13| March | 2025 ⇒ MAXIMAL MARGIN CLASSIFER),

for linear approach

$$d = \frac{|\beta_0 + \beta_1 x_1 + \beta_2 x_2|}{\sqrt{\beta_1^2 + \beta_2^2}}$$

∴ Three line [hyperplane].

$$2x + 3x_2 - 5 = 0$$

$$-x_1 + 4x_2 + 7 = 0$$

$$5x_1 - 12x_2 + 10 = 0$$

DATASET

x_1	x_2	y
3	4	+1
2	-1	-1
1	1	-1
-2	+1	-1

$= \beta_0 + 2(3)$

$$d = \frac{|-5 + 2(3) + 3(4)|}{\sqrt{2^2 + 4^2}} = \frac{13}{\sqrt{20}} = 2.9$$

$$d_2 = \frac{-5 + 2(2) + 3(-1)}{\sqrt{20}} = \frac{-4}{20} = -0.2$$

$$d_3 = \frac{-5 + 2(1) + 3(-1)}{\sqrt{20}} = \frac{-6}{\sqrt{20}} = -1.34$$

$$d_4 = \frac{-5 + 2(-2) + 3(1)}{\sqrt{20}} = \frac{-6}{\sqrt{20}} = -1.34$$

⇒ Q *

$$\beta_0 + 2(3) - 5(4)$$

$$d_1 = \frac{-5 + 2(3) - 5(4)}{\sqrt{2^2 + 4^2}} \qquad d_2 = \frac{-19}{\sqrt{4+16}}$$

$$= \frac{-2}{4.4} \qquad = -4.31$$

$$d_1 = -0.45$$

$= \beta_0 = -5 \quad \beta_1 = 2 \;,\; \beta_2 = 3 \quad — (1)$

$\beta_0 = 2 \quad \beta_1 = -1 \;,\; \beta_2 = 4 \quad — (2)$

$\beta_0 = 10 \quad \beta_1 = 5 \;,\; \beta_2 = -12 \quad — (3)$

(1) Distance $2x_1 + 3x_2 - 5 = 0$. for (3, 4) Data set

$$d_{\beta_1} = \frac{(2)(3) + 3(4) - 5}{\sqrt{2^2 + 3^2}} = \frac{13}{\sqrt{13}}$$

$$d_{(\beta_0)} = \frac{(-1)(3) + (4)(4) + 7}{\sqrt{(-1)^2 + (4)^2}} = \frac{8}{3.87}.$$

$$d_{(\beta_0)} = \frac{5(3) + (-12)(4) + 10}{\sqrt{5^2 + (-12)^2}} = \frac{-15 + (-48) - 10}{\sqrt{25 + 144}} = \frac{-43}{13}$$

$$\frac{-43}{\sqrt{169}} = -0.28$$

(2) Distance $x_1 + 4x_2 + 7$ [2, −1]

$$d_2 = \frac{(2)(2) + 3(-1) - 5}{\sqrt{2^2 + 3^2}} = \frac{4 + (-3) - 5}{\sqrt{13}} = \frac{-4}{\sqrt{13}}$$

$$d_2 = \frac{(-1)(2) + 4(-1) + 7}{\sqrt{(-1)^2 + (4)^2}} = \frac{1}{3.87} = 0.25$$

$$d_3 = \frac{(5)(2) + (-12)(-1) + 10}{\sqrt{5^2 + (-12)^2}} = \frac{32}{\sqrt{169}} = 2.46$$

(3) 1, −1

$$d_1 = \frac{(2)(1) + 3(-1) - 5}{\sqrt{13}} = \frac{-7}{\sqrt{13}}$$

$$d_2 = \frac{(-1)(1) + 4(-1) + 7}{\sqrt{17}}$$

$$d_3 = \frac{(5)(1) + (-12)(-1) + 10}{\sqrt{169}} = \frac{27}{\sqrt{169}} = 2.05$$

	H_1	H_2	H_3
x_1, x_2	$D_1(P_1)$	$D_2(P_2)$	$D_3(P_3)$
3, 4	3.60	~~4.87~~	~~-3.07~~ (−1.77)
2, −1	1.10	0.25	~~2.46~~
1, −1	1.66	~~0.49~~ 0.97	2.08
D_4 (−2, 1)	1.66	3.15	0.92

D_4 = (−2, 1)

$$d_1 = \frac{(2)(-2) + 3(1) - 5}{\sqrt{2^2 + 3^2}} = \frac{-6}{\sqrt{13}}$$

$$d_3 = \frac{(5)(-2) + (-12)(1) + 10}{\sqrt{169}} = \frac{-12}{}$$

$$d_2 = \frac{(-1)(-2) + 4(1) + 7}{\sqrt{(-1)^2 + (4)^2}} = \frac{2 + 4 + 7}{3.87} = 3.15$$