MannanNaeem_lab1

October 23, 2025

[19]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import os

df = pd.read_csv("Files\heart_dataset.csv")

# Convert famhist from 'Present'/'Absent' → 1/0
df['famhist'] = df['famhist'].map({'Present': 1, 'Absent': 0})

df.info()
df.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 412 entries, 0 to 411
Data columns (total 10 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   sbp        384 non-null    float64
 1   tobacco    372 non-null    float64
 2   ldl        373 non-null    float64
 3   adiposity  372 non-null    float64
 4   famhist    367 non-null    float64
 5   typea      371 non-null    float64
 6   obesity    372 non-null    float64
 7   alcohol    372 non-null    float64
 8   age        377 non-null    float64
 9   chd        373 non-null    float64
dtypes: float64(10)
memory usage: 32.3 KB
```

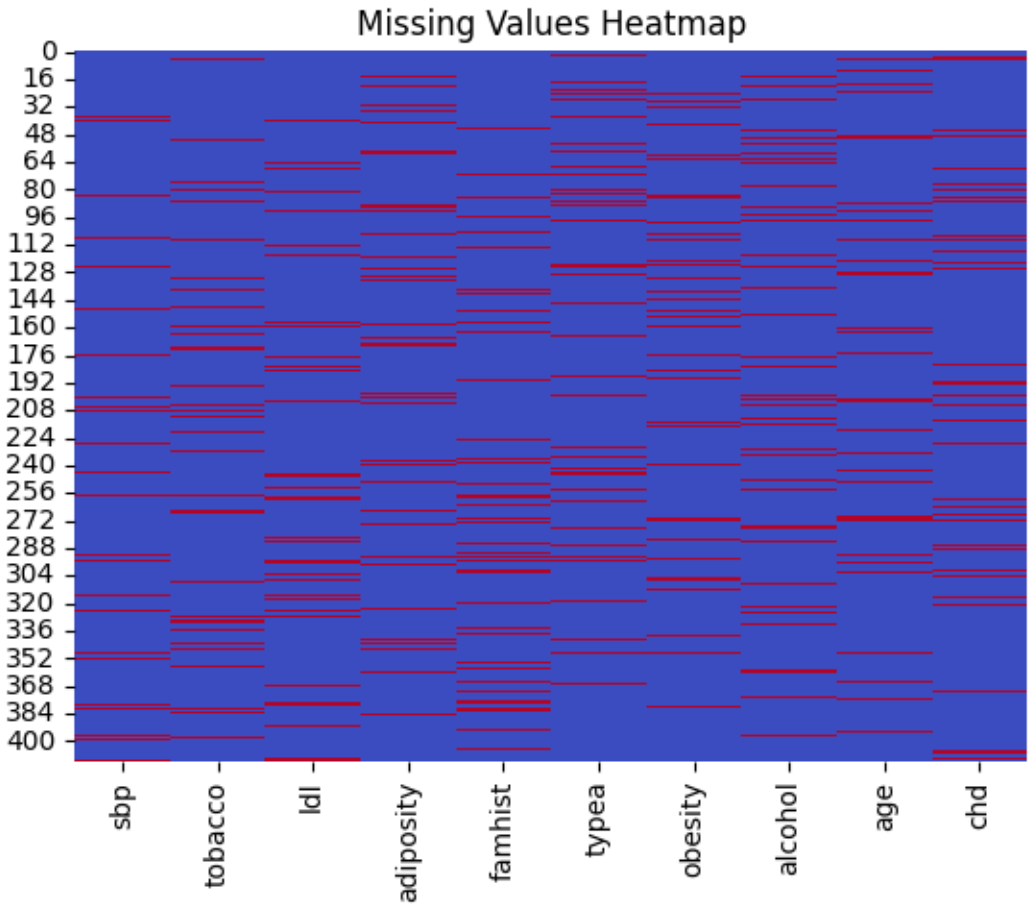
[19]:

	sbp	tobacco	ldl	adiposity	famhist	typea	obesity	alcohol	age	\
0	134.0	13.60	3.50	27.78	1.0	60.0	25.99	57.34	49.0	
1	132.0	6.20	6.47	36.21	1.0	62.0	30.77	14.14	45.0	
2	142.0	4.05	3.38	16.20	0.0	NaN	20.81	2.62	38.0	
3	114.0	4.08	4.59	14.60	1.0	62.0	23.11	6.72	58.0	
4	114.0	NaN	3.83	19.40	1.0	49.0	24.86	2.49	NaN	

```
    chd
0   1.0
1   0.0
2   0.0
3   NaN
4   NaN
```

[20]:
```
df.isnull().sum()
sns.heatmap(df.isnull(), cbar=False, cmap="coolwarm")
plt.title("Missing Values Heatmap")
```

[20]:
```
Text(0.5, 1.0, 'Missing Values Heatmap')
```

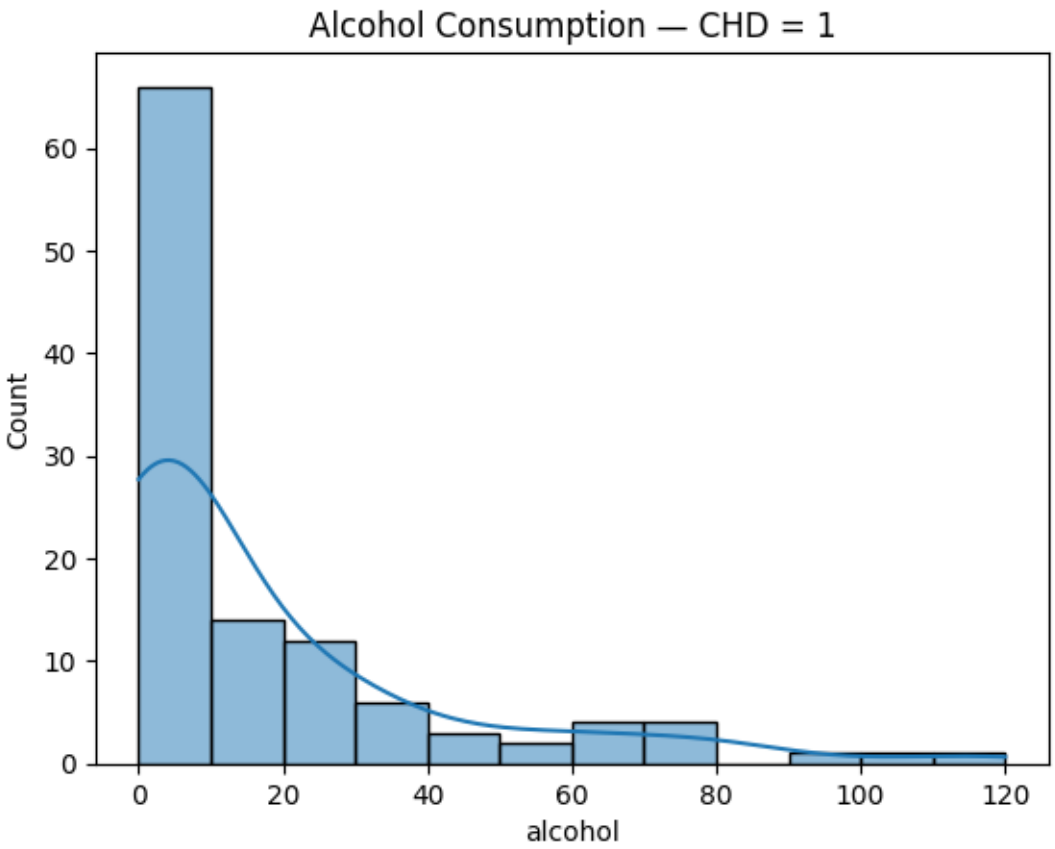


[21]:
```
df.describe()                      # (1)
df.loc[df['ldl'].idxmax()]         # (2)
df.loc[df['sbp'].idxmin()]         # (3)
