Increasing Student Ownership and Engagement through Interdisciplinary Collaboration

Vinodh Chellamuthu, Ph.D.
SIMIODE EXPO
February 11, 2022
Dixie State University (soon to be Utah Tech University)

- Public four-year university in St. George, UT
- Approximately 12,000 students
- Associate-granting institution
- Open access; lots of first-generation college students

Why students need to be exposed to interdisciplinary collaborations?
Why students need to be exposed to interdisciplinary collaborations?

➢ Allow students to get hands-on experience and introduce them to more career possibilities.

➢ Provide an opportunity for students to use the skills they learn in classes to solve messy and complex real-world problems.

➢ Develop appreciation for the value of mathematics in solving practical problems.

➢ Learn professional skills (writing, presentation, teamwork).
Each PIC Math faculty member teaches a class in which students work in teams to solve a real-world problem provided by a business, industry, non-profit, or government partner.

Emphasis on statistics and data analysis, with data provided by the partner organization.

 Builds skills needed to help students stand out in the job market and kickstart a successful career.

Training and support provided by the MAA PIC Math Program, which is funded by the National Science Foundation (NSF grant DMS-1722275) and National Security Agency.
Problems tackled by the students
Trail Activity Prediction Model for Zion National Park

Heather Smith | Douglas Baer | Nicholas Warner

Dixie State University
St. George, UT

Faculty Mentor: Dr. Vinodh Chellamuthu
Industry Liaison: Jason Pitts, Program Director
Industry Partner: Park Data Project
This work is part of the PIC Math Program
Problem Statement

Develop a model to predict the number of hikers that will utilize a given trail at any hour of the following day.
Background

• Thousands of people come to Zion National Park (ZNP) every day

  Park administration, employees, and visitors do not know how busy trails are going to be at each hour of the day

• Trail activity predictions can help park administration:
  • Plan and allocate resources
  • Protect visitors, the natural beauty, and wildlife of the park
  • Improve visitor experience by providing trail activity insights
Dataset
Mar 2015-Feb 2020, Hourly Measure of Activity (HMOA) data for five different trails:

- Angel’s Landing
- Riverside Walk
- Watchman
- Pa’rus
- Kayenta

Daily Measure of Activity (DMOA)
Sliding Window

- *Weather Forecasting Using Sliding Window Algorithm* by Piyush Kapoor and Sarabjeet Singh Bedi (2013)

**Predict HMOA for May 14, 2019**

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Predict HMOA for May 14, 2019

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Predict HMOA for May 14, 2019

Output

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99% Accurate!
May 14, 2019 Angel's Landing
Actual V. Predicted HMOA

Actual HMOA
Predicted HMOA

Sun
May 14

2179
Results

• DMOA Predictions, 2019 average accuracy: 75% - 84%

• HMOA Predictions, 2019 average accuracy: 47% - 68%

• Help ZNP plan and improve so thousands of visitors can enjoy its beauty

This Photo by Unknown Author is licensed under CC BY-SA-NC
Strategic Marketing Analysis Using Mathematical Modeling to Understand Trends in Real Time Dataset

Chandler Young, Rashe Elliott, Anthony Kerns
Faculty Advisor: Dr. Vinodh Chellamuthu
Problem

Ralph’s Transmission posed the following problem to us.

**Filter Tool:**

- Should show the likelihood of a potential customer to spend money
- This filter should be based on historical data
- This filter should be easy to use.

**Marketing Strategy:**

- Create a marketing strategy to better allocate resources to increase revenue
Web Application

- Runs a simple web server and stores all new customer information in an SQL database
- Client Application written in JavaScript, Server Application written in Python (this is where the analyzation of data and math happens, using Pandas package, to generate score)
- See Web Application
Why are these experiences significant?

- Asking Questions
- Collaborating as a team
- Communicating the findings/report to general audience

Why are these skills important?
Challenges

➢ Collaborating with **multiple stakeholders** and getting them excited and buy into the proposed project.

➢ Mixed levels of **mathematical maturity** within the class.

➢ Putting together a **team based on their skill set** (programming, communication - oral and written skills).

➢ **Mitigating the fear** of the real-world problem solving and getting them excited and motivated.

➢ Keeping students **on task** (biweekly reports, team presentations).

➢ Receiving **feedback** from industrial sponsors.

➢ Unrealistic Deadlines: meeting the deadlines was challenging on top of other courses students taking that semester.
Biggest Rewards

- Seeing students going from "consumers" to "producers."
- Students were successful in their internship/job interviews.
- Supported the university motto, "Active Learning, Active Life."
- Increased cross-disciplinary collaboration within the university.
- Helped to design "hands-on" curriculum within the math department.
- Increased opportunities for collaboration with the local community (BIG) partners.
- Small curriculum changes (such as this class) can lead to big innovations:
  - Creation of Certificate in Modeling and Simulation
Action item(s)
SCUDEML
SIMIODE Challenge Using Differential Equations Modeling

MCM: The Mathematical Contest in Modeling
ICM: The Interdisciplinary Contest in Modeling
Is Tesla on track to allow a complete switch to all-electric in the US?

If everyone switched to all-electric personal passenger vehicles in the US, how many charging stations would be needed? How should they be distributed between urban, suburban, and rural areas?

Embrace Failure

PRAISE THE PROCESS RATHER THAN THE SOLUTION

F.A.I.L.

First Attempt In Learning

Embrace failure

Failure Zone

Level of success

Fear

Success

Embrace failure

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Thank You

Education is not the learning of facts, but the training of the mind to think.

--- Albert Einstein