Stockholm University

Department of Economics

Course name:	**Economic Strategic Thinking**
Course code:	**EC2109**
Type of exam:	**Main**
Examiner:	**Robert Östling**
Number of credits:	**7,5 credits**
Date of exam:	**Wednesday March 14 2018**
Examination time:	**3 hours (09:00-12:00)**

Write your exam identification number on each answer sheet (the number stated in the upper right hand corner on your exam cover).

Use the multiple-choice answer sheet for all questions in Part A and separate answer sheets for the questions in Part B. Explain notions/concepts and symbols. If you think that a question is vaguely formulated, specify the conditions used for solving it. Only legible exams will be marked. **No aids are allowed.**

The exam consists of 8 questions. Each question is worth 8 to 28 points, 100 points in total. For the grade E 45 points are required, for D 50 points, C 60 points, B 75 points and A 90 points.

Your results will be made available on your Ladok account **(**www.student.ladok.se) within 15 working days from the date of the examination.

Good luck!

PART A: Multiple-choice questions

Indicate one alternative per question only. Correct answers give 8 points, incorrect answers minus 2 points.

QUESTION 1 (8 POINTS)

Consider the following three-player game in which three players simultaneously choose actions (Player 1 and 2 has three strategies, Player 3 has two strategies). What strategy profiles are pure-strategy Nash equilibria of this game? Payoffs and strategy profiles are denoted as usual, i.e. "X,Y,Z" means X to Player 1, Y to Player 2 and Z to Player 3.

Player 3 plays A		Player 2		
		A	B	C
Player 1	A	2,1,2	0,0,2	1,2,3
	B	0,3,1	2,2,4	3,1,0
	C	1,1,1	3,2,1	2,2,2

Player 3 plays B		Player 2		
		A	B	C
Player 1	A	2,1,3	1,0,3	1,0,4
	B	1,2,1	3,3,3	1,1,1
	C	1,2,1	1,0,0	2,1,2

(A) The game does not have a pure-strategy Nash equilibrium.
(B) C,C,A and C,B,A.
(C) A,A,B, C,B,A, and B,B,B.
(D) A,A,A and A,A,B.
(E) C,B,A and A,A,B.

QUESTION 2 (8 POINTS)

A kicker in a penalty shoot-out has to kick the ball to the left or to the right, whereas the goalkeeper simultaneously dives to the left or to the right. The kicker tries to maximize the probability of scoring and the goalkeeper tries to maximize the probability that the kicker does not score. These probabilities are shown in the payoff matrix below, i.e., 80,20 means there is an 80 percent chance the kicker does not score and a 20 percent that the kicker scores.

		Kicker	
		Left	Right
Goalkeeper	Left	80,20	0,100
	Right	0,100	80,20

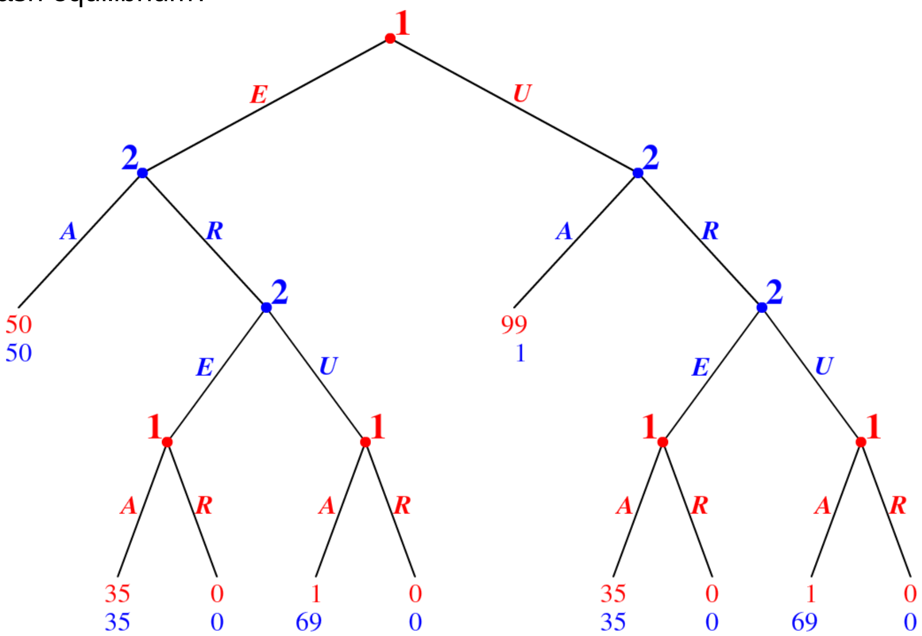
Suppose the goalkeeper has an injured arm so that the probability that the kicker scores when kicking left and the goalkeeper dives to the left increases to 40. In order words, the payoff in the upper left corner changes from 80,20 to 60,40. How does this change affect the mixed-strategy Nash equilibrium of the game?

