ysis-code-ipynb-17-4-23-full-done

April 18, 2024

[18]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
sns.set_style('whitegrid')
```

[19]:
```
data=pd.read_csv(r'C:\Users\libin\OneDrive\Desktop\UMAV PROJECTS\PROJECT␣
 ↪10\Heart Disease data.csv')
data
```

[19]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	0
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	0
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	0
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	0
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	0
…	…	…	..	…	…	…	…	…	…	…	…	..	…	…
1020	59	1	1	140	221	0	1	164	1	0.0	2	0	2	1
1021	60	1	0	125	258	0	0	141	1	2.8	1	1	3	0
1022	47	1	0	110	275	0	0	118	1	1.0	1	1	2	0
1023	50	0	0	110	254	0	0	159	0	0.0	2	0	2	1
1024	54	1	0	120	188	0	1	113	0	1.4	1	1	3	0

[1025 rows x 14 columns]

[20]:
```
data.columns
```

[20]:
```
Index(['age', 'sex', 'cp', 'trestbps', 'chol', 'fbs', 'restecg', 'thalach',
       'exang', 'oldpeak', 'slope', 'ca', 'thal', 'target'],
      dtype='object')
```

1 Attribute Information

age : The person's age in Years

sex : The person's Gender (1 = male, 2 = female)

cp (chest pain type) : The chest pain experienced (Value 1: typical angina, Value 2: atypical angina, Value 3: non-anginal pain, Value 4: asymptomatic)

trestbps : The person's resting blood pressure (mm Hg on admission to the hospital)

chol: The person's serum cholestoral in mg/dl

fbs: The person's fasting blood sugar (> 120 mg/dl, 1 = true; 0 = false)

restecg : Resting electrocardiographic measurement (0 = normal, 1 = having ST-T wave abnormality, 2 = showing probable or definite left ventricular hypertrophy by Estes' criteria)

thalach: The person's maximum heart rate achieved

exang: Exercise induced angina (1 = yes; 0 = no) exercise induced angina

oldpeak: ST depression induced by exercise relative to rest

slope: the slope of the peak exercise ST segment (Value 1: upsloping, Value 2: flat, Value 3: downsloping)

ca: The number of major vessels (0-3) colored by flourosopy

thal: 0 = normal; 1 = fixed defect; 2 = reversable defect

target: Heart disease (0 = no, 1 = yes)

[21]:
```
data.isnull().sum()
```

[21]:
```
age         0
sex         0
cp          0
trestbps    0
chol        0
fbs         0
restecg     0
thalach     0
exang       0
oldpeak     0
slope       0
ca          0
```

```
thal        0
target      0
dtype: int64
```

There is NO MISSING Values in our Dataset

2 Percentage of people having Heart Disease

[22]:
```
target = data.groupby('target').size()
target
```

[22]:
```
target
0    499
1    526
dtype: int64
```

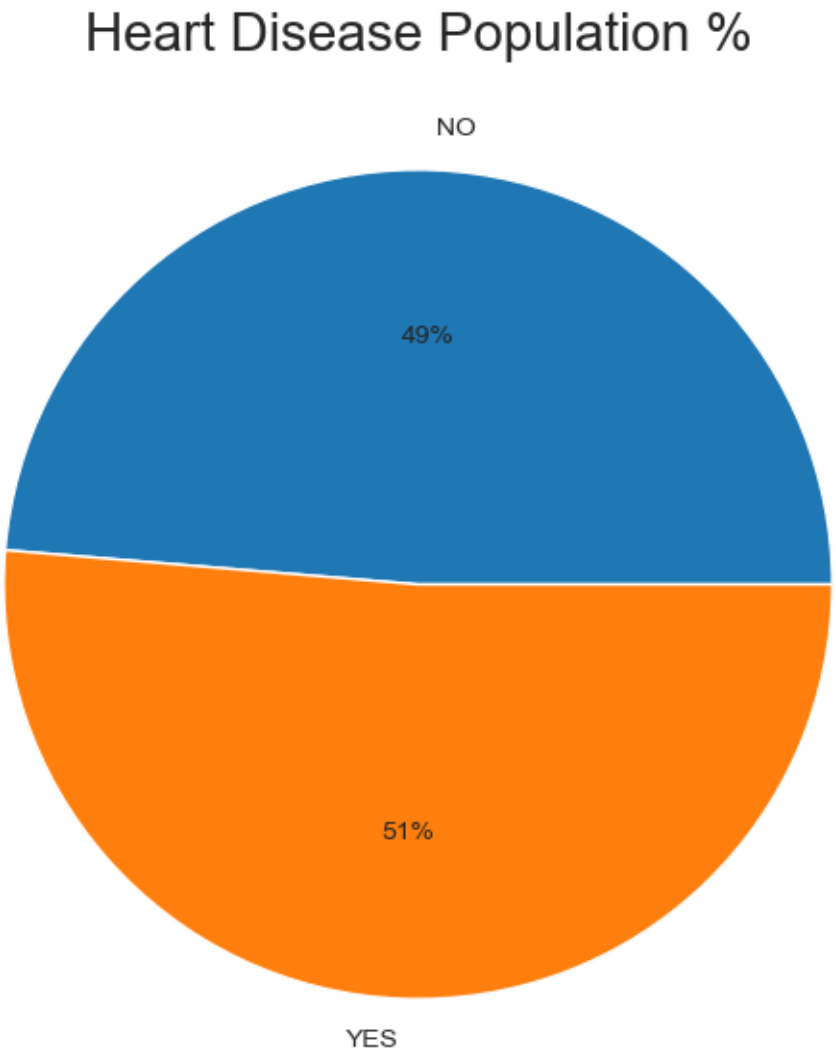
[23]:
```
#Numerical Data into Categorical Data Conversion

def heart_disease(row):
    if row==0:
        return 'NO'
    elif row==1:
        return 'YES'
```

[24]:
```
data['Heart_Disease']=data['target'].apply(heart_disease)
data.head()
```

[24]:

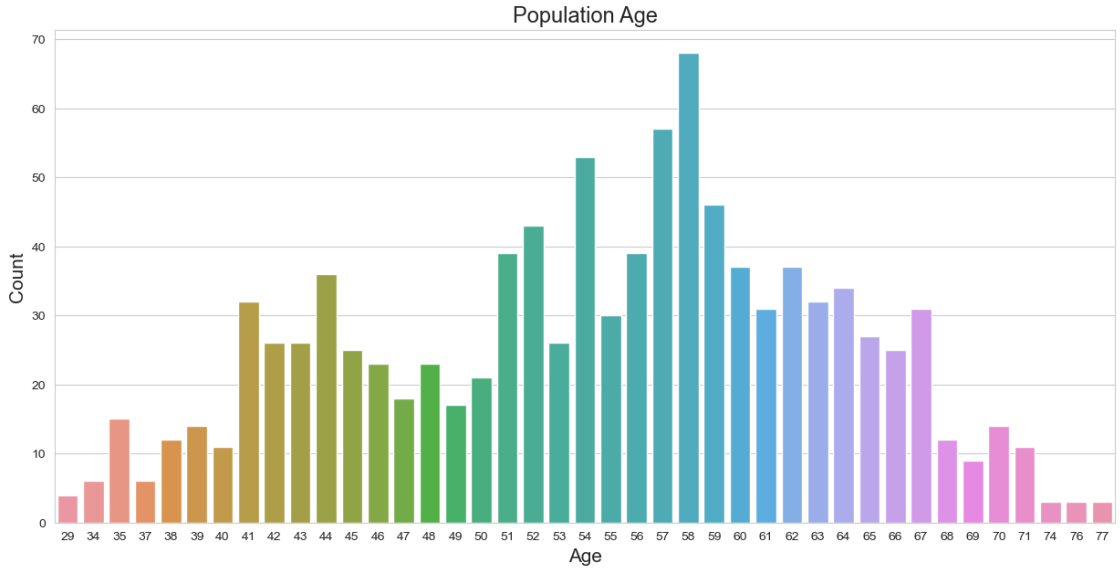
	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target	Heart_Disease
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	0	NO
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	0	NO
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	0	NO
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	0	NO
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	0	NO

[25]:
```
#Pie Chart for People having Heart Disease
plt.figure(figsize=(10,7))
plt.pie(target, labels=['NO','YES'], autopct='%0.0f%%')
plt.title('Heart Disease Population %', fontsize=20)
plt.show()
```



From the overall population, people having heart disease (51%) are greater than those who have heart disease(49%)

[26]:
```
#Countplot based on Person's Age

