I'm too lazy to delete the true/false circles. Some are lacking the correction for a false answer.

IEOR 153
Fall 2008
Midterm

Instructions: Please write your name at the top of EACH page. Notes and books are not allowed. One hand-written sheet of paper to be turned in with the exam is allowed. Calculators are allowed. Show work where appropriate in order to get partial credit.

1. **Circle** T for true or F for false. If the statement is false, add, delete, or change **a few words** to make it true. (2 points each, 28 points total).

   (a) (T – (F)) Direct shipment strategies generally reduce warehouse overhead, and but ~~increase~~ decrease warehouse inventory.

   (b) ((T) – F) Commodities are generally cheaper per item when purchased using a fixed commitment contract than when purchased using an options contract.

   (c) (T – (F)) Causal forecasting methods are most useful when sales are ~~not~~ highly dependent on economic factors.

   (d) ((T) – F) One effective way to increase speculative capacity is to obtain market information earlier, perhaps by using an "Early Write" weekend like Sport Obermeyer does.

   (e) ((T) – F) If a seller is trying to induce a buyer to reveal information about his forecast, it might be useful to encourage the buyer to use a capacity reservation contract by specifying a lower price for items bought using this kind of contract.

(f) (T – F) Consider a product that costs \$20 per unit to make, sells for \$40 per unit, and has no salvage value. If our goal is maximize our expected profit, we will generally make more than the average demand for the product.

(g) (T – F) A fixed commitment contract can increase price risk if commodity prices are falling.

(h) (T – F) If a firm is going to target different service levels for different products, it makes sense to target higher service levels for high margin products.

(i) (T – F) As the number of warehouses increases, inbound logistics costs typically increase.

(j) (T – F) If the correct supply contract is utilized, a decentralized system can be more profitable than the analogous centralized system.

(k) (T – F) Consider two supply chains which are equivalent, except that one is decentralized, so it has a variety of different companies managing the different stages, whereas one is centralized, so it has a single company managing the entire supply chain. If both supply chains are reasonably well run, we would expect the centralized supply chain to have lower costs and/or higher customer service than the decentralized supply chain.

(l) (T – F) As the fixed cost of ordering increases, the average order quantity increases in ~~periodic review~~ EOQ or continuous review inventory models.

Consider a simple supply chain consisting of a manufacturer and a retailer. Each period, the manufacturer estimates demand and then manufactures goods. The retailer observes demand, and buys enough from the retailer to meet demand. The manufacturer sells any unsold goods to a salvage company at a loss. The next two questions refer to this system

(m) (T – F) In this system, if the manufacturer finds a company willing to pay more per item for salvage, the retailer will increase the size of his order.

(n) (T – F) In this kind of the system, if the retailer helps to defray manufacturer costs by paying the appropriate amount for raw materials, both the retailer's risk and the retailers expected profit can increase.

2. Consider a television repair company's supply chain. The supply chain has many components. For example, repair people have to be trained, and their training must be kept up to date. Spare parts need to be manufactured, and stored in inventory. The repair company has to own and operate vans, take appointments, etc. Please keep your answers to the following questions brief! (30 points)

   (a) List at least two conflicting objectives between two stages of this supply chain. Be specific about the stages of the supply chain and the objectives you are referring to.

Question 2, cont.

(b) Assume that the supply chain is operated by a specific TV manufacturer, and only repairs that brand of television. Describe at least one way that optimization could be used to manage the supply chain more efficiently.

(c) Now, assume that this company repairs a variety of different brands of television. Give one reason why this multi-brand repair company is more difficult or expensive to manage, and one reason why this multi-brand repair company is easier to manage.

3. You have been hired as an operation analyst for Société Bic, a company based in Clichy, France. You have been assigned to the ballpoint pen department, which manufactures and sells Bic Cristal pens in various colors. Pens can be made very quickly, so Bic can wait for customer orders before making pens. However, there is a relatively long lead time for ink. There are two ways that Bic can make pens. To make a pen in any color (including black), base ink can be mixed with the desired color agents. This process costs \$100 per manufacturing unit. Since a significant portion of the demand is for black pens, black pens can also be made using premixed black ink, which costs \$96 per unit. The average demand for black pens is 2,000 units per month with a standard deviation of 800. The average demand for all the rest of the colors in total is 3,000 units per month with a standard deviation of 600. (Recall that to find the standard deviation of the sum of two independent random variables, you must add the variances and take the square root.) Inventory holding cost per year is 12% of process cost for the base ink, and 48% of process cost for the black ink. The fixed order cost for each ink is \$1,000 per order. The order lead time for each ink is 2 months. (24 points)

   (a) Assume a service level of 98%, which implies a z value of 1.88, and that the demand for each color of Cristal pens is independent and normally distributed. Describe the appropriate inventory strategy if you employ a continuous review system (i.e. specify how much and when to order from each ink, etc.)

Question 3, cont.

(b) Suppose that in order to employ a continuous review inventory control system, Bic will have to spend an additional \$600 per month in overhead costs to monitor the inventory levels in real-time. On the other hand, Bic could simply employ a periodic review system with monthly reviews. Under these circumstances, is it worth employing a continuous review system?

4. Consider the fixed charge capacitated facility location model we discussed in class. Recall that in this model, we are trying to select some warehouses from a set of potential warehouse sites so that fixed and variable cost is minimized, and warehouses have a capacity constraint. The model is presented below, with positive parameters f_i representing the fixed cost of building at a potential site i, d_j representing the demand at customer j, c_{ij} representing the cost of transporting a unit from potential site i to customer j (as well as the distance from potential site i to retailer j, since the cost to transport is \$1 per unit per unit distance) , and K_i representing the capacity of a warehouse built at site i. The model uses the following variables:$y_{ij}, i = 1, 2, ...m, j = 1, 2, ...n$ is the fraction of demand of customer j served by a warehouse at site i, and $x_i, i = 1, 2, ...m$ is a binary variable which equals one if we locate at candidate site i, and 0 otherwise: (18 points)

$$
\begin{aligned}
(\mathbf{IP}) \quad & \min \textstyle\sum_{i=1}^{m} f_i x_i + \sum_{i=1}^{m} \sum_{j=1}^{m} d_j c_{ij} y_{ij} \\
& s.t. \\
& \textstyle\sum_{i=1}^{m} y_{ij} = 1 && j = 1, 2, \ldots, n \quad (1) \\
& \textstyle\sum_{j=1}^{n} d_j y_{ij} \leq K x_i && i = 1, 2, \ldots, m \quad (2) \\
& x_i \in \{0, 1\} && i = 1, 2, \ldots, m \quad (3) \\
& y_{ij} \geq 0 && i = 1, 2, \ldots, m, j = 1, 2, \ldots, n \quad (4)
\end{aligned}
$$

Suppose that you are trying to solve a similar problem, with a set of customers, a set of potential sites, and the same distribution costs we discussed in class, with a few changes. Your goal is to maximize revenue, so if it is more profitable to not serve some portion (or all) of a customer's demand, then that portion of the demand is not served. For each unit sold, you receive a revenue of at least r. Also, the customers are willing to pay a premium δ for any unit that comes from a nearby warehouse, since this implies better service. More specifically, a warehouse is considered "close" to a customer if it is no further than $\bar{d}$ from the customer, and for each unit shipped from one of these "close" warehouses, your revenue per unit is $r + \delta$.

How would you modify this model to capture this situation? Note that you can change or add parameters, variables, the objective, and the constraints, as appropriate. (~~20~~ points)