

Each problem is worth 0 points. In the event of an actual quiz, you would have received warning.

1. A company operates two plants which manufacture the same item and whose total cost functions are

$$C_1 = 8.5 + 0.03q_1^2 \text{ and } C_2 = 5.2 + 0.04q_2^2,$$

where q_1 and q_2 are the quantities produced by each plant. The total quantity demanded, $q = q_1 + q_2$, is related to the price, p , by

$$p = 60 - 0.04q.$$

How much should each plant produce in order to maximize the company's profit?¹

2. A missile has a guidance device which is sensitive to both temperature, $t^\circ \text{C}$, and humidity, h . The range in km over which the missile can be controlled is given by

$$\text{Range} = 27,800 - 5t^2 - 6ht - 3h^2 + 400t + 300h$$

What are the optimal conditions for controlling the missile?¹

3. Some items are sold at a discount to senior citizens or children. The reason is that these groups are more sensitive to price, so a discount has a greater impact on their purchasing decisions. The seller faces an optimization problem: How large a discount to offer in order to maximize profits? Suppose a theater can sell q_c child tickets and q_a adult tickets at prices p_c and p_a , according to the demand functions:

$$q_c = rp_c^{-4} \quad \text{and} \quad q_a = sp_a^{-2}$$

and has operating costs proportional to the total number of tickets sold. What should be the relative price of children's and adult's tickets?¹

¹These questions are borrowed from Hughes-Hallett, Gleason, McCallum et al.'s *Calculus*, 3rd edition.

