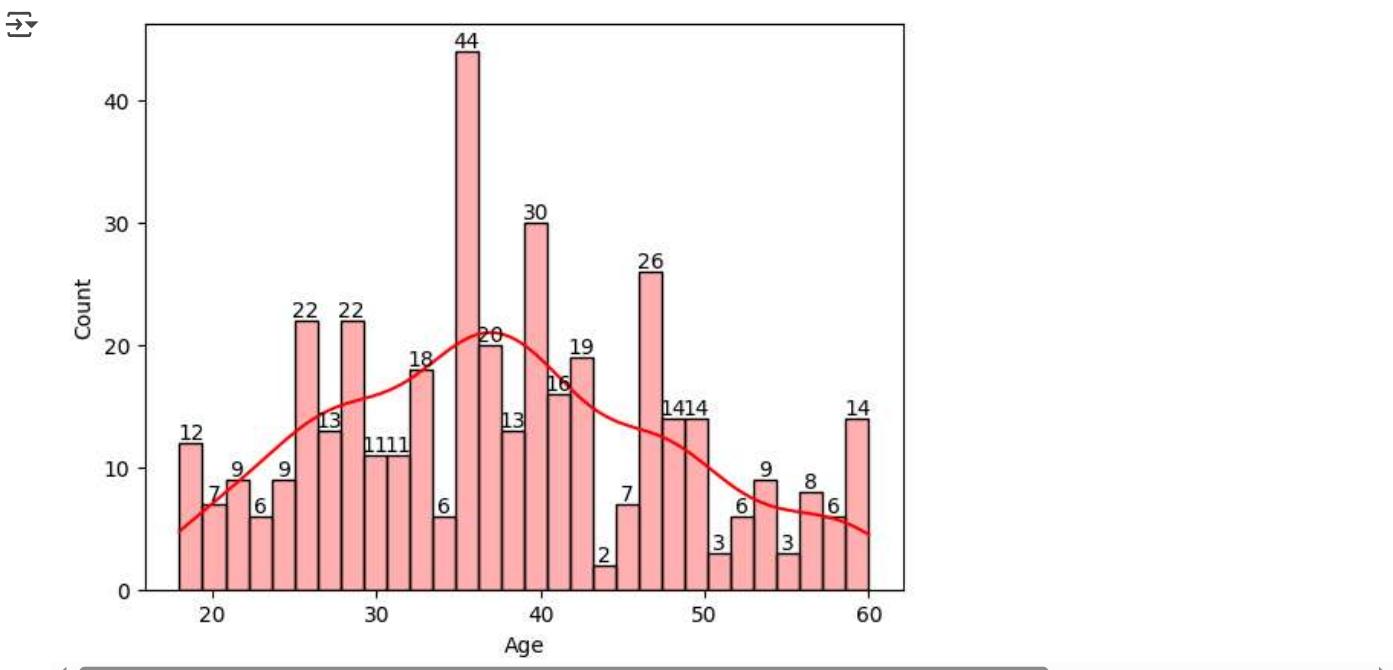
	User ID	Age	EstimatedSalary	Purchased	
count	4.000000e+02	400.000000	400.000000	400.000000	grid
mean	1.569154e+07	37.655000	69742.500000	0.357500	info
std	7.165832e+04	10.482877	34096.960282	0.479864	
min	1.556669e+07	18.000000	15000.000000	0.000000	
25%	1.562676e+07	29.750000	43000.000000	0.000000	
50%	1.569434e+07	37.000000	70000.000000	0.000000	
75%	1.575036e+07	46.000000	88000.000000	1.000000	
max	1.581524e+07	60.000000	150000.000000	1.000000	

```
df.isna().sum()
```

