Professor Robert A. Miller
Carnegie Mellon University
Strategic Corporate Management
45-870M Mini 2 2025

ASSIGNMENT 1 (9 points)
Answer Key

(Due Sunday October 26. One point per day will be deducted for each day late.)

You should form **assignment groups** of one to three to do the assignments. (Please do not ask me about groups of 4.) Each **assignment group** should submit one pdf or a word document. Use the comlabgames software to display your matrices.

You should also form **experimental groups** of four to eight to conduct the experiments. Your **experimental groups** will combine two or more **assignment groups** that include your own. Everyone in the same **assignment group** will also be in the same **experimental gro**up but not vice versa.

The purpose of combining **assignment group** is to participate in experiments in the assignments. There are a total of twelve experiments scattered throughout the five assignments.

You will be graded on your participation in the experiments, but it is not necessary to participate in every single experiment to get full credit for this portion of the course. For full credit in this portion of the course:

(i) play at least eight of the experiments in the five assignments.
(ii) be the moderator (not a player) for at least one of them.

Please list on the front page of each assignment:

(i) Who is in your assignment group.
(ii) Who is in the experimental group.
(iii) Who participated in the experiments.

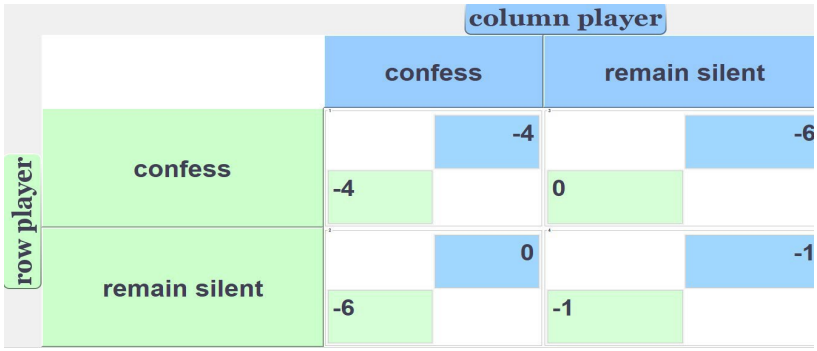
Please follow the following protocol when you schedule and run the experiments:

(i) Schedule a zoom meeting so that everyone can see who is participating.
(ii) Decide ahead of time who will be the moderator conducting each experiment.
(iii) After the experiment ends the moderator will take a screen shot to be distributed to each subject, and included in the assignment answers.
(iv) The moderator will send the output to the teaching assistant with a brief note identifying the Assignment, the experiment and the participants.

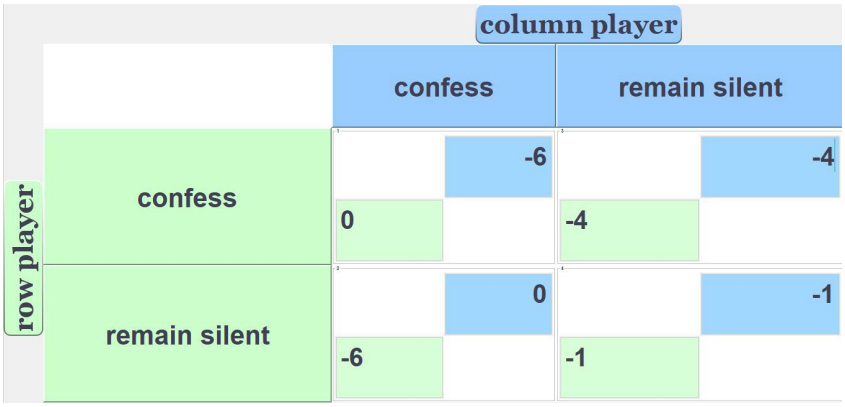
There are three multipart questions and three experiments in this assignment.

Question 1 (3 points) . . . *switching the payoffs in the prisoner's dilemma game*

Here is the prisoner's dilemma game we presented in the lecture.



Suppose the payoff in the top two columns are switched so that the matrix now looks like:



(a) Copy this modified prisoner's dilemma game from the Assignment 1 page on the course website and save it on your laptop. Then open the game within the comlabgames module and play ten or more rounds of this game amongst your own team and report the results by taking a snapshot that shows the number of outcomes in each cell.

