ECON 4673 ASSIGNMENT #2
ALBERT LOCKETT. 3254354
k44if@unb.ca

PROBLEM #1

(PG 40, PROBLEM #2)

a)

1 \ 2	X	Y
H	z, u_{2i}	z, u_{2iii}
L	$0, u_{2ii}$	$10, u_{2iv}$

b) $U_1(H, \Theta_2) = \frac{1}{2}z + \frac{1}{2}z = \underline{z}$, $\Theta_2 = (\frac{1}{2}, \frac{1}{2})$

$U_2(L, \Theta_2) = \frac{1}{2}(0) + \frac{1}{2}(10) = \underline{5}$

PLAYER 1 WOULD BE INDIFFERENT BETWEEN PLAYING H & L IF THE VALUE FOR $\underline{z = 5}$.

c) $U_1(L, \Theta_2) = \frac{1}{3}(0) + \frac{1}{3}(10) = \frac{10}{3} = \underline{3.\overline{3}}$, $\Theta_2 = (\frac{1}{3}, \frac{1}{3})$

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K44IF@UNB.CA

PROBLEM #2
(PG 63, PROB. #4)

a) $BR_1(\theta_2), \theta_2 = (1/6, 1/3, 1/2) = \{U\}$

b) $BR_2(\theta_1), \theta_1 = (1/6, 1/3, 1/2) = \{R\}$

c) $BR_1(\theta_2), \theta_2 = (1/4, 1/8, 5/8) = \{U\}$

d) $BR_1(\theta_2), \theta_2 = (1/3, 1/3, 1/3) = \{R\}$

e) $BR_2(\theta_1), \theta_1 = (1/2, 1/2, \emptyset) = \{L, R\}$

1 \ 2	L	C	R
U	2,6	∅,4	4,4
M	3,3	∅,∅	1,5
D	1,1	3,5	2,3

CALCULATIONS DONE USING COMPUTER.
(CODE ATTACHED)

ECON 4673, ASS#2
ALBERT LOCKETT, 3254354
k44sf@unb.ca

(CALCULATIONS FOR PROBLEM #2)

```
const game = {
  U: { L: [2, 6], C: [0, 4], R: [4, 4] },
  M: { L: [3, 3], C: [0, 0], R: [1, 5] },
  D: { L: [1, 1], C: [3, 5], R: [2, 3] },
}

const questionParts = {
  a: { player: 1, strategy: [ 1/6, 1/3, 1/2 ] },
  b: { player: 2, strategy: [ 1/6, 1/3, 1/2 ] },
  c: { player: 1, strategy: [ 1/4, 1/8, 5/2 ] },
  d: { player: 2, strategy: [ 1/3, 1/3, 1/3 ] },
  e: { player: 2, strategy: [ 1/2, 1/2, 0/1 ] },
}

function bestResponse({ game, strategy, player }) {
  let maxPayoff = -99999, brSet = []
  function updateBR({ payoff, s }) {
    if (payoff === maxPayoff) brSet.push(s)
    if (payoff > maxPayoff) { maxPayoff = payoff; brSet = [s] }
  }

  // eslint-disable-next-line default-case
  switch (player) {
    case 1:
      for (const s of ['U', 'M', 'D']) {
        const payoff =
          game[s].L[0] * strategy[0] +
          game[s].C[0] * strategy[1] +
          game[s].R[0] * strategy[2]
        updateBR({ payoff, s })

      }
      break
    case 2:
      for (const s of ['L', 'C', 'R']) {
        const payoff =
          game.U[s][1] * strategy[0] +
          game.M[s][1] * strategy[1] +
          game.D[s][1] * strategy[2]
        updateBR({ payoff, s })
      }
      break
  }
  return brSet
}

for (const letter of Object.keys(questionParts)) {
  const br = bestResponse({ game, ...questionParts[letter] })
  console.log(`${letter}) {${br.join(',')}}`)
}

/*
 * output:
 * a) {U}
 * b) {R}
 * c) {U}
 * d) {R}
 * e) {L,R}
 */
```

