Assignment - I (CE - III/II)

1) solve the following LP-Problem using simplex method

Min Z = 5x1 + 3x2 + 7x3

subject to

81,+ 82 + 2×3 £ 22

 $301, +2012 + 013 \leq 26$

N1 + N2 + 2N3 5 18

81, 82, 83 20

SOID:

Standard form of above LP-Problem is

Min Z = 5x, + 3x2 + 7x3 + 0.5, + 0.52 + 0.53

subject to

M1+812+2M3+51 =22

38, +282+ 83 +52 = 26

N, + N2 + 2N3 + 53 = 18

51,52,53, 81, 82,83 20

First iteration:

T	1.0	101	0 1	- 1	3	ਰ	0	^		DAY- Cakin
ı			Cil	5	3	7	0	0	0	Min. Ratio
	CB	B	XBi	×,	8/2	813	5,	52	53	XBi/arj
	0	Sı	220	1	1	2	•	0	0	22/1 = 22
	0	52	26	3	(2)	1	0	1	0	26/2 = 13+
1	0	53	18	1	1	2	0	0	1	18/1 = 18
100			Zi	0	0	0	0	0	0	
1			Zj-Cj	-5	-3	-7	0	0	0	

Tpavot column

Since the objective function is of minimization type, pivot rolumn is corresponding to most positive Zj-Cj row element.

Since $Z_j - c_j \leq 0$ we stop and the optimal solution is attained at $x_1 = 0$, $x_2 = 0$ and $x_3 = 0$.

Min Z = 5x0+ 3x0+ 7x0

=0.

2) Using Big-M method solve the following LP-Problem

Max Z = - 81, + 2012 + 3013

subject to

N1-N2+ N3 ≥4

81+812+283 28

81,-813 ≥ 2

M1-451 N3 50

5012!

Standard form of above LP-Problem is

Max Z = \$1+282+383+0.5, +0.52+0.53-MA, -MA2

Subject to 1-11-10 MARINES

X1-82+ 83-5, + A1 = 4

M, + M2 + 2 M3 + S2 = 8

X1 - X3 - 53 + A2 = 2

M1182,83, 8182, 83, A1, A2 20

10.54	State of the last			1		Marian Committee							ſ
	Iterative	on -1	G	1	2	3	0	0		-M	-M	Min. Ratio	ı
	CR	B	XBi	21,	8/2	N 3	3,	52	53	A	A 2	XB/M,	1000
	-M	A	4	and the same	-1	1	-1	0	0	1	0	1/1=4	-
Ri.	0	52	2	10	18	2	0	11	0	0	0	8/1 -8	-
	-M	A2	2	(1)	0	-1-16	0	0	-1	0	A	2/102>	
		1 2	Zj O	-2M®	W	0	M	00	M	-M	-M	8	
100	A. 212	1 20	Z1-C	-2m-17	M-2	-3	M	0	M	0	0	0	
	The second secon							-					

Since the objective function is of maxima maximization type,

pivot column corresponds to most negative Zj-Cj.

Here the most negative Zj-Cj = -2m-1 and its column index is 1.50, the entering variable is M,

Minimum ratio is 2 and its row index is 3. so, the outgoing basis variable is A2.

.. The pivot element is \$1.

												-
1	Iterat	ion - 2	Cj	1	2	3	0	0	0	-M	Min. Ratio	
	CB	B	XB!	21,	812	213	5,	52	53	A	XBi/x3	
	-M	A.	2	0	-1	(2)	71 5	80/8	80,118	1	2/2=1 ->	
	0	52	6	0	1	3	0	1	1	0	6/3=2	
	1	81,	2	1	0	-11	0	0	41	0	2/2/18/	
	4	-AM-	Zj -	ed These	M	-2M-1	M	0	- M-1	-M	AND A	
			Zj-Cj	0	M-2	-2m-41	M	0	-W-1	0	udia	
					-	7						_

most negative Zj-Cj = -2m-4 and the corresponding column index is 3.50, the entering variable is x3

Minimum ratio = 1 and its row index is 1. 50, the outgoing basis variable is A,

. The pivot element is 2.

