CIVE 3331 – Exercises 017

Exercise_017_1
(Problem 3.5)

Suppose world carbon emissions are expressed as the following product:

Carbon emissions = (Population) x (Energy/person) x (Carbon/energy)

If per capita energy demand increases at 1.5 percent per year, fossil fuel emissions of carbon per unit of energy increase at 1 percent per year, and world population grows at 1.5 percent per year,

(a) How long would it take before we are emitting carbon at twice the current rate?
(b) At that point, by what fraction would per capita energy demand have increased?
(c) At that point, by what fraction would total energy demand have increased?

Exercise_017_2
(Problem 3.7)

Consider the following desegregation of carbon emissions:

Carbon emissions (kg C/yr) = Population x (Energy (kJ/yr)/Person) x (Carbon (kg C)/Energy (kJ))

Using the following estimates for the United States and assuming that growth rates remain constant,

	Population	(kJ/yr)/Person	kg C/kJ
1990 amounts	250 x 10^6	320 x 10^6	15 x 10^-6
Growth, r (%/yr)	0.6	0.5	-0.3

(a) Find the carbon emission rate in 2020.
(b) Find the carbon emitted in those 30 years.
(c) Find the total energy demand in 2020.
(d) Find per capita carbon emission rate in 2020.

Exercise_017_3
(Problem 3.12)

Suppose some sewage drifting down a stream decomposes with a reaction rate coefficient K equal to 0.2/day. What would be the half-life of this sewage? How much would be left after 5 days?

Exercise_017_4
(Problem 3.15)

Suppose we stock a pond with 100 fish and note that the population doubles every year for the first couple of years (with no harvesting), but after quite a number of years, the population stabilizes at what we think must be the carrying capacity of the pond, 2000 fist. Growth seems to have followed a logistic curve.

(a) What population size should be maintained to achieve maximum yield, and what would be the maximum sustainable fish yield?
(b) If the population is maintained at 1500 fish, what would be the sustainable yield?

Exercise_017_5
(Problem 3.17)

A lake has a carrying capacity of 10,000 fish. At the current level of fishing, 2,000 fish per year are taken and the fish population seems to hold fairly steady at about 4,000. If you wanted to maximize the sustainable yield, what would you suggest in terms of population size and yield?

Exercise_017_6
(Problem 3.20)

Consider a simplified age structure that divides a population into three groups: ages 0-24, with 3.0 million; 25-49, with 2.0 million; and 50-74, with 1.0 million. Suppose we impose the following simplified fertility and mortality constraints: All births occur just as the woman leaves the 0-24 age category, and no one dies until their seventy-fifth birthday, at which time they all die. Suppose we have replacement-level fertility starting now. Draw the age structure in 25 years, 50 years, and 75 years. What is the total population size at each of these times?

Exercise_017_7
(Problem 3.23)

The following age structure and survival data are for China in 1980. Suppose the birth factors (corresponding to a total fertility rate of 1.0) are as shown. Estimate the population of China in 1990.

Age	Population (millions)	Lx+10/Lx	bx
0-9	235	0.957	0
10-19	224	0.987	0.25
20-29	182	0.980	0.25
30-39	124	0.964	0
40-49	95	0.924	0
50-59	69	0.826	0
60-69	42	0.633	0
70-79	24	0.316	0
80-89	6	0	0
Total	1001		

Exercise_017_8
(Problem 3.24)

Use a spreadsheet to project the China population data given in Problem 3.23 out to the year 2030. What is the population at that time?