(A) The mixed-strategy Nash equilibrium is unchanged.
(B) Both the goalkeeper and kicker are more likely to kick/dive to the left.
(C) The goalkeeper is more likely to dive to the right and the kicker more likely to kick to the left.
(D) The goalkeeper is more likely to dive to the left and the kicker more likely to kick to the right.
(E) Both the goalkeeper and kicker are more likely to kick/dive to the right.

QUESTION 3 (8 POINTS)

Consider the "alternating-offers bargaining game" shown below in which Player 1 first proposes how to split 100 SEK, either 50-50 (called E) or 99-1 (called U). Player 2 then has the choice to accept (A) or reject (R). If Player 2 accepts, the game is over and they each get what Player 1 proposed. If Player 2 rejects Player 1's proposal, the total amount to be shared shrinks and Player 2 gets to make a counterproposal whether to split 70 SEK equally (E) or unequally (U), which Player 1 then can either accept (A) or reject (R). Assuming that players only care about getting as much money as possible, how much does Player 1 get in the subgame perfect Nash equilibrium?

(A) 1
(B) 35
(C) 50
(D) 69
(E) 99



QUESTION 4 (8 POINTS)

In the TV show *Golden Balls* two contestants have to simultaneously choose "Split" or "Steal". The payoffs to both players are described by the payoff matrix below. (Note that the payoffs have been adjusted compared to the game discussed in class – it is here assumed that a player gets a negative payoff when choosing split against an opponent that picks steal.)

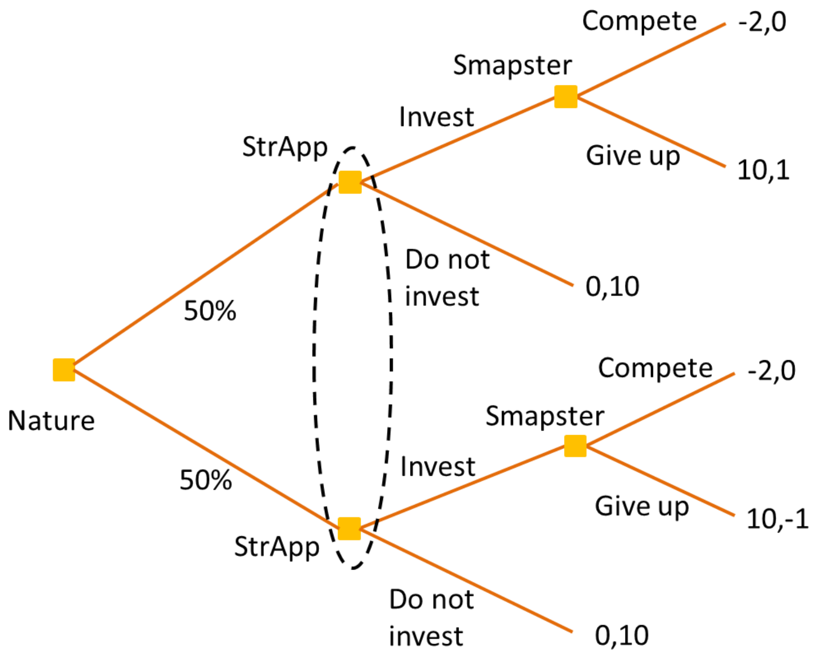
		Player 2	
		Split	Steal
Player 1	Split	50,50	-10,100
	Steal	100,-10	0,0

Comparing the pure-strategy Nash equilibrium when they choose actions simultaneously to the subgame perfect Nash equilibrium when one players get to choose first (and this is observed by the other player), which of the following statements about move-order advantages is true?

(A) Both players gain when one player moves first.
(B) The order of moves does not matter in this game.
(C) The first-moving player gains.
(D) The second-mover gains.
(E) None of the above alternatives is true.

