

***Increasing Student Ownership and Engagement through
Interdisciplinary Collaboration***

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SIMIODE EXPO
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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).

Starting Point: MAA PIC Math Program

- 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

May 14, 2019 Angel's Landing	
12:00 AM	0
1:00 AM	0
2:00 AM	0
3:00 AM	0
4:00 AM	0
5:00 AM	10
6:00 AM	130
7:00 AM	230
8:00 AM	220
9:00 AM	260
10:00 AM	220
11:00 AM	220
12:00 PM	220
1:00 PM	200
2:00 PM	160
3:00 PM	100
4:00 PM	120
5:00 PM	60
6:00 PM	10
7:00 PM	0
8:00 PM	0
9:00 PM	0
10:00 PM	0
11:00 PM	0
Total	2160

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

2019

Tue May 7	Wed May 8	Thu May 9	Fri May 10	Sat May 11	Sun May 12	Mon May 13	Sun May 14
1650	2170	2180	1760	3010	2240	2100	?

2018

Mon May 7	Tue May 8	Wed May 9	Thu May 10	Fri May 11	Sat May 12	Sun May 13	Mon May 14	Tue May 15	Wed May 16	Thu May 17	Fri May 18	Sat May 19
2130	1860	2880	1880	1900	3120	2150	2360	2400	2190	2440	2680	2990

Predicted Difference

Predict HMOA for May 14, 2019

2019

Tue May 7	Wed May 8	Thu May 9	Fri May 10	Sat May 11	Sun May 12	Mon May 13
1650	2170	2180	1760	3010	2240	2100

520 10 -420 1250 -770 -140

75

79

2018

Tue May 8	Wed May 9	Thu May 10	Fri May 11	Sat May 12	Sun May 13	Mon May 14
1860	2880	1880	1900	3120	2150	2360

