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Mark Scheme (Results)

Summer 2012

GCE Decision D2
(6690) Paper 1

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Summer 2012
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Summer 2012
6690 Decision Maths 2
Mark Scheme

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

1st Validity (Wed/Thur 13/14th June)
2nd Validity (Wednesday 20th June)
3rd Validity (Tuesday 26th June)
4th Validity (Sunday 1st July)

12 each time

(Not classified) – 'I think this is good' add your initials.
RFFU – Use it I agree
Poor example – don't use it.
Duplicate – I've changed the marks one this one - note marks changed.
Susie will mark them up as good example once they are commissioned.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

- bod – benefit of doubt
- ft – follow through
- the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- ⌐ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

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Special case for Q1

If they reduce columns then rows they get

$$\begin{bmatrix} 2 & 2 & 1 & 3 & 3 \\ 0 & 0 & 2 & 0 & 0 \\ 15 & 6 & 0 & 9 & 7 \\ 0 & 2 & 1 & 0 & 4 \\ 14 & 9 & 8 & 13 & 11 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 1 & 0 & 2 & 2 \\ 0 & 0 & 2 & 0 & 0 \\ 15 & 6 & 0 & 9 & 7 \\ 0 & 2 & 1 & 0 & 4 \\ 6 & 1 & 0 & 5 & 3 \end{bmatrix}$$

Which is a three line situation. They have not followed the instructions on the QP and so missed out the first iteration.

Please give 1M1 1A1 (if earned) for their column then row reductions, but then 2M0 (and therefore 2A0) since they have not done the first iteration of the Hungarian Algorithm.

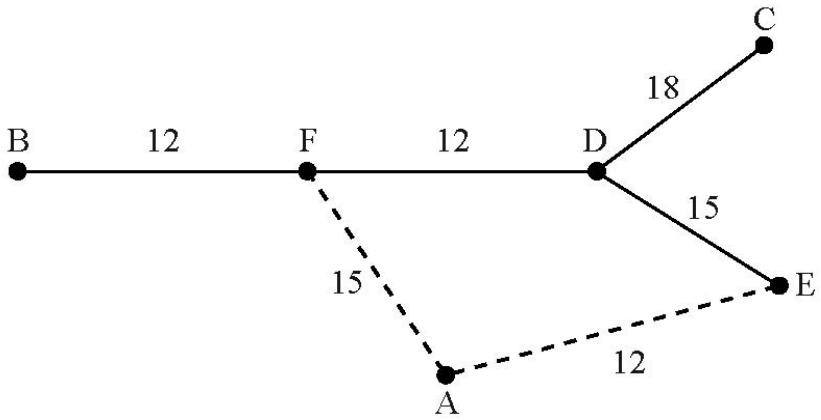
So 1M1 1A1 2M0 2A0 then other marks as usual.

June 2012
6690 Decision Mathematics D2
Pre-QPEC Mark Scheme

Question Number	Scheme	Marks
Q1(a)	$\begin{bmatrix} 129 & 127 & 122 & 134 & 135 \\ 127 & 125 & 123 & 131 & 132 \\ 142 & 131 & 121 & 140 & 139 \\ 127 & 127 & 122 & 131 & 136 \\ 141 & 134 & 129 & 144 & 143 \end{bmatrix}$	
	Reducing rows then columns	
	$\begin{bmatrix} 7 & 5 & 0 & 12 & 13 \\ 4 & 2 & 0 & 8 & 9 \\ 21 & 10 & 0 & 19 & 18 \\ 5 & 5 & 0 & 9 & 14 \\ 12 & 5 & 0 & 15 & 14 \end{bmatrix} \rightarrow \begin{bmatrix} 3 & 3 & 0 & 4 & 4 \\ 0 & 0 & 0 & 0 & 0 \\ 17 & 8 & 0 & 11 & 9 \\ 1 & 3 & 0 & 1 & 5 \\ 8 & 3 & 0 & 7 & 5 \end{bmatrix}$	1M1 1A1
	$\begin{bmatrix} 2 & 2 & 0 & 3 & 3 \\ 0 & 0 & 1 & 0 & 0 \\ 16 & 7 & 0 & 10 & 8 \\ 0 & 2 & 0 & 0 & 4 \\ 7 & 2 & 0 & 6 & 4 \end{bmatrix}$	2M1 2A1ft
	$\begin{bmatrix} 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 3 & 0 & 0 \\ 14 & 5 & 0 & 8 & 6 \\ 0 & 2 & 2 & 0 & 4 \\ 5 & 0 & 0 & 4 & 2 \end{bmatrix}$	3M1 3A1ft 4A1 cso
	Allocation: A – 1, B – 5, C – 3, D – 4, E – 2.	5A1= B1 **8**
(b)	Cost is £ 647	B1 **1** **Total 9**

