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Nerd is the Word

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"I'm very much against the system where the absolute majority of the human population is afraid of numbers," says Shamik Banerjee, a software developer in Pune, India, who volunteers at the math-help site `MathNerds.com`. MathNerds recently celebrated its tenth birthday and has responded to more than 100,000 questions in its lifetime, giving encouragement, hints, guidance, and references—but not answers!

MathNerds is an example of **inquiry-based learning**. The executive summary of IBL is "we don't give answers," but the fundamental difference from other teaching methods is that it emphasizes the **process of finding things** out rather than the things themselves. IBL includes a conversation between student and teacher, but the student does most of the talking. The teacher gives encouragement and guidance, but not much knowledge—the student spends most of his time thinking about questions (hence "inquiry") rather than listening to answers. Conversations typically are slow and take place in short segments over several days.

MathNerds requires that the student type in not only his question but what work he has already done. This forces the student to think about the question first and allows the MathNerds volunteers to assess the student's maturity level. Wendy Woodland, a middle-school teacher whose students use MathNerds, says "Now my students can't just say, 'I don't get it,' because they have to write both their question and their work in order for MathNerds to accept and respond."

There are thousands of classroom math teachers who use IBL (although this is still a small percentage of all math teachers). MathNerds is probably the only online help service that uses this method.

MathNerds: The Early Years

In 1996 Ted Mahavier and Valerio De Angelis started MathNerds (originally called Math Doctor) at Nicholls State University to exploit a new medium, the World Wide Web. The demand for this service always outstripped the ability to provide it. They gradually expanded by recruiting their colleagues until by 1999 the service had about ten people answering several hundred questions a month. They started a recruiting drive to get more volunteers and they undertook a major upgrade to the website. Today the service has about one hundred active volunteers and answers about 1,500 questions per month.

MathNerds volunteers are a diverse group, ranging from bright high school students to mathematicians working in industry to university professors with doctorates. MathNerds has been publicized by articles in the popular press.

Often energetic students use the service and like it so much that they join as volunteers. Giorgi Dalakishvili from Tbilisi, Georgia says, "I'm 19 years old now and when I joined MathNerds I was 17. I had asked many questions to MathNerds and always got help from it. I wanted to help others like I was helped."

But Email is so 20th Century!

MathNerds is web-based but has a large email component. Participants receive an email alerting them of a change in a question (an answer, a comment, a follow-up question), which may prompt them to go to the web to make a reply. It takes a few hours to get a response (the average time for the initial response is under seventeen hours). That may seem like a long time in this age of instant messaging, but remember that IBL uses slow conversations, so it's not obvious that IMs or chat rooms would improve the process.

There was a pilot project using Yahoo! Messenger in early 2005. The volunteers working on the pilot liked it, especially the Doodle whiteboard feature for writing math. The main drawback was that it required the volunteers to spend a lot of time online waiting (much like professors offering office hours) and did not fit with the way they like to work online.

One of the attractions of volunteering at MathNerds is that you can work whenever you want. "Maybe the glue is drying on some project in the basement, so I go upstairs, check the computer, and very often there is something there to respond to," says Don Girod, an emeritus professor at Canisius College. Dr. Girod's method works well for him—he is the champion answerer at MathNerds, having responded to more than 13,000 questions!

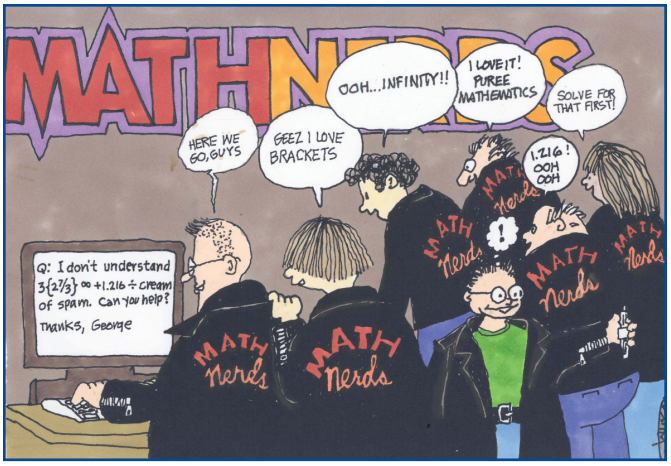
It Grows as it Goes

MathNerds has grown and evolved over the past ten years. What will the next ten bring?

