Foreword
by Keith Devlin

What is the connection between Lindsay Lohan, Tina Fey, and mathematics? This marvelous new book will tell you the answer, as its authors take you on a tour of some of the books, plays, films, television shows, and video games that weave mathematics into their stories.

The novella *Flatland*, the movies *Good Will Hunting*, *A Beautiful Mind*, *Pi,* and *Stand and Deliver*, the stage plays (and in two cases subsequently movies) *Arcadia*, *Breaking the Code* and *Proof*, and the hugely successful television crime series *NUMB3RS*—I suspect these are the most obvious examples of the appearance of mathematics in popular culture. But they are by no means unique, as a quick glance at Alex Kasman's *Mathematical Fiction Homepage* (http://kasmana.people.cofc.edu/MATHFICT) will indicate. In this compendium, editors Jessica K. Sklar and Elizabeth S. Sklar provide 24 in-depth analyses of portrayals of mathematics in popular culture.

The editors do not seek to provide a comprehensive survey of all works that contain or refer to mathematics. Instead, they have assembled what for the most part are analyses of examples where the marriage of mathematics and popular culture has real substance.

The mathematical connection is not always apparent until someone points it out. Who would think there are mathematical ideas behind the popular television series *Lost* or the disaster movie *Outbreak*? The cult comedy movie *The Princess Bride* contains an oft-quoted scene that provides an illustration of game-theoretic reasoning, and Tolstoy's *War and Peace* uses calculus as a metaphor. Science fiction novels sometimes have mathematical themes, of course, as do some video games and some cartoons. Sport appears too, though the compendium's focus on culture means it does so by way of a bestselling book, Michael Lewis's *Moneyball*.

Though many of the examples of popular culture discussed can be (and frequently are) dismissed as "shallow," the very fact that mathematics lies just beneath the surface indicates that even "mass entertainment" can have a hidden depth. Regardless of the cultural status of the examples chosen, the authors consistently deliver in-depth analyses, and the result is a unique volume that will surely fascinate.

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A Mathematician Does the *New York Times* Sunday Crossword Puzzle[1]

Gene Abrams

Introduction

A Fourier series function is a deep mathematical concept. The subject of graduate courses. The heart of Ph.D. theses. The gist of research seminars. And the 84-Across clue in the July 5, 2009 *New York Times* Sunday Crossword Puzzle.

I've been an avid crossword puzzle solver for more than thirty years, having initially become afflicted during my (limited) downtime in math graduate school. For me, crossword puzzles, especially the (generally acknowledged gold-standard) *New York Times* Sunday Crossword Puzzle, provide a nice change of pace from my duties as a math professor, as well as an entertaining way to stay in touch with both historical subjects and popular culture. But until July 5, 2009, it had never occurred to me that mathematics might in fact constitute an integral part of the crossword ethos. Just how pervasive are mathematically-oriented clues and solutions in the puzzlers' world? In this essay we examine the ubiquity of math in the *New York Times* Sunday Crossword Puzzles.[2]

The structure of this essay loosely mimics the framework used to structure the collection in which it appears. In The Game we provide examples of mathematically-oriented clues and solutions appearing in the 2009 *New York Times* Sunday puzzles, and in The Players we explore responses from a survey of puzzle constructors regarding their backgrounds and interests in mathematics. Finally, we provide two appropriately-themed crossword puzzles which the reader is invited to solve.

The Game

In this section we describe some of the many examples of mathematics and mathematically-oriented constructs arising in the 2009 *New York Times* Sunday Crosswords (NYTSXs). First, we offer a quick primer on various aspects of the NYTSX, and on cross-

word-puzzling in general. A *cruciverbalist* is a person who constructs crosswords. We identify "across" clues using an "A" and "down" clues using a "D": for instance, 3A would indicate the clue corresponding to 3-Across. If a clue contains an abbreviation, then the corresponding solution will as well. It is not uncommon for some of the squares in a puzzle to include inscribed circles, typically indicating that the letter (or letters) which go into such squares are related to each other in some (usually-not-initially-obvious) way (see, for example, the puzzle *Perpetual Motion*, discussed below). Every NYTSX puzzle has both a title and a theme: the theme of a puzzle is usually its most entertaining, creative attribute. The title of a puzzle typically contains a hint as to what the puzzle's theme might be. We offer here two examples of themes and corresponding titles which we hope will provide the reader with some context for various observations which will be made later in the essay.

Example 1. The January 25 NYTSX is titled *Fiddle Dee Dee*. Its theme: each solution occurrence of "TT" is replaced with "DD." E.g., the clue "Dairy frivolity?" (22A) yields the solution UDDERNONSENSE.

Example 2. The April 26 NYTSX is titled *Roughly Speaking*. Its theme: some single squares hold the strings "um" or "er." E.g., the clue "Wall Street newsmakers" (93D) yields the five-square solution M E/R G E/R S (er, get it?).

It's Really Math

Some of the clues and solutions used in various NYTSXs might well have come straight out of a math textbook or math history book. Here are some examples (including my previously-mentioned favorite).

Date	Placement	Clue	Solution
March 1	9D	Some operators in Boolean logic	ANDS
March 15	109D	Arithmetic series symbol	SIGMA
April 19	119A	Like most primes	ODD
April 26	103D	Kind of power	NTH
May 24	76D	Trig ratios	SINES
May 24	86D	Common thing to count in	BASETEN*
June 14	77A	Mathematician Turing	ALAN
June 21	30A	Pair in an ellipse	FOCI
June 21	44A	Mathematician de Fermat	PIERRE
July 5	84A	Fourier series function	SINE
July 12	109A	Lead-in to calculus	PRE
August 2	63D	Enigma machine	CODER
October 11	26A	Prove it	THEOREM
November 29	58D	French mathematician who pioneered in the theory of probability	FERMAT
November 29	67A	Many curves, in math	LOCI
December 13	92D	Low point	MINIMUM

*That is, "base 10."

