

- Tastee runs a trade promotion for a month, lowering the price of Nut Flakes to \$1.80. How much should Dominick's order, given the short-term price reduction?
18. Flanger is an industrial distributor that sources from hundreds of suppliers. The two modes of transportation available for inbound shipping are LTL (less than truckload) and TL (truckload). LTL shipping costs \$1 per unit, whereas TL shipping costs \$500 per truck. Each truck can carry up to 1,000 units. Flanger wants a rule assigning products to shipping mode (TL or LTL) based on annual demand. Each unit costs \$50, and Flanger uses a holding cost of 22 percent. Flanger incurs a fixed cost of \$150 for each order placed with a supplier.
 - a. Determine a threshold for annual demand above which TL is preferred and below which LTL is preferred.
 - b. How does the threshold change [relative to part (a)] if unit cost is \$150 (instead of \$50) with all other data unchanged? Which mode becomes preferable as unit cost grows?
 - c. How does the threshold change [relative to part (a)] if the LTL cost comes down to \$0.8 per unit (instead of \$1 per unit)?
 19. SuperPart, an auto parts distributor, has a large warehouse in the Chicago region and is deciding on a policy for the use of TL or LTL transportation for inbound shipping. LTL shipping costs \$1 per unit. TL shipping costs \$850 per truck plus \$150 per pickup. Thus, a truck used to pick up from three suppliers costs $850 + (3 \times 100) = \$1,150$. A truck can carry up to 2,000 units. SuperPart incurs a fixed cost of \$150 for each order placed with a supplier. Thus, an order with three distinct suppliers incurs an ordering cost of \$450. Each unit costs \$50, and SuperPart uses a holding cost of 23 percent. Assume that product from each supplier has an annual demand of 3,000 units. SuperPart has thousands of suppliers and the company must decide on the number of suppliers to group per truck if using TL.
 - a. What is the optimal order size and annual cost if LTL shipping is used? What is the time between orders?
 - b. What is the optimal order size and annual cost if TL shipping is used with a separate truck for each supplier? What is the time between orders?
 - c. What is the optimal order size and annual cost per product if TL shipping is used but two suppliers are grouped together per truck?
 - d. What is the optimal number of suppliers that should be grouped together? What is the optimal order size and annual cost per product in this case? What is the time between orders?
 - e. Which shipping policy would you recommend if each product has an annual demand of 3,000? Which shipping policy would you recommend for products with an annual demand of 1,500? Which shipping policy would you recommend for products with an annual demand of 18,000?
 20. PlasFib is a manufacturer of synthetic fibers used for making furniture upholstery. It manufactures fiber in 50 colors on one line. When changing over from one color to the next, part of the line must be cleaned, leading to a loss of material. Each changeover costs \$120 in lost material and changeover labor. Assume that each changeover requires the line to shut down for 0.5 hour. When it is running, the line produces fiber at the rate of 100 pounds per hour. The fibers sold by PlasFib are divided into three categories. There are five fast-moving colors that average sales of 31,000 pounds per color per year. There are 10 medium-moving colors that average sales of 12,000 pounds per color per year. The remaining are slow-moving products and average sales of 3,200 pounds per year each. Each pound of fiber costs \$6 and PlasFib has a holding cost of 15 percent.
 - a. What is the batch size that PlasFib should produce for each fast-, medium-, and slow-moving color? How many days of demand does this translate into?
 - b. What is the annual setup and holding cost of the policies you suggested in part (a)?
 - c. How many hours of plant operation will the above schedule require in a year (including a half-hour of setup per batch)?
 21. TopOil, a refiner in Indiana, serves three customers near Nashville, Tennessee, and maintains consignment inventory (owned by TopOil) at each location. Currently, TopOil uses TL transportation to deliver separately to each customer. Each truck costs \$800 plus \$250 per stop. Thus, delivering to each customer separately costs \$1,050 per truck. TopOil is considering aggregating deliveries to Nashville on a single truck. Demand at the large customer is 60 tons a year, demand at the medium customer is 24 tons per year, and demand at the small customer is 8 tons per year. Product cost for TopOil is \$10,000 per ton, and it uses an annual holding cost of 25 percent. Truck capacity is 12 tons.
 - a. What is the annual transportation and holding cost if TopOil ships a full truckload to each customer when they are running out of stock? How many days of inventory is carried at each customer under this policy?
 - b. What is the optimal delivery policy to each customer if TopOil ships separately to each of them? What is the annual transportation and holding cost? How many days of inventory is carried at each customer under this policy?
 - c. What is the optimal delivery policy to each customer if TopOil aggregates shipments to each of the three customers on every truck that goes to Nashville? What is the annual transportation and holding cost? How many days of inventory are carried at each customer under this policy?
 - d. Can you come up with a tailored policy that has lower costs than the policies in (b) or (c)? What are the costs and inventories for your suggested policy?
 22. Crunchy, a cereal manufacturer, has dedicated a plant for one major retail chain. Sales at the retail chain average about 20,000 boxes a month and production at the plant keeps pace with this average demand. Each box of cereal costs Crunchy \$3 and is sold to the retailer at a wholesale price of \$5. Both Crunchy and the retailer use an annual holding cost of 20 percent. For each order placed, the retailer incurs an ordering cost of \$200. Crunchy incurs the cost of transportation and loading that totals \$1,000 per order shipped.
 - a. Given that it is trying to minimize its ordering and holding costs, what lot size will the retailer ask for in each order? What are the annual ordering and holding costs for the retailer as a result of this policy? What are the annual

ordering and holding costs for Crunchy as a result of this policy? What is the total inventory cost across both parties as a result of this policy?

