EDEXCEL

Stewart house 32 Russell Square London WC1B 5DN

June 2004

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject: **6690 Decision Maths** Paper: **D2**

Question Number	Scheme	Marks
1) (a)	A game in which the gain to one player is equal to the loss of the other	B2,1,0 (2)
(b)	If there is a stable solution(s) a_{ij} in a game, the location of this stable solution is called the saddle point. It is the point(s) where row maximin = column minimax	B2,1,0 (2) [4]
2)	Subtract all terms from some $n \geq 35$, e.g. 35 4 11 3 0 19 25 16 13 16 21 15 14 17 20 14 12	M1 A1√ (2)
	Reducing rows then columns 2 4 2 0 4 5 2 0 0 0 0 0 3 1 1 0	B1
	minimum uncovered 1 1 3 1 0 3 4 1 0 0 0 0 1 2 0 0 0	M1 A1√ (3)
	minimum uncovered 1 0 2 0 0 2 3 0 0 0 0 0 2 2 0 0 1	M1 A1√
	e.g. matching D - A A M S H - S or S or S or M K - M L A A T - L M L L	A1√ A1 (4) [9]
	Total 88 points	

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3) (a)(i)	Minimum connector using eg Prim ; AC, CB, CD, CE length = 98 + 74 + 82 + 103 = 357 {1,3,2,4,5} so upper bound = 2 × 357 = 714	m1 A1 m1 A1√ (4)
(ii)	A (98) C (74) B (131) D (134) E (115) A length = 98 + 74 + 131 + 134 + 115 = 552	m1 A1 A1 (3)
(b)	Residual minimum connector is AC, CB, CD length 254 Lower bound = 254 + 103 + 115 = 472	M1 A1 m1 A1 (4)
(c)	472 ≤ solution ≤ 552	B1√ (1) 12

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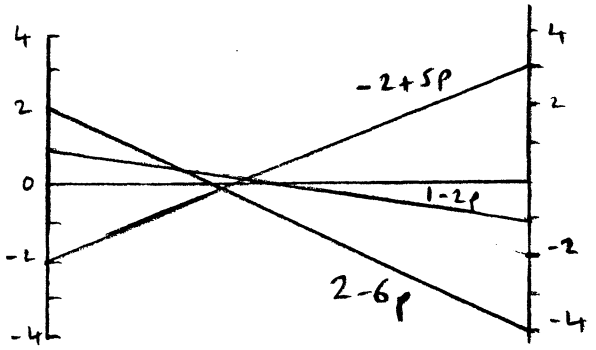
4) (a)	row min $\begin{pmatrix} -4 & -1 & 3 \\ 2 & 1 & -2 \end{pmatrix}$ $\begin{matrix} -4 \\ -2 \leftarrow \max \end{matrix}$ col max: 2, 1 ↑ min, 3 $-2 \neq 1$ ∴ not stable	M1 A1 A1 (3)
(b)	Let Emma play R_1 with probability p If Freddie plays C_1 Emmas winnings are $-4p + 2(1-p) = 2-6p$ C_2 " " " $-p + 1(1-p) = 1-2p$ C_3 " " " $3p - 2(1-p) = -2+5p$	M1 A1 A1 (3)
		M1 A1√ (2)
	need intersection of $2-6p$ and $-2+5p$	M1
	$2-6p = -2+5p$ $4 = 11p$ $p = \frac{4}{11}$	A1
	So Emma should play R_1 with probability $\frac{4}{11}$ R_2 " " " $\frac{7}{11}$ The value of the game is $-\frac{2}{11}$ to Emma.	A1√ (3)
(c)	value to Freddie $\frac{2}{11}$, matrix $\begin{pmatrix} 4 & -2 \\ 1 & -1 \\ -3 & 2 \end{pmatrix}$	B1√ B1,B1 (3) 14

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5) (a)	Idea of many supply and demand points and many units to be moved. Costs are variable and dependent upon the supply and demand points, need to minimize costs. Practical Costs proportional to number of units.	B2,1,0 (2)
(b)	Supply = 120 Demand = 110 so not balanced	B1 (1)
(c)	Adds 0, 0, 0, 10 to column f	M1, A1
	d e f A 45 B 5 30 C 30 10 cost 545	M1, A1 B1✓ (5)
(d)	$R_1 = 0$ $R_2 = -1$ $R_3 = -3$ $K_1 = 5$ $K_2 = 7$ $K_3 = 3$	M1 A1
	Ae = 3 − 0 − 7 = −4 ← Af = 0 − 0 − 3 = −3 Bf = 0 + 1 − 3 = −2 Cd = 2 + 3 − 5 = 0	M1 A1✓ A1✓ (5)
(e)	$Ae^+ \rightarrow Be^- \rightarrow Bd^+ \rightarrow Ad^-$ send 30	M1 A1✓
	d e f A 15 30 B 35 C 30 10 cost 425	DM1 A1✓ A1 (5)
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Question Number	Scheme	Marks
6) (a)	Stage – Number of weeks to finish State – Show being attended Action – Next journey to undertake	B1 B1 B1 (3)
(b)	eg	

Stage	State	Action	Value	
1	F	F – Home	500 − 80 = 420 *	M1 A1 (2)
	G	G – Home	700 − 90 = 610 *	
	H	H – Home	600 − 70 = 530 *	
2	D	DF	1500 − 200 + 420 = 1720	M1 A1√ A1√ A1 (4)
		DG	1500 − 160 + 610 = 1950 *	
		DH	1500 − 120 + 530 = 1910	
	E	EF	1300 − 170 + 420 = 1550	
		EG	1300 − 100 + 610 = 1810 *	
		EH	1300 − 110 + 530 = 1720	
3	A	AD	900 − 180 + 1950 = 2670 *	M1 A1√ A1√ A1 (4)
		AE	900 − 150 + 1810 = 2560	
	B	BD	800 − 140 + 1950 = 2610 *	
		BE	800 − 120 + 1810 = 2490	
	C	CD	1000 − 200 + 1950 = 2750 *	
		CE	1000 − 210 + 1810 = 2600	
4	Home	Home – A	−70 + 2670 = 2600 *	M1 A1 (2)
		Home – B	−80 + 2610 = 2530	
		Home – C	−150 + 2750 = 2600 *	

(c)

Home $\begin{cases} A \\ C \end{cases}$ D – G

Total profit £2600

B2√1√0

B1√ (3)

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