8	Iteral	hon -3	C.	1.1	2 2 8	3	0 1	0	0	Min. Ratio	
	CB	В	XBi	N,	2 82	23	51	52	53	XB1/02	
	3	M3	31	0	-0.5	1	-0.5	0	0.5	-	
	0	52	31	0 1	(2.5)	0 141	11.50	112-0	-0.5	3/2.5=1.2 >	
	201	81,	3	- China	-0.5	0	-0.5	0	-0.5	t was	
			2,	adation.	-2	3	-2	0	and 100	Joung	
	000	4/32	Zj-Cj	10	-41	0	1-2	0	2126	97.074	
_	ALC: NO PERSON NAMED IN					All residences and the latest and th	Designation of the last of the				

Most negative Zj-Cj = -4 and its column index is 2. So, the entering variable is \$12.

Minimum ratio is 1.2 and its row index is 2. so the outgoing variable is 32.
... Pivot element is 2.5.

	N. Company									the state of the s
	Therat	ion - 4	Cj	1	2	3	0	0	OKT	Mini Ratio
	· CB	B	XB;	M,	812	813	5,	52	53	XBi/arj
	3	23	1.6	0	1000	9 170	- Ó. 2	0.2	0.4	la labella
	2	8/2	1.2	0	1	0	0.6	0.4	-0.2	THE THE LOT A
	1	81,	3.6	0-107	60	Ound	-0.2	0.2	-0.6	books
	105	2.0+	2, 2;	94102	0 42 8.	3	0:4	1.6	0.2	I MIM
	13		Z1-C1	0	0	0	0.4	1.6	0.2	Subject
-										

Since all Zj-Cj Zo, we stop and this is the optimality criteria.

Many Hence, optimal solution is attained with value of variables as: $x_1 = 3.6$, $x_2 = 1.2$ and $x_3 = 1.6$.

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Max 2 = 3.6 + 2(1.2) + 3(1.6)

= 3.6 + 2.4 + .4.8

= 10.8 = 2KH + 1K + 2KH + 1KS

3) Find the dual of the following Min Z = 3x, -2x2 +4x3 Subject to

2x, +5x2+4x3 >7

6-d, + d2 + 3 d3 74 + phs - ph + phs

7×1, -2×2-3×3 ≤10-

M1 - 2x2 +5x3 23 H 0 5 5K 1 H 1 H 1 H

4x, +7x2 -2x322

and \$1, \$12, \$13 20 \$ got state also the solution of primal from the solution of dual. Sola: Since the objective function of the above LP problem is of minimization, the direction of each constraint has to be changed to ? type by multiplying both sides by -1.

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Min Z = 301 - 2012 + 403 subject to

2 8, + 5 8 2 + 4 8 27

6 x 1 + x 2 + 3 x 3 Z 4

-7x, +2x2+3x3 Zr10

N, -2N2 +5N3 23

481 + 782 - 28372

M11 M2, M3 20

The standard form of above LP-Problem is

Min Z = 381, -282+ H83+ 0.5, +0.52+0.53+0.54+0.55

Subject to

201 + 502 + 403 - 91 = 7 601 + 82 + 303 - 52 = 4 -701 + 202 + 303 - 53 = -10 811 - 202 + 503 - 94 = 3 401 + 702 - 203 - 95 = 2

51, 52, 83, 54, 55, 81, 82, 83 70

The dual of above primal LP-Problem is

Max Zy = 7y, + 4y2 - 10y3 + 3y4 + 2y5

subject to

24, + 642 - 743 + 44 + 445 £ 3 54, + 42 + 243 - 244 + 745 £ -2 44, + 342 + 343 + 544 - 245 £ 4 • 41, 42, 43, 44, 45 20.

Here b2 = -2 <0,

50 multiply this constraint by -1 to make b2 70.

=>-54, -42-243+244-745 = 2

Standard form of above dual LP- Problem is

2 Max Zy = 7y, +4y2-10y3 +3y4 + 2y5 +0.5, +0.52 + 0.53 -MA,

Subject to

241 + 642 - 743 + 44 + 445 + 51 = 3 -541 - 42 - 243 + 244 - 745 + 52 + A1 = 2 441 + 342 + 343 + 544 - 245 + 53 = 4 41.42, 43, 44, 45, 51, 52, 53, A1 ≥ 0.

