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1.) $h(\theta) = \theta X$

$J(\theta) = \frac{1}{2m} \Sigma (y - h(\theta))^2$; $m = 5$

$h(\theta) = \theta X$

X \ $\theta =$	0	1	2	3	4
1	0	1	2	3	4
2	0	2	4	6	8
3	0	3	6	9	12
4	0	4	8	12	16
5	0	5	10	15	20.

$y - h(\theta)$.

y \ $\theta =$	0	1	2	3	4
2	2	1	0	1	2
5	5	3	1	1	3
7	7	4	1	2	5
7	7	3	1	5	9
10	10	5	0	5	10.

$(y - h(\theta))^2$.

y \ $\theta =$	0	1	2	3	4
2	4	1	0	1	4
5	25	9	1	1	9
7	49	16	1	4	25
7	49	9	1	25	81
10.	100	25	0	25	100.
$\Sigma (y-h(\theta))^2$	227	60	3	56	219

$\frac{1}{2m} \Sigma (y-h(\theta))^2 \to J(\theta)$	22.7	6	0.3	5.6	21.9

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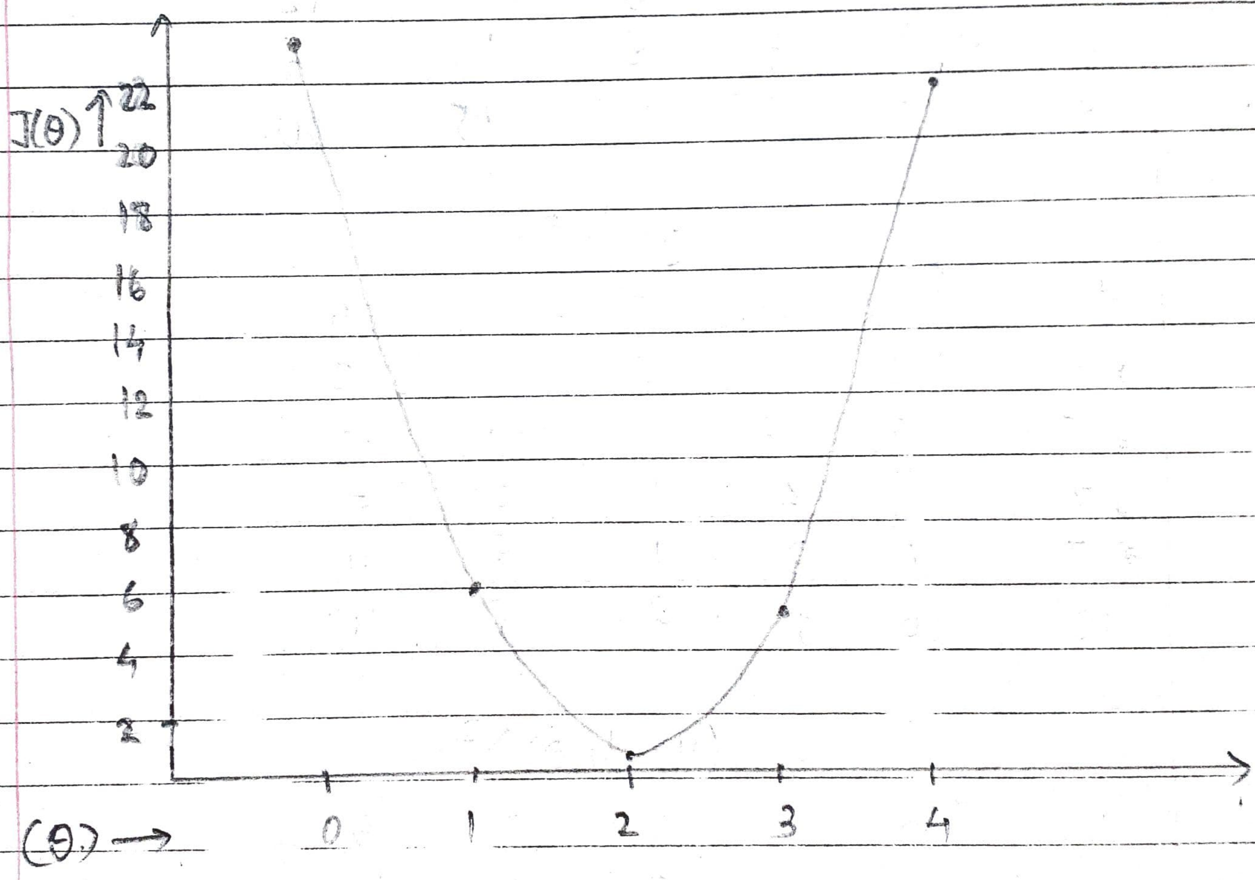
continue :-

θ	$J(\theta)$
0	22.7
1	6
2	0.3
3	5.6
4	21.9

graph:



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2.) given training set:

Sr.	x_1	y_2	class
1	85	85	No
2	71	80	No
3	75	50	yes
4	60	80	yes
5	72	3	yes

Now, for the tuple (72, 75) similarly, with different tuples is given below:

Sr.	X_1	X_2	$\cos\theta$	rank	
1	55	85	0.9997	1	No
2	71	80	0.9992	2	No
3	75	50	0.9763	3	yes,
4	60	80	0.9925		
5	72	3	0.7219		

here $\cos\theta = \dfrac{(72 \times x_1) + (75 \times x_2)}{(103.97)\ (\sqrt{x_1^2 + x_2^2})}$

2 of the ~~yes~~ nearest neighbours are 'No' and 1 of them is 'yes'.

