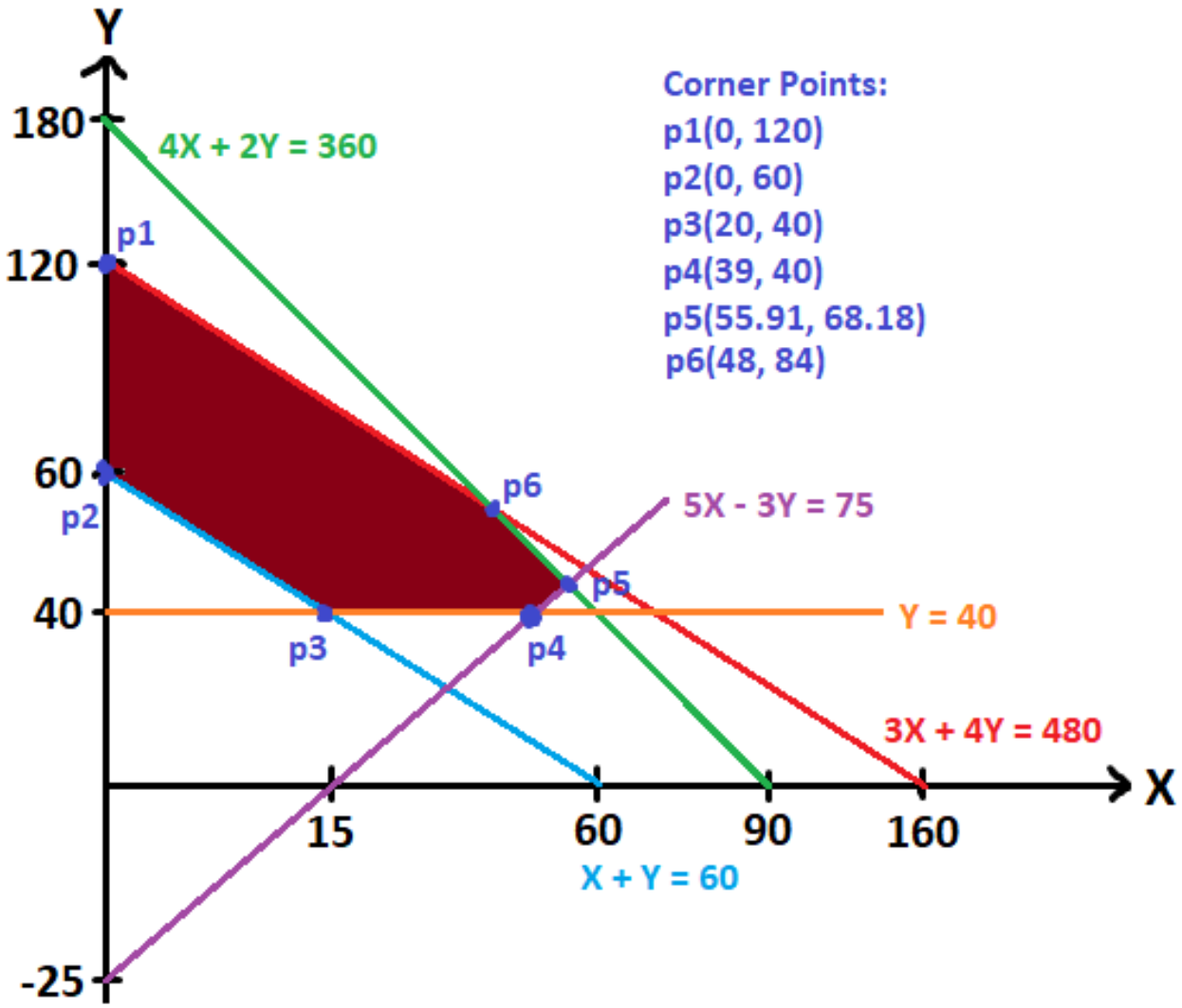
BLG368E

HOMEWORK 1

MUSTAFA CAN ÇALIŞKAN

150200097

Q1)



For p1(0, 120), 4X + 15Y = 4(0) + 15(120) = 1800

For p2(0, 60), 4X + 15Y = 4(0) + 15(60) = 900

For p3(20, 40), 4X + 15Y = 4(20) + 15(40) = 680

For p4(39, 40), 4X + 15Y = 4(39) + 15(40) = 756

For p5(55.91, 68.18), 4X + 15Y = 4(55.91) + 15(68.18) = 1246.34

For p6(48, 84), 4X + 15Y = 4(48) + 15(84) = 1452

Optimal point: **p1**

Optimal (maximized) 4X + 15Y value of the objective function subject to given constraints: **1800**

