CSE 415 HW 6

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1. Here we use Bayes' Rule, $P(H|E) = \frac{P(E|H)P(H)}{P(E|H)P(H)+P(E|{\sim}H)P({\sim}H)}$
   (a). Lucy:
   $P(\text{has HPAI}|\text{test positive}) = \frac{P(\text{test positive}|\text{has HPAI})P(\text{has HPAI})}{P(\text{test positive}|\text{has HPAI})+P(\text{test positive}|{\sim}\text{has HPAI})P({\sim}\text{has HPAI})}$
   $= \frac{(1)(0.001)}{(1)(0.001)+(0.05)(0.999)} = 0.0196$
   (b). James:
   We use the same equation as (a), except now $P(\text{has HPAI}) = 0.0125)$
   $P(\text{has HPAI}|\text{test positive}) = \frac{P(\text{test positive}|\text{has HPAI})P(\text{has HPAI})}{P(\text{test positive}|\text{has HPAI})+P(\text{test positive}|{\sim}\text{has HPAI})P({\sim}\text{has HPAI})}$
   $= \frac{(1)(0.0125)}{(1)(0.0125)+(0.05)(0.9875)} = 0.202$

   From the above calculations, Lucy should not panic. But James should, since 20% chance of getting HPAI is rather high.

Location	Condition	Outcome	Possibility
Seattle	No HPAI	Test Positive	0.05
Seattle	No HPAI	Test Negative	0.95
Back from Belize	No HPAI	Test Positive	0.05
Back from Belize	No HPAI	Test Negative	0.95
Seattle	HPAI	Test Positive	1
Seattle	HPAI	Test Negative	0
Back from Belize	HPAI	Test Positive	1
Back from Belize	HPAI	Test Negative	0
Seattle	Test Positive	HPAI	0.0196
Seattle	Test Positive	No HPAI	0.9804
Back From Belize	Test Positive	HPAI	0.202
Back From Belize	Test Positive	No HPAI	0.798
Seattle	Test Negative	HPAI	0
Seattle	Test Negative	No HPAI	1
Back From Belize	Test Negative	HPAI	0
Back From Belize	Test Negative	No HPAI	1

2. (a) There are 14 different policies, each represented by each row in the table.

(b)

$$V_{k+1}(s) \leftarrow max_a \sum_{s'} T(s,a,s')[R(s,a,s') + \gamma V_k(s')]$$

At iteration 0:
$V_0(Dorm) = V_0(Lav) = V_0(Pan) = V_0(Mes) = V_0(Amb) = V_0(Kap) = 0$ At iteration 1:
$V_1(Dorm) = max\{(0.4)(4) + (0.6)(2), (0.6)(4) + (0.4)(2), (0.75)(0) + (0.25)(-50)\} = 3.2$
$V_1(Lav) = max\{(0.4)(0) + (0.6)(10), (0.6)(0) + (0.4)(10), (0.74)(4) + (0.25)(-50)\} = 6$
$V_1(Pan) = max\{(0.6)(4) + (0.4)(2), (0.4)(4) + (0.6)(2), (0.75)(10) + (0.25)(-50)\} = 3.2$
$V_1(Mes) = max\{(0.4)(0) + (0.6)(10), (0.6)(0) + (0.4)(10), (0.75)(2) + (0.25)(-50)\} = 6$
$V_1(Amb) = 0$
$V_1(Kap) = 0$

At iteration 2:
$V_2(Dorm) = max\{(0.4)(4 + (0.5)6) + (0.6)(2 + (0.5)6), (0.6)(4 + (0.5)6) + (0.4)(2 + (0.5)6), (0.75)(0 + (0.5)3.2) + (0.25)(-50 + 0)\} = 6.2$
$V_2(Lav) = max\{(0.4)(0 + (0.5)3.2) + (0.6)(10 + (0.5)3.2), (0.6)(0 + (0.5)3.2) + (0.4)(10 + (0.5)3.2), (0.75)(4 + (0.5)6) + (0.25)(-50 + 0) = 7.6$
$V_2(Pan) = max\{(0.6)(4 + (0.5)6) + (0.4)(2 + (0.5)6), (0.4)(4 + (0.5)6) + (0.6)(2 + (0.5)6), (0.75)(10 + (0.5)3.2) + (0.25)(-50)\} = 6.2$
$V_2(Mes) = max\{(0.4)(0 + (0.5)3.2) + (0.6)(10 + (0.5)3.2), (0.6)(0 + (0.5)3.2) + (0.4)(10 + (0.5)3.2), (0.75)(2 + (0.5)6) + (0.25)(-50)\} = 7.6$
$V_2(Amb) = 0$
$V_2(Kap) = 0$

