

Ger d + Wheatley, Applied Numerical Analysis, 4th Ed. Addison-Wesley 787

5.1 POPULATION CHARACTERISTICS OF FIELD MICE

An ecologist has been studying the effects of the environment on the population of field mice. Her research shows that the number of mice born each month is proportional to the number of females in the group, and that the fraction of females is normally constant in any group. This implies that the number of births per month is proportional to the total population.

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She has located a test plot for further research, which is a restricted area of semiarid land. She has constructed barriers around the plot so mice cannot enter or leave. Under the conditions of the experiment, the food supply is limited, and it is found that the death rate is affected as a result, with mice dying of starvation at a rate proportional to some power of the population. (She also hypothesizes that when the mother is undernourished, the babies have less chance for survival, and that starving males tend to attack each other, but these factors are only speculation.)

The net result of this scientific analysis is the following equation, with N being the number of mice at time t (with t expressed in months.) She has come to you for help in solving the equation; her calculus doesn't seem to apply.

$$\frac{dN}{dt} = aN - BN^{1.7}, \quad \text{with } B \text{ given by Table 5.1.}$$

As the season progresses, the amount of vegetation varies. She accounts for this change in the food supply by using a "constant" B that varies with the season.

If 100 mice were initially released into the test plot and if $a = 0.9$, estimate the number of mice as a function of t , for $t = 0$ to $t = 8$.

In this chapter we will find how such a problem can be solved by numerical methods.

Table 5.1

for $0 < t \leq 1$ →

t	B	t	B
0	0.0070	5	0.0013
1	0.0036	6	0.0028
2	0.0011	7	0.0043
3	0.0001	8	0.0056
4	0.0004		