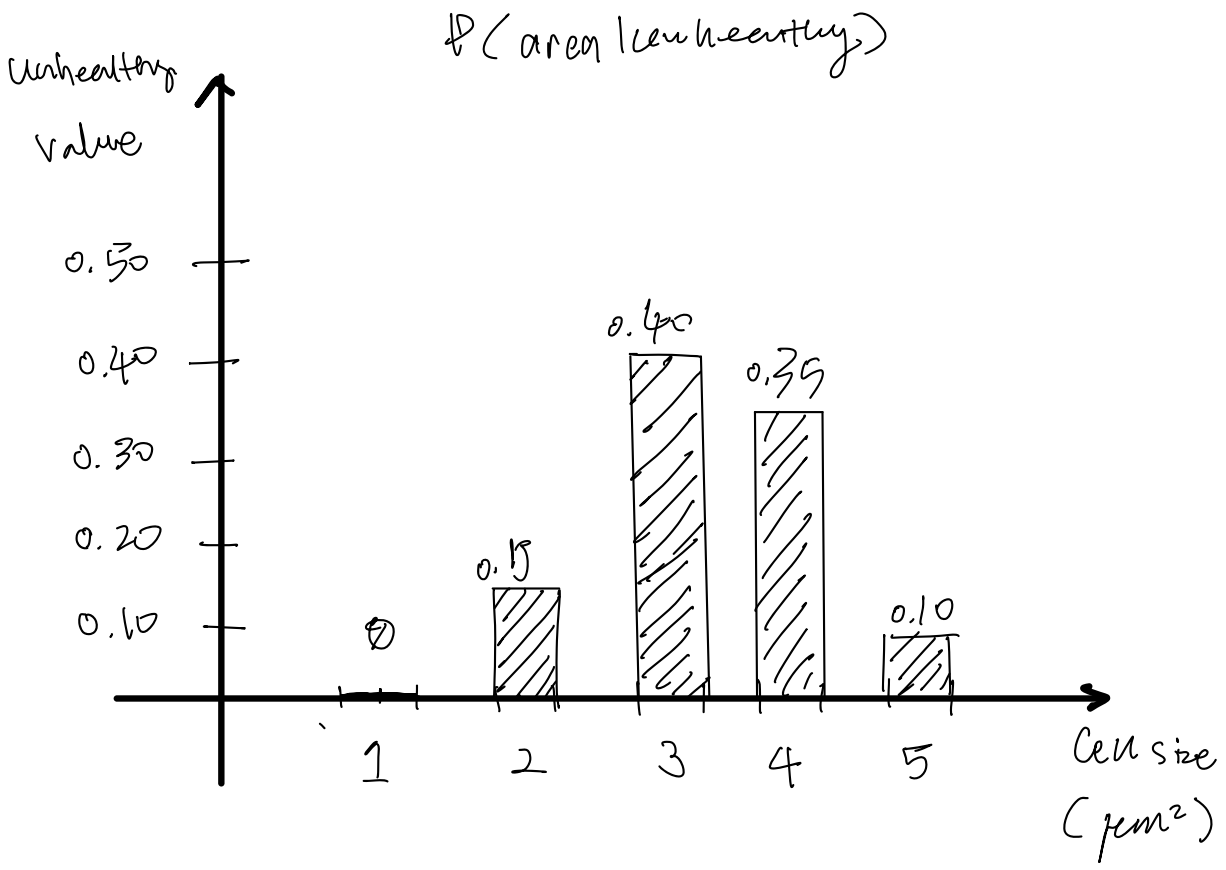
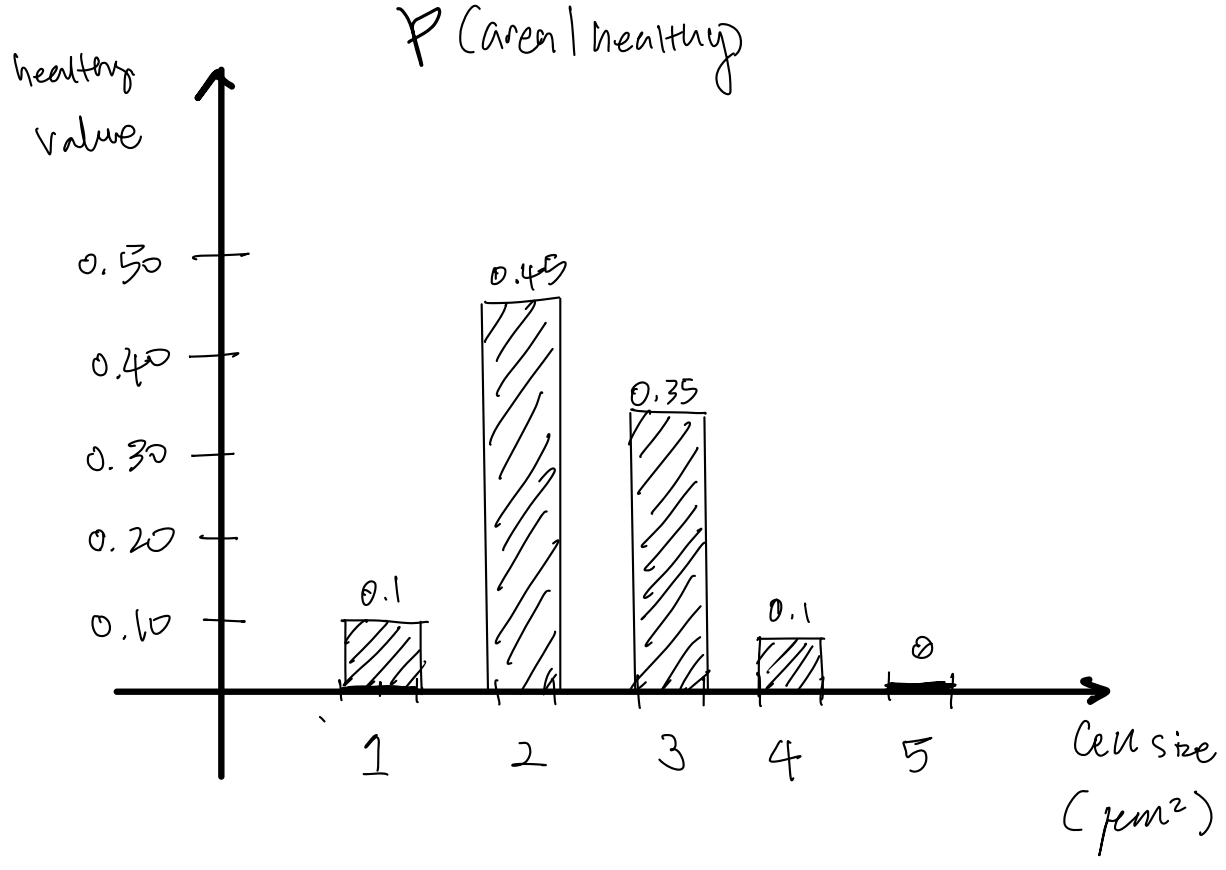
