Cournot competition

UNDERSTANDING THE PROBLEM

-Simultaneous moves (different from stackelberg competition)
-We assume that there is no difference in product from firm 1 and firm 2
-price is set by total quantity of goods out there (q),

$q = q1+q2$,
q1- goods produced by frim 1
q2- goods produced by firm 2

- Market price is decided by a function $p(q)= a-q$

a is constant
from where we can say that as supply increases price drops
$q>a$

-MARGINAL COSTS

c1 - marginal cost of firm 1
c2 - marginal cost of firm 2

-OBJECTIVE: Maximise the profit

$p(q)*qi - ci * qi$

SOLVING STRATEGY

-firm 1's best response to firm 2' output decision
-firm 2's best response to firm 1' output decision
-find a pair of mutual best response

DERIVING FIRM 1 BEST RESPONSE

-Maximise $p(q)*q1 - ci * q1 = (a-q) *q1 -c1*q1$
$= (a-(q1 + q2)) *q1 -c1*q1$
$= (a\ q1 - q1^2 - q1\ q2 - c1\ q1)$

We plot the above fixing a and q2,
Maxima of the above function is when the derivative of above function is ZERO

q1= (a-q2-c1) / 2 (Here q1 must be positive) ---> BEST RESPONSE FUNCTION FIRM 1

What we observe is that q1 decreases with

1. increase in q2

   When firm 2 produces more the price of goods is going to decrease which causes the profits for firm 1 to decrease. Hence firm1 responds by decreasing production

2. increase in c1 (marginal cost)

   The reason is that u will want to produce less of something which costs you lot to make

DERIVING FIRM 1 BEST RESPONSE

Basically the same thing we did above here we just flip q1 and q2

q2= (a-q1-c2) / 2 (Here q1 must be positive) -> BEST RESPONSE FUNCTION FIRM 2

DERIVING MUTUAL BEST RESPONSE

Firms are in equilibrium when they don't want to change what they are doing given the other firm's strategy

A pair of q1 and a2 such that both the best response function hold simultaneously

->What we have is basically a system of variables with 2 equations and 2 unknown variables

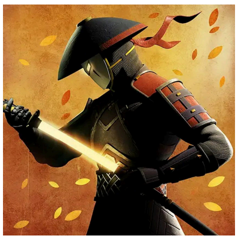
A,c1,c2 – fixed q1,q2 – variables

$q1 = (a+c1-2c2)/3$ $q2 = (a+c2-2c1)/3$

Cournot competition Game

TASK TITANS

The game is designed for two players, each of whom must complete various physical challenges. Completing each task will result in a loss of health points, but players will earn points as a reward once they finish.



RULES OF THE GAME:

1.Each player will not know the number of tasks completed by the other player.

2.All tasks are of the same kind so every task upon completion is rewarded the same number of points.

3.The amount of health points spent to finish a task for both the players differ.

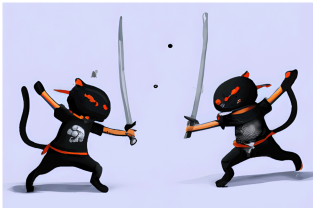
4.Points per task is determined after we get to know the number of tasks completed by both of them.

Points per task (p)= a - (t1 + t2)

Where t1 - number of tasks done by player 1

t2 - number of tasks done by player 2

a - a constant we pre decided



5. Point earned by player 1 = p * t1 - h1 *t1 ——-->1

Point earned by player 1 = p * t2 - h2 *t2 ——-->2

Where h1 = health points lost by player 1 to complete 1 task

h2 = health points lost by player 2 to complete 1 task

CALCULATING INDIVIDUAL BEST RESPONSES AND MUTUAL BEST RESPONSE :

Just as we showed in the theory part, differentiating 1 gives us the best response for player 1 and differentiating 2 gives us best response for player 2. Upon using both the differentiated equations we get the mutual best response for both the players.

Betrand competition

Firms produce a homogeneous good and compete on prices

Each firm chooses a price p1 and p2

We have a single consumer in this model and all the consumer does is decide whether to buy from a firm and which firm to buy from.

1. Prefers lower price than higher
2. The consumer has a reservation price **v** larger than marginal cost of production **c**
    - A basic assumption so that we have a deal getting done
    - Incase v<c the reservation cost is so low that no firm wants to produce at that price
3. The consumer is indifferent between the firms i.e if the firms set same price for product the consumer can buy it from any of the firms

The firms have symmetric marginal cost of production c>0 (To keep things simple)
OBJECTIVE : Firms want to MAXIMISE their profit

EQUILIBRIUM PRICES : p1=p2=c
Hence no profit made.

- If a firm deviates to p<c -ve profit
- If a firm deviates to p>c no sale and no profit

-Firm 1 profit = (p1-c)D1(p1,p2)
Where D1(p1,p2) = demand faced by firm 1 if firm 2 charges price p2. It depends upon the price of both firms.

1.Equilibrium price can't be lower than **c**
2.Equilibrium price can't be greater than **c**
-Suppose p1<p2
- Firm 2 makes nothing
-but choosing any value between c and p1 guarantees a profitable sale
- after firm 2 changes its price now firm 1 will also change and the companies will just continue doing this

3.
-Suppose p1=p2
If both the firms charge the same price demand is split equally and firm makes a profit of, profit =(p-c)1/2D(p).

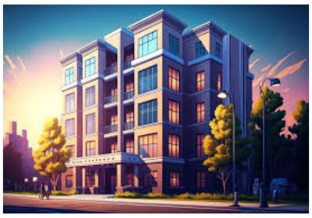
<u>Why equilibrium of prices is at marginal cost</u>

- If p1>c then firm 2 will set a price between p1 and c then firm 2 will make all the profit because firm 2 obtains the entire demand.
- Since firm 1 has no demand and makes a profit of zero firm 1 will lower the price between c and p2.
- Now firm 1 makes a profit of zero firm 1 will lower the price between c and p2. Now firm 1 obtains the entire demand.
- Both firms will repeat this process until charging a lower price does not increase profits , which occurs at the price of marginal cost only.

Consider a deviation to price pd between p1 and c
-Its better if (pd - c) > 1/2(p1 - c)
We took ½ as the probability of the order going to firm 1
-So always one company will try to reduce its price so that it gets the sale done

Bertrand competition game

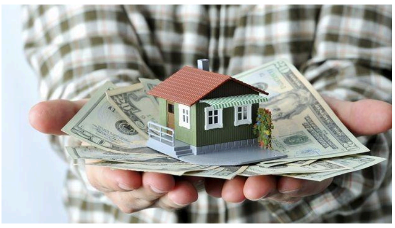
PROPERTY RUSH



This is a two player game, both will take a contract from a building owner to sell the flats in the building and will set a price higher than or equal to the price the owner wants to sell it at. Customers will buy from the one with a lower price.

RULES OF THE GAME:

1. They have to set the price greater than or equal to the initial price set by the owner.
2. The player with the lower price will get the deal.
3. If they quote the same price both of them will get half and half of the deal. But there is a chance that one of them lowers the price so that he gets the entire deal. He can't go below the initial price because in that case he will be making a loss.



The following link contains:
1.Sample data in spreadsheet
2.Code for the 1st game in python, the code gives best outputs individually and mutual best response. It also plot as graph in the intersection of the lines gives best mutual response
3.Code for the 2nd game in C.

Game_theory