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# Lab 4

## Leslie Matrix examples

(more FOR-loop practice)

*Marine Modelling* January 28, 2019

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# Chinook Example



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Suppose there are 1,000 females in each of the three age classes. Suppose survival rates in year 1 and 2 are 0.5% and 10%, respectively, and that each female in year 3 produces 2,000 female offspring.

$$\underline{n}_0 = \begin{pmatrix} 1,000 \\ 1,000 \\ 1,000 \end{pmatrix}, M = \begin{pmatrix} 0 & 0 & 2000 \\ 0.005 & 0 & 0 \\ 0 & 0.1 & 0 \end{pmatrix}$$

Now we can calculate any future population size and age distribution easily:

$$\underline{n}_k = M^k \underline{n}_0$$

# Chinook Example

Look at script `chinook_model.m` at
http://memg.ocean.dal.ca/grosse/...
...Teaching/MM2019/Materials/Lab_Materials.html

```
% chinook popluation evolution over 24 years
% initial age distribution:
x0=[1000;1000;1000];

% projection matrix:
M=[0 0 2000; 0.005 0 0; 0 .10 0];

% next 24 years (i.e., 24 years + initial distribution)
% 1) initialize an array that can hold 25 age
% distribution vectors:
X=zeros(3,25);

% 2) place the initial age distribution vector
% in the first column of X
X(:,1) = x0;
```



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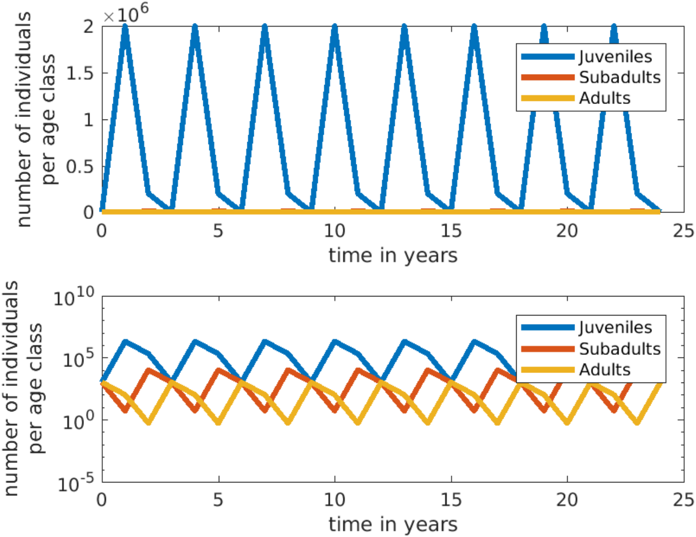
# Chinook Example

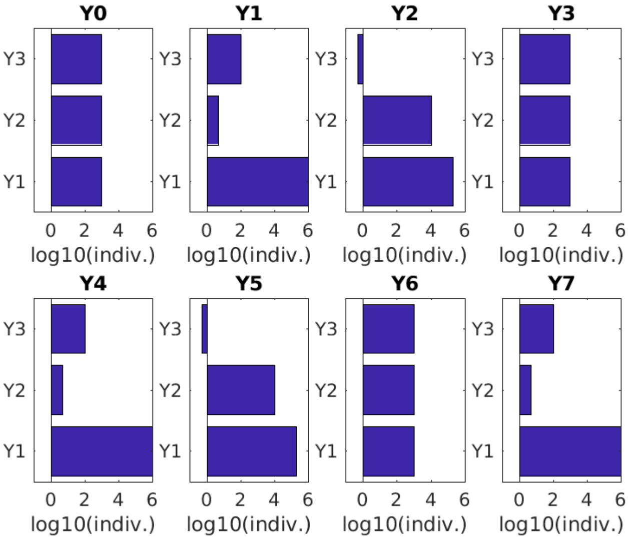
```
% 3) Calculate the 2nd through 25th column
% of X by iterating the equation x(k) = M*x(k-1)
% for k from 2 through 25
for k=2:25, X(:,k)=M*X(:,k-1); end

% 4) plot results
figure
% 4.1) plot number of salmon (X) over time (Y)
subplot(2,1,1)
plot(Y',X')
xlabel('time in years')
ylabel('number of individuals per age class')
legend('Juveniles','Subadults','Adults')
% 4.2) repeat with logarithmic scale on the y-axis
subplot(2,1,2)
semilogy(Y',X')
xlabel('time in years')
ylabel('number of individuals per age class')
legend('Juveniles','Subadults','Adults')
```

# Chinook Example

```
% 4.3) plot age distribution for years 1:8
figure
for i=1:8
    subplot(2,4,i)
    set(gca,'FontSize',14)
    barh(log10(X(:,i)));
    set(gca,'YTickLabel',{'Y1' 'Y2' 'Y3'})
    xlabel('log10(indiv.)')
    title(['Y' num2str(i)])
    axis([-1 6 0.5 3.5])
end
```


×10^6
2
1.5
1
0.5
0
number of individuals per age class
0
5
10
15
20
25
time in years
Juveniles
Subadults
Adults
10^10
10^5
10^0
10^-5
number of individuals per age class
0
5
10
15
20
25
time in years
Juveniles
Subadults
Adults



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Now modify the script. Suppose there are no births or deaths.

How do you have to modify the Leslie matrix?