1020 -1000 20 1220 -970 210

83

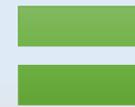
Output

Predict HMOA for May 14, 2019

Mon May 13
2100



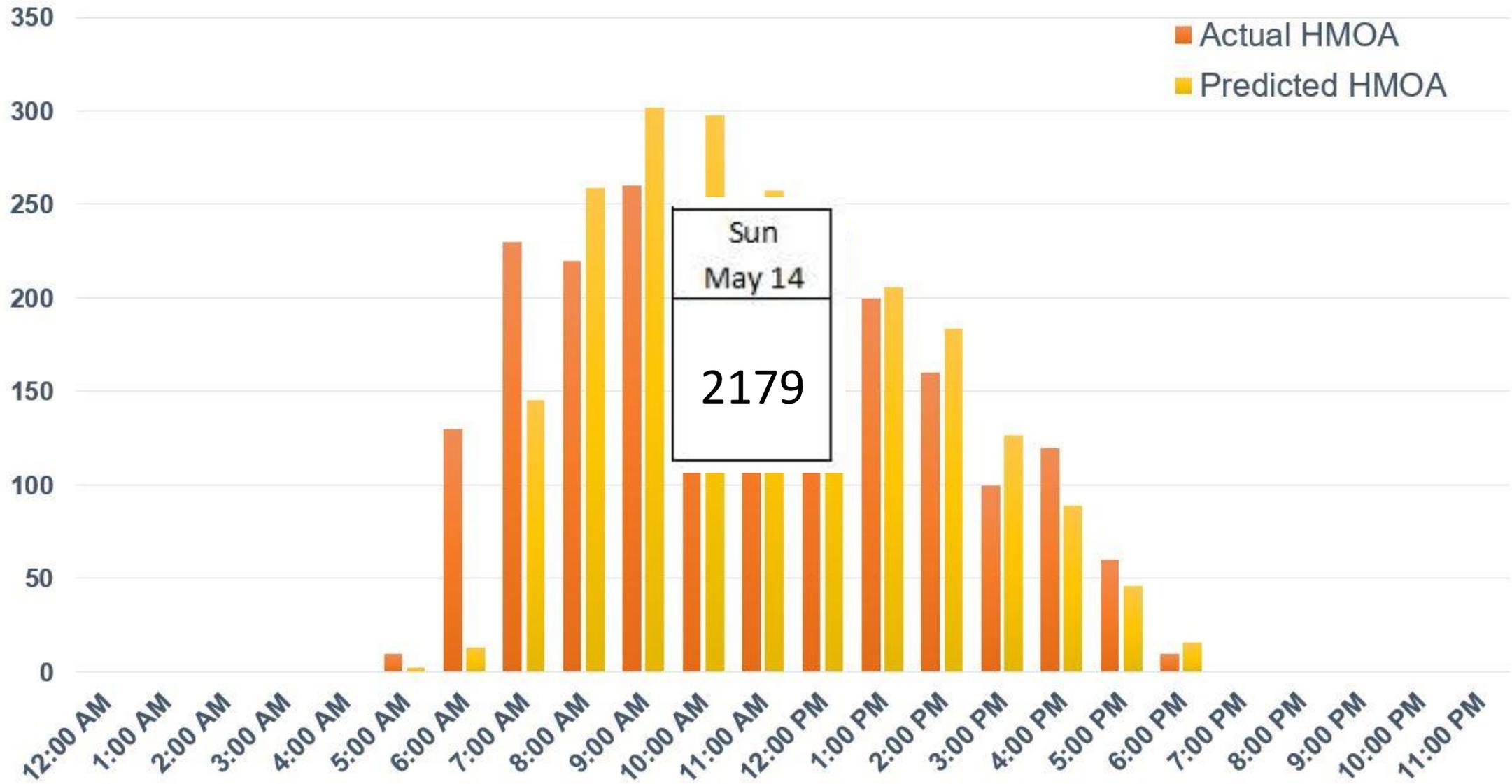
79



Sun May 14	Sun May 14
2179	2160



May 14, 2019 Angel's Landing Actual V. Predicted HMOA



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



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Strategic Marketing Analysis Using Mathematical Modeling to Understand Trends in Real Time Dataset

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

PICMath

DSUTM
DIXIE STATE UNIVERSITY
ST. GEORGE, UTAH

Problem

Ralph's Transmission posed the following problem to us.

Filter Tool:

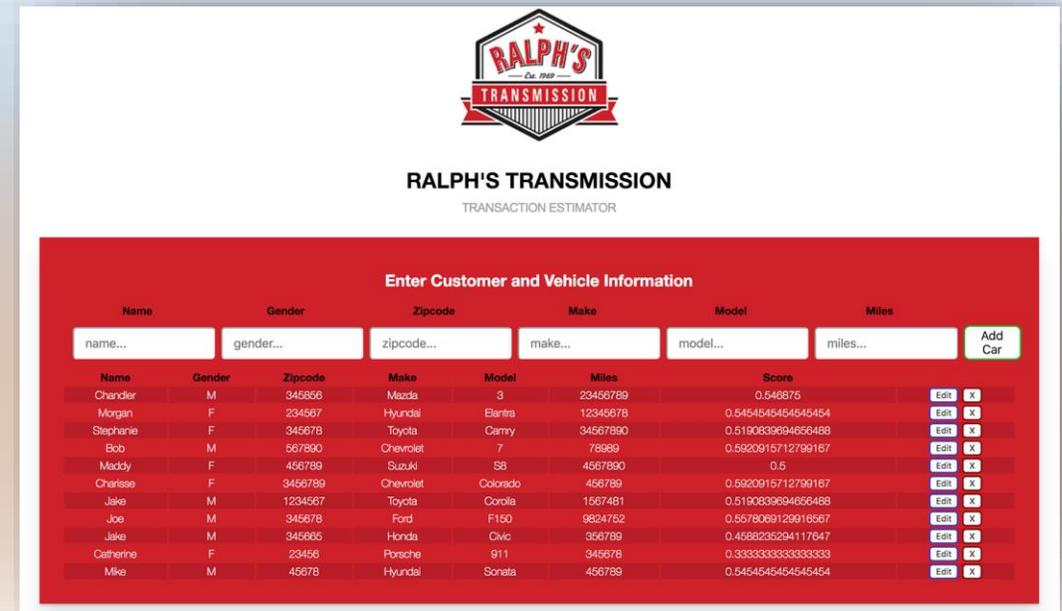
- Should show the likelihood of a potential customer to spend money
- This filter should be based on historical data
- This filter should be easy to use.

