

2

6690 Decision Mathematics D2 – June 2002

1. (b) $A E F B C O A$; 101 (c) $A E F B C D E A$
(c) $B C D E A F B$; 98
2. (a) A plays II or IV and B plays III (b) (II, III) and (IV, III)
(c) 1
3. (b) $S B F T$; 7 units
4. (b) $4\frac{1}{5}$ to A
5. 15 hours
6. (a) AB, BC, CF, FD, FE (b) (i) 744 (ii) DA or AE
(c) 498
7. (b) $I_{13} = 4$; $I_{21} = 1$; $I_{31} = -1$; $I_{32} = 2$ (d) 525 units

3

6690 Decision Mathematics D2 – June 2003

1. (a)

	A(I)	A (II)
B(I)	3	-4
B(II)	-2	1
B(III)	-5	4
2. (c) 170 km
4. (d) Value of game is $\frac{9}{7}$ to A
5. (a) cost £470 (c) optimal cost £350
6. (a) £630 (b) £1540 (c) £14660

4

6690 Decision Mathematics D2 – June 2004

2. 88 points
3. (a) (i) 714 (ii) 552 (b) 472 (c) $472 \leq \text{solution} \leq 552$
4. (b) Value to Emma is $-\frac{2}{11}$
- (c) Value to Freddie $\frac{2}{11}$, pay-off matrix is $\begin{pmatrix} 4 & -2 \\ 1 & -1 \\ -3 & 2 \end{pmatrix}$
5. (c)
- | | | | | |
|----------|----------|----------|----------|------------|
| | <i>d</i> | <i>e</i> | <i>f</i> | |
| <i>A</i> | 45 | | | |
| <i>B</i> | 5 | 30 | | |
| <i>C</i> | | 30 | 10 | Cost = 545 |
- (e)
- | | | | | |
|----------|----------|----------|----------|------------|
| | <i>d</i> | <i>e</i> | <i>f</i> | |
| <i>A</i> | 15 | 30 | | |
| <i>B</i> | 35 | | | |
| <i>C</i> | | 30 | 10 | Cost = 425 |
6. (d) total expected profit = £2600

5

6690 Decision Mathematics D2 – June 2005

1. (a)
- | | | | |
|----------|----------|----------|----------|
| | <i>D</i> | <i>E</i> | <i>F</i> |
| <i>A</i> | 20 | 4 | |
| <i>B</i> | | 26 | 6 |
| <i>C</i> | | | 14 |
- (c) cost = £1384
2. (a) 121; 129 (b) Add 33 to *BF* and *FB*; add 31 to *DE* and *ED*
(c) *FCDABEGF*; upper bound of 138 km
4. (c) Routes *ACFIK*, *ADFIK*, *ADGJK*
5. (b) £1 160 000
6. (c) *A* should play I $\frac{1}{3}$ of time and II $\frac{2}{3}$ of time; Value = $3\frac{2}{3}$

6

6690 Decision Mathematics D2 – January 2006

2.

Month	May	June	July	August	September
Production Schedule	4	4	5	5	4

Cost = £2 300

4. (a) Adds zero for costs in third column;
Adds 14 as the demand value
- (b) The total supply is greater than the total demand
- (c) The solution would otherwise be degenerated
5. (b) Row 2 dominates Row 3
Row 1 dominates column 4
- (c) $v - p_1 - 2p_2 - 4p_3 \leq 0$
 $v - 4p_1 - 6p_2 - p_3 \leq 0$
 $v - 6p_1 - 5p_2 - 2p_3 \leq 0$
 $p_1 + p_2 + p_3 \leq 1; v, p_1, p_2, p_3, \geq 0$
6. (a) Lower bound (deleting C) = 595; Best lower bound is 595 km
- (b) Adds 167 to AF and FA
137 to CH and HC
136 to DF and FD
145 to DG and GD
- (c) Upper bound = 767 km
Best upper bound = 707 starting at F

7

6690 Decision Mathematics D2 – June 2006

3. (b) 480 mins (8 hrs) (c) 396 minutes (< 7 hours) (d) 346 mins

4. (a) either
- | | |
|---------|-----|
| $A - H$ | P |
| $B - R$ | R |
| $C - W$ | H |
| $D - P$ | W |
- or $\begin{matrix} R \\ H \end{matrix}$ cost £21000

(b) not unique – gives another solution

5. Route S, C, F, J, T; Profit - £20000

6. (c) $\begin{matrix} 15 \\ 1 \quad 11 \quad 0 \\ 17 \end{matrix}$
- (d) cost = 1497 units