df['tobacco'].agg(['mean','std']) # (4)
```

[21]:
```
mean    3.676425
std     4.568564
Name: tobacco, dtype: float64
```

[22]:
```
sns.histplot(df[df['chd']==1]['alcohol'], kde=True)
plt.title("Alcohol Consumption - CHD = 1")
```

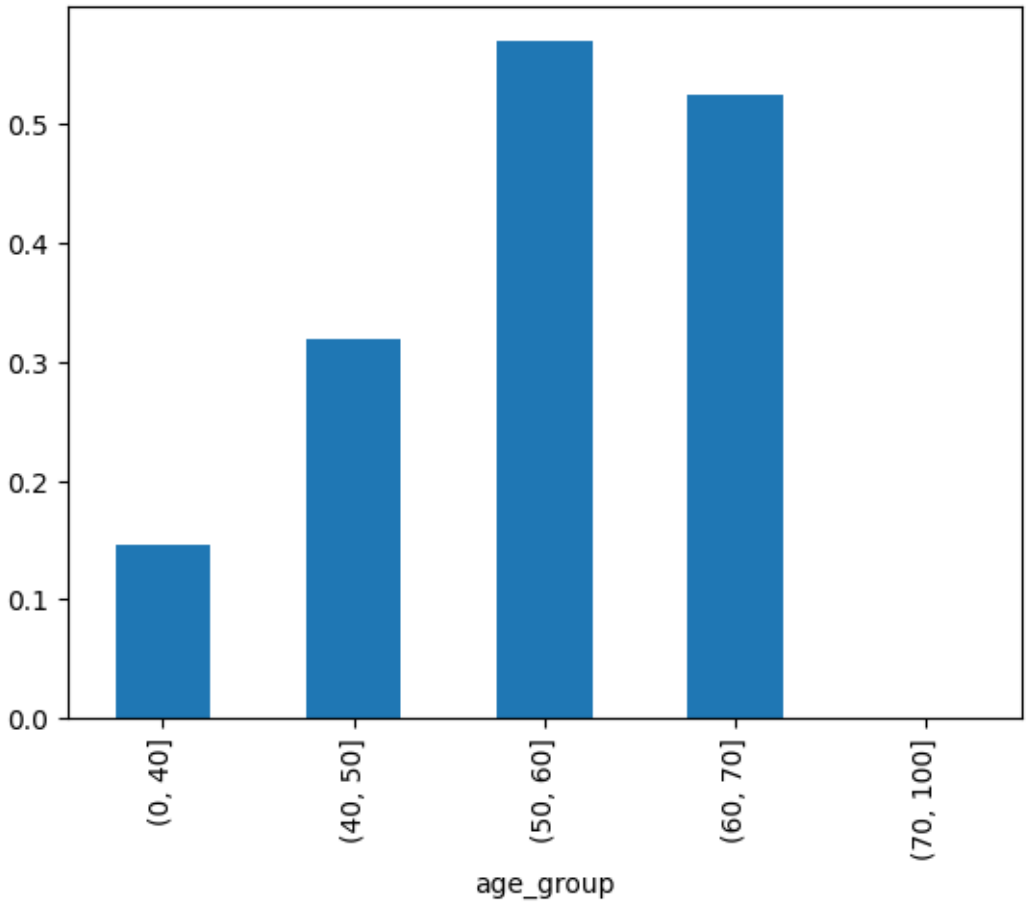
[22]:
```
Text(0.5, 1.0, 'Alcohol Consumption - CHD = 1')
```



[23]:
```
df['age_group'] = pd.cut(df['age'], bins=[0,40,50,60,70,100])
survival = df.groupby('age_group')['chd'].mean()
survival.plot(kind='bar')
```

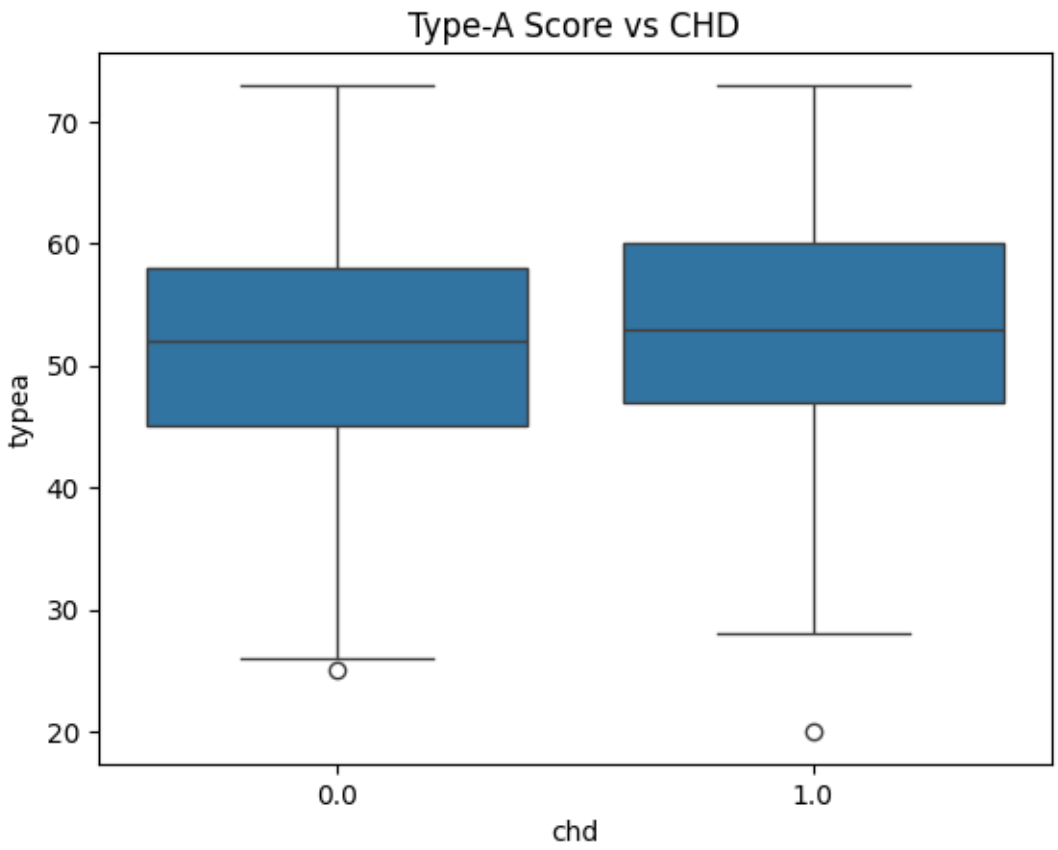
```
C:\Users\balto\AppData\Local\Temp\ipykernel_25008\217659786.py:2: FutureWarning:
The default of observed=False is deprecated and will be changed to True in a
future version of pandas. Pass observed=False to retain current behavior or
observed=True to adopt the future default and silence this warning.
