Question 3

Given, C is a classification, Y is a label representing 'ground truth', A is some 'protected attribute'

Separation = A is independent of C given Y
Sufficiency = A is independent of Y given C

Example: Sufficiency holds but not separation
A = Gender, C = Hyperlipidemia, Y = Hypertension

P (A | Y = YES, C = YES) = [0.571, 0.429]
P (A | C = YES) = [0.571, 0.429]
P (A | Y = YES) = [0.5297247688547452, 0.4702752311452548]

Here Y = Hypertension does not help calculating probability as after removing Y, the probability stays the same => **Sufficiency**

Here on the other hand Gender is not independent of Hyperlipidemia => **No Separation**

Example: Separation holds but not sufficiency

A = Gender, C = Central Obesity, Y = Hyperlipidemia

P (A | C = YES, Y = YES) = [0.571, 0.429]
P (A | Y = YES) = [0.571, 0.429]
P (A | C) = [0.530888488529951, 0.46911151147004915]

Here C = Central Obesity does not help calculating probability as after removing C, the probability stays the same. Hence Gender is independent of Central Obesity given Hyperlipidemia => **Separation**

Here on the other hand Gender is not independent of Hyperlipidemia given Central Obesity => **lack of sufficiency**