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](#)



The screenshot displays the web application interface for Ralph's Transmission. At the top, there is a logo for "RALPH'S TRANSMISSION" with a star and the text "Est. 1960". Below the logo, the text "RALPH'S TRANSMISSION" and "TRANSACTION ESTIMATOR" is displayed. The main content area is a red box titled "Enter Customer and Vehicle Information". It contains a form with input fields for Name, Gender, Zipcode, Make, Model, and Miles, along with an "Add Car" button. Below the form is a table with columns for Name, Gender, Zipcode, Make, Model, Miles, and Score. Each row in the table has "Edit" and "X" buttons next to it.

Name	Gender	Zipcode	Make	Model	Miles	Score	
Chandler	M	34566	Mazda	3	23456789	0.546875	Edit X
Morgan	F	234567	Hyundai	Elantra	12345678	0.5454545454545454	Edit X
Stephanie	F	345678	Toyota	Camry	34567890	0.5190839694656488	Edit X
Bob	M	567890	Chevrolet	7	78989	0.5920915712799167	Edit X
Maddy	F	456789	Suzuki	S8	4567890	0.5	Edit X
Charlese	F	3456789	Chevrolet	Colorado	456789	0.5920915712799167	Edit X
Jake	M	1234567	Toyota	Corolla	1567481	0.5190839694656488	Edit X
Joe	M	345678	Ford	F150	9824752	0.5578069129916567	Edit X
Jake	M	345666	Honda	Civic	356789	0.4689226294117647	Edit X
Catherine	F	23456	Porsche	911	345678	0.3333333333333333	Edit X
Mike	M	45678	Hyundai	Sonata	456789	0.5454545454545454	Edit X

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)