plt.figure(figsize=(15,7))
sns.countplot(x='age', data=data)
plt.title('Population Age', fontsize=17)
plt.xlabel('Age', fontsize=15)
plt.ylabel('Count', fontsize=15)
plt.show()
```



-> In this section, the best analysis can be divided into the elderly,middle-aged, young people by looking at the age ranges.

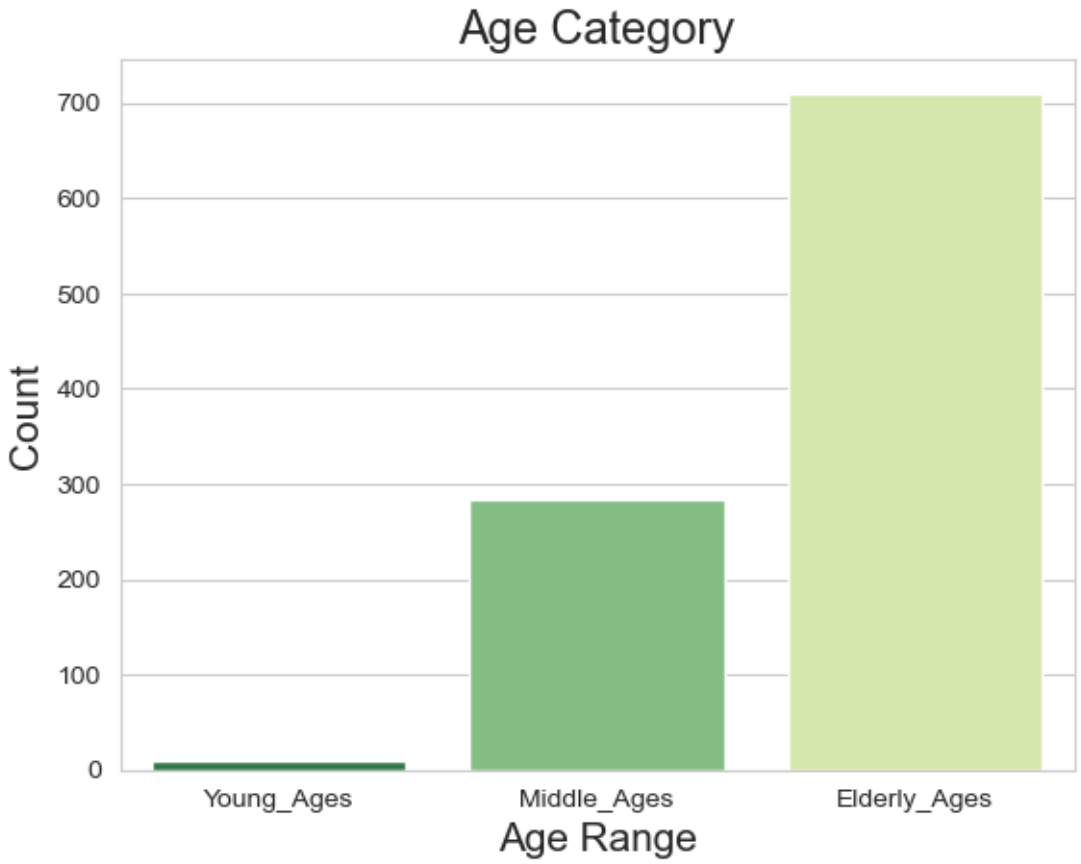
[29]:
```
#Statistical Analysis
Min_Age=data['age'].min()
Max_Age=data['age'].max()
Mean_Age=data['age'].mean()
print("Minimum Age =",Min_Age)
print("Maximum Age =",Max_Age)
print("Mean Age =",Mean_Age)
```

```
Minimum Age = 29
Maximum Age = 77
Mean Age = 54.43414634146342
```

[34]:
```
#Categorical Analysis

Young_Ages=data[(data['age']>=20) & (data['age']<35)]
Middle_Ages=data[(data['age']>=35) & (data['age']<50)]
Elderly_Ages=data[(data['age']>50)]
print('Young Ages =',len(Young_Ages))
print('Middle Ages =',len(Middle_Ages))
print('Elderly Ages =',len(Elderly_Ages))
```

```
Young Ages = 10
Middle Ages = 284
Elderly Ages = 710
```

[35]:
```
#Bar Plot Creation of Age Category

sns.barplot(x=['Young_Ages','Middle_Ages','Elderly_Ages'], y=[len(Young_Ages),␣
 ↪len(Middle_Ages), len(Elderly_Ages)], palette='YlGn_r')
plt.title('Age Category', fontsize=17)
plt.xlabel('Age Range', fontsize=15)
plt.ylabel('Count', fontsize=15)
plt.show()
```



[36]:
```
#Categorical Analysis

def gender(row):
    if row==1:
        return 'Male'
    elif row==0:
        return 'Female'
```

[37]:
```
#Applying converted data into our dataset with new column - sex1
```

```
data['Gender']=data['sex'].apply(gender)
data.head()
```

[37]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target	Heart_Disease	Gender
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	0	NO	Male
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	0	NO	Male
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	0	NO	Male
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	0	NO	Male
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	0	NO	Female

[42]:

```
#Converting Numerical Data into Categorical Data

def age_range(row):
    if row>=20 and row<35:
        return 'Young Aged'
    elif row>=35 and row<50:
        return 'Middle Aged'
    elif row>50:
        return 'Elder Aged'

data['Age_Range']=data['age'].apply(age_range)
data.head()
```

[42]:

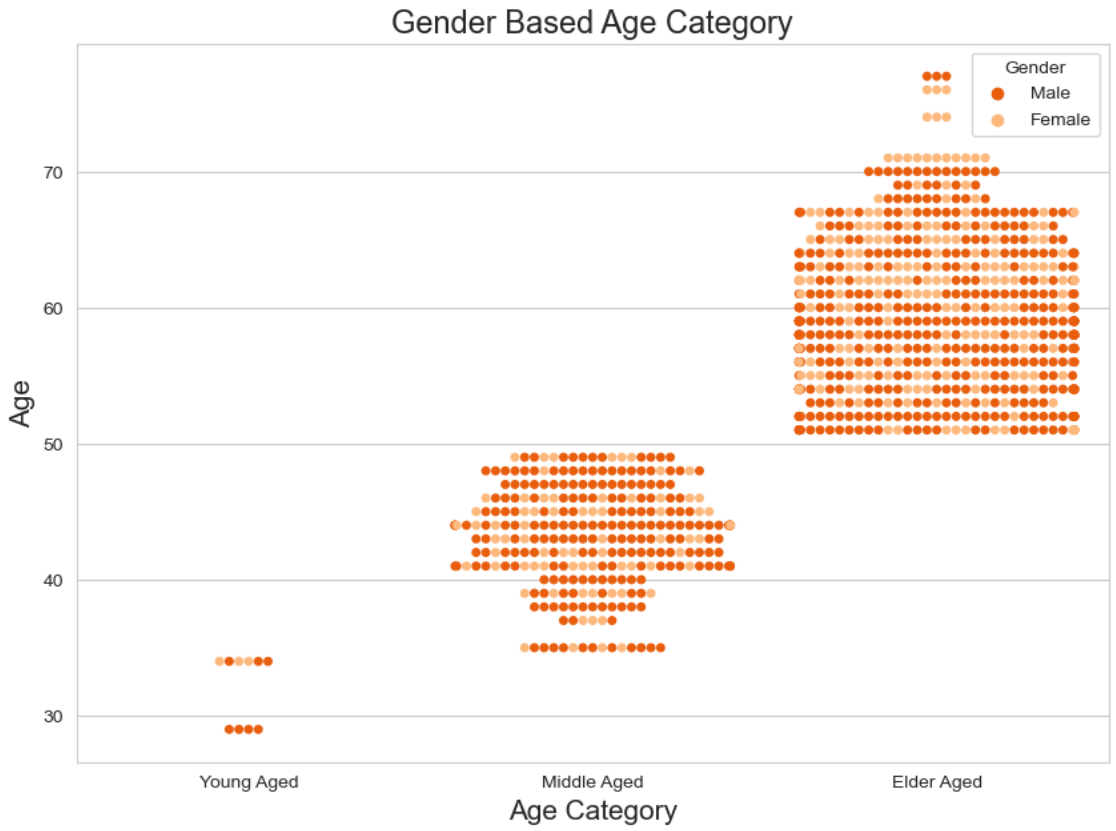
	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target	Heart_Disease	Gender	Age_Range
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	0	NO	Male	Elder Aged
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	0	NO	Male	Elder Aged
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	0	NO	Male	Elder Aged
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	0	NO	Male	Elder Aged
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	0	NO	Female	Elder Aged

[46]:

