**Operation Research Assignments**

**Linear programming Problem-1**

A company makes two products (X and Y) using two machines (A and B). Each unit of X that is produced requires 50 minutes processing time on machine A and 30 minutes processing time on machine B. Each unit of Y that is produced requires 24 minutes processing time on machine A and 33 minutes processing time on machine B.

At the start of the current week there are 30 units of X and 90 units of Y in stock. Available processing time on machine A is forecast to be 40 hours and on machine B is forecast to be 35 hours.

The demand for X in the current week is forecast to be 75 units and for Y is forecast to be 95 units. Company policy is to maximize the combined sum of the units of X and the units of Y in stock at the end of the week.

* Formulate the problem of deciding how much of each product to make in the current week as a linear program.
* Solve this linear program graphically.

**Linear programming problem-2**

The demand for two products in each of the last four weeks is shown below.

Week

1 2 3 4

Demand - product 1 23 27 34 40

Demand - product 2 11 13 15 14

Apply [exponential smoothing](http://people.brunel.ac.uk/~mastjjb/jeb/or/forecast.html)with a smoothing constant of 0.7 to generate a forecast for the demand for these products in week 5.

These products are produced using two machines, X and Y. Each unit of product 1 that is produced requires 15 minutes processing on machine X and 25 minutes processing on machine Y. Each unit of product 2 that is produced requires 7 minutes processing on machine X and 45 minutes processing on machine Y. The available time on machine X in week 5 is forecast to be 20 hours and on machine Y in week 5 is forecast to be 15 hours. Each unit of product 1 sold in week 5 gives a contribution to profit of £10 and each unit of product 2 sold in week 5 gives a contribution to profit of £4.

It may not be possible to produce enough to meet your forecast demand for these products in week 5 and each unit of unsatisfied demand for product 1 costs £3, each unit of unsatisfied demand for product 2 costs £1.

* Formulate the problem of deciding how much of each product to make in week 5 as a linear program.
* Solve this linear program graphically.

**Linear programming Problem-3**

A company is involved in the production of two items (X and Y). The resources need to produce X and Y are twofold, namely machine time for automatic processing and craftsman time for hand finishing. The table below gives the number of minutes required for each item:

Machine time Craftsman time

Item X 13 20

Y 19 29

The company has 40 hours of machine time available in the next working week but only 35 hours of craftsman time. Machine time is costed at £10 per hour worked and craftsman time is costed at £2 per hour worked. Both machine and craftsman idle times incur no costs. The revenue received for each item produced (all production is sold) is £20 for X and £30 for Y. The company has a specific contract to produce 10 items of X per week for a particular customer.

* Formulate the problem of deciding how much to produce per week as a linear program.
* Solve this linear program graphically.

**Linear programming problem-4**

A company manufactures two products (A and B) and the profit per unit sold is £3 and £5 respectively. Each product has to be assembled on a particular machine, each unit of product A taking 12 minutes of assembly time and each unit of product B 25 minutes of assembly time. The company estimates that the machine used for assembly has an effective working week of only 30 hours (due to maintenance/breakdown).

Technological constraints mean that for every five units of product A produced at least two units of product B must be produced.

* Formulate the problem of how much of each product to produce as a linear program.
* Solve this linear program graphically.
* The company has been offered the chance to hire an extra machine, thereby doubling the effective assembly time available. What is the *maximum* amount you would be prepared to pay (per week) for the hire of this machine and why?

**Linear programming Proble-5**

Solve the following linear program

minimise

4a + 5b + 6c

subject to

a + b >= 11

a - b <= 5

c - a - b = 0

7a >= 35 - 12b

a >= 0 b >= 0 c >= 0

**Solution**

To solve this LP we use the equation c-a-b=0 to put c=a+b (>= 0 as a >= 0 and b >= 0) and so the LP is reduced to

**Linear programming problem-6**

Solve the following linear program:

maximise 5x1 + 6x2

subject to

x1 + x2 <= 10

x1 - x2 >= 3

5x1 + 4x2 <= 35

x1 >= 0

x2 >= 0

**Linear programming Peoblem-7**

A carpenter makes tables and chairs. Each table can be sold for a profit of £30 and each chair for a profit of £10. The carpenter can afford to spend up to 40 hours per week working and takes six hours to make a table and three hours to make a chair. Customer demand requires that he makes at least three times as many chairs as tables. Tables take up four times as much storage space as chairs and there is room for at most four tables each week.

Formulate this problem as a linear programming problem and solve it graphically.