The **MathNerds Mentoring Network** (MMN) is still in the pilot stage and will probably change a lot over the next few years. It uses the existing MathNerds technology to provide a local service to mentor future teachers. Math questions from local school district students go to the future teachers, who can practice answering student questions without traveling to the classroom. The current system is a conversation between a student and a volunteer. MMN will upgrade the technology to create a **wiki** where several pre-service teachers and their teacher collaborate to develop the best approach to a student's question.

A **new online journal**, the *Journal of Inquiry-Based Learning in Mathematics* (`www.jiblm.org`) started in May 2007. JIBLM solicits and publishes university-level IBL course guides, and houses an archive of over 1,500 pages of inquiry-based materials that the founders of MathNerds have collected and typeset, many donated by Guilford College's *Journal of Undergraduate Research*.

A **new Spanish-language** version of MathNerds provides the same help service for Spanish speakers, with some Spanish tutorials. The MathNerds network of volunteers already included several Spanish speakers, and this new service leverages the existing website to extend the service.



Cartoon courtesy of John Johnson

Past and current support for MathNerds projects has come from Cajunworks, Lamar University, Xavier University of Louisiana, Meadows Foundation, Educational Advancement Foundation, and Texas Education Agency. The volunteers work for free, and MathNerds remains a labor of love. As Esther Fontova, a volunteer since 1998, says, "Why do I participate in MathNerds? I am sure I do it out of selfishness; where else would I get heartfelt thanks and/or blessings that give me so much pleasure? ■

How Much is a $5 Betting Coupon Worth?

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When it first opened, the Crown Casino in Melbourne, Australia charged for admission. In return, the patron was given a $5 betting coupon:

> *The $5 coupon can be used to make any standard casino bet. If the bet succeeds, the patron receives their normal winnings; win or lose, the Casino collects the coupon.*

What is the value of such a coupon? One quickly realizes that it is worth less than $5, even discounting the Casino's edge. For example, making a 50-50 bet—say, betting red or black on roulette, but ignoring the zero—the coupon is worth $2.50: half the time we win $5 (and the coupon has disappeared), and half the time we win nothing. Allowing for the single zero on an Australian roulette wheel, the average win is $18/37 \times 5 = \$2.43$.

Surprisingly, we can do better. (This was pointed out to me by my gambling colleague, Gary Watt.) Suppose we take 37 coupons, betting a coupon on each single number in roulette. Then, whatever number comes up, we win $35 \times \$5 = \$175$. Thus the value of each coupon when played on such a bet is $1/37 \times \$175 = \$4.73$. In fact, this was the best option available at the Crown Casino.

In general, suppose we make a bet with a probability of $1/n$ of success, and suppose that the expected return on this bet is $R \in [0,1]$. For example, the expected return on any roulette bet is $R = 36/37$ (e.g., after spending a dollar to play the game, you can win \$36 with probability 1/37 or you can win \$2 with probability 18/37). Then a normal successful bet of \$5 will win $(Rn-1) \times \$5$, plus the original \$5 staked, giving a total return of $Rn \times \$5$. Placing the coupon on such a bet, we don't have any \$5 stake returned, and thus the value of the coupon here is

$$V = 5\frac{(Rn-1)}{n} = 5\left(R - \frac{1}{n}\right).$$

The above calculation is very simple but it doesn't quite dispel the paradoxical flavor, the fact that the value of the coupon depends upon the probability of the bet succeeding. Perhaps the clearest way to think about it is to realise that, *if your bet succeeds then the coupon has been of no value to you*: the coupon has disappeared anyway, and the \$5 stake you otherwise would have had to risk has gone back into your pocket. Thus, expected returns being equal, you want to make the bet with the highest probability of losing.