1. (25 points) Consider the following portfolio management problem

Stock type	Medicine	Precious metal	Computer Hardware	New Energy	Retail
Interest Rate	12%	9%	5%	8%	4%
Risk factor	3.2	1.8	1.6	2.1	1.4

A business man plans to invest exactly 1 million dollars on these stocks. The investment on Precious Metal can not exceed \$25,000, The combined amount invested on Medicine and Computer Hardware must be at least \$30,000. The business man want to maximize the profit, while limit the average risk factor within 2.0.

(a) Formulate a linear programming problem using the given conditions.

(b) Rewrite the problem into a standard form.

(c) Find the dual of this problem.

2. (25 points) Solve the following problem use the Simplex method. If the problem has no solution, unbounded solution, or multiple solutions, you must state so and justify your answer.

$$\begin{aligned} \min \quad & f = 2x_1 - x_2 + 2x_3 \\ \text{subject to} \quad & 2x_1 - x_2 + x_3 = 5 \\ & x_1 + x_2 \geq 10 \\ & x_1, \, x_2 \geq 0 \\ & x_3 \text{ free} \end{aligned}$$