

QQQ – Decision 2 – Chapter 2 – Allocation Problems (Version 1)

Total Marks: 23

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

1. Four workers, A, B, C and D, are to be assigned to four tasks, P, Q, R and S. Each worker must be assigned to exactly one task and each task must be done by only one worker. The time, in hours, that each worker takes to complete each task is shown in the table below.

	P	Q	R	S
A	7.5	3.5	8	9.5
B	5	2	7	7.5
C	4	3.5	3.5	8
D	6	5	3.5	4

Reducing rows first, use the Hungarian algorithm to obtain an allocation which minimises the total time. You must explain your method and show the table after each stage. **(5)**

(Total 5 marks)

2. Five workers, A, B, C, D and E, are available to complete four tasks, P, Q, R and S.

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

Worker B cannot be assigned to task Q and worker E cannot be assigned to task S.

The time, in minutes, that each worker takes to complete each task is shown in the table below.

	P	Q	R	S
A	38	39	37	37
B	39	–	39	40
C	41	44	40	42
D	40	41	39	38
E	36	39	41	–

The Hungarian algorithm is to be used to find the least total time to complete all four tasks.

- (a) Explain how the table should be modified so that the Hungarian algorithm can be applied. (2)
- (b) (i) Use the Hungarian algorithm to obtain an allocation that minimises the total time.
(ii) Explain how you determined if the table was optimal at each stage. (6)
- (c) Calculate the least total time to complete all four tasks. (1)

(Total 9 marks)

3. Four workers, A, B, C and D, are to be assigned to four tasks, P, Q, R and S.

Each task must be assigned to just one worker and each worker can do only one task.

Worker B cannot be assigned to task Q and worker D cannot be assigned to task R.

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

	P	Q	R	S
A	65	72	69	75
B	71	–	68	65
C	70	69	73	77
D	73	70	–	71

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

- (a) (i) Explain how to modify the table so that the Hungarian algorithm could be applied.
(ii) Modify the table as described in (a)(i). **(3)**
- (b) Formulate the above situation as a linear programming problem. You must define the decision variables and make the objective function and constraints clear. **(6)**

(Total 9 marks)