A4   Q3   CSC384

Separation but no Sufficiency

A = Gender,   C = Prediction,   Y = Hyperlipidemia
= {M, F}   = {Yes, No}   = {Yes, No}

A	Y	C	P(A, Y, C)
M	Yes	Yes	0.2
M	Yes	No	0.04
M	No	Yes	0.09
M	No	No	0.17
F	Yes	Yes	0.2
F	Yes	No	0.04
F	No	Yes	0.06
F	No	No	0.2

$$P(C=Yes \mid Y=Yes, A=F) = \frac{P(C, Y, A)}{P(Y, A)} = \frac{0.2}{0.2 + 0.04} = \boxed{\frac{0.2}{0.24}}$$

$$P(C=Yes \mid Y=Yes) = \frac{P(C, Y)}{P(Y)} = \frac{0.2 + 0.2}{0.2 + 0.2 + 0.04 + 0.04} = \frac{0.4}{0.48} = \boxed{\frac{0.2}{0.24}}$$

So, $P(C \mid Y, A) = P(C \mid Y)$ so   Separation ✓

$$P(Y=Yes \mid C=Yes, A=F) = \frac{P(C, Y, A)}{P(C, A)} = \frac{0.2}{0.2 + 0.06} = \boxed{\frac{0.2}{0.26}}$$

$$P(Y=Yes \mid C=Yes) = \frac{P(YC)}{P(C)} = \frac{0.2 + 0.2}{0.2 + 0.09 + 0.2 + 0.06} = \boxed{\frac{0.4}{0.55}}$$

So, $P(Y \mid C, A) \neq P(Y \mid C)$ so no sufficiency ✗

A4 Q3 CSC 384

Sufficiency but no Separation

A = Gender   C = Prediction   Y = Hyperlipidemia
  = {F, M}   = {Y, N}   = {Y, N}

A	Y	C	P(A,Y,C)
M	Y	Y	0.2
M	Y	N	0.07
M	N	Y	0.06
M	N	N	0.17
F	Y	Y	0.2
F	Y	N	0.04
F	N	Y	0.06
F	N	N	0.2

$$P(C=Y \mid Y=Y, A=F) = \frac{P(C, Y, A)}{P(Y, A)} = \frac{0.2}{0.2+0.04} = \boxed{\frac{0.2}{0.24}}$$

$$P(C=Y \mid Y=Y) = \frac{P(C, Y)}{P(Y)} = \frac{0.2+0.2}{0.2+0.07+0.2+0.04} = \boxed{\frac{0.4}{0.51}}$$

So, $P(C \mid YA) \neq P(C \mid Y)$

   ↳ NO separation ✗

$$P(Y=Y \mid C=Y, A=F) = \frac{P(C, Y, A)}{P(C, A)} = \frac{0.2}{0.2+0.06} = \boxed{\frac{0.2}{0.26}}$$

$$P(Y=Y \mid C=Y) = \frac{P(C, Y)}{P(C)} = \frac{0.2+0.2}{0.2+0.06+0.2+0.06} = \boxed{\frac{0.4}{0.52}} = \boxed{\frac{0.2}{0.26}}$$

So, $P(Y \mid C, A) = P(Y \mid C)$ → sufficiency holds ✓