Notes for question 1

a1M1 Reducing rows **and then** columns – **See special case**
a1A1 CAO
a2M1 Double covered +e; one uncovered – e; and one single covered unchanged. 2 lines needed to 3 lines needed.
a2A1ft ft on their previous table.
a3M1 Double covered +e; one uncovered – e; and one single covered unchanged. 3 lines needed to 5 lines needed. Watch out for 'slow Hungarian' (e.g. 2 'iterations' each subtracting 1), give M0 if seen.
a3A1ft ft on their previous table. Condone one 'new' error in table here.
a4A1 CSO on final table
a5A1= B1 CAO
b1B1 CAO

Question Number	Scheme	Marks
Q2		
(a)	A E D F B C A 12 15 12 12 24 25 = 100 km	1M1 1A1 2A1 **3**
(b)	Delete A  RMST weight = 12 + 12 + 15 + 18 = 57 (km) Lower bound = 57 + 12 + 15 = 84 (km)	1M1 1A1 2M1 2A1 **4** **Total 7**

Notes for question 2

a1M1 NN Each vertex visited at least once, accept 156324 across top of table (condone lack of return to start).
a1A1 Route CAO must be stated, must return to A, accept link back to A.
a2A1 Length CAO 100. Do not ISW if candidates then go on to double the route length.
b1M1 Finding correct RMST (maybe implicit) 57 sufficient; or 12, 12, 15 and 18. Must have 4 arcs.
b1A1 CAO; tree **or** list of arcs **or** 57 **or** 12 + 12 + 15 + 18 seen.
b2M1 Adding 2 least arcs from A to 'tree'; 12 and 15 **or** AF and AE **or** 27 only. Must add these arcs distinctly.
b2A1 CAO 84

Notes for question 3

Some candidates are starting by confirming that they should use AG as their first entering square. So if the candidate starts by finding initial shadow costs and II's to confirm that AG has the most negative II, ignore this work and start marking from their first route. Do not credit shadow costs and IIs found here.

a1M1 A valid route, AG used as the empty square, θ's balance. **If AG not used mark as a misread.**
a1A1 A correct route, correctly stating exiting cell, up to my improved solution with no extra zeros.
a2M1 Finding 7 shadow costs and 6 IIs.
a2A1 Shadow costs CAO [Alt: A(17), B(18), C(18), D(0), E(2), F(-2), G(3)]
a3A1 Improvement indices CAO
a3M1 A valid route, their most negative II chosen, only one empty square used, θ's balance.
a4A1ft a correct route, correctly stating entering cell, exiting cell.
a5A1 CSO, my solution no extra zeros.
b1M1 Finding 7 shadow costs **and** all 6 IIs **or** at least1 negative II found.
b1A1 Shadow costs CAO [Alt SC: A(17), B(21), C(18), D(0), E(-1), F(-2), G(3)]
b2A1 BG = -2 found as an II.
b3A1ft CAO + conclusion. If candidates go on to perform a third iteration and determine that it is optimal, please allow this final mark. Must make link between negative II and not optimal.

Question Number	Scheme	Marks
Q3 (a)		1M1 1A1

	D	E	F	G	Supply
A	15	3 □ θ		θ	18
B		21 + θ	2 – θ		□3
C			16 + θ	13 – θ	29
Demand	15	24	18	13	70

Exiting square is BF, (θ = 2).

Shadow costs		**17**	**19**	**15**	**20**	
		D	E	F	G	Supply
0	A	15	1		2	18
1	B		23			23
1	C			18	11	29
	Demand	15	24	18	13	70

2M1 2A1

Improvement indices:

AF = 21 – 0 – 15 = 6 BG = 22 – 1 – 20 = 1

BD = 21 – 1 – 17 = 3 CD = 18 – 1 – 17 = 0

BF = 19 – 1 – 15 = 3 CE = 17 – 1 – 19 = -3

3A1

Entering square CE

	D	E	F	G	Supply
A	15	1 – θ		2 + θ	18
□		23			23
C		θ	18	11 – θ	29
Dem□nd	15	24	18	13	70

3M1 4A1ft

Exiting square is AE, (θ = 1).

