A4Q3

Assume X = Prediction, Y = Hyperlipidemia, Z = Gender, then

- **Separated**
  - P(Prediction = YES|Hyperlipidemia = YES, Gender = Female) = P(Prediction = YES|Hyperlipidemia = YES)
  - Becomes to P(X = YES|Y = YES, Z = Female) = P(X = YES|Y = YES)
- **Sufficient**
  - P(Hyperlipidemia = YES|Prediction = YES, Gender = Female) = P(Hyperlipidemia = YES|Prediction = YES)
  - Becomes to P(Y = YES|X = YES, Z = Female) = P(Y = YES|X = YES)
- **Separated and not Sufficient example**

X	YES		NO	
Z / Y	Male	Female	Male	Female
YES	0.1	0.075	0.1	0.075
NO	0.15	0.175	0.15	0.175

- **Sufficient and not Separated example**

X / Z / Y	YES		NO	
	Male	Female	Male	Female
YES	0.1	0.075	0.15	0.175
NO	0.1	0.075	0.15	0.175

P(x, y) = P(x, y, z) + P(x, y, ~z) = 0.7

P(x, z) = P(x, y, z) + P(x, ~y, z) = 0.6

P(y, z) = P(x, y, z) + P(~x, y, z) = 1

x / Z / Y	Prediction = YES		Prediction = NO	
	Gender = Male	Gender = Female	Gender = Male	Gender = Female
Hyperlipidemia = YES	0.4	0.3	0.6	0.7
Hyperlipidemia = NO	0.6	0.7	0.4	0.3

P(x, y) = P(x, y, z) + P(x, y, ~z) = 0.7

P(x, z) = P(x, y, z) + P(x, ~y, z) = 1

P(y, z) = P(x, y, z) + P(~x, y, z) = 1

$$\mathrm{P(X,Y,Z)} = \frac{P(X,Y) \times P(X,Z)}{P(X)} \neq \frac{P(X,Y) \times P(Y,Z)}{P(Y)}$$

Assume Prediction = YES is X, Hyperlipidemia = YES is Y, Gender = Female is Z

If separated, then

$$\mathrm{P(X|Y,Z)} = \mathrm{P(X|Y)}$$

$$\frac{\mathrm{P(X,Y,Z)}}{P(Y,Z)} = \frac{P(X,Y)}{P(Y)}$$

$$\mathrm{P(X,Y,Z)} = \frac{P(X,Y) \times P(Y,Z)}{P(Y)}$$

If sufficient, then

$$\mathrm{P\ (Y|X,Z)} = \mathrm{P(Y|X)}$$

$$\mathrm{P(X,Y,Z)} = \frac{P(X,Y) \times P(X,Z)}{P(X)}$$

So

$$\mathrm{P(X,Y,Z)} = \frac{P(X,Y) \times P(Y,Z)}{P(Y)} = \frac{P(X,Y) \times P(X,Z)}{P(X)}$$

$$\frac{P(Y,Z)}{P(Y)} = \frac{P(X,Z)}{P(X)}$$

$$P(Z|Y) = P(Z|X)$$

Or try to use apply Bayes rule for the separation and you get terms similar to

Sufficient

Add new node of BN, and create own prob table