Homework 1

Due: Friday Jan. 23rd, 2025 at 11:59pm ET via Dropbox and Crowdmark.

Dropbox Submission: answer sheet + codes.

Crowdmark Submission: answer sheet (with codes as an appendix).

Problem 1:

Consider the following linear optimization problem:

$$\begin{array}{ll} \max & c^T x \\ \text{s.t.} & Ax \leq b \\ & x \geq 0 \end{array} \quad \text{where } A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ -2 & -3 & 0 \\ 3 & 6 & 5 \end{bmatrix}, \quad b = \begin{bmatrix} 50 \\ 10 \\ -100 \\ 200 \end{bmatrix}, \quad c = \begin{bmatrix} 150 \\ 200 \\ 300 \end{bmatrix}.$$

a) Solve using the built-in Matlab solver *linprog*? what is the optimal basis?

b) Knowing the optimal basis, solve using the revised simplex and find the proven optimal solution in one iteration.

c) Write the dual of the above problem.

d) What are the values of the optimal dual variables?

e) Use the revised simplex to find the range of values for c_2 for which the current solution remains optimal.

f) Use the revised simplex to find the range of values for b_4 for which the current basis remains optimal as well as its shadow price .

Problem 2:

Consider the following items of sizes **13, 22, 18, 15,30, 22,14,18,9,25,30,20,10,12,24,38** that have to be packed in bins of size **80**.

Additionally, items are of two colours **blue** and **red** as indicated. In any bin, the number of blue items can not exceed the number of red items.

If you have 5 bins available,

a) give an assignment type formulation (using variables y_{kl}, z_k) and solve it in Matlab's intlinprog.

b) give a set packing formulation (using variable α_h).

c) generate all possible columns by **modifying** the matlab script below

```
D=[13,22,18,....];
n=length(D);
V=80;
A = str2mat(dec2bin(0:2^n-1))-'0'
 B=A'
 weight=D*B;
 j=find(weight<=V);
 Feasible=B(:,j);
```

and solve b) using intlinprog.

d) give a cover inequality formulation. Explain how to add the cover inequalities. Give an example, may be based on a Matlab implementation.