COMP341 Assignment 3

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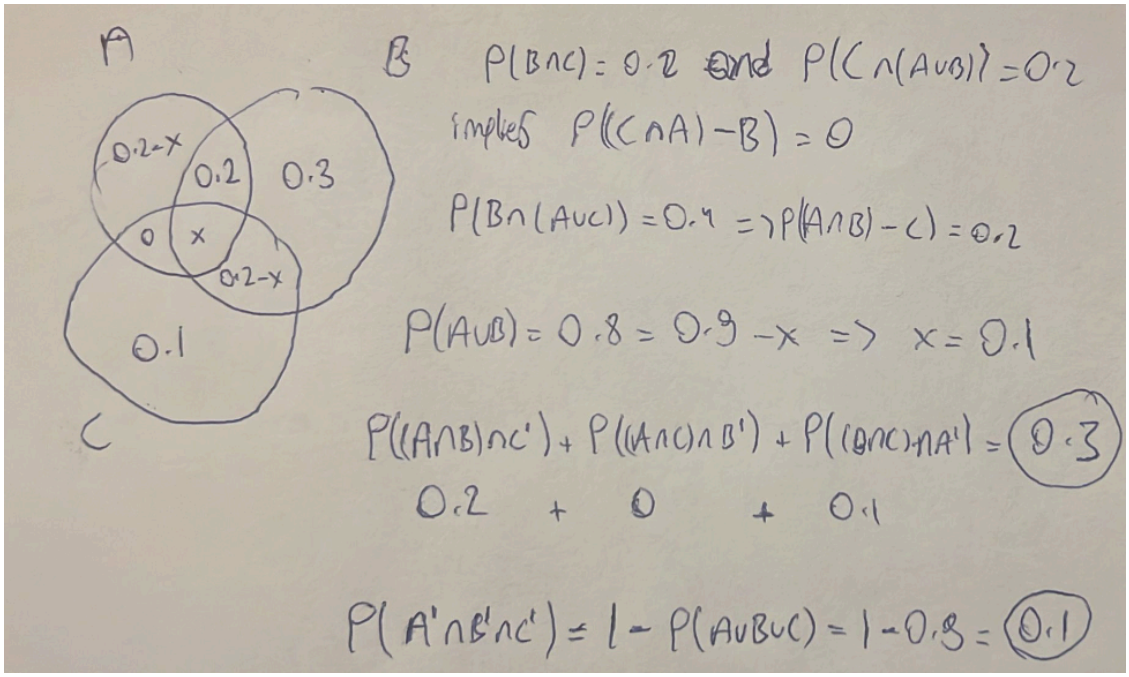
Q1)

1. **True:** Happy and smart are only connected with music so if music is given they do not affect themselves
2. **True:** Smart does not affect success since project and homework are the connections and they are given
3. **False:** Creative still affects success because of homework
4. **False:** Smart and Party are not only affected by success but also creative, homework, and music
5. **False:** Simply not enough for that conclusion, there are other dependencies,

Q2)

1-2) P(only two events) = P(A and B and C') + P(A and B' and C) + P(A' and B and C)
P(no events occurring) = 1 - P(at least one event occurring)

Solution:



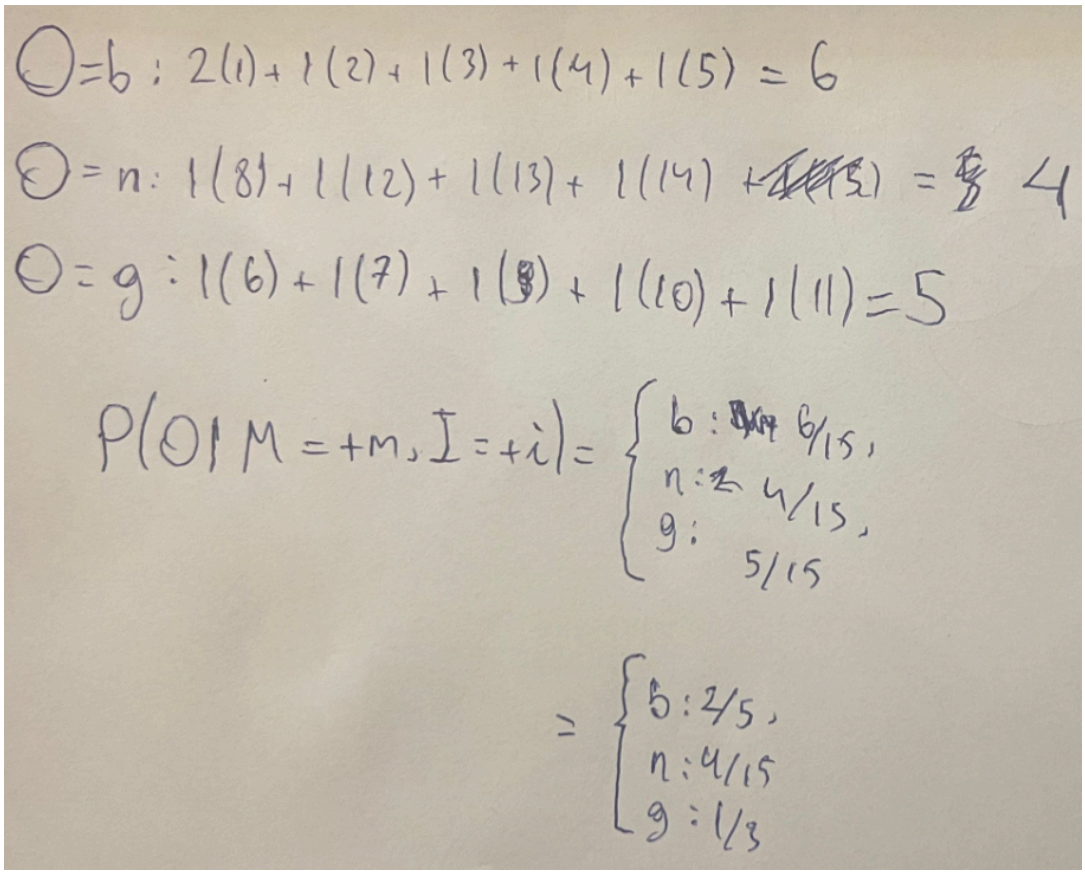
As seen in above we have found P(only two events) = **0.3**, P(no events occurring) = **0.1**

