ME598/494 Homework 1

1. Solve problems a) and b) using both Excel Solver and Matlab's *fmincon* solver. (15 points each, 60 in total)

   a) Use initial point: $\mathbf{x}_0 = (2, 2, 2, 2, 2)$ to solve:

$$\begin{aligned} \text{minimize:} \quad & (x_1 - x_2)^2 + (x_2 + x_3 - 2)^2 + (x_4 - 1)^2 + (x_5 - 1)^2 \\ \text{subject to:} \quad & x_1 + 3x_2 = 0 \\ & x_3 + x_4 - 2x_5 = 0 \\ & x_2 - x_5 = 0 \\ & -10 \le x_i \le 10, \ i = 1, \ldots, 5 \end{aligned}$$

   b) Use initial point: $\mathbf{x}_0 = (1, 1, 1, 1)$ to solve:

$$\begin{aligned} \text{minimize:} \quad & 24.55x_1 + 26.75x_2 + 39.00x_3 + 40.50x_4 \\ \text{subject to:} \quad & 2.3x_1 + 5.6x_2 + 11.1x_3 + 1.3x_4 - 5 \ge 0 \\ & 12x_1 + 11.9x_2 + 41.8x_3 + 52.1x_4 - 21 \\ & - 1.645(0.28x_1^2 + 0.19x_2^2 + 20.5x_3^2 + 0.62x_4^2)^{1/2} \ge 0 \\ & x_1 + x_2 + x_3 + x_4 - 1 = 0 \\ & 0 \le x_i, \ i = 1, \ldots, 4 \end{aligned}$$

2. Say you are in charge of designing a **cylindrical** cola can of volume V, and your objective is to minimize material usage. Formulate an optimization problem by the following steps: (1) Define design variables and the objective (10 points), (2) state constraints (5 points), (3) discuss assumptions made during modeling (5 points).

   Solve your optimization problem with a realistic cola can volume. Is your optimal solution close to the reality? If not, briefly discuss why (not restricted to engineering considerations). (20 points, optional for MAE494)