

BACK TO THE DRAWING BOARD

Reshaping a Math Course in Walt Disney World

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FURMAN

Real-World Challenges

- Students often are not as invested in or interested in the application as the professor
- Problem seems artificial and simplified
- Our thought: Instead of bringing a problem of our choosing to the students, immerse the students in a new environment and let them choose a problem that is interesting to them

Furman May Experience

- Optional three-week term following spring commencement
- Encourages innovative and intensive academic experiences
- Examples
 - Business at the Top of the World (NYC, China, etc.)
 - The Sociology of Harry Potter (on campus)
 - War and Remembrance (France and Germany)
 - From Iceland to the Galapagos Islands
 - The Farm (Iowa)
 - Slow Eating in Italy



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Math and the Mouse:

Explorations of Mathematics and Science in Walt Disney World



Course Goals

- Give students a new look at mathematics, its applications, and career options
- Experience real-world applications
 - Modeling/consulting experience
 - Problem setup/execution/analysis
- Project-based
- Encourage communication
 - Write about technical material in a non-technical way
 - Speak about technical material in an understandable way
 - Work in teams to problem solve
- Build confidence and excitement

Nontraditional Classroom

- Lack of resources
 - No textbook
 - No dedicated meeting space
 - Unreliable wifi
- Active, immersive classroom
- No restrictions on class time
- Planned, yet flexible
 - Some prepared topics, but additional projects arise based on student interests as course progresses
 - Study away



Course Topics

- Operations Research
 - Linear and Network Models
 - Linear/Integer Programming
 - Algorithms/Metaheuristics
- Network Optimization
 - Basic Graph Theory
 - Logistics and Scheduling Problems
- Probability and Statistics
 - Basic Discrete Distributions
 - Normal Distribution
 - Hypothesis Testing
 - Queuing Theory
- Physics, History, Technology



Students

- Diversity
 - Majors
 - Ages
 - Math background
 - Physical abilities/stamina
- Interviewed and selected
- Highly motivated to engage in course



Writing and Reflection

- Blog
 - mathandthemouse.blogspot.com
 - Work in pairs
 - Communicate technical information to a general audience
 - Connects friends and family with class happenings
- Journals
 - Individual reflection
 - Real-time feedback from students

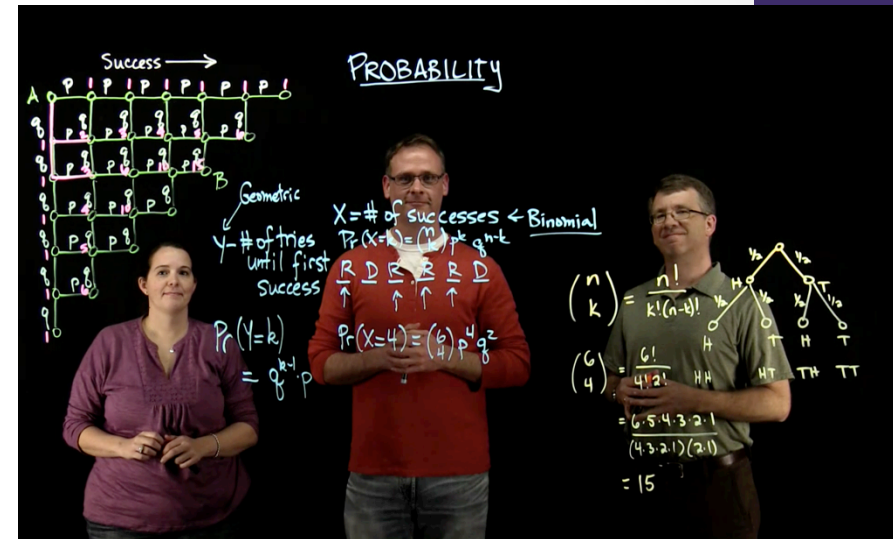


Math and the Mouse 2.0



Time Management

- Lightboard videos
- Share journal reading
- Fewer tours
- More activities
 - Hollywood Studios Knapsack
 - Liar's Dice



Project 1: Linear Modeling

- 2014
 - Activity: Work through some example problems like ones presented in introductory texts
 - Project: Read amusement-park-related MILP journal articles and present the model to the class
 - Guest Speakers: Disney professionals in the areas of industrial engineering and workforce management



Pros and Cons

- Pros:
 - Students are able to interpret models written in academic journals
- Cons:
 - Introductory problems in textbooks are too simplified for the advanced students
 - Although the journal article problems are interesting, there is a difference in understanding what someone else has modeled as opposed to modeling it yourself
 - Interaction with Disney professionals is lacking in depth. Most students don't participate in the conversation

