# IBM_Data_Science_Professional_Certificate_-Statistics_for_Data_Science_with_Python

October 23, 2023

[1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import scipy.stats
```

[2]:
```
import statsmodels.api as sm
from statsmodels.formula.api import ols
```

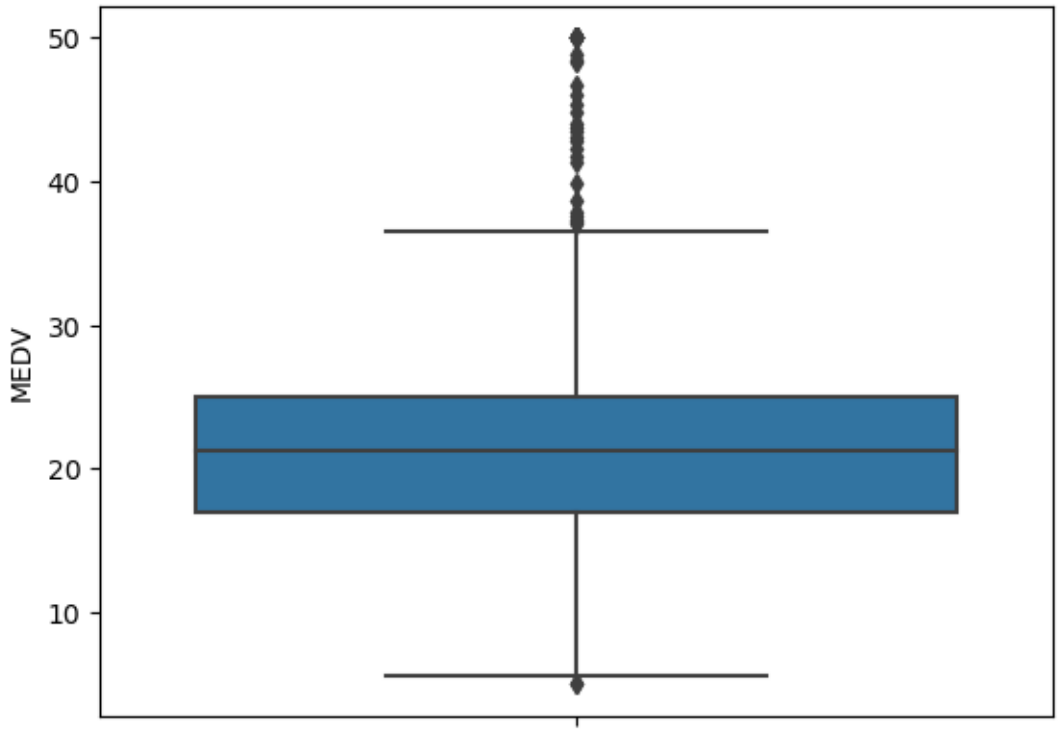
[3]:
```
#TASK4
```

[4]:
```
boston_df=pd.read_csv("https://cf-courses-data.s3.us.cloud-object-storage.
 ↪appdomain.cloud/IBMDeveloperSkillsNetwork-ST0151EN-SkillsNetwork/labs/
 ↪boston_housing.csv")
boston_df.head()
```

[4]:

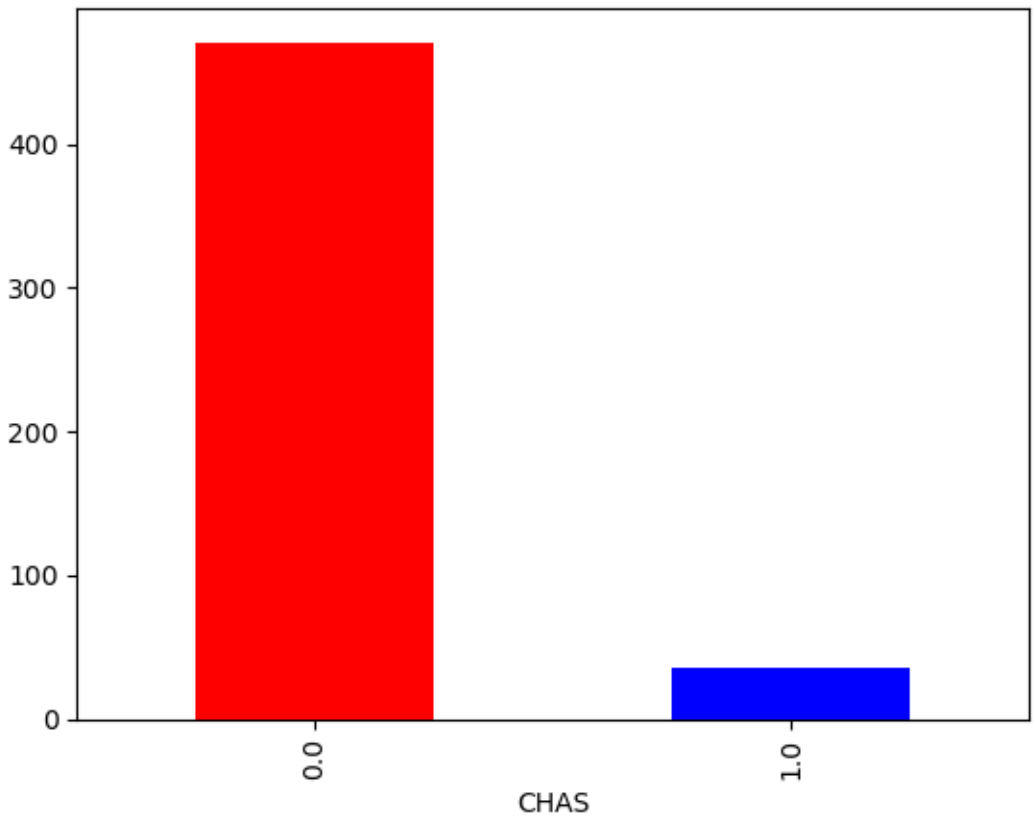
| | Unnamed: 0 | CRIM | ZN | INDUS | CHAS | NOX | RM | AGE | DIS | RAD | TAX | PTRATIO | LSTAT | MEDV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0.00632 | 18.0 | 2.31 | 0.0 | 0.538 | 6.575 | 65.2 | 4.0900 | 1.0 | 296.0 | 15.3 | 4.98 | 24.0 |
| 1 | 1 | 0.02731 | 0.0 | 7.07 | 0.0 | 0.469 | 6.421 | 78.9 | 4.9671 | 2.0 | 242.0 | 17.8 | 9.14 | 21.6 |
