

### Homework 1: Linear Optimization

A simple approach for you to finish the homework assignment is to use Markdown in Colab. That is, you enter text descriptions (文字說明) in conjunction with Python codes. After you solve ALL problems, print the text and codes into a single pdf file. Please submit a pdf that shows your name, ID, answers & Python code onto wm5. **The file name must be HW1\_XXX, where XXX is your student ID.**

**Q1.** Louisa's new sugar-free fat-free chocolate muffins are so popular that the company cannot keep up with demand. Regional demands shown in the table below total 2,000 pieces per week, but Louisa can produce only 60% of that number.

The table also shows different profit levels per muffin in four regions due to operating costs and local competition. Louisa wants to find a profit-maximization plan that fulfills between 50 and 70% of each region's demand.

	Taipei	Taichung	Tainan	Taitung
Demand	620	490	510	380
Profit	1.60	1.40	1.90	1.20

Please formulate a linear programming (LP) model and solve it using Gurobi and Python.

**Q2.** Cattle feed can be mixed from oats, corn, alfalfa, and peanut hulls. The following table shows the current cost per ton (in \$USD) of each ingredient, together with the percentage recommended daily allowances for protein, fat, and fiber that a serving of it fulfills.

We want to find a cost-minimizing approach to produce feed that satisfies at least 60% of the daily allowance for protein and fiber, while not allowing exceeding 60% of the fat allowance.

	Oats	Corn	Alfalfa	Peanut Hulls
%Protein	60%	80%	55%	40%
%Fat	50%	70%	40%	100%
%Fiber	90%	30%	60%	80%
Cost	200	150	100	75

Formulate a LP model to identify an optimal feed mix of one ton. Please briefly explain your constraints. Solve it using Gurobi and Python.

**Q3.** Several forms of gasoline are produced during the petroleum refining process, and a last step combines them to obtain market products with specified quality measures. Suppose 4 different gasolines are available, with values for the 2 indexes of quality being 99 and 210, 70 and 335, 78 and 280, and 91 and 265, respectively.

Using corresponding costs per barrel of \$48, \$43, \$58, and \$46, we would like to choose a cost-minimizing blend with a first quality index between 85 and 90 and a second quality index between 270 and 280.

Formulate a LP model to identify an optimal feed mix of one ton. Please briefly explain your constraints. Solve it using Gurobi and Python.