  survival = df.groupby('age_group')['chd'].mean()
```

[23]:
```
<Axes: xlabel='age_group'>
```



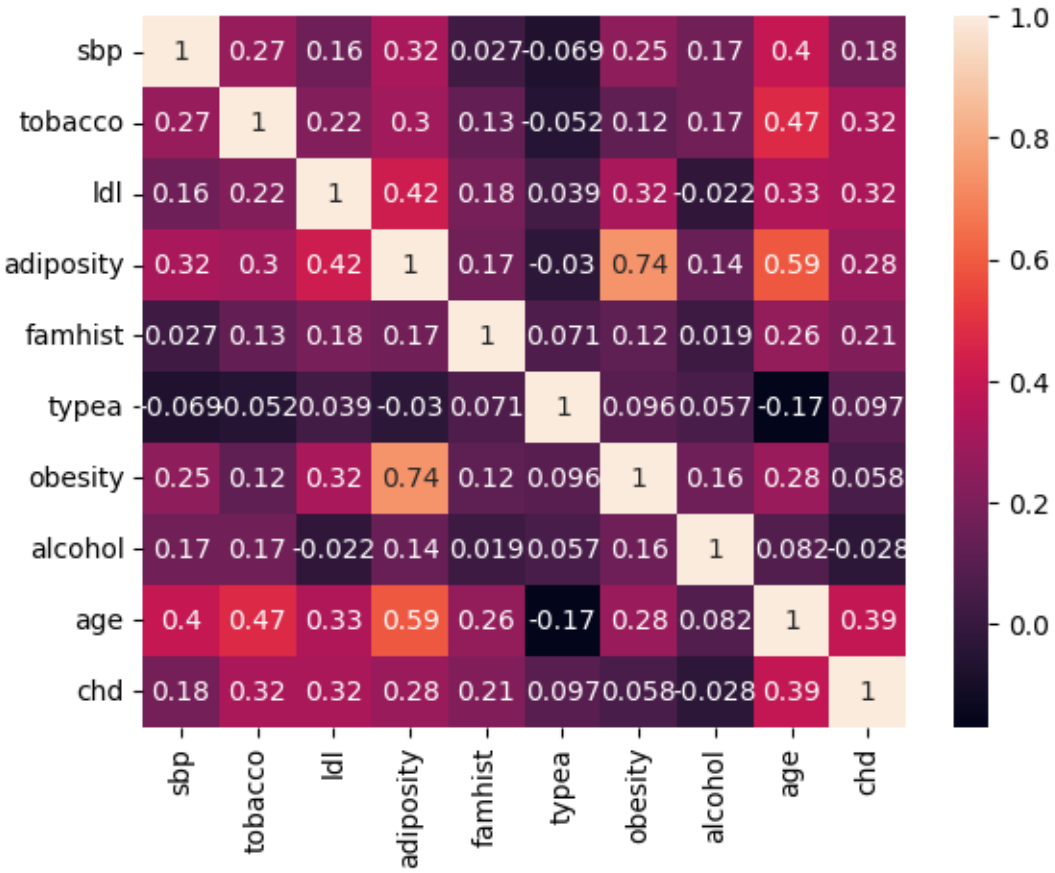
[24]:
```
sns.boxplot(x='chd', y='typea', data=df)
plt.title("Type-A Score vs CHD")
```

[24]: Text(0.5, 1.0, 'Type-A Score vs CHD')

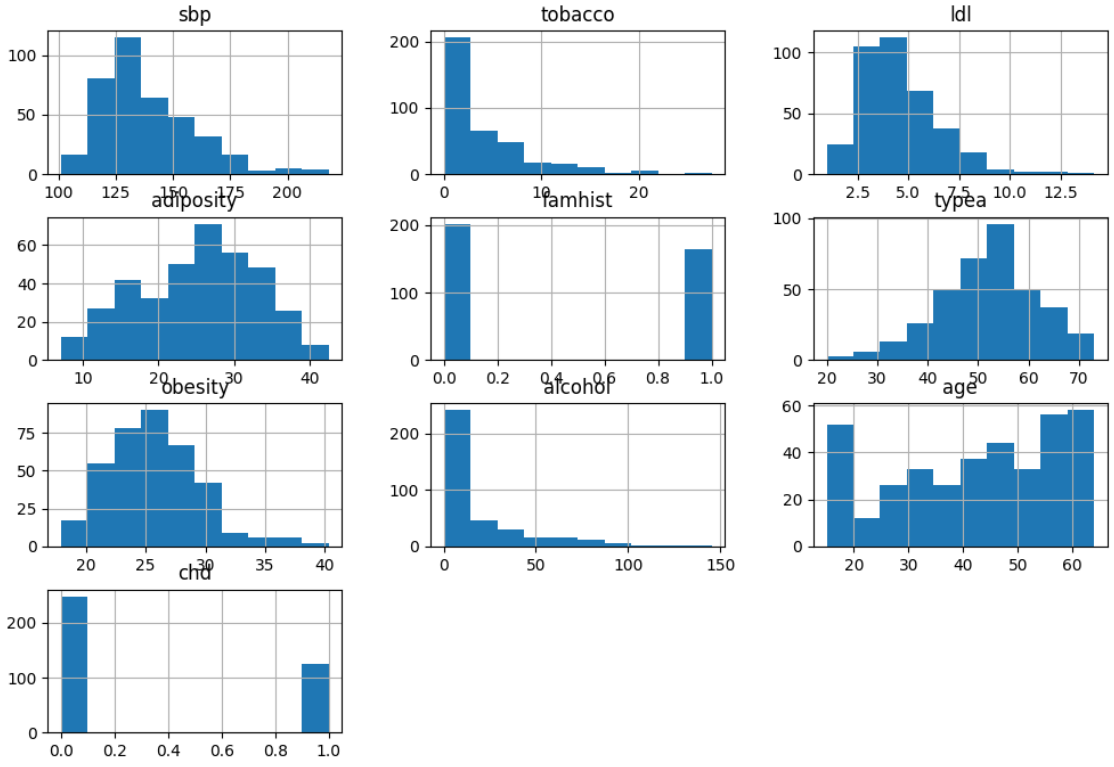


[27]:
```
df_numeric = df.select_dtypes(include=['number'])
sns.heatmap(df_numeric.corr(), annot=True)
sns.pairplot(df)
df.hist(figsize=(12,8))
sns.boxplot(x='chd', y='sbp', data=df)
```

[27]: <Axes: xlabel='chd', ylabel='sbp'>


sbp 1 0.27 0.16 0.32 0.027 -0.069 0.25 0.17 0.4 0.18
tobacco 0.27 1 0.22 0.3 0.13 -0.052 0.12 0.17 0.47 0.32
ldl 0.16 0.22 1 0.42 0.18 0.039 0.32 -0.022 0.33 0.32
adiposity 0.32 0.3 0.42 1 0.17 -0.03 0.74 0.14 0.59 0.28
famhist 0.027 0.13 0.18 0.17 1 0.071 0.12 0.019 0.26 0.21