Not only does mathematics arise in individual clues and solutions, it may actually provide the theme of a puzzle. For instance, the theme of the May 24 puzzle, *Perpetual Motion*, centers on the notion of infinity. In this particular puzzle there are two sets of eight squares containing inscribed circles; each of these sets forms (roughly) an oval shape, and the two sets are (roughly) side-by-side in the puzzle. Once the solutions from the germane clues are entered, if one reads the letters in order around the first oval, the words SYMBOLOF are

formed; around the second oval, the word INFINITY appears. Of course, the two ovals side-by-side form the infinity symbol! The five themed clues produce solutions related to infinity: for instance, the 25A clue "Bond film that's a real gem?" yields the solution DIAMONDSAREFOREVER. The mathematical pièce-de-résistance follows from the puzzle's accompanying note, in which the cruciverbalist indicates that the solver should "connect the circles in one continuous line to identify a figure invented by 29-Down" (the solution to 29-Down is seventeenth-century English mathematician JOHNWALLIS, and the figure is the aforementioned infinity symbol).

As another example of mathematics lying at the heart of a crossword, the grid of the October 18 puzzle looks (roughly) like a spiral. The theme centers around Frank Lloyd Wright's design of the Guggenheim Museum, and includes the solution SPIRALSHAPE to the 120A clue "Controversial form that 43-Down used for 23-/29-Across."

It's Really Math-y

In addition to the standard mathematics words and phrases described in the previous subsection, there are also a number of NYTSX clues, solutions, and themes which give a nod to mathematics. For instance, the May 10 clue "Tendency to throw one's club after sinking a short stroke?" (40A) yields the solution PUTTERFLYEFFECT (a pun on "butterfly effect"); the July 19 clue "Greeting from Smokey the Bear?" (72A) yields the solution URSINEWAVE (a pun on "sine wave"); and the November 8 clue "Resident of a military installation?" (25A) yields the solution BASETENANT (a pun on "base 10"—which was the solution to a clue in the May 24 puzzle earlier in the year!).

In the June 7 puzzle, themed answers include the ordinals 1ST, 2ND, 3RD, 4TH, 5TH, and 6TH (written using numerals) in six squares containing inscribed circles. For instance, 1ST is the one-square entry at the intersection of the solution for clue "Witnessed" and the solution for clue "Teacher's question at the start of show-and-tell" (that is, the intersection of the solutions SEEN1STHAND and WHOS1ST). These six circles are laid out on the grid in a manner that evokes the image of the manual transmission pattern in a stick-shift car. There is a seventh circle in the middle of the pattern, with Neutral the one-square answer. The title of this puzzle? *Shifty Business*, of course.

To solve the August 2 puzzle, a solid knowledge of the Greek alphabet (an alphabet regularly tapped by mathematicians) is essential. Each of the themed solutions is a sequence of three Greek letters. For instance, the 79D clue "Group formed at Trinity College in 1895" yields the straightforward 3-square solution $\alpha\ \chi\ \rho$. But the 91A clue "Engine attachment," whose 5-square solution intersects the 79D solution at both solutions' third square, yields the tricky AIρSE (ρ = RHO, so AIρSE is read as "airhose").

It's "Real World" Math

The mathematical words most frequently occurring in everyday life are usually associated with magnitudes, sizes, geometric shapes, and Roman numerals, to name a few. There are numerous appearances of such words in the NYTSX's, including those in the following list. Of course I'm especially fond of situations in which the cruciverbalist has chosen to use a math-oriented clue, rather than an obvious non-math choice. (See, e.g., the March 8, March 22, and April 19 clues.)

Date	Placement	Clue	Solution
February 15	98D	It's nice when checks have lots of them	ZEROES
February 15	90A	Rocket's path	ARC
February 22	31A	Geometric fig.	CIR
March 8	115D	Kind of graph	BAR
March 22	44D	x in an equation	VALUE
March 29	78D	Circle makers	COMPASSES
April 5	86D	Abacus, e.g.	ADDER
April 19	106D	Algorithm part	STEP
April 19	120A	15%, maybe	TIP
April 19	103A	90-degree turn	ELL
April 26	21A	Two lines may make one	ANGLE
May 10	91D	Highest point	APOGEE
June 14	71D	Tithe amount	TENTH
June 21	74D	Eight: Prefix	OCTA
August 23	50D	Having digits	NUMERIC
August 30	13D	1,111	MCXI
September 6	81D	Year the mathematician Pierre de Fermat was born	MDCI
October 25	14D	Draws a parallel between	EQUATES
December 6	41D	Galaxy shape	SPIRAL
December 13	49D	Amphitheater shape	OVAL
December 13	97D	Numerical comparison	RATIO
December 13	105D	Three more than quadri-	SEPTI
December 20	12D	Geom. measure	DIAM

Really?

In this final subsection of The Game, we start by singling out two types of math-related clues and solutions which appeared in the 2009 NYTSXs. First, those words which are so uncommon that they left me wondering, despite nearly forty years in the math business, "Is that *really* a word?"

Date	Placement	Clue	Solution
February 15	51D	Quintillionth: Prefix	ATTO
May 3	66A	Duodecim	XII
August 30	10A	Four-sided figure	RHOMB

Second, those solutions which left me thinking, because of my nearly forty years in the math business, "Doesn't this *really* scream for a math clue?" (Here we first give the *solution*, followed by its corresponding clue.) Admittedly, the knowledge base required to interpret the given solution mathematically may not be acquired until graduate-level math studies.

