

1985 年美国大学生数学建模竞赛 MCM 试题

1985 MCM A: Animal Populations

Choose a fish or mammal for which appropriate data are available to model it accurately. Model the animal's natural interactions with its environment by expressing population levels of different groups in terms of the significant parameters of the environment. Then adjust the model to account for harvesting in a form consistent with the actual method by which the animal is harvested. Include any outside constraints imposed by food or space limitations that are supported by the data.

Consider the value of the various quantities involved, the number harvested, and the population size itself, in order to devise a numerical quantity that represents the overall value of the harvest. Find a harvesting policy in terms of population size and time that optimizes the value of the harvest over a long period of time. Check that the policy optimizes that value over a realistic range of environmental conditions.

1985 MCM B: Strategic Reserve Management

Cobalt, which is not produced in the US, is essential to a number of industries. (Defense accounted for 17% of the cobalt production in 1979.) Most cobalt comes from central Africa, a politically unstable region. The Strategic and Critical Materials Stockpiling Act of 1946 requires a cobalt reserve that will carry the US through a three-year war. The government built up a stockpile in the 1950s, sold most of it off in the early 1970s, and then decided to build it up again in the late 1970s, with a stockpile goal of 85.4 million pounds. About half of this stockpile had been acquired by 1982.

Build a mathematical model for managing a stockpile of the strategic metal cobalt. You will need to consider such questions as:

1. How big should the stockpile be?
2. At what rate should it be acquired?
3. What is a reasonable price to pay for the metal?

You will also want to consider such questions as:

1. At what point should the stockpile be drawn down?
2. At what rate should it be drawn down?

3. At what price is it reasonable to sell the metal?

4. How should it be allocated?

Useful Information on Cobalt

The government has projected a need of 25 million pounds of cobalt in 1985.

The U.S. has about 100 million pounds of proven cobalt deposits. Production becomes economically feasible when the price reaches \$22/lb (as occurred in 1981). It takes four years to get operations rolling, and then six million pounds per year can be produced.

In 1980, 1.2 million pounds of cobalt were recycled, 7% of total consumption.