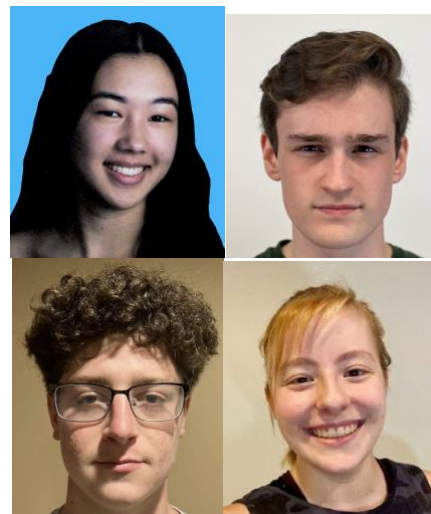## UNDERGRADUATE MATH SEMINAR

The next math seminar will be

DATE: <mark>THURSDAY, October 17</mark>

Time &   **12:30 – Refreshments in Bailey 204**

Location: **12:50 – 1:45** Seminar in **Bailey 207**

In this seminar, four Union College students, **Audrey Benson, Hunter Gould, Grace Newcombe**, and **Josh Vaidman**, (pictured clockwise from top left) who are research students of **Professor Phanuel Mariano** will present the following talk.

Title: A Central Limit Theorem for Products of 2x2 Random Non-invertible matrices and Applications

Abstract: The theory of the products of random matrices have been widely studied and applied in the fields of biology, dynamical systems, economics, engineering and statistical physics. We consider the product of an independent and identically distributed sequence of random non-invertible matrices with real entries. We prove an analog of the law of large numbers and give an explicit formula for this limit, which is called the Lyapunov exponent. We also prove a central limit theorem with an explicit formula for the variance in terms of the entries of the matrices. An important example where non- invertible matrices are essential is the random Hill's equation, which has numerous physical applications, including the modeling of lunar orbits. Recently, the products of random non-invertible matrices have been used in the mathematical model of an art collector in economics.

The Putnam Problem Solvers

On Thursday afternoons, a group of intrepid math-problem solvers work on sharpening their skills in preparation for this December's Putnam Competition. This twelve-question six-problem contest is, perhaps, the most prestigious and difficult math competition for college and university students. Though extremely challenging, under the guidance of **Professor Grant Moles**, students are having a wonderful time extending this skill set and having fun discussing math.

The PEP (Putnam Exam Preparation) squad

Even if you have no interest in taking the Putnam exam, if you enjoy working on interesting math problems outside of your coursework that often require novel approaches, consider stopping by **Bailey 102** at **4:00pm** on **Thursdays** this fall term.

Pre-Approval Time! MTH 105, 110, 113. And, Meet with your Advisor!

Don't forget: the deadline for submitting pre-approval forms for winter term course offerings is **Wednesday, October 16 at 5:00pm**. This winter term, three math courses require pre-approval: **MTH 105, 110, and 113.** Registration for the winter term then begins on October 29. As you are planning your winter courses, don't forget to meet with your advisor who must clear you to register.

Calculus Help Center: Sunday – Thursday, 7:30-10:00pm, Sorum House Seminar Room