# Lab 8 -- Evan Waldmann -- S3620596

## Table of Contents



# 1. Normalized constraints

```
%normailize using x2 as the reference variable
A = [10000/15000 1 10000/16000 10000/12000;0  1 15000/12500
 15000/20000 ;0 1 1/2 0 ; 0 0 0 1];
%A =
%    0.6667    1.0000    0.6250    0.8333
%         0    1.0000    1.2000    0.7500
%         0    1.0000    0.5000         0
%         0         0         0    1.0000
b= [10000;15000;8000;7000];
%b =
%       10000
%       15000
%        8000
%        7000
```

# 2. Objective to maximize profit

```
f= [110;220;250;140];
%take the negative of the objective to maximize profit (minimize the
 negative)
f=-f;

lb=[1000;2000;1000;2500];
ub=[];
Aeq=[];
beq=[];
X0=[];
```

# 3. Solve Model and detail the solution

```
options=optimoptions(@linprog,'Algorithm', 'dual-simplex');
[x4, fVal4, ExitFlag4, Out4, Lambda4] = linprog(f, A ,b, [], [],...
lb, ub,X0, options);

% detail the total profit, values of all variables and slack
 variables, and
% dual variables for each constraint.
```

```
%profit and solution
profit4 = -fVal4
solutions4 = x4

% dual variables
inequalityM = Lambda4().ineqlin(:)
lowerM      = Lambda4().lower(:)

%slack Variables
slackVariables = A'*solutions4 -b


Optimal solution found.


profit4 =

   $ 3000000


solutions4 =

        1000 Number of Stoves made
        2000 Number of Washers made
        8400 Number of Dishwashers made
        2500 Number of Dryers made


inequalityM =
              The multipliers for the Inequality constraints
  400.0000
         0
         0
         0
```

Dual Variables

```
lowerM =    The multipliers for the Lower bound constraints

  156.6667
  180.0000
         0
  193.3333


slackVariables =

   1.0e+03 *

   -9.3333
   -3.6000
   -0.7750
   -2.1667
```

# 4. Extra profit from one unit of washers

```
% How much would profit increase if the stamping department had the
% capacity for washers increased by one extra unit in a given month?

%increse the capacity for the washers by 1
A = [10001/15000 1 10001/16000 10001/12000;0  1 15000/12500
 15000/20000 ;0 1 1/2 0 ; 0 0 0 1];
%A =
%    0.6667    1.0000    0.6251    0.8334
%         0    1.0000    1.2000    0.7500
%         0    1.0000    0.5000         0
%         0         0         0    1.0000

b = [10001;15000;8000;7000];
%b =
%       10001
%       15000
%        8000
%        7000

options=optimoptions(@linprog,'Algorithm', 'dual-simplex');

[x5, fVal5, ExitFlag5, Out5, Lambda5] = linprog(f, A ,b, [], [],...
lb, ub,X0, options);

%increase in profit from extra washer
profit5 = -fVal5
solutions5 = x5

increaseInProfitFromWasher = profit5 - profit4
percentIncreaseInProfitFromWasher = (increaseInProfitFromWasher/
profit4)*100


Optimal solution found.


profit5 =

   3.0001e+06


solutions5 =

   1.0e+03 *

    1.0000
    2.0000
    8.4003
    2.5000
```

```
increaseInProfitFromWasher =

  $79.9920


percentIncreaseInProfitFromWasher =

    0.0027 %
```

# 5. Extra profit from relaxing target of stoves by one

```
%reset A and b
A = [10000/15000 1 10000/16000 10000/12000;0  1 15000/12500
 15000/20000 ;0 1 1/2 0 ; 0 0 0 1];
%A =
%    0.6667    1.0000    0.6250    0.8333
%         0    1.0000    1.2000    0.7500
%         0    1.0000    0.5000         0
%         0         0         0    1.0000

b= [10000;15000;8000;7000];
%b =
%       10000
%       15000
%        8000
%        7000

% relax the target for stoves from 1000 to 999
lb=[999;2000;1000;2500];

options=optimoptions(@linprog,'Algorithm', 'dual-simplex');

[x6, fVal6, ExitFlag6, Out6, Lambda6] = linprog(f, A ,b, [], [],...
lb, ub,X0, options);

% The profit increases by
profit6 = -fVal6
solutions6 = x6

increaseInProfitFromRelaxedStoves = profit6-profit4
percentIncreaseProfitFromRelaxedStoves =
 (increaseInProfitFromRelaxedStoves/profit4)*100


Optimal solution found.


profit6 =

   3.0002e+06
```

```
solutions6 =

   1.0e+03 *

    0.9990
    2.0000
    8.4011
    2.5000


increaseInProfitFromRelaxedStoves =

 $156.6667


percentIncreaseProfitFromRelaxedStoves =

    0.0052 %
```

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