Date	Placement	Solution	Clue
January 11	91D	RADII	Parts of forearms
May 31	112A	ERAT	Quod ____ faciendum
June 21	98A	PLUS	Anode indicator
July 19	59A	IDEALS	Topic in transcendentalism
July 26	27A	OLMOS	Actor Edward James ____*
August 9	37D	AMS	Pro ____
August 9	71D	ABACI	Summers
September 13	88D	HESSIAN	German mercenary
September 13	44A	EIGEN	Manfred ____, 1967 Chemistry Nobelist
October 11	1A	ANGLE	Fish
November 15	75A	TREFOIL	Girl Scout symbol
December 13	121A	DELTA	Mouth feature
December 20	26D	FALSE	Like some starts
December 27	63D	TEN	Big ____

*It would have been nice to see OLMOS clued as "*Stand and Deliver* star."[3]

We finish this section with some miscellaneous observations. It's not uncommon for a solution to be a number expressed in a foreign language in a NYTSX: for instance, ACHT (German for "eight") and SIETE (Spanish for "seven") each appeared in 2009. I learned some math history trivia in 2009: on March 29 it came to my attention that the Greek mathematician/philosopher Zeno hailed from ELEA, while on May 24 I came to find out that a painter named HALS produced a portrait of mathematician/philosopher René Descartes. And I became aware on January 11 of a (punning) interpretation of "numbers" which had never before crossed my mind: "Numbers?" (84D) OPIATES.

Think about it.[4]

The Players

Each year, thousands of puzzles are submitted to *The New York Times* by cruciverbalists (both seasoned veterans and first-timers) for review by puzzle editor Will Shortz and his staff. From among these, the 52 puzzles which are selected to appear in the Sunday *New York Times* are chosen on the basis of creativity, degree of difficulty, and breadth of included topics.

In 2009 there were 41 different individuals whose names appeared as an author or coauthor of a NYTSX. Will Shortz is the editor of each of the 52 puzzles. Some puzzles have just one author, others have two coauthors. (Since 52 puzzles were created by 41 people, the mathematical Pigeon Hole Principle implies that some cruciverbalists authored more than one 2009 puzzle. Indeed, one constructor can claim credit for five 2009 puzzles!)

In order to get a better sense of what exactly is driving the pervasiveness of math-oriented content in the NYTSXs, I put together a list of questions to ask each cruciverbalist about her/his connection to mathematics. Through the gracious assistance of Patrick Merrell, co-writer of *Wordplay*: *The Crossword Blog of The New York Times*, the following set of questions was emailed to thirty-seven of the forty-one 2009 puzzle constructors during the first week of January 2010. (Mr. Merrell included an introduction and context for these three questions, noting that potential responses would possibly be used to build the current essay.)

1. Describe your "relationship with mathematics." (For instance: Do you love it? Hate it? Did you take a lot of it in school? Or did you perhaps avoid it at all possible cost? Do you read general audience books about mathematics and mathematicians?)

2. If appropriate, describe any mathematically-oriented decisions you had to make when constructing your puzzle. For instance: Tony Orbach and Amy Reynaldo in the July 5 puzzle chose to use the clue Fourier series function to produce the answer SINE. *Be still my heart!* There are certainly more standard ways of getting SINE as an answer, e.g. _____ qua non, or Elementary trig function. Heck, Fourier series aren't typically presented in a math curriculum until graduate school…. For instance: There are Alans (resp., Pierres) other than Turing (resp., Fermat). See the June 14 (resp., June 21) puzzle.

3. Over the past twenty years or so, do you think there has been any change in the profile of mathematics in popular culture? If so, do you think that the amount of mathematics which is included as part of *New York Times* Sunday Crosswords has changed as a result?

Twenty of the thirty-seven constructors generously provided responses! (A 54 percent return rate on a voluntary survey? Are you kidding me? Heck, I've given *required* homework assignments which have yielded smaller return percentages.) These twenty respondents were responsible for twenty-eight of the fifty-two NYTSX's put out in 2009. As I'll describe below, the responses indicate that the connection between mathematics and cruciverbalism runs quite deep.

1. **Relationship with mathematics**. For many of the respondents, their "relationship with mathematics" is close and ongoing. The twenty respondents include a D. Phil. in Mathematics (from Oxford); a holder of both a B.S. in Mathematics and an M.S. in Applied Statistics; a high school math teacher with more than forty years experience in the classroom; and a consulting actuary who minored in math in college. Add to these a number of people with strong science and/or high tech connections: a family practice doctor; an M.B.A. holder in Information Systems; a veterinarian; and Ph.D. holders in Operations Research (more info on this respondent appears below) and Chemical Engineering. The vet mentioned that he loved math in high school and college, and even went so far as to contact his high school math teacher "45 years after graduation — just to tell her what a great teacher she was." The M.D. modestly described himself as "capable, but not a whiz" at math, although the author has learned that this respondent did complete a year of calculus at an Ivy League school. One 2009 puzzle constructor, currently a high school junior(!), indicated that he was indifferent to math during his freshman and sophomore years, but, now that he's taking calculus, he "…absolutely love[s] it."

For some respondents mathematics is an interest or pastime, but nonetheless has been relegated to bridesmaid status in their studies or life pursuits. One, currently a college student, notes that "If I weren't studying linguistics, there's a good chance I'd be studying math." Another writes: "I started violin studies at nine years old, and so math is an integral part of my life. I loved math class, especially geometry. I opted for music studies instead of calculus. The mathematics of a musical score are highly ordered, as are relationships between notes in the musical scale."

