Introduction to Optimization / Optimization in Applications - Assignment 02

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Problem 1:

1a)

Let the number of white wine bottles be **x1** and number of red wine bottles be **x2**.

he can sell a bottle of red wine for $12 while he can only sell a bottle of white wine for $7

Objective Function:

7x1+12x2 = Maximum Profit

Mathematical equations for constraints are:

Red wine should be aged two years per bottle and white wine one year per bottle and limited to 10,000 bottle years for each batch.

x1+ 2x2 <= 10,000 (Constraint 1)

It takes 2 gallons of grapes to make a bottle of red wine and 3 gallons of grapes to make a bottle of white wine and process a total of 18,000 gallons of grapes for each batch.

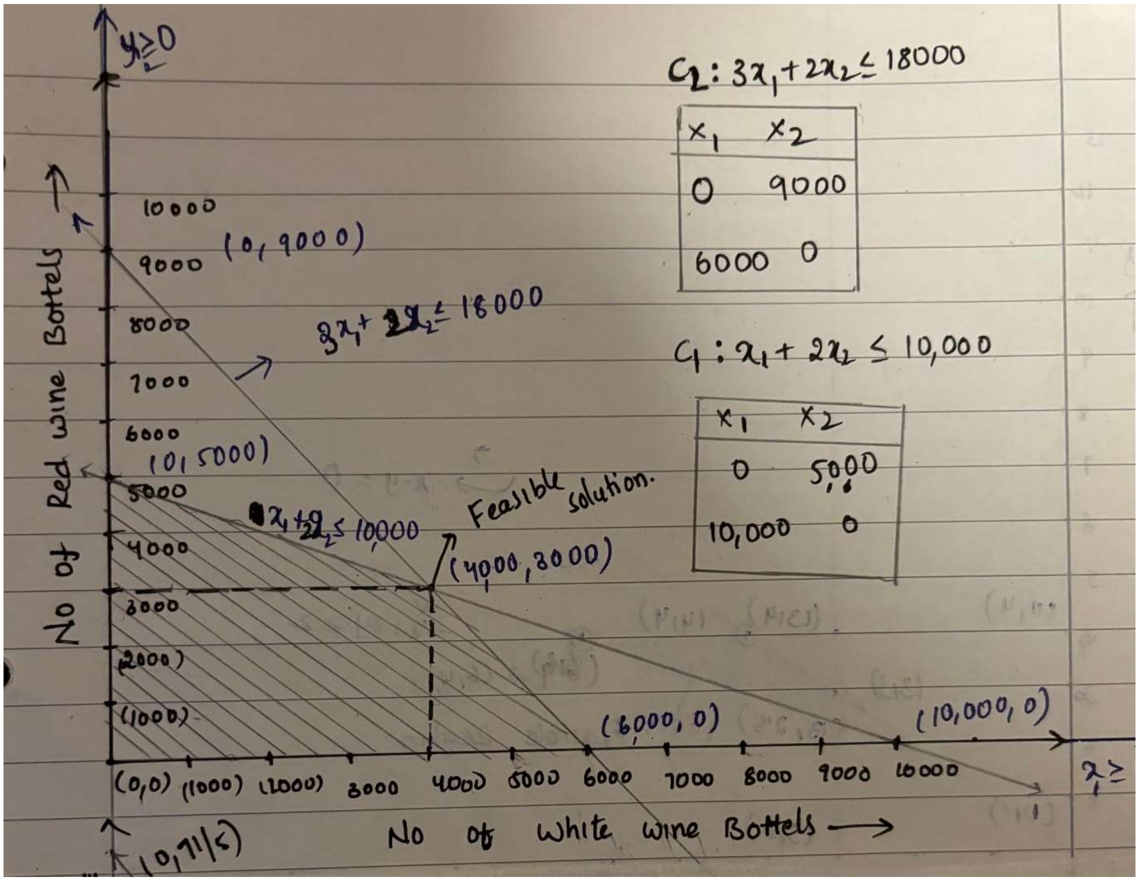
3x1+2x2 <= 18,000 (Constraint 2)

Decision Variables:

Number of wine bottles should not be non-Negative.

