

Assignment 1

Due by 4:00 p.m. on Tuesday September 25 in the assignment box near ME4436. Assignments submitted after this deadline, but before marked assignments are returned or solutions are posted, are subject to a 50% penalty. No credit thereafter.

Notes on Problem Solutions (for all questions on assignments, midterms, exam):

Show the details of your formulation, including:

- the definitions of the decision variables, including their units and their bounds,
- the objective function and the constraints as mathematical expressions in the decision variables.
- Provide labels for the constraints and objective function indicating the physical meaning of each (e.g. “limit on capacity of plant 3”), and the units.

Summarize the results in terms of the original problem as though you were reporting to a manager. If the results are unusual in any way, state why this might be so.

Be succinct. Each solution should require no more than a couple of pages.

Marks are given for using the appropriate algorithm correctly, not simply for the final solution.

1. [5 marks]. Formulate only, don't solve:

Your cereal company makes two types of trail mixes: PowerTrail and FunTrail. Each contains a mixture of nuts, dried fruit and chocolate chips. You have 250 kg of nuts, 200 kg of dried fruit, and 100kg of chocolate chips on hand. The PowerTrail mix must be at least 60% nuts and at least 25% dried fruit and no more than 10% chocolate chips. The FunTrail mix calls for at least 25% chocolate chips and at least 25% dried fruit. PowerTrail sells for \$26/kg and FunTrail sells for \$21/kg. Formulate a linear program to maximize the income from the sales of the two trail mixes.

2. [5 marks] Formulate only, don't solve:

Chandler Oil Company has 5000 barrels of oil 1 and 10,000 barrels of oil 2. The company sells two products: gasoline and heating oil. Both products are produced by combining oil 1 and oil 2. The quality level of each oil is as follows: oil 1 has quality 10, oil 2 has quality 5. Gasoline must have an average quality level of at least 8 and heating oil an average quality level of at least 6. Demand for each product must be created by advertising. Each dollar spent advertising gasoline creates 5 barrels of demand and each dollar spent advertising heating oil creates 10 barrels of demand. Gasoline is sold for \$25 per barrel, heating oil for \$20. Formulate an LP to help Chandler maximize profit. Assume that no additional oil of either type can be purchased.

[Textbook]

3. [10 marks] For the following problem, (i) formulate, (ii) solve graphically by sketching the constraints and a few isoprofit lines, (iii) solve using the simplex tableau.

A small manufacturer produces two products: plastic mugs which sell at a profit of 5¢ per mug, and plastic boxes which sell at a profit of 4¢ per box. Each mug requires 1 kg of plastic to manufacture, and each box requires 2 kg of plastic. The supply of plastic is limited to 20 kg per day. The manufacturer has a total of 16 hours of manufacturing labour available per day. Each mug requires 2 hours of labour and each box requires 1 hour of labour. Market limits dictate that mugs should be manufactured at a rate of no more than 6 per day. At what rate should the manufacturer make mugs and boxes to maximize the profit rate?

4. [10 marks] Formulate and solve by hand using the simplex tableau.

A company produces apple juice and orange juice. The net profit per litre of apple juice is \$1.20 and \$1.80 per litre of orange juice. The company wishes to control the production rates of the juices within a certain band. The production rate of apple juice should not exceed the production rate of orange by more than 5 litres per minute, and the production rate of orange juice should not exceed the production rate of apple juice by more than 2 litres per minute. How many litres per minute of each juice should the company produce to maximize profits?