```
#Swarm Plot Creation of Gender Based Age Category using MatplotLib and Seaborn

plt.figure(figsize=(10,7))
```

```
sns.swarmplot(x='Age_Range', y='age', hue='Gender', data=data, order=['Young␣
 ↪Aged','Middle Aged','Elder Aged'], palette='Oranges_r')
plt.title('Gender Based Age Category', fontsize=17)
plt.xlabel('Age Category', fontsize=15)
plt.ylabel('Age', fontsize=15)
plt.show()
```

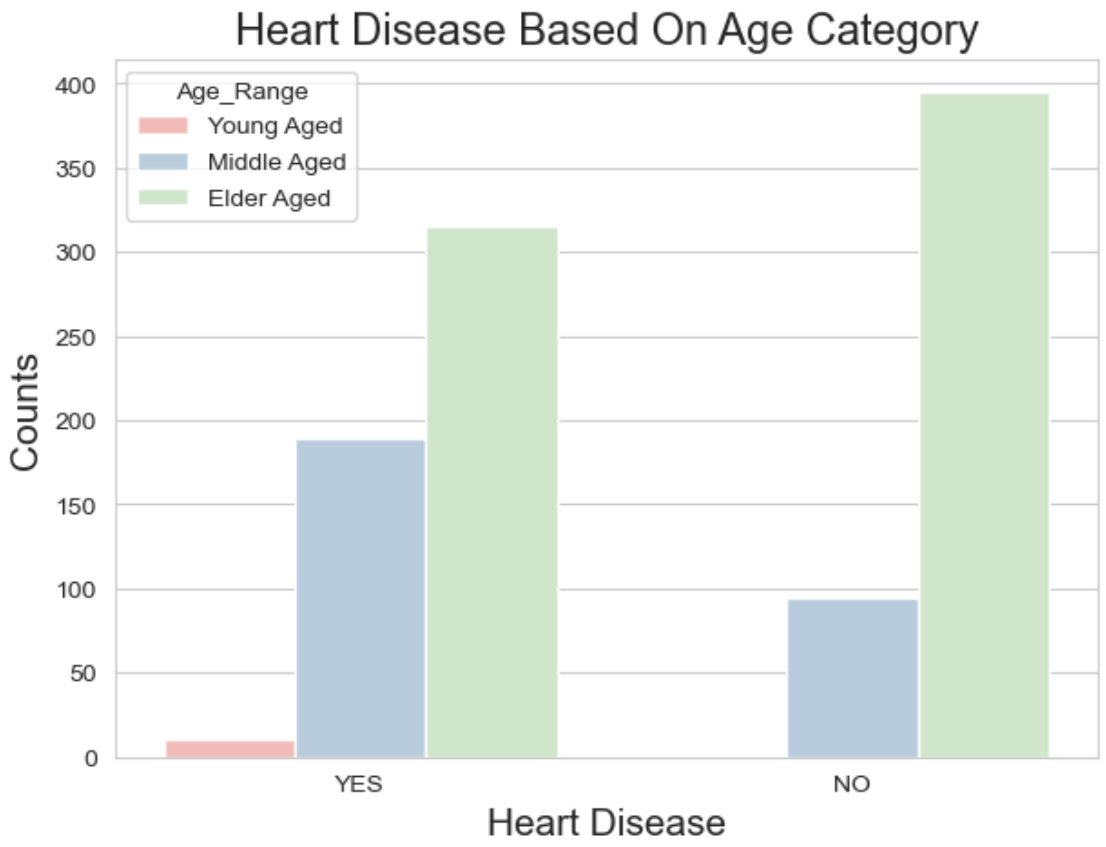
```
C:\ProgramData\anaconda3\Lib\site-packages\seaborn\categorical.py:3544:
UserWarning: 10.1% of the points cannot be placed; you may want to decrease the
size of the markers or use stripplot.
  warnings.warn(msg, UserWarning)
C:\ProgramData\anaconda3\Lib\site-packages\seaborn\categorical.py:3544:
UserWarning: 24.1% of the points cannot be placed; you may want to decrease the
size of the markers or use stripplot.
  warnings.warn(msg, UserWarning)
```



-> In Our Population Number Of Males are more in Middle Age Category and Females are more in Elder Age Category

[47]:
```
#Count Plot for Heart Disease Based On Age Category
plt.figure(figsize=(7,5))
```

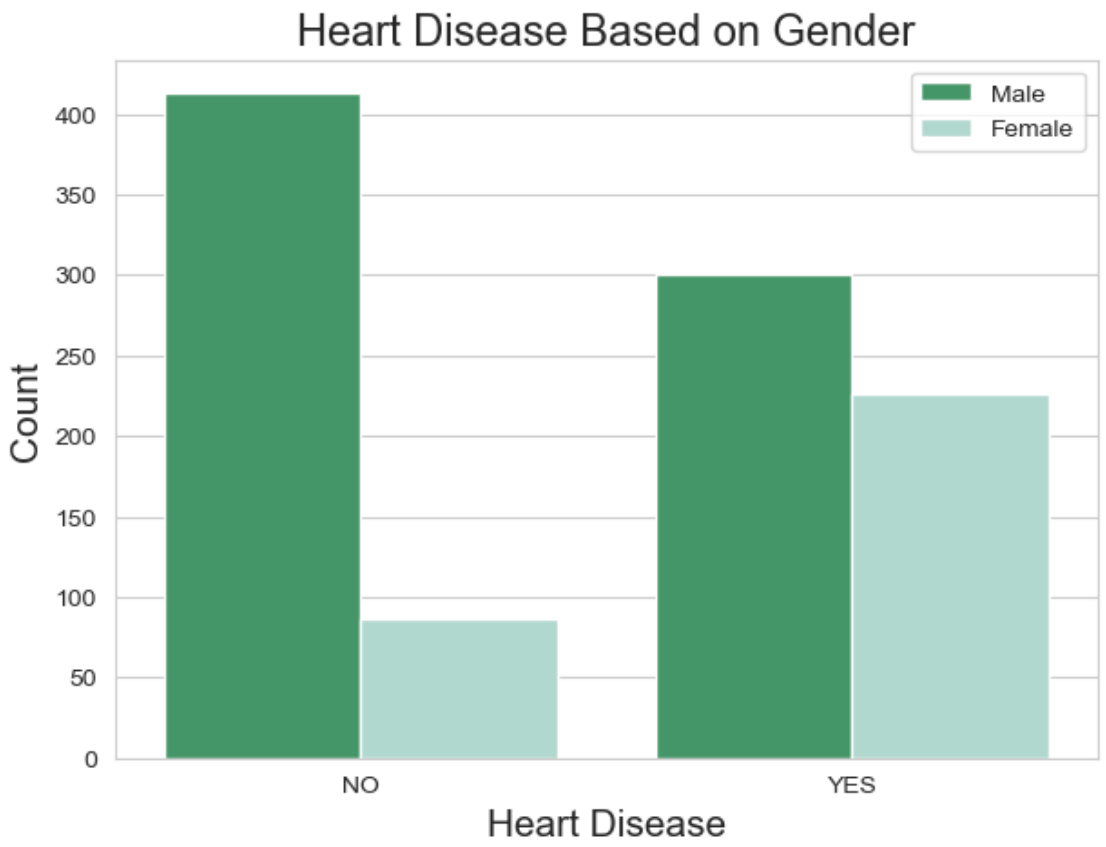
```
hue_order=['Young Aged', 'Middle Aged', 'Elder Aged']
sns.countplot(x='Heart_Disease', hue='Age_Range', data=data,␣
 ↪order=['YES','NO'], hue_order=hue_order, palette='Pastel1')
plt.title('Heart Disease Based On Age Category', fontsize=17)
plt.xlabel('Heart Disease', fontsize=15)
plt.ylabel('Counts', fontsize=15)
plt.show()
```



-> Elder Age People are most affected by Heart Disease and Middle Age People are mostly free from any kind of Heart Disease

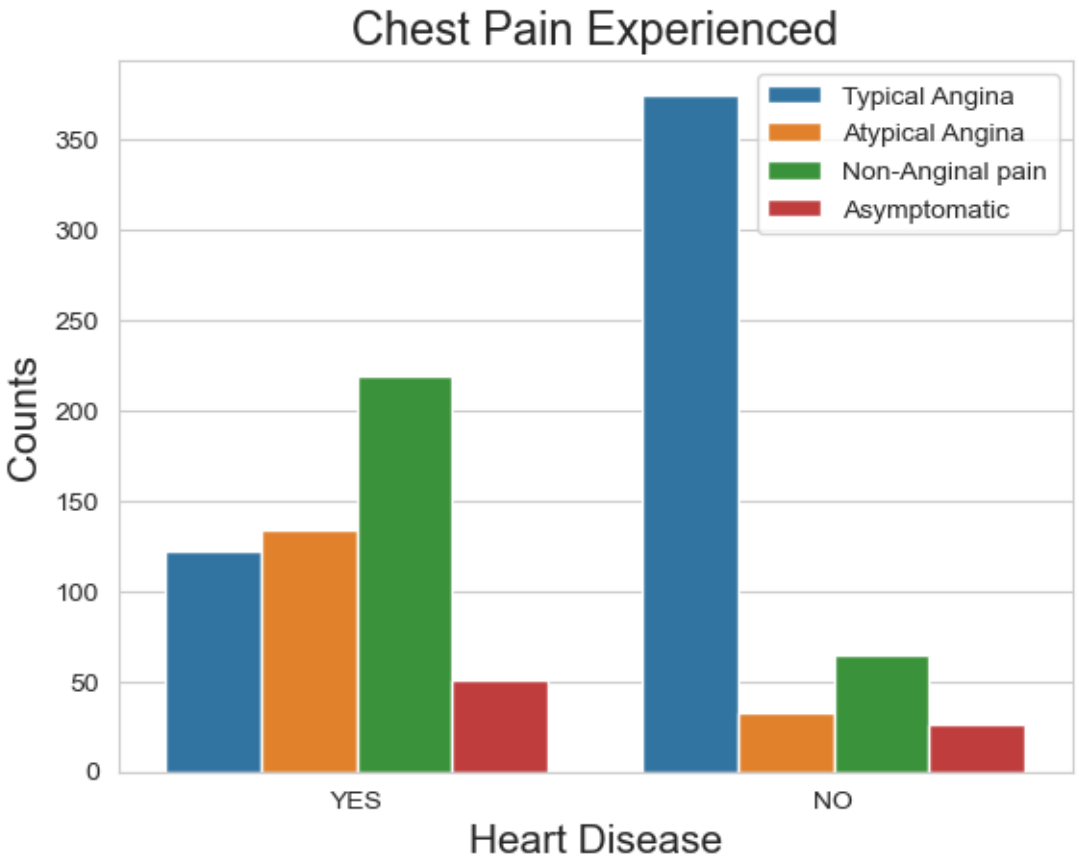
[48]:
```
#Count Plot Creation of Heart Disease Based on Gender