PG 3/9

PROBLEM #3
(PG 109, #7)

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ALBERT LOCKETT 3254354
KH4IF@UNB.CA

1 \ 2	X	Y	Z
A	2, 0	1, 3	5, x
B	5, 4	1, 3	6, 2

$\theta_1 = (\frac{1}{2}, \frac{1}{2})$

FOR $BR_2(\theta_1) = \{Y\}$, $U_2(\theta_1, Y) > U_2(\theta_1, Y')$, $Y' \in \{X, Z\}$

$U_2(\theta_1, Y) = \frac{1}{2}(3) + \frac{1}{2}(3) = 3$

$U_2(\theta_1, X) = \frac{1}{2}(0) + \frac{1}{2}(4) = 2 < U_2(\theta_1, Y)$ ← Good!

$U_2(\theta_1, Z) = \frac{1}{2}x + \frac{1}{2}(2) = \frac{x+1}{2} < U_2(\theta_1, Y)$

$$\frac{x+1}{2} < 3 \Rightarrow \underline{x < 5}$$

$\{Y\}$ WILL BE $BR_2(\theta_1)$ WHEN $x < 5$

PROBLEM # 4

(PG 141 #4)

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ALBERT LOCKETT
3254354
K441F@UNB.CA

GAME 1

1 \ 2	A	B
A	2,4	Ø,Ø
B	1,6	3,7

USE PROBABILITES

$P(S_1 = A) = p$ $P(S_2 = A) = q$

$P(S_1 = B) = 1-p$ $P(S_2 = B) = 1-q$

$\emptyset \leq p \leq 1$ $\emptyset \leq q \leq 1$

$$U_1(\sigma_1, \sigma_2) = 2pq + 1(1-p)q + 3(1-p)(1-q)$$
$$= 2pq - 2q - 3p + 3$$

$$\frac{\partial U_1(\sigma_1,\sigma_2)}{\partial p} = 2q - 3 > \emptyset \Rightarrow q > \tfrac{3}{2}$$

player 1's payoff is decreasing with p unless $q > \frac{3}{2}$ which is outside the allowed domain for q. Player 1's best response for all q is $p = \emptyset$.

$$U_2(\sigma_1, \sigma_2) = 4pq + 6(1-p)q + 7(1-p)(1-q)$$
$$= 5pq - 7p - q + 7$$

$$\frac{\partial U_2(\sigma_1,\sigma_2)}{\partial q} = 5p - 1 > \emptyset \Rightarrow p > \tfrac{1}{5}$$

player ~~1~~ 2's payoff is increasing w/ p when $p > 1/5$, so player 2's best response is to play? ~~q = Ø~~

$$BR_2(\sigma_1) = \begin{cases} q = 1, & p > 1/5 \\ q = 0, & p < 1/5 \\ 0 < q < 1, & p = 1/5 \end{cases}$$

we alredy found Player 1's $BR_1(\sigma_2)$: $p = \emptyset$

$\boxed{\therefore \text{ Mixed Strategy Nash EQ} = p = \emptyset, q = \emptyset}$

PROBLEM 4 (PG 141, # 4)

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ALBERT LOCKETT
3254354

GAME #2:

1 \ 2	L	MR	R
U	8,3	3,5	6,3
C	3,3	5,5	4,8
D	5,2	3,7	4,9

$\rightarrow$

1 \ 2	M	R
U	3,5	6,3
C	5,5	4,8
~~D~~	~~3,7~~	~~4,9~~

$\rightarrow$

1 \ 2	M	R
U	3,5	6,3
C	5,5	4,8

- Player 2's Strategy L is strictly dominated by pure strategy M.
- Player 1's strategy D is strictly dominated by a mixed strategy σ_1 of $P(s_1 = U) = 0.5$, $P(s_1 = C) = 0.5$