Q2)

a)

Deluxe: D unit

Special: S unit

Maximize: $12D + 10S$

Subject to:

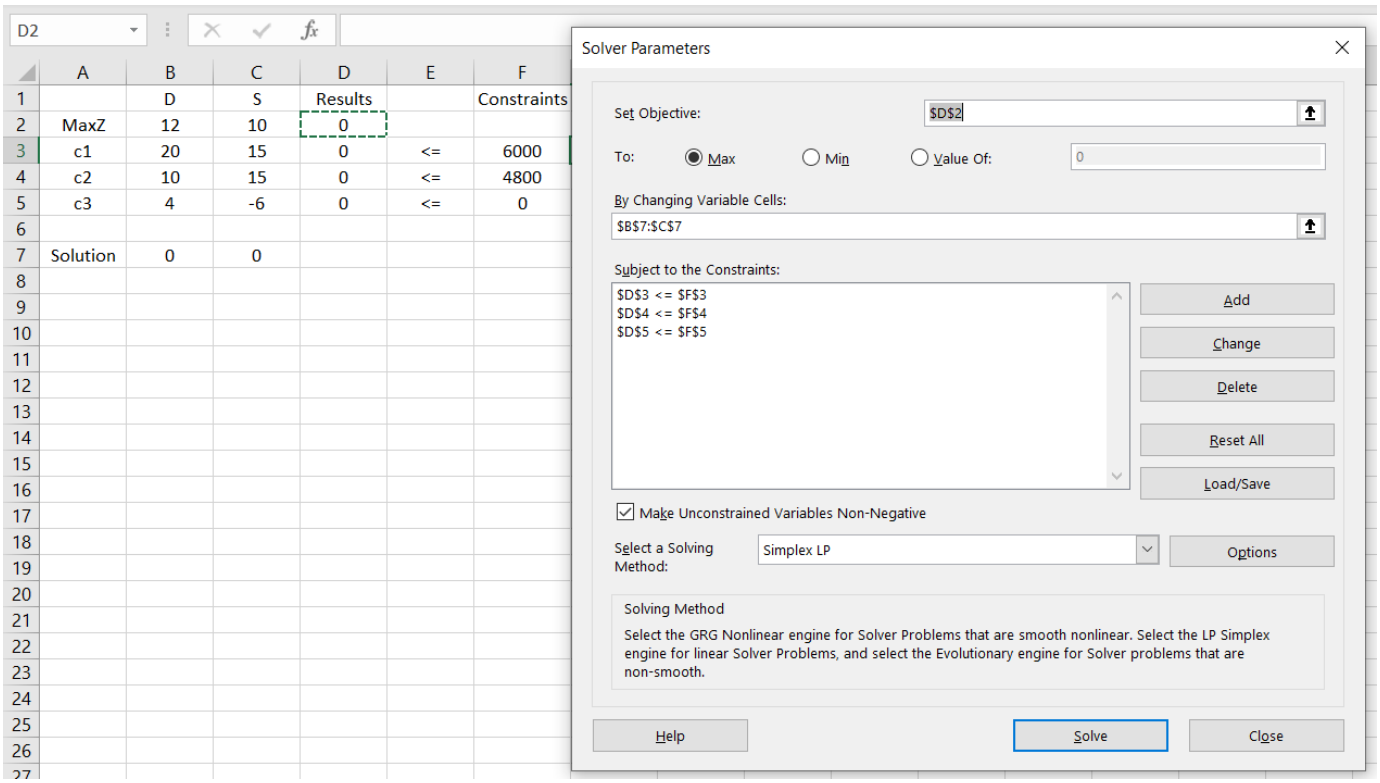
$20D + 15S \leq 6000$

$10D + 15S \leq 4800$

$S \geq 0.4(D+S)$

$S, D \geq 0$

b)



	A	B	C	D	E	F
1		D	S	Results		Constraints
2	MaxZ	12	10	0		
3	c1	20	15	0	<=	6000
4	c2	10	15	0	<=	4800
5	c3	4	-6	0	<=	0
6						
7	Solution	0	0			

Result: Solver found a solution. All Constraints and optimality conditions are satisfied.

Solver Engine

Engine: Simplex LP

Solution Time: 0.015 Seconds.

