Population & Community Ecology Homework 1

Samantha Apgar & Henry Frye

Problem 1

In this problem we look to find the density of duckweed plants per m^2 after 47 days. We will estimate the future population using the exponential growth formula, $N_t = N_0 e^{rt}$ where the initial population, N_0, is 11.1 duckweed plants per m^2. We can calculate the rate of unitless population change, r, by dividing the estimate after 20 day from the initial population.

```
r = 23.5/11.1
r
```

```
## [1] 2.117117
```

Thus with r= 2.12, we can calculate N_{27} as $N_{27} = 11.1e^{2.12\times 47}$.

```
n27 <- 11.1*exp(2.12*47)
n27
```

```
## [1] 2.081734e+44
```

Thus after a total of 47 days, the population density will be 2.08×10^{44} duckweed plants per m^2.

Problem 2

Problem 3

Part a

Given the information we would like to solve for N_7, the population in seven years.

```
n_7 <- (1.037^7)*112
n_7
```

```
## [1] 144.434
```

Thus the population density will be 144 (rounded, no units given) at year 7.

Part b

Using the exponential growth formula, $N_t = N_0 e^{rt}$, we would like to solve for an r value where $N_0 = 112$ and $N_t = 144$. Thus we solve for r as $ln(\frac{N_t}{N_0})/t = r$.

```
r <- log(144/112)/7
r
```

```
## [1] 0.03590206
```

Thus r is equal to .036 in the exponential model to achieve the same results as the discrete population growth model.

Problem 4

Problem 5

Survivorship, as defined by $\frac{S_x}{S_0}$, is calculated in the vector below.

```
age <- 0:4
sx <- c(740,280,105,32,0)
bx <- c(0,0.4,1.3,3,8,NA)
lx <- sx/740
print(lx)
```

```
## [1] 1.00000000 0.37837838 0.14189189 0.04324324 0.00000000
```

I assume that g(x) was meant to be p(x)

Solving for p(x)

Problem 6

Problem 7

The following is the setup for the population project matrix:

```
stages <- c('seedling','juvenile','small adult', 'medium adult', 'large adult')
A <-  matrix(c(
     0,  0,.015,.063,.189,
  .294,.25, 0   , 0   , 0   ,
  .176,.35,.385,.059,.012,
  0    ,.35,.461,.568,.171,
  0    , 0  ,.108,.356,.805
), nrow = 5, byrow = TRUE,
   dimnames = list(stages,stages)
)
print(A)
```

```
##                seedling juvenile small adult medium adult large adult
## seedling          0.000     0.00       0.015        0.063       0.189
## juvenile          0.294     0.25       0.000        0.000       0.000
## small adult       0.176     0.35       0.385        0.059       0.012
```

```
## medium adult    0.000     0.35      0.461       0.568       0.171
## large adult     0.000     0.00      0.108       0.356       0.805
```

Part a

To calculate λ from the popbio package we do the following:

```r
library(popbio)
lambda(A)
```

```
## [1] 1.037396
```

Thus $\lambda = 1.04$.

Part b

To calculate the stable stage distribution we do the following:

```r
stable.stage(A)
```

```
##     seedling     juvenile  small adult medium adult  large adult
##   0.10633963   0.03970536   0.08489524   0.28816968   0.48089009
```