UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2003

BEng Honours Degree in Computing Part III
MSc in Computing Science
MSc in Computing for Industry
BSc Honours Degree in Mathematics and Computer Science Part III
MSci Honours Degree in Mathematics and Computer Science Part III
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the
Associateship of the City and Guilds of London Institute
This paper is also taken for the relevant examinations for the
Associateship of the Royal College of Science

PAPER C344=Y344

DECISION ANALYSIS

Friday 9 May 2003, 10:00
Duration: 120 minutes

Answer THREE questions

Paper contains 4 questions
Calculators not required

1   You need to replace your motor-bike and must choose between a new model costing £4,000 and a second-hand one costing £2,750. The new model includes a two-year guarantee, including both repair costs and the use of a loan machine while your bike is being repaired. No guarantee comes with the second-hand machine.

You consider that there are two possibilities regarding the second hand bike:

- It is a good buy and will involve you in roughly £750 repair and temporary hire costs over the next two years.

- It is a bad buy and will involve an expenditure of roughly £1,750 over the next two years.

The probability of the second-hand machine being a good buy is only 2/5.

You have two friends, Jack and Jill, both of whom are willing to look at the second-hand model before you buy it. Jack is free immediately, but you do not trust his judgement too much. He might miss something. Here is how you rate the reliability of his opinion:

	Likelihood of Jack's report saying:	
Actual state of bike	satisfactory	unsatisfactory
good buy	1	0
bad buy	1/2	1/2

You would rather listen to Jill's advice. Look how reliable she is:

	Likelihood of Jill's report saying:	
Actual state of bike	satisfactory	unsatisfactory
good buy	9/10	1/10
bad buy	1/10	9/10

Unfortunately, Jill is very busy at the moment and there is a 1/3 chance that the second-hand model will be sold before she gets a chance to look at it. In that case, you would have to buy the new machine.

You cannot ask both your friends to look at the second-hand bike, in case you offend one of them. Assuming that you are risk neutral, determine, using decision tree analysis, what your best strategy should be.

2   A company is considering developing a large urban site and is considering a mixed project of housing, retail, office and hotel areas. Rental income will be a function of the floor areas (as measured in units of 10,000 sq. m) allocated to each activity. Expected annual profit against gross floor area for each development type is given in the following table:

AREA	Housing	Retail	Office	Hotel
0	0	0	0	0
1	2	6	1	8
2	4	9	1	12
3	6	9	2	20
4	8	10	1	16
5	10	11	15	12
6	12	12	12	10
7	14	13	20	4

Planning regulations restrict the total floor area of the complex to 7 units, but require that at least 1 unit of offices be included in each development.

a   Express the problem of finding the mix of development which will maximize the developer's return in terms of dynamic programming, defining the stages, states and recursive equations.

b   Find the solution to the developer's problem using dynamic programming.

The two parts carry, respectively, 30%, 70% of the marks.

3   A property owner has three properties, which she wishes to sell at the prices shown in the second column of the table below. She makes the following offer to an estate agent:

"I'd like you to try to sell property A for me. However, if you don't sell it within a month I'll take my business, including A, elsewhere. On the other hand, if you do sell A within a month, you may, if you wish, have your choice of B or C, and if you sell that property within a month of taking it on, you can, again only if it suits you, have a month to sell the last one".

The estate agent inspects the properties, decides on the amount he would spend advertising each one if it were put in his hands (figures in the third column of the table), and assesses his chances of selling each within a month if he tries (figures in the last column of the table). He believes that success in selling any one property would not affect his chances of selling any other. His commission is 4% of the selling price.

Property	Price (in £K)	Advertising cost (in £)	Probability of sale
A	25	800	0.7
B	50	200	0.6
C	100	400	0.5

The estate agent believes that:

- He would be indifferent between getting £1,300 outright and taking a 50- 50 chance at +£6,000 or - £1,000.

- He would be indifferent between not betting and betting on a 50-50 chance at +£1,300 or -£1,000.

- He would be indifferent between getting £3,200 for certain and taking a 50- 50 chance at +£6,000 or +£1,300.

a   Sketch the estate agent's utility curve for monetary amounts between -£1,000 and +£6,000.

b   How would you advise the estate agent?

c   What is approximate value (in £) of the client's proposition to the estate agent?

The three parts carry, respectively, 20%, 70%, 10% of the marks.

4   A large company needs to choose between two capital projects, A and B, both of which have uncertain returns, as shown in the following table:

Project A	
Return (in £m)	Probability
20	0.1
10	0.2
0	0.6
-10	0.1

Project B	
Return (in £m)	Probability
5	0.7
-1	0.3

The outcomes of A and B are thought to be independent.

a   Draw a decision tree and influence diagram for the above situation. Adjacent to the influence diagram, show the initial numeric contents of the tables associated with each node.

b   Suppose that the company has the opportunity to consult a clairvoyant about project A's outcome. Draw a new decision tree and influence diagram (without the associated initial node tables) to reflect the new situation. Use the decision tree to calculate the expected value of the clairvoyant's perfect information.

c   Repeat b, but this time consider consulting the clairvoyant about project B, instead.

d   Repeat b again, but consider consulting the clairvoyant over the outcomes of both projects this time.

The four parts carry, respectively, 30%, 20%, 20%, 30% of the marks.