```
import pandas as pd
import numpy as np


path = "/content/drive/MyDrive/framingham.csv"


df = pd.read_csv(path)
df.head()
```

	male	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalentHy
0	1	39	4.0	0	0.0	0.0	0	
1	0	46	2.0	0	0.0	0.0	0	
2	1	48	1.0	1	20.0	0.0	0	
3	0	61	3.0	1	30.0	0.0	0	
4	0	46	3.0	1	23.0	0.0	0	

Next steps: Generate code with df   View recommended plots

```
df.shape
```

```
(4238, 16)
```

```
df.size
```

```
67808
```

```
df.columns
```

```
Index(['male', 'age', 'education', 'currentSmoker', 'cigsPerDay', 'BPMeds',
       'prevalentStroke', 'prevalentHyp', 'diabetes', 'totChol', 'sysBP',
       'diaBP', 'BMI', 'heartRate', 'glucose', 'TenYearCHD'],
      dtype='object')
```

```
df.dtypes
```

```
male                 int64
age                  int64
education          float64
currentSmoker        int64
cigsPerDay         float64
BPMeds             float64
prevalentStroke      int64
prevalentHyp         int64
diabetes             int64
totChol            float64
sysBP              float64
diaBP              float64
BMI                float64
heartRate          float64
glucose            float64
TenYearCHD           int64
dtype: object
```

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

```
male                 0
age                  0
education          105
currentSmoker        0
cigsPerDay          29
BPMeds              53
prevalentStroke      0
prevalentHyp         0
diabetes             0
totChol             50
sysBP                0
diaBP                0
BMI                 19
heartRate            1
glucose            388
```

```
TenYearCHD           0
dtype: int64
```

```
df[:2]
```

	male	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalentHy
0	1	39	4.0	0	0.0	0.0	0	
1	0	46	2.0	0	0.0	0.0	0	

```
df['education'].value_counts(normalize=True)*100
```

```
1.0    41.616259
2.0    30.316961
3.0    16.622308
4.0    11.444471
Name: education, dtype: float64
```

```
from sklearn.impute import KNNImputer
```

```
columns = [['education', 'cigsPerDay', 'BPMeds', 'totChol', 'BMI', 'heartRate', 'glucose']]
impute = KNNImputer(n_neighbors = 9)
for i in columns:
    df[i] = impute.fit_transform(df[i])
```

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

```
male               0
age                0
education          0
currentSmoker      0
cigsPerDay         0
BPMeds             0
prevalentStroke    0
prevalentHyp       0
diabetes           0
totChol            0
sysBP              0
diaBP              0
BMI                0
heartRate          0
glucose            0
TenYearCHD         0
dtype: int64
```

```
#EDA
```

```
df[:2]
```

	male	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalentHy
0	1	39	4.0	0	0.0	0.0	0	
1	0	46	2.0	0	0.0	0.0	0	

```
df.rename(columns={"male":"gender"}, inplace =  True)
```

```
df[:2]
```

	gender	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalent
0	1	39	4.0	0	0.0	0.0	0	
1	0	46	2.0	0	0.0	0.0	0	

```
df['gender'].value_counts()
```

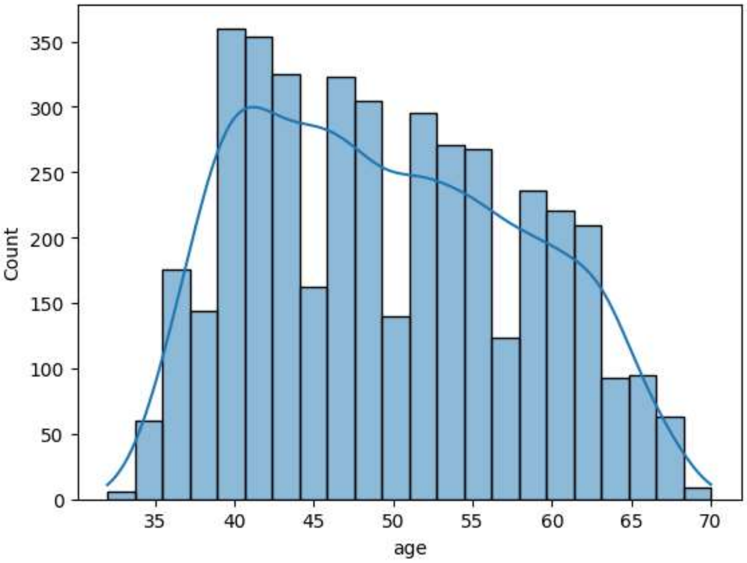
```
0    2419
1    1819
Name: gender, dtype: int64
```

```
df['age'].min(), df['age'].max()
```

```
(32, 70)
```

