

## **MA3908 class test 2010-2011**

**Answer all three parts**

**You have 40 minutes**

**No reference to notes is allowed**

### **Part a**

A company is considering a possible investment decision. It has the opportunity to invest £50,000 in a project that may generate a 12% return on its investment next year. This 12% return is estimated to have probability of 0.30 of occurring. More likely is that the project will generate a return of 5% on the investment next year, which has a probability of 0.55 of occurring. In both of these cases the company would cash in its investment at the end of the year and get its initial investment of £50,000 back.

If the company does not make either of the above returns then the project will have failed and half of the money invested will be lost.

Using a decision tree decide whether the company should choose to invest or not.

### **Part b**

A company makes two products (A and B) and for each of these products processing time is required in two departments (assembly and finishing). Each unit of product A that is produced requires 5 minutes in the assembly department, 2 minutes in the finishing department. Each unit of product B that is produced requires 23 minutes in the assembly department, 7 minutes in the finishing department.

The labour force assigned to the assembly department has (in total) 240 working hours available next week. The labour force assigned to the finishing department has (in total) 360 working hours available next week. The ratio of the number of units of product A produced to the number of units of product B produced must lie between 0.2 and 0.3.

Each unit of product A that is sold gives a profit of £15. Each unit of product B that is sold gives a profit of £12.

Formulate this problem as an integer program with linear constraints.

What assumptions have you made in formulating this problem?

### Part c

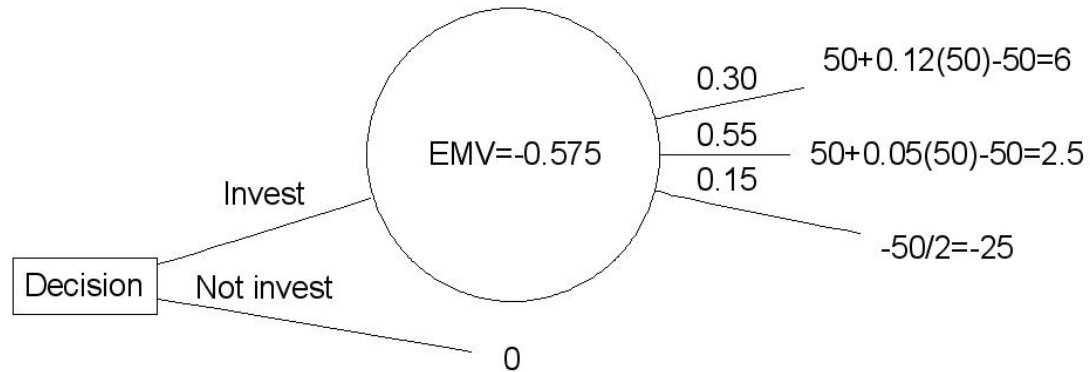
The payoff table below shows for a company the profit expected (£m) from three possible choices (A, B and C) with respect to a possible contract bid depending upon three scenarios for the forthcoming year (S1 to S3 respectively). For example if the company choose B and the scenario is S1 they will make a profit of 57 (£m). The probability of scenarios S1, S2 and S3 is estimated to be 0.36, 0.16 and 0.48 respectively. Using standard decision criteria what would you suggest the company do?

Choice	Scenario		
	S1	S2	S3
A	-3	16	-23
B	57	-5	39
C	30	49	39

## MA3908 class test answers

### Part a

The decision tree is shown below



The payoffs for each terminal node are shown. At the first terminal node (for example) we get a return of  $50 + 0.12(50)$ , the initial investment plus the 12% return, but for that return we have invested 50, resulting in a net payoff of 6 (£K).

The EMV at the chance node is  $0.30(6) + 0.55(2.5) + 0.15(-25) = -0.575$ .

So at the initial decision node we have two choices:

- invest, for which the EMV (return, profit) is -£0.575K
- not invest, for which the EMV (return, profit) is zero

Hence, on these figures, we should not invest.

### Part b

The variables relate to the number of units of each product to make. So let  $x_A$  = number of units of A produced next week,  $x_B$  = number of units of B produced next week, where these variables are  $\geq 0$  and integer.

The constraints are:

- working time (in minutes) in each department

$$\begin{aligned} 5x_A + 23x_B &\leq 240(60) && \text{(assembly)} \\ 2x_A + 7x_B &\leq 360(60) && \text{(finishing)} \end{aligned}$$

- ratio

$$\begin{aligned} 0.2 \leq x_A/x_B \leq 0.3 &\text{ which needs to be linearised to} \\ 0.2x_B \leq x_A \leq 0.3x_B & \end{aligned}$$

Objective is to maximise total profit, i.e.

$$\text{maximise } 15x_A + 12x_B$$

The key assumption here is that we have assumed that we sell each unit that we produce.

**Part c**

The payoff calculations are:

Payoff	Choice	Scenario			Equally likely	EMV
		S1	S2	S3		
	A	-3	16	-23	-3.33	-9.56
	B	57	-5	39	30.33	38.44
	C	30	49	39	39.33	37.36

Choice	Regret		
	S1	S2	S3
A	60	33	62
B	0	54	0
C	27	0	0

Criteria	Decision	Value
Optimistic - maximax	B	57
Conservative - maximin	C	30
Regret - minimax	C	27
Equally likely	C	39.33
EMV	B	38.44

On a majority vote basis therefore we would choose C.