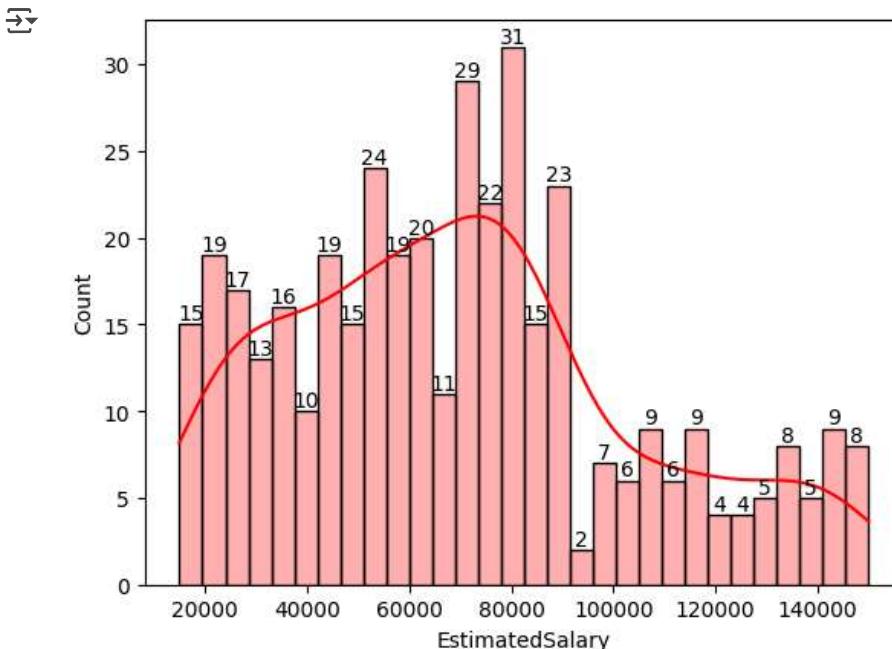
	0
User ID	0
Gender	0
Age	0
EstimatedSalary	0
Purchased	0

```
dtvne: int64
```

```
histplot = sns.histplot(df['Age'], kde=True, bins=30, color='red', alpha=0.3)
for i in histplot.containers:
    histplot.bar_label(i,)
plt.show()
```



```
histplot = sns.histplot(df['EstimatedSalary'], kde=True, bins=30, color='red', alpha=0.3)
for i in histplot.containers:
    histplot.bar_label(i,)
plt.show()
```



```
df["Gender"].value_counts()
```

Gender	count
Female	204
Male	196

```
dtvne: int64
```

```
def gender_encoder(value):
    if (value == "Male"):
        return 1
    elif (value == "Female"):
        return 0
    else:
        return -1
```

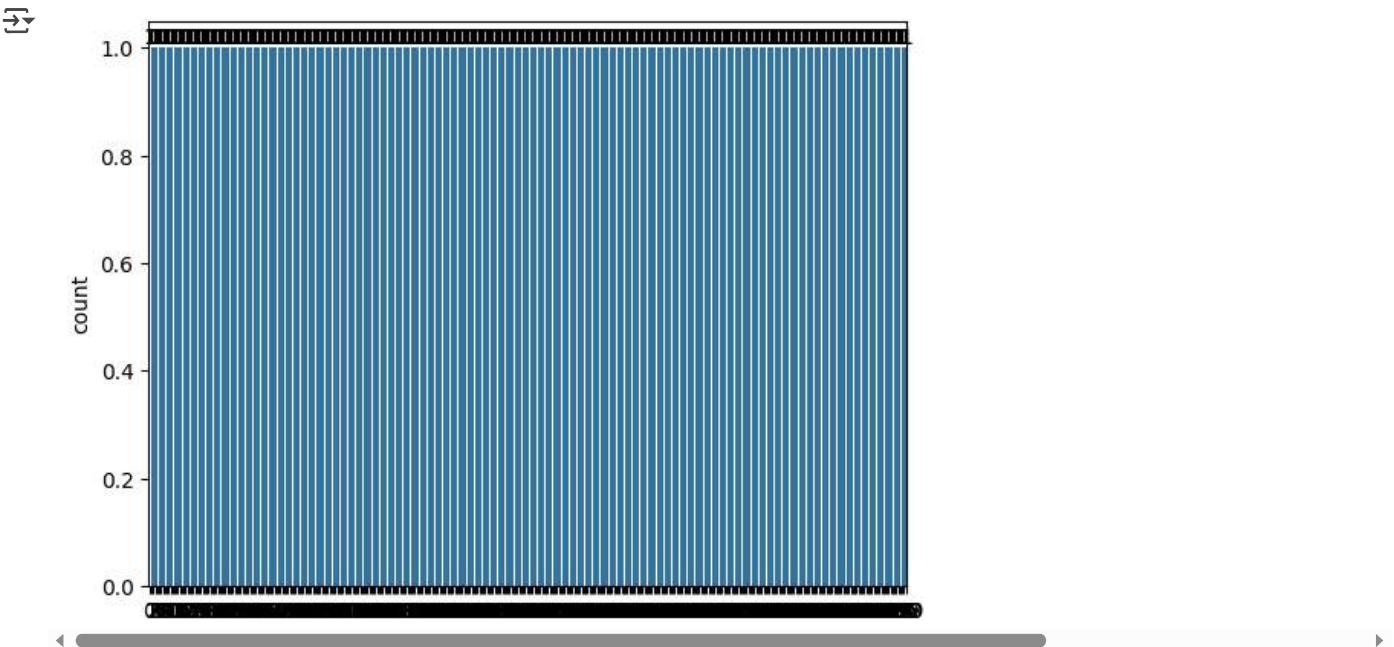
```
df["Gender"] = df["Gender"].apply(gender_encoder)
```

```
df["Purchased"].value_counts()
```

