Optional_Peer_Graded_Assignment.jupyterlite

October 8, 2024

Import the required libraries we need for the lab.

[1]:
```
import piplite
await piplite.install(['numpy'],['pandas'])
await piplite.install(['seaborn'])
```

[2]:
```
import pandas as pd
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as pyplot
import scipy.stats
import statsmodels.api as sm
from statsmodels.formula.api import ols
```

```
<ipython-input-2-b3fdaf15785b>:1: DeprecationWarning:
Pyarrow will become a required dependency of pandas in the next major release of
pandas (pandas 3.0),
(to allow more performant data types, such as the Arrow string type, and better
interoperability with other libraries)
but was not found to be installed on your system.
If this would cause problems for you,
please provide us feedback at https://github.com/pandas-dev/pandas/issues/54466

  import pandas as pd
```

Read the dataset in the csv file from the URL

[3]:
```
from js import fetch
import io

URL = 'https://cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud/
 ↪IBMDeveloperSkillsNetwork-ST0151EN-SkillsNetwork/labs/boston_housing.csv'
resp = await fetch(URL)
boston_url = io.BytesIO((await resp.arrayBuffer()).to_py())
```

[4]:
```
boston_df=pd.read_csv(boston_url)
```

Add your code below following the instructions given in the course to complete the peer graded assignment

