Derek Worthen
Math 220
April 20, 2010

1. Owl Matrix Population:

Juvenile Survival .33
Subadult Survival .75
Adult Survival .75
Subadult Fecundity .125
Adult Fecundity .26

Based off the information provided the matrix setup as followed:

A=

	Juveniles	**Sub Adults**	**Adults**
Fecundity	0	.125	.26
Sub Adult survival	.33	0	0
Adult Survival	0	.75	.75

eig(A) =
-0.0478 + 0.1930i
-0.0478 - 0.1930i
0.8455

A is a matrix representing owl population where .125 and .26 represent the probability of fecundity of sub adults and adults respectively. .33, .75 and .75 represent the probabilities of juvenile survivability to sub adult, sub adult survival to adult and adult survival, again respectively.

0.8455 is an eigenvalue of matrix A that represents the largest Lambda value, $\lambda 1$. Since $|\lambda 1|=0.8455<1$, the population is declining towards extinction. More specifically only 84.55% of the population will survive annually, meaning the population is declining at 15.45% annually.

Here the prospects are much worse than the example owl problem. In the example the owl population is growing at a rate of 1% annually while here the owl population is decreasing at 15.45% annually.

2. Blue Whale Population Matrix: A=

	Less than 2	2 or 3 years	4 or 5 years	6 or 7 years	8 or 9 years	10 or 11 years	12 and over
Fecundity	0	0	.19	.44	.50	.50	.45
2 or 3	.87	0	0	0	0	0	0
4 of 5	0	.87	0	0	0	0	0
6 or 7	0	0	.87	0	0	0	0
8 or 9	0	0	0	.87	0	0	0
10 or 11	0	0	0	0	.87	0	0
12 and over	0	0	0	0	0	.87	.88

eig(A) =

Derek Worthen
Math 220
April 20, 2010

-0.5166
-0.2580 + 0.3992i
-0.2580 - 0.3992i
0.1854 + 0.6345i
0.1854 - 0.6345i
1.1180
0.4240

A is a matrix representing whale population. the first row represents the probability of fecundity of the labeling column. Each following row represents the probability of the row class to survive to the next class (the corresponding column).

1.1180 is an eigenvalue of matrix A that represents the largest Lambda value, $\lambda 1$. Since $|\lambda 1|=1.1180>1$ and the following lambdas are less than 1, the population is increasing. More specifically increasing at 11.6% annually.

Taking [V,D]=eig(A) results in the two following matrices:
D= the following matrix where * are complex solutions

*	*	*	*	*	0	0
*	*	*	*	*	0	0
*	*	*	*	*	0	0
*	*	*	*	*	0	0
*	*	*	*	*	0	0
*	*	*	*	*	1.12	0
*	*	*	*	*	0	.42

V = the following matrix where * are complex solutions

*	*	*	*	*	-0.53	-0.01
*	*	*	*	*	-0.42	-0.03
*	*	*	*	*	-0.32	-0.05
*	*	*	*	*	-0.25	-0.11
*	*	*	*	*	-0.20	-0.22
*	*	*	*	*	-0.15	-0.45
*	*	*	*	*	-0.56	0.86

Since Column 6 (V6) of matrix D contains Lambda one, 1.12, we care about the corresponding column (V6) from matrix V. The value of V6 of matrix V is that when the sum of V6 is scaled to equal 1, the values within the vector state the percentage of the corresponding class making up the stable population. To scale the sum of V6 to 1, calculate the reciprocal of the sum V6 then multiple by V6: 1/sum(V6)*V6:

V6 after scaling =

Derek Worthen
Math 220
April 20, 2010

0.22	22% of the whale population are less than 2 years of age.
0.17	17% of the whale population are 2 or 3 years of age.
0.13	13% of the whale population are 4 or 5 years of age.
0.10	10% of the whale population are 6 or 7 years of age.
0.08	8% of the whale population are 8 or 9 years of age.
0.06	6% of the whale population are 10 or 11 years of age.
0.23	23% of the whale population are 12 years of age or older.