	D	E	F	G	Supply
A	15			3	18
B		23			23
C		1	18	10	29
Demand	15	24	18	13	70

5A1 cso **8**

(b)

Shadow costs		**17**	**16**	**15**	**20**	
		D	E	F	G	Supply
0	A	15			3	18
4	B		23			23
1	C		1	18	10	□□
	Demand	15	24	18	13	

1M1
1A1

Improvement indices:

AE = 19 – 0 – 16 = 3 BF = 19 – 4 – 15 = 0

AF = 21 – 0 – 15 = 6 BG = 22 – 4 – 20 = -2

BD = 21 – 4 – 17 = 0 CD = 18 – 1 – 17 = 0

2A1

Not optimal since a negative improvement index

3A1ft **4**

Total 12

Question Number	Scheme	Marks
Q4 (a)		

b.v	x	y	z	r	s	t	value	θ values
r	5	$\frac{1}{2}$	0	1	0	0	5	10
s	1	-2	4	0	1	0	3	$-\frac{3}{2}$
t	8	4	6	0	0	1	6	$\frac{3}{2}\leftarrow$
P	-5	-7	-4	0	0	0	0	

b.v.	x	y	z	r	s	t	value	Row ops
r	4	0	$-\frac{3}{4}$	1	0	$-\frac{1}{8}$	$\frac{17}{4}$	R1- $\frac{1}{2}$R3
s	5	0	7	0	1	$\frac{1}{2}$	6	R2 + 2R3
y	2	1	$\frac{3}{2}$	0	0	$\frac{1}{4}$	$\frac{3}{2}$	R3 ÷ 4
P	9	0	$\frac{13}{2}$	0	0	$\frac{7}{4}$	$\frac{21}{2}$	R4 + 7R3

1M1 1A1
B1
2M1 2A1
5

(b) $P + 9x + \frac{13}{2}z + \frac{7}{4}t = \frac{21}{2}$ — M1 A1 **2**

(c) $P = \frac{21}{2} - 9x - \frac{13}{2}z - \frac{7}{4}t$, so increasing x or z or t would decrease P — B1 **1**

Total 8

Notes for question 4

a1M1 Correct pivot located, attempt to divide row. If choosing negative number as pivot M0B0M0
a1A1 pivot row correct including change of b.v.
a1B1 Row operations CAO – allow if given in terms of old row 3.
a2M1 (ft) Correct row operations used at least once, column x, z, t or value correct.
a2A1 CAO on the three non-pivot rows.
b1M1 One equal sign, P, terms in x, z, t plus a non-zero number term.
b1A1 CAO
c1B1 **Explanation**, must refer to increasing x, z and t, condone no ref to $x = z = t = 0$, must have correct signs in equation in (b). Do not accept 'no negatives in profit row' o.e. alone.

Notes on question 5

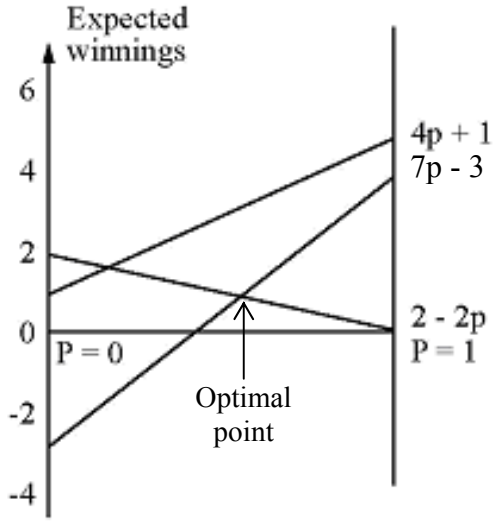
a1B1 CAO. Accept 'air dominates land' etc. Must have a named row dominating a named row
b1M1 Setting up three probability equations, implicit definition of p.
b1A1 CAO
b2M1 Three lines drawn, accept $p > 1$ or $p < 0$ here. Must be functions of p.
b2A1 CAO $0 \le p \le 1$, scale clear (or 1 line = 1), condone lack of labels. Rulers used.
b3DM1 Must have drawn 3 lines. Finding their correct optimal point, must have three lines and set up an equation to find $0 \le p \le 1$. If solving each pair of SE's must clearly select the correct one or M0, but allow recovery if their choice is clear from (c).
b3A1 CAO 5/9
b4A1ft All three options listed must ft from their p, check page 1, no negatives.
c1B1 CAO

Question Number	Scheme	Marks
Q5 (a)	Row 1 (air) dominates row 3(land), (so Row 3 can be deleted)	B1 **1**
(b)		

	Plan 1	Plan 2	Plan 3
Air	0	4	5
Sea	2	-3	1

Let Goodie play row 1 with probability p,
and row 2 with probability $1 - p$.

