BC2410 Assignment 3
Sem 1, Group 3
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Q1 a) 100

b) A C

c) B: 30
D: 100

d) B D

e) C

f) A

g) min $-5A + 5B + 10C + 100D$
s.t. $-A + B = 2$
$-3A + B + 4C + D = 5$
$B + 2C = 2$
$2A + B + C = 5$
$C \geq 0$ $D \geq 0$ $A \leq 0$ $B \leq 0$ (verified)

Q2

	A	B		constraint
labour	1/5 h	3/10 h	≤	90
test	1/7 h	3/7 h	≤	90
raw	$3	$1		
market	$7	$9		
demand	200	100		

a) let x_1 be the number of the first product produced
let x_2 be the number of the second product produced

$$\max \quad 4x_1 + 8x_2$$

s.t.

$$\frac{1}{5}x_1 + \frac{3}{10}x_2 \leq 90$$

$$\frac{1}{7}x_1 + \frac{3}{7}x_2 \leq 90$$

$$x_1 \geq 200$$

$$x_2 \geq 100$$

b) dual

$$\min \quad 90p_1 + 90p_2 + 200p_3 + 100p_4$$

$$\frac{1}{5}p_1 + \frac{1}{7}p_2 + p_3 \geq 4$$

$$\frac{3}{10}p_1 + \frac{3}{7}p_2 + p_4 \geq 8$$

$$p_1, p_2 \geq 0, \quad p_3, p_4 \leq 0$$

Q3

Let $x_i = \begin{cases} 1, & \text{if show } i \text{ is shown} \\ 0, & \text{if show } i \text{ is not shown} \end{cases}$ $\forall i = 1, 2, \ldots, 9$

Let c_i be advertising revenue for show i (in millions)

Let $y = \begin{cases} 1, & \text{more than 3 shows contain violence} \\ 0, & \text{3 or less shows contain violence} \end{cases}$

$$\max \sum_{i=1}^{9} c_i x_i - 4y$$

st

$$x_3 + x_6 + x_7 + x_9 \geq x_2 + x_3 + x_4 + x_6$$

$$x_7 \leq x_4 + x_3$$

$$x_4 + x_9 \leq 1$$

$$x_2 + x_3 + x_4 + x_7 \geq 5 - 2 - (x_1 + x_5 + x_6)$$

what if $x_1 = x_5 = x_6 = 0$ than $x_2 + x_3 + x_4 + x_7 \geq 3$

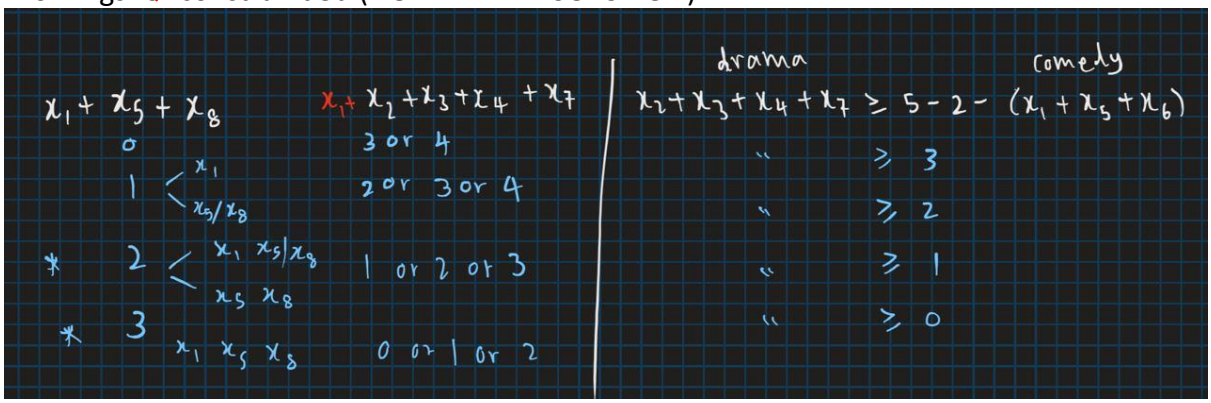
$$y \geq x_1 + x_3 + x_4 + x_6 - 3$$

$2(x_2 + x_3 + x_4 + x_7) \geq x_1 + x_5 + x_6 - 1$ should work

$$\sum_{i=1}^{9} x_i = 5$$

$x_i \in \{0, 1\}$ for $i = 1, \ldots, 9$ $\quad y \in \{0, 1\}$

Workings for constraint 3d (NOT IN FINAL SOLUTION)



