



Department of APPLIED MATHEMATICS Newsletter

Summer 2019

VMI Quality Enhancement Plan for SACS — 1 Year Down

During the 2018-19 academic year, the applied mathematics department fully rolled out the MA101-102 sequence for the VMI Quality Enhancement Plan (QEP) *Math That Matters, Math for the Modern World*.

Cadets majoring in Biology, Computer & Information Science, Economics and Business, English, History, International Studies, Modern Languages, Psychology took these classes which focused on Statistics and Mathematical Modeling. We developed the course materials with faculty from across Post to ensure that they were relevant to their majors and taught using active learning and group work.

As examples, cadets planned a dream trip to a country of their choosing (Modern Languages), looked at voting trends and prediction models (International Studies), considered population changes in central Virginia during the French & Indian War (History), laid out an art gallery (Fine arts), considered different investment plans for retirement (Army), did Cyber defense modeling (Computer Science), and more.

The cadets implemented solutions using Excel—a skill many of them remarked on positively in the course evaluations. which many of the cadets liked.

The year ended with a poster session where cadets presented over 120 posters on topics of their choosing and was highlighted in the June 2019 Institute Report: <https://www.vmi.edu/news/institute-report/>

Sample project topics: Concussions in the NFL, The Global Firepower Index, PTSD Treatments, CO2 Emissions, Unemployment Rates, Hurricane Disaster Relief, and many more.

Welcome to the newest member of the family!

Catherine Ann Chapman was born at 0530 on her due date, January 5, 2019 to proud parents Jonathan and Amy Chapman. Only an estimated 5% of babies are born on their due date. She was 8 pounds, 1 oz and 21 inches long, an astounding 90th percentile for height. Photo credit to Tamara Hattersley.



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Facebook: for VMI Department of Applied Mathematics and Computer Science



New Differential Equations Book to be written by AM Faculty, adding to an extensive list of free & low cost textbooks

In response to rising textbook costs, we have decided to develop a text to be used in the differential equations course (the current text costs about \$250). We consulting with other departments whose cadets take differential equations and have decided to have an applications/modeling focused text so that cadets can understand how this topic can be used to solve real problems and how it fits in to a wide range of disciplines from biology to chemistry to engineering, etc. In March, MAJ Bliss, LTC Cox and COL Hartman were awarded a \$12,000 grant sponsored by the Virtual Library of Virginia to develop an open, interactive online text and accompanying materials (including online homework questions).

Theirs was one of 17 funded projects among 60 proposed for funding. The materials will be developed over the course of the next year, and will be adopted in the department in fall 2020.

The department now has free electronic & low-cost print textbooks and course materials in nearly all courses within the applied mathematics curriculum:

MA101-102: Math that Matters 1 & 2

MA110: Mathematical Software

MA123,124,215: Calc 1,2 & 3

MA310: Matlab Programming

MA490W,495: Capstone

MA103: Matrix Algebra

MA114: Precalculus

MA301: Higher Math for Scientists and Engineers

MA320: Mathematical Modeling

Shenandoah Valley Math Modeling Challenge

VMI held the 4th annual Shenandoah Valley Math Modeling Challenge October 13--14, 2018. This competition challenges teams of students to answer a real-world question using whatever data and mathematics they feel is appropriate. This year we had teams from Appalachian State, Virginia Commonwealth University, and University of Virginia compete with math majors John Daniel '20 and Lindsey Mercer '21 in answering one of two questions (one on where the Olympics should be held and one on the economic viability of the US Postal Service in the face of online shopping). Teams dug in for 24 hours of math and fun, with MAJ Bliss and MAJ Chapman coordinating the event.



Faculty News

Congratulations to **Karen Bliss** who has earned tenure and has been promoted from Assistant Professor to Associate Professor and from Major to Lieutenant Colonel, effective Fall 2019. Karen has been heavily involved in the math modeling education community, the Mega Mathematics Challenge and the professional society SIAM. She is leading the effort to creating a new textbook for the MA311: Differential Equations course.