Project 1 Redesign

- 2016
- Work with Team Disney (Workforce Management) to design a project to schedule workers to Pecos Bill's Tall Tale Inn and Café



Tiered Design

- Three Tiers (hard, harder, and hardest)
- Each group composition had a mix of abilities
- Professors became part of the group to monitor and motivate each student's understanding and participation
- Groups presented their models



Outcomes

- Interactions with Disney Professionals have common ground for discussion.
- Students understand better the scope and difficulty of the modeling that Disney has to consider.
- Students report the badge of honor for having modeled a real-world problem.



Guest Speaker Feedback

“As analysts, it’s encouraging for us to talk with people who are as interested in the finished product, as how that product gets made. What we do doesn’t always excite people, but the interest from the students was both obvious and energizing.”

–Manager, Disney Experience Insights

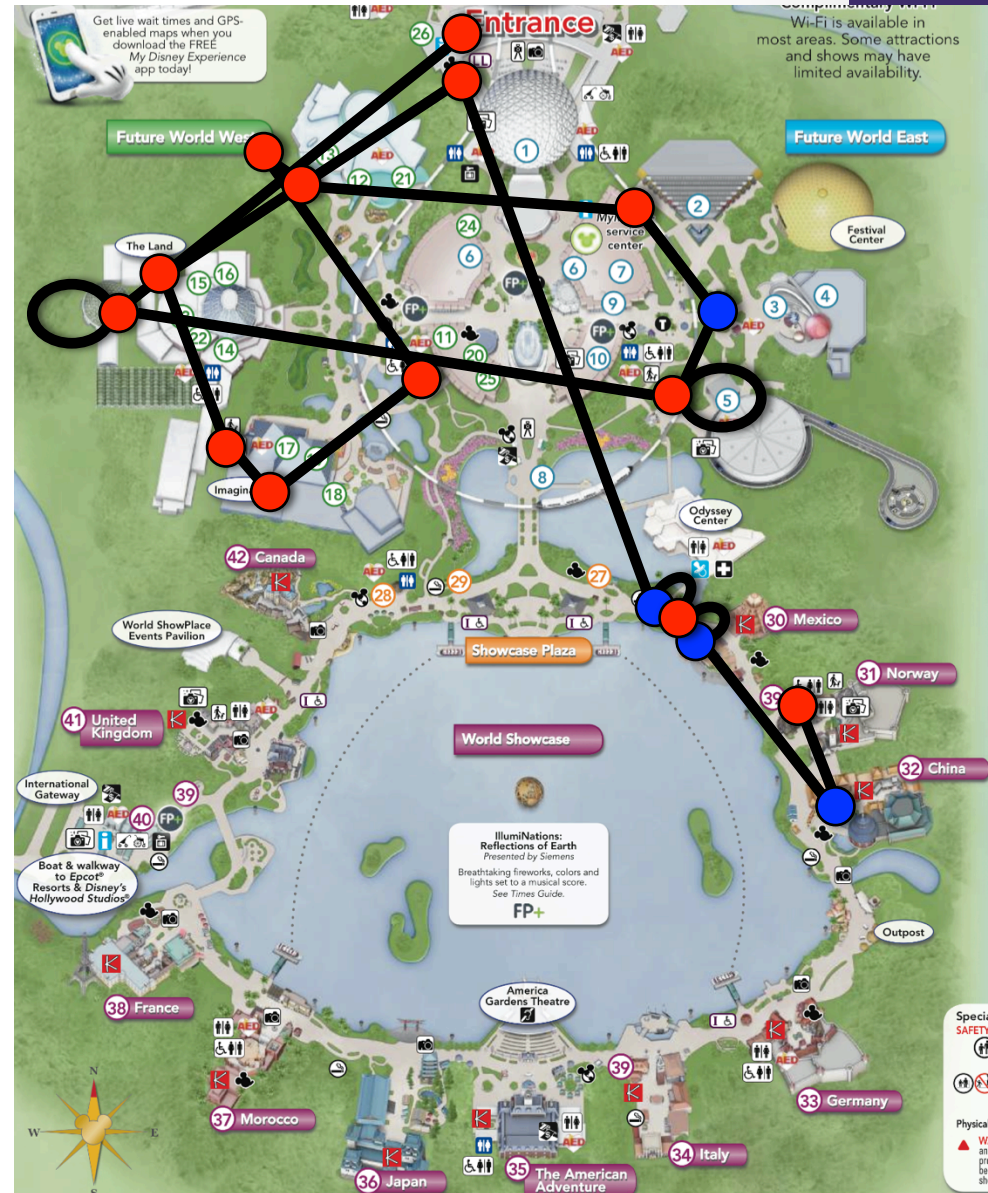


Student Feedback

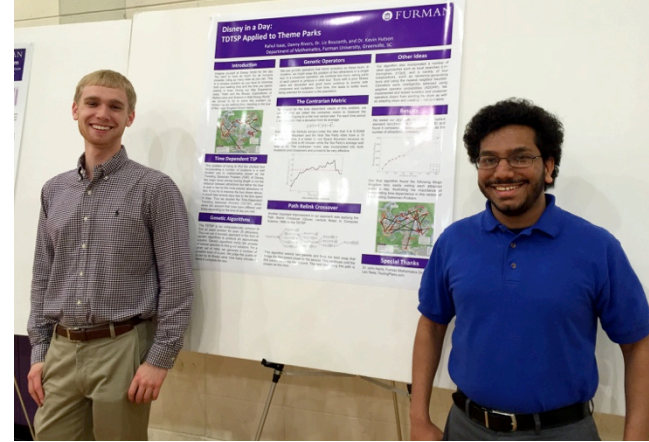
- “Although it was challenging for someone who hadn’t taken a math class in quite a while, it was such a rewarding experience.” –Alex
- “While it was the most daunting project at the onset, it turned out to be the most rewarding to work with because it was challenging and it was the project that most motivated me to want to learn more about that area of math in the future.” –Maria
- “The workforce scheduling problem was as cool as it was difficult.” –Jamie

Project 2: Networks and Algorithms

- 2014
 - Activity: Groups race in Epcot to see who can complete a list of required experiences first
 - Project: Model the park as a network, including gathering data for wait and walk times, and design and code an algorithm to find an optimal tour
 - Guest Speakers: Representatives from touringplans.com



Pros and Cons



- Pros:
 - Students loved the competition and testing out their ideas on a real-world playground. Keep for 2016.
 - Led to summer research project.
- Cons
 - Interaction with touringplans.com was lacking, mostly confined to CS students.
 - Students without programming experience can gather data through observations, but plentiful data exists online.
 - Non-CS students couldn't contribute much beyond data collection. They didn't participate in the algorithm design and implementation.

Project 2 Redesign