SCUDEM

SIMIODE Challenge Using Differential Equations Modeling

MCM: The Mathematical Contest in Modeling

ICM: The Interdisciplinary Contest in Modeling

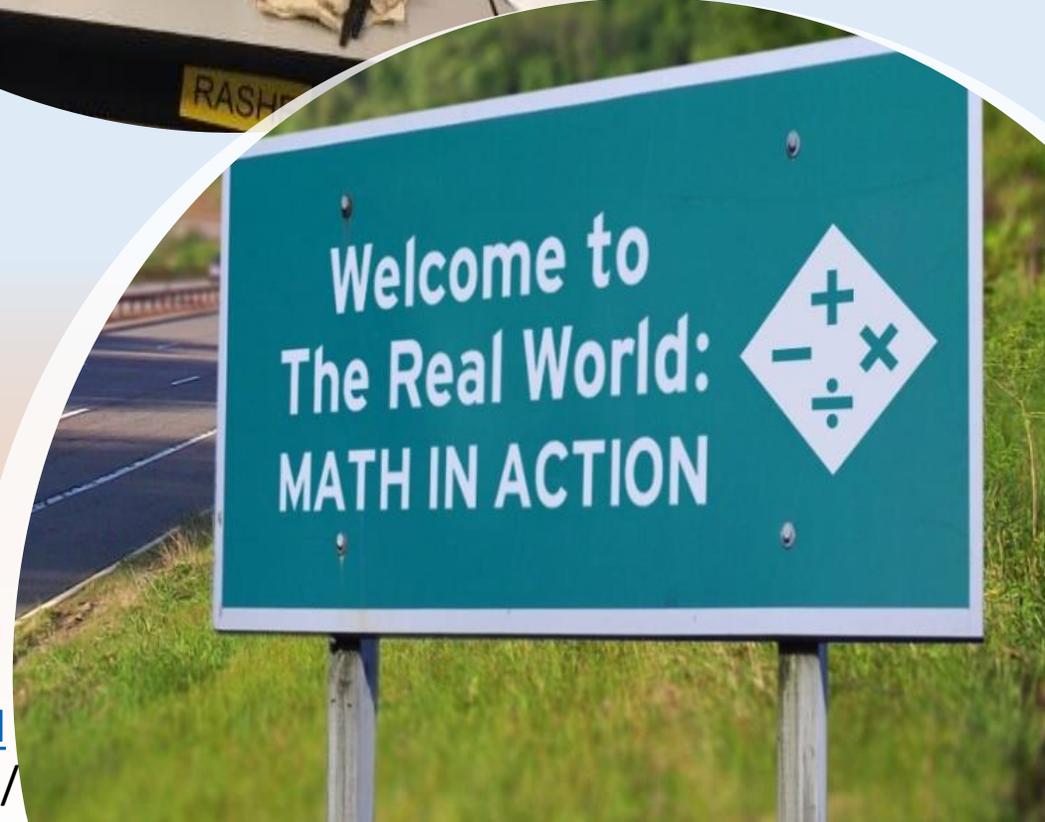
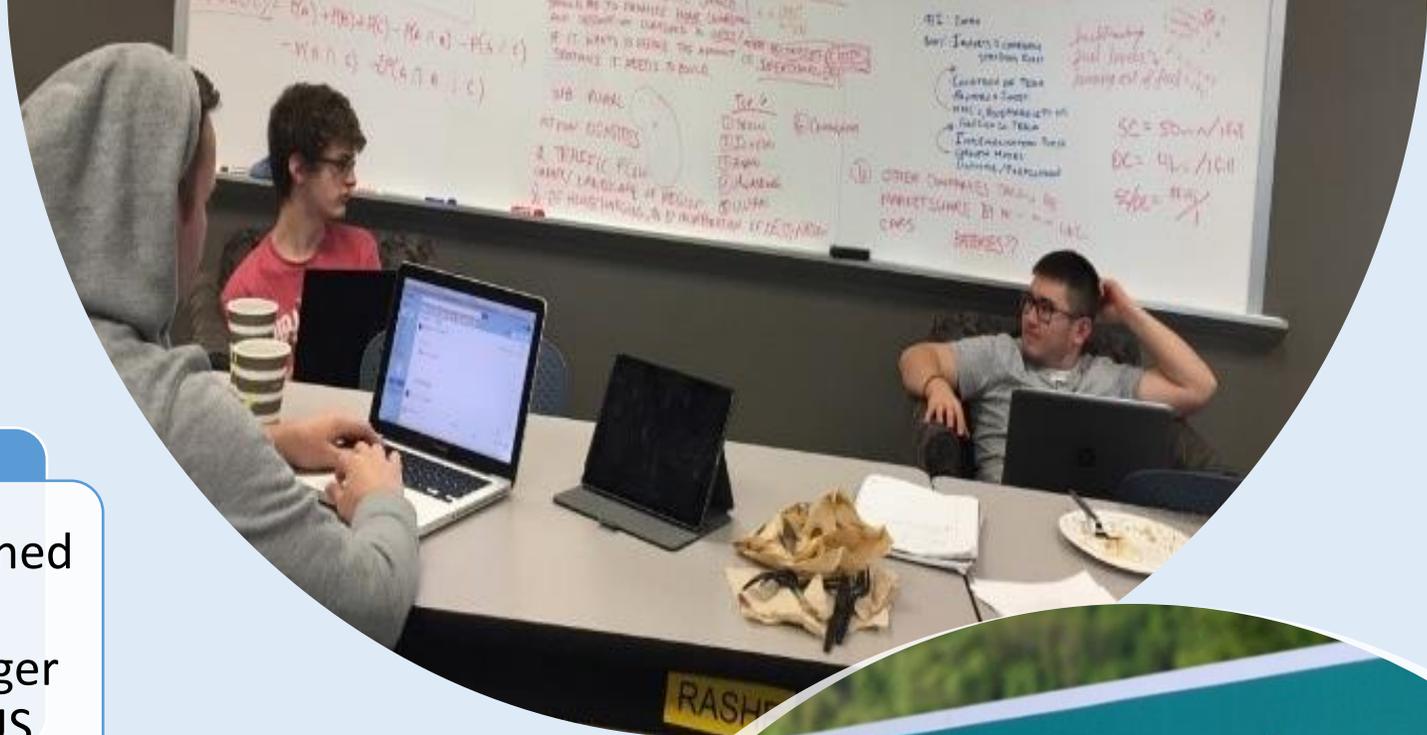
Is Tesla on track to allow a complete switch to all-electric in the US?

Curriculum
Challenge
Creativity

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?



PRAISE THE PROCESS RATHER
THAN THE SOLUTION

Embrace Failure

F.A.I.L.

First Attempt In Learning



Thank You

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

--- **Albert Einstein**