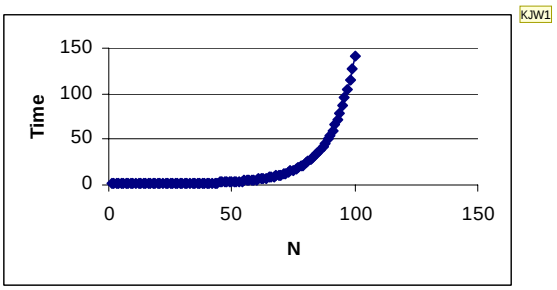
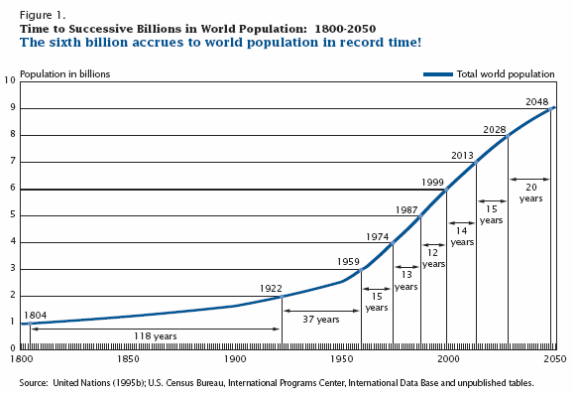
Exponential Growth – J-shaped curve



Properties of Exponential Growth

- Population will always increase by the same Percent in any two periods of time of the same length
  - Simplest example assume population doubles each year
    - 2 → 4→ 8 → 16→ 32 →64 →128→256→512
    - If r=0.05
    - 2→2.10→2.21→2.32→ 2.43→2.55→2.68 →2.81
  - Still J-shaped.



Calculating r if doubling time is known

$$t^{double} = \frac{\ln(2)}{r}$$

$$r * t^{double} = \ln(2)$$

$$r = \frac{\ln(2)}{t^{double}}$$

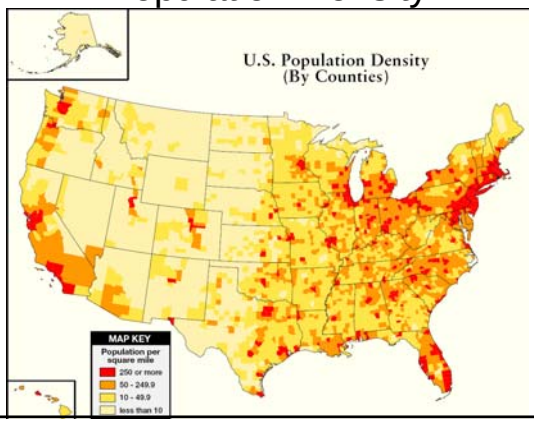
Slide 1

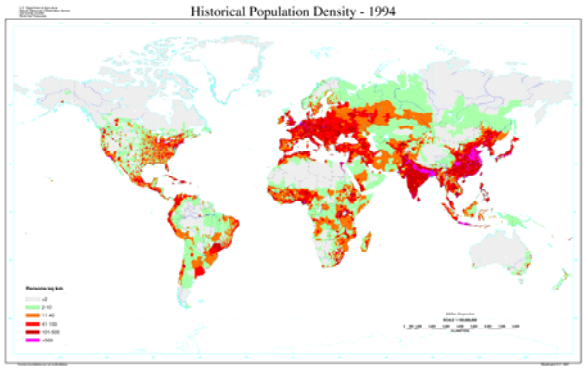
KJW1 Kevin Williams, 4/4/2005

Density

- Population Density = # of individuals / unit area
- **Density Independent Population Growth**
  - **Per capita growth is unaffected by population density (exponential growth)**
- **Density Dependent Population Growth**
  - **Per capita growth rates change depending on the population density.**
  - **Usually per capita growth rates decrease as popoulation density increases. (logistic growth)**

Population Density





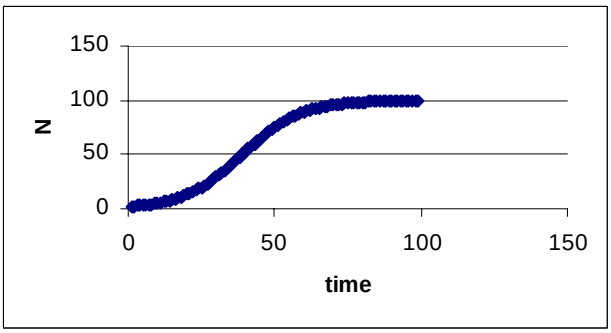
1 km^2= 0.38 miles^2
500 people/km^2 = 1315 people/mile^2

Population Density

- Arable land is not increasing
- Population is increasing
- Population density will increase as population size increases
- Leading to
  - More conflict over resources
  - Less area for none human intensive use
  - More people affected by “local” disasters
  - Increased opportunity for spread of infectious diseases

Logistic growth

- Assumes that resources may limit growth
- As density increases competition for resources will cause either decreased **fecundity** or increased **mortality** or both
- Poplulation growth declines as density increases
- Population growth stops a Carrying capacity
- K=Carrying capacity



Allee Effect

Logistic growth assumes that as population density increases, the rate of population growth decreases (i.e. birth rates decrease or death rates increase, or both)

In a few population the opposite is observed across a limited range of population denisities

- Meerkats
- Passenger pigeon
- Cougers

Why –

- Predator avoidance
- Social interactions
- Mating problesm

EXPONENTIAL GROWTH EQUATION

$$\frac{dN}{dt} = rN$$

LOGISTICS GROWTH EQUATION

$$\frac{dN}{dt} = rN\left(\frac{K - N}{K}\right)$$