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

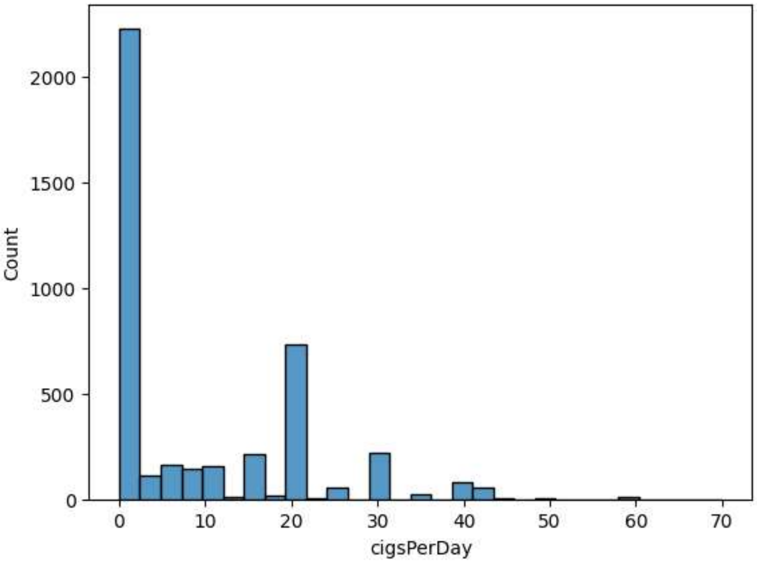
```
sns.histplot(data = df, x="age",kde=True)
plt.show()
```



```
df['currentSmoker'].value_counts(normalize = True)*100
```

```
0    50.589901
1    49.410099
Name: currentSmoker, dtype: float64
```

```
sns.histplot(data=df, x="cigsPerDay")
plt.show()
```



```
df['BPMeds'].value_counts()
```

```
     0.000000    4100
     1.000000     124
     0.111111      14
     Name: BPMeds, dtype: int64
```

```
y = df['TenYearCHD']
```

```
X = df.drop(columns="TenYearCHD")
```

```
X.shape
```

```
     (4238, 15)
```

```
y.shape
```

```
     (4238,)
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

```
X_train.shape
```

```
     (3390, 15)
```

```
y_train.shape
```

```
     (3390,)
```

```
X_test.shape, y_test.shape
```

```
     ((848, 15), (848,))
```

```
df[:3]
```

	gender	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalent
0	1	39	4.0	0	0.0	0.0	0	
1	0	46	2.0	0	0.0	0.0	0	
2	1	48	1.0	1	20.0	0.0	0	

```
# prompt: import standard scaler

from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()
scaler.fit(X_train)
X_train = scaler.transform(X_train)
X_test = scaler.transform(X_test)
```

```
from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
model.fit(X_train, y_train)
y_pred = model.predict(X_test)
```

```
y_pred[:10]
```

```
     array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0])
```

```
y_test[:10]
```

```
     3188    0
     764     0
     3264    0
     1967    0
     2185    0
     393     0
     2333    1
```

```
1159    0
3788    0
1674    1
Name: TenYearCHD, dtype: int64
```

```
pd.DataFrame({
    "Actual": y_test,
    "predicted": y_pred
})[:15]
```

	Actual	predicted
3188	0	0
764	0	0
3264	0	0
1967	0	0
2185	0	0
393	0	0
2333	1	0
1159	0	0
3788	0	0
1674	1	0
759	0	0
1803	0	0
410	0	0
157	0	0
3886	0	0

```
model.score(X_test, y_test)
```

```
0.8573113207547169
```

```
model.score(X_train, y_train)
```

```
0.8548672566371681
```

```
# prompt: import r2 score

from sklearn.metrics import r2_score

r2_score_model = r2_score(y_test, y_pred)
print("R2 Score:", r2_score_model * 100)
```

```
R2 Score: -14.293352343610755
```

```
model.coef_
```

```
array([[ 0.21494318,  0.57183733,  0.03328953, -0.01271295,  0.27893144,
         0.04401033,  0.07357614,  0.0907214 ,  0.00156521,  0.04087167,
         0.30882841,  0.01788746, -0.01694299, -0.0657164 ,  0.18885262]])
```

```
model.intercept_
```

```
array([-1.97123212])
```

```
# prompt: import accuracy score

from sklearn.metrics import accuracy_score

accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy * 100)
```

```
Accuracy: 85.73113207547169
```

Let's Improve the Score by checking with the CV - Cross validation

```
df1 = df
```

```
df1.head()
```

	gender	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalent
0	1	39	4.0	0	0.0	0.0	0	
1	0	46	2.0	0	0.0	0.0	0	
2	1	48	1.0	1	20.0	0.0	0	
3	0	61	3.0	1	30.0	0.0	0	
4	0	46	3.0	1	23.0	0.0	0	

Next steps: Generate code with df1 | View recommended plots