plt.figure(figsize=(7,5))
sns.countplot(x=data['Heart_Disease'], hue='Gender', data=data,␣
 ↪palette='BuGn_r')
plt.xlabel('Heart Disease', fontsize=15)
plt.ylabel('Count',fontsize=15)
plt.legend(labels=['Male','Female'])
plt.title('Heart Disease Based on Gender',fontsize=17)
```

```
plt.show()
```



-> We can see that Males are mostly tend to have Heart Disease

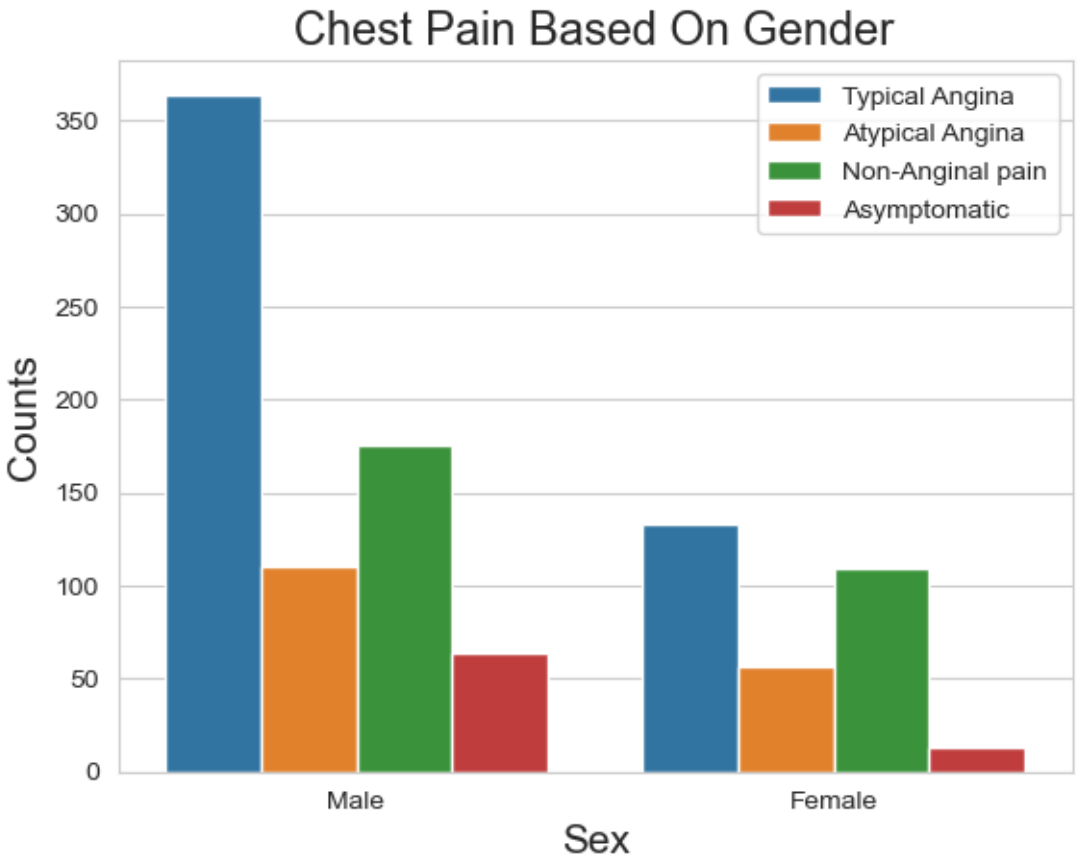
[50]:
```
#Count Plot Creation of Chest Pain Experienced

sns.countplot(x=data['Heart_Disease'], hue='cp', data=data, order=['YES','NO'])
plt.title('Chest Pain Experienced', fontsize=17)
plt.xlabel('Heart Disease',fontsize=15)
plt.ylabel('Counts',fontsize=15)
plt.legend(labels=['Typical Angina','Atypical Angina','Non-Anginal␣
 ↪pain','Asymptomatic'])
plt.show()
```



-> It seems people having Non-Anginal chest pain have a higher chance of heart disease

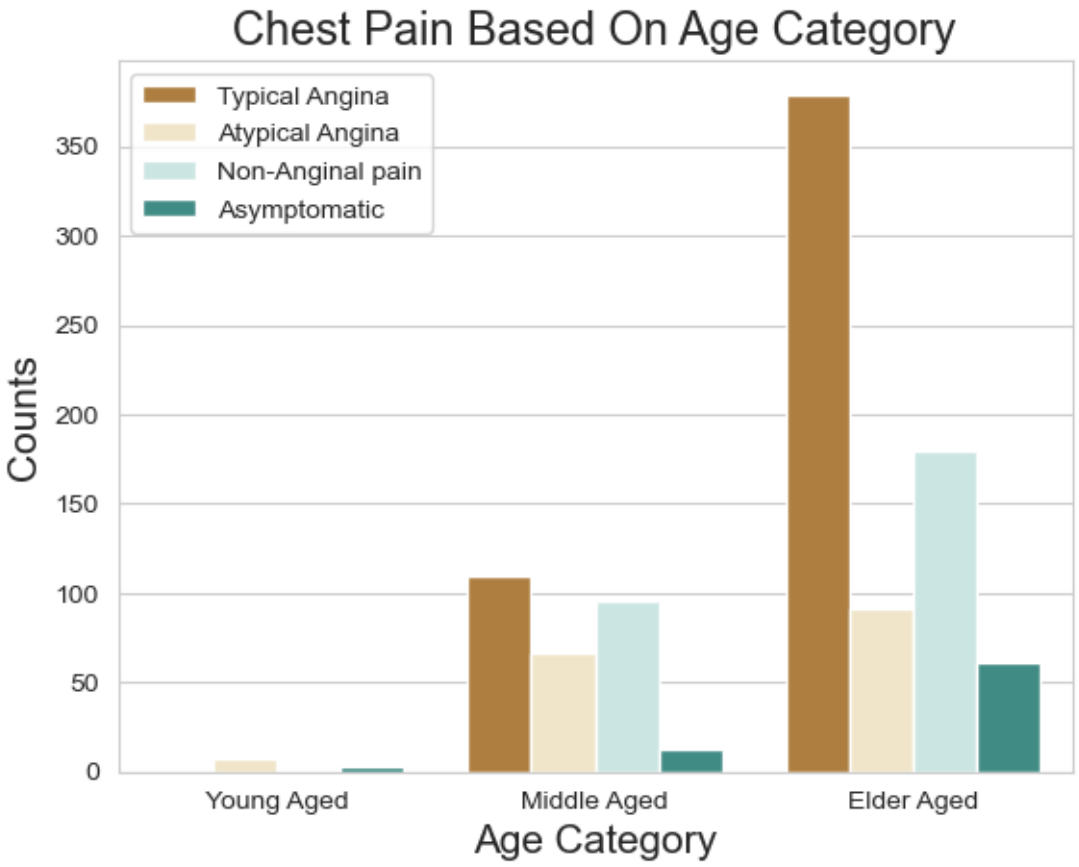
-> Typical Angina Chest pain means neither causing nor exhibiting symptoms of Heart disease.

[51]:
```
#Count Plot Creation of Chest Pain Based On Gender

