Q3.

Example 1. Separation holds but not sufficiency

A	C	Y	P(A, C, Y)
TRUE	**TRUE**	**TRUE**	0.12
TRUE	**TRUE**	**FALSE**	0.16
TRUE	**FALSE**	**TRUE**	0.10
TRUE	**FALSE**	**FALSE**	0.20
FALSE	**TRUE**	**TRUE**	0.12
FALSE	**TRUE**	**FALSE**	0.10
FALSE	**FALSE**	**TRUE**	0.10
FALSE	**FALSE**	**FALSE**	0.10

In this case, A represents the sensitive attribute *Gender,* Y represent the actual *Crime rate* of a person, C is the *prediction of the crime rate* for a person.

$$P(A \mid Y, C) = \frac{0.12}{0.12 + 0.12} = 0.50 = P(A \mid Y)$$

$$P(A \mid C, Y) = \frac{0.12}{0.12 + 0.12} = 0.50 \neq \frac{0.12 + 0.16}{0.12 + 0.16 + 0.12 + 0.10} = 0.56 = P(A \mid C)$$

Thus only separation holds.

Example 2. Sufficiency holds but not separation

A	C	Y	P(A, C, Y)
TRUE	**TRUE**	**TRUE**	0.12
TRUE	**TRUE**	**FALSE**	0.10
TRUE	**FALSE**	**TRUE**	0.16
TRUE	**FALSE**	**FALSE**	0.20
FALSE	**TRUE**	**TRUE**	0.12
FALSE	**TRUE**	**FALSE**	0.10
FALSE	**FALSE**	**TRUE**	0.10
FALSE	**FALSE**	**FALSE**	0.10

Same as in the previous case, A represents the sensitive attribute *Gender,* Y represent the actual *Crime rate* of a person, C is the *prediction of the crime rate* for a person.

$$P(A \mid Y, C) = \frac{0.12}{0.12 + 0.12} = 0.50 = P(A \mid C)$$

$$P(A \mid C, Y) = \frac{0.12}{0.12 + 0.12} = 0.50 \neq \frac{0.12 + 0.16}{0.12 + 0.16 + 0.12 + 0.10} = 0.56 = P(A \mid Y)$$

Thus only sufficiency holds.