| 2 | 2 | 0.02729 | 0.0 | 7.07 | 0.0 | 0.469 | 7.185 | 61.1 | 4.9671 | 2.0 | 242.0 | 17.8 | 4.03 | 34.7 |
| 3 | 3 | 0.03237 | 0.0 | 2.18 | 0.0 | 0.458 | 6.998 | 45.8 | 6.0622 | 3.0 | 222.0 | 18.7 | 2.94 | 33.4 |
| 4 | 4 | 0.06905 | 0.0 | 2.18 | 0.0 | 0.458 | 7.147 | 54.2 | 6.0622 | 3.0 | 222.0 | 18.7 | 5.33 | 36.2 |

[5]:
```
#For the "Median value of owner-occupied homes" provide a boxplot:
owner_occupied_homes=sns.boxplot(y="MEDV",data=boston_df)
plt.show()
```

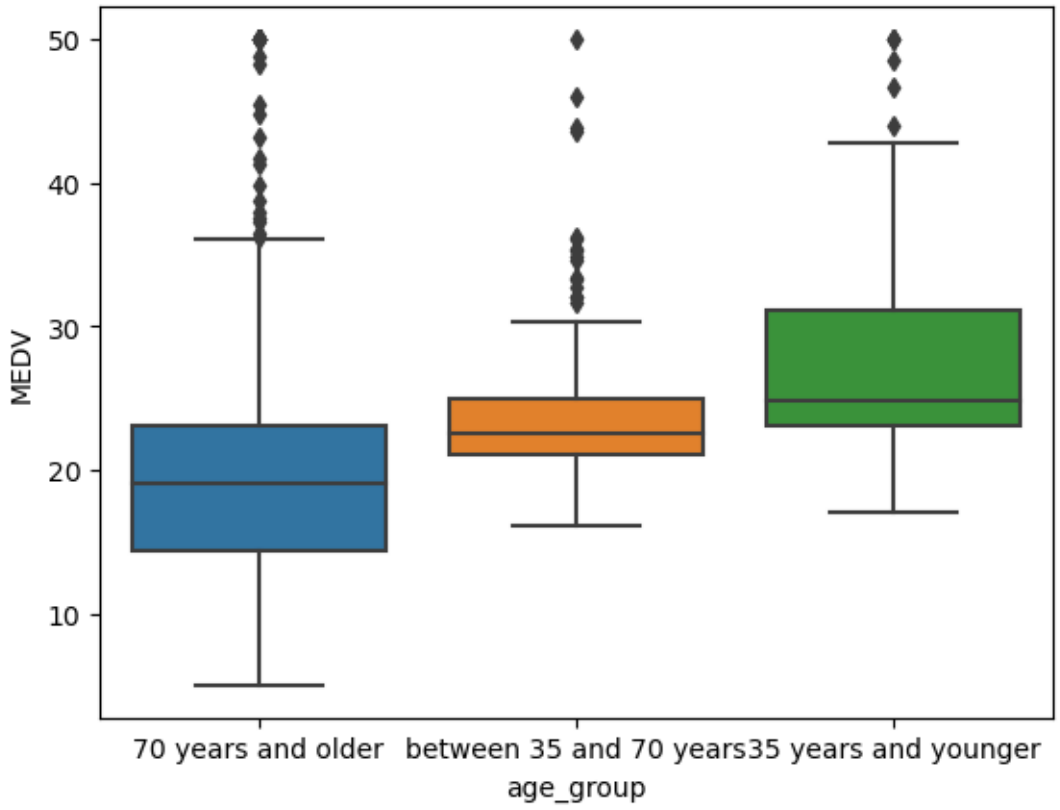



[6]:
```
#Provide a  bar plot for the Charles river variable
boston_df.groupby("CHAS").size().plot(kind="bar",color=["red","blue"])
```

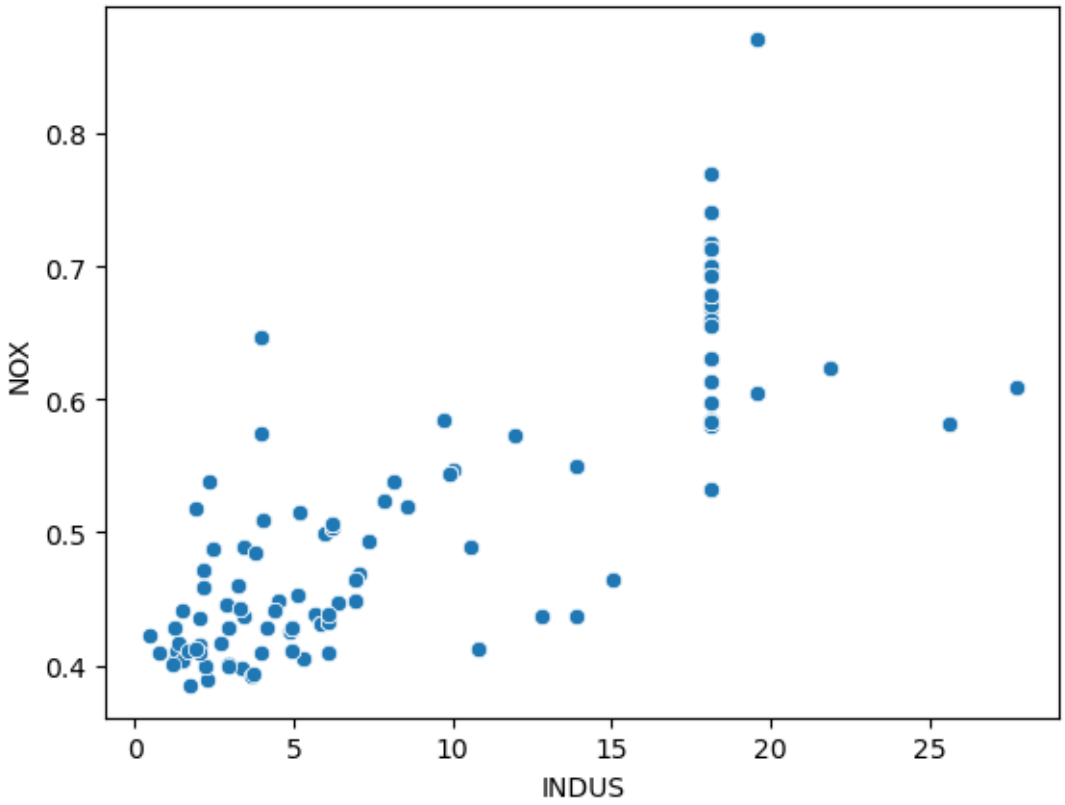
[6]: <Axes: xlabel='CHAS'>




[16]:
```
#Provide a boxplot for the MEDV variable vs the AGE variable.
#(Discretize the age variable into three groups of 35 years and younger,
