

Math 20 Introductory Problems

1. A certain economy is divided into three sectors—manufacturing, agriculture, and services. For each unit of output, manufacturing requires .10 units of input from other companies in that sector, .30 units of input from agriculture, and .30 units of input from services. For each unit of output, agriculture uses .20 units of its own output, .60 units from manufacturing, and .10 units from services. For each unit of input, the services sectors consumes .10 units from services, .60 units from manufacturing, but no agricultural products.

Determine the production levels needed to satisfy an outside demand (perhaps from a neighboring economy) of 18 units of manufacturing output, 18 units of agricultural output, and 0 units of services output.

2. The life cycle of spotted owls divides naturally into three stages: juvenile (up to 1 year old), subadult (1 to 2 years), and adult (over 2 years). The owl mates for life during the subadult and adult stages, begins to breed as an adult, and lives for up to 20 years.

A first step in studying the population dynamics is to model the population at yearly intervals, at times denoted by $k = 0, 1, 2, \dots$. Usually, one assumes that there is a 1:1 ratio of males to females at each life stage and counts only the females. Let j_k denote the number of juveniles at year k , s_k the number of subadults at year k , and a_k the number of adults at year k .

3. During the summer months, little Timmy sells sweet tea in his driveway to passing motorists. Last summer, he sold cups of tea for \$1 each and his sales averaged 20 per day. When he increased the price by a dime, he found that he lost two sales a day. Tea supplies cost little Timmy 60 cents per cup. Assuming a linear relationship between price and demand, what should the selling price be to maximize Timmy's profit?
4. An electronics manufacturer determines that the profit P in dollars obtained by producing x units of a DVD player and y units of a DVD recorder is approximated by the model

$$P = 8x + 10y - (0.001)(x^2 + xy + y^2) - 10,000.$$

Find the production level that produces a maximum profit. What is the maximum profit?