typea -0.069 0.052 0.039 -0.03 0.071 1 0.096 0.057 -0.17 0.097
obesity 0.25 0.12 0.32 0.74 0.12 0.096 1 0.16 0.28 0.058
alcohol 0.17 0.17 -0.022 0.14 0.019 0.057 0.16 1 0.082 -0.028
age 0.4 0.47 0.33 0.59 0.26 -0.17 0.28 0.082 1 0.39
chd 0.18 0.32 0.32 0.28 0.21 0.097 0.058 -0.028 0.39 1
sbp
tobacco
ldl
adiposity
famhist
typea
obesity
alcohol
age
chd
1.0
0.8
0.6
0.4
0.2
0.0


sbp
tobacco
ldl
adiposity
famhist
typea
obesity
alcohol
age
chd



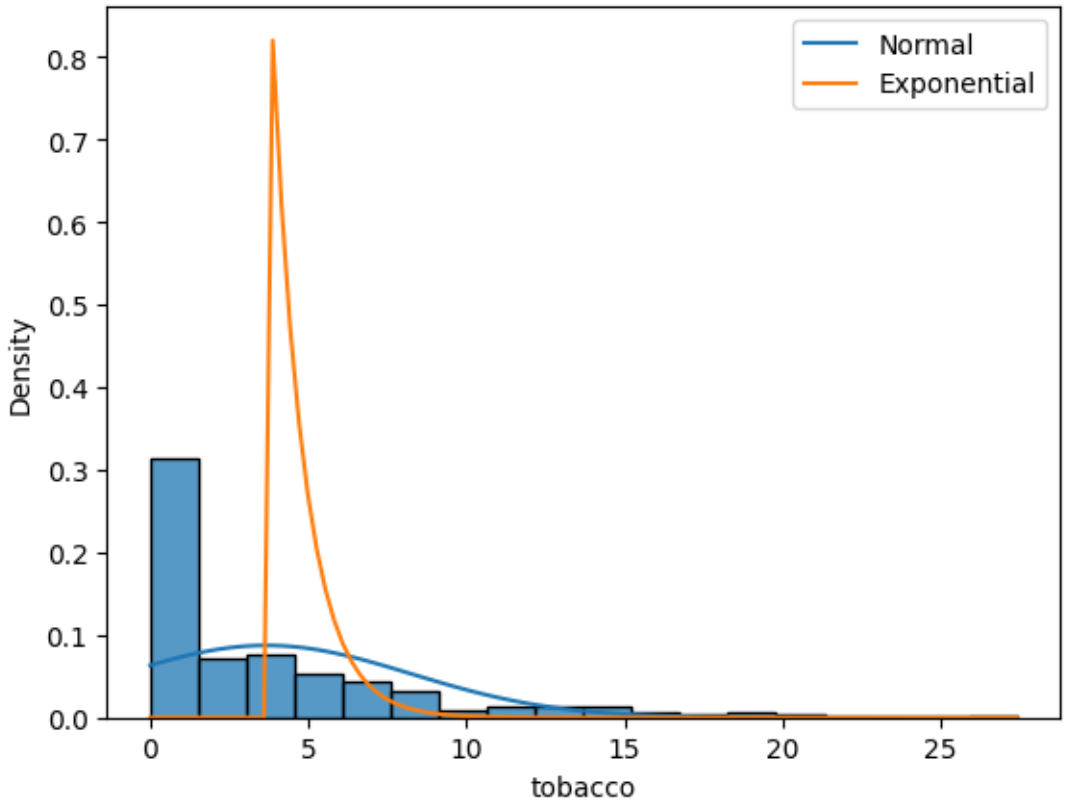
[28]:
```
sample = df.sample(100, random_state=42)
p = (sample['chd']==1).mean()
# Probability of >40% = P(X>40) with Binomial(n=100,p0)
from scipy.stats import binom
binom.sf(40,100,df['chd'].mean())
```

[28]: 0.07095922989498611

[29]:
```
prob = len(df[(df['age']>60)&(df['famhist']==1)]) / len(df)