#between 35 and 70 years and 70 years and older):
Age=sns.boxplot(x="age_group",y="MEDV",data=boston_df)
plt.show()
```

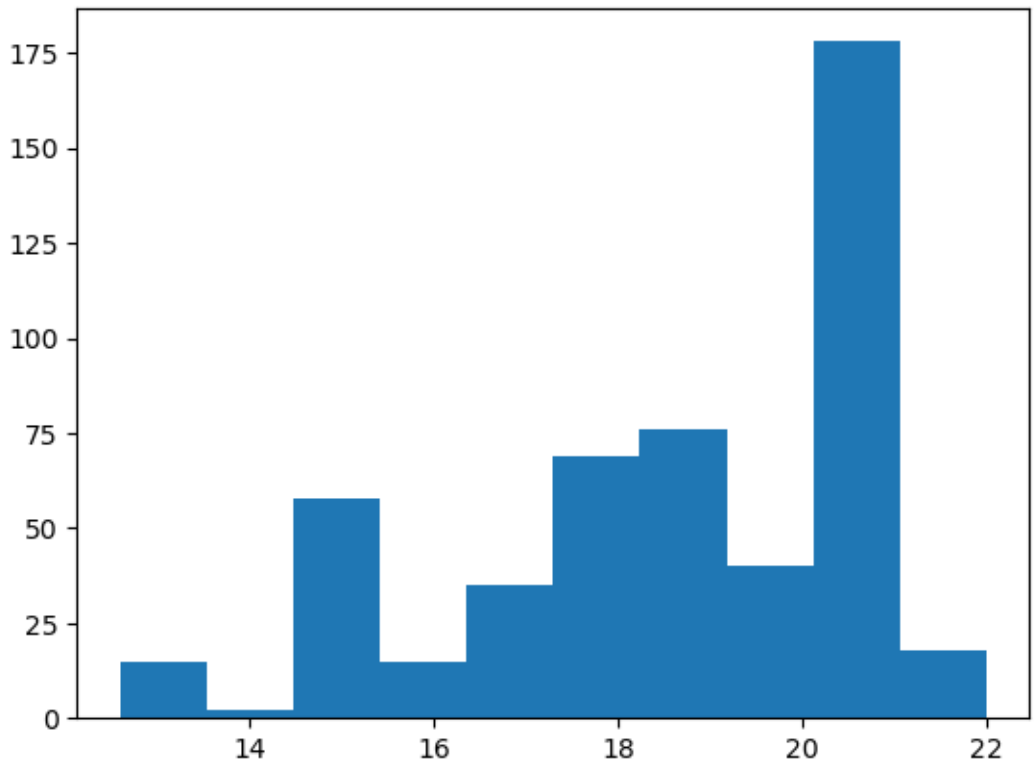



[8]:
```
#Provide a scatter plot to show the relationship between Nitric oxide␣
 ↪concentrations
#and the proportion of non-retail business acres per town. What can you say␣
 ↪about the relationship?
NO=sns.scatterplot(x="INDUS",y="NOX",data=boston_df)
plt.show()
```




[9]:
```
#Create a histogram for the pupil to teacher ratio variabl
plt.hist(boston_df["PTRATIO"])
```

[9]:
```
(array([ 15.,   2.,  58.,  15.,  35.,  69.,  76.,  40., 178.,  18.]),
 array([12.6 , 13.54, 14.48, 15.42, 16.36, 17.3 , 18.24, 19.18, 20.12,
        21.06, 22.  ]),
 <BarContainer object of 10 artists>)
```




[10]:
```
#TASK 5
```

[11]:
```
#Is there a significant difference in median value of houses bounded by the␣
 ↪Charles river or not?
#(T-test for independent samples)
#HO: The average values of houses on the river bank and those not on the river␣
 ↪bank are equal to each other.
#H1: The average values of houses on the river bank and those not on the river␣
 ↪bank are not equal to each other.
scipy.stats.ttest_ind(boston_df[boston_df["CHAS"]==1.
 ↪0]["MEDV"],boston_df[boston_df["CHAS"]==0.0]["MEDV"],equal_var = True)
#HO is rejected because the alpha value (0.05) is greater than the p value;␣
 ↪that is, there is a difference between
#the two average values.
```

[11]:
```
Ttest_indResult(statistic=3.996437466090509, pvalue=7.390623170519905e-05)
```

[12]:
```
#Is there a difference in Median values of houses (MEDV) for each proportion of␣
 ↪owner occupied
#units built prior to 1940 (AGE)? (ANOVA)
#HO: MEDV average values for the three age groups are equal to each other.
#H1: At least one of the MEDV values is different for three age groups.
```

