Octave Programming

- Octave has built-in function `glpk` to solve linear programming problems in the form:

  $$\min Cx \qquad \text{subject to} \quad Ax = b,\ x \geq 0$$

  or similar.

- Syntax:

```
[XOPT, FMIN, ERRNUM, EXTRA]
= glpk (C, A, b, lb, ub, CTYPE, VARTYPE,
SENSE, PARAM)
```

Octave Programming

- C : A **column array** containing the **objective function** coefficients.
- A : A **matrix** containing the **constraints coefficients**.
- B : A **column array** containing the right-hand side **value for each constraint** in the constraint matrix.
- LB : An **array** containing the **lower bound** on each of the variables. If lb is not supplied, the default lower bound for the variables is zero.
- UB : An **array** containing the **upper bound** on each of the variables. If ub is not supplied, the default upper bound is assumed to be infinite.

Octave Programming

- CTYPE : An array of characters containing the sense of each constraint in the constraint matrix. Each element of the array may be one of the following values.
  - U : Ax <= b
  - L : Ax >= b
  - S : Ax = b
- VARTYPE : A column array containing the types of the variables.
  - C : continuous variables
  - I : integer variables
- Sense : 1 for minimization (default) and -1 for maximization
- Refer to this link for more detail:
- https://octave.org/doc/v4.4.1/Linear-Programming.html

Example

- For example 1 in this slide:

$$\min f(x) = -2x_1 + x_2 - 3x_3$$

Subject to :

$$x_1 + x_2 + x_3 \leq 10$$
$$2x_2 - 3x_3 \geq -12$$
$$x_1, x_2, x_3 \geq 0$$

```
%% Example 1 in lecture notes
C = [-2; 1; -3];
A = [1 1 1 ; 0 2 -3];
b = [10; -12];
lb = [0; 0; 0];
ub=[];
cType = "UL";
varType = "CCC";
sense = 1;

%execute function
[xmin, fmin, status, extra] = glpk (C, ...
    A, b, lb, ub, cType, varType, sense);
```

```
xmin
fmin
```

<u>output</u>

```
xmin =


   6
   0
   4


fmin = -24
```

Any Question?

Exercise (Q1)

- Given that $f(x) = 4x_1 - 3x_2 - 2x_3 - x_4$. Find the max of the function subject to the following constraints:

$$x_1 + x_2 + x_3 + x_4 \leq 20$$

$$2x_2 - 2x_3 - x_4 \geq -10$$

$$x_1 , x_2 , x_3 , x_4 \geq 0$$

- Check your answer using Octave programming.

Answer:
$x_1 = 20$ $x_2 = x_3 = x_4 = 0$ max $f(x) = 80$

Exercise (Q2)

- Given that $f(x) = 2x_1 + 6x_2 + 10x_3$. Find the min of the function subject to the following constraints:

  $x_1 + x_2 – 4x_3 = 4$

  $4x_1 – 3x_2 + 2x_3 \geq -1$

  $3x_1 – x_2 + 6x_3 \leq 8$

  $x_1 , x_2 , x_3 \geq 0$

- Check your answer using Octave programming.

Answer:
$x_1 = 3$ $x_2 = 1$ $x_3 = 0$ min $f(x) = 12$

Exercise (Q3)

- Given that $f(x) = 4x_1 - 6x_2 - 5x_3 + 3x_4$. Find the min of the function subject to the following constraints:
- $-2x_1 + 5x_2 - 3x_3 + x_4 \leq 20$

  $5x_1 + 2x_3 + 3x_4 = 10$

  $x_1 , x_2 , x_3 \geq 0$
- Check your answer using Octave programming.

Answer:
$x_1 = x_4 = 0$ $x_2 = 7$ $x_3 = 5$ min $f(x) = -67$