1944546

1. a

2. $p(Q) = 80 - Q$

$Q = q_1 + q_2$

$TC(q_i) = 50q_i$

a) $\pi_1(q_1, q_2) = (80 - q_1 - q_2)q_1 - 50q_1$

firm 1's profit

$$\max_{q_1} \pi_1 = (80 - q_1 - q_2)q_1 - 50q_1$$

$$\frac{\partial \pi_1}{\partial q_1} = 80 - 2q_1 - q_2 - 50 = 0 \quad \text{F.O.C}$$

$$\frac{\partial^2 \pi_1}{\partial q_1^2} = -2 < 0 \quad \therefore \max$$

$$\therefore 2q_1 = 30 - q_2$$

$$q_1 = 15 - \frac{1}{2}q_2$$

$q_1(q_2) = 15 - \frac{1}{2}q_2$: Firm 1's BRF

Due to symmetry:

Firm 2's BRF: $q_2(q_1) = 15 - \frac{1}{2}q_1$

These are BRFs as both firms' are profit maximising given the choice of quantity of the other firm.

6. NE:

$q_1(q_2) = 15 - \frac{1}{2}q_2$

$\therefore q_1^N = 15 - \frac{1}{2}\left(15 - \frac{1}{2}q_1^N\right)$

$\therefore 0.75 q_1^N = 7.5$

$q_1^N = 10 = q_2^N$ (symmetry)

$\therefore$ NE price:

$$P(Q^N) = 80 - (q_1^N + q_2^N)$$

$$= 80 - 20$$

$$= 60$$

$$\pi_1^N = \pi_2^N = P(Q^N)q_1^N - 50q_1^N$$

$$= 60 \cdot 10 - 50 \cdot 10$$

$$= 100$$

(CS) Consumer surplus = (max price willing to spend - actual price) × ($\frac{1}{2}$) × quantity

$$\therefore CS = \frac{1}{2} \times (80 - 60) \times 20$$

$$= 200$$

The NE values of $P(Q^N)$, π_1^N, π_2^N occur when both firms are best responding to one another

1944546

c. $TC(q_i) = \begin{cases} F + 20q_i & \text{if } q_i > 0 \\ 0 & \text{if } q_i = 0 \end{cases}$

$F = 110$:

$\pi_1(q_1, q_2) = (80 - q_1 - q_2)q_1 - (110 + 20q_1)$

For firm 1 to produce the q_1 must at least make zero profit

$\pi_1(q_1, q_2) = 0$

$\frac{\partial \pi_1}{\partial q_1} = 80 - 2q_1 - q_2 - 20 = 0$

$2q_1 = 60 - q_2$

$q_1(q_2) = 30 - \frac{1}{2}q_2$, $q_2(q_1) = 30 - \frac{1}{2}q_1$ (symmetry)

$\therefore \pi_1(q_1, q_2) = 80q_1 - q_1^2 - (30 - \frac{1}{2}q_1)q_1 - 150 - 20q_1$

$0 = 60q_1 - 0.5q_1^2 - 140$

$q_1 = \frac{-60 \pm \sqrt{60^2 - 4(-0.5 \times -140)}}{-1}$

$= 2.38\ldots$ FOR zero profit

1944546

$\therefore$ Firms 1 and 2 will produce +ve quantities

$$\Rightarrow q_1^N = 30 - \frac{1}{2}\left(30 - \frac{1}{2}q_1^N\right)$$

$$0.75 q_1^N = 15$$

$$q_1^N = 20 = q_2^N$$

$$\therefore P(Q^N) = 80 - 40$$

$$= \underline{\underline{40}}$$

$$\Rightarrow CS = \frac{1}{2} \times (80 - 40) \times Q^N$$

$$= \frac{1}{2} \times 40 \times 40$$

$$= 800$$

The new fixed cost, F, has lead both firms to increase equilibrium quantity,

PTO

1944546

So they "spread" the burden of this cost, i.e lower their average costs. Their marginal costs have fallen. This increased quantity supplied by both firms leads to reduced equilibrium price and therefore more consumer surplus.

Q3. 5 hunters

3 or more → catch stag, each gets

$\frac{30}{x}$

>3 → don't catch stag

Hare → 7

The pure strategy NE is :

4 hunters persue the stag, one persues the hair (in any combination).

This leads to

Stag hunters' payoff = $\frac{30}{4}$
$= 7.5$

Hare hunter's payoff = 7

None of them will want to deviate as there is no profitable deviation.