QUESTION 5 (8 POINTS)

Bob is a game theory student that just finished his degree. He is considering developing a new app, called StrApp, which provides people with strategic advice. Developing the app will cost 2 million, but if he is successful he expects to raise 12 million in revenue. Unfortunately, he knows that Anna from his game theory class had a similar idea. She once talked about developing an app called Smapster that would deliver smart strategic advice on the spot. Anna has not finished her degree yet, so Bob decides whether to develop an app before Anna. Anna observes if Bob develops the app and then decides whether to develop Smapster. (Anna is a skilled programmer, so she does not have to pay a programmer to develop the app.) If she develops Smapster, none of them will get any revenue (price competition will lower the price to marginal cost, which is approximately zero). But Bob is uncertain about Anna's payoff if he invests and Anna gives up. Will she be upset because she thinks he stole her idea or will she be happy for him? He thinks either case is equally likely and realize that the strategic situation he is facing is like the game below. What is true about the Bayesian Nash equilibrium of this game?



(A) StrApp invests, Smapster always gives up.
(B) StrApp invests, Smapster gives up at upper node, competes at lower node.
(C) StrApp does not invest, Smapster always competes.
(D) There are two Bayesian Nash equilibria because StrApp is indifferent between investing and not investing.
(E) None of the above alternatives is correct.

PART B: Open-ended questions

Clearly motivate your answers to the following questions and explain any calculations that you make!

QUESTION 6 (28 POINTS)

Consider a town with two plumbers, Pat and Ronni, who are considering what hourly rate their respective plumbing companies should charge in the coming year. If they charge a high rate, the profit is 24 SEK per hour whereas the low price only gives an hourly profit of 20 SEK. Each plumber has a contract with a local insurance firm that guarantees that they each get 1,000 hours of work irrespectively of what rate they charge. In addition, the total floating demand for plumbers in the city is 2,000 hours, all of which will go to the plumber that charges the lowest price. If they both charge the same price, they get to provide 1,000 hours each (in addition to the 1,000 hours from the insurance company).

(A) (10 POINTS) Calculate the total profit during the year and draw the payoff matrix for the simultaneous-move price-setting game. What is the Nash equilibrium of the game?

(B) (4 POINTS) Explain why the game in (A) is a Prisoners' Dilemma game.

(C) (6 POINTS) Suppose there is 50% chance that they are still competitors next year and face exactly the same situation. What is the subgame perfect Nash equilibrium of this two-stage pricing game?

(D) (8 POINTS) Suppose now there is a 50% chance they play the pricing game in (A) again next year, and if they play it the next year, there is a 50% chance they will play it again — and so on forever after. Can they sustain collusion at high prices by a grim trigger strategy in this indefinitely repeated pricing game? A 50% chance of repeating the game is equivalent to an effective rate or return, R, of 1. (Why? 1 SEK tomorrow is worth $1/(1+R)$ today, so if $R = 1$, this is equivalent to earning 1 SEK tomorrow with 50% probability.)

QUESTION 7 (12 POINTS)

Suppose there is a university teacher that wants to become an artist. In order to assess whether he can make a career as an artist, he draws a painting and asks his students what they are willing to pay for it. Since he is worried that they might not report truthfully (perhaps in the hope of getting a better grade?), he decides to ask them in the following way:

> All students submit their maximal willingness to pay for the painting. The teacher then chooses a random student and draws a random price P. If the student's stated willingness to pay is above or the same as P, the chosen student must buy the painting for P. If P is above the stated willingness to pay, the student does not buy the painting.

Is it optimal for the students to truthfully state their maximal willingness to pay for the painting? Motivate your answer.

QUESTION 8 (20 POINTS)

Local governments often use external contractors for road maintenance, garbage collection, public transport etc. Contractors are typically selected by a procurement auction. Potential contractors are asked to submit bids and the contract is given to the contractor that submitted the lowest bid (provided it is below some maximal price the government is willing to pay). One problem in such auctions is that the winner sets a too low price – the contractor may turn out not to be able to deliver the service at that price. This can lead to delays if the firm defaults or to costly renegotiations with the contractor. Some local governments in Italy (as well as in other countries) have therefore instead started giving the contract to the contractor that submits the bid that is closest to the average bid. Discuss whether you think this sounds like a good idea or not!