Dr. Denis Aliyev will become Major and Assistant Professor as he finishes a three-year visiting position and moved into a tenure track position. He will be teaching the Statistics courses where he has developed new materials and embedded the use of the programming language R.

Major Lucas “Luke” Castle completed his first year of a two-year Postdoc position in support of the QEP. During the past year, Luke has been instrumental in the development of course materials and in coordinating the teaching of the courses MA101 and MA102 *Math That Matters 1 & 2*.

In Fall 2019, we will be joined by **Dr. Sarah Patterson** and her husband **Dr. Blain Patterson**, both to be at the rank of Major. Sarah, who completed her PhD at Duke University, will be starting in an assistant professor tenure-track position. Her expertise is in mathematical modeling and computational fluid flow. Blain completed his PhD in Mathematics Education from North Carolina State will be starting a three-year teaching Postdoc position.

COL Troy Siemers, who has finished 20 years at VMI, has been awarded the Major General James M. Morgan Jr. '45 Chair for Academic Excellence.

American Mathematics Competitions (AMC)

VMI continues to host the American Mathematics Competition (AMC) for 8th, 10th and 12th grade students operated by the Mathematical Association of America. The AMC 8 continues to be so popular we still need two days to run the competition to accommodate the demand. This past November, 597 students took the 8th AMC exam after which they participated in a fun math talk by COL Greg Hartman, had lunch and went on Post tours.

The fun talk focused The Traveling Salesman Problem. While the students were taking the exam their educators participated in a workshop by MAJ Karen Bliss about exploding dots which can be used to explore polynomial multiplication and division. This past February AMC there were 62 students who participated in the AMC 10 exam and 64 students who took the AMC 12 exam.

This is the first time we have ever had a student (*a 6th grader!*) score high enough on the AMC 12 to be asked to participate in the American Invitational Mathematics Examination (AIME). While the AMC 12 exam lasts 75 minutes the AIME is a 3 hours exam consisting of only 15 questions. The student was excited to participate and returned to VMI to take the exam. Since the exam took place in early March, he was given an honorary Pi-Day shirt from the department.

The support from the Dean's Office continues to provide lunch for the participants and their educators; the Applied Mathematics department provides the cost of the exam; LTC Herald coordinates all activities. This continues to be a rewarding endeavor for VMI, the department and the students cultivating a love of mathematics in the generations to come.

Applied Mathematics Research and Honors Projects

For the class of 2019, two Applied Mathematics graduates completed the VMI honor's program which included a year long thesis project. In addition, one undergraduate research project was recognized Postwide.

For her senior thesis presentation **Demetra J. Protopgyrou '19** worked with her advisor Maj. Amy Chapman on a project entitled "*Evacuation Plan for Norfolk, VA using Operations Research*". Demetra will be continuing her work in OR by pursuing a graduate degree at NC State University.

For his senior thesis presentation **Shang-Cheng Su '19** worked with his advisor LTC Jessica Libertini on a project entitled "*An Overview of World Food Security and Policy Making*."

Kao-Pu Chang '20 worked with his advisor, LTC Jessica Libertini, on a project titled "*How the application of Particle Swarm Optimization may help in the fight against cancer by using data from time sequences of medical images to determine the efficacy of a cancer treatment*." An extension of this work has been submitted to the Journal of Scientific Computing and is awaiting a publication decision. For this effort, they were awarded one of the Postwide **VMI Hinman Awards**.

Applied Mathematics Cadet Awards

Each year cadets are given awards, either at the Institute award ceremony, or at the departmental "Pi Day" celebration – around 14 March, of course. The names of these cadets are added to the plaques in the AM Department.

Demetra Protopgyrou won the John H. French Medal which has been awarded annually since 1911 to a member of the graduation class who has shown the greatest ability in mathematics.

Shang-Cheng Su won the Commodore Matthew Fontaine Maury Award which has been awarded annually since 1985 to the first standing graduate in the mathematics curriculum.

