ASSIGNMENT-2

1) **Generate the summary statistics for each variable in the table. (Use Data analysis tool pack). Write down your observation.**

CRIME_RATE	
Mean	4.871976285
Standard Error	0.129860152
Median	4.82
Mode	3.43
Standard Deviation	2.921131892
Sample Variance	8.533011532
Kurtosis	-1.189122464
Skewness	0.021728079
Range	9.95
Minimum	0.04
Maximum	9.99
Sum	2465.22
Count	506

➢ **Measure of Central Tendancy:**
- The Mean(4.8719) and Median(4.82) values are almost near, so we can take mean as the Center

➢ **Measure of Dispersion**:
- From the coefficient of variance(0.599) ,it shows that the spread is high

➢ **Measure of Symmentry/Peakedness**:
- From the Skewness value(0.0217),it describes that there are almost equal values both left and right of the mean as the value of skewness value is almost equal to 0

- From the value of Kurtosis(-1.1891),it shows that the peak is flat as the value of kurtosis is in Negative value(Platykurtic)

AGE	
Mean	68.57490119
Standard Error	1.251369525
Median	77.5
Mode	100
Standard Deviation	28.14886141
Sample Variance	792.3583985
Kurtosis	-0.967715594
Skewness	-0.59896264
Range	97.1
Minimum	2.9
Maximum	100
Sum	34698.9
Count	506

- **Measure of Central Tendancy:**
  - The Mean(68.574) and Median(77.5) values are some what near near, so we can take mean as the Center
- **Measure of Dispersion**:
  - From the coefficient of variance(0.410) ,it shows that the spread is Normal
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(-0.598),it describes that more values are in right of the mean as the skewness value is in Negative

  - From the value of Kurtosis(-0.9677),it shows that the peak is flat as the value of kurtosis is in Negative value(Platykurtic)

INDUS	
Mean	11.13677866
Standard Error	0.304979888
Median	9.69
Mode	18.1
Standard Deviation	6.860352941
Sample Variance	47.06444247
Kurtosis	-1.233539601
Skewness	0.295021568
Range	27.28
Minimum	0.46
Maximum	27.74
Sum	5635.21
Count	506

- **Measure of Central Tendancy:**
  - The Mean(11.13) and Median(9.69) values are some what near, so we can take mean as the Center
- **Measure of Dispersion**:
  - From the coefficient of variance(0.616) ,it shows that the spread is High
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(0.295),it describes that it is left leaning as the value is greater than 0
  - From the value of Kurtosis(-1.233),it shows that the peak is flat as the value of kurtosis is in Negative value(Platykurtic)

NOX	
Mean	0.554695059
Standard Error	0.005151391
Median	0.538
Mode	0.538
Standard Deviation	0.115877676
Sample Variance	0.013427636
Kurtosis	-0.064667133
Skewness	0.729307923
Range	0.486
Minimum	0.385
Maximum	0.871
Sum	280.6757
Count	506

- **Measure of Central Tendancy:**
  - The Mean(0.554) and Median(0.538) values are almost near, so we can take mean as the Center
- **Measure of Dispersion**:
  - From the coefficient of variance(0.208) ,it shows that the spread is Normal
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(0.729),it describes that it is left leaning as the value is greater than 0
  - From the value of Kurtosis(-0.064),it shows that the peak is flat as the value of kurtosis is in Negative value(Platykurtic)

DISTANCE	
Mean	9.549407115
Standard Error	0.387084894
Median	5
Mode	24
Standard Deviation	8.707259384
Sample Variance	75.81636598
Kurtosis	-0.867231994
Skewness	1.004814648
Range	23
Minimum	1
Maximum	24
Sum	4832
Count	506

- **Measure of Central Tendancy:**
  - The Mean(9.549) and Median(5) values are Far away, so we can take mean as the Center as it is high
- **Measure of Dispersion**:
  - From the coefficient of variance(0.911) ,it shows that the spread is High
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(1.004),it describes that the data in left of the mean is high as value is greater than 0
  - From the value of Kurtosis(-0.867),it shows that the peak is flat as the value of kurtosis is in Negative value(Platykurtic)

TAX	
Mean	408.2371542
Standard Error	7.492388692
Median	330
Mode	666
Standard Deviation	168.5371161
Sample Variance	28404.75949
Kurtosis	-1.142407992
Skewness	0.669955942
Range	524
Minimum	187
Maximum	711
Sum	206568
Count	506

