MAP 4484 Modeling in Mathematical Biology: Population Dynamics

Population Dynamics Study Guide for MAP 4484 Modeling in Mathematical Biology

Key Concepts:

Population dynamics is the study of how populations of organisms change over time. It looks at factors such as population size, growth rate, and mortality rate. It also examines the effects of external factors such as environmental changes, competition, and predation on population size and structure.

Equations:

• Logistic Growth Equation:

$N_{t+1} = N_t + rN_t(1-N_t/K)$

Where N_t is the population size at time t, r is the intrinsic growth rate, and K is the carrying capacity.

• Exponential Growth Equation:

$N_{t+1} = N_t * e_r$

Where N_t is the population size at time t and e_r is the exponential growth rate.

• Verhulst Equation:

$N_{t+1} = N_t + rN_t(1-N_t/K) - dN_t$

Where N_t is the population size at time t, r is the intrinsic growth rate, K is the carrying capacity, and d is the mortality rate.

Definitions:

• Population Size: The number of individuals in a population at a given time.

• Intrinsic Growth Rate: The rate at which a population grows in the absence of any external factors.

• Carrying Capacity: The maximum number of individuals that can be supported by a given environment.

• Mortality Rate: The rate at which individuals die in a population.

• Environmental Changes: Changes in the environment that can affect population size and structure.

• Competition: The struggle between individuals or groups of individuals to obtain resources.

• Predation: The act of one organism consuming another organism.

Rules:

• Population size is determined by the balance between births and deaths.

• Intrinsic growth rate is affected by environmental conditions and competition.

• Carrying capacity is determined by the availability of resources and the ability of the environment to support a certain number of individuals.

• Mortality rate is affected by environmental conditions and predation.

• Environmental changes can have both positive and negative effects on population size and structure.

• Competition can lead to decreased population size and reduced growth rate.

• Predation can lead to decreased population size and increased mortality rate.