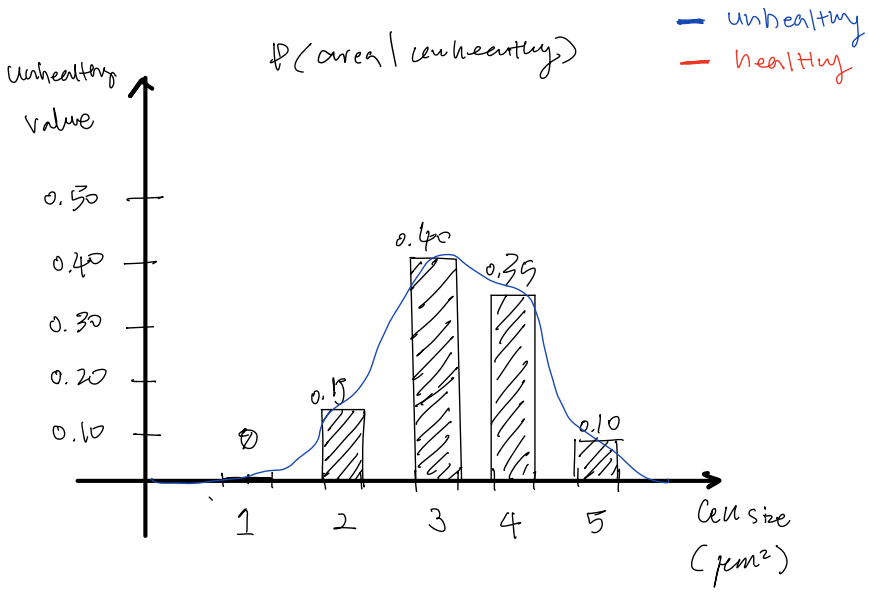
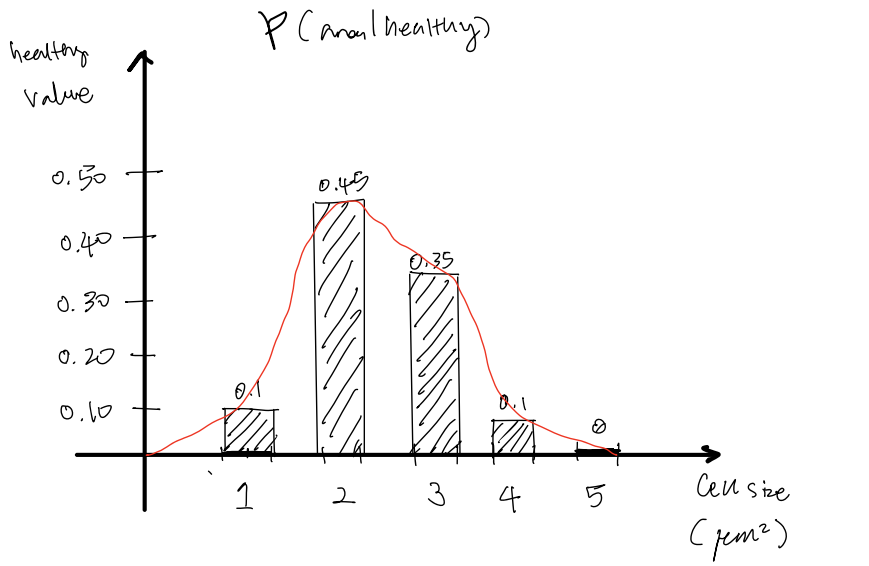
2.1

