ECONOMICS 1 (sem 2)

Tutorial 5

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https://diegobattiston.github.io

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https://diegobattiston.github.io/T5.pdf

Questions to cover today

- Q14
- Q15
- Q20
- Q18
- Q21

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Question 14

- Demand curve: $P = 15 - Q$.
- Two firms with a constant marginal cost of £3 per unit

Model	Q_1	Q_2	$Q_1 + Q_2$	P	π_1	π_2	$\pi_1 + \pi_2$
Shared monopoly							
Cournot							
Bertrand							
Stackelberg							

Shared monopoly

- Both firms behave as a single Monopoly
- MC = MR rule
- Then, just split quantities (and profits)

Shared monopoly

Cournot

- Each firm max profits taking "as given" what the other produce
- That results in a Best Response function for each firm
  - Q1* as a function of Q2
  - Q2* as a function of Q1
- **Nash Equilibrium:** Q1* is a BR to Q2* which is a BR to Q1*, …

Cournot

Model	Q_1	Q_2	$Q_1 + Q_2$	P	π_1	π_2	$\pi_1 + \pi_2$
Shared monopoly	3	3	6	9	18	18	36
Cournot	4	4	8	7	16	16	32
Bertrand							
Stackelberg							

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Bertrand

- Firms choose prices
- Subtle but important difference r/Cournot: The lowest price firm gets all the consumers
- Don’t need any calculation: A price that give profits > 0 can’t be a equilibrium, a firm is strictly better if reduces a bit the price.
    - Only possible equilibrium is each firm sets P = MC

Bertrand

Model	Q_1	Q_2	$Q_1 + Q_2$	P	π_1	π_2	$\pi_1 + \pi_2$
Shared monopoly	3	3	6	9	18	18	36
Cournot	4	4	8	7	16	16	32
Bertrand	6	6	12	3	0	0	0
Stackelberg							

Stackelberg

- Is Cournot but one firm plays first
- Player 2 makes optimal decision <u>after observing</u> Player 1 move
- We solve by **backward induction**: Start from last player and find her optimal decision. First player will “anticipate” that behaviour
    - Q2*(Q1) is similar to Cournot
    - But first player “controls” what the second plays, so her maximization is different from Cournot’s

Stackelberg

Model	Q_1	Q_2	$Q_1 + Q_2$	P	π_1	π_2	$\pi_1 + \pi_2$
Shared monopoly	3	3	6	9	18	18	36
Cournot	4	4	8	7	16	16	32
Bertrand	6	6	12	3	0	0	0
Stackelberg	6	3	9	6	18	9	27

Question 15

Because of their unique expertise with explosives, the Zambino brothers have long enjoyed a monopoly of the European market for public fireworks displays for crowds above a quarter of a million. The annual demand for these fireworks displays is $P = 140 - Q$. The marginal cost of putting on a fireworks display is 20.

A family dispute broke the firm in two. Alfredo Zambino now runs one firm and Luigi Zambino runs the other. They still have the same marginal costs, but now they are Cournot duopolists.

a) How much profit has the family lost?

b) How much consumer surplus has the general public gained?

- Nothing conceptually new compared to previous exercise
- Just compare Monopoly profits VS Cournot profits(x2)

a) Monopoly versus Cournot

- Monopoly

$$MR = MC = 20$$

$$140 - 2Q = 20 \Rightarrow Q = 60 \text{ and } P = 80$$

- Cournot

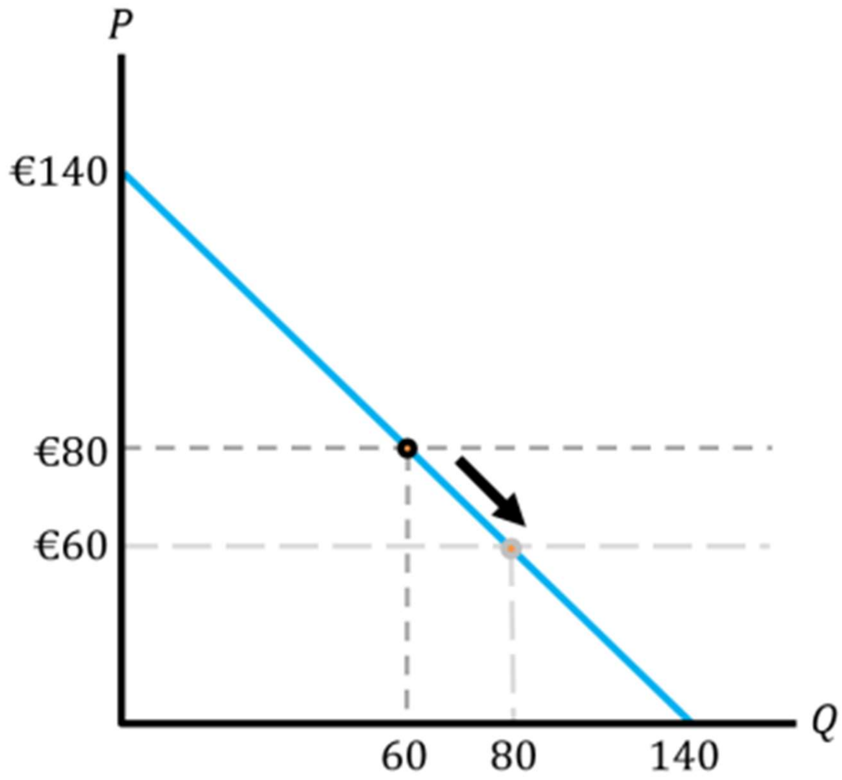
$$P = 140 - Q_1 - Q_2$$

$$MR_1 = 140 - 2Q_1 - Q_2 = 20$$ MC

$$Q_1 = \frac{120 - Q_2}{2}$$

Use $Q_1 = Q_2 \Rightarrow Q_1 = 40 \Rightarrow Q = 80$ and $P = 60$

b) Increase in Consumer Surplus



Question 20

- Duopolists with demand $\boldsymbol{P} = \mathbf{100} - \boldsymbol{Q}$ where $\boldsymbol{Q} = \boldsymbol{Q}\mathbf{1} + \boldsymbol{Q}\mathbf{2}$.
- $MC_1 = 0$
- $MC_2 = c$
- No fixed costs

Find equilibrium $\boldsymbol{P}$, $\boldsymbol{Q}$ and profits in the Bertrand model as a function of $\boldsymbol{c}$.

