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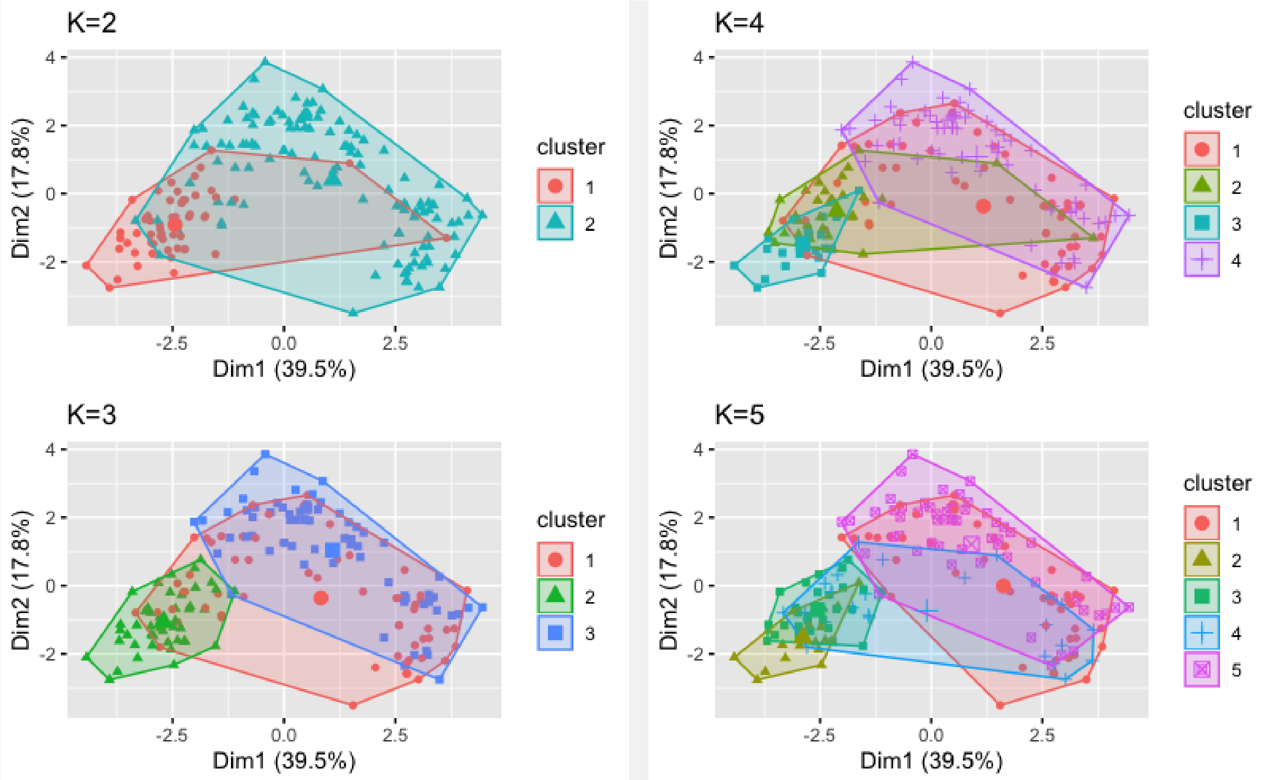
CSI 5810 Assignment 4

Question 1

For this problem I used the language R. I wasn't sure were to find the wine dataset mentioned so I assumed and used the Wine Dataset found in the UCI Machine Learning database.



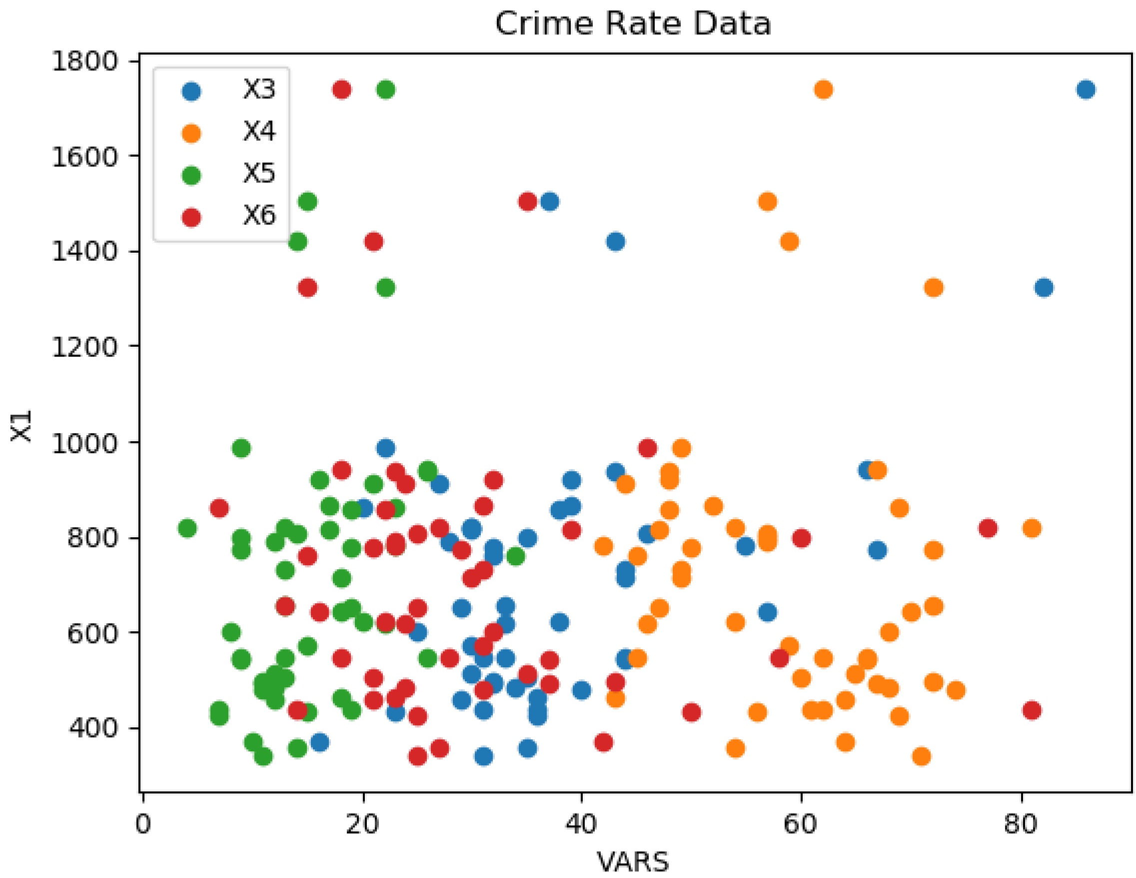
Figures of K-means clustering on Wine Dataset.

The SSE and Rand Index are as follows:

	K2	K3	K4	K5
SSE	4543801.2	2370742.3	1331953.8	916424.2
Rand Index	0.6702850	0.7186568	0.7002476	0.7164984

Question 2

Since X1 is our target values, then we do not need X2. Data:



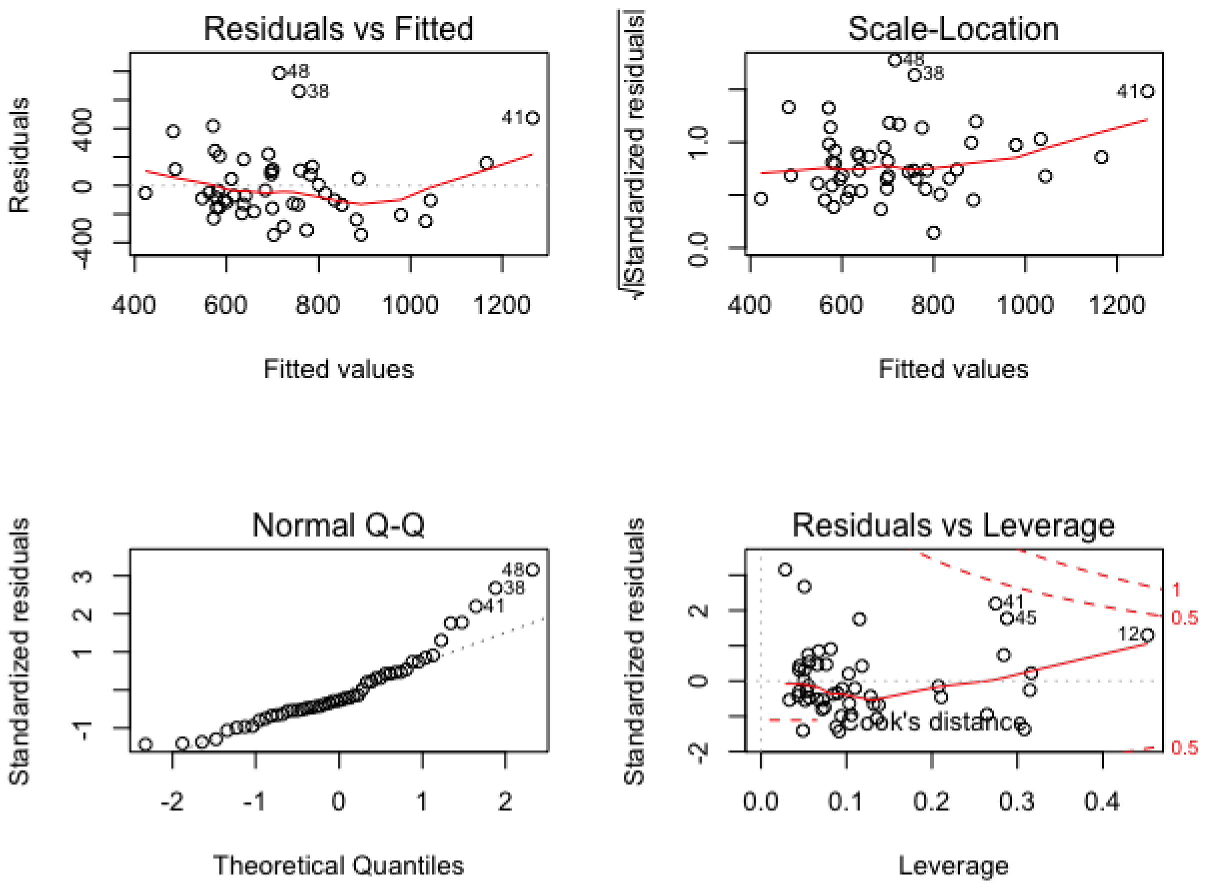
After building the linear model and reading the summary:

```
target = CrimeRate$X1
vars = as.matrix(CrimeRate[,3:7])
lm1 <- lm(target ~ vars)
summary(lm1)
```

We obtain:

	Estimate	Std.Error	tvalue	Pr(>abs(t))
(Intercept)	489.649	472.366	1.037	0.305592
varsX3	10.981	3.078	3.568	0.000884
varsX4	-6.088	6.544	-0.930	0.357219
varsX5	5.480	10.053	0.545	0.588428
varsX6	0.377	4.417	0.085	0.932367
varsX7	5.500	13.754	0.400	0.691150

This model gives us something like:



Using are Intercept and Betas 'Estimates' from our table above. This model gives us:

```
X1 = 489.65 + (10.98 * X3) - (6.09 * X4) + (5.48 * X5) + (0.38 * X6) + (5.50 * X7)
```

With a Multiple R-squared of: 0.3336 which translates to 33% accuracy. Which is not what we want.

So lets do gradient descent on each attribute(X3, X4, X5, X6, X7)

X3:

```
data = pd.read_excel("CrimeRate.xlsx")
X3 = data['X3']
N = 50
alpha = 1.3
w = np.random.randn(50)
l_rate = 15
result = []
loss = 0
for t in range(5):
    y_pred = X3.dot(w)
    loss = np.square(y_pred - Y)
    if t % 10 == 0:
        print("t: " + str(t) +" loss " + str(loss))
```

```
        result.append(loss)
    grad_y_pred = 2.0 * (y_pred - Y)
    grad_w = X3.T.dot(grad_y_pred)
    w -= l_rate * grad_w

print(w)
```

X3:

Learning Rate 15 yields: a weight of 8.056

Learning Rate 10 yields: a weight of 8.163

Similarly we can do the same with the other attributes.

X4:

Learning Rate 15 yields: a weight of 5.34

Learning Rate 10 yields: a weight of 4.415

X5:

Learning Rate 10 yields: a weight of 2.201

Learning Rate 15 yields: a weight of 1.458

X6:

Learning Rate 15 yields: a weight of 4.192

Learning Rate 10 yields: a weight of 5.995

X7:

Learning Rate 10 yields: a weight of 8.794

Learning Rate 15 yields: a weight of 6.597

This results in a new model of

```
X1 = 489.65 + (8.056 * X3) + (5.34 * X4) + (1.458* X5) + (4.192 * X6) + (6.597 *
X7)
```

Question 3

Question 4

i.

SVD of F: (rounded to 3 decimals)

F = 2.163 * [0.44 0.129 0.476 0.703 0.263]^t * [0.749 0.28 0.204 0.447 0.325 0.121] +

1.594 * [-0.296 -0.331 -0.511 0.351 0.647]^t * [-0.286 -0.528 -0.186 0.626 0.22 0.406] +

1.275 * [-0.569 0.587 0.368 -0.155 0.415]^t * [-0.28 0.749 -0.447 0.204 -0.121 0.325]+

1.0 * [0.577 0. 0. -0.577 0.577]^t * [-0. 0. 0.577 0. -0.577 0.577] +

0.394 * [-0.246 -0.727 0.614 -0.16 0.087]^t * [0.528 -0.286 -0.626 -0.186 -0.406 0.22]

ii.

Our top two singular values are: 2.163 and 1.594