Homework #1

Due Date: Monday, 2/11/19
(for, both, in-class and video students)

Reading Assignment:
- By this time, I expect that you have already gone through the slides covering the Introductory part of the course (item #1 in the "Course Materials" list at the course webpage:
  http://www2.isye.gatech.edu/~spyros/courses/IE6201/Spring19/course_materials.html
) and that you have also read the textbook chapters assigned in that presentation, especially Chapters 0 and 6.
- Regarding the part on Deterministic Inventory Control theory, beyond the developments presented in class, you can also read
  - Sections 2.1 to 2.3 from your textbook;
  - The two book excerpts on
    - Quantity Discount Models, and
    - Multiproduct Coordination Models
    that I have uploaded in Canvas
- Finally, you should also read Sections 17.1 to 17.3 from your textbook (this material offers some broader perspectives regarding the application of Inventory Control theory in contemporary supply chains).

Problem set:
1. A plant uses 5000 units per year of a certain subassembly that is purchased from a supplier at the price of $600 per unit. The plant operates 300 days per year, and it uses a continuous review policy for the replenishment of this item, with an order size of 200 units. Furthermore, the cost of placing and delivering an order is equal to $300 and the annual holding cost for this item is computed on the basis of an interest rate of 6.0%. Answer the following questions:
a. What is the expected length of the replenishment cycles for this item? Please, state your answer in terms of working days.
b. What is the resultant annual inventory holding plus ordering cost with respect to this item?
c. What is the excess cost experienced by this policy compared to the continuous review policy that employs an optimized order size for this item?
d. What is the annual inventory holding plus ordering cost that will be experienced by the company with respect to this item, if its replenishment policy is dictated by a "power-of-two" scheme that seeks to coordinate the replenishment cycles of this item with those of some other items carried by the company, and it has as its base period the working day?

2. Filter Systems produces air filters for domestic and foreign cars. One filter, part number JJ39877, is supplied on an exclusive contract basis to Oil Changers at a constant 200 units monthly. Filter Systems can produce this filter at a rate of 50 per hour. Setup time to change the settings on the equipment is 1.5 hours. Worker time (including overhead) is charged at a rate of $55 per hour and the plant idle time during setup is estimated to cost the firm $100 per hour in lost profit.

Filter Systems has established a 22% annual interest charge for determining holding cost. Each filter costs the company $2.50 to produce, and they are sold for $5.50 each to Oil Changers. The company runs 6-hour days, 20 working days per month.

Answer the following questions

a. How many JJ39877 filters should Filter Systems produce in each production run of this particular part in order to minimize its annual holding plus set-up cost?
b. Assuming that it produces the optimal number of filters in each run, what is the maximum level of on-hand inventory of these filters that the firm has at any point in time?
c. What percentage of the working time does the company produce these particular filters, assuming that the policy in part (a) is used?

3. A purchasing agent for a particular type of silicon wafer used in the production of semiconductors must decide among three sources. Source A will sell the silicon wafers for $2.50 per wafer, independently of the number of wafers ordered. Source B will sell the wafers for $2.40 each but will not consider an order for fewer than 3,000 wafers, and Source C will sell the wafers for $2.30 each but will not accept an order for fewer than 4,000 wafers. The agent operates with an order setup cost of $100 and an annual requirement of 20,000 wafers. Holding costs are computed on the basis of a 20% annual interest rate.

Answer the following questions:
a. Which source should be used, and what is the size of the standing order?
b. What is the optimal value for the holding and set-up costs for wafers when the optimal source is used?
c. If the replenishment lead time for the selected supplier is three months, what is the reorder point that should be employed by the company?

4. A warehouse of 6,000 sq. ft. stocks three items according to a dedicated storage policy. Assuming that these three items are replenished according to a continuous review policy, use the data provided below, in order compute the optimal order sizes for each item. Also, consider how much you would be willing to pay for an extra square foot of storage space.

Item	Ann. Demand	Ord. Cost ($)	Hold. Cost ($)	Unit. Stor. Req. (sq. ft.)
1	12,500	150	2.4	5.0
2	15,000	80	3.5	4.0
3	15,000	80	3.0	4.0

5. A company manages its inventory with respect to a certain item according to a periodic review policy that places orders on a weekly basis, and uses a "planning horizon" of 6 weeks. More specifically, at the beginning of each week, the company assesses / forecasts the item expected demand for the next six weeks, and determines an ordering plan for this interval according to a specified decision rule that tries to control its ordering and holding cost, while taking into consideration the company's inventory position with respect to this item. Subsequently, the company orders to its local supplier the quantity suggested by the ordering plan for the first period. This quantity is delivered by the supplier within a few hours by the order placement, and helps the company meet its needs for the running week. At the beginning of the next week, this whole cycle is repeated with an updated forecast for the next six weeks (this scheme is known as a *"rolling horizon"*-based policy and allows the companies to accommodate any changes that might have occurred in their operational environment).

The expected demand for the next six weeks is estimated at 100, 150, 75, 75, 50 and 60 units. The inventory currently held by the company with respect to this item is 60 units. Finally, each delivery costs the company $80 and the inventory holding cost is estimated at $0.75 per unit per week.

Determine the order size that should be placed by the company to its supplier assuming that the applied decision rule is the optimal policy for uncapacitated dynamic lot sizing, suggested by the Wagner-Whitin property.

Can you see any potential problems with applying this policy in the considered application context?

Extra Credit (15%)
Read the uploaded material on *Incremental Quantity Discounts* and then solve the following problem:

Company X sells motherboards for personal computers. For order sizes up to 25 motherboards, the firm charges $350 per board; for order sizes between 26 and 50 units the firm charges $315 per each board purchased beyond the first 25; finally, for order sizes above 50 units, the company charges $285 for each additional unit beyond the first 50. A company Y expects to require these motherboards for the upcoming years at a rate of 140 units per year. Ordering costs are estimated at $30 per order and holding costs are based on an 18% annual interest rate. What should be the size of the standing order for company Y?