MathWorks Math Modeling (M3) Challenge 2021

DEFEATING THE DIGITAL DIVIDE: INTERNET COSTS, NEEDS, AND OPTIMAL PLANNING

While the "digital divide" has been around for decades, the COVID-19 pandemic brought it sharply into focus, as many people saw their work, school, healthcare, grocery shopping, and socializing migrate to a virtual experience—happening within the home, using digital devices. Ensuring that everyone (particularly those in rural and low-income areas) has sufficient access to high-speed internet is a technical, logistical, and economic challenge. It is not clear which among the many ways to access the internet (e.g., cable, fiber-optic lines, satellites, mobile broadband) can best solve the connectivity issues experienced by people in different types of households and regions. In 2021's problem, students were tasked to model cost, needs assessment, and placement of towers for maximizing access to the internet. Over a long weekend in early March, 535 teams composed of 2,400 students worked on solution papers of up to 20 pages, competing for more than $125,000 in scholarships[1] in [MathWorks Math Modeling Challenge (M3 Challenge), a program of SIAM.][2]

M3 Challenge is a unique, internet-based math competition that provides a transformative, real-world experience for high school students in the United States and sixth form students in the United Kingdom, giving them the opportunity to demonstrate how the math they learn in class can be used to ultimately solve real problems. Now entering its 17th year, M3 Challenge has awarded more than $1.65 million in scholarships since its launch in 2006.

Organized by Society for Industrial and Applied Mathematics (SIAM) and sponsored by leading software developer MathWorks, M3 Challenge seeks to make math relatable to everyday life and to inspire students to study and pursue careers in applied math, computational and data sciences, and technical computing. Free of any entrance or participation fees, M3 Challenge has drawn the participation of more than 50,500 students (one third female), 4,000+ high schools, 6,000+ teachers, and 400+ Ph.D.-level judges. It has been endorsed by the National Association of Secondary School Principals (NASSP) since 2010. In 2021, in a first international foray, sixth form students in England and Wales were eligible and invited to form teams and submit papers.

Working in teams of three to five members under a 14-hour time constraint, participants use the mathematical modeling process, as well as other skills and experiences, to understand and define a particular problem, gather data and information, document their assumptions, and devise a math model to make predictions and provide insight for decisions about the issue before submitting

their solution via computer upload. The specific real-world problem that is posed each year is unknown to participants until they login during Challenge weekend. Teams may opt to use technical computing to advance a model or better reveal its implications, and extra-credit awards exist for outstanding work in that area.

After four rounds of rigorous judging by 150 professional applied mathematicians over the eight weeks immediately following Challenge weekend, six finalist teams and three technical computing awardees are selected to present their solutions to a panel of mathematical experts, usually in New York City on the last Monday in April. Unfortunately, COVID-19 derailed the in-person event for the second year, and instead those nine top teams presented their work in individual Zoom meetings with the judge panel, viewable on YouTube. "Outstanding Communication of Results Awards" in amounts of $500 each were added to team prizes four finalist teams. Thirty-seven teams were recognized with scholarship prizes starting at $1,000; the Champion team received $20,000.

The following is the Champion team's paper from the MathWorks Math Modeling Challenge 2021 **with some reviewer suggestions incorporated**.

Complete information about MathWorks Math Modeling Challenge, including an archive with problems, solutions, and judge perspectives from each Challenge year, is available at http://m3challenge.siam.org.

Michelle Montgomery
Program Director
MathWorks Math Modeling Challenge (M3C)
A program of Society for Industrial and Applied Mathematics

1. Total scholarship award amounts were increased by $25,000 in 2021 to acknowledge the inability of finalist teams to be brought to New York City for the final event and award ceremony.

2. Some of the text of this paragraph comes from the 2021 M3 Challenge problem statement.