

QQQ – Decision 2 – Chapter 2 – Allocation Problems (Version 2)

Total Marks: 23

(23 = Platinum, 21 = Gold, 18 = Silver, 16 = Bronze)

1. Four workers, A, B, C and D, are to be assigned to three tasks, 1, 2 and 3. Each task must be assigned to just one worker and each worker can do one task only.

Worker A cannot do task 2 and worker D cannot do task 3

The cost of assigning each worker to each task is shown in the table below.

The total cost is to be minimised.

	1	2	3
A	53	–	62
B	48	57	59
C	55	63	58
D	69	49	–

Formulate the above situation as a linear programming problem. You must define your decision variables and make the objective function and constraints clear. **(6)**

(Total 6 marks)

2. A team of 5 players, A, B, C, D and E, competes in a quiz. Each player must answer one of 5 rounds, P, Q, R, S and T.

Each player must be assigned to exactly one round, and each round must be answered by exactly one player.

Player B cannot answer round Q, player D cannot answer round T, and player E cannot answer round R.

The number of points that each player is expected to earn in each round is shown in the table.

	P	Q	R	S	T
A	32	40	35	41	37
B	38	–	40	27	33
C	41	28	37	36	35
D	35	33	38	36	–
E	40	38	–	39	34

The team wants to maximise its total expected score.

The Hungarian algorithm is to be used to find the maximum total expected score that can be earned by the 5 players.

- (a) Explain how the table should be modified. (2)
- (b) (i) Reducing rows first, use the Hungarian algorithm to obtain an allocation which maximises the total expected score.
- (ii) Calculate the maximum total expected score. (6)

(Total 8 marks)

3. Three workers, A, B and C, are each to be assigned to one of four tasks, P, Q, R and S.

Each worker must be assigned to at most one task, and each task must be done by at most one worker.

The amount, in pounds, that each worker will earn while assigned to each task is shown in the table below.

	P	Q	R	S
A	32	40	37	42
B	29	32	35	41
C	37	33	39	40

The Hungarian algorithm is to be used to find the maximum total amount that can be earned by the three workers.

- (a) Explain how the table should be modified. (2)
- (b) (i) Reducing rows first, use the Hungarian algorithm to obtain an allocation which maximises the total earnings.
- (ii) Explain how any initial row and column reductions were made and also how you determined if the table was optimal at each stage. (7)

(Total 9 marks)