Students had the opportunity to be engaged in a variety of research projects. The projects centered around the following topics: *Coincidences and the Birthday Problem, Differential Gene Expression in the Diapause Life Stage, Microbiome of Stream Samples, Arc-Sine & Other Bathtub Shaped Distributions, Multivariate Statistics , 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

E T S U   C e n t e r   o f   E x c e l l e n c e   i n   M a t h e m a t i c s   a n d   S c i e n c e   E d u c a t i o n

128 N. Dossett Drive
PO Box 70301
Johnson City, TN 37614

Phone: (423) 439-7592
Fax: (423) 439-7530
E-mail: haga@etsu.edu
http://www.etsu.edu/cas/math/mathexcellence/
http://www.etsu.edu/cas/math/mathexcellence/govschool/default.aspx
http://www.netstemhub.com/

2016 Governor's School for Scientific Models & Data Analysis

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

Warf-Pickel Hall
Room #315
9:30am-11:30am
Friday, June 24th, 2016

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

1. Anna Cowan
2. Noah Mesa
3. IdaLynn Nix
4. Emily Petroni

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. Alexandria Brothers
2. Lawford Hatcher
3. Hannah Johns
4. Caitlin Lakey
5. Diya Nijhawan
6. Grace Roberts
7. Amelia Taylor

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

Dr. Karl Joplin (Microbiome of Stream Samples)

1. Brian Chong
2. Katherine King
3. Keyu Chloe Li
4. Ally Manis

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. Matthew Clark
2. Rachel Eccles
3. Grace Ann Roberts
4. Lillian Wallace

(a) Look at a coin toss game between two people.

(b) Explain what happens as n approaches infinity in the coin toss game.

(c) Discuss the properties of the distribution as n approaches infinity (arc-sine distribution).

Dr. Nicole Lewis (Probability)

1. Jacob Greene
2. Hannah Holmberg
3. Carah McClurg

Probability – Sampling With Replacement versus Sampling Without Replacement.

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 ith draw.

A. Find the probability of at least one match if sampling is done

*With replacement
*Without replacement

A. B. What happens as n reaches infinity?

Dr. Nicole Lewis: (Multivariate Statistics)

1. Carmen Canedo
2. Brie Ann Davenport
3. Bailey Millett
4. Nilai Vemula

A. We will use a histogram to model the prior belief.
B. We will use a uniform prior.
C. Simulate the posterior distributions from the priors and compare the results. Suppose one is interested in predicting the number of heads y in a future sample of size 25. Compute the predictive probabilities of y using the different priors. Compare the results.

Dr. Anant P. Godbole (Coincidences and the Birthday Problem)

1. Cathy M. Charles
2. Alyssa G. Coley
3. Kacey Y. Tomsovic
4. Maia Woodard

Students will be introduced to classical problems on coincidences in probability. These will include the birthday problem and the problem of "inhaling one of Julius Caesar's last breath molecules". Various generalizations of these problems will lead to an exploration of the "square root law" and a solution of several related problems such as "the birthday problem on Mars".

EAST TENNESSEE STATE
UNIVERSITY