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Solution Manual Game Theory For Applied Economists

ECON-459: Applied Game Theory
Problem Set 1 - Solutions

1. Problems 1.5, 1.7 and 1.8 from Gibbons.
Gibbons #1.5

The question asks you to express the Cournot duopoly game as a Prisoners' Dilemma where the only two available quantities are the monopoly quantity, q_m , and the Cournot equilibrium quantity q_c . To do this, you will need to calculate the payoffs to each player under each combination of these strategies. That is for each player i we know that the profit function is

$$\pi_i(q_i, q_j) = q_i(p - c - \alpha q_j)$$

So for player 1, the following values must be calculated.

$$\pi_1(q_m, q_m) = \frac{(a-c)^2}{3}$$

$$\pi_1(q_m, q_c) = \frac{(a-c)^2}{3}$$

$$\pi_1(q_c, q_m) = \frac{(a-c)^2}{3}$$

$$\pi_1(q_c, q_c) = \frac{2(a-c)^2}{9}$$

It can be verified that $\pi_1(q_m, q_m) > \pi_1(q_m, q_c) > \pi_1(q_c, q_c) > \pi_1(q_c, q_m)$, which corresponds to the payoffs for the Prisoners' Dilemma game. These payoffs and strategies can be represented in matrix form as below.

	q_m	q_c
q_m	$\frac{(a-c)^2}{3}, \frac{(a-c)^2}{3}$	$\frac{(a-c)^2}{3}, \frac{2(a-c)^2}{9}$
q_c	$\frac{(a-c)^2}{3}, \frac{2(a-c)^2}{9}$	$\frac{2(a-c)^2}{9}, \frac{2(a-c)^2}{9}$

The second part of the question asks you to extend the game by adding a third possible quantity, q' . The game must be such that the Cournot output is still the unique Nash equilibrium, and there are no strictly dominant strategies. There is no single solution to this problem, but one way to proceed is as follows. First set up a hypothetical matrix of the game as below.