MATH-H-405 – Decision Engineering

Prof. Yves De Smet

Academic year 2012-2013 – 2nd session

Last name .....

First name .....

Faculty & Section .....

Q1 (/10)	Q2 (/10)	Q3 (/10)	Q4 (/10)	Total (/40)	Total (/20)

Please give precise and concise answers and use the notations seen in the course.

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1. Voting theory

(a) Give an example of manipulation in the two-round voting procedure.

(b) Let us consider a voting problem where a candidate, denoted A, is elected when the Condorcet method is applied. If this candidate improves his position in the preferential ranking of at least one voter, we are sure that this candidate will still be elected.
Demonstrate this statement or give a counterexample.

2. Multicriteria decision aid

Show that removing a non-discriminating criterion does not affect the PROMETHEE II ranking.

3. Game theory

Explain the prisoner's dilemma and identify all Nash equilibria.
Justify your answer.

4. Decision under uncertainty

We want to optimize the process time of a dispatching service at a fire department unit. In order to simplify the problem, we consider two types of intervention:

- Routine interventions: they represent 70% of the interventions and they need 10 minutes to be dispatched.
- Emergency interventions: they represent 30% of the interventions and they need 20 minutes to be dispatched.

(a) What is the expected dispatching time? Justify your answer.

(b) In order to optimize the expected dispatching time, we consider the following system: the calls are processed by an answering machine that asks 3 standard questions. The answers are limited to yes or no (with the phone keypad). If the call refers to an emergency intervention, we are sure that there will be at least one yes in the answers. However, due to stress, 25% of the call for a routine intervention will also lead to at least one yes in the answers. Answering the questions takes 3 minutes. We consider the given answers will reduce the dispatching time of a routine intervention from 10 minutes to 5 minutes.
What is the expected dispatching time in this context? Justify your answer.

(c) The calls with at least one yes in the answers are redirected to a second round of questions that takes 3 more minutes to be completed. Those new questions will allow to reduce the dispatching time of the emergency intervention from 20 minutes to 12 minutes (here again, if the call refers to an emergency intervention, we are sure that there will be at least one yes). On the other hand, only 10% of the calls for a routine intervention will lead to at least one yes in the answers of the second round of questions.
What is the expected dispatching time in this context? Justify your answer.