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Q3) From the data given we can create the following confusion matrix

Predicted

Actual	T	F
T	0.9	0.1
F	0.03	0.97

∴ P(TP) = 0.9
P(TN) = 0.97
P(FP) = 0.03
P(FN) = 0.1

i) Given in the entire population 0.08 have the disease

we need to find $P(\text{disease} \mid \oplus)$

disease → covid +ve; $\oplus$ → positive lab test

from Bayes Theorem

$$P(\text{disease} \mid \oplus) = \frac{P(\oplus \mid \text{disease}) \times P(\text{disease})}{P(\oplus \mid \text{disease}) \times P(\text{disease}) + P(\oplus \mid \overset{\text{no}}{\text{disease}}) \times P(\overset{\text{no}}{\text{disease}})}$$

$P(\oplus \mid \text{disease}) = P(TP) = 0.9$

$P(\text{disease}) = 0.08$ $P(\text{no disease}) = 0.92$

$P(\oplus \mid \text{no disease}) = P(FP) = 0.03$

$$\therefore P(\text{disease} \mid \oplus) = \frac{0.9 \times 0.08}{0.9 \times 0.08 + 0.03 \times 0.92}$$

$$= \frac{0.072}{0.0996} = \boxed{0.72289}$$

Yes we should diagnose the person as having COVID-19

ii) Given in the population 0.6 have the disease

$\therefore$ all parameters remain same except

$P(\text{disease}) = 0.6 \quad \& \quad P(\text{no disease}) = 0.4$

$$\therefore P(\text{disease} \mid \oplus) = \frac{P(\oplus \mid \text{disease}) \times P(\text{disease})}{P(\oplus \mid \text{disease})\,P(\text{disease}) + P(\oplus \mid \text{no disease})\,P(\text{no disease})}$$

$$= \frac{0.9 \times 0.6}{0.9 \times 0.6 + 0.03 \times 0.4} =$$

$$= \frac{0.54}{0.552} = \boxed{0.97826}$$

Yes we should diagnose the person as having COVID-19