														F
	Iterati	on 1	Cj	7	4	-10	3	2	0	0	0	- M	ska anti	
	CB	B	MB;	w,K	4/2	83	74	75	5,	52	53	A,	Min. Ratio	
													* Bi/ H	
	0	5,	3	2	6	-7	1	4	319	0	0	0	3/1,=3	
	~ M	A,	2	-2	-1	-2	2	-7	0	-10 %	0 4	015年	2/2=1	
	0	53	4	4	3	3	(5)	-2	0	0	· les	0	415=0.8 ->	
	1		7)	5 M	m	2M	-2M	ME	0	M	0	- M	, 18	
-			7;-C;	5M-7	Mry	2M+10	-2M-3	7M-2	0	M	0	0	2014	
			The Control of		14.00		1	A. ILIO				The state of the s		

Bince the objective function of above dual LP-problem is of maximization type, the pivot column corresponds to most negative Zj-G.

Here the most negative Zj-Cj is -2M-3 and its column index is 4.50 the entering variable is yu.

Minimum ratio is 0.8 and its row index is 3.

So the outgoing variable 15-53.

. The pivot element is 5.

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	There	tion-2	G	汗	4	1 100		2				1		-
	21009		-)	.()	7	-10	3	-	0	0	0	-M	1 2 2 4	
	CB	B	781	8.	72	73	84	75	5,	52	93	A,	Min. Ratio	
						SOKE	4	KS to b	18	- 5	- 13	3-4	MYBi/A	
. 1	0	5,	2:2	1.2	5.4	-7.6	0	4,4	-1	0	-0.2	0	, ,	
-	-M	A,	0.4	-6.6	-2,2/-	£3.2	0	-6.2	0	ы	-0.4	la Last	2018	
1 :	13	84	30.8	0-3	0.6	0.6	10	-0.4	0	0	0.2	0	50000	
,			7;	6.6M+2.4	2.2M+1.8	3.2M+1.8	3	6-2M-1-2	0		0.4M+0.6		1 4	
1			Zj-Cj	6.6M-4.6	2.2M - 2.2	3-2m+11-8	0	6.2M - 3.2	0	~	0.4M+0.6			

Max 7y = 7x0+4x0-10x0+3x0.8+2x0

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at y1=0, y2=0, y3=0, y4=0.8 and y5=0.

But this solution is not feasible because the final solution violates the 2nd constraint -54, -42-243+244-745 22 and the artificial variable A, appears in the basis with positive value 0.4.

Solution for primal LP-problem is: $x_1 = |Z_j - C_j|$ element corresponding $S_1| = |O| = 0$ $x_2 = |Z_j - C_j|$ element corresponding $S_2| = |M| = M$ $x_3 = |Z_j - C_j|$ element corresponding $S_3| = |O| + M + 0.6| = 0.4M + 0.6$.

Min Zn = 3x0 - 2xm + 4 (0.4m + 0.6)

= 0 - 2m + 1.6m + 2.4

~ - 2m + 2m + 2.4 [: m is very large undesirable

= 2.41.

coefficient].

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Plant: 281 4845 = 46 - (1)

(ii) - AND ON THE STATE OF MA

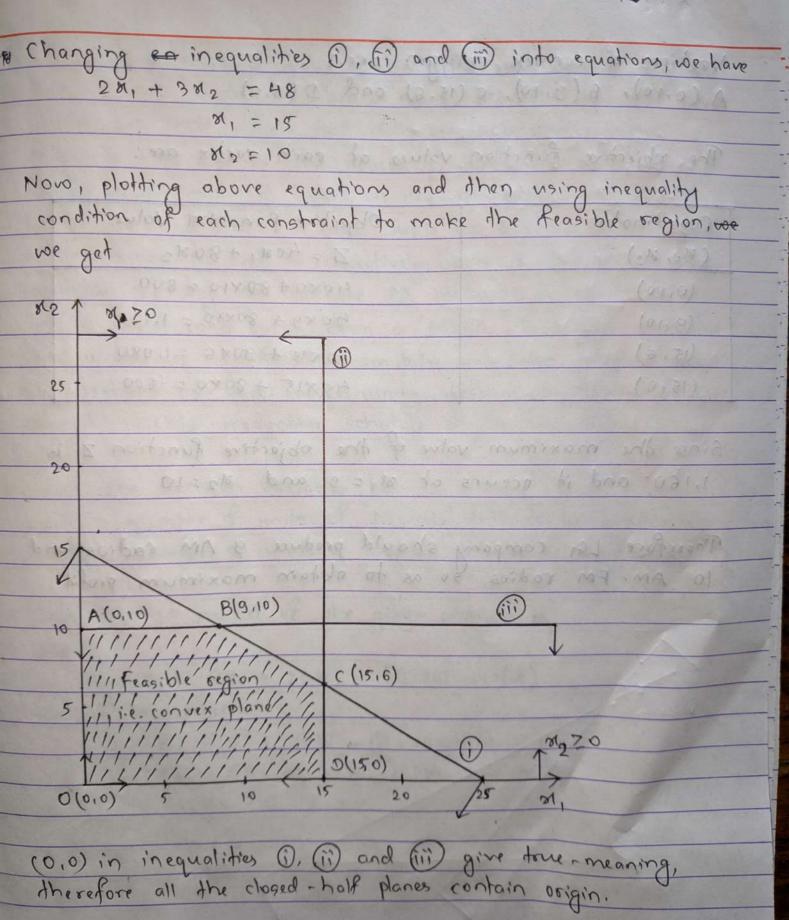
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4) LG company has been a producer of picture tubes
for television sets and certain printed circuits for radios. The company has just expanded into full scale production and marketing of AM and AM-FM radios. It has built a new plant that can operate for 48 hours per week. Production of an AM radio will require 2 hours and AM-FM radio will require 3 hours. Each AM radio will contribute Rg. 40 to profits while on AM-FM radio will coteibate Rs. 80 to profits. The marketing department, after extensive research, has determined that a maximum of 15 AM radios and 10 AM-FM radios can be sold each week