sns.countplot(x=data['Gender'], hue='cp', data=data)
plt.title('Chest Pain Based On Gender', fontsize=17)
plt.xlabel('Sex', fontsize=15)
plt.ylabel('Counts', fontsize=15)
plt.legend(labels=['Typical Angina','Atypical Angina','Non-Anginal␣
 ↪pain','Asymptomatic'])
plt.show()
```



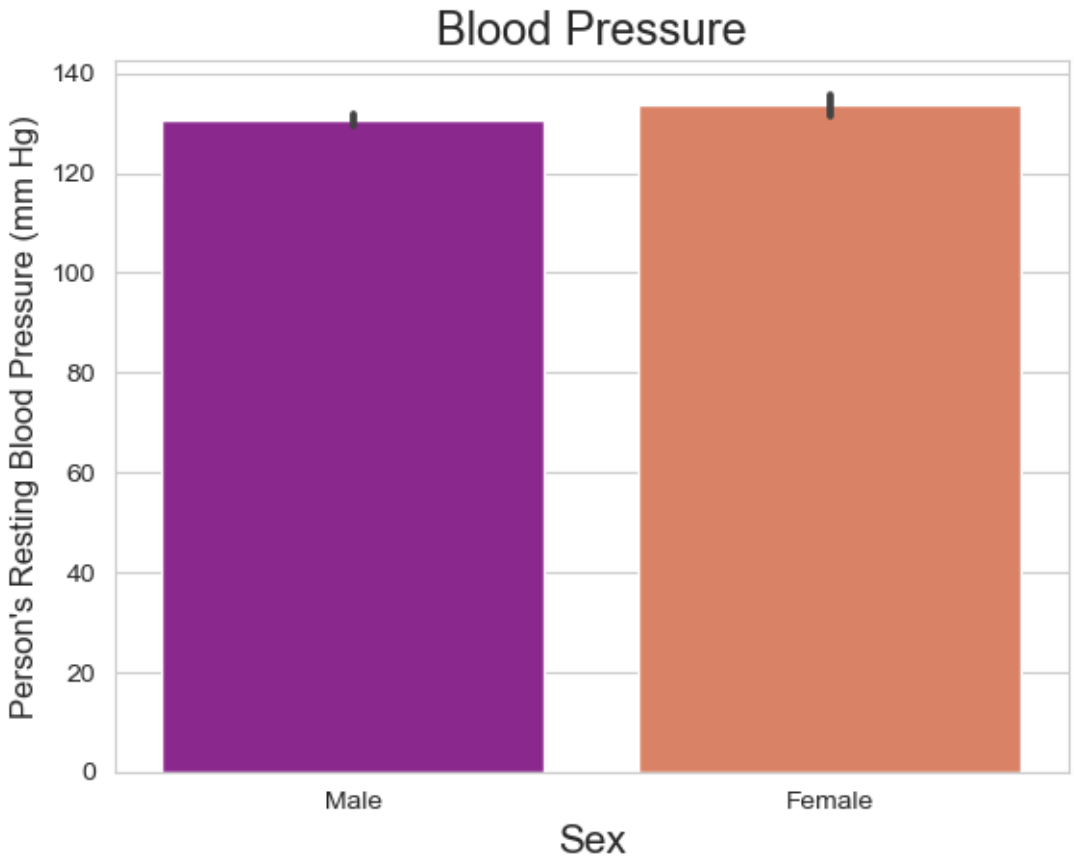
-> We can see that a higher number of men are suffering from Typical Angina type of Chest Pain

[52]:
```
#Count Plot Creation of Chest Pain Based On Age Category
sns.countplot(x=data['Age_Range'], hue='cp', data=data, order=['Young Aged',␣
 ↪'Middle Aged', 'Elder Aged'], palette='BrBG')
plt.title('Chest Pain Based On Age Category', fontsize=17)
plt.xlabel('Age Category', fontsize=15)
plt.ylabel('Counts', fontsize=15)
plt.legend(labels=['Typical Angina','Atypical Angina','Non-Anginal␣
 ↪pain','Asymptomatic'])
plt.show()
```



-> There is very high number of Typical Angina Pain in Elderly aged and Middle Aged Category

[53]:
```
#Bar Plot Creation of Person's Resting Blood Pressure
sns.barplot(x='Gender', y='trestbps', data=data, palette='plasma')
plt.title("Blood Pressure", fontsize=17)
plt.xlabel('Sex',fontsize=15)
plt.ylabel("Person's Resting Blood Pressure (mm Hg)", fontsize=12)
plt.show()
```

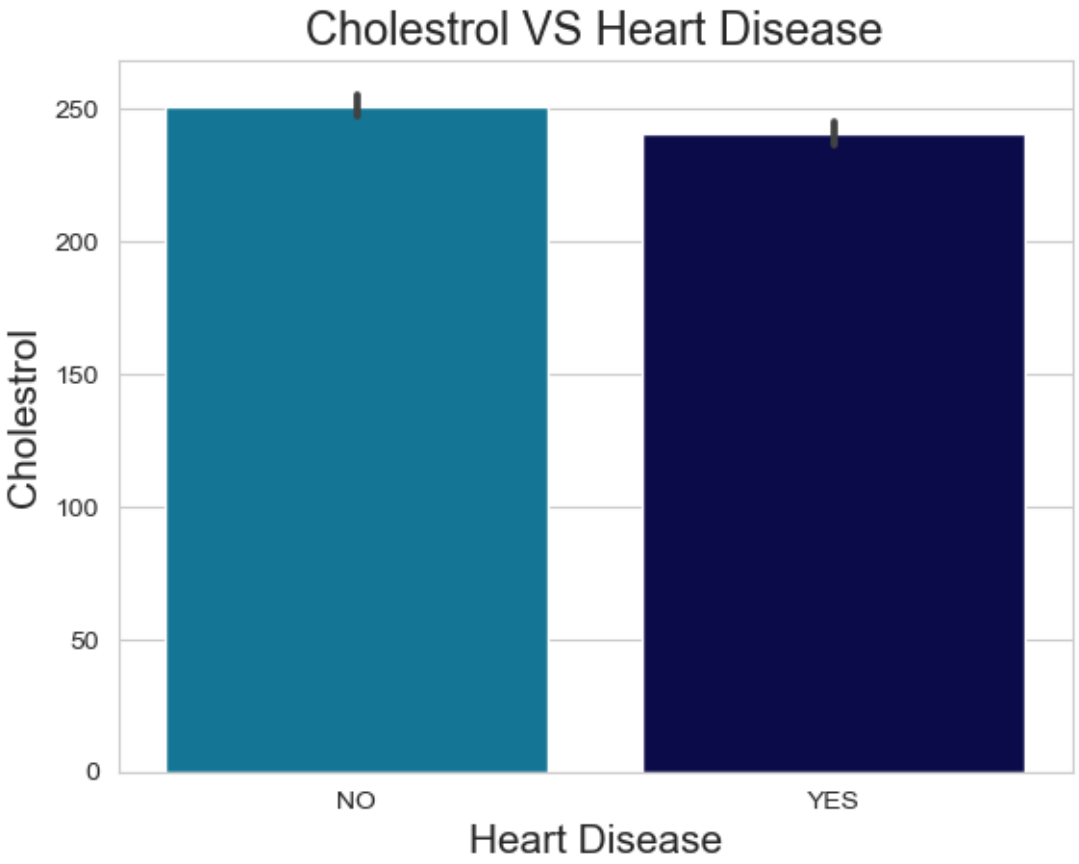


-> Blood Pressure Rate is almost equal in Males and Females

[55]:
```
#Bar Plot Creation of Cholestrol Level Based On Gender
sns.barplot(x='Gender', y='chol', data=data, palette='turbo')
plt.title("Cholestrol Level Based On Gender", fontsize=17)
plt.xlabel('Sex',fontsize=15)
plt.ylabel("Cholestrol", fontsize=15)
plt.show()
```

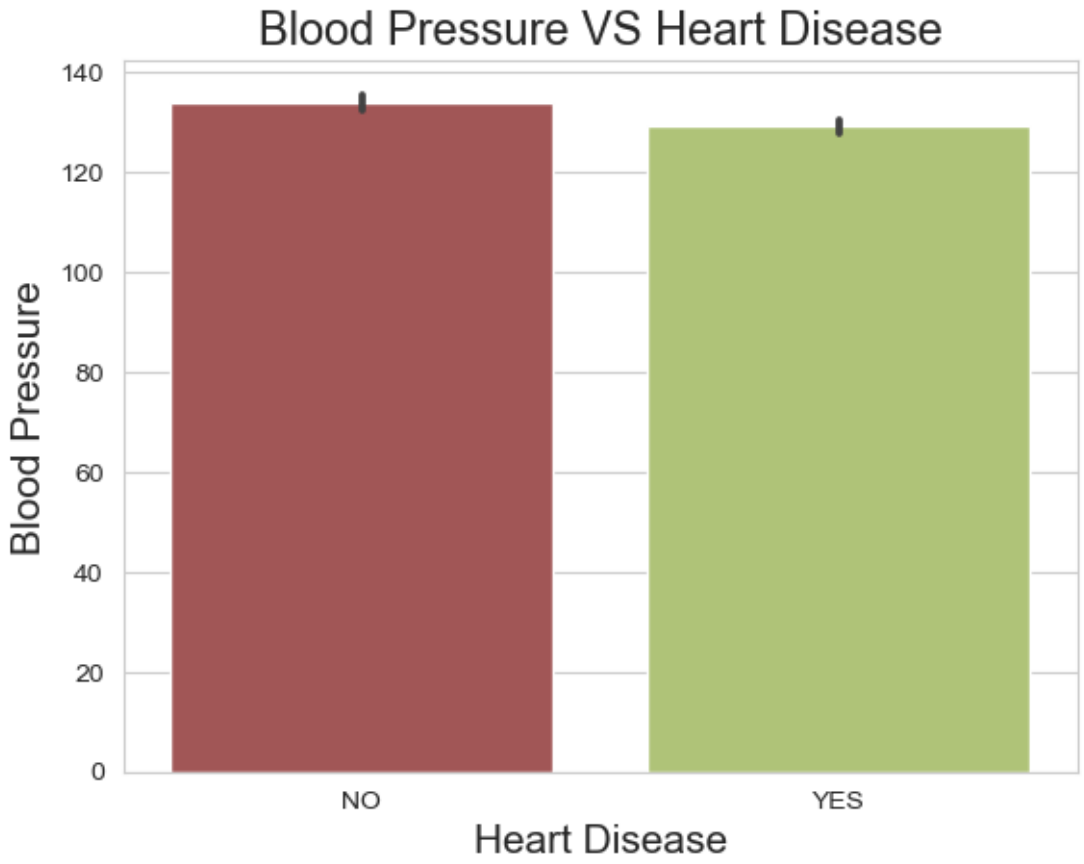
-> females have little bit of higher cholesterol than males

[56]:
```
#Bar Plot Creation of Cholestrol VS Heart Disease