$U(\sigma_1, M) = 0.5(3) + 0.5(5) = 4 > U(D, M) = 3$

$U(\sigma_1, R) = 0.5(6) + 0.5(4) = 5 > U(D, R) = 4$

Repeat Same procedure from Game #1 to find equillibrium

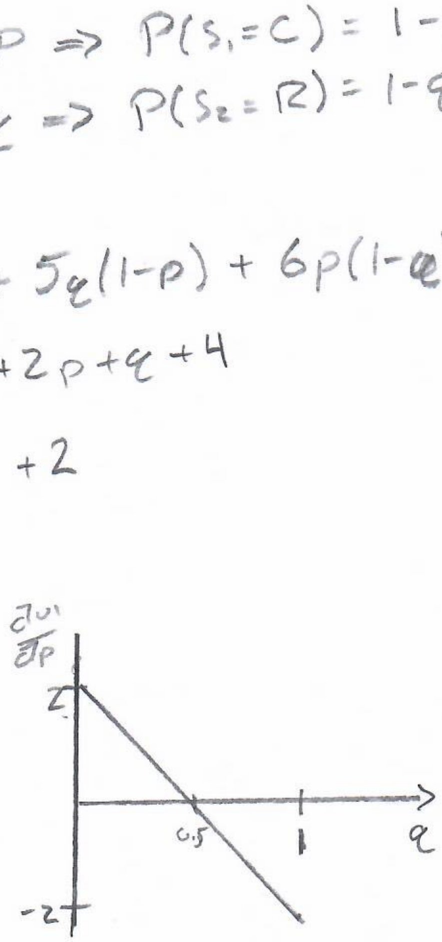
$P(s_1 = U) = p \Rightarrow P(s_1 = C) = 1-p$

$P(s_2 = M) = q \Rightarrow P(s_2 = R) = 1-q$

$U_1 = 3pq + 5q(1-p) + 6p(1-q) + 4(1-q)(1-p)$

$= -4pq + 2p + q + 4$

$\frac{\partial u_1}{\partial p} = -4q + 2$



player 1 best Response.

$$BR_1(\sigma_2) = \begin{cases} p = 1, & q < 0.5 \\ 0 < p < 1 & q = 0.5 \\ p = 0, & q > 0.5 \end{cases}$$

Solution Continue next page...

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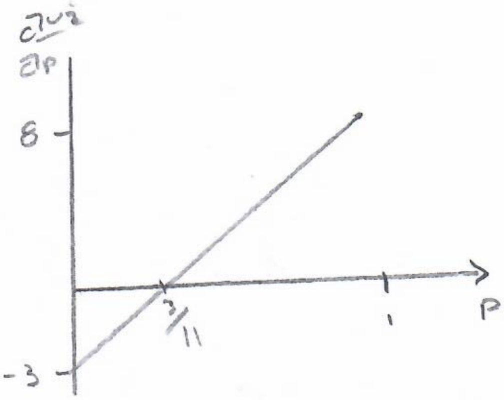
ALBERT LOCKETT
3254354, KHHIF@UNB.CA

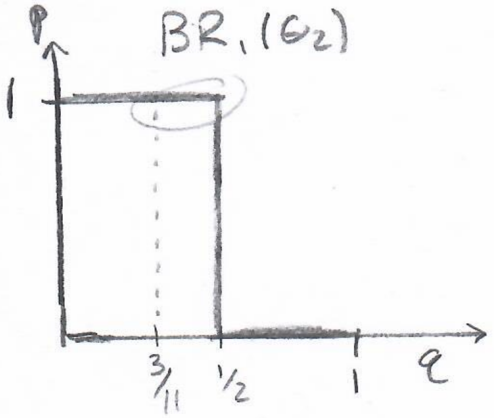
PROBLEM 4 pg 141
GAME #2 continued..

