

Carleton University
Systems and Computer Engineering
SYSC-3200: Industrial Engineering
Assignment 1 - Fall Term 2013

Due by 7:25 p.m. on Tuesday September 24 in the class. 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 formation, 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”).

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.

Note especially that marks are based on 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 cereal: WakeUp and Healthy, both consisting entirely of wheat, sugar, and bran. You have in stock 100 tons of wheat, 20 tons of sugar, and 30 tons of bran. WakeUp is made from a mix that contains at least 15% Sugar, while Healthy must be at least 50% wheat and at least 20% bran. Each ton of WakeUp sells for \$830 and each ton of Healthy sells for \$770. Formulate a linear program to maximize the revenue from the sales of the two cereals.

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

A machine tool company conducts a job-training program for machinists. Trained machinists are used as teachers in the program at a ratio of one for every ten trainees. The training program lasts for one month. From past experience it has been found that out of ten trainees hired, only seven complete the program successfully (the unsuccessful trainees are released).

Trained machinists are also needed for machining and the company's requirements for the next three months are as follows:

January	100
February	150
March	200

In addition, the company requires 250 trained machinists by the beginning of April. There are 130 trained machinists available at the beginning of the year. Payroll costs per month are:

Each trainee	\$400
Each trained machinist	\$700 (Machining or training)
Each trained machinist idle	\$500 (Union contract forbids firing a training machinist)

The company plans to hire machinists and trainees at the beginning of January, February, and March, but not April. Fractional hires are possible due to part-time arrangements. Find a schedule for hiring machinists and trainees that will meet the company's requirements while minimizing their staffing costs.

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

A shirt manufacturer produces two types of shirts: T-shirts at a profit of \$1 each and dress shirts at a profit of \$0.80 each. Each T-shirt requires 1 m² of cotton to manufacture, and each dress shirt requires 2 m² of cotton. The supply of cotton is limited to 40 m² per day. The manufacturer has a total of 16 hours of manufacturing labour available per day. Each T-shirt requires 1 hour of labour and each dress shirt requires 0.5 hours of labour. Market limit dictate that T-shirt should be manufactured at a rate of no more than 12 per day. At what rate should the manufacturer make each type of shirt to maximize profit rate.

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

A company manufactures red and blue paint. The net profit per litre of red paint is \$3 and \$6 per litre of blue paint. The company wishes to control the production rates of the two paints within a certain band. The production rate of red paint should not exceed the production rate of blue paint by more than 4 litres per minutes, and the production rate of blue paint should not exceed the production rate of red paint by more than 1 litre per minute. How many litres per minute of each paint should the company produce to maximize profits?