Only one of the twenty respondents admits to being "…decidedly NOT a math person." The remaining respondents all indicated at least some degree of comfort or ability with mathematics: "[I received a grade of] A in calc in college"; "[I did] much better on math SAT and GRE scores than verbal, but didn't like math and majored in English"; "[I] loved math until Calculus kicked my butt in my senior year of high school"; "I went to a math/science HS — I like math, but don't love it."

A number of respondents commented on the connection between puzzles and mathematics. One notes that he "loved junior high school plane geometry … figuring out proofs was literally akin to solving a puzzle." He went on to comment: "…I've been surprised to find over the years that a lot of constructors have math-oriented or music-oriented careers…. Maybe there's more to the math angle [and its relationship to crosswords] than meets the eye."

To appreciate what is clearly the most compelling "relationship with math" response I received, some historical background is in order. When the mathematical prodigy Ramanujan was in the early stages of his career in India, he shared some of his mathematical writings with various mentors in his Madras community. One such important mentor to Ramanujan was the respected mathematician S. Narayana Aiyar, in whose office the *wunderkind* was

employed as a clerk. Narayana Aiyar recognized the sheer genius demonstrated by Ramanujan's work, prompting him to recommend Ramanujan to the world's leading number theorist at the time, the British mathematician G. H. Hardy. The eventual collaboration between Hardy and Ramanujan born of this recommendation is now the stuff of legend. (Kanigel 95–98, 102–06; n.b.: "Aiyar" is spelled "Iyer" therein).

Wrote one respondent:

> I know this is going to sound bizarre at first, but my association with math predates my birth. I'm named after my great-grandfather, Narayana Aiyar…. Since the day I was named after him [he was my grandmother's father], my grandmother's only requirement was that I live up to his reputation (quite an awful burden for a kid, don't you think?). I've always loved math — being grandma's favorite must have helped! — so I ended up [in a very math-intensive field, eventually] earning a Ph.D. in industrial engineering/operations research. I guess you could say that I took a lot of math. As a matter of fact, I make my living applying math.

2. **Mathematically-oriented decisions**. When I crafted this second survey question, what I expected to receive as responses to it were explanations as to why a cruciverbalist might use a math-oriented clue in a situation in which other clue options exist. (I've mentioned specific such examples previously. Indeed, the "Fourier series function" clue provided the original motivation for this essay.) As it turns out, many of the responses did in fact address this question directly. But at least as many discussed more general relationships between mathematics and puzzle construction.

Here are the responses of the type I expected. One respondent suggested that he would "…prefer to use science/math clues if possible when a word has different contexts," while another, conversely, said that he will "…oftentimes discount mathematical and scientific answers / clues because they typically are not considered to be of relatively general enough knowledge by puzzle editors." A third "…doesn't deliberately try to include math answers." (This respondent indicated that he actually doesn't deliberately try to include answers relating to *any* specific subject too often, even those subjects that he personally likes, in order to avoid alienating those puzzlers who don't share his taste for those subjects.) A fourth suggested that his familiarity with math and computers is a "hindrance" much of the time, since things that he might find familiar might be totally unfamiliar to the average solver. A fifth remarked that he considers "…math and the sciences [to be] an absolute necessity in puzzles in terms of clues and answers, because they are an integral part of the broad spectrum of human knowledge and accomplishment." Our previously-mentioned high schooler wrote that his clue "Produce some combinations, say," with solution BOX was "…purposely intended to misdirect any math people."[5]

Here are the responses which, to me, were completely unexpected. One respondent suggested that "[Puzzle construction] is often a degree-of-freedom problem. Basically, filling the grid [once the themed solutions have been set] is like solving, semi-simultaneously, a set of 70+ equations (i.e., words)." In the same vein, another response noted that "Constructing a crossword involves solving a constraint satisfaction problem." The first constructor continues:

> On top of the degree-of-freedom analysis, there's an optimization that takes place in every constructor's mind. It is not uncommon for a constructor to have to choose between using, say, A) two fun words and two bland words, and B) three really fun words and one terrible abbreviation. As a solver, what would you prefer? Obviously, this is a rhetorical question.

A third constructor wrote, "All puzzlemaking is based on specific mathematical principles of symmetry and percentages. We observe strict rules for black / white square percentages, and word limits." Disagreements can arise among co-constructors regarding which clue to use for a particular solution; a fourth respondent described a numerically-based system for trying to resolve such issues. Narayana Aiyer's great-grandson waxed poetic about the relationship between cryptic clues (ones which require additional levels of interpretation on the solver's part)[6] and mathematics. "In a broader sense, cryptic clues have a sense of mathematical completeness that make[s] you want to write QED after you've solved them…. You know you have the answer the moment you solve the clue: there is really no need to solve the intersection clues for confirmation."

Ironically, although I learned a great deal about the decision-making processes which go into the selection of clues, in the end I did not achieve closure vis-à-vis the motivating question. The July 5 puzzle was constructed by Tony Orbach, Amy Reynaldo, and editor Will Shortz. Amy Reynaldo wrote: "We submitted two clues for SINE: "Trig function" and "Fourier series function." I know nothing about Fourier series functions … I have no idea where that [clue] came from!" Tony Orbach wrote: "I would love to say that Amy or I had been champing at the bit to get that SINE clue in — I don't think so." Both Orbach and Reynaldo, however, offered enlightening follow-up comments. Orbach:

> In general, though, I think most crossword constructors would like to use a less common clue for a given word whenever possible. We also strive to limit use of fill-in-the-blank clues, so that was most likely the reason to decide to look beyond "____ qua non." Armed with a computer and reference books and being in search of an interesting clue, you never know where you might end up — looking at the Fourier series, perhaps! [Orbach].
>
> Maybe a *Diary of a Crossword Fiend* blog commenter suggested [the clue] around the time Tony and I were working on the clues. [Reynaldo (italics added)].