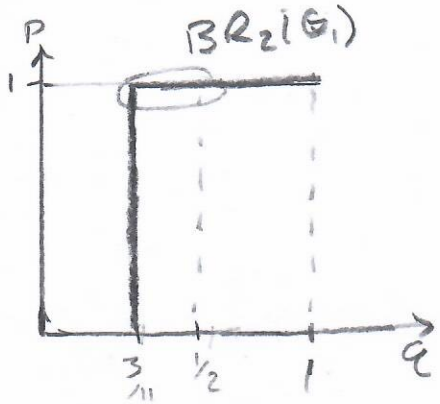
$$U_2 = 5pq + 5q(1-p) + 3p(1-q) + 8(1-p)(1-q)$$
$$= 11pq - 8p - 3q + 3$$

$$\frac{\partial U_2}{\partial q} = 11p - 3$$

$$BR_2(G_1) = \begin{cases} q = 1, & p > 3/11 \\ 0 < q < 1, & p = 3/11 \\ q = 0, & p < 3/11 \end{cases}$$







The mixed Strategy Equillibrium

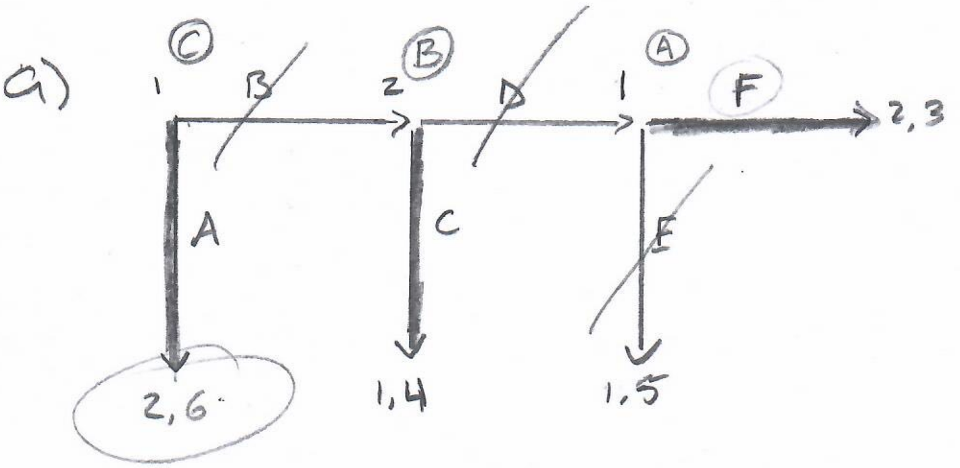
$p = 1$

$3/11 < q < 0.5$

PROBLEM 5
(PG 199, EX 1)

ECON 4673, ASS# 2
ALBERT LOCKE II
3254354 K44IF@UNB.CA

a)



