

Feedback — Problem Set 2

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You submitted this homework on **Fri 18 Jan 2013 11:23 AM PST**. You got a score of **4.00** out of **5.00**.

Question 1

Mixed Strategy Nash Equilibrium

1 \ 2	Left	Right
Left	4,2	5,1
Right	6,0	3,3

Find a mixed strategy Nash equilibrium where player 1 randomizes over the pure strategy Left and Right with probability p for Left. What is p ?

Your Answer

Score

Explanation

☐ a) 1/4

☒ b) 3/4



1.00

☐ c) 1/2

☐ d) 2/3

Total

1.00 / 1.00

Question Explanation

(b) is true.

- In a mixed strategy equilibrium in this game both players must mix and so 2 must be indifferent between Left and Right.
- Left gives 2 an expected payoff: $2p + 0(1 - p)$
- Right gives 2 an expected payoff: $1p + 3(1 - p)$
- Setting these two payoffs to be equal leads to $p = 3/4$.

Question 2

Comparative Statics

1 \ 2	Left	Right
Left	$x, 2$	$0, 0$
Right	$0, 0$	$2, 2$

In a mixed strategy Nash equilibrium where player 1 plays Left with probability p and player 2 plays Left with probability q . How do p and q change as X is increased ($X > 1$)?

Your Answer

- ☒ a) p is the same, q decreases.
- ☐ b) p increases, q increases.
- ☐ c) p decreases, q decreases.
- ☐ d) p is the same, q increases.



Score

1.00

Explanation

Total

1.00 / 1.00

Question Explanation

(a) is true.

- In a mixed strategy equilibrium, 1 and 2 are each indifferent between Left and Right.
- For p :
 - Left gives 2 an expected payoff: $2p$
 - Right gives 2 an expected payoff: $2(1 - p)$
 - These two payoffs are equal, thus we have $p = 1/2$.
- For q : setting the Left expected payoff equal to the Right leads to $Xq = 2(1 - q)$, thus $q = 2/(X + 2)$, which decreases in X .

Question 3

Employment

- There are 2 firms, each advertising an available job opening.
- Firms offer different wages: $w_1 = 4$ and $w_2 = 6$.
- There are two unemployed workers looking for jobs. They simultaneously apply to either of the firms.
 - If only one worker applies to a firm, then he/she gets the job
 - If both workers apply to the same firm, the firm hires a worker at random and the other worker remains unemployed (and receives a payoff of 0).

Find a mixed strategy Nash Equilibrium where p is the probability that worker 1 applies to firm 1 and q is the probability that worker 2 applies to firm 1.

Your Answer	Score	Explanation
<input checked="" type="radio"/> a) $p = q = 1/2$;	✗ 0.00	
<input type="radio"/> b) $p = q = 1/3$;		
<input type="radio"/> c) $p = q = 1/4$;		
<input type="radio"/> d) $p = q = 1/5$.		
Total	0.00 / 1.00	

Question Explanation

(d) is correct.

- In a mixed strategy equilibrium, worker 1 and 2 must be indifferent between applying to firm 1 and 2.
- For a given p , worker 2's indifference condition is given by $2p + 4(1 - p) = 6p + 3(1 - p)$.
- Similarly, for a given q , worker 1's indifference condition is given by $2q + 4(1 - q) = 6q + 3(1 - q)$.
- Both conditions are satisfied when $p = q = 1/5$.

Question 4**Treasure**

- A king is deciding where to hide his treasure, while a pirate is deciding where to look for the treasure.
- The payoff to the king from successfully hiding the treasure is 5 and from having it found is 2.
- The payoff to the pirate from finding the treasure is 9 and from not finding it is 4.
- The king can hide it in location X, Y or Z.

Suppose the pirate has two pure strategies: inspect both X and Y (they are close together), or just inspect Z (it is far away). Find a mixed strategy Nash equilibrium where p is the probability the treasure is hidden in X or Y and $1 - p$ that it is hidden in Z (treat the king as having two strategies) and q is the probability that the pirate inspects X and Y:

Your Answer		Score	Explanation
<input checked="" type="radio"/> a) $p = 1/2, q = 1/2$;	✓	1.00	
<input type="radio"/> b) $p = 4/9, q = 2/5$;			
<input type="radio"/> c) $p = 5/9, q = 3/5$;			
<input type="radio"/> d) $p = 2/5, q = 4/9$;			
Total		1.00 / 1.00	

Question Explanation

(a) is true.

- There is no pure strategy equilibrium, so in a mixed strategy equilibrium, both players are indifferent among their strategies.
- For p :
 - Inspecting $X \setminus Y$ gives pirate a payoff: $9p + 4(1 - p)$
 - Inspecting Z gives pirate a payoff: $4p + 9(1 - p)$
 - These two payoffs are equal, thus we have $p = 1/2$.
- For q : indifference for the king requires that $5q + 2(1 - q) = 2q + 5(1 - q)$, thus $q = 1/2$.

Question 5**Treasure**

- A king is deciding where to hide his treasure, while a pirate is deciding where to look for the treasure.
- The payoff to the king from successfully hiding the treasure is 5 and from having it found is 2.
- The payoff to the pirate from finding the treasure is 9 and from not finding it is 4.
- The king can hide it in location X , Y or Z .

Suppose instead that the pirate can investigate any two locations, so has three pure strategies: inspect XY or YZ or XZ . Find a mixed strategy Nash equilibrium where the king mixes over three locations (X , Y , Z) and the pirate mixes over (XY , YZ , XZ). The following probabilities (king), (pirate) form an equilibrium:

Your Answer	Score	Explanation
<input type="radio"/> a) $(1/3, 1/3, 1/3), (4/9, 4/9, 1/9);$		
<input type="radio"/> b) $(4/9, 4/9, 1/9), (1/3, 1/3, 1/3);$		
<input type="radio"/> c) $(1/3, 1/3, 1/3), (2/5, 2/5, 1/5);$		
<input checked="" type="radio"/> d) $(1/3, 1/3, 1/3), (1/3, 1/3, 1/3);$	1.00	✓

Total

1.00 / 1.00

Question Explanation

(d) is true.

- Check (a):
 - Pirate inspects (XY, YZ, XZ) with prob $(4/9, 4/9, 1/9)$;
 - Y is inspected with prob $8/9$ while X (or Z) is inspected with prob $5/9$;
 - King prefers to hide in X or Z, which contradicts the fact that in a mixed strategy equilibrium, king should be indifferent.
- Similarly, you can verify that (b) and (c) are not equilibria in the same way.
- In (d), every place is chosen by king and inspected by pirate with equal probability and they are indifferent between all strategies.