Students had the opportunity to be engaged in a variety of research projects. The projects centered around the following topics: ***Embedded Subsequences, Differential Gene Expression in the Diapause Life Stage, Microbiome of Stream Samples, Arc-Sine & Other Bathtub Shaped Distributions, Five Second Rule , Probability, and Cancer Cells/Cell Culture.***

In each project, model building and data analysis played a critical role and was interwoven in a statistical and biological context. Listed below is a brief description of each project as well as the names of students involved in the research. The students reported their research findings to their parents and university faculty on the last day of the Governor's School.

Dr. Anant P. Godbole, Director
Ms. Angela Haga, Assistant Director

Dr. Karl Joplin, Biological Sciences Instructor
Dr. Nicole Lewis, Mathematics Instructor
Dr. Hugh Miller, Lab Instructor

Tennessee Governor's School for Scientific Models and Data Analysis

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EAST TENNESSEE STATE UNIVERSITY

Governor's School for Scientific Models and Data Analysis

Student Project Presentation

Hosted by: The Center of Excellence in Mathematics & Science Education

Warf-Pickel Hall
Room #315
9:30am-11:30am
Friday, June 30th, 2017

Project Presentation

Dr. Karl Joplin: (Differential Gene Expression in the Diapause Life Stage

1. Andrew Joyner
2. Forrest Whiting
3. Gabriel Isaac
4. Naomi Horn

How does gene expression change during developmental changes between two different life stages? Looking at insect diapause (similar to hibernation) to examine the differences between non-diapause states. Comparison of specific sequences using RT-PCR amplification of mRNA.

Dr. Hugh Miller: (Cancer Cells/Cell Culture)

1. Angelica Bautista
2. Esha Talati
3. Parneeta Mohapatra
4. Zepher Barber
5. Aysha Patel

A lymphoma cell line called U937 appears to have heterogeneous sizes. The students tried to answer the question; does the size of U937 cells change as the cells age in culture? Cells that had been cultured for various times were applied to microscope slides and images of random fields were captured. Cell areas were analyzed using the Image J software.

Dr. Karl Joplin (Microbiome of Stream Samples)

1. Hannah Heath
2. Maggie Kelly
3. Ashton Barber
4. Naveena Priestley

What is the microbiome diversity of environmental samples? The microbiome encompasses 95-99% of the biome in any sample (including humans). We will explore the microbiome of aquatic streams by collecting samples, extracting DNA, selecting PCR primers for specific bacteria from a sequencing run, and looking if they are present in another stream.

Dr. Nicole Lewis (Arc-Sine & Other Bathtub Shaped Distributions)

1. Hope Olds
2. Fisher Latham
3. Gabriel Blaylock
4. KaDarrell Howell

Harry and Ron are playing a coin toss game. They flip the coin n times. For each head, Harry wins a dollar and for each tail, Ron wins a dollar. After each coin toss, we keep track of who is in the lead and calculate the proportion of times Harry is in the lead.

(a) Keep track of who is in the lead and calculate the proportion of times Harry is in the lead.

(b) Explain what happens as n approaches infinity in the coin toss game; this percentage has a

probability distribution that is U-shaped, or bathtub shaped.

(c) Discuss the properties of this distribution, and also those of other bathtub shaped distributions.

(d) Discuss the applications of this distribution.

Dr. Nicole Lewis (Probability– Sampling with Replacement vs Sampling without Replacement)

1. Allen Wilson
2. Asia Gibson
3. Kayleigh Roberts

A box contains n tickets numbered 1, 2, …, n. A random sample of n tickets is selected from the box, one at a time. A "match" occurs if the ticket numbered i is selected on the i^{th} draw.

A. Find the probability of at least one match if sampling is done .
   *With replacement
   *Without replacement

B. Using R, write a code to simulate all possible combinations for any n.
   *With replacement
   *Without replacement

C. Using R, construct a plot of the probabilities.
   *With replacement
   *Without replacement

D. What happens as n reaches infinity?
   *With replacement
   *Without replacement

Dr. Anant P. Godbole (Embedded Subsequences)

1. Will Mitchell
2. Michael Montoya
3. Sarah Clabo
4. Justin Ellis
5. Alex Griffy
6. Sylvia Vonderwell

Students will be introduced to classical problems in mathematics, the notion of being compactly **embedded** expresses the idea that one set or ... any bounded set in X is totally bounded in Y, i.e. every sequence in such a bounded set has a **subsequence** that is Cauchy in the norm ||•||Y.

Dr. Nicole Lewis: (Extension of "Five Second Rule")

1. Isha Sahasrabudhe
2. Rohit Krishnamoorthy
3. Lydia Ham
4. Baylee McIntyre

Using data from the experiment with Dr. Joplin, students will analyze their findings using ANOVA. Analysis of Variance (ANOVA) is a statistical procedure used in statistics quite often. ANOVA is not taught in traditional introductory courses but the students in this project group will learn about ANOVA and how to apply it to real world applications.

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