Kelia Aardema won the Baldwin Alexander and Stephen Taylor Pendleton Scholarship which was established in 1971 by Miss Agnes Pendleton in memory of her father Baldwin Alexander Pendleton, and her grandfather Stephen Taylor Pendleton, who was first honor graduate in the Class of 1848. This award is given to a rising first classman majoring in mathematics, who has "demonstrated unusual skill in his or her subject."

John Vesterman won the Colonel Robert H. Knox '24 Prize which has been awarded annually to a third classman selected by the faculty of the mathematics department as the most promising mathematics major in this class.

The VMI-SIAM Award in Industrial and Applied Mathematics goes to a first or second classman for outstanding performance and lasting contribution by demonstrating exemplary talent in Industrial or Applied Mathematics through a research, service, or other professional project. For 2018, the award was given to **Kao-Pu Change** for his project "How the application of Particle Swarm Optimization may help in the fight against cancer by using data from time sequences of medical images to determine the efficacy of a cancer treatment "

The MCM/ICM Contest Award is for outstanding team performance and effort in describing, analyzing, and proposing a solution to an open-ended problem proposed as part of the COMAP MCM/ICM contest and was established in 2016. This year's winning team was **Cadet David Carter, Cadet Jacob Wentworth, and Cadet Yu**.

The Charlotte and James Griffin '63 Applied Mathematics Prizes are monetary prizes are awarded in the spring of each year to those cadets who have achieved a cumulative 4.0 GPA within the Applied Mathematics major. The awardees are

2019: **Shang-Cheng Su** 2020: **MacGregor Baxter** 2021: **John Vesterman** 2022: **John Suter**

Applied Mathematics Graduates

In May of 2018, the Applied Mathematics Department graduated 10 seniors, a record number for the department. Combined with 34 minors, there were 44 graduates (out of around 300 receiving degrees) seriously studying mathematics during their time at VMI. All but one is commissioning.

US Air Force: Jacob Wentworth

US Army: John Mackie Chase, Barry Thaxton, Dolan Walsh

US Navy: Justin Moore

Air Force, Republic of China: Kuan-Wei Yu

Army, Republic of China: Mu-Chi Lu

Navy, Republic of China: Shang-Cheng Su

Demetra Protogyrou will be attending NC State University to pursue a Masters, and possibly PhD, in Operations Research.



Applied & Industrial Mathematics (AIM) Program

In the summer of 2019 the Applied and Industrial Mathematics (AIM) program will enter its eighth summer. This program gives cadets from VMI experience in the practical applications of applied mathematics which the classroom cannot provide. For five-ten weeks of the summer, student teams and faculty advisors from VMI are joined with a (usually local) business, industry, or government agency (client). This partnership is beneficial to all involved. The student participants are exposed to the practical applications of mathematics and computer science in a "real world" setting and acquire knowledge which will aid them in their senior capstone project and later in life, including contact with potential employers. Former Governor Terry McAuliffe highlighted this program as a program having large impact on Virginia in a speech on higher education.

In these seven summers forty-two VMI cadets have worked on projects. AIM alumni have taken jobs, graduate school appointments, and internships at an impressive group of institutions, including: John Hopkins Applied Physics Laboratory, Ernst and Young, Pricewaterhouse Cooper, Center for Army Analysis, Dell Computers, NASA, Coca-Cola, JP Morgan, Deloitte, Financial Risk Group, US Army, US Navy, US Air Force, North Carolina State University Institute for Advanced Analytics, Harvard Business School, Colorado State University Mathematics Department and George Mason University Operations Research Department and others. This summer we will work on the following projects

Cadet Vesterman, COL Basu and LTC David will be applying a Rubin Causal model to the problem of conflict prediction in the hope of identifying the factors that truly cause conflict.

Cadet Carter and LTC David will be working with the VMI Alumni Association to identify factors in donor data that is most predictive of donations.

Cadet Tucker and COL Hartman will be working with Laser Tag Source to help them better understand their customer base through empirical analysis.

Cadet Gothard, Cadet Gibson and COL Siemens will be working with the Frontier Culture Museum to better understand their sales and potential developing a better system to quantitatively track this.