CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
J1418

Project Title
A Mathematical Analysis of Animal Food Chains in Serengeti National Park, Africa: A Computer Simulation Program

Abstract

Objectives/Goals
Computer languages such as Java can be used to code programs which simulate future generations of data based on a solid mathematical model, such as in the case of generating data for large population counts. This study aimed to create a simulation that could help show how different levels in the Serengeti ecosystem would react to changes in the population. The research hypothesis was: If a change is made in one animal population within a food chain, (1) the level of the food chain that is most directly related to the manipulated population will experience the most population change; and (2) the level of the food chain that is least directly connected or neutral will experience the least change.

Methods/Materials
The materials used in this project were one HP Touch Smart 310 PC (w/ Mouse and Keyboard) along with a Java 6.0 Eclipse IDE running on Windows 7.
A linear regression model was built with four parameters:
P(t+1)=P(t)*a+P(t-1)*b+P(t-2)*c+1*d. P(t) represents the population at time t; a,b,c represent change rate coefficients; and d is the adjustment factor. In order to find a, b, c, d to minimize errors, matrix manipulations in the Normal Equation were done. After this model was completed, the starting populations of animals were manipulated to test the effectiveness of this model.

Results
The results showed the linear regression model was successful in simulating possible ecosystem changes. When the population of lions was increased, this resulted in a rapid decline in the populations of various herbivores. When the population of lions was decreased, this resulted in an increase of herbivore populations. For example, when the population of zebras was increased, the population of lions also increased. When the population of zebras decreased, the population of lions also decreased. These results supported the actual data.

Conclusions/Discussion
The hypothesis was supported by the data generated in the simulation. It was found that vultures and elephants (both neutral animals) were barely affected by the manipulation. On the other hand, the levels of the food chain directly connected to each other, such as carnivores and herbivores showed the most change in each population. To improve this project, the simulation would need to include all species to be more realistic. With this, the next step would be to create a program which could find a ratio to create an equilibrium within the ecosystem.

Summary Statement
A computer simulation program coded with Java, used to represent animal populations in future generations, was created with a linear regressive model and was tested with manipulated populations.

Help Received
Mother helped glue together project and buy materials.