- (i) Set up the mathematical model for the production mix of AM-FM radios
- (ii) Find from the graphical method, the number of AM and AM-FM radios that maximize the total profit. MIN 24 5 3 x 0 - 2 x M + 4 (0:4 M + 0:6)

Let the decision variables be main me a X1 = number of units of AM radio to be produced X2 = number of units of AMrfM radio to be produced.

Then. LP model of the given problem is: Maximize (total profit) Z = 40 m, + 80 m2 subject to constraints Plant: 20, +302 = 48 - 0 Am radio: 81, = 15 - (i) AMFM radio: 8/2 \$10 and \$1, \$2 70.



Vertices of convex polygon are: A (0,10), B (9,10), C (15,6) and D (15,0)

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The objective function values at each vertex are:

-		The state of the s
1	Coordinates	Objective Function Value
	(M1, M2)	Z=40x1+80x2
	(0,10)	40x0480x10 = 800
	(9,10)	40x9+80x10=1,160
	(15,6)	40×15 + 80×6 = 1,080
	(15.0)	40×15 +80×0 = 600

Since the maximum value of the objective function Z is

Therefore LG company should produce 9 AM radios and 10 AM FM radios so as to obtain maximum profit.

One is sold under the brand name 'Monita" and the other under stz. 'Suzie". These two dolls are processed on two machines - M and N. The processing time for each "Monita" is 3 hours and 7 hours on the machines M and N respectively and that for each "Suzie" is 6 hours and 6 hours on machines M and N respectively. There is 18 hours of time available per day on machine M and 30 hours on machine B. The profit contribution from a "Monita" is a Rs. 8 and that from a "Suzie" is Rs. 20, Formulate and solve graphically this problem as linear programming problem to determine the ophimal weekly production schedule of the two dolls.

Sola!

Let the decision variables be

N, = number of units of "Monila" doll to be produced.

Nz = number of units of "Suzie" doll to be produced.

Then the LP model of the given problem is

Max Z = 8x, + 20x2 (Total profit)
subject to constraints

30, + 602 = 18 - 1 (Machine M) 70, + 602 = 30 - 1 (Machine N) 81, 82 70

Changing	in equalities (i) and (ii) into 1 3×1 + 6×2 = 18	linear equations, we have
00	3×, +6×2 = 18	on the stell with a
=>	X1 + X2 = 1	
11 (34:21)	5 6 0 1 3 10.010 mg nopplag	vound to contrav
	fx, + 6x2 = 30	(0,80F) 2 bas
	8/1 + 8/2 =1	
	(3º) 10/5 1 dobs to soulov not	must arrivate off
Now plots	ing above equations and then	using in equality condition
of each c	ting above equations and then onstraint to make the feasible of	region, voe get.
	> ×1,20	(swall)
Market	> x1 50	(0.0)0
6+	2 = 8(0) 4 20(3) = 60	(21a) A
5-5	2 = 3 (3) + 20(15) = 54	(a,(a))a
5	2 = 10 200 + (86.4) + 200 00 = 5	(0,83,8)3 3
4.5		
034	value of the objective hinches	
100	actual lomitigo with (800) A xx	
3.5	100 has 95 25 20 m	alders at next with
1 3	A(013)	
2-5 -	11/1/	non and carefored
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1.5 *	11111 1111111111 8(3,1.5)	THAT STORY
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0.5	1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/	,0)
0000	0) 0.5 1 1.5 2 2.5 3 3.5 4 4.5	5 55 6
	20	

(0,0) in inequalities D and (i) give true meaning, therefore, all the closed-half planes contain origin o (0,0).

