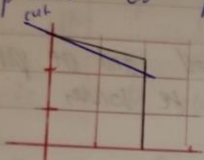
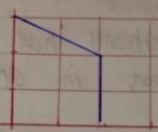
Mang Sci 202 Exam Paper

Q 1 A) i) In esente we cut of a section of the feasible solution area such that we omit the fraction part and end up with only integer points as part of our boundry see example



Blue line = cut

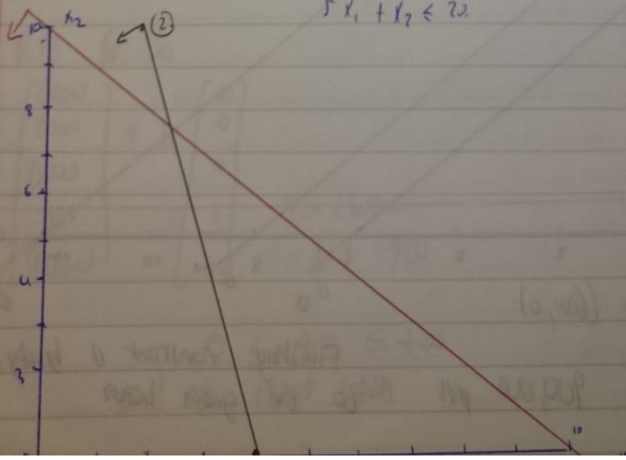


new region

ii. - Solve problem using simplex table, disregarding integer conditions
- Take basic variable with the largest fraction solution
- Express each coefficient as an integer with a positive fraction
  eg: $b = [3 + \frac{1}{2}] + [0 + \frac{7}{22}](S_1) + [0 + \frac{1}{22}](S_2)$
- Group integer and fraction parts together.
- Theory is that fractional part must be ≤ 0
- Convert this constraint into an equality by adding a slack variable and add to final table
- Use dual simplex to remove infeasibility

b: Max $10x_1 + 8x_2$ ST: $x_1 + x_2 \leq 10$

$5x_1 + x_2 \leq 20$



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2 A. Feasible Region:

The area created by the constraints in the LP, where the optimal solution may lie. This can be non-convex, a single point, line, polygon or an unbounded area

Binding constraints

These constraints have all their value used and are part of the solution, in one sense they limit the solution

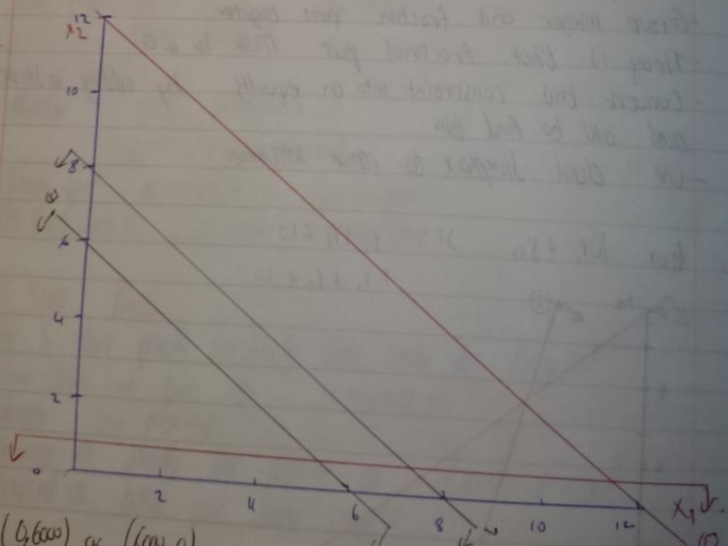
B i. Max $150x_1 + 90x_2$

ST: $x_1 + x_2 \leq 12000$

$x_1 \leq 8000$

$x_1 + x_2 \leq 6000$ $x_1, x_2 \geq 0$

ii.



(0,6000) or (6000,0)

Soln: 900,000 pvl

Finishing constraint is binding solution to the given value

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2 b iii.

Basis	C_B	X_1	X_2	S_3	S_4	S_5	
		150	90	0	0	0	
S_3	0	0	0	1	0	-1	600
S_4	0	0	-1	0	1	-1	2000
X_1	150	1	1	0	0	1	6000
Z_j		150	150	0	0	150	900 000
$C_j - Z_j$		0	-60	0	0	-150	

Shadow price for constraint 1 and 2 are zero ~~Adding~~ Having one more unit of this constraints will result in a zero euro increase in profit, these constraints are non-binding

For constraint 3, the price is 150, each extra one unit of finishing process will result in €150 of extra profit → binding constraint.

iv. Obj coef range for X_2:

$C - 150 \le 0$

$C \le 150$

As long as price is below 150 it will have no effect.