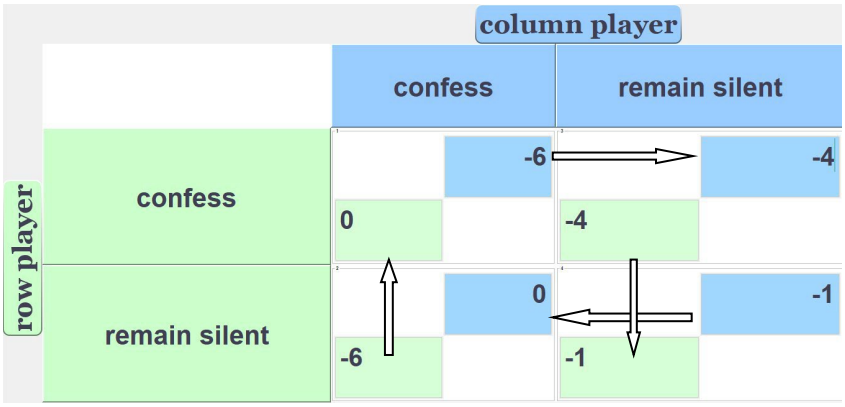
(b) What is the empirical distribution (from your group)?

(c) What is the best response of the green and red players?

Row Player's Best Response: Confess if the column player confesses. Remain silent if the column player remains silent.

Column Player's Best Response: Remain silent if the row player confesses. Confess if the row player remains silent.

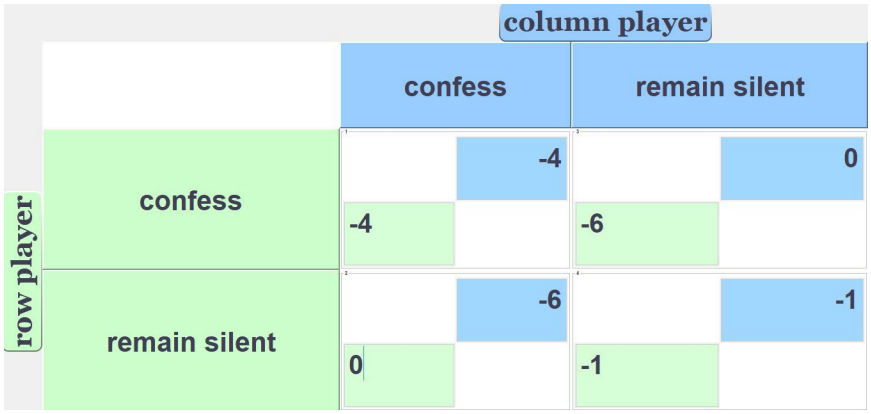
(d) Using the arrow notation, to show the best replies in this game. (That is, copy the bi-matrix diagram on to your answer sheet, and then paste your best reply arrows on to the bi-matrix.)



(e) Is there a pure strategy Nash equilibrium?

No. All cells have arrows going out, meaning that there does not exist a combination of pure strategies where each player is playing her best reply to the other player's strategy.

(f) Now change the bi-matrix one in yet another way by exchanging the off-diagonal cells so that it looks like the bi-matrix just below and repeat (a) through (e). So first, play ten or more rounds of this game amongst your own team and report the results by taking a snapshot that shows the number of outcomes in each cell.



(g) What is the empirical distribution now (from your group)?

(h) What is the best response of the green and red players now?

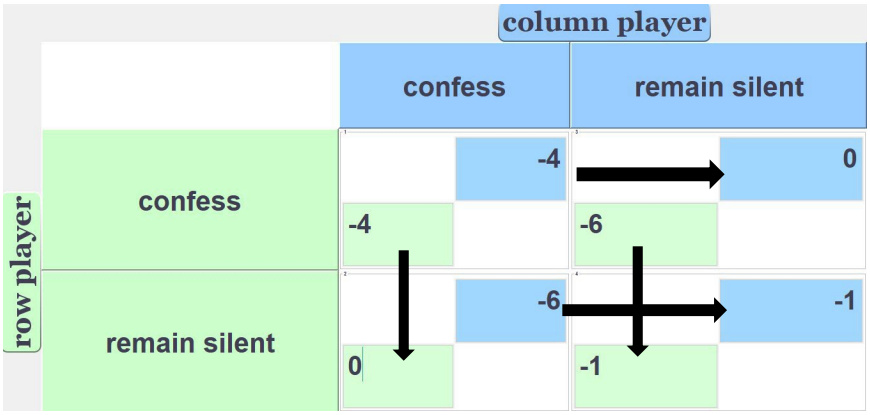
Row Player's Best Response:

Remain silent whether the column player confesses or remains silent.

