1. A medical equipment company produces a piece of diagnostic equipment at two factories. Three medical centers have placed orders for this month. The table below shows what the cost would be for shipping one unit from each factory to each of these customers.

	Customer 1	Customer 2	Customer 3
Factory 1	600	800	700
Factory 2	400	900	600

The number of units that will be produced at each factory is already determined: Factory 1 will produce 400 units and Factory 2 will produce 500 units. Lastly, the demand for the product from Customers 1, 2 and 3 are 300, 200 and 400, respectively. Assume we are required to meet all demand.

Formulate a linear programming model for this problem.

2. Oski University keeps a supercomputer for research use by its faculty, Ph.D. students, and research associates. During all working hours, an operator must be available to operate and maintain the computer, as well as to perform some programming services.

It is now the beginning of the fall semester, and the head operator must devise a schedule that assigns different employees to different time slots. There must be exactly one operator staffed on the supercomputer Monday through Friday from 8am to 10pm. Because all operators are students, they are only free to work only a limited number of hours each day, as shown in the following table.

Employee	Monday	Tuesday	Wednesday	Thursday	Friday
1	6	0	6	0	6
2	0	6	0	6	0
3	4	8	4	0	4
4	5	5	5	0	5
5	3	0	3	8	0
6	0	0	0	6	2

(Assume that the employees time can be split up into multiple shifts in one day, e.g., Employee 1 can work multiple short shifts on Monday, as long as the total time she works is less than 6 hours).

The employees are paid at different rates due to variability in their experience:

Operator	1	2	3	4	5	6
Wage ($/hr)	10.00	10.10	9.90	9.80	10.80	11.30

Finally, operators 1-4 are each guaranteed to be staffed at least 8 hours a week, and operators 5 and 6 are guaranteed 7 hours a week.

Formulate a linear programming model that minimizes total weekly staffing costs while ensuring that the supercomputer is always staffed.

3. Consider a school district with I neighbourhoods, J schools, and G grades in each school. Each school j has a capacity of C_{jg} for grade g. In each neighbourhood i, the student population of grade g is S_{ig}. Finally, the distance of school j from neighbourhood i is d_{ij}. Formulate a linear programming problem that assigns all students to schools, while minimizing the total distance traveled by all students. (Ignore the fact that in real life, we clearly cannot assign fractions of students to schools).

4. Suppose you are managing a factory for 5 periods, and you need to decide how much to produce in each period. There is a demand at the end of each period and there are two costs involved.

   The first cost is a holding cost: for every unit of product held in inventory from the *end* of period i to the beginning of period $i+1$, you incur a holding cost h_i. The second cost is associated with changing your order: if you change the quantity of product produced in $i-1$ to a different amount in i, you incur a cost per unit change c_i (for example, if your order quantity from period 1 to period 2 increases or decreases by 5 units, the associated order change cost is $5 \times c_2$). Lastly, assume you start with zero inventory and a production level of zero.

   For the parameters given in table 1 formulate a linear programming model that minimizes cost.

Table 1: Parameters for question 4.

	Period 1	Period 2	Period 3	Period 4	Period 5
Demand (d_i)	50	80	60	110	90
Holding cost (h_i)	1	2	1.5	1	0.5
Production change cost (c_i)	3	2	1.5	2	2