Q3)

a) Product of all conditional probabilities is the joint probability distribution:

P(S,M,B,I,P,W,N,O) = P(S) P(M|S) P(B) P(I|S) P(P|M,B,I) P(W|P,I) P(N|W,I,S) P(O|N,W)

b) Numbers inside the parentheses denote the row number which the amount was extracted from.



Q4)

a) Using the table provided for the political outcome we have I have constructed the required tables and the conditional probabilities of P(O |M = +m, I= +I, W = +w) and P(O |M = +m, I= +I, W = -w)

W= +w					Summing Probabilites	
N	P(N|W=+w, I=+I, S)	O	P(O|N, W = +w)	P(O|M=+m, I=+i, W=+w)	P(O |M = +m, I= +I, W = +w)	
+n	0.75	b	0.3	0.225		
+n	0.75	n	0.3	0.225	b	0.45
+n	0.75	g	0.4	0.30	n	0.25
-n	0.25	b	0.9	0.225	g	0.30
-n	0.25	n	0.1	0.025		
-n	0.25	g	0.0	0.0		
W= -w						
N	P(N|W=-w, I=+I, S)	O	P(O|N, W = -w)	P(O|M=+m, I=+i, W=-w)	Summing Probabilites	
+n	0.75	b	0.0	0.0	P(O |M = +m, I= +I, W = -w)	
+n	0.75	n	0.1	0.075		
+n	0.75	g	0.9	0.675	b	0.025
-n	0.25	b	0.1	0.025	n	0.15
-n	0.25	n	0.3	0.075	g	0.825
-n	0.25	g	0.6	0.15		

b) Using the utility values from the given table we calculate:

For W = +w:

EU(W = +w) = 0.45 * -120 + 0.25 * 0 + 0.30 * 40 = -42

For W = -w:

EU(W = -w) = 0.025 * -80 + 0.15 * 20 + 0.825 * 120 = 100

Thus, EU(W = +w) = -42, EU(W = -w) = 100, so optimal action is to choose the minimum wage increase.

c)

For S = +s using the above table we calculate:

EU(W = +w | S = +s) = 0.45 * -120 + 0.25 * 0 + 0.3 * 40 = -42
EU(W = -w |S = +s) = 0.025 * -80 + 0.15 * 20 + 0.825 * 120 = 100

Thus EU(S = +s) = max(-42, 100) = 100

For S = -s using the given table we calculate:

EU(W = +w | S = -s) = 0.225 * -120 + 0.025 * 0 + 0.75 * 40 = 3
EU(W = -w | S = -s) = 0.025 * -80 + 0.15 * 20 + 0.825 * 120 = 100

Thus, EU(S = -s) = max(3, 100) = 100

We need to calculate the values of $P(S = +s \mid M = +m, I = +i)$ and $P(S = -s \mid M = +m, I = +i)$ to find the VPI. Applying Bayes theorem to find them:

$P(S = +s \mid M = +m, I = +i) = P(M = +m, I = +i \mid S = +s) * P(S = +s) / P(M = +m, I = +i)$
$P(S = -s \mid M = +m, I = +i) = P(M = +m, I = +i \mid S = -s) * P(S = -s) / P(M = +m, I = +i)$

$P(M = +m, I=+i \mid S = +s) = P(M = +m \mid S = +s) * P(I = +i \mid S = +s) = 0.9 * 0.5= 0.45$
$P(M = +m, I=+i \mid S = -s) = P(M = +m \mid S = -s) * P(I = +i \mid S = -s) = 0.2 * 0.75= 0.15$

We know that:
$P(M = +m, I = +i) = P(M = +m, I = +i \mid S = +s)*P(S = +s)+P(M = +m, I = +i \mid S = -s)*P(S = -s)$
$P(M = +m, I = +i) = 0.45 * 0.25 + 0.15 * 0.75 = 0.225$

Finally we have
$P(S = +s \mid M = +m, I = +i) = 0.45 * 0.25$ (since $P(S = s+) = 0.25$) $/ 0.225 = 0.5$
$P(S = -s \mid M = +m, I = +i) = 0.15 * 0.75$ (since $P(S= s-) = 0.75$) $/ 0.225 = 0.5$

$EU(\text{with PI}) = P(S = +s \mid M = +m, I = +i) * EU(S = +s) + P(S = -s \mid M = +m, I = +i) * EU(S = -s)$
$= 0.5 * 100 + 0.5 * 100 = 100$

VPI = EU(with PI) - EU = 100 - 100 = 0
This means knowing S does not change the optimal action!