CS 3200
Assignment 5
2022/04/04
Robert Li

A1:
Method just simply applied the power method code provided in lecture, I used eigs, max and min function to verify.
(a)
I got the result here, which is very closely matched 16.1168. I used the initial x0 of

[1;1;1],and the result is shown blow. The 1.611683e+01=16.1168

```
>> A5Q1

matlab_largest =

   16.1168

Converged in 5 iters
 Eigen Vector is [2.833459e-01 , 6.416729e-01 ]^T value is 1.611683e+01
```

(b)I got the result here, which the expected value and actual value are too far, we can get the exact value in 100 iteration, and power method failed to converge in 100 iterations. Since the eigenvalue of B is [3.-1,-3], therefore, power method is hard to find the greater magnitude with |3| = |-3|, so it is not converging.

```
>> A5Q1

matlab_largest =

    3.0000

Power method failed to converge in 100 iterations
```

(c)I got the result here,which the expected value and actual value are too close so there only one iteration, and result have only half. I used the [1;-1;1] to test the different result, this make sense because B * [1;-1;1] = [1;-1;1]. This is what power method can do only.

```
>> A5Q1

matlab_largest =

    3.0000

Converged in 1 iters
 Eigen Vector is [1.000000e+00 , -1.000000e+00 ]^T value is 1.666667e+00
```

(d)I made change to power method from * to \ in first lane in the loop, and I find the smallest meaning least magnitude is 0 here, which matched the value checked by eig function.

```
e =

   16.1168
   -1.1168
   -0.0000


Converged in 2 iters
 Eigen Vector is [5.000000e-01 , -1.000000e+00 ]^T value is 0.000000e+00
```

A2

```
largest_eigenvalue =

    0.9106


largest_eigenvalue_changed =

    1.0797
```

Method used: I simply made the matrix with the displacement of birth rate and death rate, used the eigs and max function in Matlab to find the largest value.

(a) The largest eigenvalue is 0.9106.

(b) Since the largest eigenvalue less than 1, the population will keep decreasing and eventually become 0.

(c) Base on what we got in (B), at year 1000, I expected the population closely equal or equal to 0.

(d) The largest eigenvalue become 1.0797 by the change, in this case, since the value is greater than 1, the population will increase in long-term.

A3

```
w =

    2.2361


eigenValue_a =

    2.2361
    3.8730


eigenValue_b =

         0
    2.2361
    2.2361
```

Method used: I parsed the equation into matrix form, by getting the frequency of vibration to another side, we can directly calculate the eigenvalue by eig function, therefore, we can get the eigenvalue by applying the sqrt function.

Source page form Google:

https://www.claytex.com/tech-blog/what-are-eigenvalues-in-engineering-systems/

(a) By reviewing the eigenvalue use in engineering system, I think the eigenvalue represent the stability of the spring system. Here I got 2.2361 and 3.8730, by comparing to the real frequency value, I find out the eigenvalue here have 2 situation, stable or the increasing, we can tell it by observing the graph, I assume when one side of the spring press other side hard, there is harder frequency push back from the wall, since the the mass will increase when pushing(k+m).

(b) The eigenvalue for this problem will be 3 situations of stability. I assume the 0 frequency will be on the middle car since the pushing force will be canceled by get the force to other 2 cars. The other 2 frequency will be constant since it will keep pushing forward, and the force will be constant.