At iteration 3:
$V_3(Dorm) = max\{(0.4)(4 + (0.5)7.6) + (0.6)(2 + (0.5)7.6), (0.6)(4 + (0.5)7.6) + (0.4)(2 + (0.5)7.6), (0.75)(0 + (0.5)6.2) + (0.25)(-50 + 0)\} = 7$
$V_3(Lav) = max\{(0.4)(0 + (0.5)6.2) + (0.6)(10 + (0.5)6.2), (0.6)(0 + (0.5)6.2) + (0.4)(10 + (0.5)6.2), (0.75)(4 + (0.5)7.6) + (0.25)(-50 + 0) = 9.1$
$V_3(Pan) = max\{(0.6)(4 + (0.5)7.6) + (0.4)(2 + (0.5)7.6), (0.4)(4 + (0.5)7.6) + (0.6)(2 + (0.5)7.6), (0.75)(10 + (0.5)6.2) + (0.25)(-50)\} = 7$
$V_3(Mes) = max\{(0.4)(0 + (0.5)6.2) + (0.6)(10 + (0.5)6.2), (0.6)(0 + (0.5)6.2) + (0.4)(10 + (0.5)6.2), (0.75)(2 + (0.5)7.6) + (0.25)(-50)\} = 9.1$
$V_3(Amb) = 0$
$V_3(Kap) = 0$

At iteration 4:
$V_4(Dorm) = max\{(0.4)(4+(0.5)9.1)+(0.6)(2+(0.5)9.1), (0.6)(4+(0.5)9.1)+(0.4)(2+(0.5)9.1), (0.75)(0+(0.5)7)+(0.25)(-50+0)\} = 7.75$
$V_4(Lav) = max\{(0.4)(0+(0.5)7)+(0.6)(10+(0.5)7), (0.6)(0+(0.5)7)+(0.4)(10+(0.5)7), (0.75)(4+(0.5)9.1)+(0.25)(-50+0) \ = 9.5$
$V_4(Pan) = max\{(0.6)(4+(0.5)9.1)+(0.4)(2+(0.5)9.1), (0.4)(4+(0.5)9.1)+(0.6)(2+(0.5)9.1), (0.75)(10+(0.5)7)+(0.25)(-50)\} = 7.75$
$V_4(Mes) = max\{(0.4)(0+(0.5)7)+(0.6)(10+(0.5)7), (0.6)(0+(0.5)7)+(0.4)(10+(0.5)7), (0.75)(2+(0.5)9.1)+(0.25)(-50)\} = 9.5$
$V_4(Amb) = 0$
$V_4(Kap) = 0$

At iteration 5:
$V_5(Dorm) = max\{(0.4)(4+(0.5)9.5)+(0.6)(2+(0.5)9.5), (0.6)(4+(0.5)9.5)+(0.4)(2+(0.5)9.5), (0.75)(0+(0.5)7.75)+(0.25)(-50+0)\} = 7.95$
$V_5(Lav) = max\{(0.4)(0+(0.5)7.75)+(0.6)(10+(0.5)7.75), (0.6)(0+(0.5)7.75)+(0.4)(10+(0.5)7.75), (0.75)(4+(0.5)9.5)+(0.25)(-50+0) \ = 9.875$
$V_5(Pan) = max\{(0.6)(4+(0.5)9.5)+(0.4)(2+(0.5)9.5), (0.4)(4+(0.5)7.75)+(0.6)(2+(0.5)7.75), (0.75)(10+(0.5)9.5)+(0.25)(-50)\} = 7.95$
$V_5(Mes) = max\{(0.4)(0+(0.5)7.75)+(0.6)(10+(0.5)7.75), (0.6)(0+(0.5)7.75)+(0.4)(10+(0.5)7.75), (0.75)(2+(0.5)9.5)+(0.25)(-50)\} = 9.875$
$V_5(Amb) = 0$
$V_5(Kap) = 0$

At iteration 6:
$V_6(Dorm) = max\{(0.4)(4+(0.5)9.875)+(0.6)(2+(0.5)9.875), (0.6)(4+(0.5)9.875)+(0.4)(2+(0.5)9.875), (0.75)(0+(0.5)7.95)+(0.25)(-50+0)\} = 8.1375$
$V_6(Lav) = max\{(0.4)(0+(0.5)7.95)+(0.6)(10+(0.5)7.95), (0.6)(0+(0.5)7.95)+(0.4)(10+(0.5)7.95), (0.75)(4+(0.5)9.875)+(0.25)(-50+0) \ = 9.975$
$V_6(Pan) = max\{(0.6)(4+(0.5)9.875)+(0.4)(2+(0.5)9.875), (0.4)(4+(0.5)9.875)+(0.6)(2+(0.5)9.875), (0.75)(10+(0.5)7.95)+(0.25)(-50)\} = 8.1372$
$V_6(Mes) = max\{(0.4)(0+(0.5)7.95)+(0.6)(10+(0.5)7.95), (0.6)(0+(0.5)7.95)+(0.4)(10+(0.5)7.95), (0.75)(2+(0.5)9.875)+(0.25)(-50)\} = 9.975$
$V_6(Amb) = 0$
$V_6(Kap) = 0$

(c) Based on the analysis, the optimal policy for each state is:
Dormitory Y
Lavatory X
Pantry X
Mess Hall Y
Ambushed *
Kaput *