```
X = df1.drop(columns={"TenYearCHD"})
```

```
y = df['TenYearCHD']
```

```
X.shape, y.shape
```

```
     ((4238, 15), (4238,))
```

```
# prompt: import train test split

from sklearn.model_selection import train_test_split
X_train_cv, X_test, y_train_cv, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
X_train, X_val, y_train, y_val = train_test_split(X_train_cv, y_train_cv, test_size=0.25,random_state=1)
```

```
X_test.shape, y_test.shape
```

```
     ((848, 15), (848,))
```

Generate | Using ... | import standard scaler | Close

< 1 of 4 > Undo changes Use code with caution

```
# prompt: import standard scaler

from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()
scaler.fit(X_train)
X_train = scaler.transform(X_train)
X_test = scaler.transform(X_test)
X_val = scaler.transform(X_val)
```

Generate | Using ... | import Logistic regression | Close

< 1 of 4 > Undo changes Use code with caution

```
# prompt: import Logistic regression

from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
model.fit(X_train, y_train)
```

```
▾ LogisticRegression
LogisticRegression()
```

```
model.coef_
```

```
     array([[ 0.22227067,  0.58535055,  0.02438671, -0.06570819,  0.30855561,
              0.03117776,  0.08007633, -0.00478253,  0.03896179,  0.08912729,
              0.31058245,  0.08798583, -0.11481075, -0.05661747,  0.22148162]])
```

```
model.intercept_
```

```
     array([-2.03205876])
```

```
y_pred_cv =  model.predict(X_val)
y_pred_cv[:15]
```

```
     array([0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0])
```

```
y_val[:15]
```

```
     1430    1
     1810    0
     1655    0
     2760    0
     4085    0
     4084    0
     1266    1
     3685    0
     2295    0
     2954    1
     1683    0
     1753    0
     3161    0
     2859    0
     4144    1
     Name: TenYearCHD, dtype: int64
```

```
pd.DataFrame({
    "Actual": y_val,
    "predicted": y_pred_cv
})[:35]
```

	Actual	predicted
1430	1	0
1810	0	0
1655	0	0
2760	0	0
4085	0	0
4084	0	1
1266	1	0
3685	0	0
2295	0	0
2954	1	0
1683	0	0
1753	0	0
3161	0	0
2859	0	0
4144	1	0
1746	0	0
2613	0	0
3220	1	0
1815	0	0
2059	0	0
636	0	0
0	0	0
2974	0	0
1105	0	0
1544	0	0
3094	1	0
2443	1	0
323	0	0
3073	0	0
1625	0	0
2810	0	0

Checking how much varies from the Data

```
zero = 0
one = 0
for i in y_pred_cv:
  if i == 0:
    zero +=1
  else:
    one +=1

print(zero)
print(one)
```

```
827
21
```

```
# Error
y_val.shape, y_pred_cv.shape
```

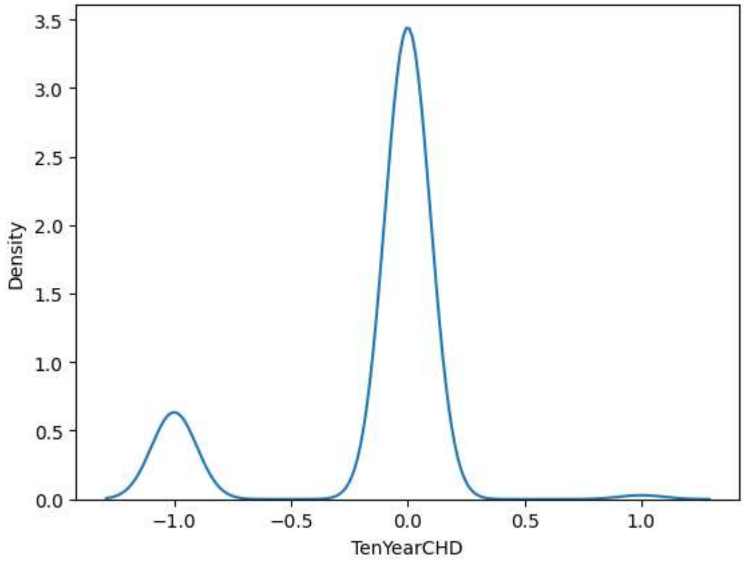
```
((848,), (848,))
```

```
Error = y_pred_cv - y_val
Error[:10]
```

```
1430   -1
1810    0
1655    0
2760    0
4085    0
4084    1
1266   -1
3685    0
2295    0
2954   -1
Name: TenYearCHD, dtype: int64
```

```
sns.kdeplot(Error)
```

```
<Axes: xlabel='TenYearCHD', ylabel='Density'>
```



Check for the MSE

Generate | Using ... | import mean sqaure error | Close

< 1 of 3 > Undo changes Use code with caution

```
# prompt: import mean sqaure error

from sklearn.metrics import mean_squared_error
mse = mean_squared_error(y_val, y_pred_cv)
print("Mean squared error:", mse)
```

```
Mean squared error: 0.1615566037735849
```