If F plays 1 G's expected winnings are $0 + 2(1-p) = 2 - 2p$
If F plays 2 G's expected winnings are $4p - 3(1-p) = 7p - 3$ — 1M1 1A1
If F plays 3 G's expected winnings are $5p + (1-p) = 4p + 1$



2M1 2A1

$7p - 3 = 2 - 2p$ — 3DM1

$9p = 5$

$p = \frac{5}{9}$ — 3A1

Goodie should play

Row 1 (air) with probability $\frac{5}{9}$, row 2 (sea) with probability $\frac{4}{9}$ and never row 3 (land). — 4A1ft **7**

(c) The value of the game to Goodie is $\frac{8}{9}$. — B1 **1**

Total 9

Notes for question 6

a1B1 CAO

b1M1 Two numbers on each arc

b1A1 CAO do give bod since they might well cross these number out.

c1M1 One valid flow augmenting route found and a valid value stated.

c1A1 Flow increased by at least 2

c2M1 A second correct flow route and value correct.

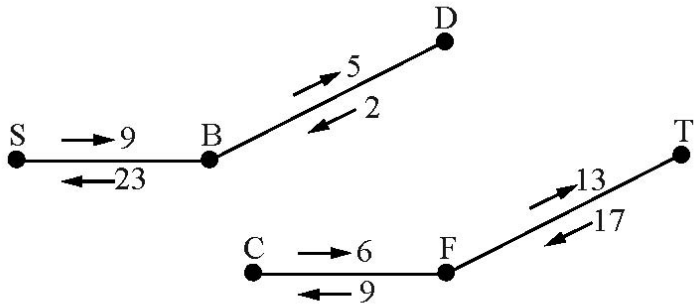
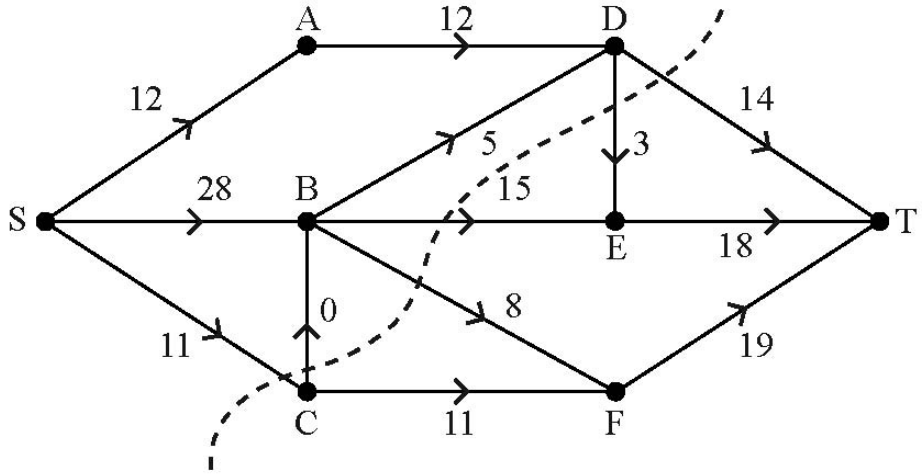
c2A1 CSO Flow increased by 5 and no more.

d1M1 Consistent flow pattern ≥ 48. One number only per arc. No unnumbered arcs.

d1A1 CAO must follow from their routes.

e1M1 Must have attempted (d) - at least one number on all but one arc, and made an attempt at a cut, condone one missing arc if listed. (Accept sum of arcs as evidence of cut here only.)

e1A1CSO For (d) and (e) Cut and (d) correct, Cut may be drawn. Must refer to max flow-min cut theorem three words out of four.