Purchased	count
0	257
1	143

```
dtvne: int64
```

```
countplot = sns.countplot(df["Purchased"])
for i in countplot.containers:
    countplot.bar_label(i,)
plt.show()
```

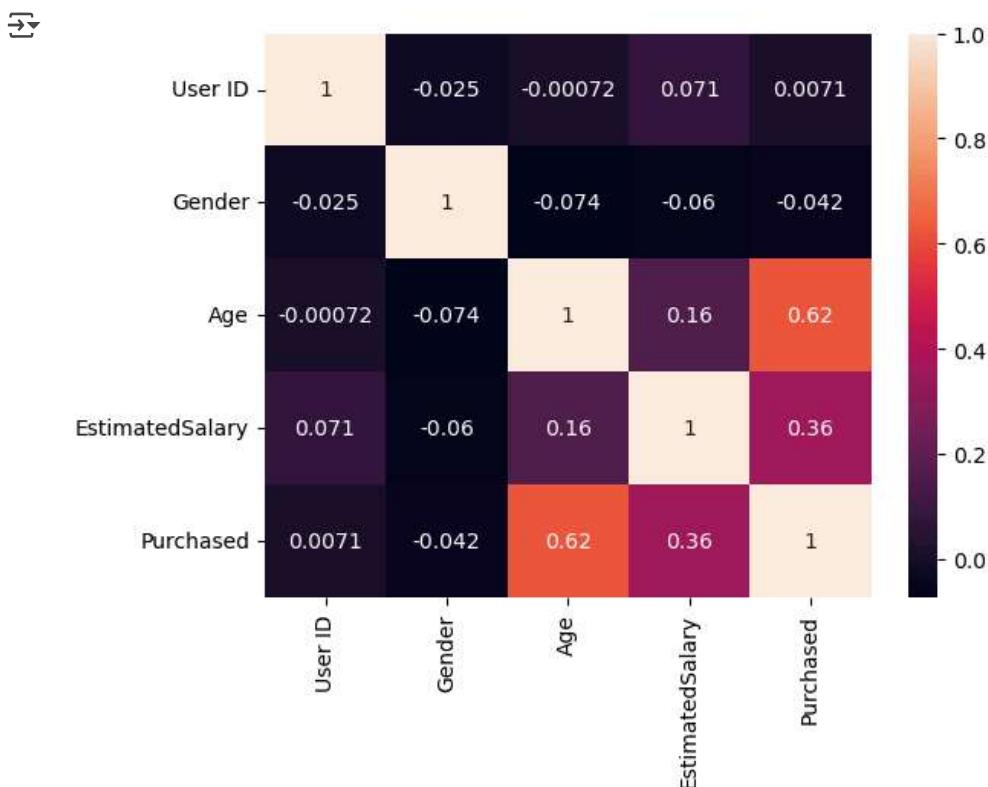


```
countplot = sns.countplot(df["Purchased"], hue=df["Gender"], palette="twilight")
for i in countplot.containers:
    countplot.bar_label(i)
plt.show()
```

