

Sums of Squares (FNS 195-S) Independent Study 2

Fall 2014
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The second independent study will follow the pattern of the first. It will be due on the final day of class: Thursday, December 4. You should choose a topic that you find interesting and that you want to learn more about. You should seek out a few sources, including at least one actual paper book.

Here are a few suggested topics:

- Diophantus and the *Arithmetica*. Describe what we know about Diophantus and his work, *Arithmetica*. What is the subject matter of the work? How was the work preserved through history, and how was it rediscovered in Europe?
- De Moivre's Theorem and Euler's Formula. Discuss Abraham de Moivre and his relationship to the formula $(\cos \theta + \sin \theta \sqrt{-1})^n = \cos(n\theta) + \sin(n\theta)\sqrt{-1}$. Discuss Leonhard Euler's work leading to the famous formula:

$$e^{i\pi} + 1 = 0.$$

[Source: *Dr. Euler's Fabulous Formula*, by Paul J. Nahin.]

- The History of Complex Numbers. When and why did square roots of negative numbers enter mathematics? Discuss Cardano's formula and the work of Rafael Bombelli. [Source: *An Imaginary Tale: The Story of $\sqrt{-1}$* , by Paul J. Nahin.]
- The Golden Ratio. Discuss the place of the number $\Phi = \frac{1+\sqrt{5}}{2}$ in mathematics. What mathematical and non-mathematical things have people said about this number? What is its relationship to the Fibonacci numbers? [Source: *The Golden Ratio*, by Mario Livio.]
- Fibonacci and the *Liber Abaci*. What do we know about Fibonacci? Discuss the significance of his mathematical work the *Liber Abaci*. Discuss his role in introducing the Hindu-Arabic numerals (1, 2, 3, 4, 5, 6, 7, 8, 9, 0) to Europe. [Source: *The Man of Numbers: Fibonacci's Arithmetic Revolution*, by Keith Devlin.]
- Fermat's Christmas Theorem. What does this theorem say? Who proved it, and when? Discuss in particular the early contributions of Diophantus, Brahmagupta, and Fibonacci.
- Fermat's Last Theorem. What does this theorem say? What does it have to do with Fermat? Describe the progress of attempts to prove the theorem from Leonhard Euler to Andrew Wiles. (You do not need to go into full mathematical detail!) [Source: *Fermat's Last Theorem*, by Simon Singh.]

You are also free to choose your own topic. I'm happy to meet and discuss choices.