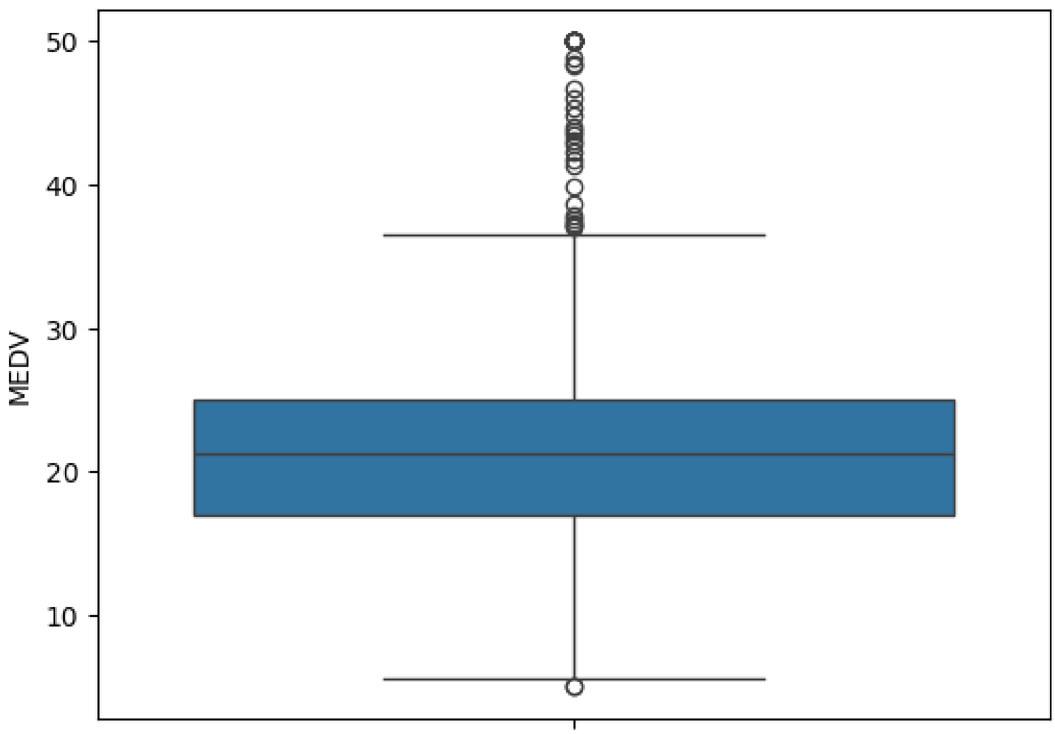
[5]:
```
boston_df
```

[5]:
```
     Unnamed: 0     CRIM    ZN  INDUS  CHAS    NOX     RM   AGE     DIS  RAD  \
0             0  0.00632  18.0   2.31   0.0  0.538  6.575  65.2  4.0900  1.0
1             1  0.02731   0.0   7.07   0.0  0.469  6.421  78.9  4.9671  2.0
2             2  0.02729   0.0   7.07   0.0  0.469  7.185  61.1  4.9671  2.0
3             3  0.03237   0.0   2.18   0.0  0.458  6.998  45.8  6.0622  3.0
4             4  0.06905   0.0   2.18   0.0  0.458  7.147  54.2  6.0622  3.0
..          …        …    …     …     …     …     …     …       …    …
501         501  0.06263   0.0  11.93   0.0  0.573  6.593  69.1  2.4786  1.0
502         502  0.04527   0.0  11.93   0.0  0.573  6.120  76.7  2.2875  1.0
503         503  0.06076   0.0  11.93   0.0  0.573  6.976  91.0  2.1675  1.0
504         504  0.10959   0.0  11.93   0.0  0.573  6.794  89.3  2.3889  1.0
505         505  0.04741   0.0  11.93   0.0  0.573  6.030  80.8  2.5050  1.0

       TAX  PTRATIO  LSTAT  MEDV
0    296.0     15.3   4.98  24.0
1    242.0     17.8   9.14  21.6
2    242.0     17.8   4.03  34.7
3    222.0     18.7   2.94  33.4
4    222.0     18.7   5.33  36.2
..     …        …      …     …
501  273.0     21.0   9.67  22.4
502  273.0     21.0   9.08  20.6
503  273.0     21.0   5.64  23.9
504  273.0     21.0   6.48  22.0
505  273.0     21.0   7.88  11.9

[506 rows x 14 columns]
```

Median value of owner-occupied homes

[6]:
```
sns.boxplot(y=boston_df["MEDV"])
```

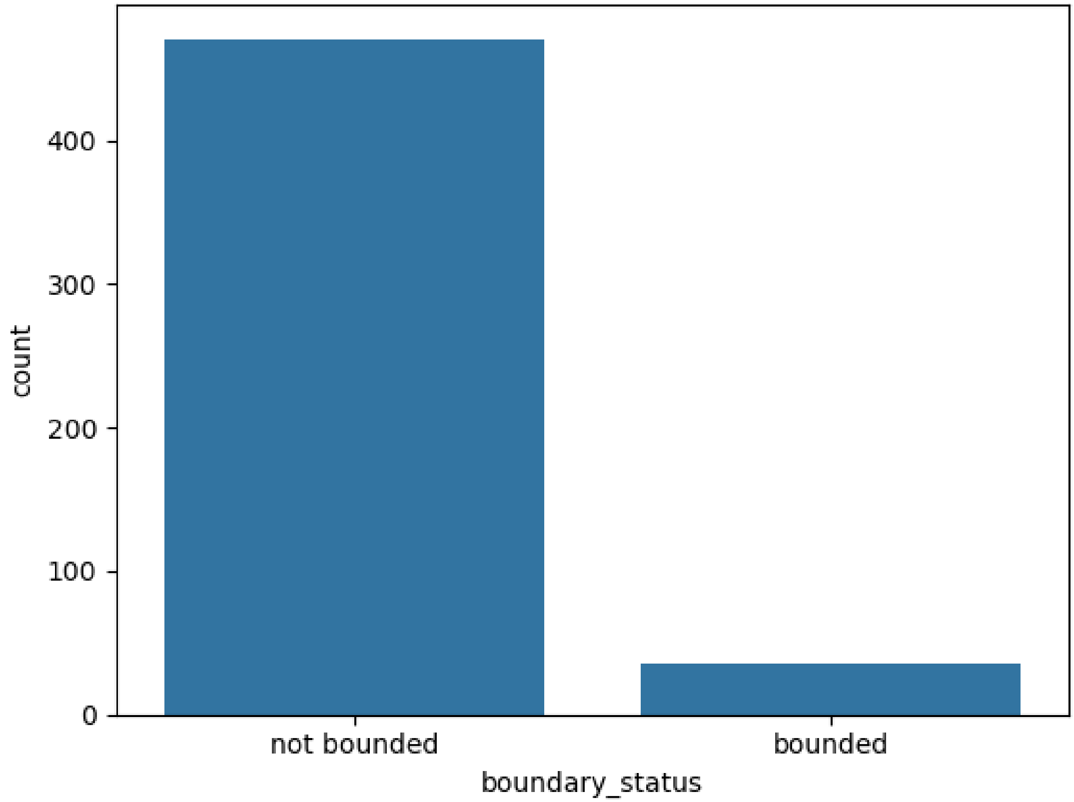
[6]:
```
<AxesSubplot:ylabel='MEDV'>
```