5 on the RHS of the equation comes from the total 5 shows that can be shown

2 on the RHS of the equation comes from the 2 shows that are neither drama nor comedy

Q4

a) max $x_{12} + x_{15} + x_{13} + x_{26} + x_{27} + x_{23} + x_{34} + x_{47} + x_{49} + x_{57} + x_{56} + x_{69} + x_{79}$

This three is the flow

s.t.

$$x_{12} + x_{15} + x_{13} = x_{69} + x_{79} + x_{49}$$

$$x_{12} - x_{26} - x_{27} - x_{23} = 0$$

$$x_{13} + x_{23} - x_{34} = 0$$

$$x_{34} - x_{47} - x_{49} = 0$$

$$x_{15} - x_{56} - x_{57} = 0$$

$$x_{26} + x_{56} - x_{69} = 0$$

$$x_{27} + x_{57} + x_{47} - x_{79} = 0$$

$0 \le x_{12} \le 9$

$0 \le x_{15} \le 20$

$0 \le x_{13} \le 5$

$0 \le x_{23} \le 18$

$0 \le x_{26} \le 20$

$0 \le x_{27} \le 15$

$0 \le x_{34} \le 15$

$0 \le x_{47} \le 5$

$0 \le x_{49} \le 16$

$0 \le x_{57} \le 5$

$0 \le x_{56} \le 14$

$0 \le x_{69} \le 6$

$0 \le x_{79} \le 8$

b)

$$\min \quad 7x_{12} + 8x_{15} + 7x_{13} + 10x_{26} + 8x_{27} + 5x_{23} + 12x_{34} + 4x_{47} + 7x_{49} + 12x_{57} + 11x_{56} + 13x_{69} + 2x_{79}$$

s.t.

$$1 = x_{12} + x_{15} + x_{13}$$

$$x_{12} - x_{26} - x_{27} - x_{23} = 0$$

$$x_{13} + x_{23} - x_{34} = 0$$

$$x_{34} - x_{47} - x_{49} = 0$$

$$x_{15} - x_{56} - x_{57} = 0$$

$$x_{26} + x_{56} - x_{69} = 0$$

$$x_{27} + x_{57} + x_{47} - x_{79} = 0$$

$$x_{69} + x_{79} + x_{49} = 1$$

$$x_{ij} \geq 0, \quad \forall (i,j) \in A$$

A is not defined

c) $\min \; 7x_{12} + 8x_{15} + 7x_{13} + 10x_{26} + 8x_{27} + 5x_{23} + 12x_{34} + 4x_{47} + 7x_{49} + 12x_{57} + 11x_{56} + 13x_{69} + 2x_{79}$