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M=[0 0 0; 1 0 0; 0 1 0];
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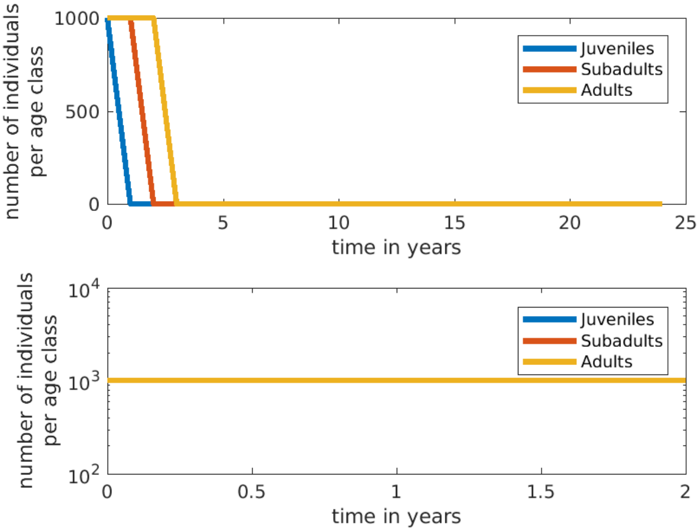
Now plot evolution over time and age distribution over time.



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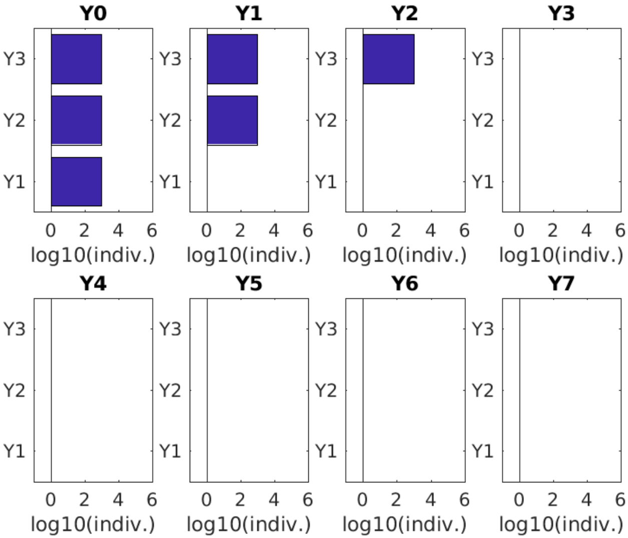


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Now modify the script again. Suppose the reproduction in year 3 reduces to 1,000 female offspring compared to our previous Leslie matrix of

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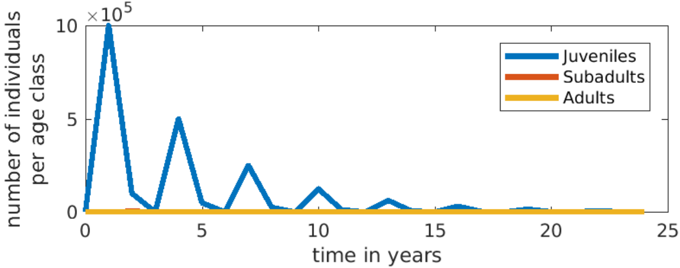
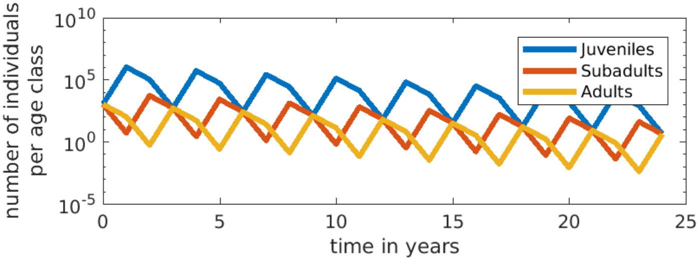
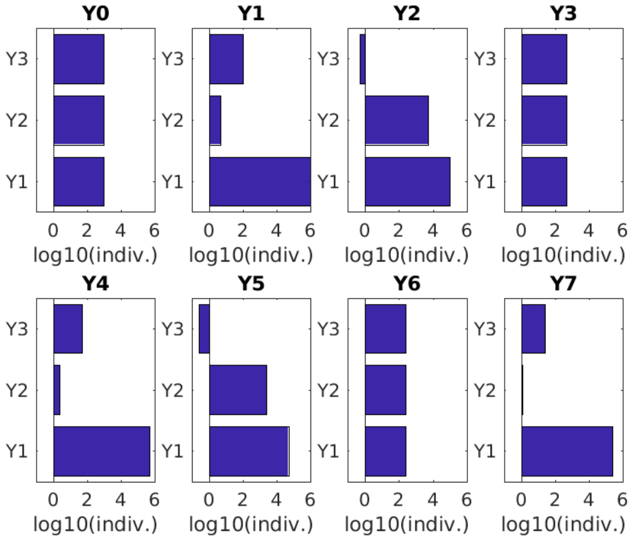


×10^5
10
5
0
0
5
10
15
20
25
time in years
number of individuals per age class
Juveniles
Subadults
Adults

10^10
10^5
10^0
10^-5
0
5
10
15
20
25
time in years
number of individuals per age class
Juveniles
Subadults
Adults







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