Vertices of convex polygon are 0(0.0), A (0.3), B (3.1.5) and (4.29,0)

The objective function values at each vertex are:

1	6	The state of the s
	Coordinates	Objective function value
	(811,812)	Z = 881 + 2082
	0(0.0)	Z = 8(0) + 20(0) = 0
	A (013)	Z = 8(0) + 20(3) = 60
	B(3,1.5)	Z = 8(3) + 20(1.5) = 54
	c (4.29,0)	7 = 8 (4.29) + 20(0) = 34.32

since the maximum value of the objective function Z=60 occurs at the vestex A(0,3), the optimal solution to the given LP problem is 84 = 0 and 812 = 3.

Therefore, the manufacturer of baby doll should produce o monito "Monito" doll and 3 "Suzie doll" so as to obtain maximum profit.

6) Show by Simplex method that the following LP-problem has unbounded solution:

Max Z = 3x1 + 6x2

subject to

3×1+4×0 212

-201 + N2 £4

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Standard form of above LP problem is

Max Z = 3x1, +6x2+0.5, +0.52-MA,

subject to

3d, + 4 N2 - 5, + A, = 12

-2×1+ ×2+52 = 4

M1, M2, S1, S2, A1 70

	Thero	tion-1	Cj	3	6	0	0	- M	No Lang
		B	XBi	81,	8/2	5,	5 2	A,	Min. Ratio
	CB	0	7 0 (XBi/X2
	-M	A	12	3	(4)	-1	0	D	12/4=3 ->
,	0	52	4	-2	181	0	, 101	0	4/1 = 4
-	1	2	7;	-3M	-4M	M	0		
-	1		Zi-Ci	-3M -3	-4M - 6T	M	0	0	20 0
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Since the objective function is of maxima maximization type, the pivot column corresponds to the most negative Zj-Gj

The most negative $Z_j - C_j = -4m - 6$ and its column index is 2. So the entering variable is 312.

The minimum ratio is 3% and its row index is 1.50 so, the outgoing basis variable is A,

.. The pirot element is 4.

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1	Therah	ion - 2	Cj	3	6	0	910 301	H1 1080 119	
-	·CB	В	XB.	N,	8/2	S,	52	Min. Ratio	
			N. A. C. C.				050	*Bila,	
	6	×2	3	0.75	1	-0.25	0	- 19100	
	0	52	1	-2.75	0	(0.25)	10 15 MA	1/0.25 =4-7	2
			Z; A	45	- 68.0	-1.5	0	I E XOM	
			Zj-Cj	1.5	. 0	-1.5 1	0	sof loogdaz	
-	_		and the second second second		A STATE OF THE PARTY OF THE PAR				

Most negative Zj-G = -1.5 and its column index is 3.

So the entering variable is S1.

Minimum ratio is 4 and its row index is 2. 50, the Minimum ratio basis variable is S2.

The pivot element is 0.25

	1000000								
1	Iteration - 3		Cj	3	6	(0	0	DO-LUA DA	
	CB	B	XBi	M,	812	3,	52	Min. Ratio	1
			Mary !	0	1000	April	ME-	XBi/X,	100
	6	2012	A	+2	1/4	0	"de	-2-1	
	0	5,	4	-11	0	. Lust a	A	winds and have	
	Party.	- 3 (5)	Zj	-12	.6	0	6	er price sol	
		William S	Zj-Cj	15 1	0	0	0		
_			1000	A Commence of the Commence of		The second second		The second secon	100

Most negative Zj-rj is -15 and its column index is 1.

so on should enter into the basis.

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But all the coefficients in the x, column i.e. pivot column & are negative or zero. so x, cannot be entered into the basis.

Hence the solution to the given LP problem is unbounded.