Charles river variable

[7]:
```
boston_df['boundary_status'] = boston_df['CHAS'].apply(lambda x: 'bounded' if x␣
↪== 1 else 'not bounded')
boundary_counts = boston_df['boundary_status'].value_counts().reset_index()
boundary_counts.columns = ['boundary_status', 'count']

sns.barplot(x='boundary_status', y='count', data=boundary_counts)
```

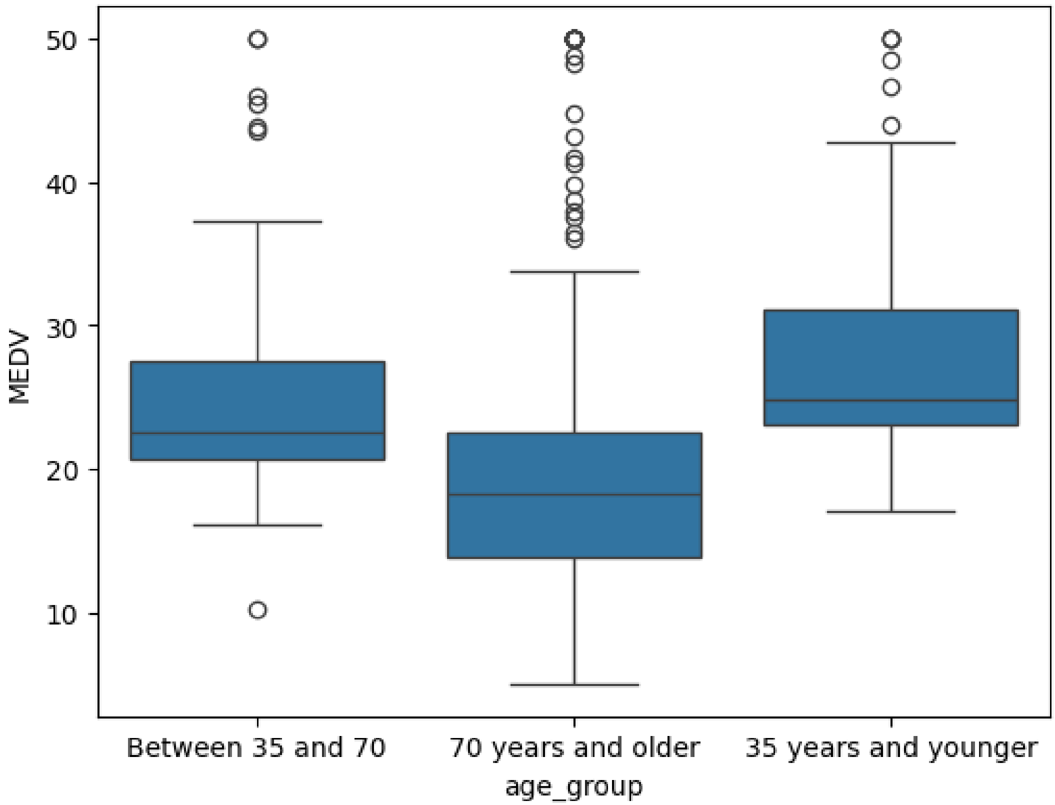
[7]:
```
<AxesSubplot:xlabel='boundary_status', ylabel='count'>
```



MEDV variable vs the AGE variable

[8]:
```
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'
boston_df.loc[boston_df['AGE'] > 70, 'age_group'] = '70 years and older'
sns.boxplot(x='age_group', y='MEDV', data=boston_df)
```