The other pure strategy NE :

All hunters' persue hare getting payoff of 7 each.

There are no profitable deviations

1944546

b) Stag: $\begin{cases} \frac{45}{5} & \text{is 5 persue} \\ 0 & \text{otherwise} \end{cases}$

Hare: 7 for sure

persue stag w/ prob p, don't w $(1-p)$

	less than 4 others	4 others persue stag
stag	0	9
hare	7	7

exp. payoff stag $= p^4(0) + (1-p^4)\cdot 9$

exp. payoff hare $= 7$

in a mixed strategy NE, player is indifferent between each strategy $\therefore$ has no incentive to deviate;

$\Rightarrow 7 = 9(1-p^4)$

$9p^4 = 2 \qquad p^4 = \frac{2}{9} \qquad p = \left(\frac{2}{9}\right)^{\frac{1}{4}}$

$= 0.6865\ldots$

1944546

$\therefore p = 0.69 \leftarrow$ probability each hunter persues stay as symmetric NE

This is probability where:

exp. payoff stay = payoff hare

$\therefore$ NE

Q4. n players

$Y_0 = 10$

$y_i = 0, 1, \dots, 3$

$y_i + \frac{Y_2}{n}$

a) $n = 1$ Total number of fish = 100

$y_i + \frac{Y_2}{1}$ $\therefore$ NE fish in june = 0

b) NE fish in june = 10

c) NE no. fish in june = 10

Section B

5. (b)

(d)

6. The gini coefficient is a number which measures how much disparity (in income) there is among members of a population, in this case the neighbourhood.

Gini coefficient $= \left(\dfrac{\text{sum of differences}}{\text{number of pairs}} \right) \left(\dfrac{1}{2} \right)$,

$\left(\dfrac{1}{5} \right)$

It is the relative mean difference.

Alternatively gini coeff can be found from the Lorenz curve

$$\therefore \text{Gini coeff} = \left(\frac{\Delta^{AD} + \Delta^{AC} + \Delta^{AB} + \Delta^{BD} + \Delta^{BC} + \Delta^{CD}}{6}\right) \times \left(\frac{1}{2}\right) \times \frac{1}{\left(\frac{y^D + y^A + y^B + y^C}{4}\right)}$$

$$\text{Gini} = \left(\frac{(40-20) + (40-5) + (40-15) + (15-20) + (15-5) + (5-20)}{6}\right) \times \frac{1}{2} \times \frac{1}{\left(\frac{20+40+15+5}{4}\right)}$$

$$= \frac{35}{3} \times \frac{1}{2} \times \frac{1}{20}$$

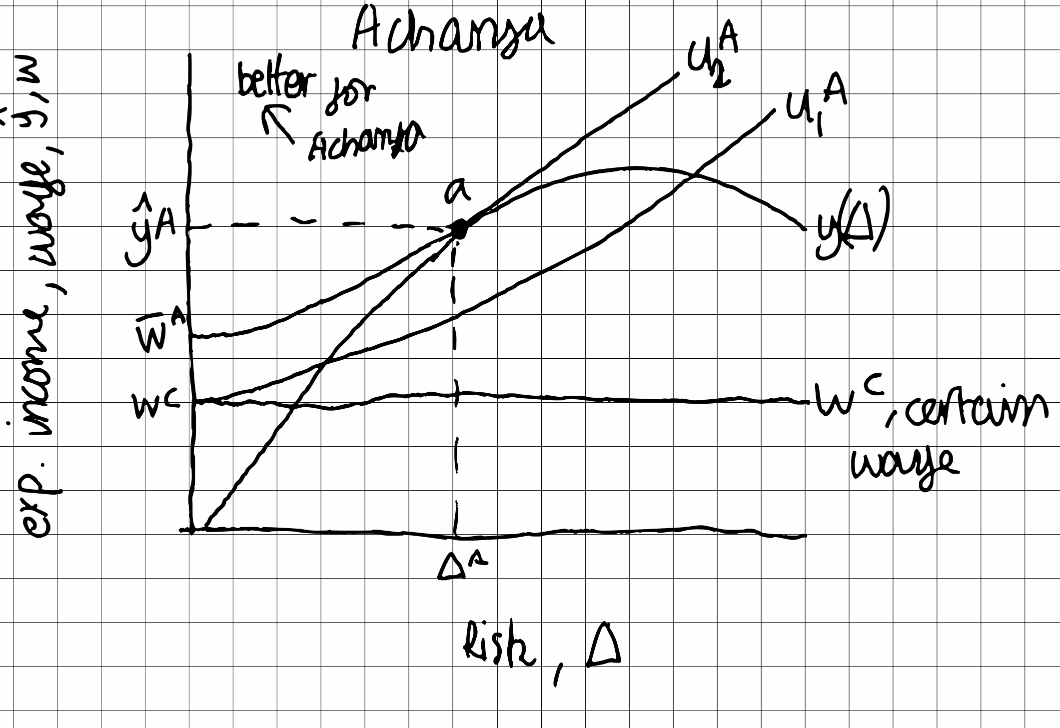
$$= 0.2916\ldots$$

$$= \underline{\underline{0.292}}$$

Q7. Acharya : $y^A = 40$

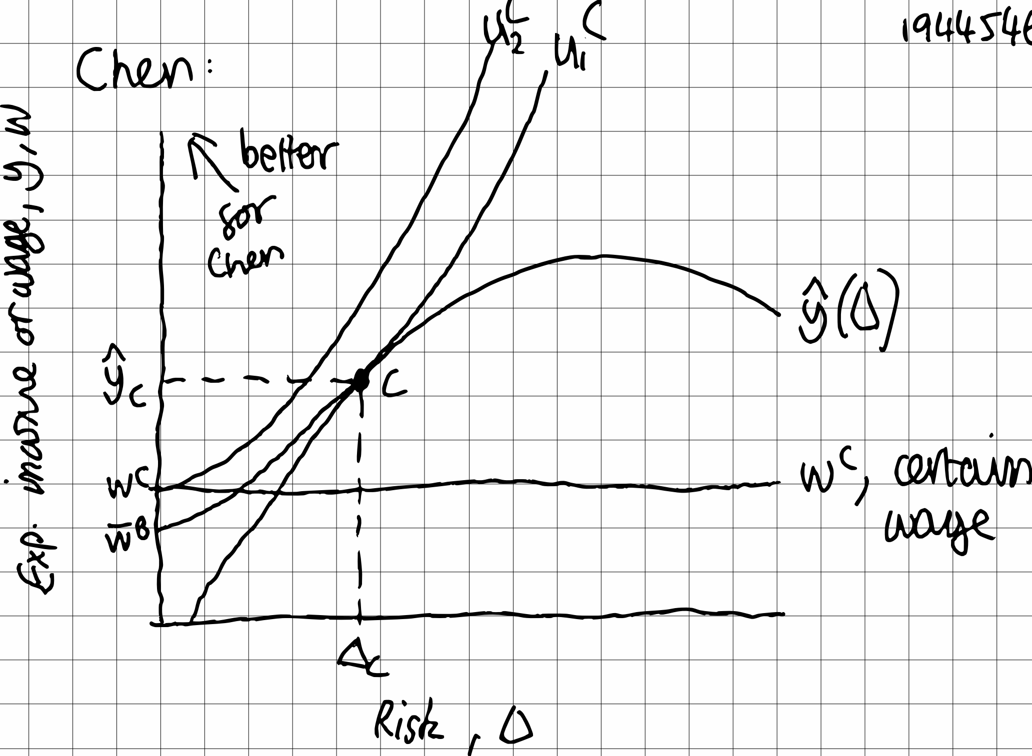
Chen : $y^C = 5$

Acharya have greater wealth than Chen. This will make them less risk averse than Chen:



1944546

Chen:



Here are two sets of indifference curves for Acharya and Chen. Chen are more risk averse and chooses the higher indifference curve U_2^C, where they are paid w^C, the certain wage, rather than bearing risk at point C, the tangency between the risk -return schedule and the lower indifference curve. Achanya is less risk averse and prefers to bear risk and engage in production of goods and services with their own project (as the owner-operator) as their indifference curve, U_2^A, is the curve that is tangent to the risk return schedule and their highest possible indifference curve.

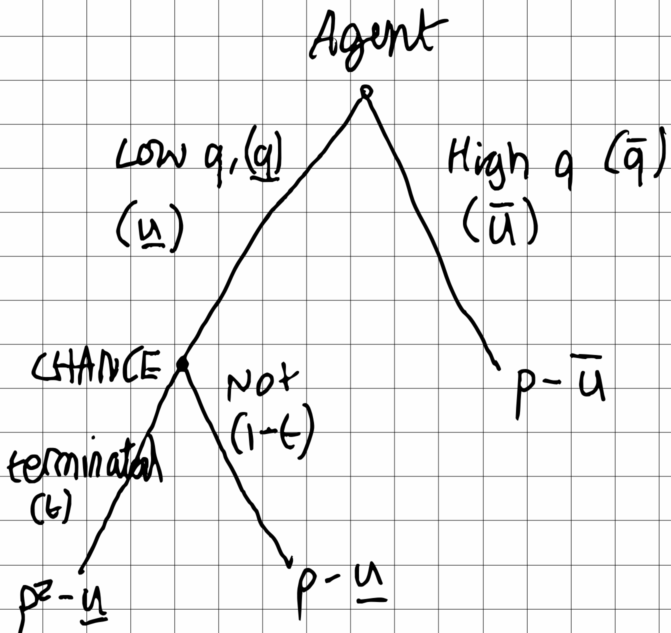
1944546

Q8.

a) This is a problem of incomplete contracts as an incomplete contract is one where the contract is not enforceable, e.g by courts, at close to zero cost of the exchanging parties. There is also asymmetric information; in this question, the quality of the good the agent provides is unknown to the principal and "cannot be measured costlessly", therefore the contract is incomplete.

This is a problem of hidden attributes, the principal would like to know the quality of the good, but lacks verifiable information, therefore adverse selection results.

b) GAME TREE of interaction:



At the NE, the agent is indifferent between high and low q, ∴

$$p - \bar{u} = (1-t)(p - \underline{u}) + t(p^2 - \underline{u})$$

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$$p - \bar{u} = (1-t)(p - \underline{u}) + t(p^z - \underline{u})$$

$$p - \bar{u} = (1-t)p - (1-t)\underline{u} + t(p^z - \underline{u})$$

$$p - (1-t)p = \bar{u} - (1-t)\underline{u} + t(p^z - \underline{u})$$

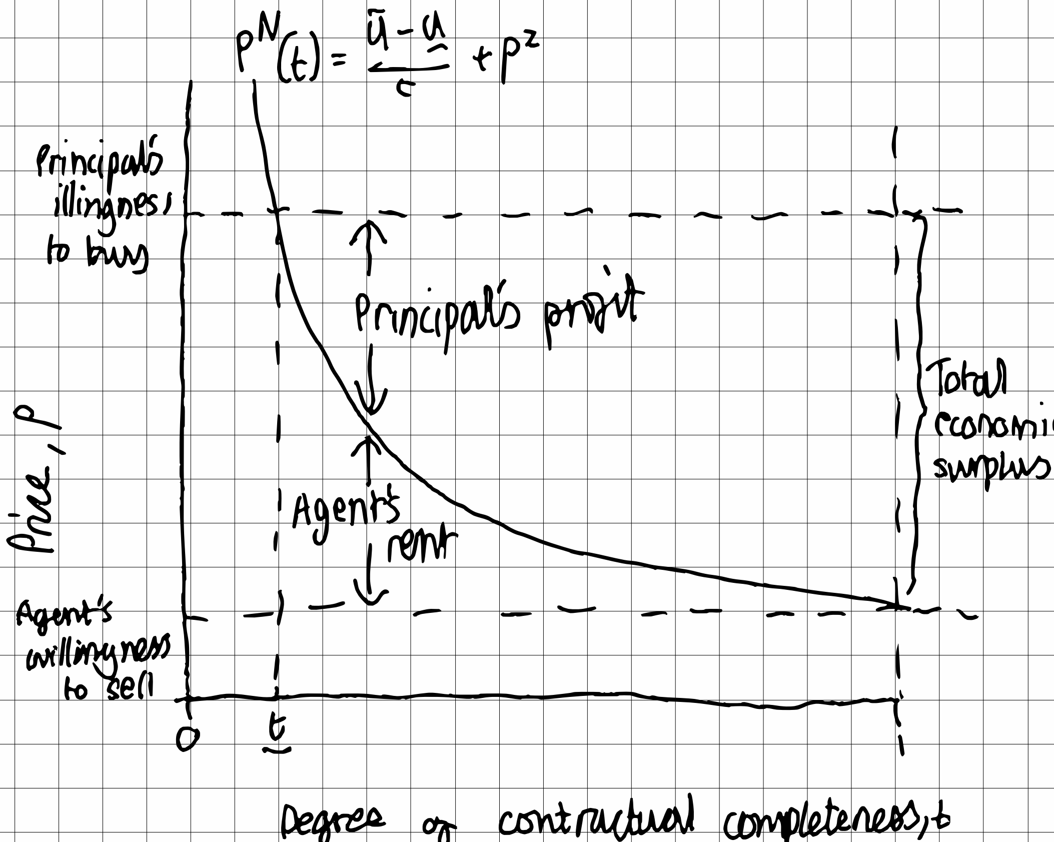
$$tp = \bar{u} - (1-t)\underline{u} + t(p^z - \underline{u})$$

$$tp = \bar{u} - \underline{u} + tp^z$$

$$p^N = \frac{\bar{u} - \underline{u}}{t} + p^z$$

This is the price that the agent needs to be offered by the principal to make him indifferent between the exp. payoff of providing high q ($\bar{q}$) and low q ($\underline{q}$), i.e the incentive compatible price, so the agent provides high q ($\bar{q}$).
This is the NE price principal will offer.

c)



- As t increases, the agent's rents fall. In the case of t=1, i.e complete contract, the principal receives all the rent, the agent gets p^z, their fallback price and no rent.

d) π^E = revenue − costs

$\bar{p} = 1$

for one unit purchased

$\pi^E = 1 \times \bar{p} - p^N \times 1$

$= \bar{p} - \left[\frac{\bar{u} - \underline{u}}{t} + p^2\right]$

for $t = \underline{t}$

$\Rightarrow \pi^E = 1 - \left[\frac{\bar{u} - \underline{u}}{\underline{t}} + p^2\right]$

$= \frac{\underline{t}}{\underline{t}} - \frac{\bar{u} - \underline{u}}{\underline{t}} - \frac{\underline{t} p^2}{\underline{t}}$

$$\pi^E = \frac{\underline{t} - \underline{t} p^2 - \bar{u} + \underline{u}}{\underline{t}}$$

1944546

$$\pi^E = \frac{\underline{t} - \underline{t}p^2 - \bar{u} + \underline{u}}{\underline{t}}$$

$$\frac{\partial \pi^E}{\partial p^2} = \frac{-\underline{t}}{\underline{t}}$$

$= -1 < 0 \therefore \pi^E$ decreasing in p^2

$\dfrac{\partial \pi^E}{\partial \bar{u}} = \dfrac{-1}{\underline{t}} < 0 \quad \therefore \pi^E$ decreasing in $\bar{u}$

$\dfrac{\partial \pi^E}{\partial \underline{u}} = \dfrac{1}{\underline{t}} > 0 \quad \therefore \pi^E$ increasing in $\underline{u}$

$$\frac{\partial \pi^E}{\partial \underline{t}} = \frac{(1-p^2)\cdot \underline{t} - (\underline{t} - \underline{t}p^2 - \bar{u} + \underline{u})\cdot 1}{\underline{t}^2}$$

$= \dfrac{\bar{u} - \underline{u}}{\underline{t}^2} > 0$ since $\bar{u} > \underline{u}$ $\therefore$

π^E increasing in $\underline{t}$

1944546

e. If contract complete

$$\pi_c^E = \bar{p} - (\bar{u} - \underline{u} + p^2)$$

$$wtp = \pi_c^E - \pi_{incomplete}^E$$

$$= \left(\bar{p} - (\bar{u} - \underline{u} + p^2)\right) - \frac{\underline{t} - \underline{t}p^2 - \bar{u} + \underline{u}}{\underline{t}}$$

$$= (1 - \bar{u} + \underline{u} - p^2) - \frac{\underline{t} - \underline{t}p^2 - \bar{u} + \underline{u}}{\underline{t}}$$

$$= \frac{\underline{t}}{\underline{t}}(1 - \bar{u} + \underline{u} - p^2) - \left(\frac{\underline{t} - \underline{t}p^2 - \bar{u} + \underline{u}}{\underline{t}}\right)$$

$$= \frac{-\underline{t}\bar{u} + \underline{t}\underline{u} + \bar{u} - \underline{u}}{\underline{t}}$$

$$= \frac{\bar{u} - \underline{t}\bar{u}}{\underline{t}} + \frac{-\underline{u} + \underline{t}\underline{u}}{\underline{t}}$$

$$= \frac{\bar{u}(1-\underline{t}) - \underline{u}(1-\underline{t})}{\underline{t}} = \frac{1-\underline{t}}{\underline{t}}(\bar{u} - \underline{u})$$