Further Linear programming examples:

Q1)

A company produces two types of syrup, A and B. The syrups are a blend of sugar, fruit and juice.

Syrup A contains 30 % sugar, 50 % fruit and 20 % juice. Syrup B contains 20 % sugar, 35 % fruit and 45 % juice. Each litre of syrup A costs 75p and each litre of syrup B costs 60p. There is a maximum daily production of 40,000 litres of syrup A and 45,000 litres of syrup B. A confectionery manufacturer places an order for 60,000 litres of syrup but required,

* Below 25 % sugar
* At least 40 % fruit
* No more than 35 % juice.

The company will blend syrups A and B to meet confectionery manufacturer’s requirements.

The company would like to maximise profit by minimizing the cost.

1. How much of syrups A and B should be used to satisfy the order?
2. What is the cost of the syrups?

Q2)

A chocolate manufacturer is producing two hand-made assortments, gold and silver.

It will take 30 mins to make all the chocolates for one box of gold assortment and 20 mins to make the chocolates for one box of silver assortment.

It will take 12 mins to wrap and pack the chocolates in one box of gold assortment and 15 mins for one box of silver assortment.

The manufacturer needs to make at least twice as many silver as gold assortments.

The gold assortment will be sold at a profit of 60p and the silver at a profit of 40p.

There are 300 hours available to make the chocolates and 200 hours to wrap them. The profit is to be maximised.

Solve parts a) and b) using linprog in MATLAB, use MATLAB’s help (within the terminal) on the function intlinprog, hence solve this problem for an integer number of boxes.

1. How many boxes of gold and silver assortments are made?
2. What is the expected profit?
3. How many boxes of gold and silver assortments are made?
4. What is the expected profit?
5. Comment on the difference of the solutions?
6. What is the minimum length of time required to make and wrap the chocolates?

Q3)

A company makes four different types of backpack A, B, C and D. Each type A uses 2.5 units of material, needs 10 mins of cutting time and 5 mins of stitching time. All figures are represented in table 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A | B | C | D |
| Material units | 2.5 | 3 | 2 | 4 |
| Cutting time in mins | 10 | 12 | 8 | 15 |
| Stitching time in mins | 5 | 7 | 4 | 9 |

Table 1: Summary of material required, cutting time and stitching time

There are 1400 units of material available each week, 150 hours per week available on the cutting machine and 80 hours available on the stitching machine.

Market research says that they will sell at most 500 backpacks each week.

The profit is £7.50, £5, £6 and £9 for types A, B, C and D respectively. The company wishes to maximise its profit.

1. How many of each backpack does the company produce?
2. What is the total profit?
3. Find the optimal schedule for the workshop?

Q4)

A pump system is being designed to supply fluids to different locations on a plant. Taking water as an example, there are a number of sources in the plant and a number of sinks. There is a single transport cost per unit of water per meter of 10p. The cost of external water is 5p per unit. Table 2 describes the sources in the plant. Table 3 shows the sinks in the plant and Table 4 their distances from the sources.

|  |  |  |
| --- | --- | --- |
| Source | Supply/unit | Cost |
| Process A | 100 | - |
| Process B | 200 | - |
| Process C | 50 | - |
| External source | Practically unlimited | 5p |

Table 2: Sources in the plant and cost of external sources

|  |  |
| --- | --- |
| Sink | Demand |
| Process I | 50 |
| Process II | 340 |
| Process III | 70 |

Table 3: Sinks in the plant

|  |  |  |
| --- | --- | --- |
| Source | Sink | Distance (m) |
| Process A | Process I | 6 |
| Process II | 7 |
| Process III | 3 |
| Process B | Process I | 4 |
| Process II | 8 |
| Process III | 4 |
| Process C | Process I | 9 |
| Process II | 6 |
| Process III | 10 |
| External source | Process I | 9 |
| Process II | 2 |
| Process III | 2 |

Table 4: Distance between sources and sinks

Your boss wants you to minimize the amount of external water used and minimize the cost to the company.

What are your recommendations to your boss pertaining to water minimization and cost minimization?

What sources and sinks should be connected?

A pump is needed for every 100 units of water to be transferred, how many pumps are needed? (Assume: any pump connected from a source may be used to connect multiple sinks but each source requires a separate pump)