**Midterm Exam: Global logistics management**

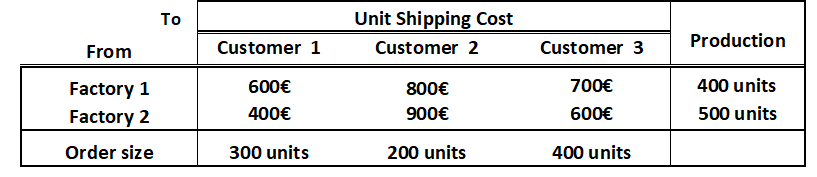
***Exercise 1: Linear Programming: Graphical solution (30 points)***

A farmer in Iowa owns 450 acres of land. He is going to plant each acre with wheat or corn. Each acre planted with wheat yields $2000 profit, requires three workers, and requires two tons of fertilizer. Each acre planted with corn yields $3000 profit, requires two workers, and requires four tons of fertilizer. There are currently 1000 workers and 1200 tons of fertilizer available.

1. Formulate the problem of linear programming for optimizing the production cycle. (15 points)
2. Plot the constraints and resolve the problem graphically. Explain what the optimal production plan is giving the existing constraints. (15points)

***Exercise 2: Medical Equipment (25 points)***

AED Cardiovascular Company’s division produces precision diagnostic equipment at two factories. Three medical centers have placed orders for this month's production output. The table below shows what the cost would be for shipping each unit from each factory to each of these customers. The number of units that will produced at each factory and the number of units ordered by each customer are also shown in the table.

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A decision now needs to be made about shipping plan for how many units to ship from each factory to each customer.

Solve this problem applying the "maximum flow at minimum cost" method.

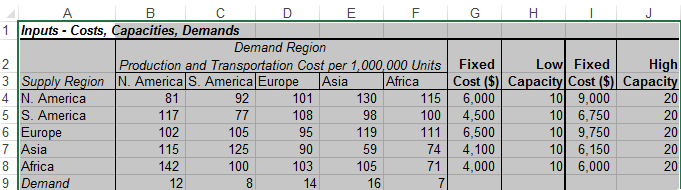
***Exercise 3: SunOil Case Study (45 points)***

Consider SunOil, a manufacturer of petrochemical products with worldwide sales. The Vice President of Supply Chain can consider several different options to meet demand. One possibility is to set up a facility in each region. The advantage of such an approach is that it lowers transportation cost and also helps avoids duties that may be imposed if product is imported from other regions. The disadvantage of this approach is that plants are sized to meet local demand and may not fully exploit economies of scale. ***An alternative approach is to consolidate plants in just a few regions****.* This improves economies of scale but increases transportation cost and duties.

The manager must consider these quantifiable trade-offs along With nonquantifiable factors such as the competitive environment and political risk. Network optimization models are useful for managers considering regional configuration. The first step is to collect the data in a form that can be used for a quantitative model.

For SunOil, the Vice President of Supply Chain decides to view the worldwide demand in terms of five regions-North America, South America, Europe, Africa, and Asia.

The data collected are shown in the Figure below. Annual demand for each of the five regions is shown in cells B9:F9. Cells B4:F8 contain the variable production, inventory, and transportation cost (including tariffs and duties) of producing in one region to meet demand in each individual region. For example, as shown in cell C4, it costs $92,000 (including duties) to produce 1 million units in North America and sell them in South America. Observe that the data collected at this stage are at a fairly aggregate level.



There are fixed as well as variable costs associated with facilities, transportation, and inventories at each facility. Fixed costs are those that are incurred no matter how much is produced or shipped from a facility. Variable costs are those that are incurred in proportion to the quantity produced or shipped from a given facility. Facility, transportation, and inventory costs generally display economies of scale and the marginal cost decreases as the quantity produced at a facility increases.

In the models we consider, however, all variable costs grow linearly with the quantity produced or shipped. SunOil is considering two different plant sizes in each location. Low-capacity plants can produce 10 million units a year, whereas high-capacity plants can produce 20 million units a year, as shown in cells H4:H8 and J4:J8, respectively. High-capacity plants exhibit some economies of scale and have fixed costs that are less than twice the fixed cost of a low-capacity plant, as shown in cells I4:I8. All fixed costs are annualized.

***The vice president wants to know what the lowest cost network should look like.***

1. Explain the objective of SunOil. (5 points)
2. Formulate the linear programming. (15 point)
3. Using solver in Excel, find the lowest-cost network the supply chain team will adopt. (20 points)