Column Player's Best Response:

Remain silent whether the row player confesses or remains silent.

(i) Using the arrow notation, to show the best replies in this game.



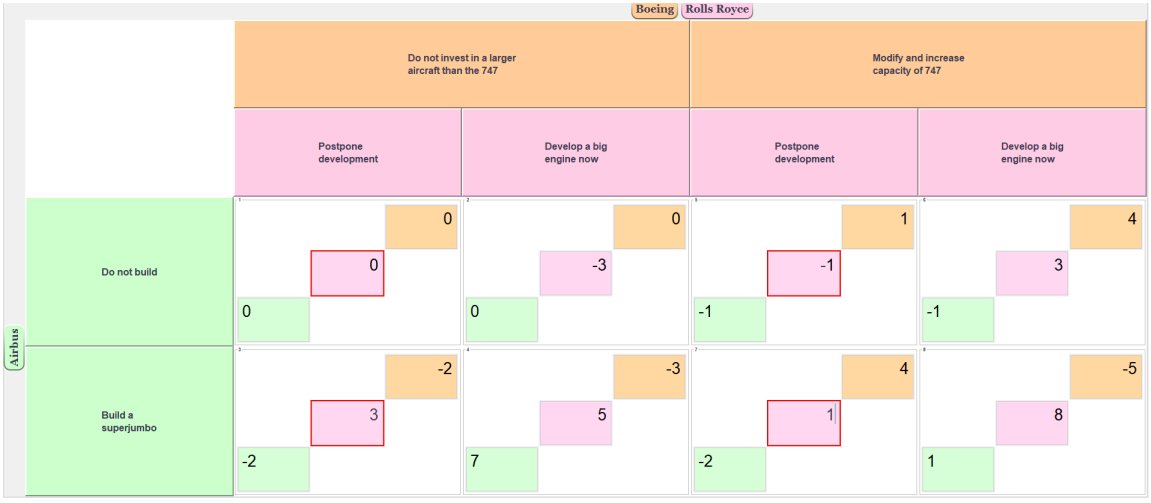
(j) Is there a pure strategy Nash equilibrium?

Yes, both players choose to remain silent

Question 2 (3 points) . . . *superjumbo*

By 2000 Boeing had established a monopoly in the jumbo commercial airliner market with its 747, and up until that time did not have much incentive to build a bigger jet. Airbus found it would be profitable to enter the large aircraft market if and only if Rolls Royce would agree to develop the engines. Rolls Royce was willing to develop bigger engines if it could be assured that at least one of the two commercial airline manufacturers would be willing to buy them.

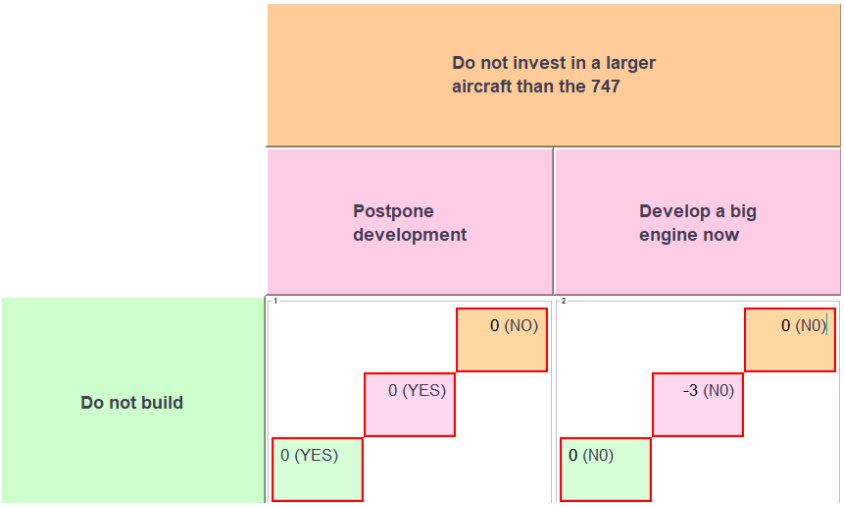
Payoffs in the cells in the matrix below represent changes in the expected values of the respective firms conditional on choices made by all of them. If the status quo remains, the value of each firm remains the same, so each firm is assigned 0 in the top left corner. The four (pink) highlighted payoffs to Roll Royce show the possible payoffs it will receive by postponing development. For example, if Airbus builds and Boeing modifies and increases, Rolls Royce receives 1.