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7) Show by Simplex method that the following LP-problem has infeasible solution:

Max Z = 3x1+2x2 Subject to makelon to bethe of the state of the state of

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3 x, +4 x 2 Z 12

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Standard form of above LP-problem is

Max Z = 301, + 222 + 0.5, + 0.52 - MA,

subject to

28, + 82 + 5, = 2

3d, +402-52+MA, =12

81,82,31,82,A, 70

-										
_	Iteration-1		C;	3	2	0	0	I-M		-
	·CB	В	XBi	ø,	8/2	8,	52	A,	Min-Ratio	
			2		A CONTRACTOR	100	Allen		XBi/x	
	0	SI	12	2	(1)	1	0	0	2/1 = 2 ->	-
1	-M	A,	2 12	3	4	D	-1	1	12/4=3	
		1000	Z; &	-3M	-4M	.0	M	- M	74-3	
	TO SE		Z; -C;	-3M-3	-4M-21	0	M	0		

The most negative Zj-Cj = -4M-2 and its column index is 2.

So the entering variable is 22

Minimum ratio is 2 and its row index is 1.

18 so the outgoing basis variable is s, .. The Ppivot element is 1.

Iterati	Theration -2 (3	3 2		0	-M	HOTER	
CB	В	XBi	· ×,	N2	15,	92	A	Min. Ratio	
2	21 2	2	2		1	0	. 0	10	
-M	A,	4	-5	0	-4	-1	Z EX	M	
[F 3] 0.1		7;	5M+4	2	4M +2	M	0 -M	la de la companya de	
		Zj-Cj	5M+1	0	HM+2	M	0		
			-						

since all Zj-Cj Zo, we stop and the ophimal solution is attained at x1, =0 and x2 = 2.

Max Z = 3 x (0) + 2 x (2)

0 = 40 / 080 /0

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But this solution is infeasible because the final optimal solution violates the 2nd constraint 301, + 402. 212

since 3(0) + 4(2) = 8 < 12.

and the artificial variable A1 appears in the basis with positive value 4.

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8) Table below is optimal solution of following LPproblem then with the help of table answer questions given below:

Max Z = 3x, +2x2+x3

Subject to

OC # 100

HX1 + 812 + 813 = 30

2x, +3x2+ x3 5 60

M, + 2M2 + 303 £40

N1, N21 N3 20

-									
			C	3	2	1	0	0	
	CB	В	XBi	ø,	812	213	- 32	53	36
	13	- 21,	3	10	0	1/5	-1/10	0	
	2	812	18	.0	1	115	215	0	
	0	53	# 18/46	0	0//	12/5	-A/10	- Judton	1
	2.34	E YELD	4 Zj	. 3	2	organism	1/2	0,4	1
			Zj-(j	0	120	0	- 1/2	0 0	170

- (i) State basic and non-basic variables
 - > Basic variables: N, N2, S3 Non-basic variables: N3, S2
- (ii) State solutions
 - => Solutions are: x1, =38, x12 = 2 and x13 = 0.

Max 7 = 3x3+2x2+0

- (iii) What is the nature of solution in above table?
 - => The nature of solution in above table is non-degenerate because none of the basic variables has its value zero in XB; column.
- (ii) State does problem propossess alternative solution? If yes give reason and if not give reason.
 - 2) Yes, the above problem possesses alternative solution because one non basic variable &3 whose corresponding Zj-Cj rovo element is zero.
 - (v) State new objective function value when second resource is increased by unit amount.
 - => Current Max 4 = 3x3 + 2x2 + 0

= 13

The element of Zj-row corresponding to \$3 tie. So i.e. at optimal solutions second resource is \$\frac{1}{2}\$. Which is the dual price of the given problem.

Therefore, new objective function value when second resource is increased by to unit amount = 13 + 1/2

= 27

vi) State new objective function value when 52 is forced into solution,

> The Zj-cj row element corresponding to non-basic variable so is \frac{1}{2}, which is the reduced cost for it.

Therefore new objective function value when 32 is forced into solution = 13-1

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vii) What does 33=1 mindicate?

- 30 22

\$ 53 is a slack variable used in third constraint and \$ 53 = 1 indicates that third resource has surplus of 1 unit while producing x3 product.

The element of 21 - 8 on correspondent to Enterest of

Therefore, now objective function value when excended

1+21 = humano tino di pol bisassinii di arangeno

Current max 2 = 8×3 + 2×2+9

after dual price of dhe given problem.