Assignment #1 CS-697AB ML

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1. Fit a predictive linear regression model to estimate weight of the fish from its length, height and width? (the data source fish.csv can be found here: https://www.kaggle.com/aungpyaeap/fish-market) (50 points)

   -Report the coefficients values by using the standard Least Square Estimates

```
regressor.coef_
print("coefficients values by using the standard Least Square Estimates are -\n", regressor.coef_)
```

```
coefficients values by using the standard Least Square Estimates are -
 [102.36098666 -33.89771707 -33.96666471  28.4816904   -0.87430779]
```

   -What is the standard error of the estimated coefficients, R-squared term ?

```
regressor.coef_
print("Coefficients are", regressor.coef_)
print("R-squared term value is " + str(r2_score(y_pred, y_test)))
print("The Mean Squared Error is " + str(mean_squared_error(y_test, y_pred)))
```

```
Coefficients are [102.36098666 -33.89771707 -33.96666471  28.4816904   -0.87430779]
R-squared term value is 0.8035095525723281
The Mean Squared Error is 21814.86179533342
```

- 95% confidence interval

```
#Least square as an optimizer
import statsmodels.api as sm
results = sm.OLS(y_train, X_train).fit()
print("The 95% confidence interval:", results.conf_int(0.05))
results.summary()
```

```
The 95% confidence interval:                  0           1
Length1  106.185590  456.191354
Length2 -326.643326   17.311038
Length3 -156.852512  -18.644847
Height    23.786320   93.703741
Width   -152.876759   11.970048
```

]:

OLS Regression Results

Dep. Variable:	y	**R-squared (uncentered):**	0.850
Model:	OLS	**Adj. R-squared (uncentered):**	0.843
Method:	Least Squares	**F-statistic:**	120.4
Date:	Sat, 19 Feb 2022	**Prob (F-statistic):**	4.58e-42
Time:	13:15:41	**Log-Likelihood:**	-749.56
No. Observations:	111	**AIC:**	1509.
Df Residuals:	106	**BIC:**	1523.
Df Model:	5		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Length1	281.1885	88.270	3.186	0.002	106.186	456.191
Length2	-154.6661	86.743	-1.783	0.077	-326.643	17.311
Length3	-87.7487	34.855	-2.518	0.013	-156.853	-18.645
Height	58.7450	17.633	3.332	0.001	23.786	93.704
Width	-70.4534	41.573	-1.695	0.093	-152.877	11.970

Omnibus:	30.535	**Durbin-Watson:**	1.529
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	46.728
Skew:	1.303	**Prob(JB):**	7.13e-11
Kurtosis:	4.820	**Cond. No.**	316.

-Is there any dependence between the length and weight of the fish?

- Yes, there is dependence between the length and weight of fish.

2. Using the data source in Q1 fit the Ridge and Lasso Regression Models. (25 points)
   - Report the coefficients for both the models

```
lasso = Lasso(alpha=0.2)

# Fit the regressor to the data
lasso.fit(X,y)

# Compute and print the coefficients
lasso_coef = lasso.coef_
print(lasso_coef)
```

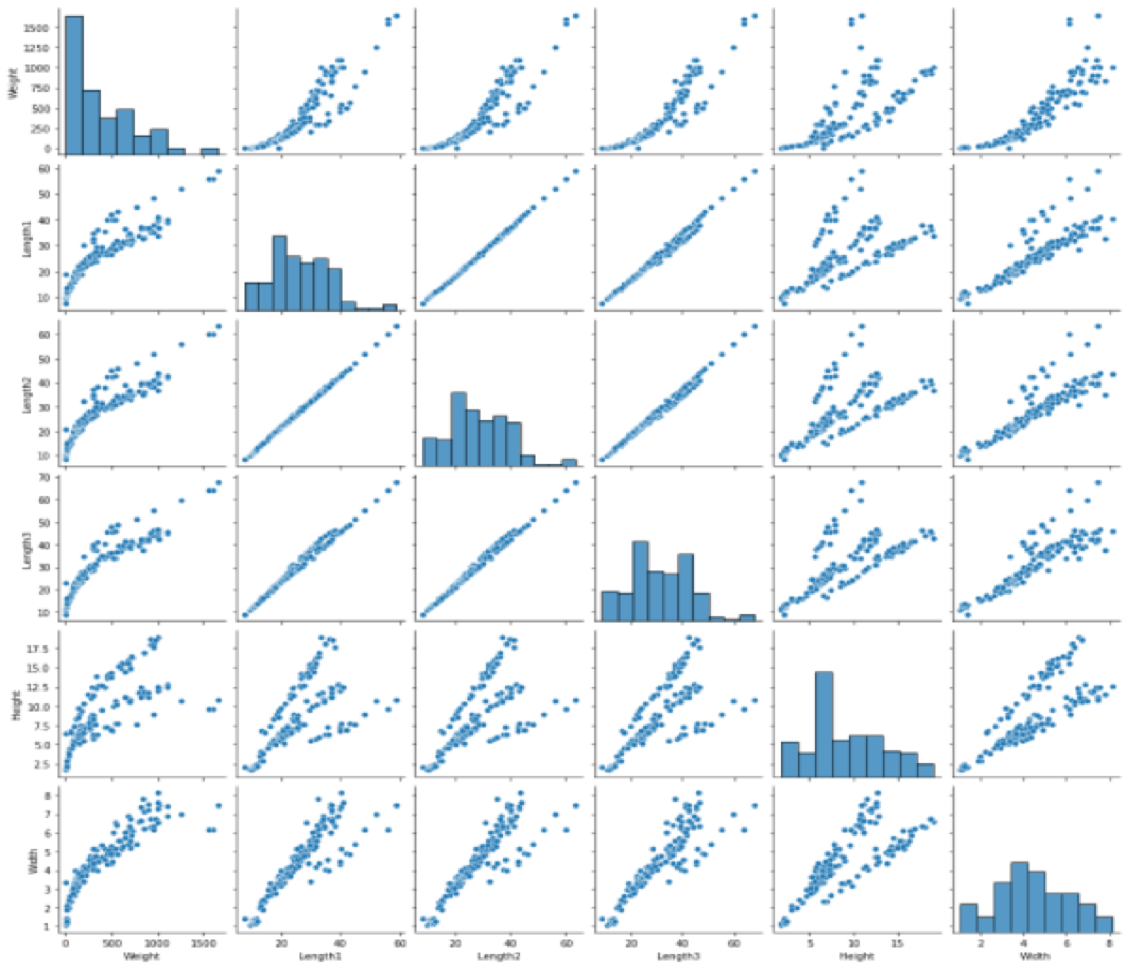
```
[ 57.26889086  -4.57378381 -26.33466176  26.89081153  24.25900587]
```

```
ridge = Ridge(alpha=1,max_iter=40) #ridge model
ridge.fit(X_train,y_train)
ridge_coef = ridge.coef_
print(ridge_coef)
```

```
[ 83.4591279  -18.04075474 -32.09257368  26.77762824   0.33036577]
```

- Report the attribute(s) least impacting the weight of the fish.
    - The height of the fish is the least impacting attribute. We can see that the weight and height attributes are not closely scattered compared to others.

```python
import seaborn as sns
ax = sns.pairplot(df[num_col])
```



3. Modify the example code for Logistic Regression to include all the four attributes in iris dataset for two class and multi-class classification. Report any difference in the performance if noted.

    - Results in multi class classification is more accurate compared to two class classification. Because, we are using **multi_class="multinomial"** in multi class classification.
    - Two-Class Classification

```
X = iris["data"][:,[0,1,2,3]]  # sepal lenght, sepal width,petal lenght,petal width
y = (iris["target"] == 2).astype(np.int)  # 1 if Iris virginica, else 0
print(X)
print(y)
```

```
[[5.1 3.5 1.4 0.2]
 [4.9 3.  1.4 0.2]
 [4.7 3.2 1.3 0.2]
 [4.6 3.1 1.5 0.2]
 [5.  3.6 1.4 0.2]
 [5.4 3.9 1.7 0.4]
 [4.6 3.4 1.4 0.3]
 [5.  3.4 1.5 0.2]
 [4.4 2.9 1.4 0.2]
 [4.9 3.1 1.5 0.1]
 [5.4 3.7 1.5 0.2]
 [4.8 3.4 1.6 0.2]
 [4.8 3.  1.4 0.1]
 [4.3 3.  1.1 0.1]
 [5.8 4.  1.2 0.2]
```

```python
from sklearn.linear_model import LogisticRegression

X = iris["data"][:, (0,1,2, 3)]  # petal length, petal width
y = (iris["target"] == 2).astype(np.int)

log_reg = LogisticRegression(solver="lbfgs", C=10**10, random_state=42)
log_reg.fit(X, y)

x0, x1,x2,x3 = np.meshgrid(
        np.linspace(2.9, 7, 50).reshape(10, 5),
        np.linspace(0.8, 2.7, 20).reshape(10, 2),
            np.linspace(2.9, 7, 50).reshape(10, 5),
        np.linspace(0.8, 2.7, 20).reshape(10, 2),
    )
X_new = np.c_[x0.ravel(), x1.ravel(),x2.ravel(),x3.ravel()]

y_proba = log_reg.predict(X_new)
```

```python
print(y_proba)
```

```
[0 0 0 ... 1 1 1]
```

```python
log_reg.predict([[5, 2,3,4]])
```

```
49]: array([1])
```

```python
log_reg.predict_proba([[5, 2,3,4]])
```

```
50]: array([[4.21884749e-15, 1.00000000e+00]])
```

- Multi-class classification

```python
X = iris["data"][:,[0,1,2,3]]  # sepal lenght, sepal width,petal lenght,petal width
y = (iris["target"] )

softmax_reg = LogisticRegression(multi_class="multinomial",solver="lbfgs", C=10, random_state=42)
softmax_reg.fit(X, y)
print(X,y)
```

```
[[5.1 3.5 1.4 0.2]
 [4.9 3.  1.4 0.2]
 [4.7 3.2 1.3 0.2]
 [4.6 3.1 1.5 0.2]
 [5.  3.6 1.4 0.2]
 [5.4 3.9 1.7 0.4]
 [4.6 3.4 1.4 0.3]
 [5.  3.4 1.5 0.2]
 [4.4 2.9 1.4 0.2]
 [4.9 3.1 1.5 0.1]
 [5.4 3.7 1.5 0.2]
```

```python
x0, x1,x2,x3 = np.meshgrid(
        np.linspace(2.9, 7, 50).reshape(10, 5),
        np.linspace(0.8, 2.7, 20).reshape(10, 2),
            np.linspace(2.9, 7, 50).reshape(10, 5),
        np.linspace(0.8, 2.7, 20).reshape(10, 2),
    )
X_new = np.c_[x0.ravel(), x1.ravel(),x2.ravel(),x3.ravel()]

y_proba = softmax_reg.predict(X_new)
y_predict = softmax_reg.predict(X_new)

#zz1 = y_proba[:, 1].reshape(x0.shape)
zz = y_predict.reshape(x0.shape)
```

```python
softmax_reg.predict([[5, 2,3,4]])
```

18]: array([2])

```python
softmax_reg.predict_proba([[5, 2,3,4]])
```

19]: array([[1.27836043e-05, 9.50772858e-05, 9.99892139e-01]])