8

6690 Decision Mathematics D2 – June 2007

1. (b) 165 miles (c) 148 miles
3. (b) 270 seconds (c) 2132 seconds

9

6690 Decision Mathematics D2 – June 2008

2. (e) £6100
3. (b) Maximin route: LADHR
5. (b) Value £197 000
6. (a) GH(38) GF(56) CA(57) EC(59) FE(61) CD(64) CB(68)
(b) 806 (km) (d) 597 (km) (e) 560 (km)
(f) $560 < \text{length} \leq 597$

6690 Decision Mathematics D2 – June 2009

1. (a) J – 4, M – 2, R – 3, (D – 1) (b) £33

2. (b) 257 (c) 257 (d) 254 (e) 254
 (f) $254 < \text{optimal} \leq 257$

3. (c)

	A plays 1	A plays 2	A plays 3
B plays 1	5	-1	2
B plays 2	-6	4	-3

(d) B should play 1 with a probability of 0.7,
 play 2 with a probability of 0.3 and never play 3.
 The value of the game is 0.5 to B

4. (a) Value of cut $C_1 = 34$; Value of cut $C_2 = 45$ (b) 28

5. (a) $x = 0, y = 0, z = 2$ (b) $P - 2x - 4y + \frac{5}{4}r = 10$

6. (a)

	A	B	C
X	16	6	
Y		6	8
Z			15

 (b)

	A	B	C
X	$16 - \theta$	$6 + \theta$	
Y		$9 - \theta$	$8 + \theta$
Z	θ		$15 - \theta$

(c)

	A	B	C	£524
X	1	15	16	
Y			17	
Z	15			

6690 Decision Mathematics D2 – June 2010

1. (b) £186 (d) £125 (e) £117

2. (b) £90

3. (a)

	A	B	C	D
X	18	31	4	
Y			18	29

(c) Not optimal

4. (b) SAEHT, £38 000 (c) £32 500

5. (a) 41 (b) 69 and 64

(d) e.g. SBADHT – 2, SCGEDHT – 2

6. (a) $P - x - 2y - 6z = 0$

(c) $P = 52, x = 0, y = 20, z = 2, r = 0, s = 0, t = 6$

12

6690 Decision Mathematics D2 – June 2011

1. (a) 37, 42, 34, 42, 34, 37 (b) ACBEFDA, 107 (c) 91 km
3. (a) $P - 7x + z + 4s = 320$
(c) $P = 376$, $x = 8$, $y = 1$, $z = 0$, $r = 14$, $s = 0$, $t = 0$
4. Play 2 with probability p and 3 with probability $(1 - p)$
5. (a) $a = 1$, $b = 5$, $c = 13$, Flow = 49 (b) 69 and 64
(c) e.g. SBEHT – 7, with either SBEHDAFGT – 2 or SBCEHDAFGT – 2
(d) 58 (f) Cut through HT, HG, GF, FT Value 58
7. (a) £10 600
(b) London – A – D – G – I – London
London – A – E – F – I – London

13

6690 Decision Mathematics D2 – June 2012

1. (a) Allocation: A – 1, B – 5, C – 3, D – 4, E – 2 (b) £647
2. (a) 100 km (c) 84 km
3. (b) Not optimal
4. (b) $P = \frac{21}{2} - 9x - \frac{13}{2}z - \frac{7}{4}t$
5. (c) $\frac{8}{9}$
6. (a) 46 (c) e.g. SBDET – flow 3, SBCFT – flow 2
7. Month: Jan Feb Mar Apr
No. made: 2 2 2 2

14

6690 Decision Mathematics D2 – June 2013

1. (b) 112 (d) 78 (e) 78 (f) ABDECA
2. (d) Optimal
3. (a) 44 (b) 71
4. (a) $\begin{bmatrix} 4 & -6 \\ -2 & 3 \\ -1 & 3 \end{bmatrix}$ (b) $\begin{bmatrix} -4 & 2 & 1 \\ 6 & -3 & -2 \end{bmatrix}$
5. (a) Variable z (c) $P=45; x=20; y=14; z=37; r=s=t=0$
7. The actions Nigel should take are:
Keep, Keep, Replace, Keep in years 1, 2, 3 and 4 respectively
His income will be £32 000.

15

6690 Decision Mathematics D2 – June 2013 (R)

1. (b) $C = 2, J = 4, K = 3$ and $N = 1$, maximum profit £664
2. (b) 750 (c) 634 (d) $634 < \text{optimal} \leq 750$
4. Robin should play R1 with probability $\frac{4}{5}$;
R2 never; R3 with probability $\frac{1}{5}$
The value of the game is $\frac{7}{5}$ to Robin
5. (b) $P + x + 4s + 18t = 240$
6. (a) 93 (d) 98
8. Fresh = 1, Frozen = 1, Canned = 3
Monthly income = £ 21 500