Curiosities of Counting
Grad Student: Mary Claire Simone

<u>Seminar Description</u>: This seminar will be an exploratory introduction to *combinatorics*, the branch of math that studies fancy counting. We will learn and practice using essential counting techniques and strategies, and then apply them to problems involving discrete graphs (collections of dots and edges) and the symmetries of triangles, squares, cubes, and more. The end of the seminar will include some arts and crafts and appreciation of M.C. Escher's artwork.
No prerequisites.

<u>Sources</u>: Jeff Dekofsky's TED-ed talk "The Infinite Hotel Paradox," Math Circle activities on Graph Theory, Coloring Problems, and Escher Tilings, seminar lecture notes

<u>Format:</u> We will meet once a week as a group for an hour on either Tuesday or Thursday (time/date will be set based on our availability). During our meetings, we will have mini lectures, small group discussions, and opportunities to collaborate on practice problems and activities. Students can volunteer to present practice problems to the group. There will be at least two student-run presentations in which a student or group of students leads the seminar through a Math Circle Activity; more student-run presentations can be arranged if there is interest.

<u>Learning Objectives</u>: Our goal is to create an environment where we all feel comfortable contributing our ideas as we explore the power of counting. We will work towards this by asking questions and collaborating to figure out ways to answer them. As a result, we will practice mathematical thinking and gain experience talking math with others.
(Bonus takeaway – appreciation that not all math is calculus.)

<u>Outline</u>:
- ● Meeting #1: Infinity
  - ○ *Before – watch Hilbert Hotel Video*
  - ○ Introductions and Community Agreements
  - ○ Discussion on Infinities

- Meeting #2: Combinatorics Intro
  - Mini Lecture by Mary Claire – counting problems and notation
  - Practice Problems
- Meeting #3: Continue Combinatorics Intro
  - *Before – continue working on practice problems*
  - Students present problems
  - Wrap up combinatorics intro
- Meeting #4: Graph Theory
  - Student presentation on Math Circle Activity: Graph Theory
  - Practice Problems
- Meeting #5: Graph Theory
  - *Before – continue working on practice problems*
  - Students present problems
  - Mini Lecture by Mary Claire – colorings of graphs
  - Practice Problems
- Meeting #6: Ramsey Theory
  - *Before – continue working on practice problems*
  - Students present problems
  - Mini Lecture by Mary Claire – Pigeon-Hole Principle
- Meeting #7: Symmetries
  - *Before – work on Part 1 of Symmetry Activity: Rotations and Flips*
  - Work through Part 2 of Symmetry Activity: Counting Distinct Colorings
- Meeting #8: M.C. Escher
  - Student presentation on Math Circle Activity: Tilings
  - Tessellation Activity
- Meeting #9: TBD
  - *We may move this meeting up earlier in the quarter if we want to spend more time on a particular topic*