3. Speckled Alder shrub:

A=

	Less than .1cm	.1 - .9cm	1 - 1.9cm	2 - 2.9cm	3 - 3.9cm
Sprout Production	.58	.02	.06	.10	.14
.1 - .9cm	.12	.76	0	0	0
1 - 1.9cm	0	.12	.86	0	0
2 - 2.9cm	0	0	.14	.58	0
3 - 3.9cm	0	0	0	.38	.83

eig(A) =
0.5588 + 0.0521i
0.5588 - 0.0521i
0.9338
0.7793 + 0.1048i
0.7793 - 0.1048i

A is a matrix representing Speckled alder population. the first row represents the probability of sprout production of the labeling column. Each following row represents the probability of the row class to survive to the next class (the corresponding column).

0.9338 is an eigenvalue of matrix A that represents the largest Lambda value, $\lambda 1$. Since $|\lambda 1|=0.9338 < 1$, the population is declining towards extinction. More specifically only 93.4% of the current population survives to the following year, meaning a decline at a rate of 16.6% occurs annually.

4. Speckled Alder Shrub Continued (altered):

	Less than .1cm	.1 - .9cm	1 - 1.9cm	2 - 2.9cm	3 - 3.9cm
Sprout Production	.58	.12	.36	.60	.84
.1 - .9cm	.12	.76	0	0	0
1 - 1.9cm	0	.12	.86	0	0
2 - 2.9cm	0	0	.14	.58	0
3 - 3.9cm	0	0	0	.38	.83

Derek Worthen
Math 220
April 20, 2010

eig(A) =
0.5191 + 0.0875i
0.5191 - 0.0875i
1.0187
0.7765 + 0.1728i
0.7765 - 0.1728i

A is a matrix representing Speckled alder population. the first row represents the probability of sprout production of the labeling column. Each following row represents the probability of the row class to survive to the next class (the corresponding column).

1.0187 is an eigenvalue of matrix A that represents the largest Lambda value, $\lambda 1$. Since $|\lambda 1|=1.0187>1$ and the following lambdas are less than 1, the population is increasing. More specifically increasing at 1.9% annually.

Taking [V,D]=eig(A) I obtain the two following matrices:
D= the following matrix where * are complex solutions

*	*	0	*	*
*	*	0	*	*
*	*	1.0187	*	*
*	*	0	*	*
*	*	0	*	*

V = the following matrix where * are complex solutions

*	*	.8446	*	*
*	*	.3918	*	*
*	*	.2964	*	*
*	*	.0946	*	*
*	*	.1905	*	*

Determining the percentage of each class in the stable population is calculated by scaling the sum of column 3 (V3) of matrix V to equal 1. To scale the sum of V3 to 1, calculate the reciprocal of the sum V3 then multiple by V3: 1/sum(V3)*V3:

V3 after scaling:

0.46	46% of the alder population has a stem diameter less than .1cm.
0.22	22% of the alder population has a stem diameter between .1-.9cm.
0.16	16% of the alder population has a stem diameter between 1-1.9cm.
0.05	5% of the alder population has a stem diameter between 2-2.9cm
0.10	10% of the alder population has a stem diameter between 3-3.9cm.

The General equation to calculate how much of a thriving population may be harvested while maintaining a constant level of such population: $(\lambda 1-1)/ \lambda 1$ therefore, (1.0187-1)/1.0187 equals .02, 2% of the alder population may be harvested safely.

5. Blue Whale continued:

Derek Worthen
Math 220
April 20, 2010

The General equation to calculate how much of a thriving population may be harvested while maintaining a constant level of such population: $(\lambda 1-1)/\ \lambda 1$ therefore, (1.1180-1)/1.1180 equals .1055, 10.6% of the Blue whale population may be harvested safely.