

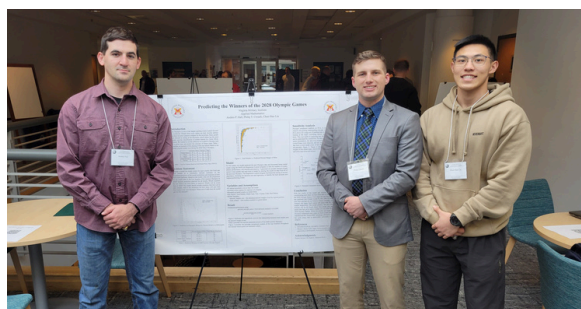
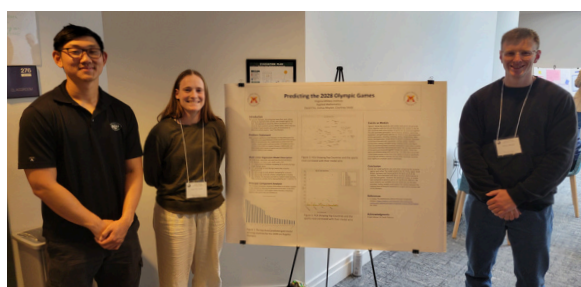
VMI APPLIED MATHEMATICS

In 2024-2025, our cadets explored mathematics beyond the classroom—through research, global study, industry projects, and national competitions. These experiences prepared them not just to solve problems, but to lead with insight, innovation, and impact.



Quick 2024-2025 Statistics

- 11 Majors Graduated
- 34 Minors Completed
- 7 Departmental Awards Presented
- 15 Cadets Studied Abroad
- 9 Cadets in Senior Capstone Research
- 4 AIM Projects with Industry Partners
- 3 Honors Theses Defended



Mathematics Association of America Meeting

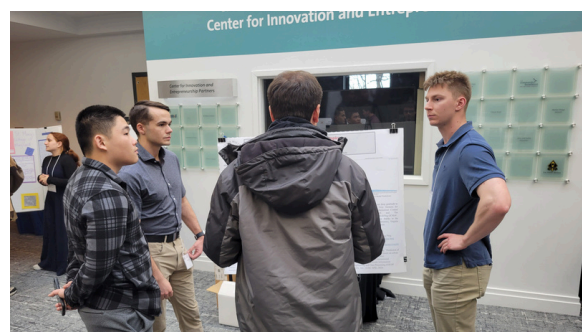
At the Spring 2025 MAA Section Meeting, senior cadets represented VMI with distinction by presenting their capstone and honors thesis work. Students delivered both poster and oral presentations, showcasing applied mathematics research on topics ranging from military logistics to data science and modeling. Their work sparked engaging discussions and reflected the strong research culture within the department.



Applied Mathematics Senior Capstones

As a requirement for the applied mathematics capstone, seniors must participate in the COMAP Mathematical Modeling Contest or Interdisciplinary Modeling Contest. The contests challenge teams of up to three students to analyze, model, solve, and present solution reports to an open-ended application problem in only 96 hours. This year, we had 9 students participate in the competition. They had to create a model to predict the number of medals each country would win in the 2028 summer Olympics.

- Team 1: David Cho, Joshua Moylan and Courtney Smith
- Team 2: Kevin Dougherty, Hai-Hsin Huang, and James Wynn
- Team 3: Philip Crouch, Andres Hall, and Chun-Hao Liu





Graduating Seniors

In academic year 2024-2025, The Applied Mathematics Department graduated 11 majors, 9 in spring 2025 and 2 in fall 2024. Combined with 34 minors, there were 44 graduates (out of around 300 receiving degrees) seriously studying mathematics during their time at VMI.