- **Measure of Central Tendancy:**
  - The Mean(408.23) and Median(330) values are some what near, so we can take mean as the Center
- **Measure of Dispersion**:
  - From the coefficient of variance(0.412) ,it shows that the spread is Normal
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(0.66),it describes that the data in left of the mean is high as value is greater than 0
  - From the value of Kurtosis(-1.142),it shows that the peak is flat as the value of kurtosis is in Negative value(Platykurtic)

PTRATIO	
Mean	18.4555336
Standard Error	0.096243568
Median	19.05
Mode	20.2
Standard Deviation	2.164945524
Sample Variance	4.686989121
Kurtosis	-0.285091383
Skewness	-0.802324927
Range	9.4
Minimum	12.6
Maximum	22
Sum	9338.5
Count	506

- **Measure of Central Tendancy:**
  - The Mean(18.45) and Median(19.05) values are almost near, so we can take mean as the Center
- **Measure of Dispersion**:
  - From the coefficient of variance(0.117) ,it shows that the spread is Low
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(-0.802),it describes that the data in right of the mean is high as value is less than 0
  - From the value of Kurtosis(-0.285),it shows that the peak is flat as the value of kurtosis is in Negative value(Platykurtic)

AVG_ROOM	
Mean	6.284634387
Standard Error	0.031235142
Median	6.2085
Mode	5.713
Standard Deviation	0.702617143
Sample Variance	0.49367085
Kurtosis	1.891500366
Skewness	0.403612133
Range	5.219
Minimum	3.561
Maximum	8.78
Sum	3180.025
Count	506

- **Measure of Central Tendancy:**
  - The Mean(6.284) and Median(6.208) values are almost near, so we can take mean as the Center
- **Measure of Dispersion**:
  - From the coefficient of variance(0.111) ,it shows that the spread is Low
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(0.403),it describes that the data is left learning which have more data on left of mean
  - From the value of Kurtosis(1.891),it shows that the peak is sharp as the value of kurtosis is Positive(Leptokurtic)

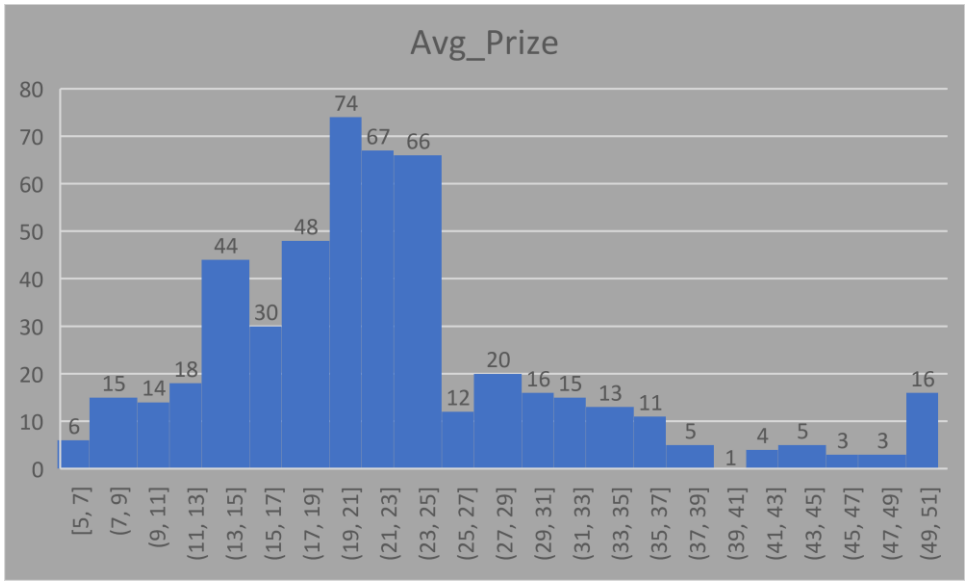
LSTAT	
Mean	12.65306324
Standard Error	0.317458906
Median	11.36
Mode	8.05
Standard Deviation	7.141061511
Sample Variance	50.99475951
Kurtosis	0.493239517
Skewness	0.906460094
Range	36.24
Minimum	1.73
Maximum	37.97
Sum	6402.45
Count	506