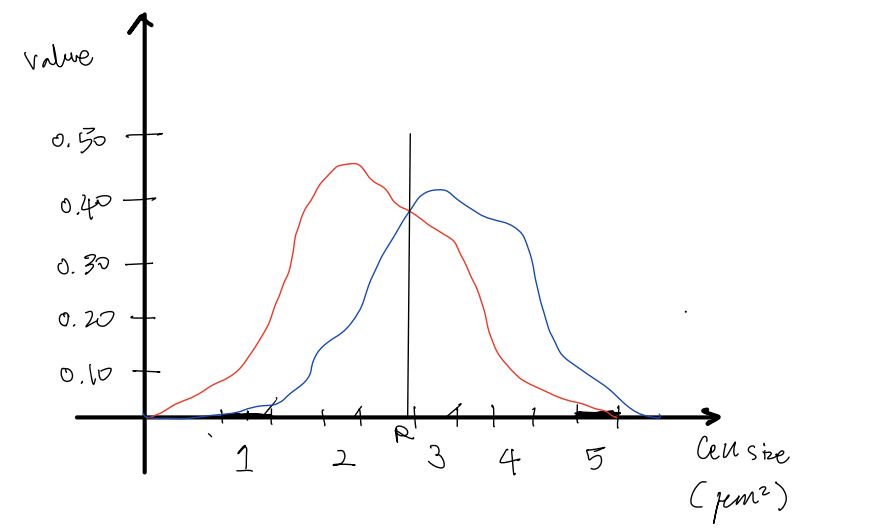

P(area | unhealthy)
unhealthy value
0.50
0.40
0.30
0.20
0.10
0
0.15
0.40
0.35
0.10
1
2
3
4
5
Cell size (μm²)


P(area | healthy)
healthy value
0.50
0.40
0.30
0.20
0.10
0.1
0.45
0.35
0.1
0
1
2
3
4
5
Cell size (μm²)

Likelihood Graphs:







2.3

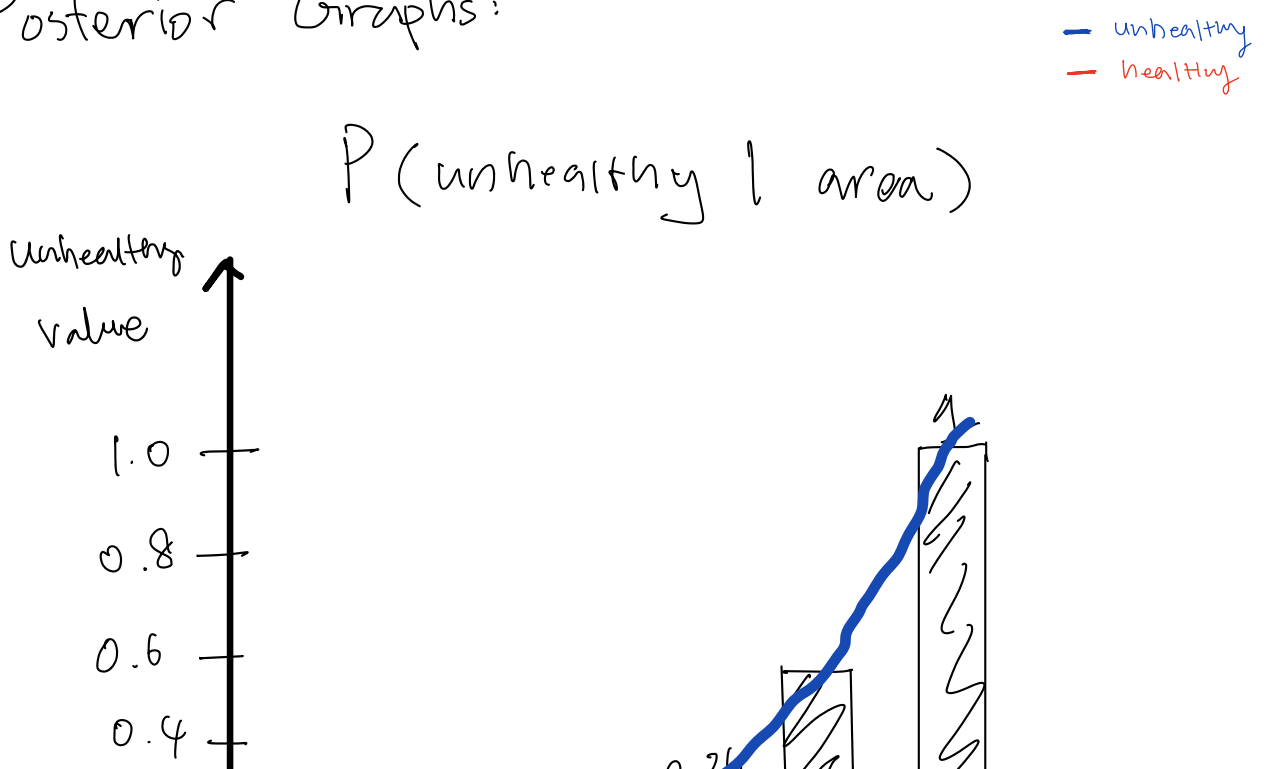
Computation: Bayes Rule.

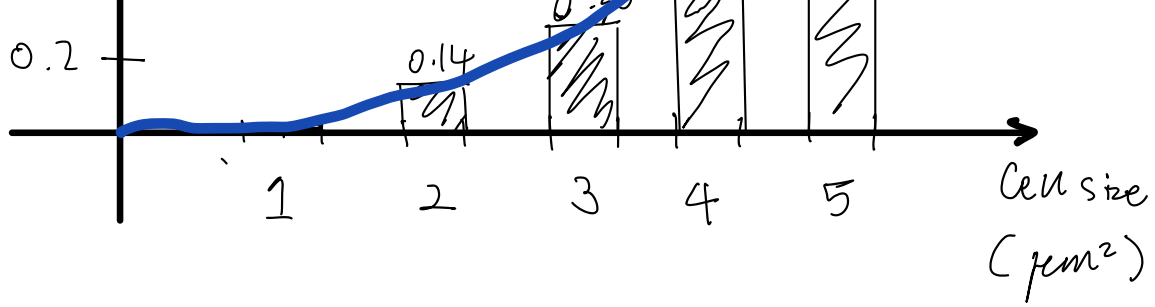
$$P(A \mid B) = \frac{P(AB)}{P(B)}$$

$$P(\text{unhealthy} \mid \text{area}) = \frac{P(\text{area} \mid \text{unhealthy})\, P(\text{unhealthy})}{\left[P(\text{area} \mid \text{unhealthy})\, P(\text{unhealthy}) + P(\text{area} \mid \text{healthy})\, P(\text{healthy})\right]}$$