Question Number	Scheme	Marks
Q6		
(a)	Initial flow = 46	B1 **1**
(b)		M1 A1 **2**
(c)	E.g. SBDET – flow 3 SBCFT – flow 2	1M1 1A1 2M1 2A1 **4**
(d)		M1 A1 **2**
(e)	(The value of the flow is 51). The cut through DT, DE, BE, BF, CB and SC has value 51 By max flow-min cut theorem flow is maximal	M1 A1cso **2** **Total 11**

Question Number	Scheme	Marks
Q7	Let x_{ij} be 0 or 1 $\begin{cases}1 \text{ if worker } (i) \text{ does task } (j)\\ 0 \text{ otherwise}\end{cases}$ where $i \in \{\text{A, B, C, D}\}$ and $j \in \{\text{P, Q, R, S}\}$	B1
	minimise $P = 23x_{AP} + 41x_{AQ} + 34x_{AR} + 44x_{AS}$ $+ 21x_{BP} + 45x_{BQ} + 33x_{BR} + 42x_{BS}$ $+ 26x_{CP} + 43x_{CQ} + 31x_{CR} + 40x_{CS}$ $+ 20x_{DP} + 47x_{DQ} + 35x_{DR} + 46x_{DS}$	1M1 1A1
	Subject to	
	$x_{AP} + x_{AQ} + x_{AR} + x_{AS} = 1$ or $\sum x_{Aj} = 1$	
	$x_{BP} + x_{BQ} + x_{BR} + x_{BS} = 1$ or $\sum x_{Bj} = 1$	2M1
	$x_{CP} + x_{CQ} + x_{CR} + x_{CS} = 1$ or $\sum x_{Cj} = 1$	
	$x_{DP} + x_{DQ} + x_{DR} + x_{DS} = 1$ or $\sum x_{Dj} = 1$	2A1 3M1
	$x_{AP} + x_{BP} + x_{CP} + x_{DP} = 1$ or $\sum x_{iP} = 1$	
	$x_{AQ} + x_{BQ} + x_{CQ} + x_{DQ} = 1$ or $\sum x_{iQ} = 1$	
	$x_{AR} + x_{BR} + x_{CR} + x_{DR} = 1$ or $\sum x_{iR} = 1$	3A1 **7**
	$x_{AS} + x_{BS} + x_{CS} + x_{DS} = 1$ or $\sum x_{iS} = 1$	**Total 7**

Notes for question 7

1B1 Defining variables fully both 'bits' values and subscripts. Penalise poor variable choice, (AP etc.) here.
1M1 Attempt at a 16 term expression, coefficients 'correct', but condone 2 slips.
1A1 CAO + minimise. Penalise reversed subscripts once only per question.
2M1 Four eqns, each in four vars, coeffs of 1, all 16 vars included, = 1, accept $\leq 1, \geq 1$ here for this M only
2A1 Any 4 CAO. Penalise reversed subscripts once only per question.
3M1 All 8 equations, each in four variables, unitary coefficients, all 16 variables included = 1.
3A1 CAO. Penalise reversed subscripts once only per question.

Notes for question 8 – see alts too

ALL M marks - Must bring earlier optimal results into calculations. Ignore extra rows. Must have necessary right 'ingredients' (– storage costs, overheads, extra worker costs) at least once per stage.

1M1 First stage completed. 3 rows.
1A1 CAO condone missing * here. No extra rows.
2M1 Second stage completed. Expect 3 states.
2A1ft Any 2 states correct. Ft for * values only No missing/extra rows. (Penalise * errors only once in the qn).
3A1 CAO All 3 states correct. No missing rows. (Penalise * errors only once in the question).
3M1 3rd stage completed. Expect 3 states.
4A1ft Any state correct. Ft on * values only. No missing rows. (Penalise * errors only once in the qn).
5A1ft Any 2 states correct. Ft on * values only. No missing rows. (Penalise * errors only once in the qn).
6A1 CAO All 3 states correct. No missing/extra rows. (Penalise * errors only once in the question).
4M1 4th stage completed.
7A1 CAO Final, state correct. No missing/extra rows. (Penalise * errors only once in the question).
1B1 CAO. Must have attempted algorithm, getting at least one M mark.

Question Number	Scheme	Marks
Q8	E.g.	