So, in the end, an unnamed blog commenter may in fact be the one to thank for creating the "Fourier series function" clue. And to thank, as well, for inspiring this essay.

3. **Profile of mathematics in popular culture**. As to the question of whether or not the profile of mathematics in popular culture has changed over the past twenty years, the vast majority of responses can be collectively paraphrased as "not much, if at all."

A few of the respondents mentioned that the depiction of math in popular culture, other than in the TV series *NUMB3RS*, was at best unflattering; they wrote that mathematicians are made out to be "eccentric, mentally unbalanced geniuses" and that "…math and science is viewed as something nerds would be interested in." One stated: "I don't see that we've moved a great deal beyond the stereotypical portrait of nerds with pocket protectors."[7]

As to the specific question of the appearance of mathematically-related items in the NYTSXs, one respondent noted that there are certainly more "hi tech" clues than there used to be, while another noted that "…allusions to math in the past were minimal compared to now."

One contributor commented that creative, geometric shapes are now often used in the grid itself (e.g., in the previously-mentioned October 18 spiral puzzle). A handful of respondents remarked that the amount of mathematically-oriented content appearing in NYTSXs has increased during Will Shortz's tenure as editor (which began in 1993).

Conclusion … and Puzzles!

As one survey respondent put it, "crossword puzzles … wind up reflecting a fair amount of pop culture." We hope that this essay has brought to light an interface between mathematics and popular culture, reflected in the *New York Times* Sunday Crossword Puzzles. We also hope the reader will try her/his hand at solving the two puzzles given below. Our intention in presenting these puzzles is to give the reader topic-appropriate examples of how title, theme, and clue choice combine to produce challenging, informative, and (hopefully) entertaining puzzles.

The first puzzle, *MATH and Popular Culture*, should be accessible to the crosswording novice. (We note that this puzzle, at grid size 1515, is smaller than the standard 2121 grid size used in most *New York Times* Sunday Crosswords.) The second puzzle, titled *Do the Math*, is more representative of the type of puzzle which would actually appear as a NYTSX. (A short *mea culpa* is warranted here: *Do the Math*, constructed by the author of this essay, admittedly violates some of the aforementioned common guidelines of good cruciverbalism.)

Notes

1. This essay is dedicated to the memory of Stan Abrams; a puzzle and pen were his constant companions.

The author is extremely grateful to each of the twenty respondents to the survey of 2009 NYTSX puzzle constructors. They are, in alphabetical order by surname: Alan Arbesfeld, Michael Ashley, Eric Berlin, Daniel Finan, Victor Fleming, Matt Ginsberg, Elizabeth C. Gorski, David J. Kahn, Lynn Lempel, Caleb Madison, Patrick Merrell, Andrea Carla Michaels, Will Nediger, Tony Orbach, Amy Reynaldo, Phil Ruzbarsky, Barry Silk, Michael Torch, Narayan Venkatasubramanyan, and Robert H. Wolfe. Special thanks to Patrick Merrell for agreeing to email the survey questions to the 2009 constructors. Very special thanks to Victor Fleming, who through a series of email correspondences taught me some of the do's and don'ts of cruciverbalism; this e-discussion provided the impetus for the construction of the first of the two puzzles which appear in this essay. The author acknowledges John Allen Paulos, whose numerous books about mathematics' role in society include *A Mathematician Reads the Newspaper* and *A Mathematician Plays the Stock Market*; the title of the current essay derives from these.

2. That the *New York Times* Sunday Crosswords should provide a reflection of popular culture is indicated by puzzle editor Will Shortz, on the *Times*' Crossword Submission Guidelines website. Shortz writes that the Sunday puzzles provide "…well-balanced test[s] of vocabulary and knowledge, ranging from classical subjects like literature, art, classical music, mythology, history, geography, etc., to modern subjects like movies, TV, popular music, sports and names in the news."

3. *Stand and Deliver* is a 1988 film which tells the true-life story of Jaime Escalante, a math teacher in a longtime-underachieving urban Los Angeles high school who helps a group of students prepare for, and ultimately pass, the AP calculus exam. The film stars Edward James Olmos as Escalante, and features Lou Diamond Phillips in a supporting role as one of the students. Olmos' portrayal of Escalante earned him a 1989 Oscar nomination for Best Actor in a Leading Role, and the film was hugely popular upon release.

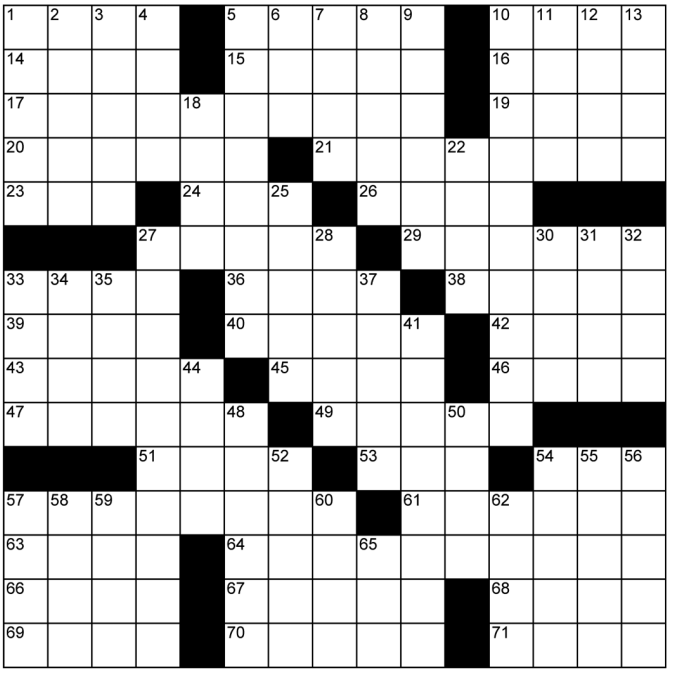
4. Hint: Opiates are things that numb…

5. The word "combination" has a precise interpretation to a mathematician as "subset." For instance, if we start with the set $S = \{a, b, c, d\}$, the subset $\{a, c\}$ is a *combination chosen from S*. Specifically, in a "combination," elements are not repeated, and the order in which the elements are presented does not matter. E.g., the combination $\{a, c\}$ is the same as the combination $\{c, a\}$. The word "combination" is contrasted to the word "permutation," a related concept in which the order of the elements does play a role.

6. For instance, in the August 30 puzzle *Literally so*, the 121A clue "W--THL-SS R-AD-TER" looks like the words "worthless roadster," but without the letters "OREOS." The solution should therefore be some sort of response which can be interpreted as a bad car from which sweets have been removed. Answer? LEMONDROPCOOKIES.

MATH and Popular Culture

Gene Abrams / Victor Fleming



Puzzle accompanies the essay "A Mathematician Does the New York Times Sunday Crossword Puzzle" by G. Abrams

ACROSS

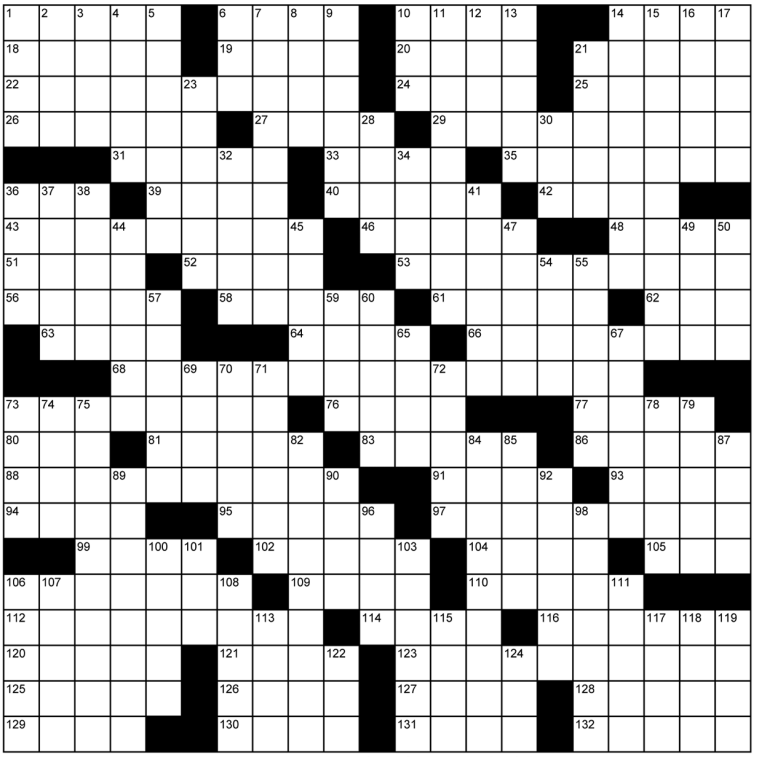
1 Finished the cake
5 Scam with a fake Web page
10 Hawaiian four-stringers
14 Alaskan city 1,161 16-Acrosses from where the Iditarod starts
15 "Shucks!"
16 1,760 yards
17 Like Plato and Socrates, say
19 ___ mater
20 Traveling, as a road show
21 Repetitive toy train sound
23 Ham on ___
24 ___ TURN (turnpike sign)
26 Babe in baseball
27 Arkansas or Colorado
29 Store-bought hair
33 Farm-related prefix
36 Of sound mind
38 Suave competitor
39 Trudge
40 Person, place or ___
42 ___ Diner (establishment on "Alice")
43 Latin profession?
45 19-country grp.
46 Downwind, on deck
47 Cloverleaf component
49 Coin worth five shillings
51 Polynesian food
53 Author Le Shan
54 ___ de Cologne
57 Kind of district where landlords may flourish
61 Prepares burgers, perhaps
63 Port of Pennsylvania
64 Promos touting the nonexistence of positive integer solutions to x^n + y^n = z^n for n>2 ?
66 "Mad" cartoonist Drucker
67 First-string players
68 Agcy. that inspects workplaces
69 "To Live and Die ___" (1985 film)
70 Peter of "Young Frankenstein"
71 Green veggies

DOWN

1 ___ it (about to experience trouble)
2 Like many a bad one-liner
3 Overdo the stage directions
4 Trial version
5 Traditional Sunday fare
6 1968 election monogram
7 "___ Around" (Beach Boys hit)
8 Mexican mister
9 Baseball sportscaster's cry
10 "Pulp Fiction" acress who tells a joke that starts, "Three tomatoes are walking down the street ..."
11 Start to meter?
12 Ticklish doll
13 Chair
18 Female relative
22 Car roof variety
25 Salt Lake City native
27 In meteorology, expression used to denote the standard deviation of wind direction
28 Computer of the '40s
30 Banana covering
31 Magazine that gives Style awards
32 Last term in many a threat
33 Concerning, in a memo
34 Isolated valley
35 Sound of a crows
37 ___ nous (confidentially)
41 Words of congrats to an athlete, often
44 Actor Sharif
48 House that goes up quickly
50 Bit of Halloween makeup
52 "Takes ___ know ..."
54 Alex's mom on Family Ties
55 Word before male or particle
56 "___ directed"
57 Half up front?
58 Its atomic weight is 55.845
59 Tomorrow's woman
60 Deuce topper
62 Flapjack chain
65 Practice starter?

