		q	$1-q$
		mp	mm
p	RR	$\frac{1-k}{4}, \frac{k-1}{4}$	$0, 0$
$1-p$	RS	$0, 0$	$\frac{k}{4}, -\frac{k}{4}$

$$E_1(\pi(rr)) = E_1(\pi(RS))$$

$$\frac{1-k}{4} \cdot q = \frac{k}{4} \cdot (1-q$$

$$q - kq = k - kq \Rightarrow q = k$$

$$E_2(\pi(mp)) = E_2(\pi(mm))$$

$$\frac{k-1}{4} \cdot p = -\frac{k}{4}(1-p) \Rightarrow p = k$$

$$mx\,AE = ((\underbrace{k, 1-k, 0, 0}_{s_1}) (\underbrace{0, k, 0, 1-k}_{s_2}))$$

4 4

320.1

	pp	mp	pm	mm
R, R	$1, -1$	$\frac{1-k}{4}, \frac{1-k}{4}$	$\frac{3+k}{4}, \frac{-3-k}{4}$	$0, 0$
R, S	$\frac{1}{4}, -\frac{1}{4}$	$0, 0$	$\frac{1+k}{4}, \frac{1-k}{4}$	$\frac{k}{4}, -\frac{k}{4}$
~~S, R~~	~~$\frac{3}{4}, -\frac{3}{4}$~~	~~$\frac{1-k}{4}, \frac{1-k}{4}$~~	~~$\frac{1}{2}, \frac{1}{2}$~~	~~$-\frac{k}{4}, \frac{k}{4}$~~
S, S	~~$0, 0$~~	~~$0, 0$~~	~~$0, 0$~~	~~$0, 0$~~ ← nooit gespeeld

- $0 < k < 1$
- $k > 1$

NE

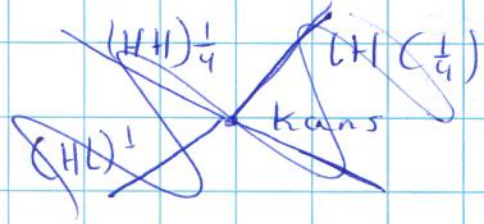
$$SR, mP = \frac{1}{4}(H, H) \Rightarrow 0, 0 \quad (S, m)$$
$$\frac{1}{4}(HL) \Rightarrow 1, -1 \quad (S, P)$$
$$\frac{1}{4}(LH) \Rightarrow -1-k, 1+k \quad (R, m)$$
$$\frac{1}{4}(LL) \Rightarrow 1, -1 \quad (R, P$$

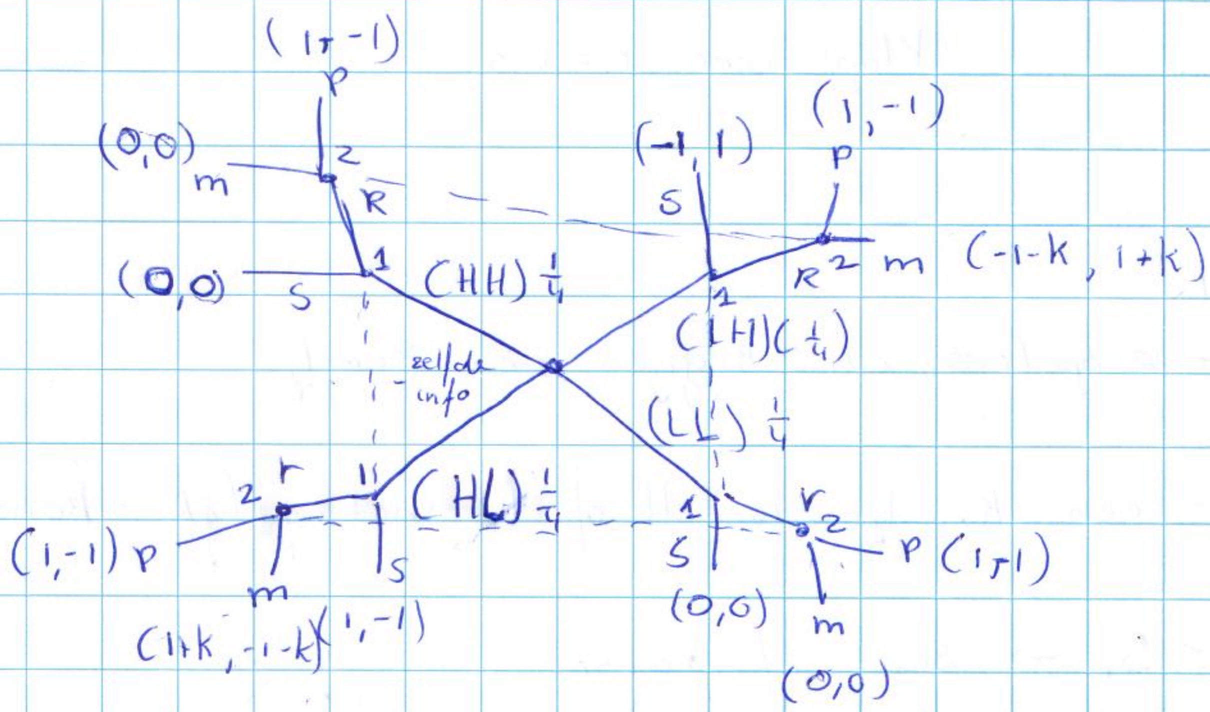
$$\frac{1-k}{4}, \frac{-1+k}{4}$$

$0 < k < 1$

① strikt gedomineerde strategieën vinden
- SS wordt strikt gedom door $\frac{1}{2}(R,R) + \frac{1}{2}(RS)$
- PP " door mp
- Pm door mp

② Zwak gedom strategie
- SR ⇒ SR wordt met een positieve kans gespeeld alleen als S_2 mp kiest
  ⇒ stel S_2 mp kiest $Br_1 = p \cdot (RR) + (1-p) \cdot (SR)$
  is mp best keus? nee mm ⇒ geen mixN E
  waar S_2 SR kiest





31.2 S_1 : SS, SR, RS, SS

S_1 kiest S als 'H' en R als 'L'

S_2 : PP, PM, MP, MM

$6r(1-2R)=0$

$r=0$ of $r=\frac{1}{2}$

∇ oc = 2^e afgeleide ≤ 0 $\Rightarrow$

$6-24r \leq 0$

Klopt voor $r=0.5$

316. 1

- 2 spelers, elk krijgen een kaartje

- een kaartje is H of L met gelijke kansen

- S_1 $\rightarrow$ See of raise

$\downarrow$ kaarten vergelijken

$\searrow$ extra bedrag K in de pot

$\downarrow$

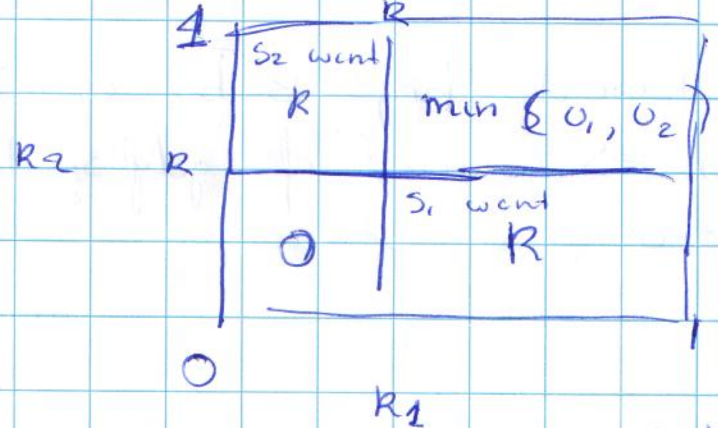
- S_2 $\rightarrow$ Pass of meet

$\downarrow$ eigen kaartje weg S_1 wint

$\searrow$ extra bedrag K betalen, kaarten vergelyken b $b_1 = v_1$

$b_2 = v_2$

$r^* = ?$ Welke r maximaliseert de verwachte prijs



$\cancel{P(v \geq R)}$.