$\therefore$ the predicted class of (72, 75) will be 'No'.

$\therefore$ (72, 75, NO)

Q-3. number of states : 8.
$a = -4.930$
$b = 0.030$

i) Equation of the regression line :
$$\hat{y} = -4.930 + 0.030x$$

ii) Interpretation of the slope in the words of the given problem:
here, slope = 0.030 means, on Average, for every increase of 1 shopping centre, retail sales increases 0.030 billion dollars.

iii) Interpretation of the intercept in the words of the given problem:
here, intercept = -4.930 means, no matter How many stores are there in the states, the retail sales after ~~combining~~ calculating it on the basis of the number of stores will be \$ 4.930 b. ~~less~~ (billion dollars.) less.

iv). regression line to predict the sales for a state with 500 stores. :
$$\hat{y} = -4.930 + 0.030x$$
here x = number of stores.
$$\therefore \hat{y} = -4.930 + 0.030(500)$$
$$= -4.930 + 15$$
$$= 10.07$$

∴ The sales for a state with 500 stores is $10.07 billion.
(10.07 billion dollars.)

v.) No, We should not use this regression Line (model) to predict the sales for a state with ~~500~~ & 100 stores.
Because this will be an example of extrapolation. as this is being trained on a certain range of data and being used to predict on different range of data. here the range of stores' number is around 370 - 2976 and 100 falls in different range.
→ So, we can predict the sales for a state with 100 stores but it is not advisable because of extrapolation.

4.) To be predicted : Amount of rain fall next day has input parameters :
i) Temperature ii) humidity
Order of polynomial : 2

So, from given information, the hypothesis will be :

$$h(\theta) = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_1^2 + \theta_4 x_2^2 + \theta_5 x_1 x_2$$

This can be transformed into :

$$h(\theta) = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3 + \theta_4 x_4 + \theta_5 x_5$$

where, $x_3 = x_1^2$;
$x_4 = x_2^2$;
$x_5 = x_1 x_2$. (format)
... (Ans. 1)

∴ The number of parameter to be learnt is 5. (num.)
... (Ans. 2)

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5.) with two features of & taking linear regression (multivariable regression) we can solve this problem

the eq^n will be.

$$h(\theta) = \theta_0 x_0 + \theta_1 x_1 + \theta_2 x_2.$$

$$\theta = \begin{bmatrix} \theta_0 \\ \theta_1 \\ \theta_2 \end{bmatrix} \qquad x = \begin{bmatrix} 1 \\ x_1 \\ x_2 \end{bmatrix} \begin{matrix} \\ \rightarrow 10^{th} \text{ marks} \\ \rightarrow 12^{th} \text{ marks.} \end{matrix}$$

$$h(\theta) = \theta^T x$$

cost function & all that will be be similar.

2.) To make it a classification problem, we will have to make few features binary such as Age and color of the shirt. After that, by using logistic regression, our model will be able to identify weather a person is a researcher or not.

6) Model M_1 Model M_2

Model M_1:

Actual Class \ Predicted class	+	-
+	150	40
-	60	250

Model M_2:

Actual Class \ Predicted Class	+	-
+	250	45
-	5	200

here,

TP	FN
FP	TN.

$\triangleright$ $\left.\begin{matrix} TP = 150 \\ FN = 40 \end{matrix}\right\} P = 190$; $P' = 210$

$\left.\begin{matrix} FP = 60 \\ TN = 250 \end{matrix}\right\} N = 310$; $N' = 290$

All = 500

$\triangleright$ Accuracy : $\frac{TP + TN}{All} = \frac{150 + 250}{500} = 0.8$.

$\triangleright$ Sensitivity : $\frac{TP}{P} = \frac{150}{190} = 0.7894$.

$\triangleright$ Specificity : $\frac{TN}{N} = \frac{250}{310} = 0.8064$

$\triangleright$ Precision : $\frac{TP}{TP+FP} = \frac{150}{150+60} = 0.7142$

$\triangleright$ Recall : $\frac{TP}{TP+FN} = \frac{150}{150+40} = 0.7894$

6 continue

for model M_2.

	+	−
+	250	45
−	5	200

TP	FN
FP	TN

TP = 250
FN = 45
FP = 5
TN = 200.

- Accuracy $= \frac{TP+TN}{All} = \frac{250+200}{500} = 0.9$

- Sensitivity $= \frac{TP}{P} = \frac{250}{250+45} = 0.8474$

- Specificity $= \frac{TN}{N} = \frac{200}{200+5} = 0.9756$

- Precision $= \frac{TP}{TP+FP} = \frac{250}{250+5} = 0.9803$

- Recall $= \frac{TP}{TP+FN} = \frac{250}{250+45} = 0.8474$

→ From both the models, we can observe that for model m_1, Accuracy is 80%. where that is for model m_2, Accuracy is 90%. Similarly model m_2 is more sensitive, more precise and so model M2 is more accurate.