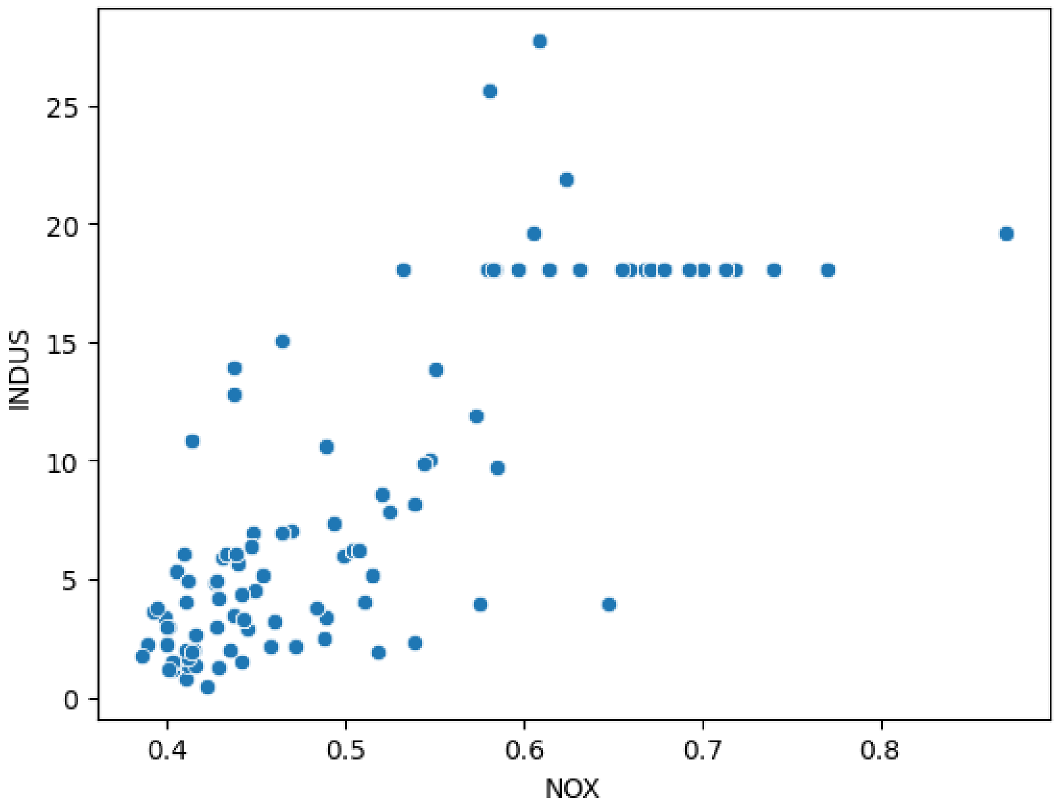
[8]: <AxesSubplot:xlabel='age_group', ylabel='MEDV'>



Scatter plot between Nitric oxide concentrations and the proportion of non-retail business acres per town

[9]:
```
sns.scatterplot(x=boston_df["NOX"], y=boston_df["INDUS"], data=boston_df)
```

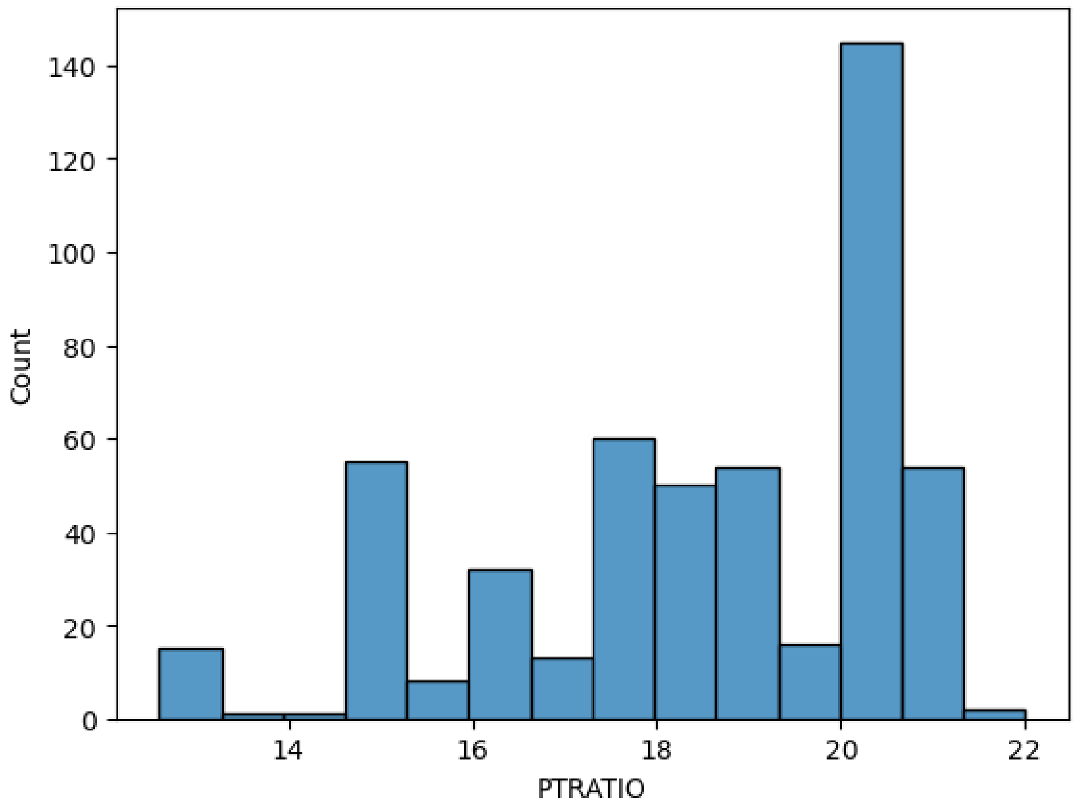
[9]: <AxesSubplot:xlabel='NOX', ylabel='INDUS'>