sns.barplot(x='Heart_Disease', y='chol', data=data, palette='ocean_r')
plt.title('Cholestrol VS Heart Disease', fontsize=17)
plt.xlabel('Heart Disease', fontsize=15)
plt.ylabel('Cholestrol', fontsize=15)
plt.show()
```



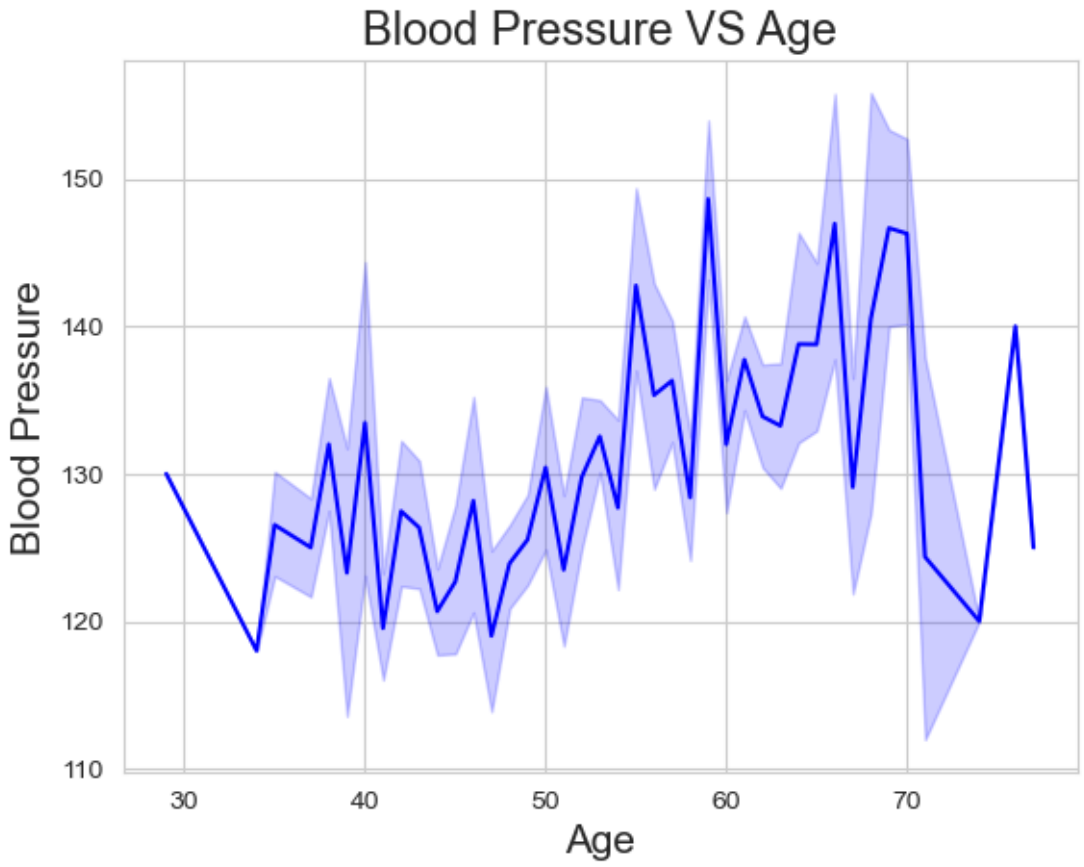
-> Higher Cholestrol Level causes Chances Of Heart Disease

[57]:
```
#Bar Plot Creation of Blood Pressure VS Heart Disease
sns.barplot(x='Heart_Disease', y='trestbps', data=data, palette='tab20b_r')
plt.title('Blood Pressure VS Heart Disease', fontsize=17)
plt.xlabel('Heart Disease', fontsize=15)
plt.ylabel('Blood Pressure', fontsize=15)
plt.show()
```



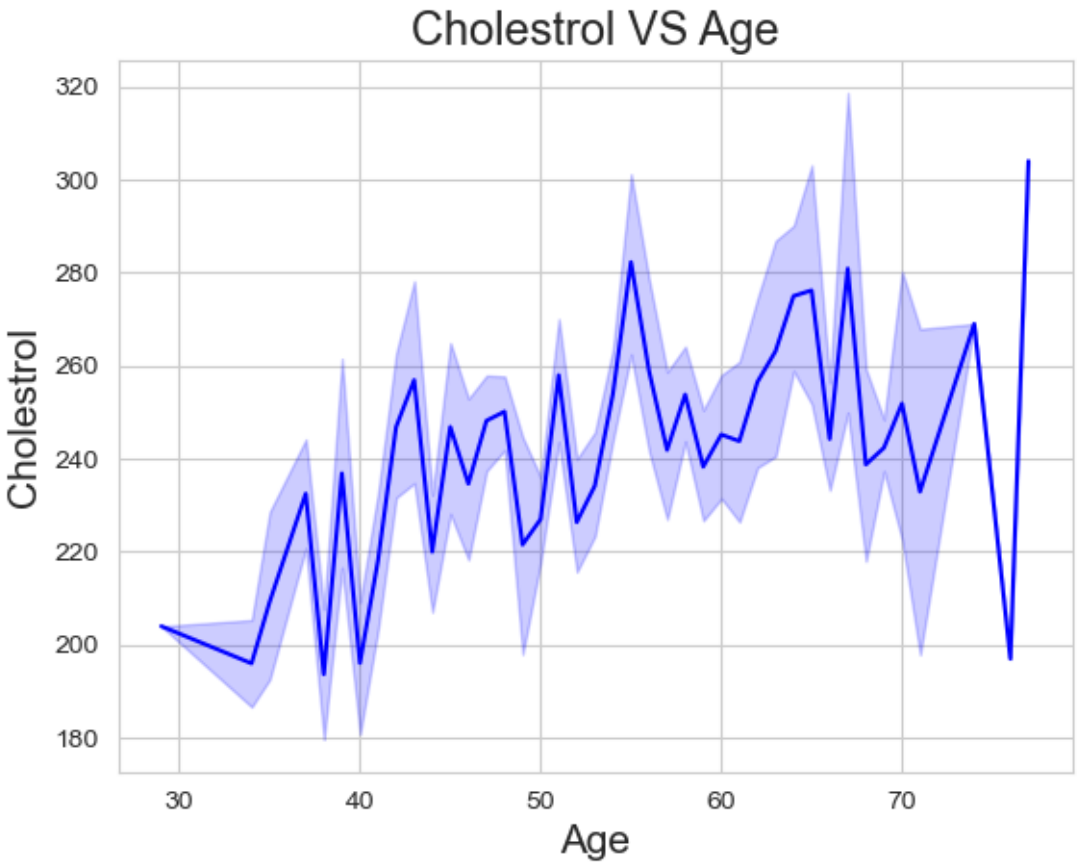
-> Higher Blood Pressure Level results Chances Of Heart Disease

[59]:
```
#Line Plot Creation of Blood Pressure VS Age
sns.lineplot(x='age', y='trestbps', data=data, color='b')
plt.title('Blood Pressure VS Age', fontsize=17)
plt.xlabel('Age', fontsize=15)
plt.ylabel('Blood Pressure', fontsize=15)
plt.show()
```



-> Here we can observe that Blood Pressure increases between age of 50 to 60 and somehow continue the pattern till 70

[60]:
```
#Line Plot Creation of Cholestrol VS Age