Iterations: 3 Subproblems: 0

Solver Options

Max Time Unlimited, Iterations Unlimited, Precision 0.000001, Use Automatic Scaling

Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 1%, Assume NonNegative

Objective Cell (Max)

Cell	Name	Original Value	Final Value
$D$2	MaxZ Results	0	3840

Variable Cells

Cell	Name	Original Value	Final Value	Integer
$B$7	Solution D	0	120	Contin
$C$7	Solution S	0	240	Contin

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$D$3	c1 Results	6000	$D$3<=$F$3	Binding	0
$D$4	c2 Results	4800	$D$4<=$F$4	Binding	0
$D$5	c3 Results	-960	$D$5<=$F$5	Not Binding	960

c)

Microsoft Excel 16.0 Sensitivity Report
Worksheet: [OR_HW1_q2_table.xlsx]Sheet1
Report Created: 4/6/2023 12:41:25 AM

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$B$7	Solution D	120	0	12	1.333333333	5.333333333
$C$7	Solution S	240	0	10	8	1

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$D$3	c1 Results	6000	0.533333333	6000	1200	1200
$D$4	c2 Results	4800	0.133333333	4800	1200	800
$D$5	c3 Results	-960	0	0	1E+30	960

The first two rows of the figure show that the optimal values of D and S are 120 and 240, respectively. It also indicates that the allowable increase for D is 1.33, and for S it is 8. This means that the coefficients of D and S can be increased by 1.33 and 8 units, respectively, without changing the optimal solution. Similarly, the allowable decrease for D is 5.33 and for S it is 1.

The last three rows of the figure indicate that the shadow price for c1 is 0.5333, for c2 it is 0.1333, and for c3 it is 0. This means that an increase of one unit in the right-hand side of c1 and c2 would increase the objective function by 0.5333 and 0.1333 units, respectively, while an increase of one unit in the right-hand side of c3 will not have any effect on the objective function value. The allowable increase for c1 and c2 is 1200, indicating that the right-hand side values of these constraints can be increased by up to 1200 units without changing the optimal solution. The allowable decrease for c1 is also 1200, while for c2 it is 800. For c3, the allowable increase is set to a very high value of 1E+30, which means that the constraint can be relaxed without affecting the optimal solution.

Q3)

$X_{11} + X_{21} + X_{31} \leq 5000$ $\quad X_{12} + X_{22} + X_{32} \leq 6000$ $\quad X_{13} + X_{23} + X_{33} \leq 6000$

Gas 1 Constraints
Octane rating at least 10, at most 1% sulfur

$(12X_{11} + 6X_{12} + 8X_{13}) / (X_{11} + X_{12} + X_{13}) \geq 10$ $\quad$ Gas 1 $= X_{11} + X_{12} + X_{13} = Y_1$

$(0.5X_{11} + 2X_{12} + 3X_{13}) / (X_{11} + X_{12} + X_{13}) \leq 1$

Gas 2 Constraints
Octane rating at least 8, at most 2% sulfur. $\quad$ Gas 2 $= X_{21} + X_{22} + X_{23} = Y_2$

$(12X_{21} + 6X_{22} + 8X_{23}) / (X_{21} + X_{22} + X_{23}) \geq 8$

$(0.5X_{21} + 2X_{22} + 3X_{23}) / (X_{21} + X_{22} + X_{23}) \leq 2$

Gas 3 Constraints
Octane rating at least 6, at most 1% sulfur

$(12X_{31} + 6X_{32} + 8X_{33}) / (X_{31} + X_{32} + X_{33}) \geq 6$ $\quad$ Gas 3 $= X_{31} + X_{32} + X_{33} = Y_3$

$(0.5X_{31} + 2X_{32} + 3X_{33}) / (X_{31} + X_{32} + X_{33}) \geq 1$

$Y_1 + Y_2 + Y_3 \leq 14000$

$Y_1 \geq 3000$ $\quad Y_2 \geq 2000$ $\quad Y_3 \geq 1000$

Purchasing Costs:
$45(X_{11} + X_{21} + X_{31}) + 35(X_{12} + X_{22} + X_{32}) + 25(X_{13} + X_{23} + X_{33}) = C_1$

Transforming Cost:
$4(Y_1 + Y_2 + Y_3) = C_2$

Advertising Cost:
$20(A_1 + A_2 + A_3) = C_3$

s.t. $X_{ij}, A_i \geq 0$ for $i = 1,2,3$, $j = 1,2,3$

Max $Z = \underbrace{70(10A_1 + Y_1) + 60(10A_2 + Y_2) + 50(10A_3 + Y_3)}_{\text{REVENUE}} - \underbrace{[C_1 + C_2 + C_3]}_{\text{COST}}$