histogram for the pupil to teacher ratio variable

[10]:
```
sns.histplot(boston_df['PTRATIO'])
```

[10]: <AxesSubplot:xlabel='PTRATIO', ylabel='Count'>



Is there a significant difference in median value of houses bounded by the Charles river or not?

Null Hypothesis (H0): There is no significant difference in MEDV across houses bounded by the river. Alternative Hypothesis (H1): There is diff in MEDV across houses bounded by the river.

[13]:
```
group_0 = boston_df[boston_df['CHAS'] == 0]['MEDV']
group_1 = boston_df[boston_df['CHAS'] == 1]['MEDV']
scipy.stats.ttest_ind(group_0, group_1, equal_var=True)
```

[13]:
```
TtestResult(statistic=-3.996437466090509, pvalue=7.390623170519905e-05,
df=504.0)
```

p value is larger than alpha, we fail to reject the NULL hypothesis, There is not significant diff

Is there a difference in Median values of houses (MEDV) for each proportion of owner occupied units built prior to 1940 (AGE)? (ANOVA)

Null Hypothesis (H0): There is no significant difference in MEDV between houses built prior and after 1940. Alternative Hypothesis (H1): there is a significantly different MEDV between houses built proir and after 1940.

make the two different categories

[21]:
```
boston_df.loc[(boston_df['AGE'] > 84), 'age_group'] = 'prior to 1940'
boston_df.loc[(boston_df['AGE'] <= 84), 'age_group'] = 'after 1940'
```

test for equality of variances using levene test

[22]:
```
scipy.stats.levene(boston_df[boston_df['age_group'] == 'prior to 1940']['MEDV'],
                   boston_df[boston_df['age_group'] == 'after 1940']['MEDV'],
                   center='mean')
```

[22]:
```
LeveneResult(statistic=1.4055510245413045, pvalue=0.2363550102480432)
```

since we checked variance equality, we can make one way ANOVA

[23]:
```
f_statistic, p_value = scipy.stats.f_oneway(boston_df[boston_df['age_group'] ==␣
 ↪'prior to 1940']['MEDV'], boston_df[boston_df['age_group'] == 'after␣
 ↪1940']['MEDV'])
print("F_Statistic: {0}, P-Value: {1}".format(f_statistic,p_value))
```

```
F_Statistic: 70.89786758512082, P-Value: 3.9330184294042697e-16
```

p value is larger than alpha, we fail to reject the NULL hypothesis, There is not significant diff

Can we conclude that there is no relationship between Nitric oxide concentrations and proportion of non-retail business acres per town? (Pearson Correlation)

null hypothesis: the is no correlation alternative hypothesis: there is correlation

[30]:
```
scipy.stats.pearsonr(boston_df["NOX"], boston_df["INDUS"])
```

[30]:
```
PearsonRResult(statistic=0.7636514469209192, pvalue=7.913361061210442e-98)
```

p value is larger than alpha, we fail to reject the NULL hypothesis, There is no relationship between the two continious variables

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: additional weighted distance have no effect on median value of owner occupied homes. H1: additional weighted distance have effect on median value of owner occupied homes.

[36]:
```
X = boston_df["DIS"]
y = boston_df["MEDV"]
## add an intercept (beta_0) to our model
X = sm.add_constant(X)

model = sm.OLS(y, X).fit()
predictions = model.predict(X)

# Print out the statistics
model.summary()
```

[36]:

Dep. Variable:	MEDV	**R-squared:**	0.062
Model:	OLS	**Adj. R-squared:**	0.061
Method:	Least Squares	**F-statistic:**	33.58
Date:	Tue, 08 Oct 2024	**Prob (F-statistic):**	1.21e-08
Time:	10:15:49	**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.

p value is less than alpha, we reject the null hypthesis There is evidence that the ditatnces have effect on median price

[ ]:

```

```