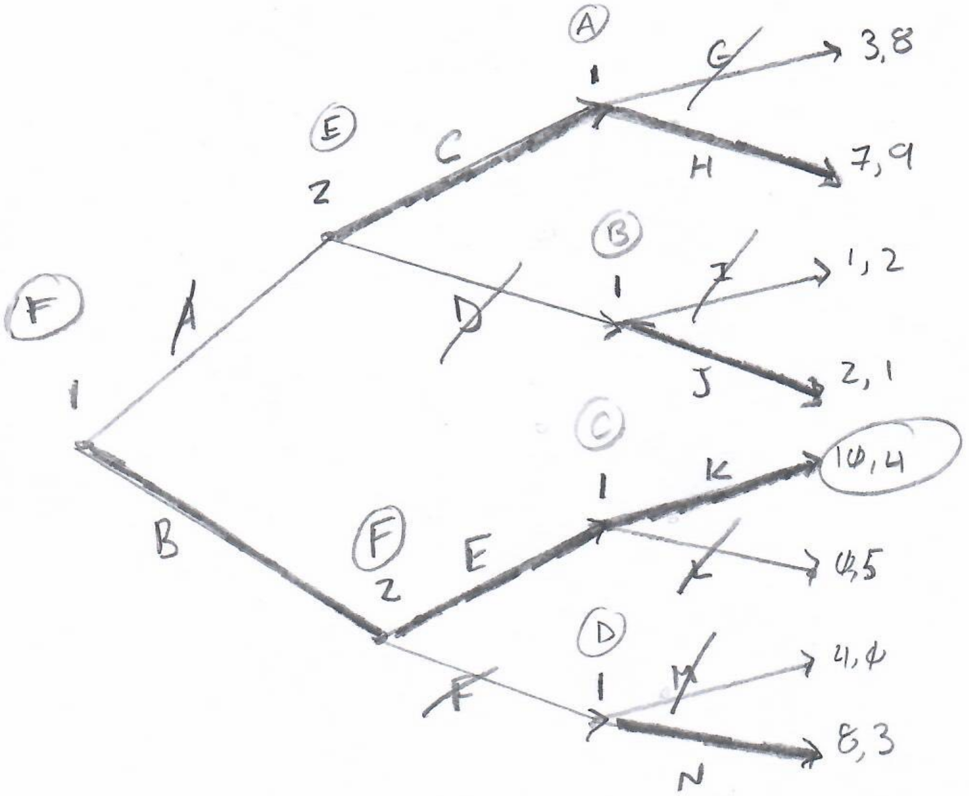
A - at node A, player 1's strategy F yeilds higher payoff

B - at node B, Player 2's strategy C yeids a higher payoff (4 > 3)

C - at node C, player 1's strategy A yeilds higher payoff

The equillibrium will be ACF.

b)



PROB #5 (pg page 1)

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ALBERT LOCKETT
3254354, K44?F@UNB.CA

b continued)

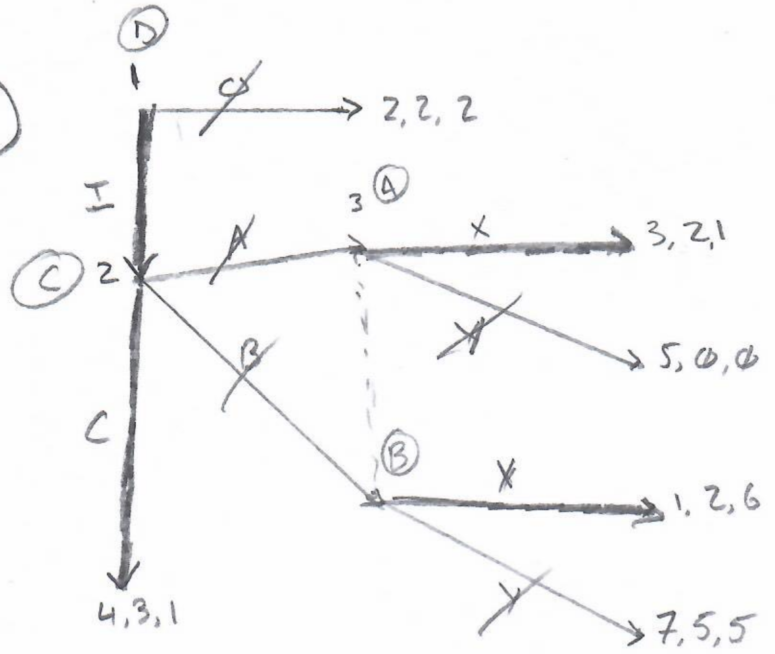
Node (A) BR_1 = H
Node (B) BR_1 = J
Node (C) BR_1 = K
Node (D) BR_1 = N

Node (E), BR_2 = C
Node (F), BR_2 = E

Node (G), BR_1 = B

The equillibrium will be BEK

c)



Node (A), BR_3 = X
Node (B), BR_3 = X
Node (C), BR_2 = C

Node (D), BR_1 = I

The equillibrium is ICX.