Will Flowers

Math 547

Prairie

11/25/13

Matlab Assignment 2

Part I

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 0.7-70% of the fish in Lake A. will remain here one week later | 0-No fish in lake B will be found in lake A a week later. | 0-No fish found in lake C will be found in lake A a week later | 0.2-20% of fish in lake D will be found in lake A. a week later | 0.1-10% of fish in lake E will be found in lake A. a week later |
| 0.1-10% of fish in Lake A. can be found in lake B. one week later | 0.5-50% of the fish in lake B. will be found there a week later | 0-No fish in lake C will be found in lake B a week later | 0.2-20% of fish in lake D will be found in lake B. a week later | 0.1-10% of fish in lake E will be found in lake B. a week later |
| 0-no fish travel from lake A. to lake C. in one week | 0.2-20% of fish in lake B. will be found in lake C. a week later | 0.8-80% of fish in lake C will be found in lake C. a week later | 0-None of the fish in lake D will be found in lake C. a week later | 0-None of the fish in lake E will be found in lake C. a week later |
| 0.1-10% of fish in lake A will be found in lake D. one week later | 0.2-20% of fish in lake B will be found in lake D. a week later | 0.2-20% of fish in lake C will be found in lake D a week later | 0.6-60% of fish in lake D will be found in lake D a week later | 0.1-10% of fish in lake E will be found in lake D. a week later |
| 0-No fish travel from lake A. to lake E. in one week. | 0.1-10% of fish in lake B will be found in lake E. a week later | 0.1-10% of fish in lake C will be found in lake E. a week later | 0-None of the fish in lake D will be found in lake E. a week later | 0.9-90% of fish in lake E will be found in lake E. a week later |
| Sum = .9-10% loss in fish population from week to week | 1.1-10% growth in population from week to week | 1.1-10% growth in population from week to week | 1-No net growth or loss in population from week to week | 1.2-20% growth in fish population from week to week |

1. The above table describes the meaning of the entries of the transformation matrix. (Lake Artichoke = Lake A., Lake Banana = Lake B., etc). X(0) is the initial conditions which is represented by this matrix:

|  |
| --- |
| 200 |
| 0 |
| 0 |
| 100 |
| 0 |

X(0) =

1. 
2. Using Matlab, I calculated the eigenvectors and eigenvectors of A to be:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| V1 | V2 | V3 | V4 | V5 |
| -0.4638 | 0.4650 | 0.5517 | 0 | -0.3536 |
| 0.6294 | 0.3787 | 0.2994 | 0 | -0.7071 |
| -0.4887 | 0.3171 | -0.7369 | -0.6667 | 0.3536 |
| 0.3851 | 0.5373 | -0.0690 | -0.3333 | 0.4950 |
| -0.0393 | 0.5011 | 0.2413 | 0.6667 | 0.0707 |
| Associated Eigenvalue: 0.5424 | 1.0388 | 0.7187 | 0.8 | 0.4 |

To find a closed formula for x(t), I used thm. 7.1.6. Since I calculated the eigenbasis and eigenvalues, I needed to find the coordinates of the vector x0, with respect to the eigenbasis v1-v5(above). I set up the Augmented matrix (V:x0), put it in rref form, and found the coordinates, c1-c5. For the closed form x(t) = (A^t)(x0)=c1(A^t)v1+…c5(A^t)v5=c1(λ1^t)v1+…c5(λ5^t)v5. Plugging in, and rounding for room:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | -0.46 |  | 0.47 |  | 0.55 |  | 0 |  | -0.35 |
|  | 0.63 |  | 0.38 |  | 0.3 |  | 0 |  | -0.71 |
| X(t) = -77(.54^t)\* | -0.49 | +78(1.04^t)\* | 0.32 | +294\*(.72^t) | -0.74 | -180\*(.8^t) | -0.67 | + 98\*(.4^t)\* | 0.35 |
|  | 0.39 |  | 0.54 |  | -0.069 |  | -0.33 |  | 0.50 |
|  | -0.04 |  | 0.50 |  | 0.24 |  | 0.67 |  | 0.071 |
|  |  |  |  |  |  |  |  |  |  |

x(20) using this formula is

|  |  |  |
| --- | --- | --- |
| 78.02 |  | 77.8 |
| 63.48 |  | 63.3 |
| 54.15 | Vs. the other calculation of x(20): | 53.99 |
| 90.55 |  | 90.29 |
| 82.56 |  | 82.31 |

They are within .8, or 1 fish of each other, per lake.

1. As t goes to infinity, Lake Eggplant will have the least amount of fish. This is because its eigenvalue is the smallest, and that is being compounded each week (raised to the t power). For the phase plane, the eigenvector is R^5, so plotting was difficult.



1. Populations don’t tend to increase or change at specific time intervals. It is more of a continuous process, which is why this would be better represented by a continuous dynamical system.

Part II

1. A is a 10304X70 matrix. The dimension 10304 represents the pixels of each 92X112 picture, and the 70 represents the 70 different pictures. The variables are each of the pixels in each picture



1. Covariance = A\*A^T. The matrix will be of size 10304X10304. We can use (A^T)\*A = C1, to find the eigenvalues and eigenvectors of the covariance matrix. (A^T)\*A\*v = µv. Multiplying both sides by A, rearranging, and using the fact that C, the covariance matrix is equal to A\*A^t, we come up with C\*(A\*vi) = µ(Avi). The eigenvalue is given as µi, and the eigenvector is given as Avi.
2. 
3. 

This image accounts for about 80% of the variance

1. 

This image accounts for 92.8% of the variance. It’s still not very good.



The above image is supposed to be me, but since it only accounts for 92.8% of the variance, it’s still not quite recognizable. From orthonormal projections we can derive a formula for the reconstructed face: = (E1 dot (X-MF))E1+…+(Ek dot(X-MF))Ek

1. 

This picture looks more like the original, because it uses more eigenfaces, and takes care of more the variance-98.3%

1. The graph below shows that, indeed, the distance on # 41-42(my face) is minimized.



1. i) Test face # 15 matched with corresponding class faces 29-30. Test face # 11 does not match. It should have matched with class face 21 or 22, but it matched most strongly between pictures 56-58.

ii) Test face 38 had a min Euclidean distance of about 3750, another had about 3500. The threshold for a minimum Euclidean distance should be 3000. The people that have been recognized have been well within that range, otherwise, they were making a completely crazy face.

iii) If the threshold is too high, the software will be more prone to making errors, and matching up people who are not matches. If the threshold is too low, the program will not recognize anyone.

1. The minimum Euclidean Distance for test face 43 is 5250. My threshold defined earlier would definitely not recognize this as a face. The image below still resembles a face because of the process of reconstruction. The program looks at and compares the image with the mean of all of our human faces to construct something like a human face.

