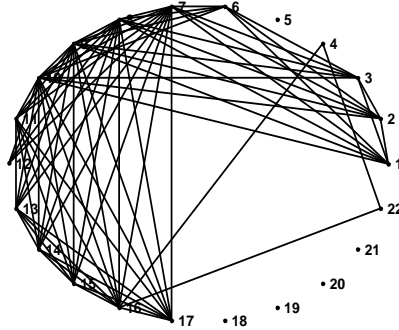


Course: Introduction to Linear Algebra MAT2580 Section (6643) (3 credits) Total points – 60 total available points – 65 (with extra points)

Biodiversity and the Hudson River
Eco-Math link through Linear Algebra



1. Create the adjacency matrix of the given food web based on the literature that is provided. If you name it as “Hudson_Adjacency_Matrix” then the Matlab code will recognize it. If you name it differently, then you need to adjust the name inside the code. **(10 points – correct adjacency matrix)**
2. Run the code `code_competition_graph.m` in Matlab command window.
 - a. You should be able to see the corresponding competition graph of the given food web. Verify the graph actually represent the given food web. Check the isolated nodes in the competition graph and see whether they do not share any preys with other species in the given food web. Check whether the nodes that have common edge are actually species which share preys. **(5 points – competition graph)**
3. Run the code `code_competition_graph_Laplacian.m` in Matlab command window. This code will delete zero rows from the competition matrix (adjacency matrix of the competition graph – note we used different definition of adjacency matrix when we had undirected graph *i.e.* the competition graph).
 - a. Once you run the code you will be able to see two set of eigenvalues in your window. The first and second column of eigenvalues are associated with the regular weighted competition matrix and the Laplacian of the competition matrix.
 - b. You can play around with the results.
 - i. First type the name of the weighted competition matrix in the Matlab command window to check whether all zero rows are deleted or not. You need to identify those species which are deleted and create a record of the correspondence between species and rows and columns since the matrix is revised.
 - ii. Check your Laplacian to make sure that you get zero if you add any row.

- iii. Are your competition graph and Laplacian symmetric? Don't forget to check the properties of symmetric matrices.
 - iv. Your first eigenvalue of the Laplacian must be zero.
 - v. Identify the algebraic connectivity or the second smallest eigenvalue of the Laplacian. Note that if this value is zero then your graph is disconnected. If you do it correctly, this value should not be zero.
 - vi. If your second smallest eigenvalue of the Laplacian is not equal to zero, then identify the second eigenvector corresponding to the second smallest eigenvalue. Based on the signs of the elements of this eigenvector, partition the competition graph in two partition.
 - vii. Record your interpretation based on this findings and analyze it. **(10+5 points)**
4. Remove those species that belonged in the smallest cluster from the competition graph and save the code in a different name, such as code_competition_graph_Laplacian1.m repeat the step 3 again. **(10+5 points)**
 5. Conclusion, interpretation based on findings – **10 points**
 6. **Relevant Extra thoughts/work – 5 points**
 7. **Cover page – 5 points**

Don't forget to record the steps. Note the record the species that you are deleting from the matrix.

1. To learn how to collect data.
2. To learn how to apply core mathematical concepts (particularly eigenvalues and eigenvectors) in solving real-world problems.
3. To understand interdisciplinary approach and the significance of it in real-world applications.
4. To write technical reports and disseminate the key findings.
5. To understand how to present research findings.
6. To learn how to work as a team.
7. To be able to use computer technology to assist in the above.

General Education Learning Goals

1. To understand interdisciplinary approach and the significance of it in real-world applications.
2. To gather, analyze, and interpret the data with scientific reasoning
3. To improve communication skills via group work and oral presentations
4. To use logical thinking to deliver a written report

Project Assessment Rubric

- 1 – Very poor
- 2 – Poor
- 3 – Average

- 4 - Good
- 5 - Excellent

	1	2	3	4	5
<p><u>Communication skills: Oral Presentation</u></p> <p>Express ideas orally that are coherent, persuasive, and ethical</p>					
<p><u>Communication Skills: Sequencing Logical Thinking in written report</u></p> <p>Express ideas in written form that are coherent, persuasive, and ethical</p>					
<p><u>Problem Solving Skills</u></p> <p>Understand and analyze a problem</p>					
<p><u>Problem Solving Skills</u></p> <p>Apply reasoning and analytic processes to solve the problem</p>					
<p><u>Problem Solving Skills</u></p> <p>Interpret the results from the interdisciplinary field perspectives</p>					
<p><u>Team Work</u></p> <p>How well the member work with other team members: contribution towards the problem solving and helping one another</p>					