Q1 p-norm → Eucliden Di's.

p-norm $\left(\sum z_i^{p}\right)^{\frac{1}{p}}$

$$\sqrt{(x_1-x_2)^2+(y_1-y_2)^2}.$$

↓

$$\begin{cases} p=2 \\ z = \vec{x} - \vec{y} \end{cases}$$

$$\sqrt{\sum_{i=1}^{n}\left(\begin{bmatrix}x_1\\x_2\\\vdots\\x_n\end{bmatrix}-\begin{bmatrix}y_1\\y_2\\\vdots\\y_n\end{bmatrix}\right)^2}$$

Q2.

1-norm

q_1 (4, 5)

2	(3, 4)	−
4	(6, 3)	−
4	(7, 6)	−
3	(3, 7)	− ⊕
5	(5, 9)	−
4	(2, 3)	+
5	(9, 5)	+

K-NN

K=1 ⊖ 100%

K=7 ⊖ $\frac{5}{7} \approx 70\%$

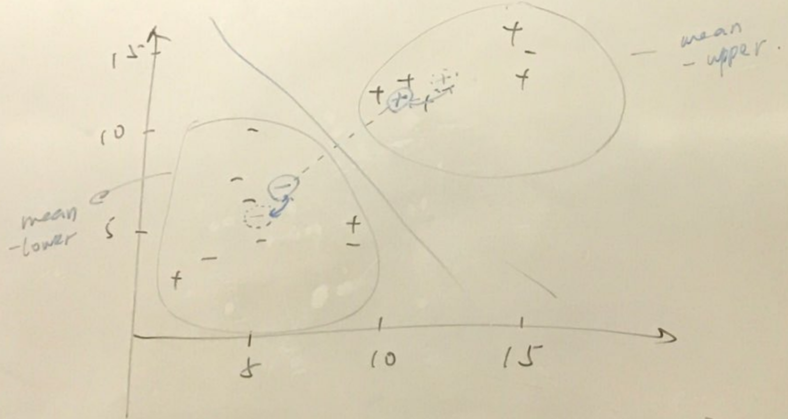
k=3

q_2 (13, 12)

1	(12, 10)	+
4	(10, 13)	+
4	(17, 12)	+
4	(14, 15)	+
3	(10, 12)	+
12	(9, 4)	−
4	(15, 14)	−
11	(9, 5)	+

k=1 ⊕ 100%

k=7 ⊕ $\frac{6}{7} \approx 83\%$



mean of all ⊕ points = $\left(\frac{2+9+12+10+17+14+10}{7}, \frac{3+5+10+13+12+15+12}{7} \right) = (10.6, 10)$

all ⊖ points = $\left(\frac{3+6+7+3+5+9+15}{7}, \frac{4+3+6+7+9+4+14}{7} \right) = (6.9, 7.4).$

mean-upper = (12.4, 12.1)

mean-lower = (5, 5.3)

⊕

d_1 b d e b b d e

d_2 b c e a b d d c c c

d_3 a d a d e a e e

d_4 b a d b e d a b

⊖

d_5 a b a b a b a e d

d_6 a c c c a c c e d

d_7 e a e d a e a

d_8 d e d e d

Multinomial counts

	a	b	c	class
d_1	0	3	0	+
d_2	0	3	3	+
d_3	3	0	0	+
d_4	2	3	0	+
d_5	4	3	0	−
d_6	4	0	3	−
d_7	3	0	0	−
d_8	0	0	0	−

aggregate ⟹

	a	b	c
⊕	5 (+1)	9 (+1)	3 (+1)
⊖	11 (+1)	3 (+1)	3 (+1)

Laplace smooth ⟹

	a	b	c	
⊕	6	10	4	20
⊖	12	4	4	20

nomilization ⟹

	a	b	c
⊕	$\frac{6}{20}$	$\frac{10}{20}$	$\frac{4}{20}$
⊖	$\frac{12}{20}$	$\frac{4}{20}$	$\frac{4}{20}$