```

[30]:
```
from scipy.stats import norm, expon
sns.histplot(df['tobacco'], kde=False, stat="density")
x = np.linspace(df['tobacco'].min(), df['tobacco'].max(), 100)
plt.plot(x, norm.pdf(x, df['tobacco'].mean(), df['tobacco'].std()),␣
  ↪label="Normal")
plt.plot(x, expon.pdf(x, df['tobacco'].mean()), label="Exponential")
plt.legend()
```

[30]: <matplotlib.legend.Legend at 0x293e2d44590>



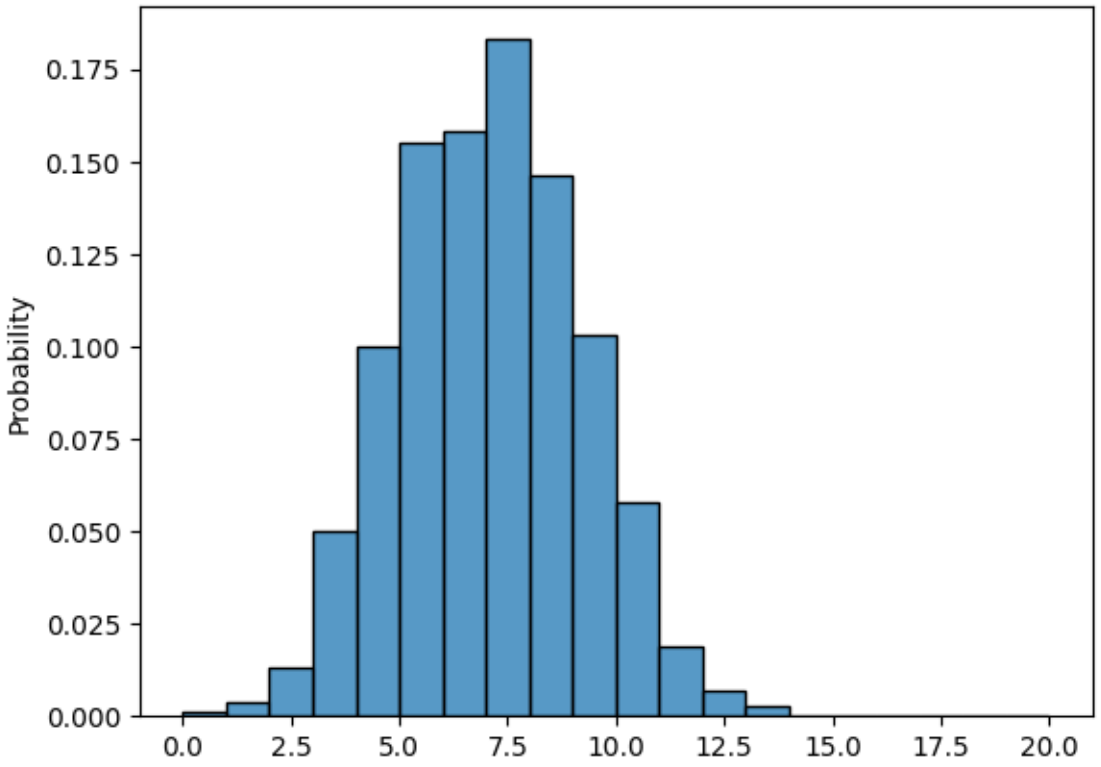
[31]:
```
from sklearn.datasets import load_iris
from scipy.stats import norm, binom, ttest_ind
import numpy as np

iris = load_iris(as_frame=True).frame
```

[32]:
```
setosa = iris[iris['target']==0]['petal length (cm)']
mean, std = setosa.mean(), setosa.std()

def plot_std_normal_with_probability(mean, std, lower, upper):