US Air Force: Ben Beirstine,

US Army: Andres Hall,

US Navy:

US Marines: Courtney Smith,

Air Force, Republic of China:

Army, Republic of China:

Navy, Republic of China:

James Wynn,

David Cho,

Hai-Hsin Huang,

Chun-Hao Liu,

Joshua Moylan,

Brendan Killeen, David Mack, and Kevin

Dougherty acceptor positions in industry.

Honors Thesis

For the class of 2025, one Applied Mathematics graduates and two minors completed a year long thesis project as a requirement for the VMI Honors Program.

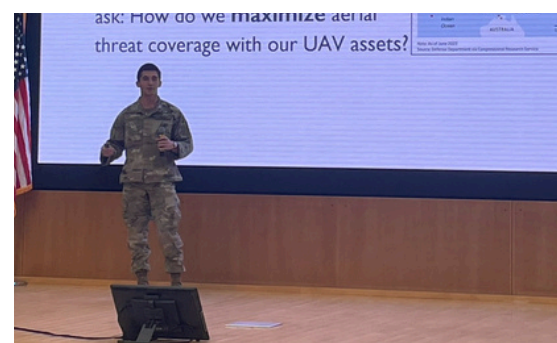
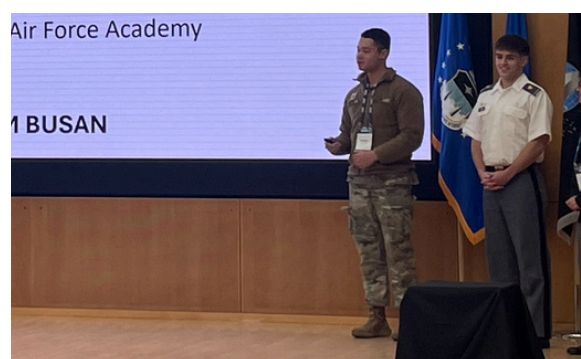
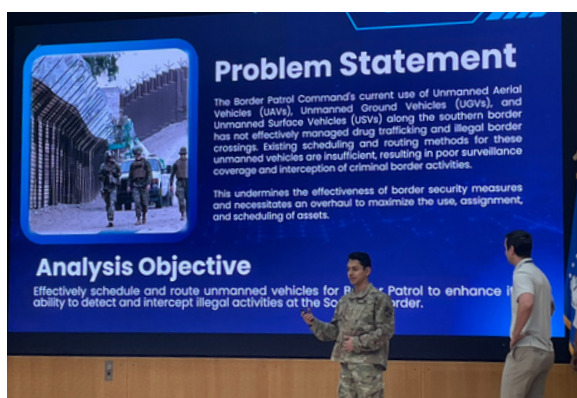
- Cadet Ben Bierstine (AM major) defended his honors thesis on US Airforce logistics. He used operations research to create a linear program to determine the optimal configuration of planes to minimize the response time to respond to a threat in the Pacific Theater. His committee consisted of Major Sarah Patterson (Advisor) and Lieutenant Colonel Amy Chapman.
- Cadet Jude Roberts (AM minor) defended his interesting thesis on Assessing the Efficacy of LLM-GPT4o Mini-for Resume Selection and Human Talent Management: A Comprehensive Analysis of Accuracy, Precision, Recall, Consistency, Reliability, and Efficiency. His committee consisted of Dr. Sherif Abdelhamid (Advisor) and Dr. Denis Aliyev.
- Cadet Cate Dowden (AM minor) defended her thesis, "Establishing Statistical Correlations Between Operational Parameters and Oxygen System Failures in the F/A-18". Her committee consisted of Capt. Robert McMasters (Advisor) and Colonel John David.



Applied Mathematics Major Awards

Each year, cadets are recognized for academic excellence during Pi Day and the Institute Awards Ceremony. Their names are engraved on permanent plaques in the department.

- John H. French Medal: James Wynn – For the greatest ability in mathematics (established 1911).
- Commodore Matthew Fontaine Maury Award: Kevin Dougherty – First standing graduate in mathematics (established 1985).
- Pendleton Scholarship: Benjamin Davis – Awarded to a rising first classman showing unusual mathematical skill.
- Col. Robert H. Knox '24 Prize: George Sullivan – Most promising third classman in mathematics.
- VMI-SIAM Award: Hai-Hsin Huang – For exceptional applied math research including “Immune Cell Dynamics During a Flu Infection.”
- MCM/ICM Contest Award: David Cho, Joshua Moylan, Courtney Smith – Top team in VMI’s mathematical modeling competition.
- Griffin '63 Applied Math Prizes (4.0 GPA in major):
 - Aiden Psczulkoski ('27)
 - George Sullivan ('27)
 - Finn Willems ('28)



Applied and Industrial Mathematics

In summer 2025, the Applied and Industrial Mathematics (AIM) program marked its fourteenth year. Founded by Colonel John David, AIM gave cadets hands-on experience applying mathematics in real-world settings through partnerships with local businesses, industries, and government agencies. Over five weeks, cadets collaborated on practical projects that supported their senior capstones and built valuable career connections. AIM is certainly a high-impact initiative in Virginia higher education.

This year's projects included:

- Cadet Kohan and Col. David with the VMI Baseball team
- Cadets Davis and Naifeh with Col. David at GWU Bioinformatics
- Cadet Aguilar Fricke and Major Patterson with Trinity Industries
- Cadet Carman and Major Miller with Modine Engineering



Military Operations Research Symposium

In Spring 2025, select cadets attended the Military Operations Research Society (MORS) Education and Professional Development Symposium at the U.S. Air Force Academy.

This event brought together students, faculty, and professionals focused on applying analytical methods to complex military and national security challenges. VMI cadets engaged with leaders in operations research, attended hands-on workshops, and gained valuable insight into real-world defense applications of applied mathematics.

The experience broadened their professional networks and deepened their understanding of how mathematical modeling supports critical decision-making in military contexts.

Datathon 2025

A team of VMI cadets placed in the Top 10 at the 2025 Virginia Datathon, hosted by the Office of Data Governance and Analytics. The event challenges participants to analyze real-world data and propose innovative solutions to public policy problems.

Rechnna Sok and James Wynn represented the Applied Mathematics Department, with sponsorship and mentorship from Dr. Denis Aliyev (AM) and Dr. Salih Yasun (IS). Their strong showing reflected a combination of technical skill, analytical thinking, and teamwork under pressure.

Events like the Datathon give cadets hands-on experience in data science, preparing them to apply mathematical tools in impactful, real-world contexts.



Math in Tuscany

This past summer, 15 cadets traveled to Castiglion Fiorentino, a hilltop town in the heart of Tuscany, for the third installment of VMI's Applied Mathematics Study Abroad in Italy program. Led by Col. Troy Siemers, the five-week program combined rigorous academics with rich cultural exploration across Italy.

While immersed in the scenic surroundings of the Tuscan countryside, cadets enrolled in two courses: Differential Equations and History of Mathematics in Europe. The experience offered a unique opportunity to study mathematical theory while tracing its historical roots in some of the world's most iconic cities.

In addition to their coursework, cadets visited Pisa, Florence, and Rome, where they explored landmarks such as the Leaning Tower, the Uffizi Gallery, and the Pantheon. These excursions brought mathematical history to life, bridging classroom concepts with their real-world and historical significance.

The program fosters not only academic growth but also cultural awareness, global perspective, and camaraderie among participants. As in past years, the Italy trip continues to be a highlight of the department's summer offerings—blending mathematics, travel, and history into a memorable and enriching experience.



Math Support Expands: Tutoring and GSS

The Math Resource Center remains a cornerstone of academic support in the Applied Mathematics Department, offering free peer tutoring for cadets at all levels—whether they're aiming for an A or just trying to pass. Staffed by trained, knowledgeable tutors, the center provides help for a wide range of courses including Calculus, Differential Equations, Matrix Algebra, and Probability & Statistics.

Open lab hours run Sunday through Thursday evenings (1800–2300) and midday Monday through Thursday (1200–1600). Cadets can also schedule individual sessions with Capt. Kristi Brown during weekday mornings.

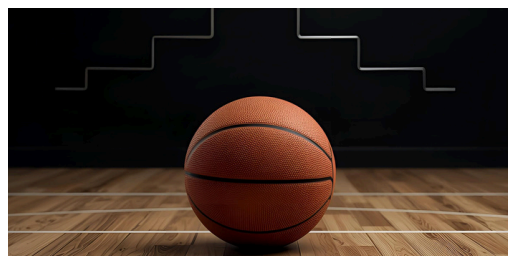
This year, academic support has expanded with the addition of GSS Plus (Group Study Sessions) through the Miller Academic Center. These weekly evening sessions (held at 2000) offer collaborative review and guided practice for many math and core curriculum courses. Peer tutoring and GSS sessions are designed to boost confidence, reinforce learning, and fit into cadets' busy schedules.

Whether through one-on-one tutoring or group-based review, VMI continues to invest in the academic success of its cadets.

Math–Madness Brackets

Each March, the Applied Mathematics Department hosts its Math-Madness Bracket Challenge, where cadets and faculty fill out NCAA tournament brackets using data, statistics, and analytical models—not just team loyalty.

The challenge blends sports with math, encouraging students to apply real-world problem-solving to a fun, competitive event. Whether or not the picks pan out, it's a great way to connect and celebrate the power of predictive thinking.



Applied Mathematics Chess Club

Dr. Denis Aliyev launched the Math Department Chess Club to foster community, strategic thinking, and friendly competition among cadets and faculty alike. Several online chess tournaments, open to all math majors, minors, and professors are hosted each semester. These events provide a chance for cadets to engage in a different kind of problem-solving—one that sharpens logic, foresight, and focus in a relaxed but competitive setting.

Whether participants are seasoned players or complete beginners, the tournaments have become a fun and inclusive way to connect the department outside of formal academics. The club continues to grow each year and reflects the department's culture of intellectual curiosity, collaboration, and mental discipline—on and off the board.



Pi Day

Each March, the Applied Mathematics Department marks Pi Day (on approximately 3/14) with an evening of celebration, community, and mathematical fun. This year's event, organized by Lt. Col. Meagan Herald, featured the presentation of departmental cadet awards, recognizing outstanding achievement in mathematics. Cadets, faculty, and guests enjoyed a festive catered dinner, math-themed games and puzzles, and received a custom Pi Day t-shirt designed by Capt. Kristi Brown—a highlight of the night and a favorite keepsake among attendees. Pi Day continues to be a beloved department tradition, combining academic recognition with creativity, camaraderie, and a shared love of mathematics.



Open Source Textbooks

The Applied Mathematics Department at VMI continues to lead in the open educational resources (OER) movement, providing free, high-quality, and adaptable learning materials for cadets and educators alike. With a strong history of authoring and supporting open-source textbooks, the department remains committed to improving access, affordability, and engagement in mathematical education.

The most recent addition to the department's growing library is Exploring Differential Equations: An Interactive, Student-Centered Approach by Lt. Col. Cox. This innovative text emphasizes conceptual understanding and active learning, combining theory with interactive tools that let students visualize and explore solutions to differential equations in real time.

Unlike traditional static texts, this online book includes embedded code, graphs, and dynamic exercises—allowing learners to experiment, model, and gain intuition through immediate feedback. It is freely accessible to anyone and aligns with the department's growing interest in incorporating technology and interactivity into instruction.

This launch builds on years of open-textbook development by VMI faculty.

- APEX Calculus - Gregory Hartman et al.
- APEX PreCalculus - Amy Givler Chapman, Meagan Herald, Jessica Libertini
- Fundamentals of Matrix Algebra - Gregory Hartman
- Introduction to Scientific Programming: MATLAB and Mathcad - Troy Siemers
- Exploring Differential Equations: An Interactive, Student-Centered Approach - Geoffrey Cox

These texts are not only cost-free but also openly licensed, allowing instructors to tailor content and structure to match their course needs. By embracing open-source materials, the department removes financial barriers, fosters curricular flexibility, and encourages student-driven exploration—empowering cadets to take ownership of their learning in and beyond the classroom.

Example 225. Handling Coefficients on s . Find $y(t)$ if $Y(s) = \frac{3s+9}{(s-2)^2+16}$

Solution.

Checkpoint 226. Give the Numerator of the Split Fractions.

After adjusting the numerator to match L_9 and separating the fractions, type-in the numerators of the separated fractions?

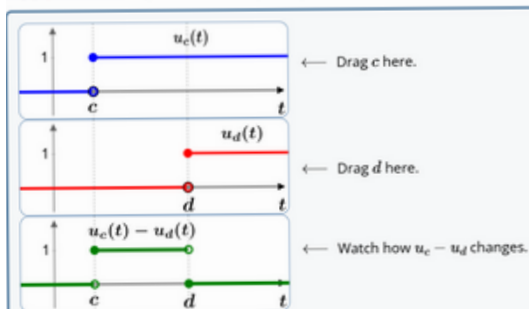
$$Y(s) = \frac{s+3}{(s-1)^2+9} = \frac{\boxed{}}{(s-1)^2+9} + \frac{\boxed{}}{(s-1)^2+9}$$

The answers you enter should be fully simplified.

Check me

Compare me

Interactive Question 252. Exploring the Effect of c and d .



(a) Selecting the ON-Interval Expression.

Which expression represents a function, $f(t)$, that is active (ON) on the interval $[2, 5]$ and 0 elsewhere?

Choose one:

- ☐ A. $2f(t) + 5f(t)$
- ☐ B. $f(t)(u_5(t) - u_2(t))$
- ☐ C. $f(t)(u_2(t) - u_5(t))$
- ☐ D. $f(t)u_5(t) - u_2(t)$

Check Me

Compare me

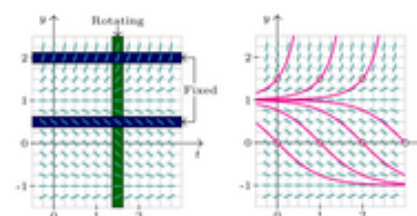
Slope Fields of Autonomous Equations

Autonomous equations have a distinctive look in their slope fields. Consider:

$$y' = y^2 - 1.$$

Here, the slope at any point (t, y) depends only on y . Moving up or down (changing y) changes the slope, but sliding left or right (changing t) does not. The result is a "striped" slope field—each horizontal line has the same slope pattern all the way across.

Figure 94(a) illustrates this. As you go up the plane, the slope segments gradually rotate, reflecting how $f(y)$ changes with y . But moving sideways leaves the segments fixed—the slopes don't shift with t .



Mathematics into the Community

Since 2014, the Applied Mathematics Department has hosted math competitions for middle and high school students across the region. These events, organized primarily by Col. Greg Hartman and Lt. Col. Meagan Herald, bring hundreds of visitors to VMI and remain a favorite among students and teachers.

For high schoolers, we offer the nationally recognized AMC 10 and 12 exams—challenging tests that reward logic and problem-solving over memorization. For middle schoolers, a new modeling contest was introduced in 2023, developed in collaboration with Dr. Karen Bliss (SIAM). The first challenge—“How many people are streaming video right now?”—asked students to analyze real-world data and justify their reasoning.

Unlike traditional tests, these contests have no single correct answer. Students are judged on their reasoning and mathematical approach. Teachers praised the format as “low-floor, high-ceiling,” engaging for learners at all levels.

Each event includes a fun math talk, free lunch (thanks to the Dean’s office), and a campus tour—making it an exciting and educational experience that brings mathematics to life.



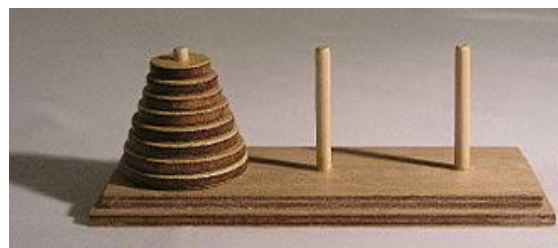
Computational Seminar

In 2023, Col. John David established a computational working group to connect scholars across departments and institutions through shared interests in applied computing, modeling, and educational innovation. The group has promoted collaboration and highlighted a variety of tools and methods for research and instruction. Featured talks have included:

- “Creating Machine Learning Models Without Coding Using MATLAB Apps” – Col. John David
- “Introduction to the AMPL Language and the Fair Division Method” – Lt. Col. Amy Chapman
- “Building Deployable User Apps in MATLAB” – Col. Troy Siemers
- “Using R Data Visualization Tools for Teaching, Learning, and Research” – Dr. Denis Aliyev
- “Image Processing in MATLAB” – Lt. Col. Sarah Patterson
- “Interactive Textbook Development for Differential Equations” – Lt. Col. Geoffrey Cox

Middle School Math Circle

The Maury River Middle School Math Circle, run by MAJ Patterson and COL Dimitrova-Grajzl, is a weekly program designed to spark curiosity and excitement about mathematics among early middle school students. Through hands-on games like Set and 24, and explorations of classic puzzles such as the Tower of Hanoi, students build problem-solving skills, logical reasoning, and a genuine love for math in a fun, supportive environment.



Faculty Awards

Col. Dimplekumar Chalishajar, professor of Applied Mathematics, recently surpassed 121 peer-reviewed research publications, just one year after reaching 100. His latest paper will appear in *Chaos, Solitons and Fractals*, a journal published by ScienceDirect.

"Publishing over ten high-impact papers each year while balancing teaching is extraordinary," said Col. Troy Siemers, department head. Maj. Gen. Cedric T. Wins '85 added, "VMI is fortunate to have him."

A VMI faculty member since 2008, Chalishajar collaborates with researchers in 10 countries, supports VMI's Cyber Defense Lab, and serves on the editorial/review boards of over 40 journals. He's also reviewed 265 research articles and 27 doctoral theses.

"My research is my passion," he said.

"Teaching is the best way of learning."

For spring 2025, Lt. Col. Geoff Cox received the VMI Awards Faculty Development Leave to work on "Interactive Textbook Development - Paving the Way for Modern Textbooks." He is leading the effort to create a new textbook for the MA311: Differential Equations course.

Col. John David, who has finished 14 years at VMI, has been renewed as the Jackson-Hope Distinguished Professor of Natural Science.

Hires and Promotions

Major Megan Miller has moved into a tenure track position after finishing a three-year visiting position. She completed her PhD in Mathematics from North Carolina State on arterial network modeling with pulmonary hypertension. She has been coordinating the differential equations course and expanding the department offerings of proficiency based learning courses.

Captain Laura Toner completed her first year as lecturer. She completed her Masters in Mathematics Education from James Madison University. Laura brings 15 years of experience as a high school teacher and adjunct professor for James Madison University and Blue Ridge Community College. She also coaches softball and track, both at a little league and high school level, and enjoys working with kids both inside and outside of the classroom to help them gain success. During the past year, Laura has been instrumental in adding new technology to the precalculus and calculus sequence.

Congratulations to Sarah Patterson who has earned tenure and has been promoted from Assistant Professor to Associate Professor and from Major to Lieutenant Colonel, effective Fall 2025. Sarah has been involved in undergraduate research and coordinates the applied mathematics capstone.