- Modify project with goal of enhancing the interaction with touringplans.com
- New project
 - Find an optimal tour of nine attractions in Hollywood Studios using genetic algorithms
 - No coding. All operations created from scratch and executed by hand
 - Students crowd-source the genetic algorithm by interacting with each other



Guest Speaker Feedback

“It’s interesting to see how the questions got more sophisticated over two years. The stuff I learned in grad school is now being approached by third-year undergrads. Y’all must be doing something right.”

–Len Testa, President of touringplans.com



Student Feedback

- “One of the most rewarding experiences of the trip was meeting with Len Testa after working on the genetic algorithm project. I think that this was because we had all been working with similar types of ideas to the ones he worked with, so we could understand what was involved in the techniques he talked about and the types of projects that his company worked on.”
–Lindsay
- “In general, having our classwork lead up to a guest speaker who works on that topic was really cool.” –Zack
- “The genetic algorithms project was favorite because you could watch how these operators were taking members of the population and making them better, one by one. Because of that project, I’m interested in learning more about genetic algorithms and how they can be used.” –Mary Lib

Course Impact

- 75% of students take Operations Research course at Furman
- 63% of students take Probability and Statistics courses at Furman
- 62% of graduates have pursued advanced degrees in OR/Stat/Applied Math/CS
- 2016 class:
 - 4/12 were already math majors
 - 6/12 became math majors after the course

Course Evaluations

- “This was hands down my favorite class I have ever taken. Period.” –Alyssa
- “I can’t speak highly enough about the Math and the Mouse May Experience program or about how influential the course experiences were for my academic growth.” –Maria
- “Something that I liked about this course was it challenged me to think in new ways.” –Molly
- “It’s a great blend of fun and learning and it’s things like this that make me love Furman so much. This class rarely felt like actual class, but I definitely learned a lot.” –Zack

Thank You!

- Furman University Rinker Center for Study Away and International Education
- Furman University Mathematics Department
- Encouraging Effective Teaching Innovation MathFest Session Organizers