s.t. $30 = x_{12} + x_{15} + x_{13}$

$x_{12} - x_{26} - x_{27} - x_{23} = 0$

$x_{13} + x_{23} - x_{34} = 0$

$x_{34} - x_{47} - x_{49} = 0$

$x_{15} - x_{56} - x_{57} = 10$

$x_{26} + x_{56} - x_{69} = 0$

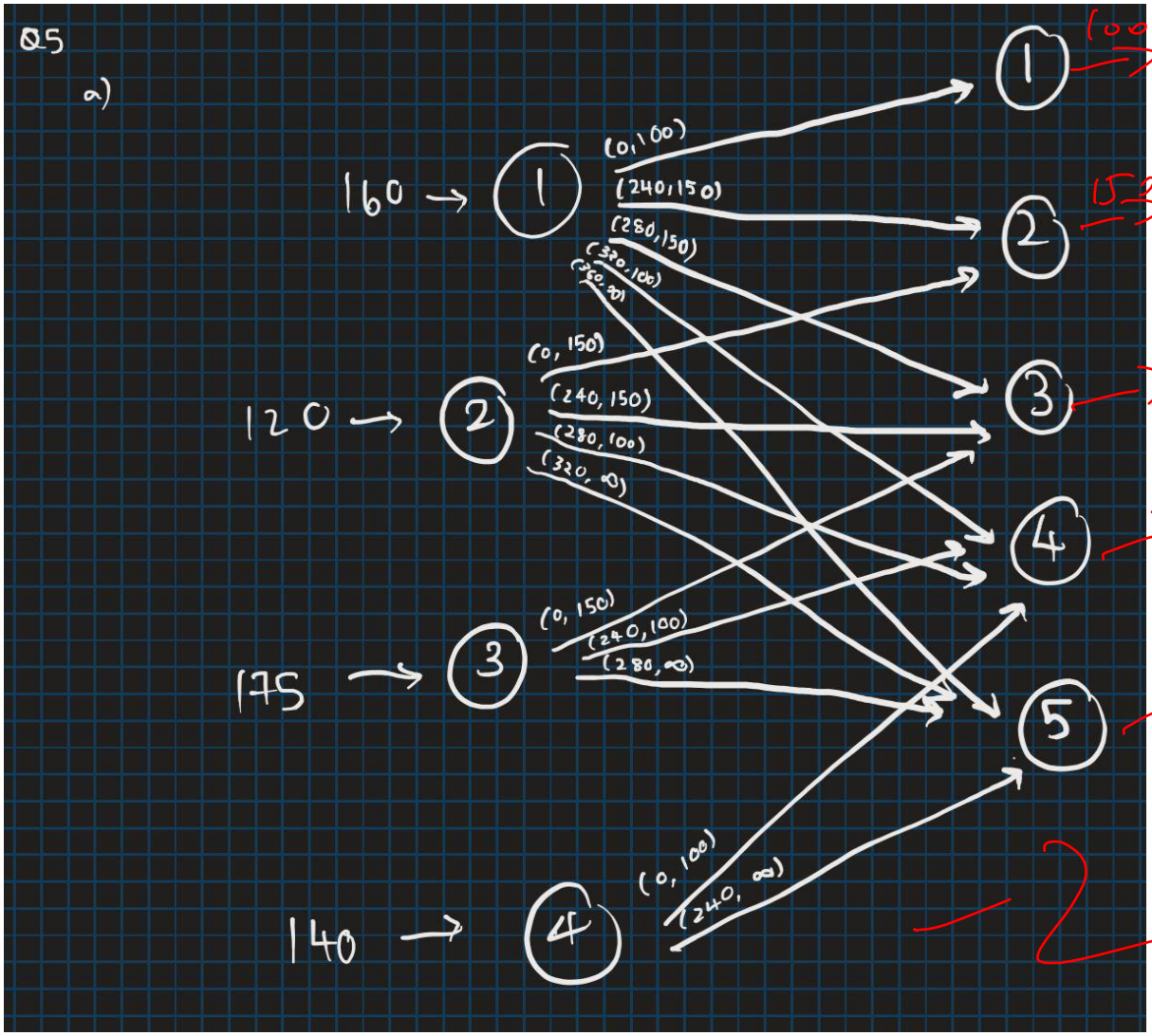
$x_{27} + x_{57} + x_{47} - x_{79} = 15$

$x_{69} + x_{79} + x_{49} = 5$

where are the capacity constraints?

$x_{ij} \geq 0, \; \forall (i,j) \in A$

not defined.


Q5
a)
160
120
175
140
1
2
3
4
5
(0,100)
(240,150)
(280,150)
(320,100)
(320,∞)
(0,150)
(240,150)
(280,100)
(320,∞)
(0,150)
(240,100)
(280,∞)
(0,100)
(240,∞)
100
150
100
95
2

b)

$$\min \; 240x_{12} + 280x_{13} + 320x_{14} + 360x_{15} + 240x_{23} + 280x_{24} + 320x_{25} + 240x_{34} + 280x_{35} + 240x_{45}$$

s.t.

$$160 = x_{11} + x_{12} + x_{13} + x_{14} + x_{15}$$

$$120 = x_{22} + x_{23} + x_{24} + x_{25}$$

$$175 = x_{33} + x_{34} + x_{35}$$

$$140 = x_{44} + x_{45}$$

$$x_{11} \leq 100$$

$$x_{12} + x_{22} \leq 150$$

$$x_{13} + x_{23} + x_{33} \leq 150$$

$$x_{14} + x_{24} + x_{34} + x_{44} \leq 100$$

$$x_{ij} \geq 0 \; ; \; \forall (i,j) \in A$$

$x_{15} + x_{25} + x_{35} + x_{45} + x_{55} = 95$.

not defined