Assignment 1 Econ 514

Two exercises in julia for future use.

1. In the directed search problem with incomplete information what we showed in the class was that firms always want to undercut the other firm's wage. They do this because the type L workers want to avoid competing against the type H workers and are willing to accept much lower wages to do that. The purpose of this question is just to figure out whether this is still true if there is a productivity difference.

Start with the notebook directed_search_complete_info_julia, modify the code to calculate firms' profits when type H workers produce more output than type L workers. Then the revenue the firm gets when it hires a type H worker be $y_H > y_L$ for both firms. Assign values, for example $y_H = 1$, $y_L = .75$ then recalculate the firms profit function and graph it as is done in the last cell of the current notebook. Drawing the graph is enough to complete the assignment, but if you are ambitious try to look for a symmetric equilibrium in which the derivative of each firm's profit function is zero when each firm offers the same wage.

2. Using the notebook at ring_game_julia, redo the notebook except that at the beginning, load the csv file fake_data.csv in place of ecma.csv. You'll have to modify the code slightly to work because there are more subjects, and of course, the results will be different.

3. Lest you think this game theory stuff is bs that has no real world applications, here is a problem suggested to me Alex Dong, who saw it on a Korean game show called Running Man. There are 8 rooms and 8 contestants. Each person must choose to go to one of the rooms (assume the choice is once for all and each person decides simultaneously). Once everyone is in their room, a prize in each room is split among all the players in that room. The prize is room 1 is 40K (won I assume), the prize in rooms 2,3 and 4 is 50K won, the prize in rooms 5,6 and 7 is 70K won, while the prize in room 8 is 100K won. So if all 8 people go to room 8, each of them will get 100/8 K won.
This is directed search game. Write an algorithm (in julia of course) to find all the pure strategy Nash Equilibrium. Find the unique symmetric mixed equilibirum.
There you go, if you ever get to be on the show you can use game theory to make money.

4. A simple cournot equilibrium problem: The demand curve is given by

$$p = A - bQ$$

where is the total quantity produced by n identical firms with cost functions given by

$$C(q) = cq^2.$$

In a symmetric equilibrium, all firms will produce the same quantity q^* so that $Q^* = nq^*$ defines the Nash equilibrium price. Create a julia notebook and use sympy to find the symmetric Nash equilibrium analytically. What happens when n goes to infinity.