Students had the opportunity to be engaged in a variety of research projects. The projects centered around the following topics: ***Forensic Etomology, Arc-Sine & Other Bathtub Shaped Distributions, Circadian Activity of Lucilia Flies, Bayesian Statistics , Probability, Microarray Data Analysis, 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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**P r o j e c t P r e s e n t a t i o n P r o g r a m**

# 2015 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 26th, 2015

# Project Presentation

**Dr. Karl Joplin:** (Forensic Entomology)

1. Spenser Johnson
2. Brandon Patel
3. Kaleb Roderick
4. Cameron Stone
5. Brenna Flynn
6. Todd Simmons

Insects perform a valuable service of breaking down carcasses in the environment and are known to utilize dead organisms in a secession that can be used to date time of death where other methods are inconclusive or where evidence is lacking. We have utilized new pieces of liver to collect species that appear on dead meat to ask how many species are involved, how the species composition change with time and what is the natural history of this secession.

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

1. Anup Challa
2. Mary Katherine Dewane
3. Allycia Lee
4. Shailey Shah
5. Ashwin Jagadish
6. Madison Hostetler

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** (Circadian Activity of Lucilia Flies)

1. Caroline Wilson
2. Cortlyn Holdren
2. Annie Tieu

Students are introduced to Circadian Rhythms by setting up an activity monitor, collecting data from males & females *Lucilia regina* and analyzing the results. The activity patterns in L:D and D:D will be compared with those from similar activity in *Sarcophaga.*


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

1. Abigail Ezell
2. Julia Goncalves
3. Mya Spivey
4. Mackinzie Hutchison
5. Jacob Raines
6. Mia Spivey

(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 distribitution).

**Dr. Nicole Lewis** (Probability)

1. Mitchell Long
2. David Massie
3. Alexis Greene
4. Matthew Toppenberg

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 $i^{th}$ 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. Joplin:** (Micro Array Data Analysis)

1. Cameron Austin
2. Kassandra Ayala
3. Brianna Wheeler

Students were introduced to microarray data from a study of diapausing and non-diapausing flesh flies, Sarcophaga crassipalpis. The data were normalized and examined for genes that are diapause up- or down-regulated during this developmental state. Genes were then identified using the GenBank dataset .

**Dr. Nicole Lewis:** (Bayesian Statistics)

1. Aiden Gonzalez
2. Amelia Baran

Spin a penny on a table. Let p denote the probability that it lands heads. We want to estimate this probability starting with different prior beliefs about p. 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.