P $\Uparrow$ *

$E(r) = 0 \cdot \text{kans} + R \cdot P(v_1 \geq r \text{ en } v_2 \leq r) +$
$r \cdot P(v_2 \geq r \text{ en } v_1 \leq r)^{*} + E(\min\{v_1, v_2\}^{***}$
$| v_1 \geq R \text{ en } v_2 \geq R) \cdot P(v_1 \geq r \text{ en } v_2 \geq R)$ ** $\}$

* $P(v_1 \geq R) \cdot P(v_2 \leq R)$

$\Downarrow$

$1 - F(r) \cdot F(r) = (1-R)R$ uniforme verdeling

** $(1-R)^2$

*** $R + \frac{1}{3}(1-R)$

$E(R) = 2v^2(1-R) + (1-R)^2 \cdot (r + \frac{1}{3}(1-R)) \Rightarrow$
$\frac{1}{3}(1 + 3r^2 - 4R^3) \Rightarrow \max R$

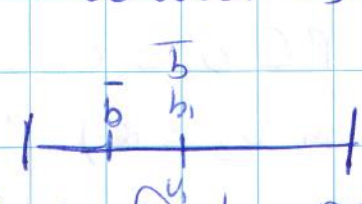
FOC $= \frac{dE}{dr} = 0 = 6r - 12R^2 = 0$

① $b_1 > v_1$

i) $\bar{b} < v_1 \Rightarrow 1$ wint, b_1 is de prys
- Onder $b_1 = v_1 \Rightarrow$ niks veranderd

ii) $\bar{b} = v_1 \Rightarrow 1$ wint, prys is $\bar{b} = v_1 \Rightarrow 0$
- Onder $b_1 = v_1 \Rightarrow 1$ wint of gelykspel
prys is $v_1 \Rightarrow 0$

iii) $v_1 < \bar{b} < b_1 \Rightarrow 1$ wint maar $R > v_1 \Rightarrow$
negatieve uitbetaling
- Onder $b_1 = v_1$ 1 verliest $\rightarrow$ krygt 0



~~② $b_1 = v_1$~~
~~i) $\bar{b} < v_1$ speler 1 wint prys $\bar{b}$~~
~~ii) $\bar{b} = v_1$ spe~~

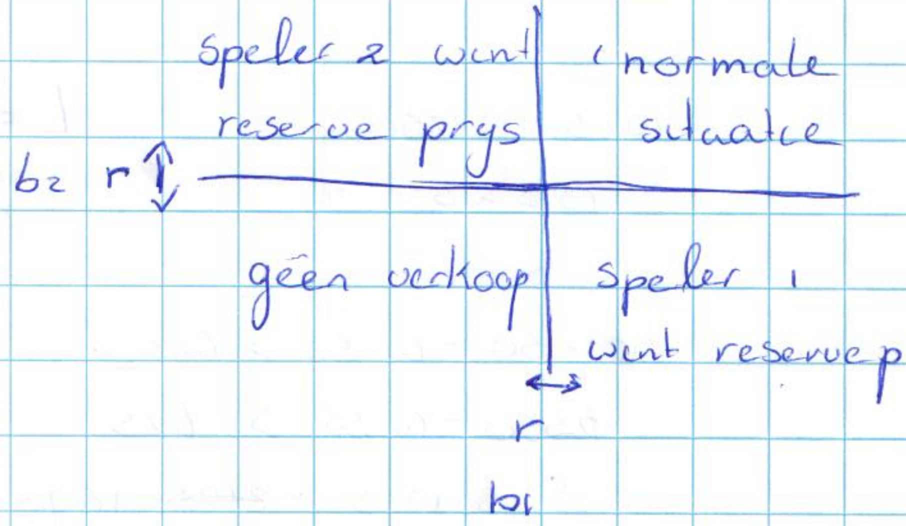
iv) $\bar{b} > v_1 \Rightarrow$ speler 2 wint, payoff $1 = 0$
Onder $b_1 = v_1 \Rightarrow$ speler 2 wint payoff $1 = 0$

Dus in iii is het beter om sowieso $b_1 = v_1$ te kiezen.
Dus $b_1 = v_1$ is weakly dominanted

Werkcollege B week 3

310. 2

- 2 bieders
- $v_i \sim U[0,1]$
- reserveprijs r



① $b_i = v_i$ is een zwak dominate strategie

② Optimale r vinden (dat E_p maximaliseert)

verwachte prijs

Laten zien : $b_i =$

wat is zwak dominant onafhankel van wat an doen
deze strategie is net zo goed

Wanneer wint Speler 1 $b_1 \geq b_2$
$b_1 \geq R$

$$b_1 \geq \underbrace{\max\{b_2, v\}}_{\bar{b}}$$

c $\quad \Pi_u = \omega \cdot l \Rightarrow 50 \cdot 25 = 1250$

$\Pi_F = 25 \cdot 75 - 1250 = 625 \Rightarrow l(100-l) - \omega l$

$\omega \cdot L > 1250$

$L(100-L) \cdot \omega l > 625$

$\omega \cdot 50 > 1250 \qquad L = 50$

$\omega > 25$

$50 \cdot 50 - \omega \cdot 50 > 625$

$2500 - \omega \cdot 50 > 625$

$-50\omega > -\cancel{3125}\ 1875$

$\omega < \cancel{62,5}\ 37.5$

$L = 50 \qquad 25 < \omega < 37,5$

d $\quad L = \frac{1}{2} \cdot (100 - \omega) \qquad \omega = 0$

$\Rightarrow l = 50$

177.1

a Players : Firm , Union (U)

Th : (ω, yes, L) (ω, nee)

playerfunction: $P(\emptyset) = U$ $P(\omega) = \text{Firm}$

$P(\omega, \text{yes}) = \text{Firm}$

preferences: $F = \pi$ $U = \omega L$

b $\pi = L(100 - L) - \omega L$

$\Rightarrow 100L - L^2 - \omega L$

$\pi' = L - 2L - \omega = 0$

$\Rightarrow L = \frac{1}{2}(100 - \omega)$

$L = 50 - \frac{1}{2}\omega > 0$

$\omega < 100 \Rightarrow \text{yes}$

$\omega \geq 100 \Rightarrow \text{nee}$

yes ($L = 0$)

$\pi_u = \omega \cdot L$

$= \omega \cdot \frac{1}{2}(100 - \omega)$

$\Rightarrow 50\omega - \frac{1}{2}\omega^2$

$\pi_u' = 50 - \omega = 0 \Rightarrow$

$\omega = 50$

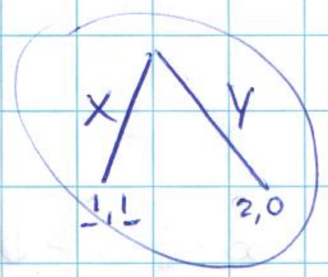
$L = \frac{1}{2} \cdot (100 - 50) = 25$

		yxx	yxy	yzx	yzy	zxx	zxy	zxx	zzy
P1	X	0,2	0,2	0,2	0,2	1,1	1,1	1,1	1,1
	Y	0,2	0,2	2,0	2,0	0,2	0,2	2,0	2,0
	Z	1,0	2,0	1,0	2,0	1,1	2,0	1,1	2,0

3

173,4

a



← sub game

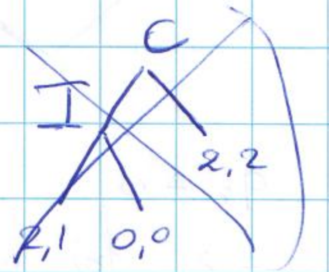
P2 kiest x (yxx)
P1 kiest z

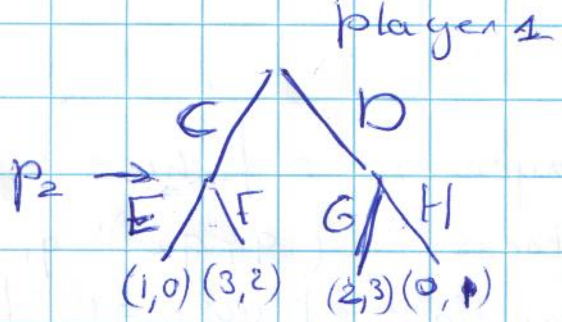
(z, yxx)

b $P_2 = y > x > z$

Werkcollege B week 2

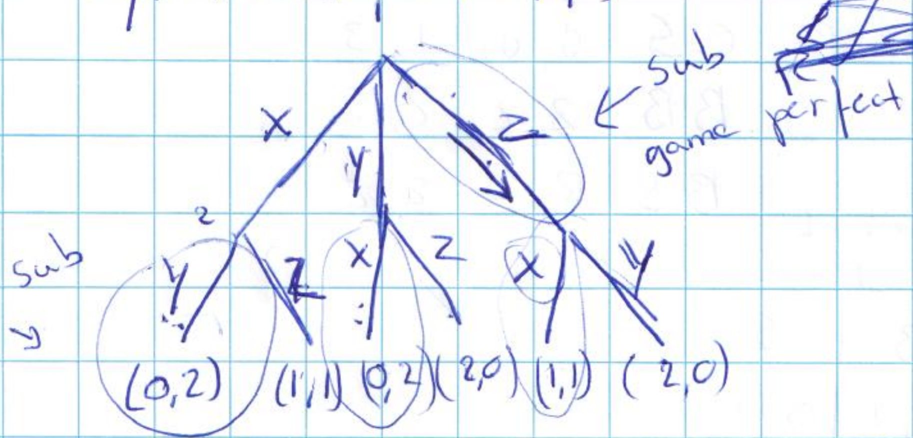
156.2





Players : 2 players
Terminal history : (C, E, G) (C, F) (C, E, H) D
player function : $P(\emptyset) = 1$ $P = (C) = 2$ $P = (C, E) = 1$
preferens : $p1 = (C,F) > D > (C,E,G) > (C,E,H)$
$p2 = (C,E,G) > (C,F) > (C,E,H) = D$

P : 2 people
TH : (x,y) (x,z) (y,x)
(y,z) (z,x) (z,y)



$P_1 : x > y > z$
$P_2 : z > y > x$

$P(x) = P(y) = P(z) = 2$

pf : $P = (\emptyset) = 1$ ~~[illegible]~~

preferens : $P_1 : x > y > z$
$P_2 : z > y > x$

Stackelberg model

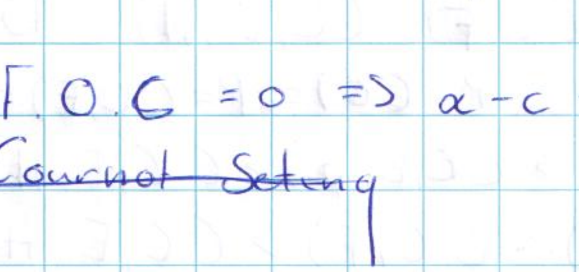
Player : 2 firms
historis : (q_1, q_2) $q_1 \geq 0$ $q_2 \geq 0$
P functio : $P(\emptyset) = 1$ $P(q_1) = 2$ for all q_1
Preference : $\pi_1 = q_1 \, Pd(q_1 + q_2) - C_2(q_1) =$
$q_1(a - c - q_1 - q_2)$

$F.O.C = 0 \Rightarrow a - c - q_1 - q_2 - q_2 = 0$

~~Cournot Seting~~

Player 1

$$\pi_1 = q_1(a - c - q_1 - (a - c - q_1)/2) = q_1(a - c - q_1)/2$$

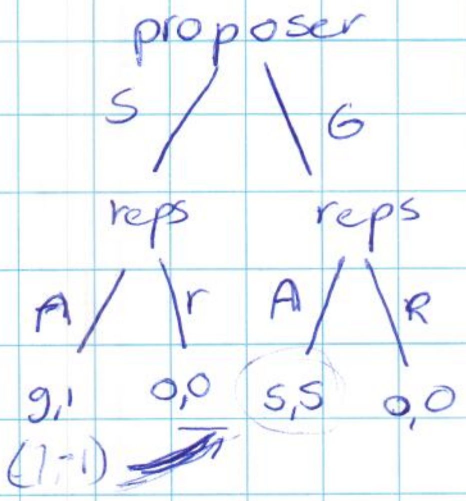


		p2	
		B	S
p2	CB	3, 1	0, 0
	CS	0, 0	1, 3
	BB	2, 2	2, 2
	BS	2, 2	2, 2

		p2	
		B	S
p1	B	3, 1	0, 0
	S	0, 0	1, 3

NE
1) [CB, B]
2 [BB, S]
3 [BS, S]

Hoor college B week 2



Strategies proposer: {S,G

Statregies resp {AA, AR, RA, RR

NE

↳ first letter choice after S
second " G

Strategie game that corresponds to extensive form

respon

prop	A,A	A,R	R,A	R,R
S	9,1	9,1	0,0	0,0
G	5,5	0,0	5,5	0,0

Nash E in pure strategie

NE
i, [S, AA]
ii [S, AR]
iii [G, RA]

Werkcollege week 1

27.1

	Q	~~F~~
Q	$2+2\alpha,\ 2+\alpha 2$	$3\alpha,\ 3$
F	$3,\ 3\alpha$	$1+\alpha,\ 1+\alpha$

Geen presoners dilemma

b $\quad 2+2\alpha = 3\cancel{\alpha}$

$\quad 2\alpha = \cancel{+\alpha}\ 1$

$\quad \alpha = 0.5$

by $\quad 0 \leq \alpha < 0{,}5 \quad$ is het een prisoners dilemma

33.1 $\quad 2 \leq k \leq n$

34.1

141.2

	R	P	S
R	0, 0	-1, 1	1, -1
P	1, -1	0, 0	-1, 1
S	-1, 1	1, -1	0, 0

$q_1 \quad q_2 \quad q_3 \quad = q_1 + q_2 + q_3 = 1$

$-q_2 + q_3 = c = 0$

$q_1 - q_3 = c = 0$

$-q_1 + q_2 = c = 0$

$q_1 = q_2 = q_3 = \frac{1}{3}$

$0 = 3c$

$0 = c$

N;E $(\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$ $(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}$

TB VS LM Kan niet

	L	M		R	
T	2, 2	0,3	p	1,3	1
B	3, 2	1, 1	$1-p$	0.2	0
	q	$1-q$			

$2p + 2 - 2p \geq 3p + 1-p \;\Big|\; \geq 3p + 2 - 2p$

$p = \frac{1}{2}$ $\qquad\qquad 1 - p \geq 2 - 2p$

$p \geq 1$

TB VS LR Kan niet

$\cancel{2p} + 2 - \cancel{2p} = 3p + 2 - 2p \geq 3p + 1-p$

$2 = 3p + 2 - 2p$

$2 = p + 2$

$0 = p$

TB VS MR Kan niet

$3p + 1 - p = 3p + 2 - 2p > 2p + 2 - 2p$

$p = 1$

TB VS LMR Kan niet

$2p + 2 - 2p = 3p + 1 - p = 3p + 2 - 2p$

$p = \frac{1}{2} \qquad p = 1$

which is higher than $\frac{2(1-\varepsilon)}{2-\varepsilon}$, because
$\varepsilon\delta$ is positive $\rightarrow$ $\varepsilon\delta > 0$

141.1 $\quad S_1 = T = S_2 = M$ of R

		L	M	R
1	T	2, 2	0, $\underline{3}$	$\underline{1}$, $\underline{3}$
0	B	$\underline{3}$, $\underline{2}$	$\underline{1}$, 1	0, $\underline{2}$
		0 / q	q / 0	1−q / 1−q

pure; als je ergens vol voor gaat

1) $(0,1)$ $(1,0,0)$ $\Big\rangle$ puur
2) $(1,0)$ $(0,0,1)$
3) $(1,0)$ $(0,q,1-q)$ als $q \leq \frac{1}{2}$
puur mix

$\pi = 1-q \geq q \Rightarrow$
$1 \geq 2q \Rightarrow$
$\frac{1}{2} \geq q$

0	T
1	B

$q \geq 1-q$ $\qquad 3q \geq 2q + 1 - q$
$2q \geq 1$ $\qquad 2q \geq 1$
$q \geq \frac{1}{2}$ $\qquad q \geq \frac{1}{2}$

4) $(0,1)$ $(q,0,1-q)$ $q \geq \frac{1}{2}$

$$
\begin{array}{c|cc|c}
B & S & C & \\
\hline
S & 1,1 & 1-\varepsilon,\ 2-\delta & p \\
C & 2-\delta,\ 1-\varepsilon & -\delta,-\delta & 1-p \\
 & q & 1-q &
\end{array}
$$

$$q+(1-q)\cdot(1-\varepsilon) = (2-\delta)\,q + -\delta+\delta q$$
$$q+1-\varepsilon-q+\varepsilon q =$$
$$1-\varepsilon+\varepsilon q = 2q-\cancel{\delta q}\ \cancel{\varepsilon}-\delta+\cancel{\delta q}$$
$$1-\varepsilon+\varepsilon q = 2q\ \cancel{\varepsilon q}\ -\delta$$
$$1-\varepsilon+\delta = 2q-\varepsilon q$$
$$= q(2-\varepsilon)$$
$$\frac{1-\varepsilon+\delta}{2-\varepsilon} = q$$

$$p+(1-\varepsilon)\cdot(1-p) = 2p-\cancel{\delta p}-\delta+\cancel{\delta p}$$
$$\cancel{p}+1-\cancel{p}-\varepsilon+\varepsilon p = 2p-\delta$$
$$1-\varepsilon+\delta = 2p-\varepsilon p$$
$$= p(2-\varepsilon)$$
$$\frac{1-\varepsilon+\delta}{2-\varepsilon} = p$$

$$1-\frac{1-\varepsilon+\delta}{2-\varepsilon} =$$
$$\frac{2-\varepsilon}{2-\varepsilon}-\frac{1-\varepsilon+\delta}{2-\varepsilon} =$$

$$\Pi \Rightarrow 1\cdot\left(\frac{1-\varepsilon-\delta}{2-\varepsilon}\right)+(1-\varepsilon)\cdot\left(\frac{1-\varepsilon+\delta}{2-\varepsilon}\right)$$
$$\Rightarrow \frac{1-\varepsilon+\delta}{2-\varepsilon}+(1-\varepsilon)\left(\frac{2-\varepsilon}{2-\varepsilon}-\frac{1-\varepsilon+\delta}{2-\varepsilon}\right)$$
$$\Rightarrow \frac{1-\varepsilon-\delta}{2-\varepsilon}+(1-\varepsilon)\left(\frac{1-\delta}{2-\varepsilon}\right)$$
$$\Rightarrow \frac{1-\varepsilon-\delta}{2-\varepsilon}+\frac{1-\varepsilon-\delta+\varepsilon\delta}{2-\varepsilon} = \frac{2-2\varepsilon+\varepsilon\delta}{2-\varepsilon}$$

130. 2

		S	C	
A	S	$1, 1$	$\underline{1-\varepsilon}, \underline{2}$	$p = \frac{1-\varepsilon}{2-\varepsilon}$
	C	$\underline{2}, \underline{1-\varepsilon}$	$0, 0$	$1-p = \frac{1}{2-\varepsilon}$
		q	$1-q$	

$$1q + (1-\varepsilon)\cdot(1-q) \geq 2q$$
$$q + 1 - q - \varepsilon + \varepsilon q > 2q$$
$$1 - \varepsilon + \varepsilon q > 2q$$
$$1-\varepsilon > 2q - \varepsilon q$$
$$1-\varepsilon > q(2-\varepsilon)$$

$$\frac{1-\varepsilon}{2-\varepsilon} = q$$

$$1p + (1-\varepsilon)\cdot(1-p) > 2p$$

$$\cancel{1p} + 1 - \cancel{p} - \varepsilon + \varepsilon p > 2p$$
$$1 - \varepsilon + \varepsilon p > 2p$$
$$1-\varepsilon > 2p - \varepsilon p$$
$$1-\varepsilon > p(2-\varepsilon)$$
$$\frac{1-\varepsilon}{2-\varepsilon} > p$$

$$1 - \frac{1-\varepsilon}{2-\varepsilon} \Rightarrow$$
$$\frac{2-\varepsilon}{2-\varepsilon} - \frac{1-\varepsilon}{2-\varepsilon} = \frac{1}{2-\varepsilon} = 1-q$$

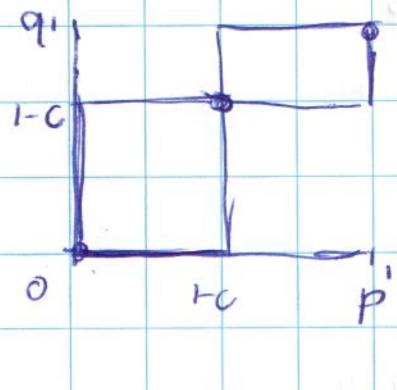
$$\pi = \frac{1-\varepsilon}{2-\varepsilon} + \frac{1-\varepsilon}{2-\varepsilon} = \frac{2(1-\varepsilon)}{2-\varepsilon}$$

114.3

		1	0	
		nE	E	
1	nE	$\underline{0}, \underline{0}$	$0, -c$	p
0	E	$-c, 0$	$\underline{1-c}, \underline{1-c}$	$1-p$
		q	$1-q$	

$$0 > -cq + (1-c)\cdot(1-q)$$
$$-cq + 1 - q - c + cq$$
$$0 > 1 - q - c$$
$$q > 1-c$$

$$0 > -cp + (1-c)(1-p)$$
$$-cp + 1 - p - c + cp$$
$$0 > 1-p-c$$
$$p > 1-c$$



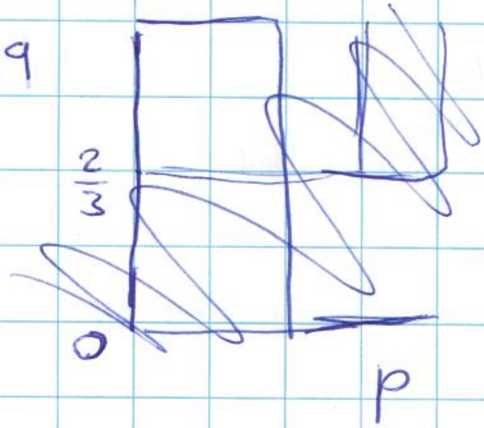
1) $(0,1)$ $(0,1)$
2) $(1,0)$ $(1,0)$
3) $(1-c,c)$ $(1-c,c)$

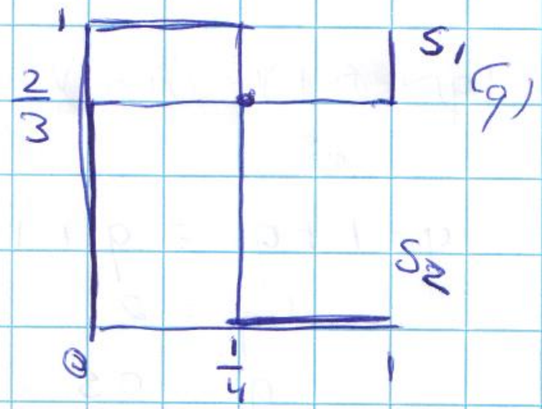
2

114.2

	L	R^2			
T	6,0	0,6	p	20%	(25)
B	3,2	6,0	$1-p$	80%	
	q	$1-q$			

$$6q > 3q + 6 - 6q \qquad 2-2p > 6p$$
$$3q > 6 \qquad 2 > 8p$$
$$q > \frac{2}{3} \qquad \frac{1}{4} > p$$

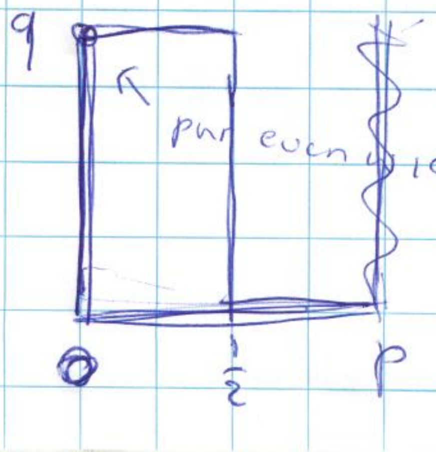




	L	R	
T	0,1	0,2	p
B	2,2	0,1	$1-p$
	q	$1-q$	

$$0 \geq 2q$$
$$q = 0$$

$$1p + 2 - 2p > 2p + 1 - p$$
$$1 > 2p$$
$$\frac{1}{2} > p$$



ma 4 Werkcollege A week 2

Pure N.E

	h	t	
h	1, -1	-1, 1	p
t	-1, 1	1, -1	$1-p$
	q	$1-q$	

$$\cancel{1q + (-1)\cdot(1-q) = 2q-1}$$

$$q - 1 + q = q + 1 - q$$
$$4q = 2$$
$$q = 0.5$$

$$-p + 1 - p = p - 1 + p$$
$$2 = 4p$$
$$\tfrac{1}{2} = p$$

$2 > 4p$ $\quad$ $4q > 2$

$\tfrac{1}{2} > p$ $\quad$ $q > \tfrac{1}{2}$

if $n \uparrow \Rightarrow P[\text{good is provided}]$

$P[\text{good provided}] = 1 - P[\text{no calls}]$
$= 1 - P(i \text{ does not call}) \cdot P(\text{no call})$
$= 1 - P(i \text{ doesn't call}) \cdot \frac{c}{v}$

if $n \uparrow \Rightarrow P(i \text{ does not call} \uparrow)$
$\Rightarrow P(\text{good provided}) \downarrow$ in a symmetric NE (not consistant with expermental evidence)

~~payoff~~

π_i (no one calls) $= 0$

π_i (i calls) $= v - c$

π_i (i doesn't call, at least one other does) $= v$

Symmetric N.E = each player calls with prob. p

in a ~~mix~~ equilibrium: $E\pi_i(\text{call}) = E\pi_i(\text{doesn't call})$

$v - c = 0 \cdot p$(no one else calls] $+ v \cdot p$(at least one else calls)

$v - c = v \cdot (1 - P(\text{no calls}))$

$v - c = v - v\, P(\text{no calls})$)

$P[\text{no calls} = \frac{c}{v}$

$(1-p)^{n-1} = \frac{c}{v} \iff$

$(1-p) = \left(\frac{c}{v}\right)^{\frac{1}{n-1}} \iff$

$p = 1 - \left(\frac{c}{v}\right)^{\frac{1}{n-1}} \Rightarrow$ at symmetric N.E

if $n \uparrow \Rightarrow p$

if $n \uparrow \Rightarrow \frac{1}{n-1} \downarrow \Rightarrow \left(\frac{c}{v}\right)^{\frac{1}{n-1}} \uparrow$ (because $\frac{c}{v} < 1$)

$\Rightarrow 1 - \left(\frac{c}{v}\right)^{\frac{1}{n-1}} \downarrow$ intuitive

Hoorcollege week 2

$U_1(a^*) \geq U_i(a_i, a_{-i}^*)$

$$
\begin{array}{c|c|c|c}
 & H & T & \\
\hline
H & 1,-1 & -1,1 & p \\
T & -1,1 & 1,-1 & 1-p \\
\hline
 & q & 1-q &
\end{array}
$$

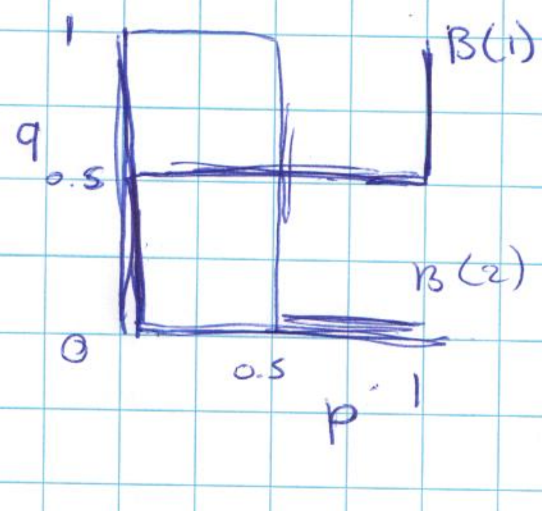
(Player 1: rows; player 2: columns)

$E\pi_1(h) = 1\cdot q + (-1)\cdot(1-q) = 2q-1 = 0 \quad 2q = 1$

$E\pi_1(T) = -1\cdot q + 1\cdot(1-q) = 1-2q$

$$B_1(q) = p = \begin{cases} \{0\} & \text{if } q < \frac{1}{2} \\ \{p : 0 \leq p \leq 1\} & \text{if } q = \frac{1}{2} \\ \{1\} & \text{if } q = 1 \end{cases}$$

$$B_2(p) = q = \begin{cases} \{1\} & \text{if } p < \frac{1}{2} \\ \{q : 0 \leq q \leq 1\} & \text{if } p = \frac{1}{2} \\ \{0\} & \text{if } p > \frac{1}{2} \end{cases}$$



N.E $(p,q) = (\frac{1}{2}, \frac{1}{2})$

74.2

Tentamen 2011

a players: 1 en 2

actions: $x_1\ x_2 = 0 \geq 100 \leq$

preferens: target T dicht by T ~~maxs profit~~ win 100

zie gegeven in de vraag

b) ~~player 1~~ = $T = 30 + (x_1 + x_2)/4 \Rightarrow$

$T = 30 + (T + x_2)/4 \Rightarrow$

$T = 30 + \frac{1}{2}T$

$\frac{1}{2}T = 30$

$T = 60$

c Ja

d $T = 30 + \frac{1}{2}\bar{x} \Rightarrow$

$T = 30 + \frac{1}{2}T$

$T = 60$

42.2

a) $f(x_1, x_2) = \frac{1}{2} \cdot 3x_1 x_2$

$C(x_i) = x_i^2$

$\pi = \frac{3}{2} x_1 x_2 - x_i^2 \implies \frac{3}{2} x_1 x_2 - x_1^2$

$\frac{3}{2} x_2 - 2x_1 = 0 \qquad x_2 - 2x_1$

$x_1 = \frac{3}{4} x_2$

$$\frac{\partial \pi_1}{\partial x_1} = \frac{3}{2} x_2 - 2x_1$$

$b_1(x_2) = \frac{3}{4} x_2$

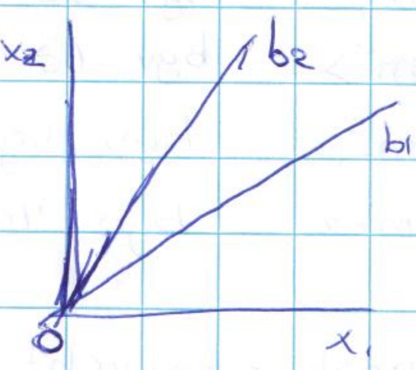
$b_2(x_1) = \frac{3}{4} x_1$

$x_1 = \frac{3}{4} x_2$

$x_1 = \frac{9}{16} x_1$

$x_1 = 0$

$x_2 = 0$



$\frac{3}{2} x_1 x_2 - x_i^2$

$\frac{3}{2} - 1 = \frac{1}{2}$

b) $2x_1 x_2 - x_i$

$b_1 = 2x_1 x_2 - x_1$

$\downarrow$

$\frac{1}{2} = x_1 - x_1$

$\downarrow$

$\frac{1}{2} >$ zeg $1 = x_1$

$\downarrow$

$\frac{1}{2} <$ zeg $0.1 = -0.8x_1$

respons x_1

$x_2 > \frac{1}{2}$	1
$x_2 = \frac{1}{2}$	$0 \le x_1 \le 1$
$x_2 < \frac{1}{2}$	0

Week 1 wc(e)

	S	H
S	$\underline{2}, \underline{2}$	0, 1
H	1, 0	$\underline{1}, \underline{1}$

30.1 $n = 100$ $m = 500$

$2 \leq m < n$

$\frac{1}{n}$ $S > H$

~~m~~ bijv 50 jagen S

~~m~~ > bijv. 60 jagen S

~~m~~ - 1 bijv 49 jagen S

~~m~~ - 2 bijv. 40 jagen S

nash evenwicht iedereen jaagt op S
of iedereen jaagt op H

31.1 $(2\min_j e_j) - e_i$ $k = 100$

(e_i, e_i, e_i, e_i) $2e_i - e_i = e_i$

$(30, 30, 30, 30)$ $2 \cdot 30 - 30 = 30$

$(20, 30, 30, 30)$ $2 \cdot 20 - 20 = 20$

$(10, 20, 30, 40, 50)$ $2 \cdot 10 - 20 = 0$

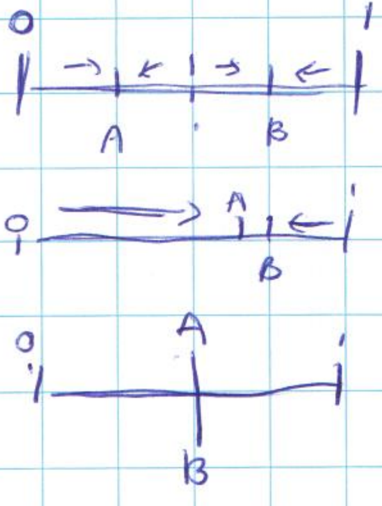
$2 \cdot 10 - 10 = 10$

$2 \cdot 10 - 30 = -10$

evenwicht als ze allemaal het zelfde getal kiezen

74.1 Hotelling

Kritiek 10



$\in$ N.E

6g. 1 Bertrand with fixed-cost

f = fixed cost $\quad C_i(q_i) = \begin{cases} f + c \cdot q_i & \text{if } q_i > 0 \end{cases}$

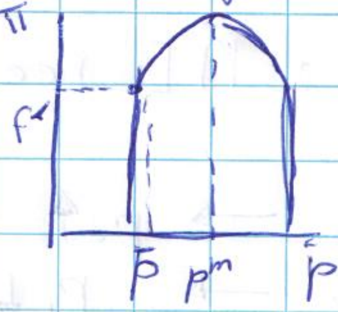
Laat zien dat er een N.E als $(\bar{p}, \bar{p}) = (p_1, p_2)$

Neem $\bar{p}$ als prys waarvoor

$(p_i - c)(\alpha - p_i) = f$ winst gelyk aan fixed cost

met $\bar{p} < p_i^m$

winst gelyk aan fixedcost



Cases

nee

- $p_1 = p_2 < \bar{p} \rightarrow p_1 \uparrow$
- $p_1 = p_2 > \bar{p} \rightarrow p_2 \downarrow$
- $p_1 < p_2 - p_1 < p^m \rightarrow p_1 \uparrow$
- $p_1 < p_2 - p_1 \geq p^m \rightarrow p_1 \downarrow, p_2 \downarrow$
- $p_2 < p_1 - p_2 < p^m \rightarrow p_2 \uparrow$
- $p_2 < p_1 - p_2 \geq p^m \rightarrow p_2 \downarrow \; p_1 \downarrow$
- $p_1 = p_2 = \bar{p} \rightarrow$ Als $p_1 \downarrow$ dan verlies
  - Als $p_1 \uparrow$ dan 0
  - Als $p_2 \uparrow$ dan 0 anders $p_2 \downarrow$ verlies

If $p_1 = p_2$, F_1 receives all demand. Show that $\bar{p} = p_1 = p_2$ is only NE

- $p_1 < p_2$: N.E nee !!

  $p_1 < C_2 \rightarrow P_1 \uparrow$

  $p_1 = C_2 \rightarrow P_1 \uparrow$

  $C_2 < P_1 < p_1^m \rightarrow P_1 \uparrow \quad P_2 \downarrow$

  $p_1 = p_1^m \rightarrow P_2 \downarrow$

  $p_1^m < p_1 \rightarrow P_1 \downarrow$

$p_2 < p_1$: N.E nee !!

$P_2 < C_2 \rightarrow p_2 \uparrow$

$P_2 = C_2 \rightarrow P_1 \downarrow \quad P_2 \uparrow$

$C_2 = P_2 = p_2^m \quad P_1 \uparrow \quad P_2 \downarrow$

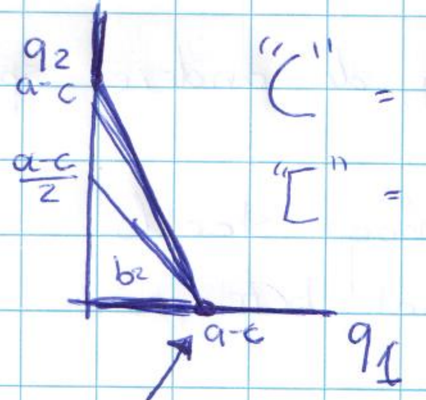
$p_2 = p_2^m \rightarrow P_2 \downarrow$

$p_2^m < p_2 \rightarrow P_2 \downarrow$

68.2 Ne als $p_1 = p_2 = C_2$ krygt Firm 2 een deel van de markt ? Nee !! $P_1 \downarrow$

$p_1 < p_2 = C_2$

(3.)



"(" = excl

"[" = incl

n.E = $q_1 = a-c$

$q_2 = 0$

68.2 Bertrand

Vb

- players : firm 1 en 2
- price p_i
- max π_i

waar $\pi_i = \begin{cases} Q(p_i - c) & \text{if } p_i < p_j \\ \frac{1}{2}Q(p_i - c) & \text{if } p_i = p_j \\ 0 & \text{if } p_i > p_j \end{cases}$

waar $Q = a - \min\{p_i, p_j\}$

Hier : $c_1 < c_2 < p_1^m < p_2^m$

als : $p_1 = p_2 = c_2$ dan krygt Firm 1 alle demand

laat zien dat $\boxed{p_1 = p_2 = c_2}$ enige n.E is.

- $p_1 = p_2 = c_2$ firm 1 en 2 wykt niet af
- $p_1 = p_2 < c_2$ firm 2 maarkt verlies dus $P_2 \uparrow$

$p_1 = p_2 > c_2$ P_1 als P_2 $\downarrow$

$p_1 < p_2$ en als $p_1 < \cancel{p} c_2$ $\quad p_1 = p_1^m$

$p_1 = c_2 \quad p_1^m < p_1$

$c_2 < p_1 < p_1^m$

Afwijkingen voor $\underline{\underline{1}}$ van de andere spelers

① $b_k < \underline{v}$ k verliest nog steeds
0 = niet beter

② $\underline{v} < b_k < \bar{v}$ verliest 0 = niet beter

③ $b_k = \bar{v}$ ⟹ twee winnaren
$\frac{1}{2}(v_k - \bar{v}) \leq 0$
dus niet beter

④ $b_k > \bar{v}$ ⟹ k wint alleen
$v_k - \bar{v} \leq 0$
dus niet beter

Er is geen eenzijdige afwijking die beter is voor de afwijkende speler dus er is een N.E

Werkcollege B week 3

294.2 afwykingen

① $b_i > \bar{v}$ => niks veranderd C_i wint
prys blyft het zelfde

② $b_i \in (\underline{v}, \bar{v})$ niks veranderd
$\underline{v} < b_i < \bar{v}$)

③

$b_i = \underline{v}$ => iedereen wint $\frac{1}{n}(v_i - \underline{v})$

④ $b_i < \underline{v}$ i verliest

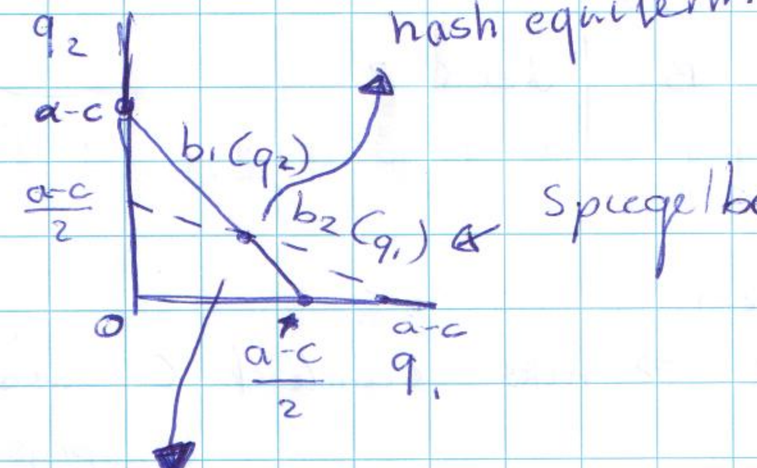
$i \to b_i = \bar{v}$ (voor elke type

andere spelers $j \neq i$: $\underline{v}$

$\Downarrow$

i wint $v_1 - \underline{v}$
speler $j \to 0$

3.



$$q_1 = \frac{1}{2}(a-c-q_2) \Rightarrow$$

$$q_1 = \frac{1}{2}\left(a-c-\frac{1}{2}(a-c-q_1)\right) \Rightarrow$$

$$q_1 = \frac{a-c}{3}$$

$$q_2^* = \frac{a-c}{3}$$

(1) - duopoly : firm$_1$ en firm 2 "subject to"

- quantity q_i
- Firm$_1$: max $S_i = \frac{q_1}{q_1+q_2}$ s.t. $\Pi_1 \geq 0$

Firm$_2$: max $\Pi_i = q_2(p-c)$ met

$$p = a - q_1 - q_2$$

(2) BRF Firm 1: $\Pi_1 = 0 \Rightarrow q_1(a-q_1-q_2-c) = 0 \Rightarrow$

Tip: S_i stygt altyd in q_1 $\boxed{q_1 = a-c-q_2}$

$$b_1(q_2) = \begin{cases} a-c-q_2 & \text{if } a-c \geq q_2 \\ 0 & \text{otherwise} \end{cases} \quad \boxed{[0,a-c]} \text{ if } q_2 = 0$$

$$\frac{1}{2}(a-c-q_1) \text{ if } q_1 \leq a-c$$

BRF Firm 2 : $b_2(q_1) \begin{cases} \frac{a-c}{3} & \text{if } q_1 \ldots \\ 0 & \text{if otherwise} \end{cases}$

Werkcollege (b) week 1

60.1 Cournot (quantity comp) $\underline{Vb}$

1 Wie zyn je spelers q_1 en q_2
Action sets : q en preferens
2. Find BRF

3. Wanneer is er een nash equilerem

$\boxed{1}$ Firm 1 en 2

quantity q_i $i = 1$ en 2

Preferens $\max \Pi_i = q_i(p-c)$

$p(q_1, q_2) = a - q_1 - q_2$

$\boxed{2.}$ $\max \Pi_i = q_i(a - q_i - q_j - c)$ $i = 1,2$

First Foc $\frac{\partial \Pi}{\partial q_i} = a - 2q_i - q_j - c = 0$ $j \neq i$

~~Second~~

Second Soc : $\frac{\partial^2 \Pi_i}{\partial^2 q_i} = -2 < 0$ ← Global max

$$q_i = \frac{1}{2}(a - c - q_j)$$

BRF : $b_i(q_i)$ if $a - c \geq q_j$

otherwise 0

	Q	F
Q	2, 2	0, 3
F	3, 0	1, 1

	Q	F
Q	2, 2	0, 1
F	1, 0	1, 1

Collusion in Cournot

$$\pi_1 (q_1, q_2) = q_1 (a - c - q_1 - q_2)$$
$$\pi_2 (q_1, q_2) = q_2 (a - c - q_1 - q_2) +$$

$$\Sigma \pi_3 = (q_1 + q_2)(a - c - q_1 - q_2) \Rightarrow$$

$$Q(a - c - Q)$$
$$F.O.C = (a - c - Q) - Q = 0$$

collusion $\rightarrow$ $\boxed{Q = \frac{a-c}{2}}$

$$Q_{nash} = \frac{2(a-c)}{3}$$

Bertrand

(i) if $p_j < c$ = $p_1 : p_1 > p_j$
(ii) if $p_j = c$ = $p_1 : p_1 \geq p_j$
(iii) if $c < p_j \leq p^m$ = does not exist!
(iv) if $p_j > p^m$ = $B_1(p_j) = (p^m)$

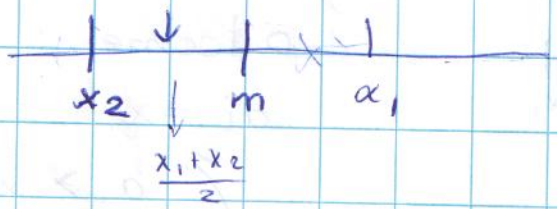
$$u_i(a) = \begin{cases} n & \text{if } i \text{ is sole winner} \\ k & \\ & \end{cases}$$

← best

← split

← lose

2 players   analyze situation from p_1 perspective



if $x_2 < m$: $x_1 > x_2$

~~$B_1(x_2)$~~

1 win ~~we~~ when: $\frac{x_1+x_2}{2}$ is $< m \iff x_1 < 2m - x_2$

$$B_1(x_2) = \begin{cases} \{x_1 : x_2 < x_1 < 2m - x_2\} & \text{if } x_2 < m \\ \{m\} & x_2 = m \\ \{x_1 : 2m - x_2 < x_1 < x_2\} & \text{if } x_2 > m \end{cases}$$

We assume that people vote

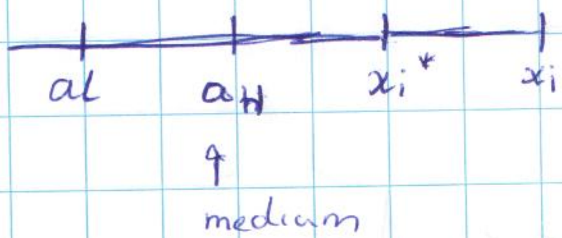
Week 1 hoorcollege B

$a_i = x_1 > x_1^*$ is weakly dominated by $a_i = x_1^*$

$a_H = \frac{(n-1)}{2}^{th}$ highest action of others

$a_L = \frac{(n+1)}{2}^{th}$ second highest

1.

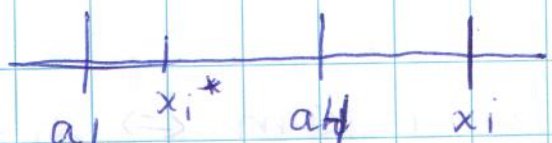


outcome

$a_i = x_i^*$	$a_i > x_i^*$
aH	a_H

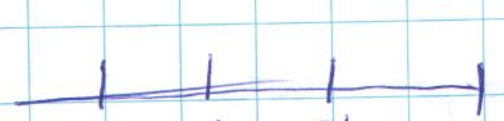
indriffend

2.



3.

4.



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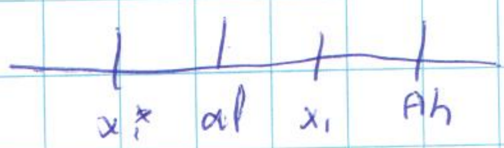

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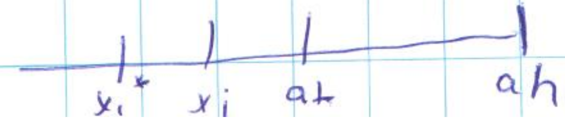

pref i

	$a_1 = x_1$	$a_i > x^*$
1.	aH	aH → indriffend
2.	x_1^*	ah → wors
3.	x_1^*	x_i → wors
4.	al	aH → wors
5.	al	x_1 → wors
6.	al	al → indrif
	$x_1 = x_1^*$	$a_i = x_i$