

## **Decision Analysis**

Course No. 2614

### **Final Exam**

February 12, 2007

This exam consists of four questions, of which you may choose three questions to answer. If you answer all four questions, please indicate which three you wish to have graded. If you do not do so, the first three answered questions will be graded.

The total time for this exam is 60 minutes. Each question is composed for approximately 20 minutes answering time. Accordingly, each question offers the possibility of obtaining 20 points. The importance of the sub-questions is indicated by the points that you can achieve. The maximum number of points that you can achieve in the exam is 60.

Admitted Aids: Pocket calculator; dictionary without handwritten notes.

### **Question 1:**

Consider the following matrix game with payoffs for players 1 and 2, respectively, where player 1 has the choice between strategies T, M, and B, while player 2 chooses between L, C, and R.

	<b>L</b>	<b>C</b>	<b>R</b>
<b>T</b>	2, 0	1, 1	4, 2
<b>M</b>	3, 4	1, 2	2, 3
<b>B</b>	1, 3	0, 2	3, 0

- Explain the concept of a dominated strategy. What strategies survive iterated elimination of strictly dominated strategies in the game above? **(3)**
- Explain the concept of a Nash equilibrium. What are the pure-strategy Nash equilibria of this game? **(5)**
- What are the mixed-strategy Nash equilibria? **(12)**

## Question 2:

Two international companies, Won Co. and Tu Inc., are contemplating a “merger of equals”. Both companies have already agreed on all the major economic issues. However, several important social issues remain outstanding:

1. The surviving company’s name
2. The location of corporate headquarters
3. The chairman of the surviving company
4. The CEO of the surviving company
5. Which side will layoff the 6,000 employees to eliminate overlapping responsibilities

Both sides are able to assess the relative importance of each issue. Moreover, both have an idea of the total monetary value of the social issues, so that they can also place a monetary value on each social issue. The following table shows the individual assessments which prior to negotiations are held confidentially.

		Won Co.		Tu Inc.	
	<b>Issue</b>	<b>mill. €</b>	<b>%</b>	<b>%</b>	<b>mill. €</b>
1	Name	300	6	44	2,000
2	Headquarters	2,000	38	13	600
3	Chairman	300	6	13	600
4	CEO	600	12	8	400
5	Layoffs	2,000	38	22	1,000
	<b>Sum</b>	<b>5,200</b>	<b>100</b>	<b>100</b>	<b>4,600</b>

Both executive boards have fixed positions on these issues, but, in order to express their commitment to the joint venture, the companies agree to handle these remaining issues “fairly”.

- a) Discuss the procedure “Taking Turns” and its possible variants. Assume that parties do not know each other’s preferences and always select the most preferred available item. **(7)**
- b) Discuss the procedure “Divide and Choose” and its plausibility for the problem at hand. If Won is the divider, what difference does it make to know Tu’s preferences? **(6)**
- c) Characterize the settlement under the Knaster-Steinhaus procedure and its plausibility for the problem at hand. Assume that players do not know each other’s preferences. **(7)**

### Question 3:

An entrepreneur is faced with the difficult task of having to choose between two uncertain investment projects  $P_1$  and  $P_2$ . A thorough analysis of both alternatives revealed that their net present values crucially depend on future market conditions. The scenario analysis resulted in five relevant market scenarios,  $S_1 \dots S_5$ , for which the entrepreneur was able to determine the realization probabilities. The net present values of both projects for each of the five scenarios together with their realization probabilities (bottom row) are given in the following table:

	$S_1$	$S_2$	$S_3$	$S_4$	$S_5$
$P_1$	-30	30	0	-20	20
$P_2$	-30	-20	-20	30	30
	0.1	0.2	0.3	0.2	0.2

- a) Determine the risk profiles of both projects and illustrate them graphically. **(10)**
- b) Assume that the entrepreneur is a risk averse expected-utility maximizer. Which project should she choose? Explain the criterion on which the entrepreneur can base her decision. **(10)**

### Question 4:

Consider an urn containing 300 balls: 100 balls are blue and 200 balls are red or white. Assume that a person is offered two lotteries before drawing a ball from the urn: in lottery  $L_1$  she receives 100 \$ if the ball is blue and 0 \$ if it is red or white. In lottery  $L_2$  she receives 100 \$ if the ball is white and 0 \$ if it is blue or red.

Assume that the same person is offered two other lotteries: in lottery  $L_3$  she receives 100 \$ if the ball is blue or red and 0 \$ if it is white. In lottery  $L_4$  she receives 100 \$ if the ball is red or white and 0 \$ if it is blue.

- a) In experiments it is often observed that subjects prefer  $L_1$  to  $L_2$  and  $L_4$  to  $L_3$ . Show that this behaviour violates expected utility maximization. **(9)**
- b) Explain the *independence axiom*, which is needed for the expected utility theorem to hold. Show why it is violated by the behaviour described in a). **(11)**