→ ⊕ (0.3, 0.5, 0.2)

⊖ (0.6, 0.2, 0.2)

$\underline{d} = [a, a, a, b]$

d, e

$p = (\vec{x} \mid \text{class}) = n! \, \frac{\theta_1^{x_1}}{x_1!} \cdot \frac{\theta_2^{x_2}}{x_2!} \cdot \dots \cdot \frac{\theta_k^{x_k}}{x_k!}$

where $n = x_1 + x_2 \dots x_k = \sum_{i=1}^{k} x_i$

$\quad$ a b c

$\vec{x} = (3, 1, 0) \qquad n = 3 + 1 = 4$

$P(\vec{x} \mid ⊕) = 4! \cdot \frac{0.3^3}{3!} \cdot \frac{0.5^1}{1!} = 0.054$

$P(\vec{x} \mid ⊖) = 4! \cdot \frac{0.6^3}{3!} \cdot \frac{0.2^1}{1!} = 0.1728$

②

+

d_1 b d e b b d e

d_2 b c e b b d d c c c

d_3 a d a d e a e e

d_4 b a d b e d a b

−

d_5 a b a b a b a e d

d_6 a c a c a c c e d

d_7 e a e d a e a

d_8 d e d e d

[1 1 1] +
[0 0 0] +

Multivariant apperance

	a	b	c	class
d_1	0	1	0	+
d_2	0	1	1	+
d_3	1	0	0	+
d_4	1	1	0	+
d_5	1	1	0	−
d_6	1	0	1	−
d_7	1	0	0	−
d_8	0	0	0	−

[1, 1, 1] −
[0, 0, 0] −

$\xrightarrow{\text{aggregate}}$

	a	b	c
+	2	3	1
−	3	1	1

no. documents

$\xrightarrow{\text{Laplace Smooth}}$

	a	b	c
+	3	4	2
−	4	2	2

$\xrightarrow{\text{nomilization}}$

	a	b	c
+	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{2}{6}$
−	$\frac{4}{6}$	$\frac{2}{6}$	$\frac{2}{6}$

→ + (0.5, 0.67, 0.33)

− (0.67, 0.33, 0.33)

$\underline{d} = [a, a, a, b]$

$$\vec{x} = \begin{array}{ccc} a & b & c \\ (1, & 1, & 0) \end{array}$$

$P(\vec{x} \mid +) = 0.5 \cdot 0.67 \cdot (1 - 0.33) = 0.222$

$P(\vec{x} \mid -) = 0.67 \cdot 0.33 \cdot (1 - 0.33) = 0.148$

+

Q5

prior

$P(cancer) = 0.008$ $\quad$ $P(\neg cancer) = 0.992$

$P(\oplus \mid cancer) = 0.98$ $\quad$ $P(\ominus \mid cancer) = 0.02$

$P(\oplus \mid \neg cancer) = 0.03$ $\quad$ $P(\ominus \mid \neg cancer) = 0.97$

1st Test $\hookrightarrow$

$$\frac{P(\oplus, cancer)}{P(\oplus, \neg cancer)} = \frac{P(\oplus \mid cancer) \cdot P(cancer)}{P(\oplus \mid \neg cancer) \cdot P(\neg cancer)} = \frac{0.98 \cdot 0.008}{0.03 \cdot 0.992} = \frac{0.0078}{0.0298} < 1$$

$\boxed{\neg cancer}$

2nd Test $\hookrightarrow$

$$\frac{P(\oplus, \oplus, cancer)}{P(\oplus, \oplus, \neg cancer)} = \frac{P(\oplus \mid cancer) \cdot P(\oplus \mid cancer) \cdot P(cancer)}{P(\oplus \mid \neg cancer) \cdot P(\oplus \mid \neg cancer) \cdot P(\neg cancer)} = \frac{0.98 \cdot 0.98 \cdot 0.008}{0.03 \cdot 0.03 \cdot 0.992} = \frac{0.0077}{0.0009} > 1$$

cancer