- **Measure of Central Tendancy:**
  - The Mean(12.65) and Median(11.36) values are some what near, so we can take mean as the Center
- **Measure of Dispersion**:
  - From the coefficient of variance(0.564) ,it shows that the spread is High
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(0.90),it describes that the data is left learning which have more data on left of mean
  - From the value of Kurtosis(0.493),it shows that the peak is sharp as the value of kurtosis is Positive(Leptokurtic)

AVG_PRICE	
Mean	22.53280632
Standard Error	0.408861147
Median	21.2
Mode	50
Standard Deviation	9.197104087
Sample Variance	84.58672359
Kurtosis	1.495196944
Skewness	1.108098408
Range	45
Minimum	5
Maximum	50
Sum	11401.6
Count	506

- **Measure of Central Tendancy:**
  - The Mean(22.53) and Median(21.2) values are almost near, so we can take mean as the Center
- **Measure of Dispersion**:
  - From the coefficient of variance(0.408) ,it shows that the spread is Normal
- **Measure of Symmentry/Peakedness**:
  - From the Skewness value(1.108),it describes that the data is left learning which have more data on left of mean
  - From the value of Kurtosis(1.495),it shows that the peak is sharp as the value of kurtosis is Positive(Leptokurtic)

2) Plot a histogram of the Avg_Price variable. What do you infer?



From the Histogram,it describes that,

- The Mean(22.53) and Median(21.2) values are almost near, so we can take mean as the Center
- From the coefficient of variance(0.408) ,it shows that the spread is Normal
- From the Skewness value(1.108),it describes that there are more value on the left side of center(Mean) and there is a Tail on the right
- From the value of Kurtosis(1.495),it shows that the peak is sharp as the value of kurtosis is Positive(Leptokurtic)

3) Compute the covariance matrix. Share your observations.

Column1	CRIME_RATE	AGE	INDUS	NOX	DISTANCE	TAX	
CRIME_RATE	8.516147873						
AGE	0.562915215	790.7924728					
INDUS	-0.110215175	124.2678282	46.97142974				
NOX	0.000625308	2.381211931	0.605873943	0.013401099			
DISTANCE	-0.229860488	111.5499555	35.47971449	0.615710224	75.66653127		
TAX	-8.229322439	2397.941723	831.7133331	13.02050236	1333.116741	28348.6236	
PTRATIO	0.068168906	15.90542545	5.680854782	0.047303654	8.74340249	167.8208221	
AVG_ROOM	0.056117778	-4.74253803	-1.884225427	-0.024554826	-1.281277391	-34.51510104	
LSTAT	-0.882680362	120.8384405	29.52181125	0.487979871	30.32539213	653.4206174	
AVG_PRICE	1.16201224	-97.39615288	-30.46050499	-0.454512407	-30.50083035	-724.8204284	

From the table, we Infer the following:

- The Age and Tax has high Positive covariance value(2397.941)--→Both the values are located in the positive Quadrant(Positive relationship)
- The Avg_Prize and Tax has high Negative covariance value(-724.82)→Both the values are located in the Negative Quadrant(Negative relationship)
- In the table ,some of the Covariance values are related opposite quadrants(2,4),which defines that there is less/No relation between the catagories

4) Create a correlation matrix of all the variables (Use Data analysis tool pack)
a) Which are the top 3 positively correlated pairs and
b) Which are the top 3 negatively correlated pairs.

	CRIME_RATE	AGE	INDUS	NOX	DISTANCE	TAX	P
CRIME_RATE	1						
AGE	0.006859463	1					
INDUS	-0.005510651	0.644778511	1				
NOX	0.001850982	0.731470104	0.763651447	1			
DISTANCE	-0.009055049	0.456022452	0.595129275	0.611440563	1		
TAX	-0.016748522	0.506455594	0.72076018	0.6680232	0.910228189	1	
PTRATIO	0.010800586	0.261515012	0.383247556	0.188932677	0.464741179	0.460853035	
AVG_ROOM	0.02739616	-0.240264931	-0.391675853	-0.30218819	-0.209846668	-0.292047833	-0
LSTAT	-0.042398321	0.602338529	0.603799716	0.590878921	0.488676335	0.543993412	0
AVG_PRICE	0.043337871	-0.376954565	-0.48372516	-0.42732077	-0.381626231	-0.468535934	-0

The Top Positive Correlated Pairs:

- Tax and Distance-→(0.910228188533182)
- NOX and INDUS→(0.763651446920914)
- INDUS and TAX→(0.720760179951544)

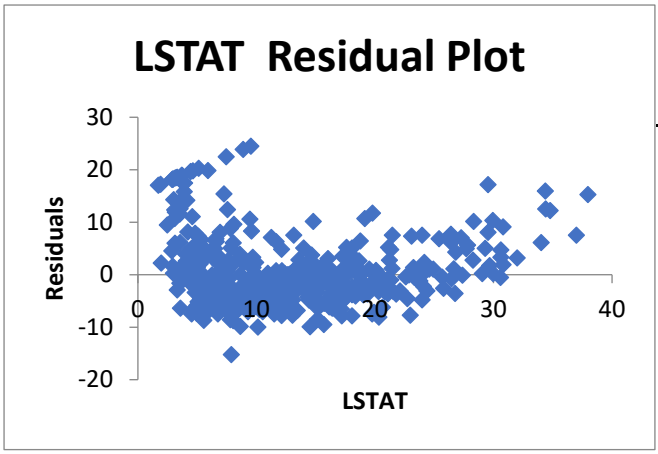
The Top Negative Correlated Pairs:

- AVG_PRIZE And LSTAT→(-0.737662726174014)
- LSTAT and AVG_ROOM→(-0.613808271866396)
- AVG_PRIZE and PTRAITO→(-0.507786685537561)

5) Build an initial regression model with AVG_PRICE as 'y' (Dependent variable) and LSTAT variable as Independent Variable. Generate the residual plot.

a) What do you infer from the Regression Summary output in terms of variance explained, coefficient value, Intercept, and the Residual plot?

b) Is LSTAT variable significant for the analysis based on your model?



	Coefficients
Intercept	34.55384088
LSTAT	-0.95004935

P-value
3.74E-236
5.0811E-88

Adjusted R Square 0.543241826

A)From the Regression model it describes that:

- The P-value is 5.0811E-88
- The Adjusted R Square value is 0.5432
- The Intercept (Value of y, when x=0) is 34.5538
- There is no pattern in Residual Plot
- The Co-efficient (Change of y with increase in X) value of LSTAT is -0.9500

B)The Regression model is suitable for the Prediction, By following below condition:

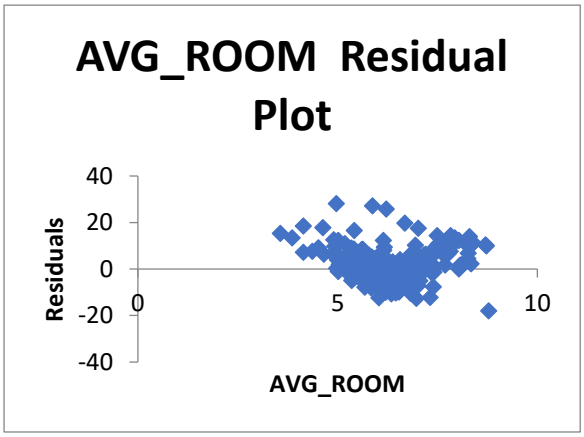
- The P-value is less than 0.05
- The Adjusted R square is some what near one
- There is no Pattern in the Residual Plot

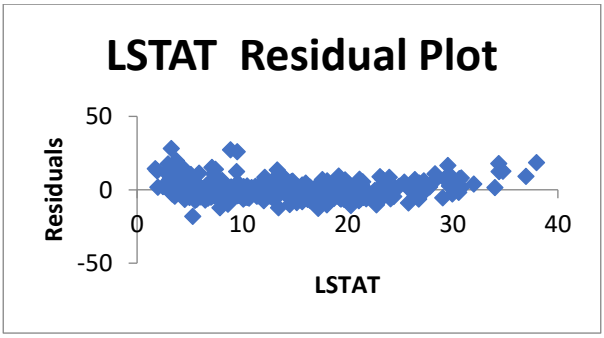
6)

build a new Regression model including LSTAT and AVG_ROOM together as Independent variables and AVG_PRICE as dependent variable.

a) Write the Regression equation. If a new house in this locality has 7 rooms (on an average) and has a value of 20 for L-STAT, then what will be the value of AVG_PRICE? How does it compare to the company quoting a value of 30000 USD for this locality? Is the company Overcharging/ Undercharging?

b) Is the performance of this model better than the previous model you built in Question 5? Compare in terms of adjusted R-square and explain.