>Show hidden output

Next steps: [Explain error](#)

```
sns.heatmap(df.corr(), annot=True)
plt.show()
```



▼ Data preparation

```
x = df[["Age", "EstimatedSalary"]]
y = df["Purchased"]

scaler = StandardScaler()
x = scaler.fit_transform(x)

x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state=42)

x_train.shape, x_test.shape, y_train.shape, y_test.shape
```

→ ((320, 2), (80, 2), (320,), (80,))

▼ Model building

```
model = LogisticRegression(n_jobs=-1)
```

```
model.fit(x_train, y_train)
```

→ ▾ LogisticRegression ⓘ ⓘ
LogisticRegression(n_jobs=-1)

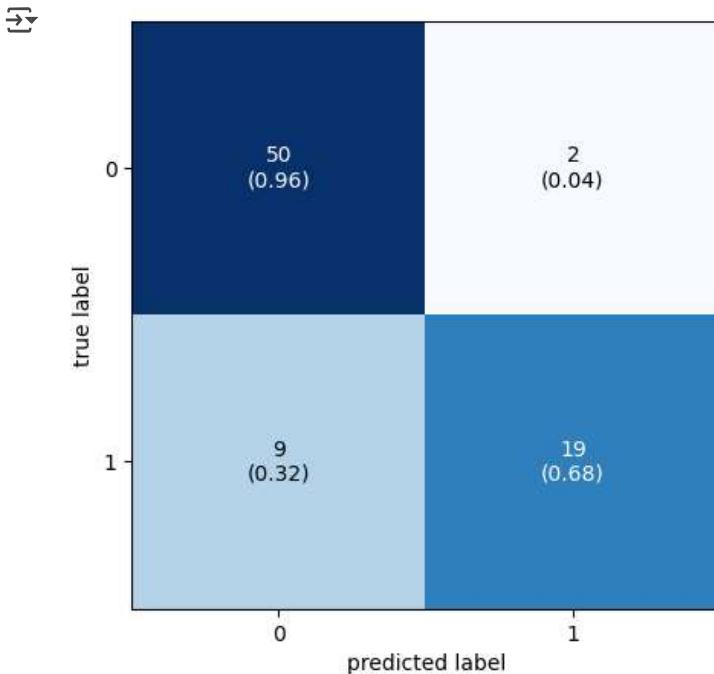
```
y_pred = model.predict(x_test)
```

▼ Evaluation

```
cm = confusion_matrix(y_test, y_pred)
print(cm)
```

→ [[50 2]
 [9 19]]

```
plot_confusion_matrix(conf_mat=cm, figsize=(5,5), show_normed=True)
plt.show()
```



```
print(f"TN value is {cm[0][0]}")
print(f"FP value is {cm[0][1]}")
```

```
print(f"FN value is {cm[1][0]}")  
print(f"TP value is {cm[1][1]}")
```

→ TN value is 50
FP value is 2
FN value is 9
TP value is 19

```
print(f"Accuracy score is {accuracy_score(y_test, y_pred)}")
```

→ Accuracy score is 0.8625

```
print(f"Error rate is {1-accuracy_score(y_test, y_pred)}")
```

→ Error rate is 0.13749999999999996

```
print(f"Precision score is {precision_score(y_test, y_pred)}")
```

→ Precision score is 0.9047619047619048

```
print(f"Recall score is {recall_score(y_test, y_pred)}")
```

→ Recall score is 0.6785714285714286

```
print(classification_report(y_test, y_pred))
```

	precision	recall	f1-score	support
0	0.85	0.96	0.90	52
1	0.90	0.68	0.78	28
accuracy			0.86	80
macro avg	0.88	0.82	0.84	80
weighted avg	0.87	0.86	0.86	80

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