```
boston_df.loc[(boston_df['AGE'] <= 35), 'age_group'] = '35 years and younger'
boston_df.loc[(boston_df['AGE'] > 35)&(boston_df['AGE'] < 70), 'age_group'] =␣
 ↪'between 35 and 70 years'
boston_df.loc[(boston_df['AGE'] >= 57), 'age_group'] = '70 years and older'
```

[13]:
```
#Is there a difference in Median values of houses (MEDV) for each proportion of␣
 ↪owner occupied
#units built prior to 1940 (AGE)? (ANOVA)

thirtyfive_lower=boston_df[boston_df['age_group'] == '35 years and␣
 ↪younger']['MEDV']
thirtyfive_seventy= boston_df[boston_df['age_group'] == 'between 35 and 70␣
 ↪years']['MEDV']
seventy_older= boston_df[boston_df['age_group'] == '70 years and older']['MEDV']

scipy.stats.f_oneway(thirtyfive_lower,thirtyfive_seventy,seventy_older)

#Since the alpha value (0.05) is greater than p, H0 is rejected; That is, at␣
 ↪least one of the
#average values is different from the others.
```

[13]:
```
F_onewayResult(statistic=29.028583208977576, pvalue=1.1723548056383608e-12)
```

[14]:
```
#Can we conclude that there is no relationship between Nitric oxide␣
 ↪concentrations and proportion of
#non-retail business acres per town? (Pearson Correlation)
#H0: there is no relationship between the two data
#H1: There is a relationship between two data.

scipy.stats.pearsonr(boston_df['NOX'], boston_df['INDUS'])

#Since the alpha value (0.05) is greater than the p value, the H0 hypothesis is␣
 ↪rejected;
#That is, there is a relationship between two data.
```

[14]:
```
PearsonRResult(statistic=0.7636514469209149, pvalue=7.913361061242812e-98)
```

[15]:
```
#What is the impact of an additional weighted distance  to the five Boston␣
 ↪employment centres on the
#median value of owner occupied homes? (Regression analysis)
#H0:beta1 equal to zero (DIS has no effect on MEDV)
#H1:beta1 not equal to zero(DIS has an effect on MEDV)

y=boston_df["MEDV"]
x=boston_df["DIS"]
x=sm.add_constant(x)
```

```
model=sm.OLS(y,x).fit()
predictions=model.predict(x)
model.summary()

#Since alpha(0.05) is greater than the p value, H0 is rejected; i.e. DIS has an␣
 ↪impact on MEDV
```

[15]:

| | | | |
|---|---|---|---|
| **Dep. Variable:** | MEDV | **R-squared:** | 0.062 |
| **Model:** | OLS | **Adj. R-squared:** | 0.061 |
| **Method:** | Least Squares | **F-statistic:** | 33.58 |
| **Date:** | Mon, 23 Oct 2023 | **Prob (F-statistic):** | 1.21e-08 |
| **Time:** | 11:11:33 | **Log-Likelihood:** | -1823.9 |
| **No. Observations:** | 506 | **AIC:** | 3652. |
| **Df Residuals:** | 504 | **BIC:** | 3660. |
| **Df Model:** | 1 | | |
| **Covariance Type:** | nonrobust | | |

| | **coef** | **std err** | **t** | **P> \|t\|** | **[0.025** | **0.975]** |
|---|---|---|---|---|---|---|
| **const** | 18.3901 | 0.817 | 22.499 | 0.000 | 16.784 | 19.996 |
| **DIS** | 1.0916 | 0.188 | 5.795 | 0.000 | 0.722 | 1.462 |

| | | | |
|---|---|---|---|
| **Omnibus:** | 139.779 | **Durbin-Watson:** | 0.570 |
| **Prob(Omnibus):** | 0.000 | **Jarque-Bera (JB):** | 305.104 |
| **Skew:** | 1.466 | **Prob(JB):** | 5.59e-67 |
| **Kurtosis:** | 5.424 | **Cond. No.** | 9.32 |

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[ ]:

[ ]: