

MathWorks Math Modeling (M3) Challenge 2019

One is Too Many and a Thousand Not Enough: Understanding Substance Abuse

The use and abuse of opioids and other substances such as nicotine, marijuana, and alcohol take a toll on our health care and criminal justice systems, our family life and workplace, and many other areas of society. Understanding how substance abuse spreads and why it affects some individuals more than others are important factors in controlling and restricting the consumption of these and other substances, but how do we determine this? That's the problem 877 teams composed of nearly 4,000 students examined while competing for \$100,500 in scholarships in [MathWorks Math Modeling \(M3\) Challenge](#).

M3 Challenge is a unique, internet-based math competition that provides a transformative, real-world experience for high school students, giving them the opportunity to demonstrate how the math they learn in class can be used to make predictions and provide insight about important topics in today's world, and ultimately solve real problems. Now entering its 15th year, M3 Challenge has awarded more than \$1.4 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 and open to all high school juniors and seniors in the United States, M3 Challenge has drawn the participation of more than 45,000 students (one third female), 4,000+ high schools, 5,000+ teachers, and 400+ Ph.D.-level judges. It has been endorsed by the National Association of Secondary School Principals (NASSP) since 2010.

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 provide insight for decisions about the issue before submitting their solution via computer upload. Technical computing may be used 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 were selected to present their solutions to a panel of mathematical experts in New York City on April 29. Thirty-seven teams were recognized with scholarship prizes, with the Champion team receiving \$20,000 plus an additional \$1,000 for winning the M3 Challenge Technical Computing Third Place award.

The following is the Champion team's paper from MathWorks Math Modeling Challenge 2019 **with some reviewer suggestions incorporated**.

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