- b. What lot size minimizes the inventory costs (ordering, delivery, and holding) across both Crunchy and the retailer? How much reduction in cost relative to (a) results from this policy?
 - c. Design an all unit quantity discount that results in the retailer ordering the quantity in (b).
 - d. How much of the \$1,000 delivery cost should Crunchy pass along to the retailer for each lot to get the retailer to order the quantity in (b)?
23. A steel service center sources products from an integrated steel mill at a cost of \$2,000 per ton. Demand for steel at the service center is 50 tons per month. The service center has an annual holding cost of 25 percent and incurs a fixed cost of \$2,000 for each order. How many tons of steel should the service center order per replenishment? What is the annual ordering and holding cost incurred by the service center?

The integrated steel mill incurs a fixed cost of \$4,000 for each order placed by the steel service center. Steel costs the mill \$1,000 per ton and the mill has an annual holding cost of 20 percent. Assuming that the mill builds up its steel (for the service center) at the rate of 50 tons per month, what are the annual fixed cost and holding cost incurred by the mill as a result of the service center's ordering policy? What is the annual cost incurred by both the service center and the steel mill?

If the steel mill and the service center could work in a coordinated manner, what is the optimal order size that minimizes their joint fixed and holding costs? What annual savings could the supply chain expect as a result of coordination? Design an all unit quantity discount that the integrated steel mill could use to get the service center to order the coordinated amount without increasing annual costs at the service center.

24. The Orange company has introduced a new music device called the J-Pod. The J-Pod is sold through Good Buy, a major electronics retailer. Good Buy has estimated that demand for the J-Pod will depend on the final retail price p according to the demand curve

$$\text{Demand } D = 2,000,000 - 2,000p$$

The production cost for Orange is \$100 per J-Pod.

- a. What wholesale price should Orange charge for the J-Pod? At this wholesale price, what retail price should Good Buy set? What are the profits for Orange and Good Buy at equilibrium?
 - b. If Orange decides to discount the wholesale price by \$40, how much of a discount should Good Buy offer to customers if it wants to maximize its own profits? What fraction of the discount offered by Orange does Good Buy pass along to the customer?
25. The Orange company prices J-Pods at \$550 per unit. Good Buy sells the J-Pods at \$775. Annual demand at this retail price turns out to be 450,000 units. Good Buy incurs ordering, receiving, and transportation costs of \$10,000 for each lot of J-Pods ordered. The annual holding cost used by the retailer is 20 percent.

- a. What is the optimal lot size that Good Buy should order?
- b. The Orange company has discounted J-Pods by \$40 for the short term (about the next two weeks). Good Buy has decided not to change the retail price but may change the lot size ordered from Orange. How should Good Buy adjust its lot size given this discount? How much does the lot size increase because of the discount?

26. MCParts, an MRO distributor, sources products from three different suppliers in the Atlanta region. Currently, MCParts uses TL transportation to source separately from each supplier. Each truck costs \$1,000 plus \$400 per stop. Thus, delivering to each customer separately costs \$1,400 per truck. MCParts is considering aggregating sourcing on a single truck. Demand for the fastest selling product is 120,000 units a year, demand for the medium selling product is 60,000 units per year, and demand for the slowest moving product is 12,000 units per year. Each product costs \$10 and MCParts incurs an annual holding cost of 25 percent. Truck capacity is 12,000 units.

- a. What is the annual transportation and holding cost if MCParts sources a full truckload from each supplier in each order? How many days of inventory is carried for each product under this policy?
 - b. What is the optimal order quantity of each part if MCParts sources separately from each supplier? What is the annual transportation and holding cost? How many days of inventory is carried for each part under this policy?
 - c. What is the optimal order quantity for each product if MCParts aggregates shipments from each of the three suppliers on every truck that arrives from Atlanta? What is the annual transportation and holding cost? How many days of inventory are carried at each customer under this policy?
 - d. Can you come up with a tailored policy that has lower costs than the policies in (b) or (c)? What are the costs and inventories for your suggested policy?
27. AZOR, a European detergent manufacturer, has dedicated a plant for one major retail chain. Sales at the retail chain average about 10,000 jugs of detergent a month and production at the plant keeps pace with this average demand. Each jug of detergent costs AZOR €5 and is sold to the retailer at a wholesale price of €10. Both AZOR and the retailer use an annual holding cost of 25 percent. For each order placed, the retailer incurs an ordering cost of €100. AZOR incurs the cost of transportation and loading that totals €1,600 per order shipped.
- a. Given that it is trying to minimize its ordering and holding costs, what lot size will the retailer ask for in each order? What are the annual ordering and holding costs for the retailer as a result of this policy? What are the annual ordering and holding costs for AZOR as a result of this policy? What is the total inventory cost across both parties as a result of this policy?
 - b. What lot size minimizes the inventory costs (ordering, delivery, and holding) across both AZOR and the retailer? How much reduction in cost relative to (a) results from this policy?
 - c. Design an all unit quantity discount that results in the retailer ordering the quantity in (b).