Stage	State	Action	Dest.	Value	
April	0	4	0	400+ 300	= 700*
(4)	1	3	0	150+300	= 450*
	2	2	0	300+300	= 600*
March	0	3	0	300+700	= 1000*
(3)		4	1	400+ 300+450	= 1150
	1	2	0	150+300+700	= 1150
		3	1	150+300+450	= 900*
		4	2	400+150+300+600	=1450
	2	1	0	300+300+700	= 1300
		2	1	300+300+450	= 1050*
		3	2	300+300+600	= 1200
Feb.	0	2	0	300+1000	= 1300
(2)		3	1	300+ 900	= 1200*
		4	2	400 +300+1050	=1750
	1	1	0	150+300+1000	= 1450
		2	1	150+300+ 900	= 1350*
		3	2	150+300+1050	=1500
	2	0	0	300+ 1000	= 1300*
		1	1	300+300+ 900	= 1500
		2	2	300+300+1050	=1650
Jan.	0	2	0	300+1200	= 1500*
(2)		3	1	300+1350	= 1650
		4	2	400 +300+1300	= 2000

Month	Jan	Feb	March	April
Number made	2	3	3	3

1M1 1A1 **2**

2M1

2A1ft

3A1 **3**

3M1
4A1ft

5A1ft

6A1 **4**

4M1 7A1 **2**

B1 **1**

Total 12

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Rewarding Learning

Alt correct solution – adding the storage costs at start of month.

Stage	State	Action	Dest	Value	
April	0	4	0	400 + 300 = 700*	1M1
(4)	1	3	0	300 = 300*	1A1
	2	2	0	300 = 300*	
March	0	3	0	300 + 700 = 1000*	2M1
(3)		4	1	400 + 150 + 300 + 300 = 1150	
	1	2	0	300 + 700 = 1000	
		3	1	150 + 300 + 300 = 750*	2A1ft
		4	2	400 + 300 + 300 + 300 = 1300	
	2	1	0	300 + 700 = 1000	
		2	1	150 + 300 + 300 = 750*	3A1
		3	2	300 + 300 + 300 = 900	
Feb	0	2	0	300 + 1000 = 1300	
(2)		3	1	150 + 300 + 750 = 1200*	3M1
		4	2	400 + 300 + 300 + 750 = 1750	4A1ft
	1	1	0	300 + 1000 = 1300	
		2	1	150 + 300 + 750 = 1200*	5A1ft
		3	2	300 + 300 + 750 = 1350	
	2	0	0	1000 = 1000*	
		1	1	150 + 300 + 750 = 1200	6A1
		2	2	300 + 300 + 750 = 1350	
Jan	0	2	0	300 + 1200 = 1500*	4M1
(2)		3	1	150 + 300 + 1200 = 1650	
		4	2	400 + 300 + 300 + 1000 = 2000	7A1

Month	Jan	Feb	March	April	
Number made	2	3	3	3	B1

Special Case 1: Working forward Max 7/12 version 1

Stage	State	Action	Dest	Value	
Jan	0	2	0	300 = 300*	1M1
(2)		3	1	300 = 300*	1A1
		4	2	400 + 300 = 700*	
Feb	0	2	0	300 + 300 = 600*	2M1
(2)		3	1	300 + 300 = 600*	
		4	2	400 + 300 + 300 = 1000	
	1	1	0	150 + 300 + 300 = 750	
		2	1	150 + 300 + 300 = 750	
		3	2	150 + 300 + 300 = 750*	2A0
	2	0	0	300 + 700 = 1000	
		1	1	300 + 300 + 700 = 1300	
		2	2	300 + 300 + 700 = 1300	3A0
March	0	3	0	300 + 600 = 900*	3M1
(3)		4	1	400 + 300 + 600 = 1300	4A0
	1	2	0	150 + 300 + 600 = 1050*	
		3	1	150 + 300 + 600 = 1050	
		4	2	400 + 150 + 300 + 600 = 1450	5A0
	2	1	0	300 + 300 + 750 = 1350	
		2	1	300 + 300 + 750 = 1350	
		3	2	300 + 300 + 750 = 1350*	6A0
April (4)	0	4	0	400 + 300 + 900 = 1600	4M1
	1	3	0	150 + 300 + 1050 = 1500*	
	2	2	0	300 + 300 + 1350 = 1950	7A1

