Mathematics and Equity, Past and Present, through the Lives and Work of Women Mathematicians

Jackie Dewar, Lily Khadjavi, Alissa Crans

LMU|LA
Loyola Marymount University

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Women & Mathematics Course Background

- Inspired by Teri Perl's book ***Math Equals***
- Elective upper division MATH course, but truly interdisciplinary, sometimes cross-listed with HONORS or Women's Studies
- Examines the lives of 9 women mathematicians throughout history (4th through 20th century)
- Engages students in mathematical topics related to the work of these women
- Addresses gender equity in mathematics education (K to doctoral-level) and careers
- Team teaching effort supported by a Tensor-MAA Women & Mathematics grant: Women & Mathematics for Future Teachers

Hypatia
370? - 415
Alexandria

The Overarching Course Goals are

- To examine the lives and contributions of 9 women mathematicians from the 4th to the 20th centuries
- To investigate current gender issues related to women's skills and participation in mathematics from grade school through graduate school and their participation in math-related careers
- To provide students an opportunity to experience "doing mathematics" in a supportive and cooperative environment and to encourage them to be aware of their own mathematical thinking
- To undertake a deeper investigation that explores one or more of the above areas

Emilie du Chatelet
1706 - 1749
France

Selected Learning Outcomes: Be able to

- **Synthesize** from the 9 women's biographies common experiences/obstacles faced by these women & **identify** factors that enabled their success
- **Discuss** the current situation in the US regarding women's participation and achievement in mathematics in K-12, higher ed, and industry
- **Read critically** articles in journals and news media about gender issues in math education
- **Make & investigate** mathematical conjectures

Maria Agnesi
1718 - 1799
Italy

Recurring Mathematical Themes

- The distinct and vital roles of inductive and deductive reasoning in mathematics
- The occurrence and value of multiple representations in mathematics
- Mathematics is much more than "a study of numbers," which is the view held by many students when they enter the course

Sophie Germain
1776 - 1831
France

Assessment data indicates the course

- Encourages students, some of whom are future K-12 teachers, to adopt a more expert view of mathematics
- Provides students with an opportunity to "do math" in a supportive environment
- Prepares them to discuss the current US situation regarding women's ability and participation in mathematics
- Informs future teachers about equitable classroom practices and encourages them to incorporate these into their teaching

Mary Somerville
1780 - 1872
Scotland

Course Activities and Assignments

- Read/discuss biographies & gender equity research
- Write a short paper on gender equity issues
- Mini-lectures & doing math in pairs or small groups
- 20-minute quizzes every 2 to 3 weeks
- Significant research project on topic of student's choice + 2 minute in-class "elevator speech"
- Electronic poster and in-class report on a modern woman mathematician; if a future teacher, student does a lesson plan not a poster
- Final reflective writing assignment that addresses major course goals

Ada Byron
Lovelace
1815 - 1852
England

One of the lessons: Biographical & Gender aspects

Read biography of Sonya Kovalevskaya and post answers to these questions on discussion board:

- What sort of access did Sonya Kovalevskaya have to education? What similarities/differences did you note with the previous women's lives?
- How did Sonya handle her family responsibilities?
- What sort of a mathematics did she work on and what sort of career did she have, if any?
- Were there any surprises or new developments for women in mathematics showing up in her life?

In-class we discuss similarities/differences between her life/career and previous women

Sonya Kovalevskaya

1850 - 1891

Russia

One of the lessons: Mathematical aspects

1/2 + 1/4 + 1/8 + ··· = ?

1. Introduce infinite series through Zeno's paradox
   - Can I get to the other side of the room?
   - Can the sum of infinitely many terms be finite?
2. Find the sum of an infinite geometric series numerically, algebraically, geometrically and kinesthetically
3. Follow-up assignments:

   Repeat these activities for
   1/3 + 1/9 + 1/27 + ··· = ?

   Utilize the concept of geometric series to (a) interpret infinite repeating decimals (b) analyze data from a 1972 public health problem in Iraq (Zill & Wright, 2009)

Grace Chisolm Young
1868 - 1944
England

1/2 + 1/4 + 1/8 + ··· Numerically

Find **a pattern** by adding successive terms

1/2	= 1/2
1/2 + 1/4	= 3/4
1/2 + 1/4 + 1/8	= 7/8
1/2 + 1/4 + 1/8 + 1/16	= 15/16

Students see the more terms added, the closer to 1.

Inductive Reasoning leads to an expression for the nth partial sum $\frac{2^n - 1}{2^n} = 1 - \frac{1}{2^n}$

which can be explored with or without limits.