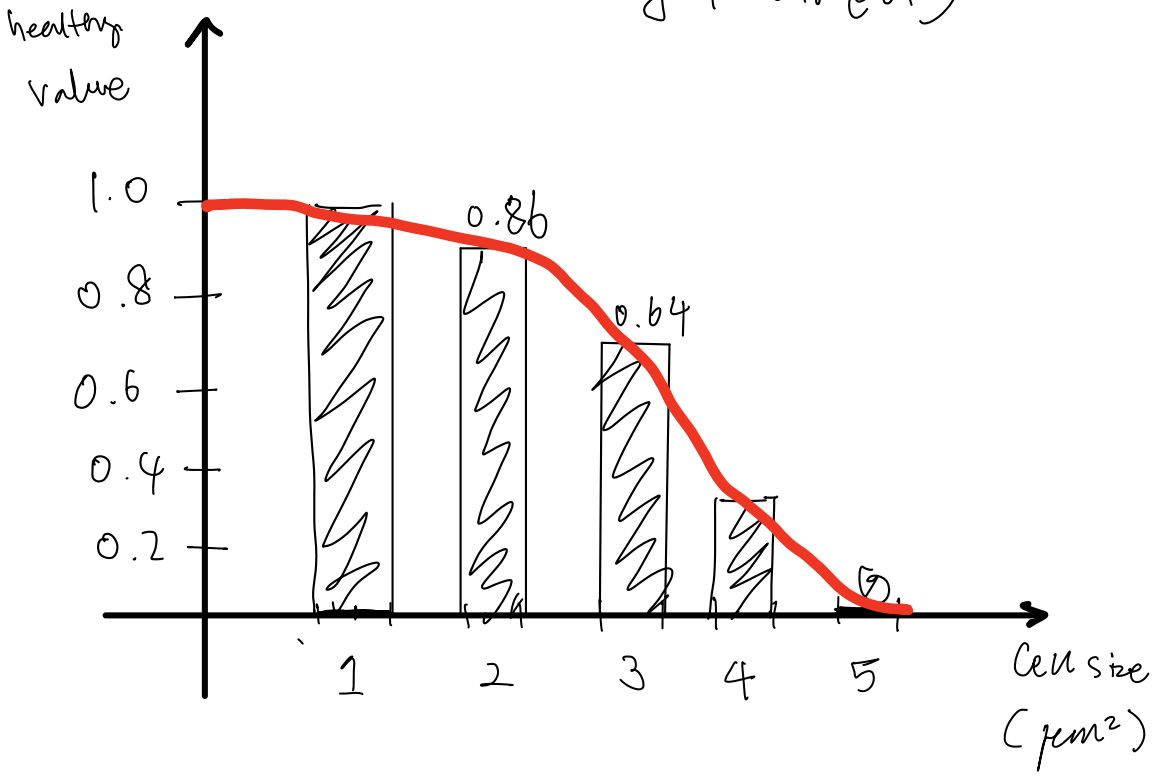
$$P(\text{healthy} \mid \text{area}) = \frac{P(\text{area} \mid \text{healthy})\, P(\text{healthy})}{\left[P(\text{area} \mid \text{unhealthy})\, P(\text{unhealthy}) + P(\text{area} \mid \text{healthy})\, P(\text{healthy})\right]}$$

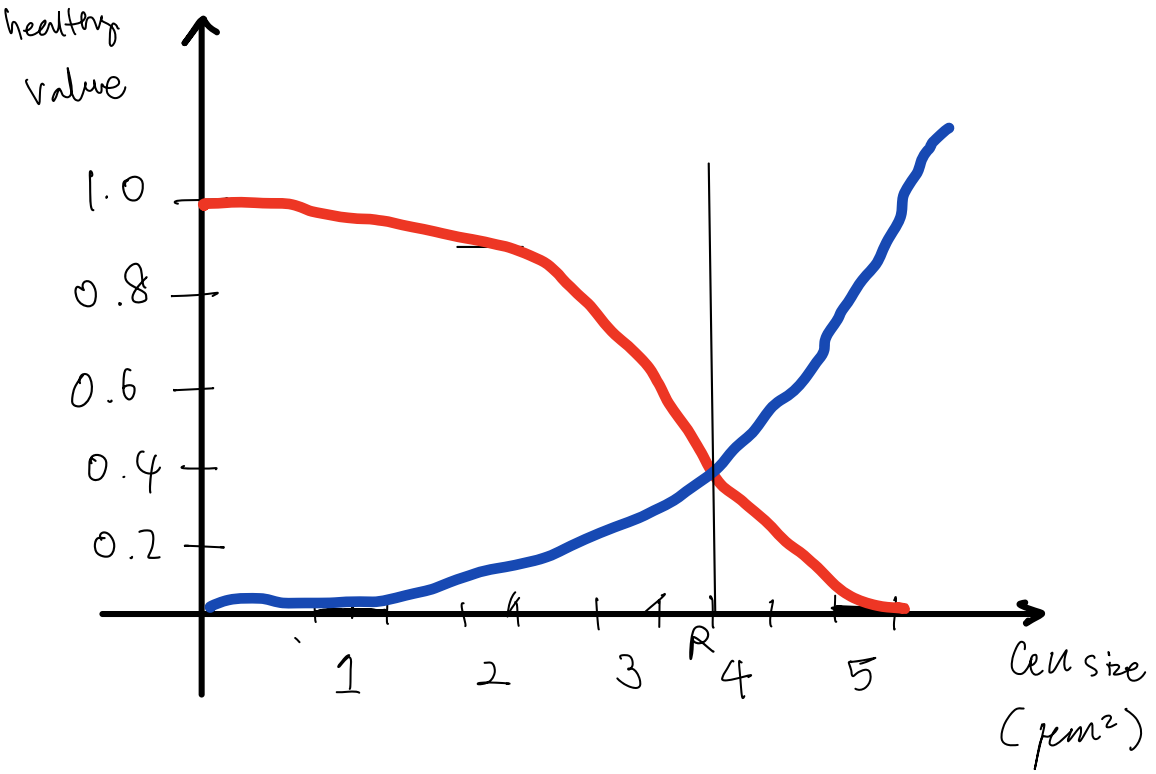
Posterior Graphs:





P(healthy | area)





2.4

For Area = 5:

$$P(\text{unhealthy} \mid \text{area}) = \frac{P(\text{area} \mid \text{unhealthy})\, P(\text{unhealthy})}{\left[P(\text{area} \mid \text{unhealthy})\, P(\text{unhealthy}) + P(\text{area} \mid \text{healthy})\, P(\text{healthy})\right]}$$

$$= \frac{0.1\left(\frac{1}{3}\right)}{0.1\left(\frac{1}{3}\right) + 0} = 1$$

$$P(\text{healthy} \mid \text{area}) = \frac{P(\text{area} \mid \text{healthy})\, P(\text{healthy})}{\left[P(\text{area} \mid \text{unhealthy})\, P(\text{unhealthy}) + P(\text{area} \mid \text{healthy})\, P(\text{healthy})\right]}$$

$$= 0$$

$P(\text{unhealthy} \mid \text{area} = 5) > P(\text{healthy} \mid \text{area} = 5)$

$\therefore$ For area = 5, unhealthy

For Area = 3:

$$\langle \text{unhealthy} \rangle \quad P = \frac{0.4\left(\frac{1}{3}\right)}{0.4\left(\frac{1}{3}\right) + 0.35\left(\frac{2}{3}\right)} = 0.36$$

$$\langle \text{healthy} \rangle \quad P = \frac{0.35\left(\frac{2}{3}\right)}{0.4\left(\frac{1}{3}\right) + 0.35\left(\frac{2}{3}\right)} = 0.64$$

$P(\text{unhealthy} \mid \text{area} = 3) < P(\text{healthy} \mid \text{area} = 3)$

$\therefore$ For area = 3, healthy

For Area = 2:

$$\langle \text{unhealthy} \rangle \quad P = \frac{0.15\left(\frac{2}{3}\right)}{0.15\left(\frac{1}{3}\right) + 0.45\left(\frac{2}{3}\right)} = 0.14$$

$$\langle \text{healthy} \rangle \quad P = \frac{0.45\left(\frac{2}{3}\right)}{0.15\left(\frac{1}{3}\right) + 0.45\left(\frac{2}{3}\right)} = 0.86$$

$P(\text{unhealthy} \mid \text{area} = 2) < P(\text{healthy} \mid \text{area} = 2)$

$\therefore$ For area = 2, healthy

2.5

For Area = 5:

$P(\text{healthy} \mid \text{area}) < P(\text{unhealthy} \mid \text{area})$

if & only if

computed

$P(\text{area} \mid \text{healthy}) \quad P(\text{area} \mid \text{unhealthy})$

From the Graph

$0 < 1 \quad \text{iff} \quad \emptyset < 0.1$

$\therefore$ unhealthy

For Area = 3:

$P(\text{healthy} \mid \text{area}) > P(\text{unhealthy} \mid \text{area})$

if & only if

computed

$P(\text{area} \mid \text{healthy}) < P(\text{area} \mid \text{unhealthy})$

From the Graph

$0.64 > 0.36 \quad \text{contradict} \quad 0.35 < 0.4$

$\therefore$ unhealthy

For Area = 2 :

P(healthy | area) > P(unhealthy | area)

if & only if

P(area | healthy) > P(area | unhealthy)

computed

From the Graph

0.86 > 0.14 iff 0.45 > 0.15

∴ healthy