Khemis Miliana University

Faculty of Science and Technology

Mathematics and Computer Science Department

جامعة جيلالي بونعامة– خميس مليانة

كلية العلوم والتكنولوجيا

قسم الرياضيات و الاعلام الالي

Module : Operations Research 1

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Exercise sheet 2

This exercise sheet will be covered in the in-class meetings. There are two different types of exercises:

> **Home**: This exercise should be solved by you alone before/after the in-class meeting.
>
> **In-class**: This exercise will be solved during the in-class meeting. I will give you some time where you can discuss and solve the exercise in a small group. Afterwards, we will discuss possible solutions.

Exercise 1: (In-class)

A company has two factories, one at Liverpool and one at Brighton. In addition it has four depots with storage facilities at Newcastle, Birmingham, London and Exeter. The company sells its product to six customers C1,…, C6. Customers can be supplied either from a depot or from the factory directly. Assume that from each factory to a depot or a customer a different distribution costs arise. The same applies to the costs from a depot to the customer. Each factory has a monthly capacity which cannot be exceeded, a depot a maximum monthly throughput which cannot be exceeded and each customer has a monthly requirement which must be met.

Task:

1. Design a mathematical model which minimize the costs and explain all of its components.
2. Extend this problem into a multicommodity flow problem (home)

Exercise 2: (In class)

Suppose a company has m warehouses and n retail outlets. A single product is to be shipped from the warehouses to the outlets. Each warehouse has a given level of supply, and each outlet has a given level of demand. We are also given the transportation costs between every pair of warehouse and outlet, and these costs are assumed to be linear. More explicitly, the assumptions are:

- The total supply of the product from warehouse i is a_i, where $i = 1, 2, \ldots, m$.
- The total demand for the product at outlet j is b_j , where $j = 1, 2, \ldots, n$.
- The cost of sending one unit of the product from warehouse i to outlet j is equal to c_{ij} , where: $i = 1, 2, \ldots, m$ *and* $j = 1, 2, \ldots, n$. The total cost of a shipment is linear in the size of the shipment.

The problem of interest is to determine an optimal transportation scheme between the warehouses and the outlets, subject to the specified supply and demand constraints. Graphically, a transportation problem is often visualized as a network with m source nodes, n sink nodes, and a set of $m \cdot n$ "directed arcs."

Task:

1. Design a mathematical model which minimize the costs and explain all of its components.
2. Extend this problem into a multicommodity flow problem