RHS for S_4

$$\begin{bmatrix} 6000 \\ 2000 \\ 6000 \\ 900 \\ 900000 \end{bmatrix} + b \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$$

$900 + b \ge 0$

$b \ge -900$

$0 \le 900 \le +\infty$

will not effect soln

3. Ai: Minimise: $6X_{11} + 8X_{12} + 10X_{13} + 7X_{21} + 11X_{22} + 11X_{23}$
$+ 4X_{31} + 5X_{32} + 12X_{33}$

ST: supply

$X_{11} + X_{12} + X_{13} \leq 150$

$X_{21} + X_{22} + X_{23} \leq 175$

$X_{31} + X_{32} + X_{33} \leq 275$

$X_{41} + X_{42} + X_{43} \leq 50$

demand

$X_{11} + X_{21} + X_{31} + X_{41} \leq 200$

$X_{21} + X_{22} + X_{32} + X_{42} \leq 150$

$X_{31} + X_{23} + X_{33} + X_{43} \leq 300$

All variables ≥ 0.

ii: North west corner.

- Starting are top left cell, allocate as much as possible to cell.
- Adjust row and column totals
- if row total is zero move down one cell, if column zero move right one
- repeat above steps until all rows and columns = 0

i. Initial

	W	K	D	T.
G	6 150	8	10	150 150=0
B	7	11	11	175
A.	4	5	12	275
D	0	0	0	50
T	200 150=50	150.	300	

Round 1.

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	W	K	D	T.
G	6(150)	8	10	0
B	7(50)	11	11	175 50=125
A	4	5	12	275
D	0	0	0	50
T	50-50=0	150	300	

5.

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	W	K	D	T
G	6(150)	8	10	0
B	7(50)	11(125)	11	125-125=0
A	4	5	12	275
D	0	0	0	50.
T:	0	150-125=25	300	

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	W	K	D	T.
G	6(150)	8	10	0
B	7(50)	11(125)	11	0
A	4	5(25)	12(250)	250-250
D	0	0	0(50)	0
T	0	25-25=0	300-300=0	

Solution = 6(150) + 7(50) + 11(125) + 5(25) + 12(250) + 0(50)
= 5750

Alternative least cost method:

- Pick lowest cost in table, allocate as much as possible to this cell.
- Adjust row and column totals
- Repeat until all row/column totals are zero

iii Modi Method

		W $K_1 = 6$	K $K_2 = 10$	D $K_3 = 6$	T.
$R_1 = 0$	G	6 150	8	10	
$R_2 = 1$	B	7 50-25	11 125+25	11	
$R_3 = 6$	A	4 25	5 25-25	12 250	
$R_4 = -6$	D	0	0	0 50	
	T:				

Options:

G→K 8-0-10 = -2
G→D 10-6-0 = 4
B→D 11-1-6 = 4
A→W 4-6-6 = -8
D→W 0+6-6 = 0
K→W 0+6-10 = -4

problem
cont
find

		W $K_1 = 6$	K $K_2 = 10$	D $K_3 = 10$
$R_1 = 0$	G	150 −150 (6)	0 +150 (8)	0 (10)
$R_2 = 1$	B	25 +150 (7)	150 −150 (11)	0 (11)
$R_3 = 2$	A	25 (4)	0 (5)	250 (12)
$R_4 = -10$	D	0 (0)	0 (0)	50 (0)

$G \to K$ $8-10-0 = -2$

$G \to D_0$ $10-10-0 = 0$

$B \to D_0$ $11-1-10 = 0$

$A \to K$ $5-10-2 = -7$

$D_u \to W$ $10-6 = 4$

$D_u \to K$ $= 0$

		W $K_1 = 6$	K $K_2 = 8$	D $K_3 = 0$
$R_1 = 0$	G	0 (6)	150 (8)	0 (10)
$R_2 =$	B	175 (7)	0 (11)	0 (11)
$R_3 =$	A	25 (4)	0 (5)	250 (12)
$R_4 =$	D_4	0 (0)	0 (0)	50 (0)

IV. - This information can be incorporated into the optimal solution
- Assign an extremely large cost M in the Box from Galway to Cavan, current value = 5.

V. - Solution will change
- Given increase in cost from Galway to Cavan the solution will no longer be optimal
- Savings will be calculated using Modi method
- Iterate to obtain new solution
- Dublin and Limerick will supply Cavan

VI. - Firstly it needs to increase supply, currently short by 50
- Largest cost is from delivering to Dublin
- Company should try and reduce this cost
- Maintain current solution or improve by changing cost