Month	Jan	Feb	March	April	
Number made	2	3	3	3	B1

Special Case 2: Working forward Max 7/12 version 2

Stage	State	Action	Dest	Value	
Jan	0	2	0	300 = 300*	1M1
(2)		3	1	150 + 300 = 450*	1A1
		4	2	400 + 300 + 300 = 1000*	
Feb	0	2	0	300 + 300 = 600*	2M1
(2)		3	1	150+ 300 + 300 = 750*	
		4	2	400 + 300 + 300 + 300 = 1300	
	1	1	0	300 + 450 = 750	
		2	1	150 + 300 + 450 = 900	
		3	2	300 + 300 + 450 = 1050*	2A0
	2	0	0	1000 = 1000	
		1	1	150 + 300 + 1000 = 1450	
		2	2	300 + 300 + 1000 = 1600	3A0
March	0	3	0	300 + 600 = 900*	3M1
(3)		4	1	400 + 150 + 300 + 600 = 1450	4A0
	1	2	0	300 + 750 = 1050	
		3	1	150 + 300 + 750 = 1200*	
		4	2	400 + 300 + 300 + 750 = 1750	5A0
	2	1	0	300 + 1050 = 1350	
		2	1	150 + 300 + 1050 = 1500	
		3	2	300 + 300 + 1050 = 1650*	6A0
April (4)	0	4	0	400 + 300 + 900 = 1600	4M1
	1	3	0	300 + 1200 = 1500*	
	2	2	0	300 + 1650 = 1950	7A1

Month	Jan	Feb	March	April	
Number made	2	3	3	3	B1

Special Case 3: Reversed states Max 7/12 version 1

Stage	State	Action	Dest.	Value	
April	0	4	0	400+ 300 = 700*	1M1
(4)	1	3	0	150+300 = 450*	1A1 CAO
	2	2	0	300+300 = 600*	
March	0	3	0	300+700 = 1000*	2M1
(3)	1	2	0	150+300+700 = 1150	
	2	1	0	300+300+700 = 1300	
	0	4	1	400+ 300+450 = 1150	
	1	3	1	150+300+450 = 900*	2A0
	2	2	1	300+300+450 = 1050*	
	1	4	2	400+150+300+600 =1450	3A0
	2	3	2	300+300+600 = 1200	
Feb.	0	2	0	300+1000 = 1300	3M1
(2)	1	1	0	150+300+1000 = 1450	4A0
	2	0	0	300+ 1000 = 1300*	
	0	3	1	300+900 = 1200*	
	1	2	1	150+300+900 = 1350*	5A0
	2	1	1	300+300+900 = 1500	
	0	4	2	400 +300+1050 =1750	
	1	3	2	150+300+1050 =1500	6A0
	2	2	2	300+300+1050 =1650	
Jan.	0	2	0	300+1200 = 1500*	4M1
(2)	0	3	1	300+1350 = 1650	
	0	4	2	400 +300+1300 = 2000	7A1 CAO

Month	Jan	Feb	March	April	
Number made	2	3	3	3	B1

Special Case 4: Reversed states Max 7/12 version 2

Stage	State	Action	Dest	Value	
April	0	4	0	400 + 300 = 700*	1M1
(4)	1	3	0	300 = 300*	1A1 CAO
	2	2	0	300 = 300*	
March	0	3	0	300 + 700 = 1000*	2M1
(3)	1	2	0	300 + 700 = 1000	
	2	1	0	300 + 700 = 1000	2A0
	0	4	1	400 + 150 + 300 + 300 = 1150	
	1	3	1	150 + 300 + 300 = 750*	
	2	2	1	150 + 300 + 300 = 750*	
	1	4	2	400 + 300 + 300 + 300 = 1300	
	2	3	2	300 + 300 + 300 = 900	3A0
Feb	0	2	0	300 + 1000 = 1300	3M1
(2)	1	1	0	300 + 1000 = 1300	4A0
	2	0	0	1000 = 1000*	
	0	3	1	150 + 300 + 750 = 1200*	
	1	2	1	150 + 300 + 750 = 1200*	5A0
	2	1	1	150 + 300 + 750 = 1200	
	0	4	2	400 + 300 + 300 + 750 = 1750	
	1	3	2	300 + 300 + 750 = 1350	6A0
	2	2	2	300 + 300 + 750 = 1350	
Jan	0	2	0	300 + 1200 = 1500*	4M1
(2)		3	1	150 + 300 + 1200 = 1650	
		4	2	400 + 300 + 300 + 1000 = 2000	7A1 CAO

Month	Jan	Feb	March	April	
Number made	2	3	3	3	B1

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