Example 1: Separation holds but not sufficiency

Set A = Gender, C = Diabetes, Y = Hyperlipidemia (using same definitions as the handout)

Joint probability distribution for Hyperlipidemia, Gender, and Diabetes:

	Gender = Male		Gender = Female	
	Diabetes = YES	Diabetes = NO	Diabetes = YES	Diabetes = NO
Hyperlipidemia = YES	0.1494	0.0819	0.1123	0.0615
Hyperlipidemia = NO	0.1132	0.1807	0.1159	0.1851

Gender is conditionally independent of Diabetes given Hyperlipidemia.
→ P(Gender | Hyperlipidemia) = P(Gender | Hyperlipidemia, Diabetes)

P(Gender = Male | Hyperlipidemia = YES)	0.571
P(Gender = Male | Hyperlipidemia = YES, Diabetes = YES)	0.571
P(Gender = Male | Hyperlipidemia = YES, Diabetes = NO)	0.5709999999999998
P(Gender = Male | Hyperlipidemia = NO)	0.49399999999999994
P(Gender = Male | Hyperlipidemia = NO, Diabetes = YES)	0.49399999999999994
P(Gender = Male | Hyperlipidemia = NO, Diabetes = NO)	0.494

Diabetes is conditionally independent of Gender given Hyperlipidemia.
→ P(Diabetes | Hyperlipidemia) = P(Diabetes | Hyperlipidemia, Gender)

P(Diabetes = YES | Hyperlipidemia = YES)	0.6459421684394565
P(Diabetes = YES | Hyperlipidemia = YES, Gender = Male)	0.6459421684394565
P(Diabetes = YES | Hyperlipidemia = YES, Gender = Female)	0.6459421684394565
P(Diabetes = YES | Hyperlipidemia = NO)	0.3850423492316574
P(Diabetes = YES | Hyperlipidemia = NO, Gender = Male)	0.38504234923165737
P(Diabetes = YES | Hyperlipidemia = NO, Gender = Female)	0.3850423492316574

Therefore, separation holds (A is independent of C given Y).

Gender is **not** conditionally independent of Hyperlipidemia given Diabetes.
→ P(Gender | Diabetes, Hyperlipidemia = YES) ≠ P(Gender | Diabetes, Hyperlipidemia = NO)

P(Gender = Male | Diabetes = YES, Hyperlipidemia = YES)	0.571
P(Gender = Male | Diabetes = YES, Hyperlipidemia = NO)	0.49399999999999994

Therefore, sufficiency does not hold (A is not independent of Y given C).

Example 2: Sufficiency holds but not separation

By setting C = Hyperlipidemia (instead of Diabetes) and Y = Diabetes (instead of Hyperlipidemia), Example 1 can be used to show that sufficiency holds but not separation.

Hence, sufficiency and separation can't be enforced at the same time.