    x = np.linspace(mean-4*std, mean+4*std, 200)
    y = norm.pdf(x, mean, std)
    plt.plot(x, y)
    plt.fill_between(x, y, where=(x>=lower)&(x<=upper), alpha=0.4)
    plt.title("Normal PDF with Shaded Probability")
    plt.show()

prob = norm.cdf(1.8,mean,std)-norm.cdf(1.2,mean,std)
```

[33]:
```
p = (iris['target']==0).mean()
prob_8 = binom.pmf(8, 20, p)
```

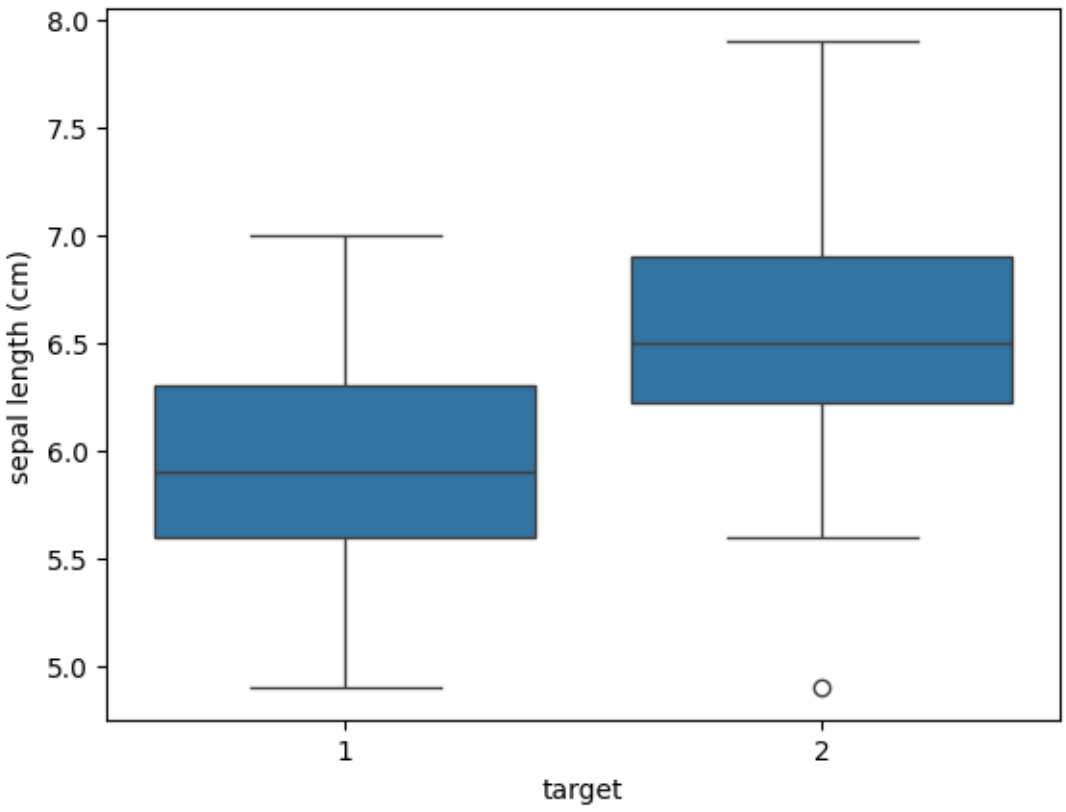
```
prob_10plus = binom.sf(9, 20, p)

sims = [np.sum(np.random.binomial(1,p,20)) for _ in range(1000)]
sns.histplot(sims, stat="probability", bins=range(0,21))
```

[33]: <Axes: ylabel='Probability'>



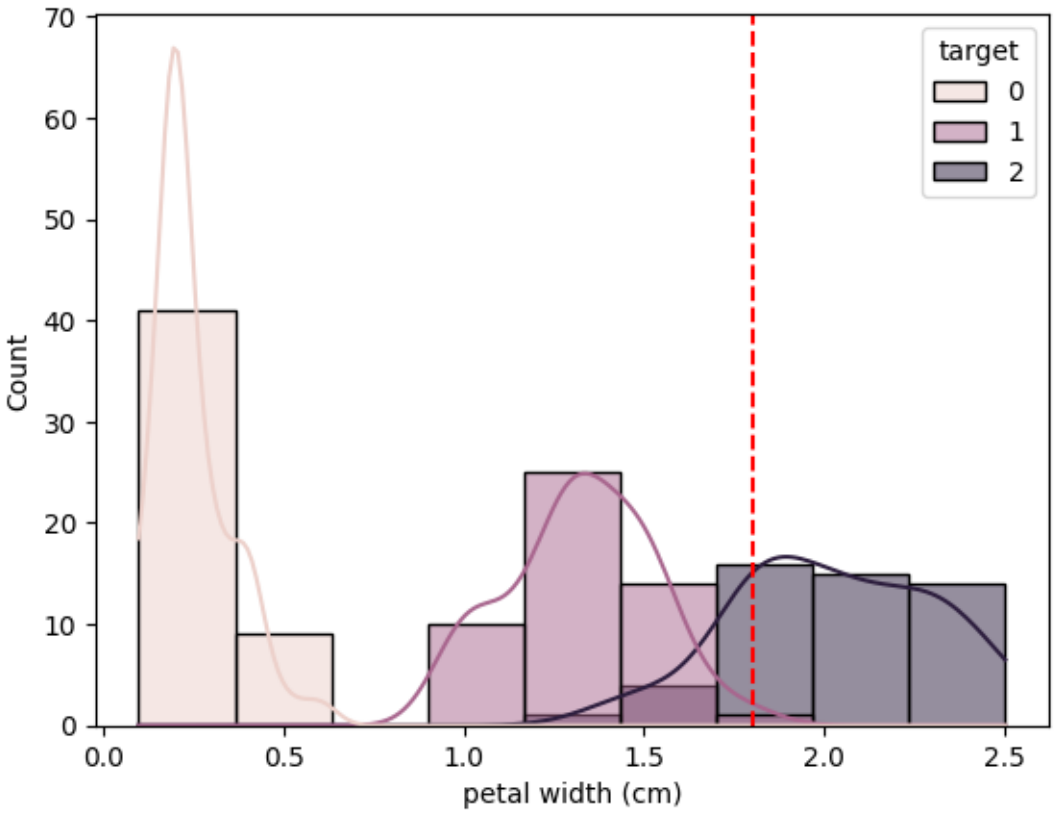
[36]:
```
versicolor = iris[iris['target']==1]['sepal length (cm)']
virginica = iris[iris['target']==2]['sepal length (cm)']
t_stat, p_val = ttest_ind(versicolor, virginica, equal_var=False)

sns.boxplot(data=iris[iris['target']!=0], x='target', y='sepal length (cm)')
```

[36]: <Axes: xlabel='target', ylabel='sepal length (cm)'>



[37]:
```
def bayes(prior, likelihood, evidence):
    return (prior * likelihood) / evidence

p_virginica = (iris['target']==2).mean()
p_width_given_virginica = np.mean((iris['target']==2) & (iris['petal width␣
 ↪(cm)']>1.8)) / np.mean(iris['target']==2)
p_width = np.mean(iris['petal width (cm)']>1.8)

posterior = bayes(p_virginica, p_width_given_virginica, p_width)

sns.histplot(data=iris, x='petal width (cm)', hue='target', kde=True)
plt.axvline(1.8, color='red', linestyle='--')
```

[37]: <matplotlib.lines.Line2D at 0x293dd795a50>


target
0
1
2
Count
petal width (cm)
0
10
20
30
40
50
60
70
0.0
0.5
1.0
1.5
2.0
2.5