

ECO/MTH 375: Midterm 1 (Take-home)

February 22, 2019

Name: _____

Partner: _____

Make sure to **show your work or explain your answers** for all questions; I reserve the right to give no credit to solutions with no work or explanation.

For this exam, you are allowed to discuss problems and work with **one** other person. However, you are **not** allowed to write up solutions with them – your work must be your own. **If you have a partner, you must write their name on the front sheet under your own.** Either way, you **must** have this front sheet attached to the front of your exam when you turn it in. **Do not write out your answers on the exam question sheet – you must write solutions on separate pages.**

Other than working with a partner, you may use a calculator, your notes, and the course textbook. You may not use any other resources when working on the exam. This exam will be due on **Wednesday, February 27, in class.** Good luck, and have fun!

1. The Daily Bugle has just interviewed Peter for a position at their New York branch. Based on the interview, HR believes there is a 10% chance Peter has High ability, a 30% chance Peter has Medium ability, and a 60% chance Peter has Low ability to complete the job they are considering him for. HR must decide whether or not to Hire Peter, keeping in mind that once Peter starts his job, he may decide to Work hard or to Shirk his duties. (Peter may also Reject the offer.)

- If HR decides to hire Peter, Peter accepts, and he has High ability, then the Daily Bugle will get a payoff of 10 if Peter Works and a payoff of 2 if Peter Shirks. In this situation, Peter gets a payoff of 2 for Working and a payoff of 1 for Shirking.
- If HR decides to hire Peter, Peter accepts, and he has Medium ability, then the Daily Bugle will get a payoff of 7 if Peter Works and a payoff of -1 if Peter Shirks. In this situation, Peter gets a payoff of 2 either way if he decides to work or shirk – thus, he is equally likely to do either.
- If HR decides to hire Peter, Peter accepts, and he has Low ability, then the Daily Bugle will get a payoff of 3 if Peter Works and a payoff of -4 if Peter Shirks. In this situation, Peter gets a payoff of 1 for Working and a payoff of 3 for Shirking.
- If Peter doesn't end up working at the company (either from not getting an offer or from Rejecting one), then the Daily Bugle gets a payoff of -1 : everyone at the firm gets bummed out from missing a chance to work with THE Peter Parker!
- Peter will get a payoff of 0 for not getting an offer and a payoff of 1 for getting to Reject an offer: Peter would get some smug satisfaction for getting to refuse an offer from J.Jonah Jameson.

a) (5 points) Use the Harsanyi doctrine to model this scenario as a single game and draw the game tree. Make sure your tree reflects each player's information appropriately.

b) (5 points) Find *all three* probabilities (as beliefs of the Daily Bugle) that Peter will Work, Shirk, or Reject the offer *if* an offer were to be made. Assume all players have full knowledge of what the other players know and don't know and that each player acts rationally.

c) (5 points) Calculate the expected payoffs for the Daily Bugle for both making an offer to Peter and for rejecting Peter.

d) (5 points) Find all Bayesian equilibria of this game. Keep in mind that each player's strategies can depend on their information about the state of the game. Explain your answer.

2. The following table describes payoffs for the USA and the USSR during the Cold War in their race for nuclear supremacy. Each strategy refers to the amount of money/effort on both countries put into developing/maintaining nuclear weapons.

USSR

		None	Moderate	Heavy
USA	None	0,0	-9999,-5	-9999,-10
	Moderate	-5,-9999	-5,-5	-500,-10
	Heavy	-10,-9999	-10,-500	-10,-10

Payoffs to (USA,USSR)

- a) (6 points) Find all Nash equilibria in this game. For each Nash equilibrium, determine whether or not said equilibria are also dominant-strategy or iterated-dominance equilibria.
- b) (3 points) The strategy profile carried out in the Cold War was (Heavy, Heavy). Explain why this strategy profile was the one implemented instead of any of the other Nash equilibria you found in a).
- c) (3 points) Do you believe that the payoff vectors described in this table are reasonable, meaning they could describe actual payoffs to Cold War nuclear buildup? Explain why/why not.

3. (5 points) Explain in your own words why all dominant-strategy equilibria must also be Nash equilibria.

4. Consider the standard Prisoner's Dilemma (with simultaneous movement) with payoff table

		Column	
		Deny	Confess
Row	Deny	-1,-1	-10,0
	Confess	0,-10	-8,-8

Payoffs to (Row,Column)

Suppose we added a wrinkle to this game where each player has a 50% chance of being a "Nice" criminal or an "Evil" criminal.

If an Evil criminal chooses to Deny while the other criminal Confesses, the Evil criminal has a 60% chance to put out a hit on the other criminal, which would result in a change of -30 to this other criminal's payoff (as they are forced into a life in hiding, which is worse than living in jail). Assume neither criminal has knowledge of whether the other criminal is Nice or Evil.

- a) (5 points) Sketch the game tree for this game. Make sure to take into account each player's information sets at different points in the game. Assume an Evil criminal must always put a hit on the other criminal with probability 0.6 – this is not something the Evil criminal gets to decide.
- b) (5 points) Find all Nash equilibria for this game, assuming both players are risk neutral.
- c) (3 points) What would you expect each criminal to do in this situation?