Mathematics 172

Quiz 10 Name: Key

You must show your work to get full credit.

A problem with the discrete logistic equation

$$N_{t+1} = N_t + rN_t\left(1 - \frac{N_t}{K}\right)$$

is that the right hand side of this equation becomes negative if N_t is very large. But this would imply that N_{t+1} is negative, which makes no sense biologically. One way people have fixed this problem is by using the equation

$$N_{t+1} = N_t e^{r\left(1-\frac{N_t}{K}\right)}$$

where r is still the per capita growth rate for the unconstrained population and K is still the carrying capacity. Let us analyze this model when $r = 1.2$ and $K = 100$. Then the equation becomes

$$N_{t+1} = N_t e^{1.2\left(1-\frac{N_t}{100}\right)}.$$

To do this enter

```
\Y1 = Xe^(1.2^(1-X/100))
\Y2 = X
Xmin=0
Xmax=150
```

and use `ZoomFit` to plot these functions. The graphs should intersect at two points. These points are the equilibrium points.

1. What is first equilibrium point? $N_* = 0$

What is $f'(N_*)$ (that is the slope) at this point? 3.32

Is this point stable or unstable? Unstable

2. What is second equilibrium point? 100

What is $f'(N_*)$ (that is the slope) at this point? -.2

Is this point stable or unstable? Stable

3. If $N_0 = 110$ then find

$N_1 =$ 97.56

$N_2 =$ 100.46

An estimate of N_{50} ≈ 100