**Part 1: A Food Web**

Recent rains have caused a dramatic increase in the insect population of a mountain park. The insects are annoying to people and animals and health officials are concerned there will be an increase in disease. Health authorities want to use an insecticide that would literally wipe out the entire insect population of the park. You, as an employee of the Environmental Protection Agency, must determine how detrimental this would be to the environment. Specifically, you are concerned on the effects on the food web of the six animals known to populate park.Consider the following digraph of a food web for the six animals and the insects that are causing the problem:



**Answer the following: Show all work and use complete sentences.**

1. Construct the associated matrix F to represent this web (list the animals alphabetically). What does a row containing a single one indicate? What does a column of zeros indicate?

2. Which animals have the most direct sources of food? How can this be determined from the matrix? Find the number of direct food sources for each animal.

3. Column Insect has the most 1's. What does this suggest about the food web?

4. Find F2. Explain why the entry from bear to insect went from 0 to 2?

5. What does the 4th row 6th column of F3 + F2 + F denote?

**Part 2:** If an insecticide is introduced into the food web, killing the entire insect population, several animals will lose a source of food.

6. Construct a new matrix F' to represent the food web with no insects.

7. What has happened to the row sums? Compare these with those of the original matrix. Which animals are directly affected?

8. Find F’2 and F’2 + F’. What do they tell you? Will all the animals be affected by the insecticide? Which animal(s) will be least affected?

9. Is there an option besides death for these animals? If so, what is it?

10. Organize and summarize your findings in a video to the health officials. Take and support a position on whether using an insecticide to destroy the insect population is harmful to the environment.

**Part 2: Truck Rentals**

Lisa Crawford is getting into the moving-truck rental business in three nearby counties.  She has the funds to buy about 120 trucks.  Her studies show that 20% of the trucks rented in Durham County go to Wake County, 15% go to Johnston County, 10% go to Franklin County, and the rest stay in Durham County.  From Wake County, 22% of rentals go to Durham County, and 46% stay in Wake County, 15% goes to Franklin and the rest move to Johnston County.  From Johnston County, 27% of rentals go to Durham County, 31% go to Wake County, 5% goes to Franklin County, and the rest stay in Johnston County. From Franklin County, 38% stay in the county, 41% goes to Wake County, 12% goes to Johnston County and the rest go to Durham.

**Answer the following: Show all work and use complete sentences.**

a) Draw a transition diagram that displays this information.  (You can do this using Word, Paint, Google Drawing, etc).

b) Write a transition matrix that represents this scenario.  List your rows and columns in the order Durham, Franklin, Wake, Johnston.

c) What is the sum of the entries in the rows?  Why does this sum make sense?

d) If Lisa starts with 45 trucks in Durham County, 30 trucks in Wake County, 20 trucks in Franklin County and 25 trucks in Johnston County, and all the trucks are rented one Saturday, how many trucks will she expect to be in each county the next morning?

e) In the long run how many trucks should Lisa have in each county?

**Rubric: Part 1: Insecticide**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Matrix constructed and labeled correctly and question #1 is answered. (5 points)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Questions 2-5 answered correctly in complete sentences (5 points each)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ F’ is constructed and labeled correctly (5 points)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Questions 7-9 answered correctly in complete sentences (5 points each)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Video is accurate, appropriate and interesting. (20 points)

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|  |  **Part 2: Truck Rentals (5 points each)** |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_  | Transition Diagram provided labeled  |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_  | Transition matrix provided and labeled  |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_  | Rows and Columns listed and labeled in the correct order  |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_  | Sum of the rows with explanation on why it makes sense (c)  |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Question about truck location (d) answered correctly Question about future trucks (e) answered correctly |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_  | Neatness and Organization  |