Intro to Stat

Hari yadav

HW 3

02/16/2020

① we have

$$p(x) = \frac{e^{\beta_0 + \beta_1 X}}{1 + e^{\beta_0 + \beta_1 X}}$$

Subtract from 1 ~~from~~ both side,

$$1 - p(x) = 1 - \frac{e^{\beta_0 + \beta_1 X}}{1 + e^{\beta_0 + \beta_1 X}}$$

$$\Rightarrow 1 - p(x) = \frac{1 + \cancel{e^{\beta_0 + \beta_1 X}} - \cancel{e^{\beta_0 + \beta_1 X}}}{1 + e^{\beta_0 + \beta_1 X}}$$

$$\Rightarrow 1 - p(x) = \frac{1}{1 + e^{\beta_0 + \beta_1 X}}$$

$\Rightarrow$ multiply $e^{\beta_0 + \beta_1 X}$ both side,

$$\Rightarrow 1 - p(x)(e^{\beta_0 + \beta_1 X}) = \frac{e^{\beta_0 + \beta_1 X}}{1 + e^{\beta_0 + \beta_1 X}} \rightarrow P(x)$$

$$= \quad 1 - p(x)\, e^{\beta_0 + \beta_1 x} = P(x)$$

or, $$\frac{p(x)}{1 - p(x)} = e^{\beta_0 + \beta_1 x}$$

proved

(2) (a) $p(x) = \dfrac{e^{\beta_0+\beta_1 x}}{1+e^{\beta_0+\beta_1 x}}$, Given $\beta_0 = -6$

$\beta_1 = 0.05$

$\beta_2 = 4$

$X_1 = 50$

$X_2 = 0.8$

$$\Rightarrow P(X) = \frac{e^{(-6+0.05\times50)+0.8}}{1+e^{-6\times0.05\times50+0.8}}$$

$$= \frac{e^{(-6+2.5+0.8)}}{1+e^{(-6+2.5+0.8)}} = \frac{e^{-2.7}}{1+e^{-2.7}}$$

$$= \frac{0.06720}{1+0.06720} = 0.06296$$

(b) Given $p(x) = 50\% = 0.5$, $X_1 = ?$

$$0.5 = \frac{e^{(-6+0.05*X_1+0.8)}}{1+(e^{-6+0.05\times X_1+0.8})}$$

$x = 104$ hours <u>Ans</u>

Q3. We now examine the differences between LDA and QDA.

a. If the Bayes decision boundary is linear, do we expect LDA or QDA to perform better on the training set ? On the test set ?

If the Bayes decision boundary is linear, we expect QDA to perform better on the training set because its higher flexiblity may yield a closer fit. On the test set, we expect LDA to perform better than QDA, because QDA could overfit the linearity on the Bayes decision boundary.

b. If the Bayes decision boundary is non-linear, do we expect LDA or QDA to perform better on the training set? On the test set ?

If the Bayes decision bounary is non-linear, we expect QDA to perform better both on the training and test sets.

c. In general, as the sample size nn increases, do we expect the test prediction accuracy of QDA relative to LDA to improve, decline, or be unchanged? Why ?

Roughly speaking, QDA (which is more flexible than LDA and so has higher variance) is recommended if the training set is very large, so that the variance of the classifier is not a major concern.

d. True or False: Even if the Bayes decision boundary for a given problem is linear, we will probably achieve a superior test error rate using QDA rather than LDA because QDA is flexible enough to model a linear decision boundary. Justify your answer.

False. With fewer sample points, the variance from using a more flexible method such as QDA, may lead to overfit, which in turns may lead to an inferior test error rate.

(4) Given $\bar{x}_1 = 8$, $\bar{x}_2 = 0$, $\sigma^2 = 25$, 75%

So

$$P_1(4) = \frac{0.75 e^{-(1/72)(4-8)^2}}{0.75 e^{-(1/72)(4-8)^2} + 0.25 e^{-(1/72)(4-0)^2}}$$

$$= \frac{0.60055}{0.60055 + 0.20018}$$

$$= 0.7500$$

So 75% is the Answer.

(5) Given, Traing Data Error Rate = 20%.

Test Data Error Rate = 26%.

Avg Error Rate = 18%.

K = 1

In the case of KNN with K = 1, error is 0%.

But we have average Rate of 18% which implies a test rate of 36% of KNN which is greater than test Data error rate 26%, So better to choose logistic Regression.

(6) (a)

we may write $\frac{P(x)}{1-P(x)} = 0.32$

$P(x) = 0.24$

So 24%. Answer

(b) we may write $\frac{P(x)}{1-P(x)} = \frac{0.15}{1-0.15}$

$= 0.1764$

So odd is 17.64 % Answer

A	B	C	D	E	F	G	H	I	J
Q7.a									
LDA 2 Category 2 Dimentinal Data									
Trainiing Data set				Mean Corrected Data		Dimentional function		Results	
Class	x1	x2		x10	x20	f1	f2	Classification	
0	-6	9		-5.33333333	7			0	
0	-4	8		-3.33333333	6			0	
0	1	8		1.66666667	6			0	
0	-4	6		-3.33333333	4			0	
0	-4	2		-3.33333333	0			0	
0	-2	3		-1.33333333	1			0	
0	2	5		2.66666667	3			0	
0	-2	7		-1.33333333	5			0	
1	2	-2		2.66666667	-4			1	
1	3	-4		3.66666667	-6			1	
1	-1	-3		-0.33333333	-5			1	
1	2	2		2.66666667	0			1	
1	-2	-6		-1.33333333	-8			1	
1	3	1		3.66666667	-1			1	
1	2	-6		2.66666667	-8			1	
g	2								
m1	-2.375	6							
m2	1.28571429	-2.57142857							
m	-0.66666667	2							
corr1	7.4107	-0.8571							
	-0.8751	6.2857							
corr2	3.9048	2.8571							
	2.8571	9.9524							
corr0	8.9524	-75714							
	-75714	27							
corr0-1	0	-0.1321							
	-0.1321	0							
p		0.53333333							
		0.46666667							