X1 >= 0, x2>= 0

1b)



Graph 1.1

The coordinates of the corner points of the feasible solution domain:

1) (0,5000)
2) (6000,0)
3) (0,0)
4) (4000,3000) the Intersection of two Constraints C1 and C2

Points	7x1 + 12x2
(0,5000)	60000
(6000,0)	42000
(0,0)	0
(4000,3000)	64000

The maximum Profit corresponds with 4000 white wine bottles and 3000 red wine bottles which give profit of 64000 dollars.

1c)

Equation is successfully executed in MATLAB Using simplex Algorithm and Maximum profit of 64000 dollars is obtained at 4000 white wine and 3000 red wine bottles.

SimplexMethodTL_2018.m

```matlab
% Tom Lahmer, 2018
% Simplex Method, 2nd phase.
% The following data are provided by the user:
% Matrix A
A=[1 2 1 0 ; 3 2 0 1];
%Vecto0r b
b=[10000,18000]';
% Vector c
c = [-7; -12; -0;0];
% First basis, i.e. as many indices as constraints between 1 and number of design variables
B= [3, 4];

if length(B) ~= length(b)
    fprintf('The basis needs to have as many entries as constraints!');
    return;
end

AllIndices = 1:1:length(c);
N = setdiff(AllIndices,B); % Set of non-basis entries

NoOptSolution = true;
iter =0;

while NoOptSolution && iter <150
    iter = iter+1;
    fprintf('\nIteration %d ... ',iter);

    if det(A(:,B))~=0 % check for invertability
        GammaBN = inv(A(:,B))*A(:,N);
        xB = inv(A(:,B))*b;
        zetaN = c(B)'*GammaBN - c(N)';
        costfunction = c(B)'*xB
    else
        fprintf('The chosen basis does not result in an admissible solution');
```

1.2 MATLAB Code

```
>> SimplexMethodTL_2018

Iteration 1 ...
costfunction =

     0


Iteration 2 ...
costfunction =

      -60000


Iteration 3 ...
costfunction =

      -64000


The optimal solution is
x =

        4000
        3000
           0
           0

with objective c^Tx = -64000.000000>>
```

1.3 MATLAB Result

Problem 2:

Objective Function:

Let x be the number of scarves and y be the number of hats.

Maximum Profit $=20x + 12y$

Mathematical equations for constraints are:

Scarf uses 8 ounces of yarn, and a hat uses 5 ounces and has a total of 71 ounces of yarn.

$8x + 5y <= 71$ constraint

Decision Variables:

Sofia wants to make at least 2 scarves and 3 hats:

$x >= 2$

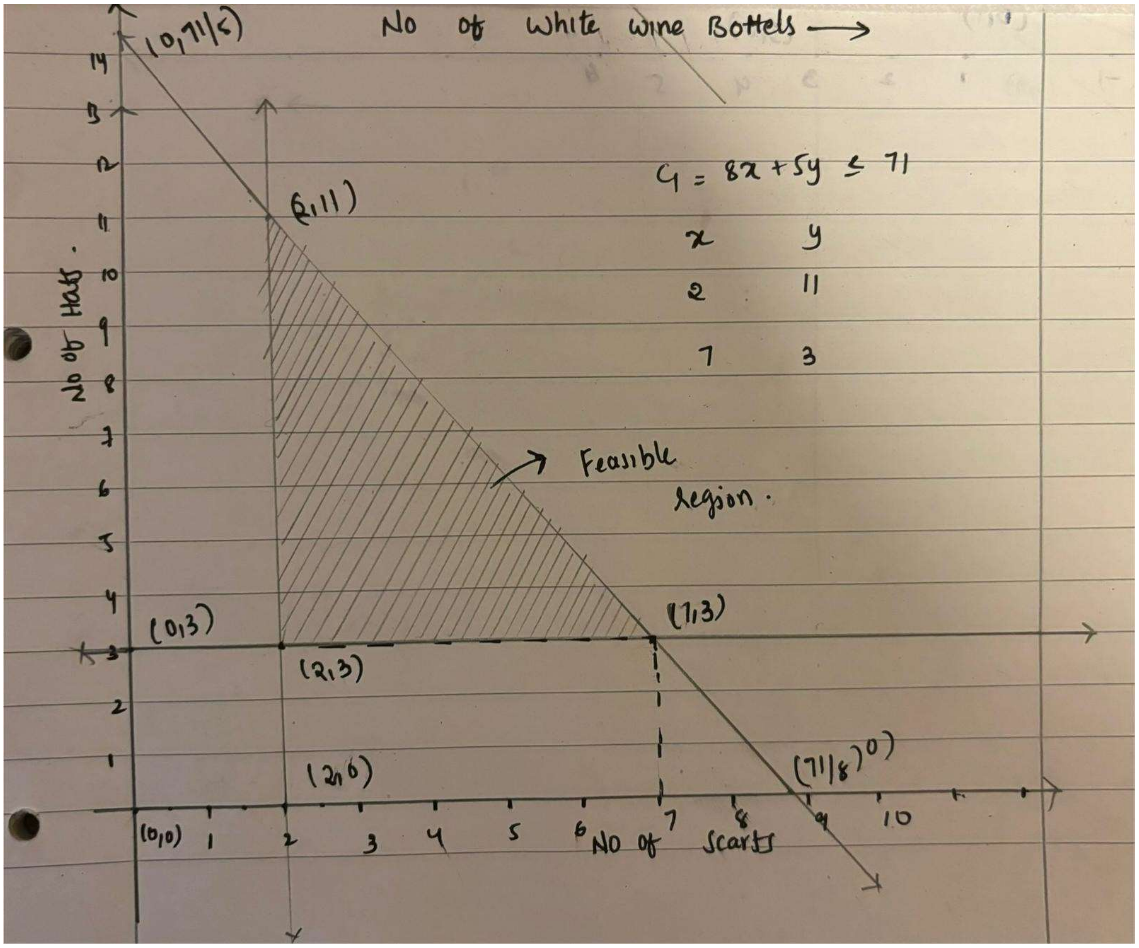
$y >= 3$

The coordinates of the corner points of the feasible solution domain:

1) (2,11) intersection of Constraint with x >= 2
2) (2,3) intersection of Decision Variables
3) (7,3) Intersection of Constraint with y >= 3

Points	20x + 12y
(2,11)	172
(2,3)	76
(7,3)	176

The maximum Profit corresponds with 7 scarves and 3 hats which give profit of 176 dollars.



Graph 2.1

2b)

selling the scarves for 15 each and each hat for 10 euros which changes objective function as

15x + 10y = Maximum Profit

The coordinates of the corner points of the feasible solution domain:

1) (2,11) intersection of Constraint with x >= 2
2) (2,3) intersection of Decision Variables
3) (7,3) Intersection of Constraint with y >= 3

Points	15x + 10y
(2,11)	140
(2,3)	60
(7,3)	135

Yes, the Solution changes and maximum profit occurs at 2 scarves and 11 hats with 140 euros of maximum profit.

Problem 3:

3a) Minimum $Z = 2x - 5y + 20$,

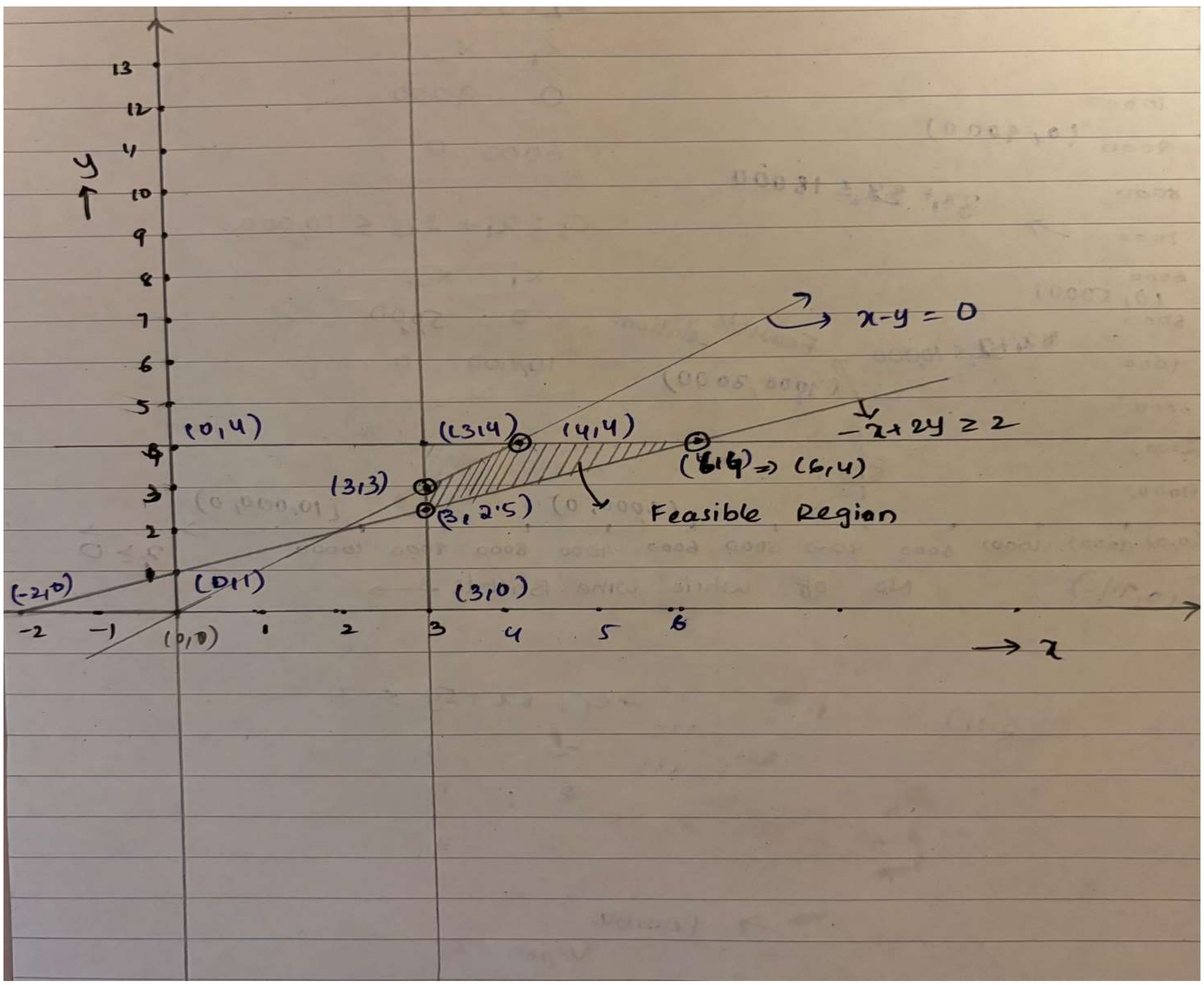
s.t $x - y <= 0$.

(c1) $-x + 2y >= 2$.

(c2) $x >= 3$.

(c3) $y <= 4$,

(c4) $x, y >= 0$.



Graph 3.1

3b)

The coordinates of the corner points of the feasible solution domain:

1) (3,3) intersection of x >= 3 and x-y = 0
2) (3,2.5) intersection of x >= 3 and -x + 2y >= 2
3) (6,4) Intersection of y <= 4 and -x + 2y >= 2
4) (4,4) Intersection of y <= 4 and x-y = 0

Points	2x – 5y +20
(3,3)	11
(3,2.5)	13.5
(6,4)	12
(4,4)	8

Hence, Minimum of Z occurs at (4,4)