MATH1058: Problem Sheet 0

Problem 1 (Diet problem, reprise)**.** *Let us consider an extension of the diet problem seen in the lectures to the case with a limited food availability.*

Let I be the set of nutrients, J the set of of foods, a_{ij} the amount (in grams) of nutrient i in a unit of food j, for all $(i, j) \in I \times J$, b_i the least amount (in grams) of nutrient $i \in I$ the diet should contain, q_j the availability (in units) of food of type $j \in J$, and c_j its cost (in pounds per unit).

Also assume that:

- *the amount (in units) of food* 1 *should be no more than 50% of the total (amount of units).*
- *the amount (in units) of food* 2 *should be at least two times the total amount of all foods except for foods 1, 2, and 3.*

Propose a linear programming formulation for this problem (where the total cost should be minimized).

Problem 2 (Shoes)**.** *We own a small shoe factory, producing 5 types of shoes. Three people work for us. The time needed by each of them to create a ready-to-sell pair of shoes of each type is reported in the following table (in hours per pair):*

Type/employee	*1*	*2*	*3*
1	*1.5*	*3.5*	*4*
2	*1.8*	*2*	*3*
3	*2*	*1*	*2.5*
4	*2.5*	*1.5*	*3.5*
5	*3.5*	*3.5*	*4.2*

Due to production constraints imposed by the unions, each employee must work no less than 8 hours a day, but no more than 10.

The next table indicates, for each type of shoes, the selling price and an estimate of the corresponding demand on the market:

Type	*Price*	*Demand*
1	*56*	*4*
2	*86*	*3*
3	*45*	*3*
4	*42*	*5*
5	*65*	*8*

Propose a mathematical programming formulation for the problem of choosing how many pairs of each shoe to manufacture so as to maximizing the total revenue, subject to production and demand constraints.