sns.lineplot(x='age', y='chol', data=data, color='b')
plt.title('Cholestrol VS Age', fontsize=17)
plt.xlabel('Age', fontsize=15)
plt.ylabel('Cholestrol', fontsize=15)
plt.show()
```



Similarly Cholestrol Increasing in the age group of 40-60

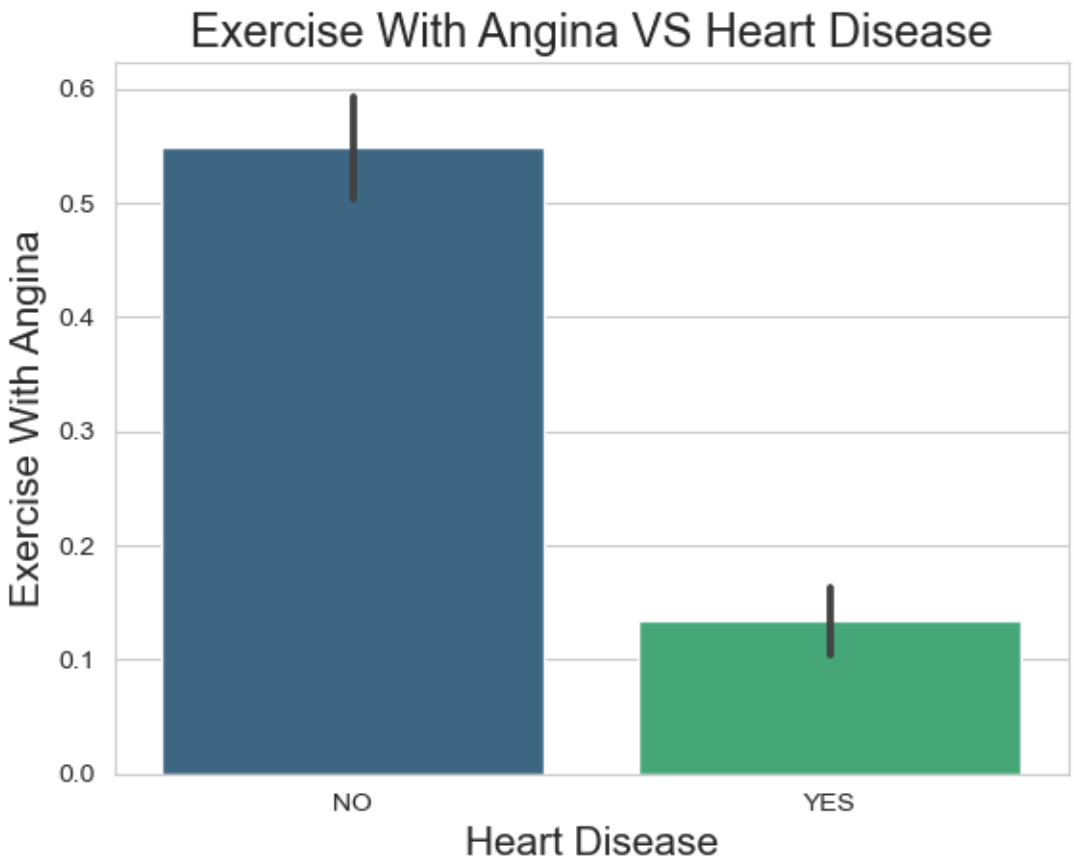
[62]:
```
#Line Plot Creation of ST Depression VS Age

sns.lineplot(x='age', y='oldpeak', data=data, color='g')
plt.title('ST Depression VS Age', fontsize=17)
plt.xlabel('Age', fontsize=15)
plt.ylabel('ST depression', fontsize=15)
plt.show()
```

-> we can observe from here that ST depression mostly increases bw the age group of 30-40 -> ST depression refers to a finding on an electrocardiogram, wherein the trace in the ST segment is abnormally low below the baseline.

[63]:
```
#Bar Plot Creation of ST depression VS Heart Disease
sns.barplot(x='Gender', y='oldpeak', data=data, palette='twilight_r')
plt.title('ST depression VS Heart Disease', fontsize=17)
plt.xlabel('Sex', fontsize=15)
plt.ylabel('ST depression', fontsize=15)
plt.show()
```

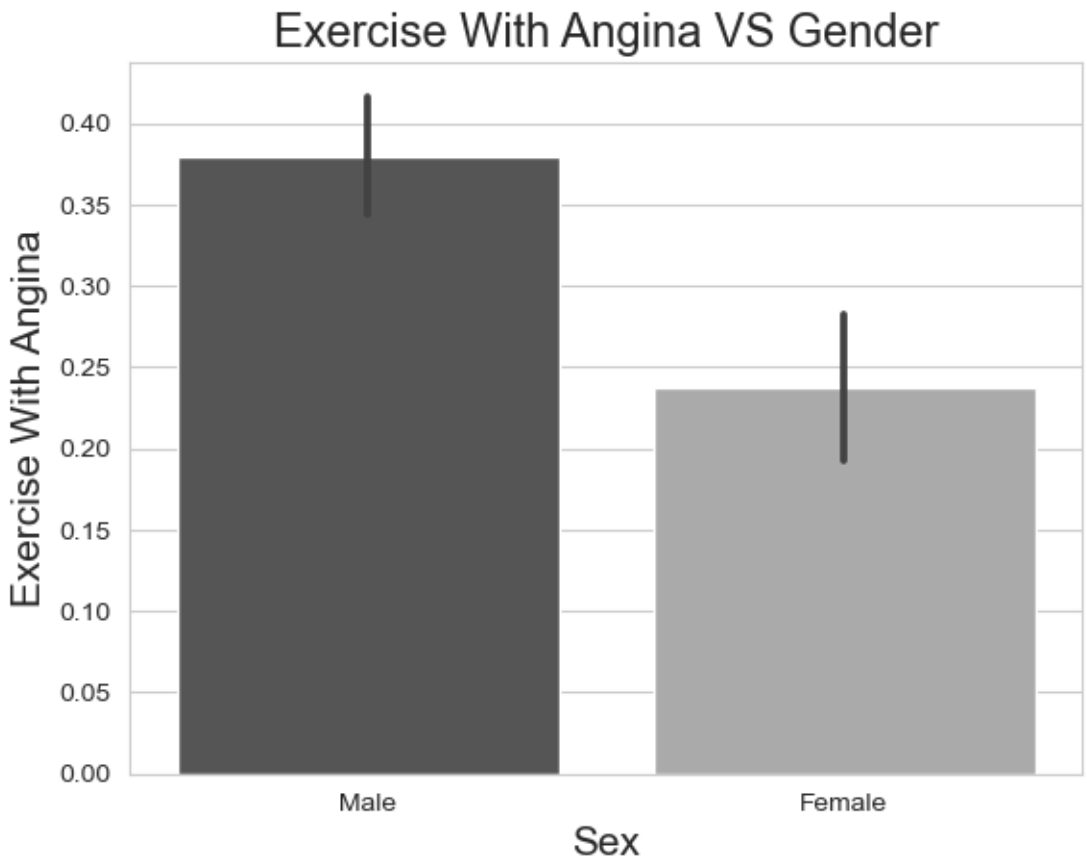
-> More Males are prone to ST depression as compare to females

[64]:
```
#Bar Plot Creation of Exercise With Angina VS Heart Disease

sns.barplot(x='Heart_Disease', y='exang', data=data, palette='viridis')
plt.title('Exercise With Angina VS Heart Disease', fontsize=17)
plt.xlabel('Heart Disease', fontsize=15)
plt.ylabel('Exercise With Angina', fontsize=15)
plt.show()
```



-> If you suffer from Angina, you may be concerned that exercise but seems like it will not make your symptoms worse.

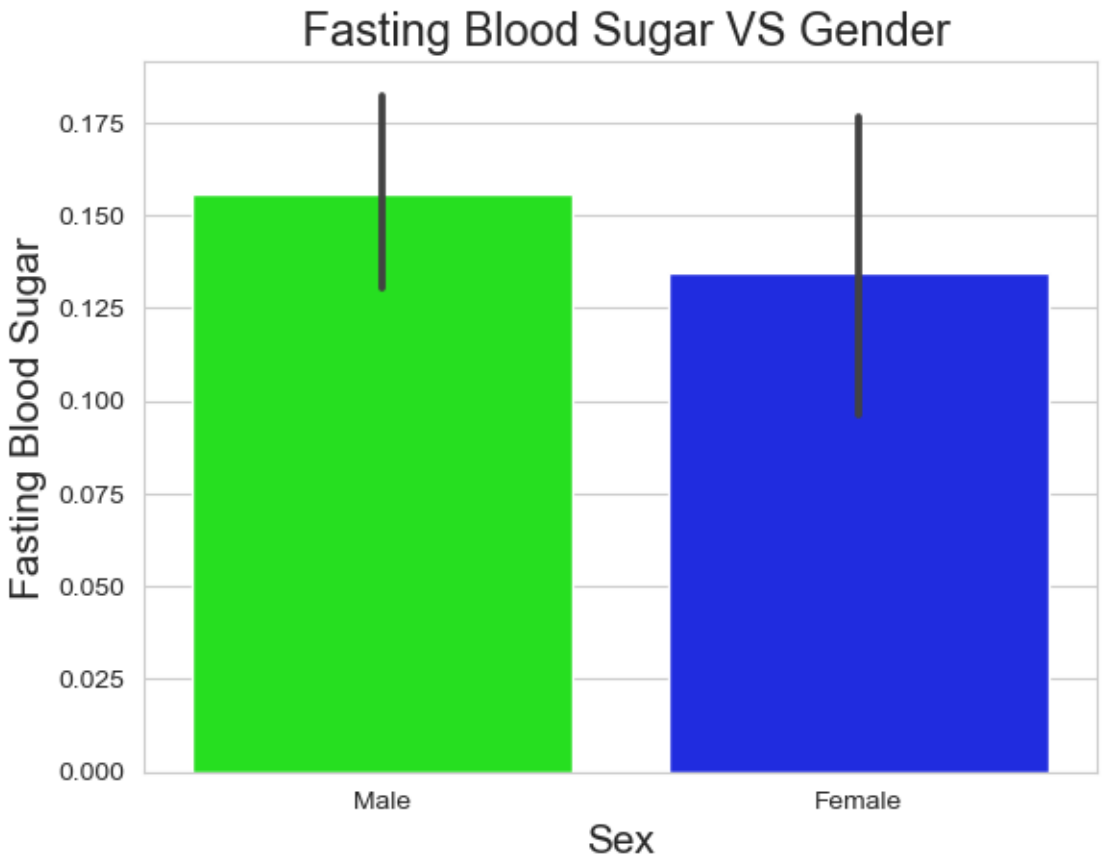
[65]:
```
#Bar Plot Creation of Exercise With Angina VS Gender