(a) First, copy this game from the Assignment 1 page on the course website and save it on your laptop. Then open comlabgames and play at least rounds of this amongst your own team and report the results by a taking snapshot. *Note that you will not be graded on your experimental results: I just want you to see what you would really do in this situation for each of the roles you might play.*

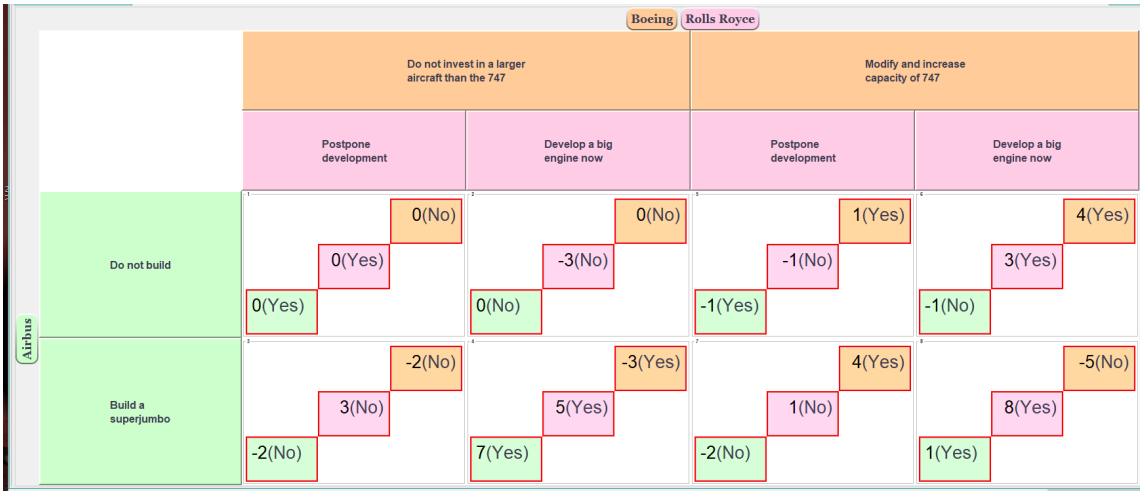
(b) What is the empirical distribution that your group generated for each player for the experiment you conducted above?

Rather than use arrows, sometimes it is neater to type YES is a reply and NO if not. We can illustrate best replies in this 3 player game by tagging each reply as either a best reply (YES) or not (NO). The next figure partially completes the exercise. The PINK YES shows that if Boeing does not invest and Airbus does not build, then the best reply of Rolls Royce is to postpone development.



(c) What is the best response of each player to the empirical distribution you generated?

(d) Complete this diagram showing the best replies for all three players using this terminology.



(e) Find the Nash equilibrium for this game.

The NE is the cell with three "YES": (Build a superjumbo, Do not invest, and Develop a

big engine now).

(f) Comment on the main differences between your strategy selections and the Nash equilibrium.

(g) When you were Boeing, assuming the other players continued to play the same way, would you have achieved higher profits or lower losses on average by playing the NE strategy as opposed to what you played in the experiment? (Explain.)

To clarify, the question assumes that the other players' strategies follow the same distribution as in the experiment, for example, say Airbus "Do not build" 25% of the time, and Rolls Royce "Postpone development" 25% of the time. Then the question asks you to compare the expected payoff of Boeing by playing its Nash equilibrium strategy given the empirical distribution of the other players' strategies, to the average payoff of Boeing in the experiment.

Question 3 (3 points) . . . *Cola wars from the previous century*

Read the article on Cola wars and answer the following questions, by distilling the main considerations that guided the decisions of the major parties in this episode of a strategic rivalry that continues to this day.

(a) Who are the major players in this episode? (By a major player, I mean a team of individuals with a common goal. I am not looking for a list of individuals.)
(b) What are the most important choices for each major player mentioned in (a)?
(c) Are there any minor players? (Minor players might be different groups of demanders, each of whom is associated with a probability distribution that affects the outcomes and payoffs of the major players.)
(d) What were the main factors affecting the payoffs of the major players?
(e) What are the main sources of uncertainty that the major players must contend with?
(f) In reflecting on this piece of history, was Pepsi ahead of its time, or simply reacting to market exigencies? Justify your answer by drawing upon the evidence provided in the article.