Do the Math

Gene Abrams



Puzzle accompanies the essay "A mathematician does the New York Times Sunday Crossword Puzzle" by G. Abrams

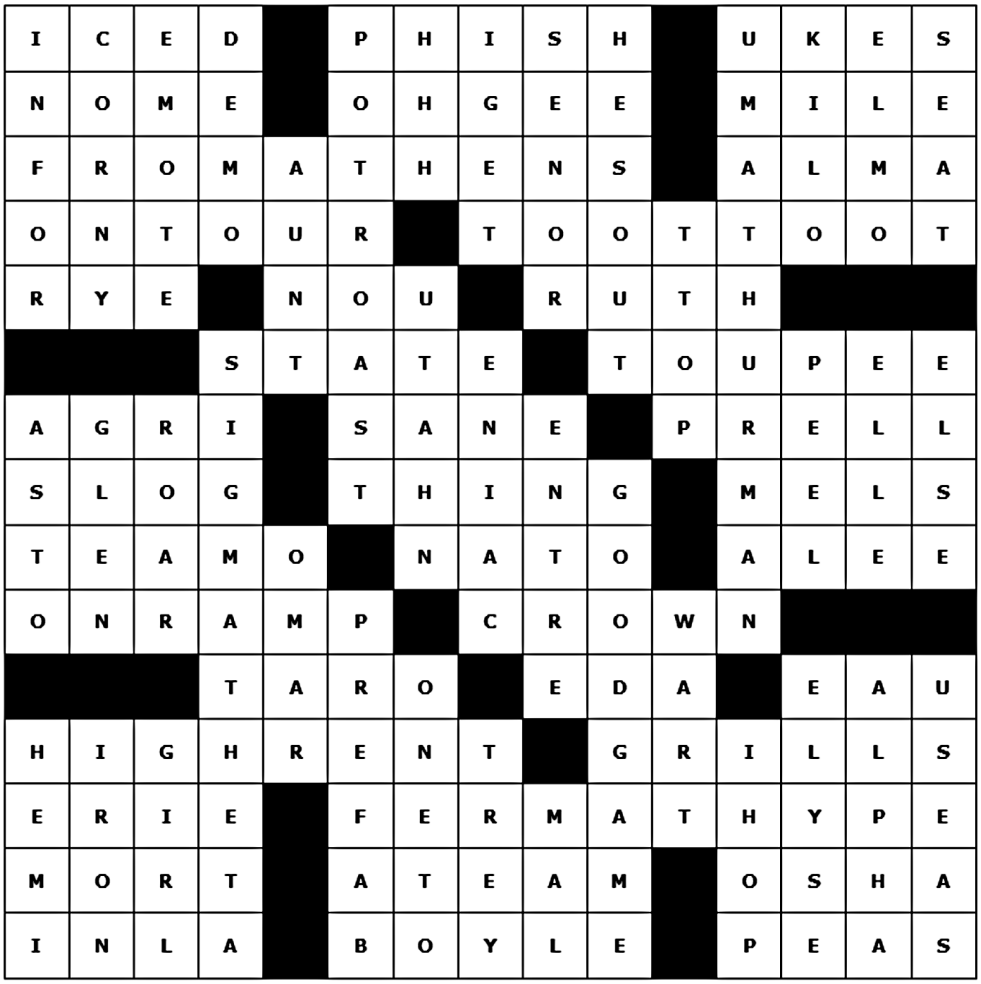
ACROSS

1 *Amazon port city*
6 *Melville main man*
10 *Opening scene*
14 *Approximately*
18 *Sports venue*
19 *One of 71D*
20 *Painful sound*
21 *Brat topping*
22 *Actress Mia Wallace?*
24 *Certain*
25 *Send payment*
26 *Ramanujan university*
27 *Viking explorer*
29 *No legal move*
31 *Tennis star Dementieva*
33 *Kon-_____*
35 *He again turns off the sound*
36 *Elec. cash dispenser*
39 *Clarkson was the first*
40 *Pavarotti sings Ave Maria either in C, _____*
42 *Son after Abel*
43 *Musketeer post-diet?*
46 *Town on Hawaii's Big Island*
48 *Unhappy utterance*
51 *Sweater Girl Turner*
52 *Charlie's wife*
53 *Rescuer after chem. explosion?*
56 *School on the Seine*
58 *Sculpts with steel*
61 *St. Petersberg sister city*
62 *Bygone can material*
63 *Emerald Isle*
64 *Part of Q.E.D.*
66 *Imelda's narrow stilettos*
68 *Blues singer Willie Mae?*
73 *Displaced persons*
76 *Grape residue*
77 *Utah mountain bike mecca*
80 *Blood doping hormone*
81 *Paper used in artwork*
83 *Plumb loco*
86 *Sound*
88 *For n>2, x^n + y^n = z^n has no positive integer solutions! ?*
91 *Country Slaughter*
93 *Afghanistan province*
94 *Tractor and trailer*
95 *Internet gossip*
97 *Umpire Hallion calling balls and strikes?*
99 *Med. school course*
102 *Sedgwick and others*
104 *Ladies' lanes lg.*
105 *Cartoon drawing*
106 *Lake and province*
109 *Bruins' sch.*
110 *Biblical lady-led land*
112 *Hall of Fame 2nd Baseman Charlie*
114 *Coup d'____*
116 *Jefferson place*
120 *Families have them*
121 *Money for a month*
123 *Departing Venizelos International?*
125 *Danish town near Odense*
126 *Author Stanley Gardner*
127 *Mean man*
128 *Reddish dye*
129 *Paranormal abilities*
130 *Ascent*
131 *Tomato type*
132 *On the plus side*