Emmy Noether
1882 - 1935
Germany

1/2 + 1/4 + 1/8 + ⋯ Algebraically

$$S = 1/2 + 1/4 + 1/8 + 1/16 + \cdots$$
$$S/2 = 1/4 + 1/8 + 1/16 + \cdots$$
$$S - S/2 = 1/2$$
$$S = 1$$

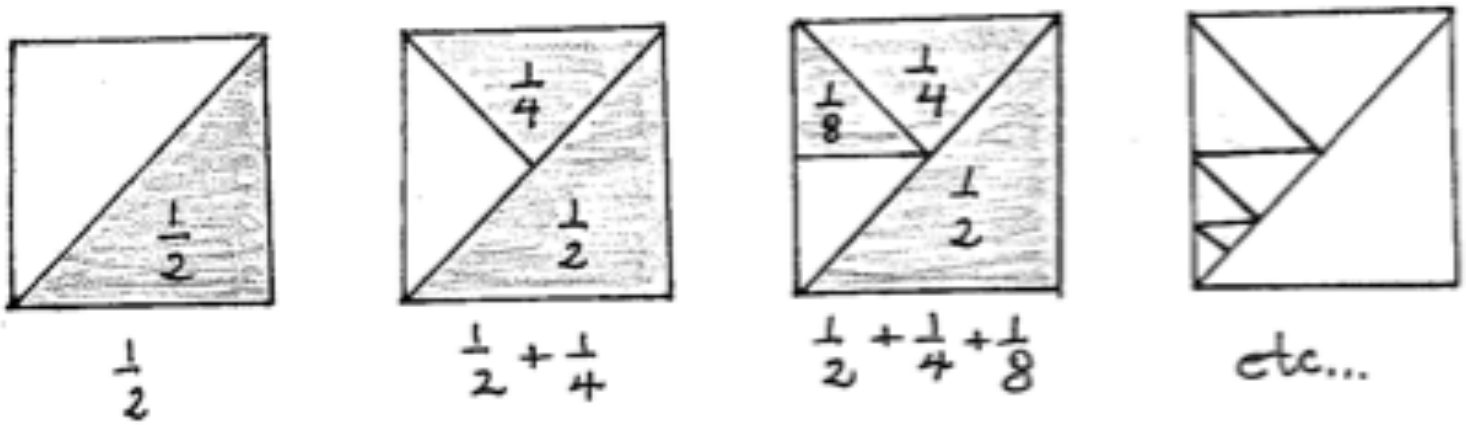
Can repeat for the general infinite geometric series:

$$S = a + ar + ar^2 + \cdots = a/(1-r),\ |r|<1$$

Can present a more rigorous derivation

Gloria Hewitt
1935 -
United States

1/2 + 1/4 + 1/8 + ⋯ Geometrically



$\frac{1}{2}$ $\frac{1}{2}+\frac{1}{4}$ $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}$

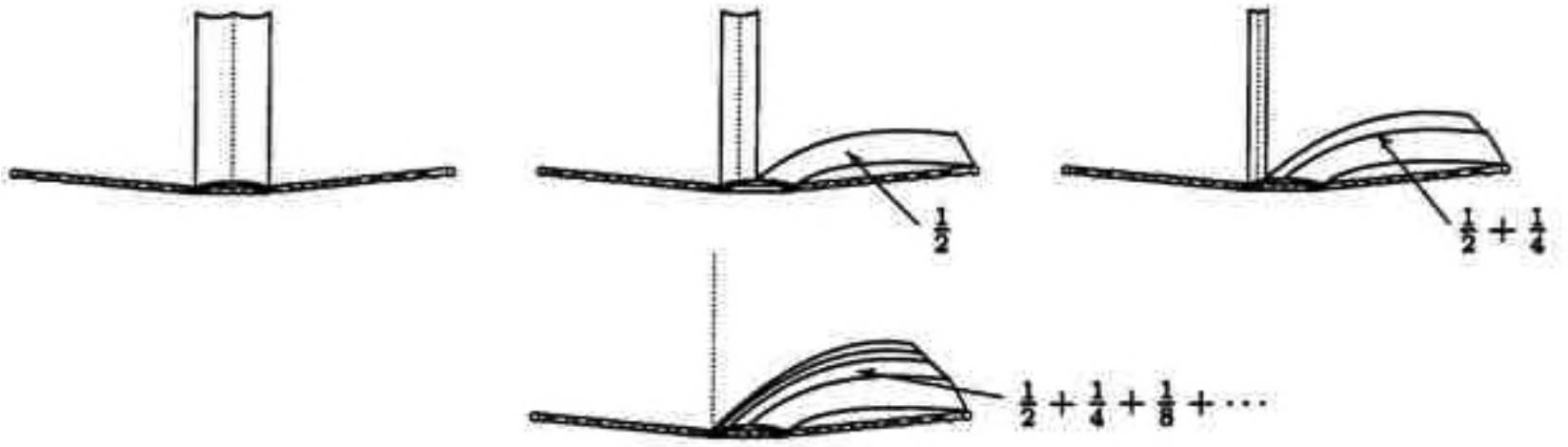
By asking two questions:

1. Do we need to shade points outside?
2. Will we eventually shade every point inside?

we can develop an epsilon-N proof.

Fan Chung
1949 -
Taiwan

1/2 + 1/4 + 1/8 + ··· Kinesthetically



Randrianantoanina, B. (2004). A Visual Approach to Geometric Series. *CMJ. 35*(1), 43-47.

Evelyn Boyd Granville

1924 -

United States

End-of-semester reflection prompts

- Identify common experiences and obstacles in the lives of the 9 historical women studied. How have things changed for modern women mathematicians? What challenges remain in the 21st century?
- Review your responses to what mathematics is and how new mathematical knowledge is produced. Discuss your current view and how the course changed or reinforced it. Give specific examples.
- On the **MenRSmartR** blog you read: "In all of history there have been no women geniuses. This clearly indicates males have a superior intelligence!" Draw on material from this course to craft a response.

Cleopatria Martinez

1948 -

United States

QUESTIONS?

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