Wilfrid W. Csaplar Jr. Help Sheet for Week #7 Econ 476

A Nash equilibrium is one in which no party has a reason to change their strategy. All parties assume that the other parties will not change their strategies. Thus, the Cournot model is also a Nash equilibrium. We will apply the Nash equilibrium to game theory.

<table>
<tr><td colspan="2" rowspan="2">Payoff Matrix</td><td colspan="2">Player 2</td></tr>
<tr><td>Strategy A</td><td>Strategy B</td></tr>
<tr><td rowspan="2">Player 1</td><td>Strategy C</td><td>Payoff 2-1
Payoff 1-1</td><td>Payoff 2-3
Payoff 1-3</td></tr>
<tr><td>Strategy D</td><td>Payoff 2-2
Payoff 1-2</td><td>Payoff 2-4
Payoff 1-4</td></tr>
</table>

Using the matrix above, player 1 can only move up and down and player 2 can only move left or right. Therefore, player 1 will either be choosing between payoff 1-1 and payoff 1-2 or they will be choosing between payoff 1-3 and payoff 1-4. Which pair they are deciding between depends upon which strategy player 2 uses. Similarly, player 2 will either choose between payoff 2-1 and payoff 2-3 or between payoff 2-2 and payoff 2-4. The former choice will be made if player 1 chooses strategy C and the latter choice will be made if player 1 chooses strategy D.

Note the when figuring out player 1's best strategy, we must first assume that player 2 has made a choice. Then compare the upper-right-hand entries in that row and choose the highest number. Those are the only possible equilibria. Then find player 2's best strategies by assuming that player 1 has chosen a strategy and then find the highest number in the lower-left-hand entries in that column. Those represent the only possible equilibria. If there is a box with both payoffs chosen, then the corresponding strategies are a Nash equilibrium because those strategies are the best they can do given the other player’s strategy.

A secure strategy is the strategy which gives the player the best worst case scenario. The cooperative solution is the pair of strategies which gives the most combined utility.

Some facts about Nash equilibria:

1) There may be no equilibrium. (In more advanced theory, we can figure out how to create some interesting strategies.)

2) There can be no more equilibria than the number of strategies that the person with the fewest choices has. So in the example above, there can be no more than two equilibria. If one player had three strategies and the other had six strategies, there can be no more than three equilibria.

3) The Nash equilibrium may not be the socially optimal point, i.e., the cooperative equilibrium. In that case, we get something akin to the “Prisoners’ Dilemma.”