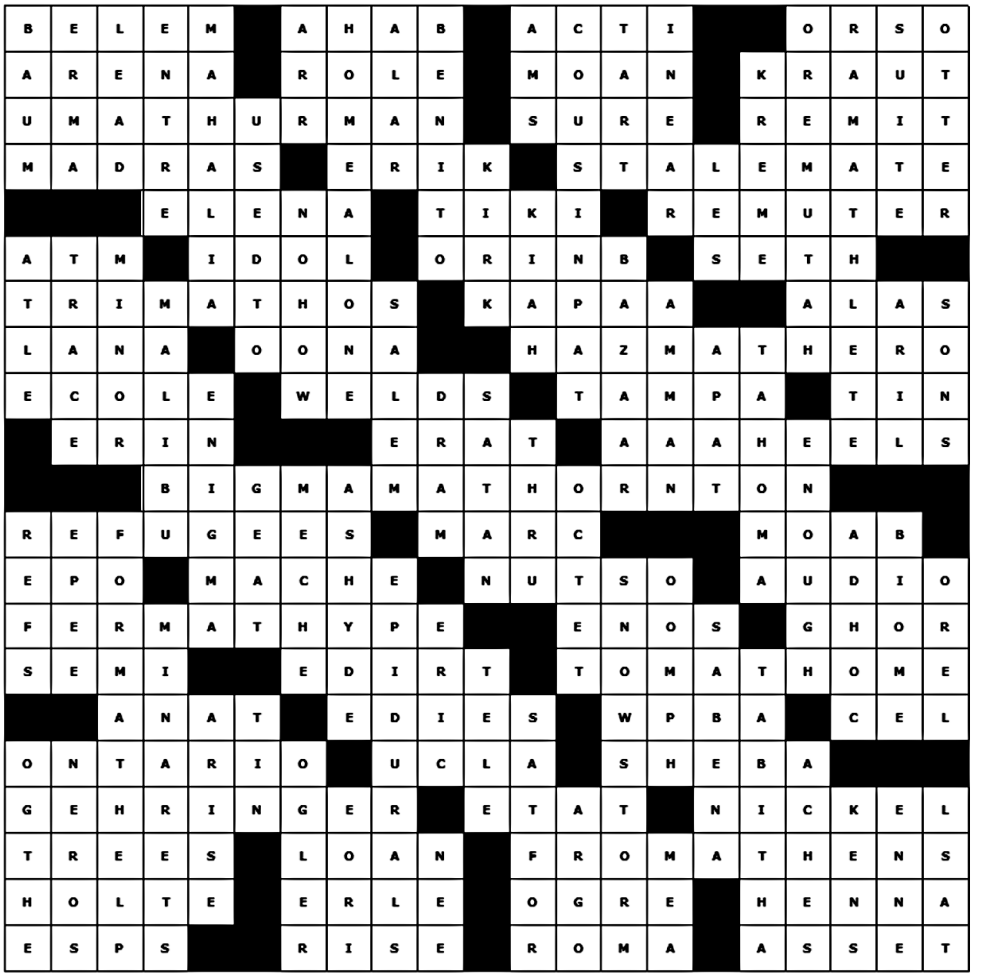
DOWN

1 *Oz creator*
2 *Humorist Bombeck*
3 *"_____. or get out of the way!"*
4 *Between in Barcelona*
5 *Gospel singer Jackson*
6 *Penn. Stn. sign*
7 *Christmas movie*
8 *Winglike*
9 *Adolf's ally*
10 *Puzzle-appropriate prof. org.*
11 *Teddy's 3rd child, to Jon Jon*
12 *Sour*
13 *Type of hearing aid*
14 *City south of Salt Lake*
15 *Colorado State NCAA participant?*
16 *Large hotel room*
17 *Playful mammal*
21 *Krispy ___ donuts*
23 *Had in the past*
28 *Enterprise captain*
30 *Guitarist Paul*
32 *"____, no way!"*
34 *Australian girl's name*
36 *Norwegian Fields Medalist Selberg*
37 *Outline in pencil*
38 *Secondary area of study*
41 *Marketplace*
44 *Pepperdine home*
45 *Oregon capital*
47 *Jordan capital*
49 *Seed cover*
50 *Tevye had none*
54 *___ on the back*
55 *Town on Lake Tahoe*
57 *WWII code machine*
59 *Unit of volume*
60 *Devil*
65 *Finished, in a text message*
67 *Sufficient*
69 *Beowulf tribesman*
70 *Royals pitcher Gil*
71 *Fredric March, both as Jekyll and _____*
72 *Eight at music*
73 *Umps*
74 *Olympic sword*
75 *Assistance from an editor?*
78 *Not generalizable*
79 *Climactic region*
82 *Childbirth pain blockers*
84 *Blizzard*
85 *Exertion sound*
87 *Pitcher Hershiser*
89 *Mosque features*
90 *Anglicized 27A*
92 *Former Belgian airline*
96 *At a distance*
98 *Bewitched girl*
100 *Get up*
101 *Bygone can material*
103 *Took 119D, as an example*
106 *Amorite king _____ Giant*
107 *Roman fiddler and others*
108 *One who stares*
111 *Often paired with pains*
113 *One-letter prefix connoting high-tech*
115 *Jason's ship*
117 *Lay and Kesey*
118 *Feminine suffix*
119 *Ref. to 103D*
122 *Birth surname*
124 *"___ culpa!"*

Solution to *MATH and Popular Culture*



Solution to *Do the Math*



7. Many in the mathematics community have been working hard over the past few decades to increase the profile of mathematics in popular culture. So I was admittedly somewhat discouraged by the overall tone of these responses.

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About the Contributors

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Kris **Rowan** is an independent scholar who is fascinated by popular culture, from film and television to music and photography. She is the author of and contributor to numerous pop culture blogs online. While her educational background is in liberal arts, she works as a project manager in the field of information technology.

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