P-value
0.668764941
3.47226E-27
6.66937E-41

Adjusted R Square	0.637124475

	Coefficients
Intercept	-1.358272812
AVG_ROOM	5.094787984
LSTAT	-0.642358334

A)Regression Equation=Intercept+Coefficient*AVG_ROOM+Coefficient*LSTAT

AVG_PRIZE= -1.3582+5.094*7+ -0.6423*x20

AVG_PRIZE= 21.46 USD

From the AVG_PRIZE value, we can come to an conclusion that the company is Overcharging

B)From the Regression Model,

- The Adjusted R square value in 5th question is 0.5432
- The Adjusted R square value in 6th question is 0.6371

By comparing the both Adjusted R square value ,it shows that MLR-2 (AVG_ROOM,LSTAT vs AVG_value) →The MLR-2 is more better than SLR (LSTAT vs AVG_PRIZE) Model

7) Build another Regression model with all variables where AVG_PRICE alone be the Dependent Variable and all the other variables are independent. Interpret the output in terms of adjusted Rsquare, coefficient and Intercept values. Explain the significance of each independent variable with respect to AVG_PRICE.

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	29.24131526	4.817126	6.070283	2.53978E-09
CRIME_RATE	0.048725141	0.078419	0.621346	0.534657201
AGE	0.032770689	0.013098	2.501997	0.012670437
INDUS	0.130551399	0.063117	2.068392	0.03912086
NOX	-10.3211828	3.894036	-2.65051	0.008293859
DISTANCE	0.261093575	0.067947	3.842603	0.000137546
TAX	-0.01440119	0.003905	-3.68774	0.000251247
PTRATIO	-1.074305348	0.133602	-8.0411	6.58642E-15
AVG_ROOM	4.125409152	0.442759	9.317505	3.89287E-19
LSTAT	-0.603486589	0.053081	-11.3691	8.91071E-27

Adjusted R Square	0.688298647

From the Regression model, it describes the following:

- Intercept value→29.24131526
- Adjusted R square→0.68829864
- The P-value of the CRIME_RATE is greater than 0.05 (0.53465) ,so we can not use this model for the Prediction

8) Regression model using only the significant variables you just picked and answer the questions below:

a) Interpret the output of this model.

b) Compare the adjusted R-square value of this model with the model in the previous question, which model performs better according to the value of adjusted R-square?

c) Sort the values of the Coefficients in ascending order. What will happen to the average price if the value of NOX is more in a locality in this town?

d) Write the regression equation from this model.

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	29.42847349	4.804729	6.124898	1.84597E-09
AGE	0.03293496	0.013087	2.516606	0.012162875
INDUS	0.130710007	0.063078	2.072202	0.038761669
NOX	-10.27270508	3.890849	-2.64022	0.008545718
DISTANCE	0.261506423	0.067902	3.851242	0.000132887
TAX	-0.014452345	0.003902	-3.70395	0.000236072
PTRATIO	-1.071702473	0.133454	-8.03053	7.08251E-15
AVG_ROOM	4.125468959	0.442485	9.3234	3.68969E-19
LSTAT	-0.605159282	0.05298	-11.4224	5.41844E-27

Adjusted R Square	0.688683682

- Intercept value→29.42847349
- Adjusted R square→0.688683682
- All P-values are less than 0.05,so we can use this model for Prediction
- By comparing the Adjusted R square of (7 & 8th Question),it describes that not much change in the value and also from the (Adjusted

square→0.688683682) it satisfies the second condition (Adjusted R square is some what near 1)

- There is no Pattern in the Residual Plot

Column1	*Coefficients*
NOX	-10.27270508
PTRATIO	-1.071702473
LSTAT	-0.605159282
TAX	-0.014452345
AGE	0.03293496
INDUS	0.130710007
DISTANCE	0.261506423
AVG_ROOM	4.125468959
Intercept	29.42847349

- When there is increase in NOX value in the locality ,the AVG_PRIZE may be decrease with respect to NOX

- The Regression Equation=29.42+0.032*AGE+0.130*INDUS+(-10.272)*NOX+0.261*DISTANCE+(-0.014)*TAX+(-1.071)*PTRATIO+4.125*AVG_ROOM+(-0.605)*LSTAT