Case $c = 0$

- Standard Bertrand
- $P = 0$, $Q = 100$, Profits = 0

Case $c > 0$

- Firm 1 can charge $P \approx c$ and push firm 2 out of the market
- $P = c,\ \ Q_1 = 100 - c,$ Profits of 1 = $(100 - c)c$
- But limit for this: firm 1 will not set a price higher than a monopolist
- Monopolist would set $MR = 100 - 2Q = MC = 0$

$$\Rightarrow \quad Q^M = 50 \text{ and } \quad P^M = 50$$

- Then, $P^M = 50$ is the maximum price firm 1 will charge (even if $c > 50$)

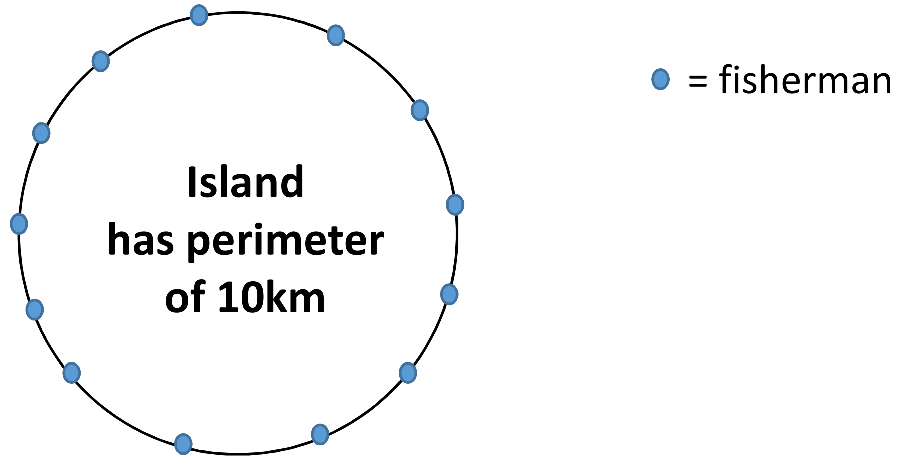
Summary

- $\boldsymbol{c = 0}$ $\Rightarrow P = 0,\ \ Q = 100,$ Profits = 0
- $\boldsymbol{0 < c < 50}$ $\Rightarrow P = c,\ \ Q = 100 - c,$ Profits1 = $(100 - c)c$
- $\boldsymbol{c > 50}$ $\Rightarrow P = 50,\ \ Q = 50,$ Profits1 = 2500

Question 18

The 1,000 residents of Great Donut Island are all fishermen. Every morning they go to the nearest port to launch their fishing boats and then return in the evening with their catch. The residents are evenly distributed along the 10-kilometer perimeter of the island. Each port has a fixed cost of €1,000/day.

If the optimal number of ports is 2, what must be the **per kilometre travel cost?**



We need to find t = cost per kilometre knowing that optimal N = 2

Key:

- The total cost for the island is:

TRAVEL COSTS + PORT'S COST

(A) + (B)

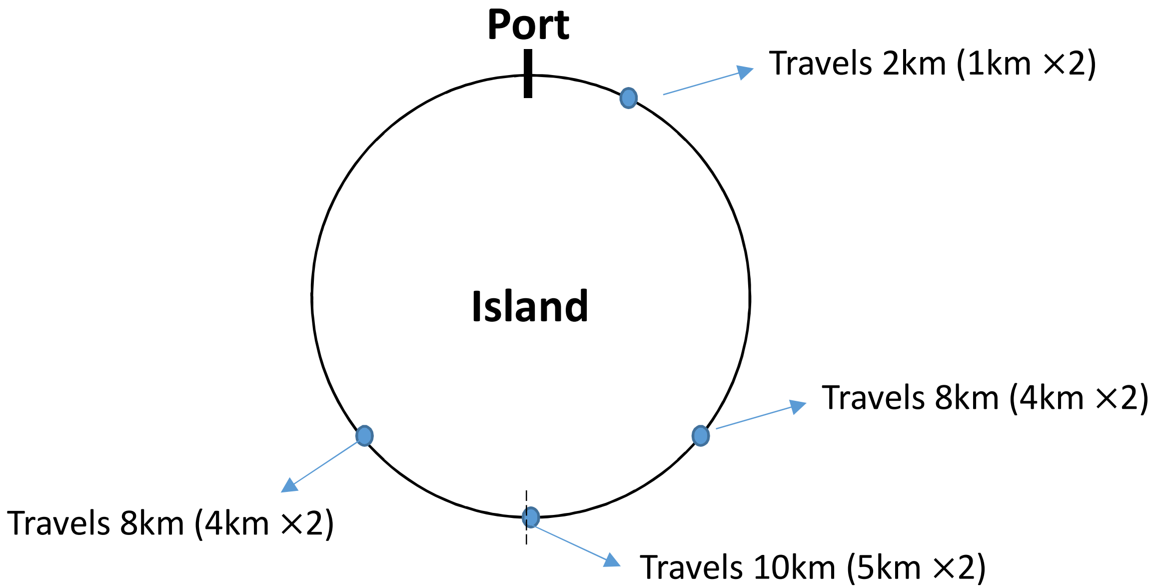
(A) is reduced if we build more ports

(B) is increased if we build more ports

Then, there should be an optimal N of ports

Travel Costs:

With one port

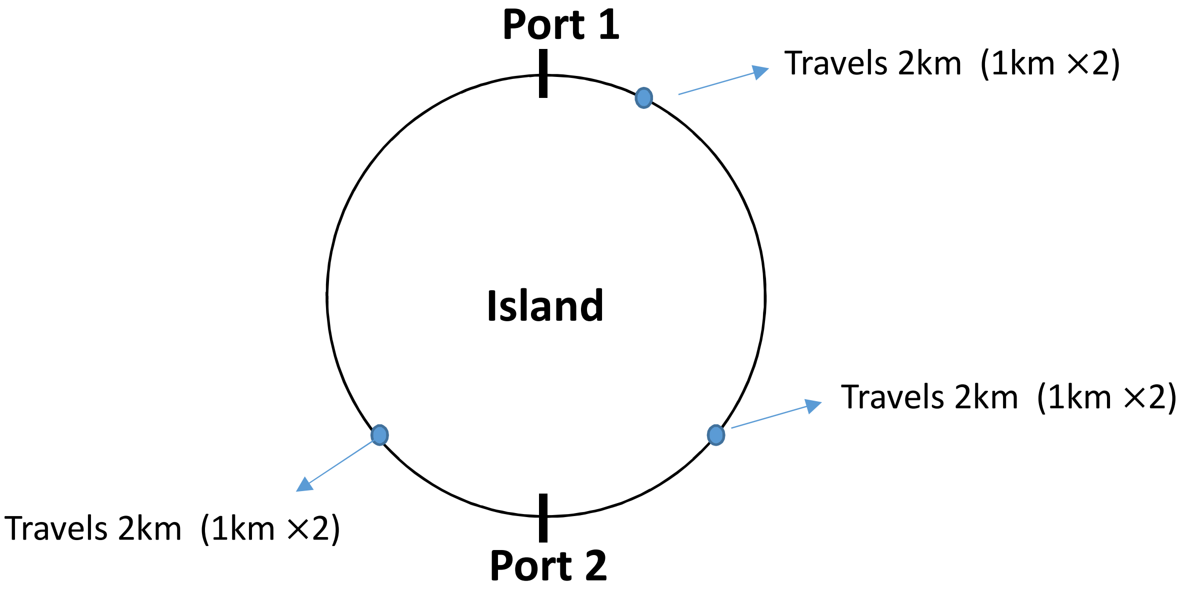


The average trip is 5km

The total cost (all fishermen) is 5km x 1000 x t

Travel Costs:

With two ports

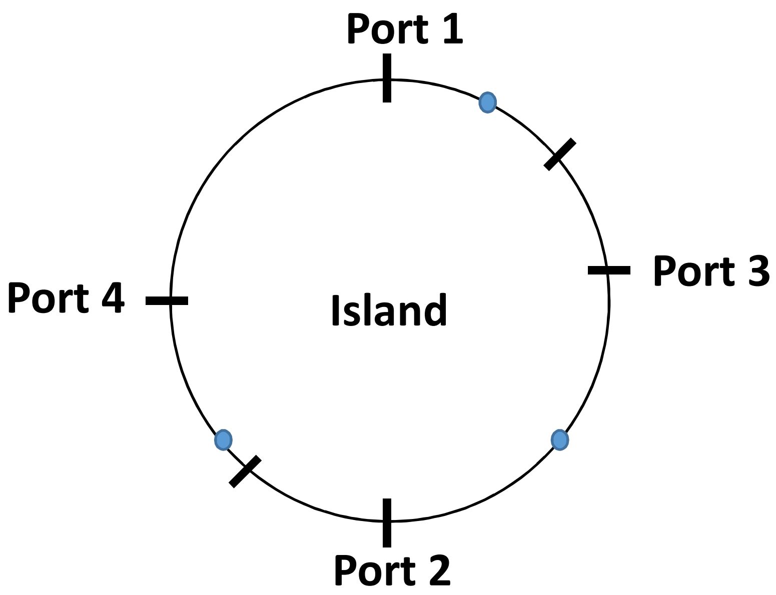


The average trip is 2.5km

The total cost (all fishermen) is 2.5km x 1000 x t

Travel Costs:

With N ports



The average trip is $\frac{10}{2N}$ km (half of maximum distance)

The total cost (all fishermen) is $\frac{10}{2N}$ x 1000 x t

Total Costs:

TC = TRAVEL COSTS + PORT'S COST

$$= \frac{10}{2N} 1000t \quad + \quad 1000N$$

Optimal N of ports $\frac{\partial TC}{\partial N} = 0$

$$\frac{-5000t}{N^2} + 1000 = 0 \qquad \Longrightarrow \qquad t = \frac{N^2}{5} = \frac{4}{5}$$

Question 21

Alfred and Barry each own a restaurant on a busy high street. At the moment they each earn £100 of profit. They each have the option of running an advertising campaign. If Alfred advertises and Barry does not then Alfred's profits would be £110 and Barry's £105. If Barry advertises and Alfred does not then Alfred's profits would be 115 and Barry's 101. If both advertise their profits would be 104.

a) If both have to decide simultaneously whether to advertise, what are the **Nash equilibrium** outcomes?

- When strategies are discrete options => Write payoff matrix
- Then check Best Responses

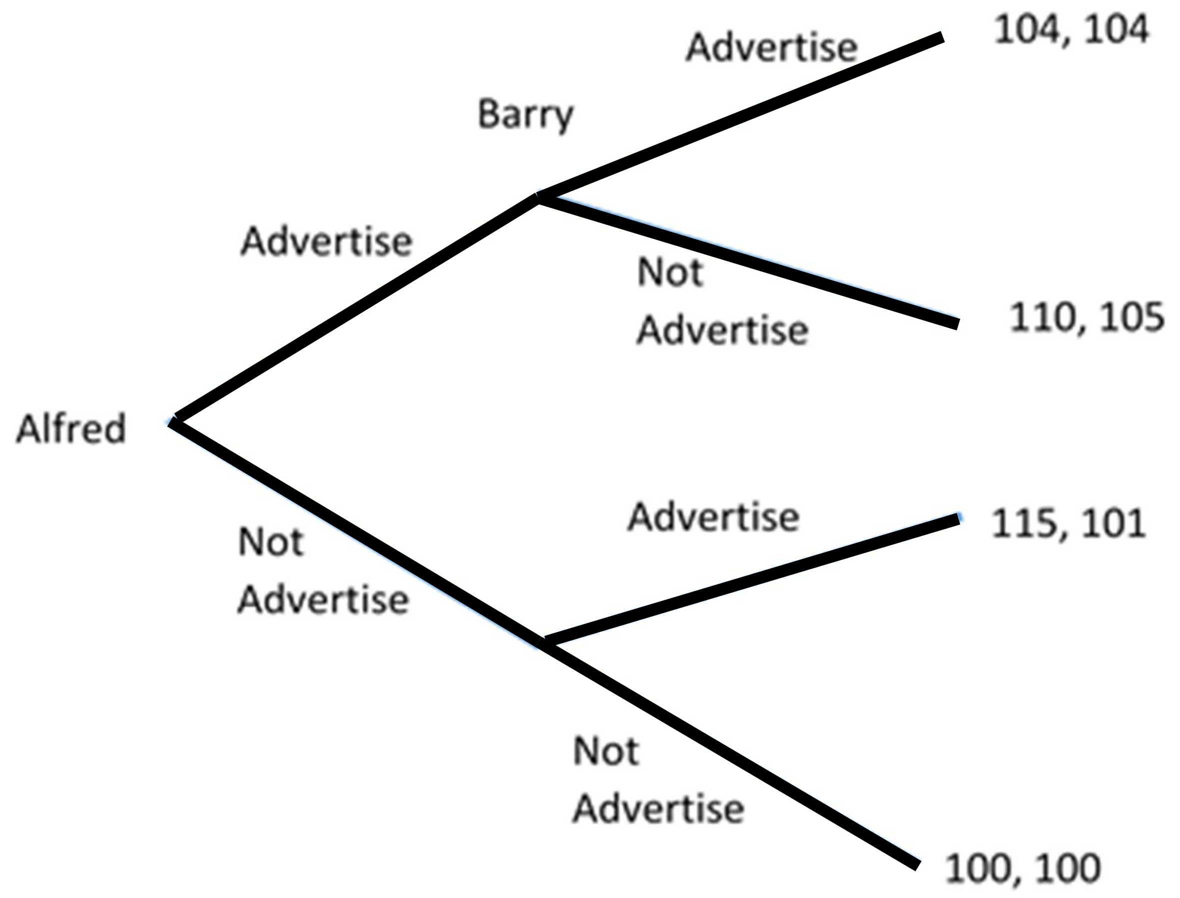
		Barry	
		A	**NA**
Alfred	**A**	104, 104	<u>110</u>, <u>105</u>
	NA	<u>115</u>, <u>101</u>	100, 100

NE when both playing Best Response to each other

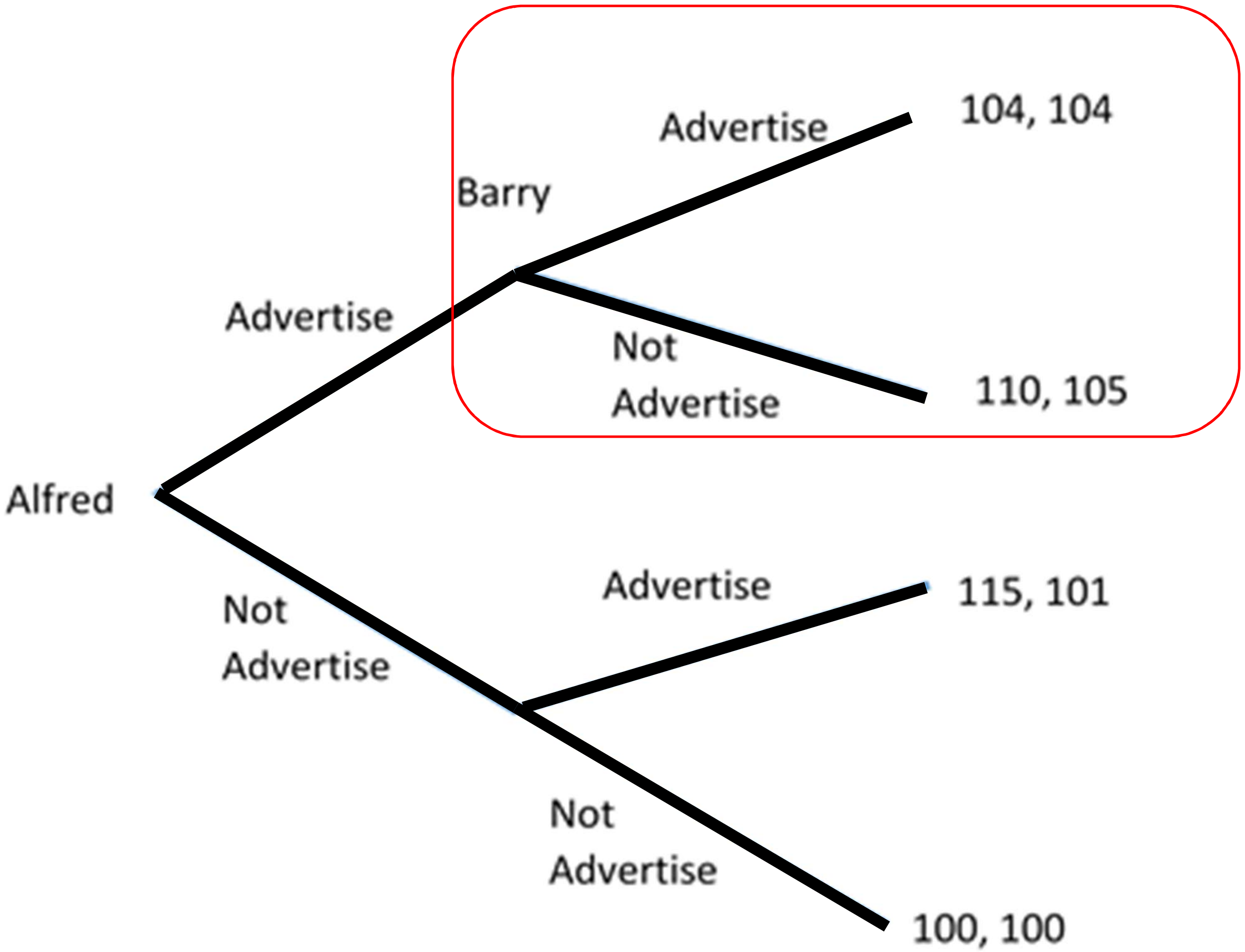
b) Same game than (a) but dynamic (Alfred play first).

- Find SPE
- Are there other NE?

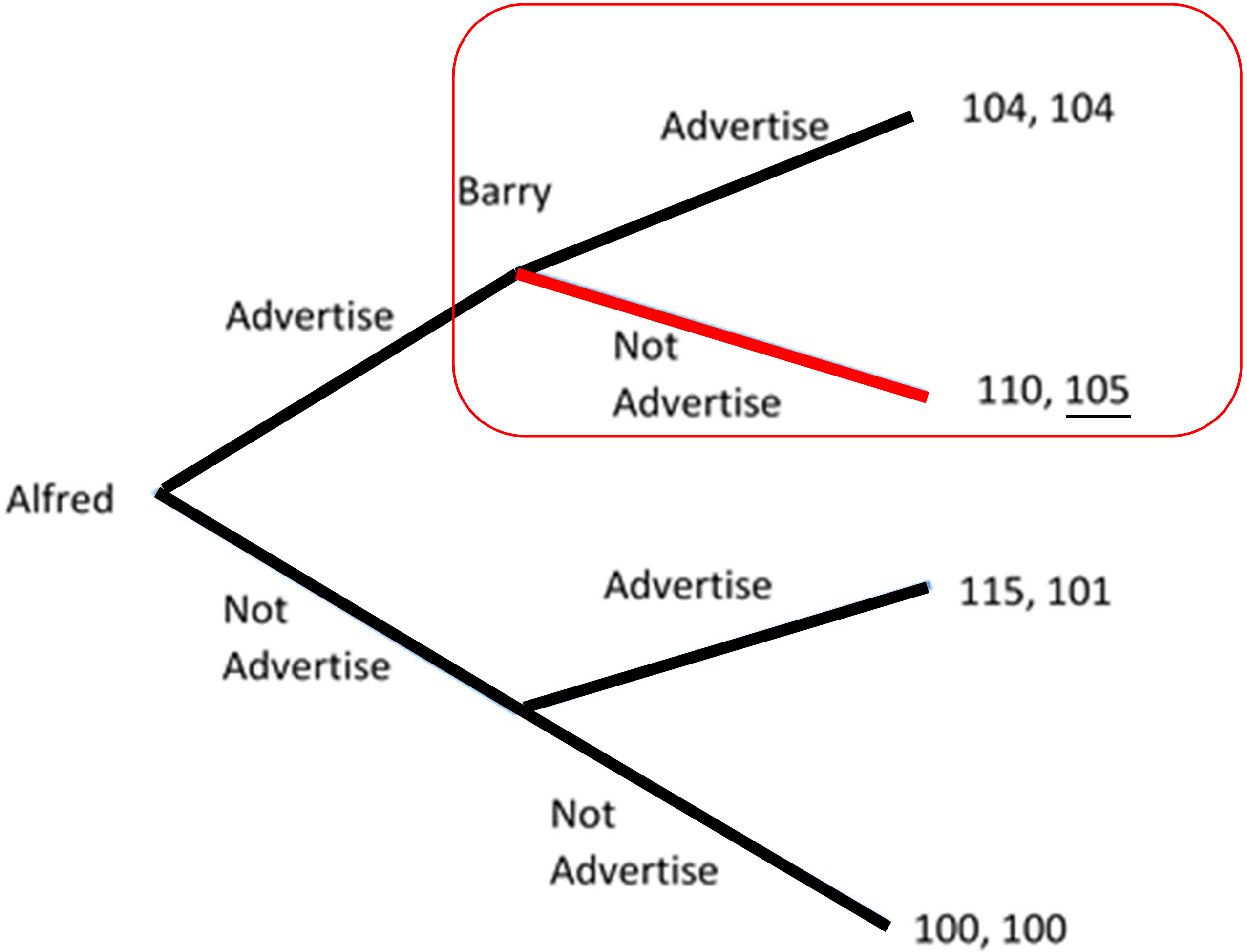
- **Subgame Perfect Equilibrium**: Is a Nash Equilibrium with the <u>additional</u> property of being a NE in every sub-game
- In other words:
  - Moves must be rational if we look at any part of the game
  - No one plays a “non-credible threat”
- We **always** find the SPE using **backward induction**


Alfred
Advertise
Not Advertise
Barry
Advertise
104, 104
Not Advertise
110, 105
Advertise
115, 101
Not Advertise
100, 100

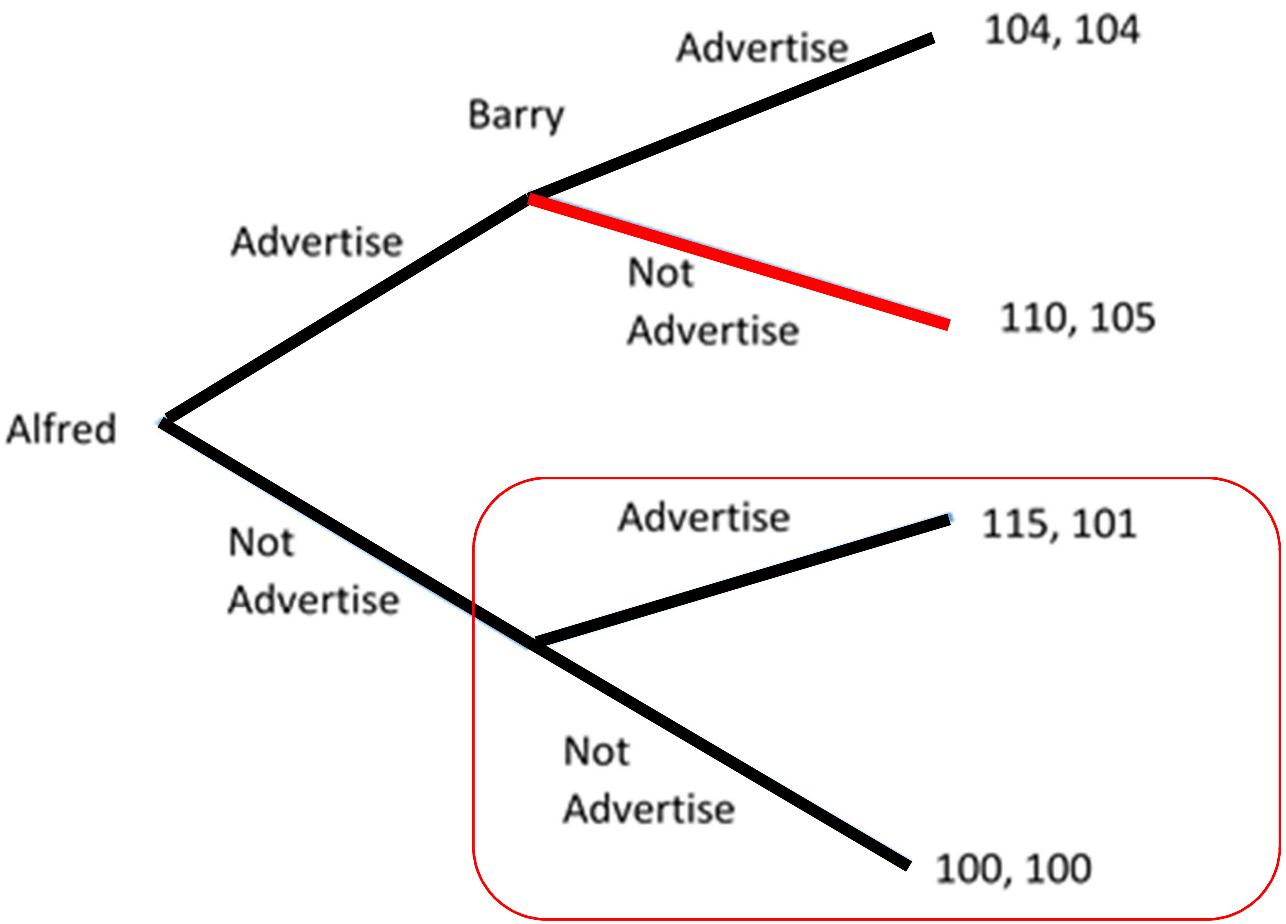
Start with last (or one of the last) subgames



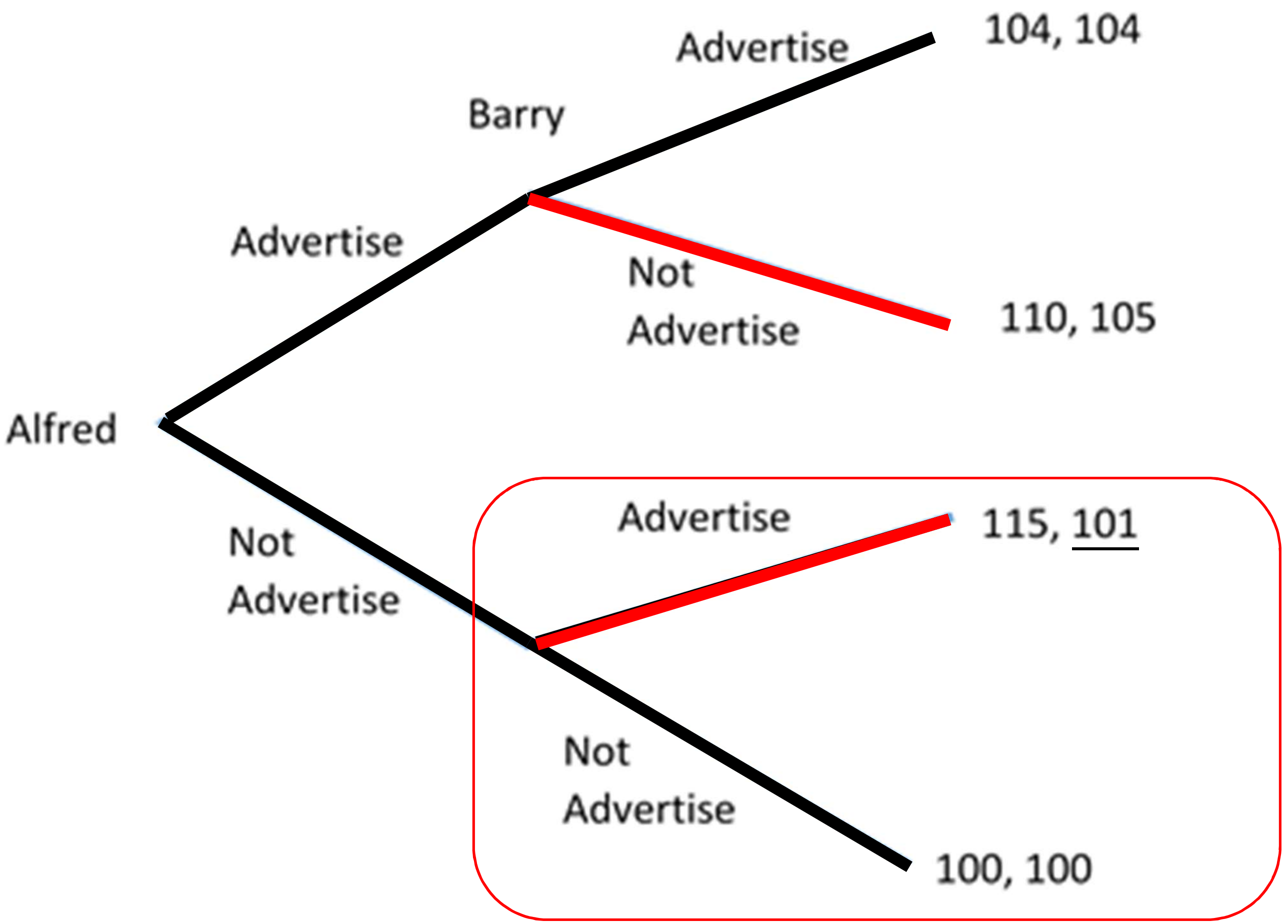
Barry prefers 105 > 104 in such a subgame



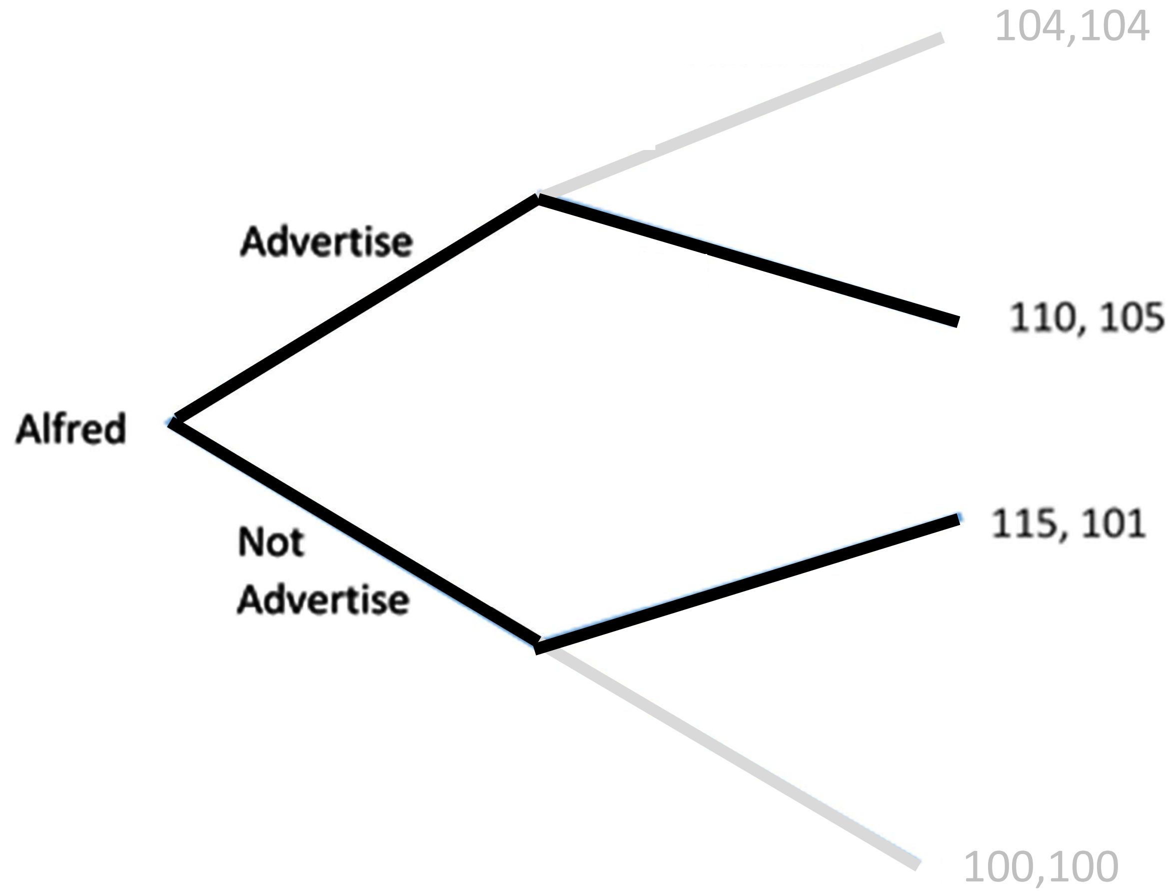
In the other final subgame, Barry prefers 101>100



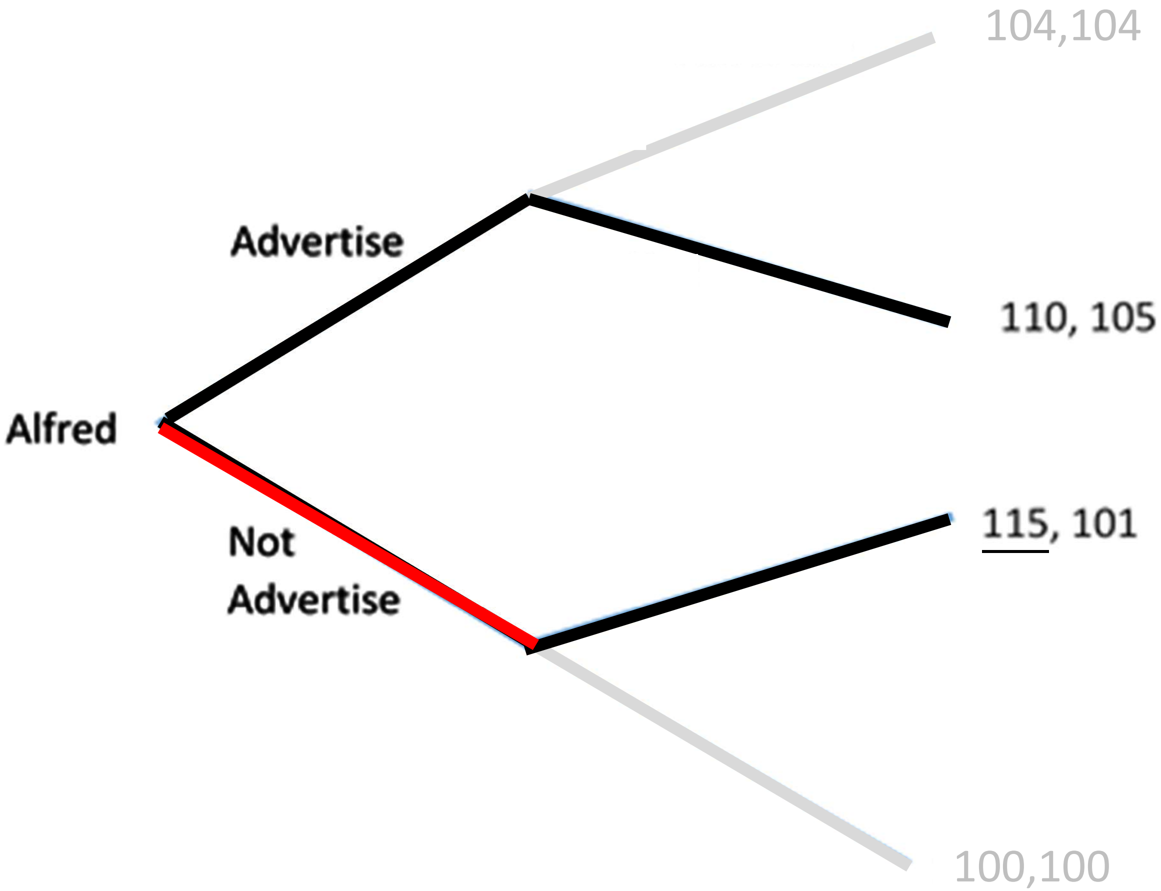
In the other final subgame, Barry prefers 101>100



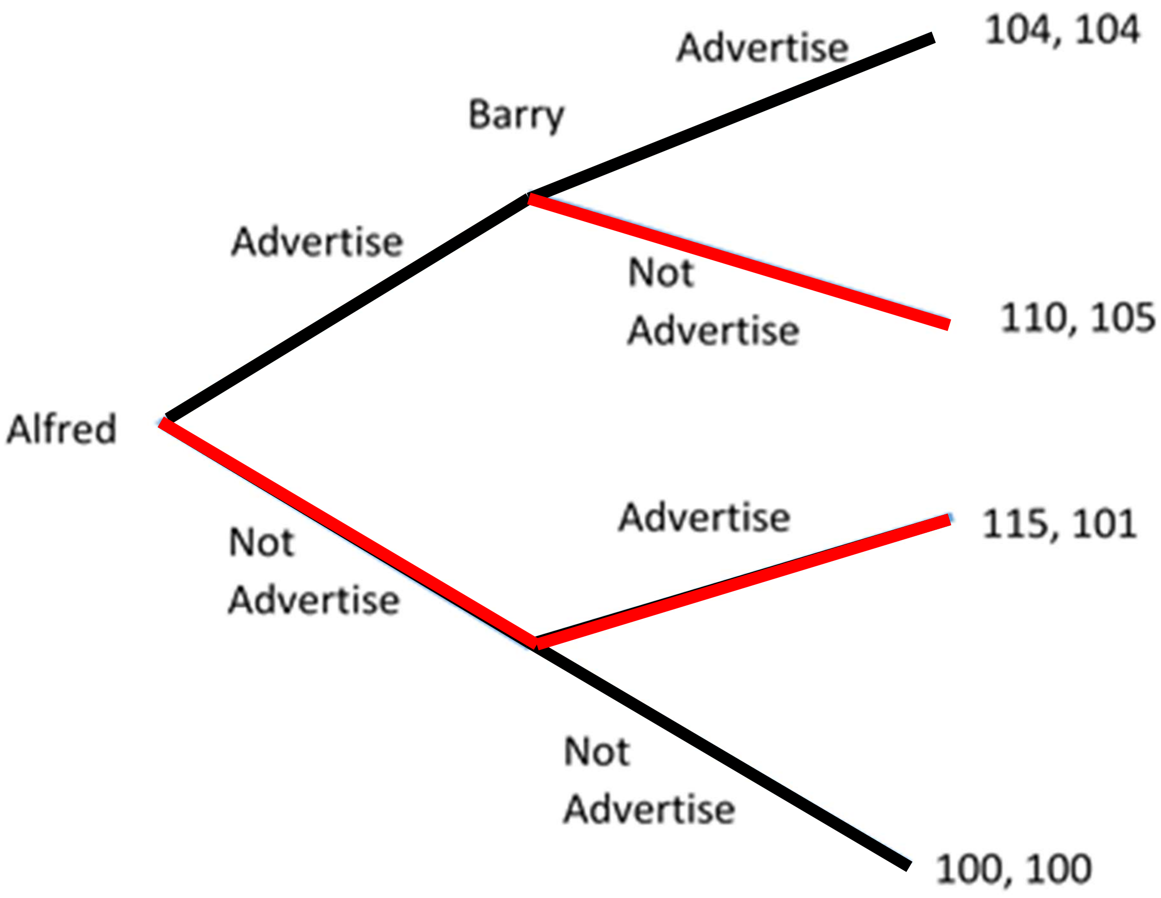
Now Alfred "anticipates" Barry's moves in each node



And prefers 115 > 110



Put all the moves together to see the SPE



SPE: Alfred plays NA. Barry plays A in response to NA and NA in response to A

Important Notes:

- Barry’s strategy indicates what he plays IN ANY situation, even those that never occur (e.g. Alfred playing A)

- The fact that Barry plays NA in the upper node is a “credible threat”

- There are some NE that are not SPE

- Write the payoff matrix
- Barry’s strategy has two elements (what to do in the upper node and what to do in the lower node)
- Find Best Responses

		Barry			
		A-A	**A-NA**	**NA-A**	**NA-NA**
Alfred	**A**	104, 104	<u>104</u>, 104	110, <u>105</u>	<u>110</u>, <u>105</u>
	NA	<u>115</u>, <u>101</u>	100, 100	<u>115</u>, <u>101</u>	100, 100

NE but not SPE

SPE