sns.barplot(x='Gender', y='exang', data=data, palette='binary_r')
plt.title('Exercise With Angina VS Gender', fontsize=17)
plt.xlabel('Sex', fontsize=15)
plt.ylabel('Exercise With Angina', fontsize=15)
plt.show()
```



-> Males do Exercise when having Angina

-> Angina - A type of chest pain caused by reduced blood flow to the heart.

[66]:
```
#Bar Plot Creation of Fasting Blood Sugar VS Gender
sns.barplot(y='fbs', x='Gender', data=data, palette='hsv')
plt.title(' Fasting Blood Sugar VS Gender', fontsize=17)
plt.xlabel('Sex', fontsize=15)
plt.ylabel('Fasting Blood Sugar', fontsize=15)
plt.show()
```



-> Males have high number of Fasting Blood Sugar over 120

[70]:
```
num_col = data.select_dtypes(include=np.number)
num_col.cov()
```

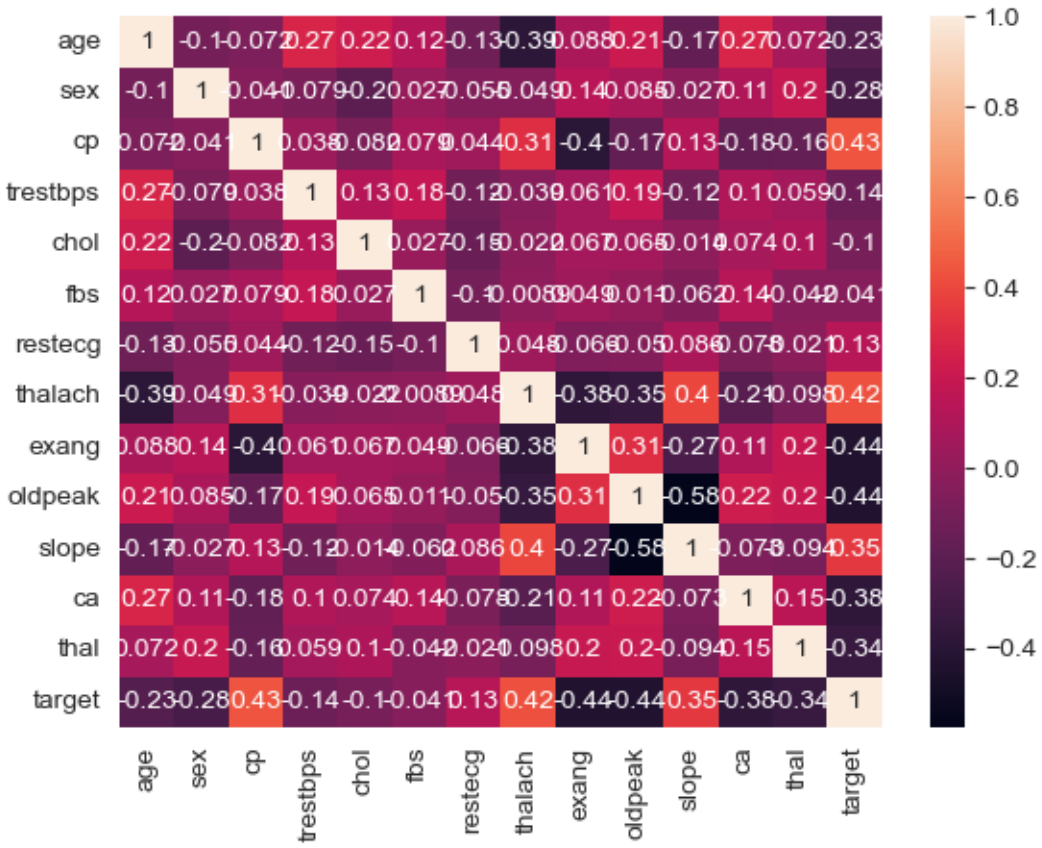
[70]:

	age	sex	cp	trestbps	chol	fbs	\
age	82.306450	-0.431198	-0.672251	43.085733	102.890625	0.392164	
sex	-0.431198	0.211944	-0.019491	-0.636863	-4.708984	0.004465	
cp	-0.672251	-0.019491	1.060160	0.688565	-4.336914	0.029108	
trestbps	43.085733	-0.636863	0.688565	306.835410	115.657227	1.135165	
chol	102.890625	-4.708984	-4.336914	115.657227	2661.787109	0.495117	
fbs	0.392164	0.004465	0.029108	1.135165	0.495117	0.127111	
restecg	-0.635490	-0.013395	0.023687	-1.144685	-4.014648	-0.019583	
thalach	-81.446089	-0.522838	7.268296	-15.822822	-25.841797	-0.072719	
exang	0.378144	0.030288	-0.195451	0.506798	1.643555	0.008303	
oldpeak	2.218825	0.045812	-0.211407	3.857971	3.933301	0.004549	
slope	-0.947742	-0.007584	0.083727	-1.303344	-0.454102	-0.013634	
ca	2.539458	0.053021	-0.187017	1.887842	3.949219	0.050406	
thal	0.407093	0.056697	-0.104385	0.644446	3.209961	-0.009333	
target	-1.040392	-0.064346	0.223903	-1.215584	-2.579102	-0.007339	

```
             restecg     thalach     exang   oldpeak     slope        ca  \
age        -0.635490  -81.446089  0.378144  2.218825 -0.947742  2.539458
sex        -0.013395   -0.522838  0.030288  0.045812 -0.007584  0.053021
cp          0.023687    7.268296 -0.195451 -0.211407  0.083727 -0.187017
trestbps   -1.144685  -15.822822  0.506798  3.857971 -1.303344  1.887842
chol       -4.014648  -25.841797  1.643555  3.933301 -0.454102  3.949219
fbs        -0.019583   -0.072719  0.008303  0.004549 -0.013634  0.050406
restecg     0.278655    0.587909 -0.016373 -0.031085  0.028073 -0.042482
thalach     0.587909  529.263325 -4.136114 -9.456022  5.618078 -4.929917
exang      -0.016373   -4.136114  0.223514  0.172684 -0.078077  0.052558
oldpeak    -0.031085   -9.456022  0.172684  1.380750 -0.417527  0.268673
slope       0.028073    5.618078 -0.078077 -0.417527  0.381622 -0.046765
ca         -0.042482   -4.929917  0.052558  0.268673 -0.046765  1.062544
thal       -0.006718   -1.400290  0.057865  0.147810 -0.036076  0.095335
target      0.035496    4.865194 -0.103558 -0.257632  0.106736 -0.196954

                thal    target
age         0.407093 -1.040392
sex         0.056697 -0.064346
cp         -0.104385  0.223903
trestbps    0.644446 -1.215584
chol        3.209961 -2.579102
fbs        -0.009333 -0.007339
restecg    -0.006718  0.035496
thalach    -1.400290  4.865194
exang       0.057865 -0.103558
oldpeak     0.147810 -0.257632
slope      -0.036076  0.106736
ca          0.095335 -0.196954
thal        0.385219 -0.104856
target     -0.104856  0.250071
```

[72]:
```
sns.heatmap(num_col.corr(),annot=True)
```

[72]:
```
<Axes: >
```


age
sex
cp
trestbps
chol
fbs
restecg
thalach
exang
oldpeak
slope
ca
thal
target
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4

[ ]: