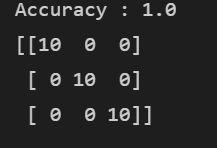
**2022S CS 559-B: Homework 1**

**Name: Janmejay Mohanty**

Solution 1:





Solution 2:

1. Using Probabilistic Generative Model Equation:

------(1)

Using the maximum likelihood to determine the parameters of the logistic regression model,

Here,

denotes class ;

denotes class ;

We want to find out the values of that can maximize the posterior probabilities associated to the observed data.

Therefore, the likelihood function:

--------(2)

Taking the negative logarithm of the likelihood function on equation (2) [Cross Entropy]:

-----(3)

Therefore:

From equation (1) and (3),

------(4)

Taking derivative of equation (4) with respect to ,

--(5)

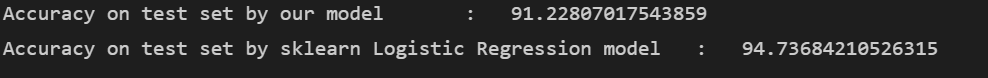
Also,

------(6)

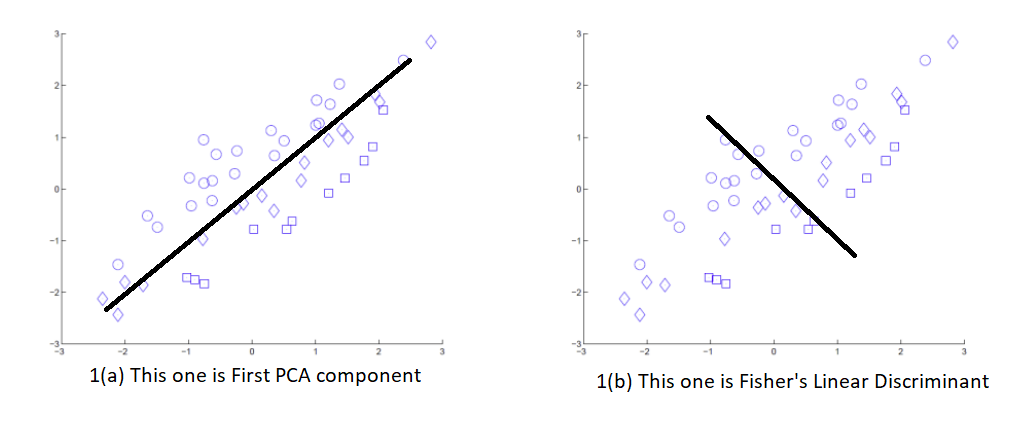
From equation (5) and (6),

-----------(7)

From equation (1) and (7),



Solution 3:



1. (a)

|  |  |
| --- | --- |
| X | Y |
| 2 | 2 |
| 0 | 0 |
| -2 | -2 |

**Covariance Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
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|  |  |  |  |  |

Here,

C represents Covariance Matrix.

represents Eigen Values.

represents Identity Matrix.

Taking the determinant of matrix,

or

Now, we are finding the Eigen Vector’s for each Eigen Value’s:

Here,

represents the Covariance Matrix.

W represents the Eigen Vector.

represents the Eigen Values.

For

--------------(1)

--------------(2)

From equation (1) and (2), we can say that:

---------------(3)

Taking then :

Finding the square root of the sum of squares of the elements in matrix,

Now, dividing the elements of matrix with value:

So, the Eigen Vector are and

For

---------------------------(4)

---------------------------(5)

From equation (4) and (5), we can say that:

---------------------------(6)

Taking then :

Finding the square root of the sum of squares of the elements in matrix,

Now, dividing the elements of matrix with value:

So, the Eigen Vector are and .

**As, ,**

The Eigen Vector associated with the largest Eigen Value corresponds to the first principal component; the Eigen Vector associated with the second largest Eigen Value corresponds to the second principal component.

**Therefore, the first principal component is and .**

(b)

|  |  |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |

First Principal Component,

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |

Mean

Using Unbiased Variance,

(c)

We have calculated eigen value corresponding to the first principal component, that is 8.

So, the cumulative explained variance of the first principal component is % total variance .

As it lies between 90-95%, therefore we can say that variance of the data is captured.

Solution 4:



The equation of the SVM hyperplain :

|  |  |  |  |
| --- | --- | --- | --- |
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Going through the above table, we can say that there are only 4 points counted as supported vectors

Now, we can calculate the bias as the average of the bias obtained from each supported vector by,

For then

For then



Distance of from hyperplane, ,

Distance Formula

No is not within the margin classifier.



As point z doesn’t satisfies the equation, so we can say it doesn’t lie on the hyperplane.

For classifying new observations,

As, it’s sign is showing negative.

Therefore, we can say that point belongs to negative class.