HW3 - Staff Planning

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LP Problem

Let's assume that the base salary for a 8 hour shift is *2a*, then we can use the formulation:

$$min\ 2(x_{6-14} + x_{10-18} + x_{14-22}) + 3(x_{02-10} + x_{18-02}) + 4x_{22-06}$$

$$\begin{aligned} s.t \quad & x_{6-14} + x_{02-10} && \geq 700 \\ & x_{10-18} + x_{06-14} && \geq 500 \\ & x_{14-22} + x_{10-18} && \geq 600 \\ & x_{18-02} + x_{14-22} && \geq 300 \\ & x_{22-06} + x_{18-02} && \geq 100 \\ & x_{02-10} + x_{22-06} && \geq 50 \end{aligned}$$

- Between 6-10
- Between 10-14
- Between 14-18
- Between 18-22
- Between 22-02
- Between 02-06

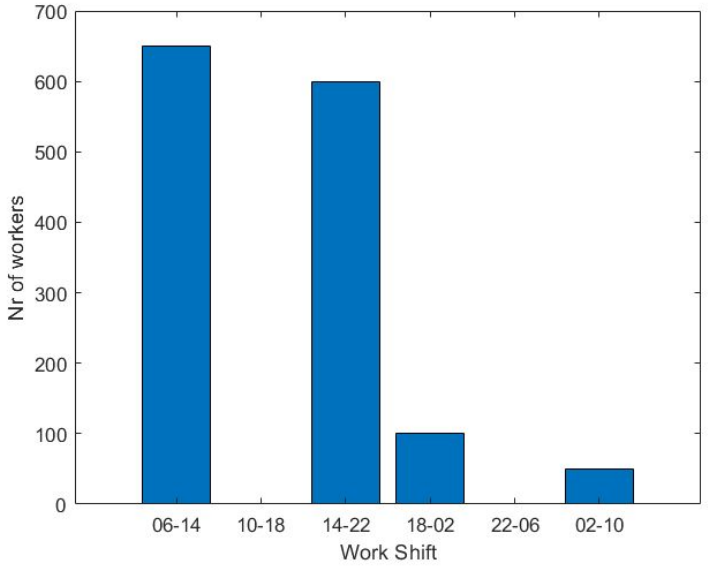
From this it is easy to formulate the problem to a form: $min\ cx,\ s.t.\ Ax \leq b$

Task 1-2

- Define problem in the above form
- Solve it with *linprog / intlinprog*
- *Using Simplex alg.*

- Solution: [650, 0, 600, 100, 0, 50]
- Cost: 2950*a

- For task 2 we only need to change the b vector
- Solve it again with *linprog / intlinprog*
- *We get the same solution*




```
%% Task 1
options = optimset('Algorithm','dual-simplex','LargeScale','off');
% LP problem parameters
f = [2,2,2,3,4,3];
b = [-700;-500;-600;-300;-100;-50];
A = [-1, 0, 0, 0, 0, -1; ...
     -1,-1, 0, 0, 0, 0;...
     0, -1, -1, 0, 0,0;...
     0, 0, -1,-1, 0, 0;...
     0, 0, 0, -1,-1, 0;...
     0, 0, 0, 0, -1, -1];
lb = [0,0,0,0,0,0]; % lower bound

[x1,fval1] = linprog(f,A,b,[],[],lb,[],options)
```

```
%% Task 2
options = optimset('Algorithm','dual-simplex','LargeScale','off');
% LP problem parameters
f = [2,2,2,3,4,3];
b = [-700;-250;-600;-300;-100;-50];
A = [-1, 0, 0, 0, 0, -1; ...
     -1,-1, 0, 0, 0, 0;...
     0, -1, -1, 0, 0,0;...
     0, 0, -1,-1, 0, 0;...
     0, 0, 0, -1,-1, 0;...
     0, 0, 0, 0, -1, -1];
lb = [0,0,0,0,0,0]; % lower bound

[x1,fval1] = linprog(f,A,b,[],[],lb,[],options)
```

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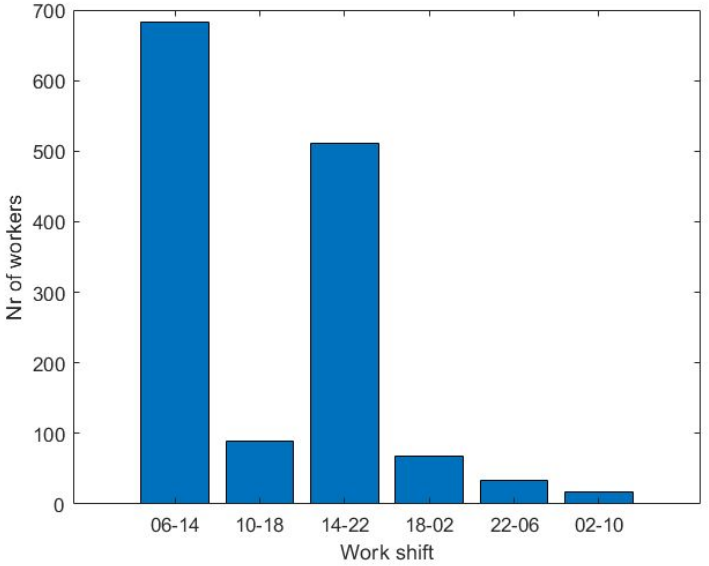
Task 3

- Now we need to change the solving method to the interior point method

```
options = optimset('Algorithm','interior-point','LargeScale','on');
```

- This method is gradient based so now we can expect that we may got a solution which is not an extreme points, but it can be in the middle of a side if *c* orthogonal to one of the sides of the polytope.
- Solution:
  [682.85, 88.76, 511.24, 67.15, 32.85, 17.15]
- Cost: 2950*a



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