Book Review

The Numbers Behind *NUMB3RS*: Solving Crime with Mathematics

Reviewed by Brent Deschamp

The Numbers Behind *NUMB3RS*: Solving Crime with Mathematics
Keith Devlin and Gary Lorden
Plume, 2007
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Since reading *The Numbers Behind* NUMB3RS*: Solving Crime with Mathematics*, I've started watching the television show *NUMB3RS* again. I've always found crime dramas predictable and repetitive, and nothing much has changed. Still, I've tuned in a few times out of a morbid curiosity spawned from this book.

As many readers know, *NUMB3RS* focuses on FBI agent Don Eppes, who solves crime with the help of his younger brother Charlie, a mathematician.

The question I've been asking myself since I finished the book is: why was this book written?

The authors, Keith Devlin and Gary Lorden, offer a reason in the opening line of the appendix. They write, "'Is the math in *NUMB3RS* real?' Both of us are asked this question a lot." The two are certainly qualified to answer. Both hold doctorates in mathematics, Devlin works at Stanford, and Lorden works at Caltech. Both are also reasonable people to ask. Devlin is known for his work promoting mathematics on National Public Radio, and Lorden is the mathematical consultant to *NUMB3RS*.

From this question one infers the book was written to show how the math in *NUMB3RS* is real, but I'm not entirely comfortable with that response. This is not really a book about mathematics; it deals too much with the television show to merit that description.

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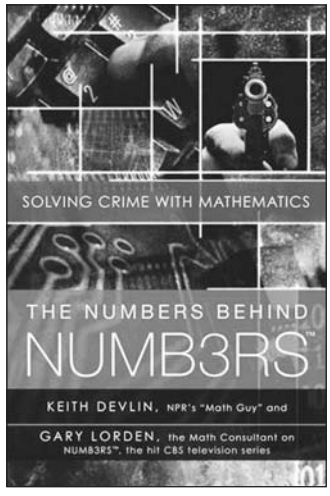

Thus, I keep asking, is this book selling math, or is it selling the television show? Why was it written?

To be sure, this book contains math, and it is good math. In thirteen chapters the authors cover the following topics: geographic profiling, statistics, data mining, link analysis, geometric clustering, machine learning, neural networks, facial recognition software, change-point detection, Bayesian inference, DNA profiling, cryptography, fingerprints, networks, risk analysis, and math in casinos. It's interesting, and for the most part it's well written.

But then the book ends with an appendix providing an episode guide for the first three seasons of the television show. Why is that important, and what does it have to do with the math involved in crime solving? Most of the entries read like a slightly more intelligent version of the kind of entries logged on a fan's website. Yes, vague descriptions of the math used in each episode are mentioned, but they are just that: vague.

If this 256-page book is meant to explore the use of math in crime solving, then why is nearly fifteen percent of the book solely devoted to the television show?

Based on what has been written thus far, it may seem as if my opinion of this book is rather poor. Certainly, parts of the book are rather disappointing, but other parts are fascinating. I learned a lot from this book. I'll focus on the two chapters I found most intriguing.

The chapter on DNA profiling was an eye-opener for me. Like most people I have a rough understanding of how DNA matches are done, but until reading this book I had little idea of what truly goes into performing a DNA comparison. Only certain loci on the DNA strand are used in the comparison, thirteen locations in all, and even then the exact sequence is not recorded, but instead a count of the various base pairs is recorded. A DNA profile, to me, now feels more like a hash function.

What was more surprising, though, was the authors' discussion of the FBI CODIS system that houses DNA profiles. If evidence points to a suspect, then obtaining a DNA sample and comparing it to DNA evidence found at the scene has a very low probability of showing an incorrect match. If instead the authorities run a search of CODIS looking for a DNA match, a "cold hit", then the odds of finding an incorrect match rise dramatically. The authors end the chapter with calculations based on the Arizona state database. With 65,000 entries they show the probability of finding two matches that agree on nine of thirteen loci during a search for cold hits is about five percent.

These sorts of discussions are fascinating for two reasons. First, it's nice to see math in action. The science is well presented, and the book discusses the differences inherent in the two viewpoints of having a suspect and searching for a suspect. By the end of the chapter an argument has been made that is based on sound mathematical principles and shown in direct calculation.

Second, it points out a common misconception. I've seen my fair share of crime dramas, and I can recall many instances where a DNA sample was run through the system and a cold hit was found. Inevitably, the name on the screen turned out to be the killer. On television, DNA enjoys an aura of infallibility, and discussions like these point out that methodology is just as important as facts.

The discussion is also paired with an actual court case and reports from the forensic community about DNA profiling. In this way the facts become more than an academic enterprise. The chapter has a reality to it that sells the material.

Another chapter that revolves around an actual court case is the discussion of image enhancement. The case involves the beating of Reginald Denny in 1992 during the Los Angeles riots following the Rodney King trial. Damian Williams stood trial for his participation in the beating, and the defense used image enhancement of news footage to show the attacker in the film had the same rose tattoo as Williams.

Since the book is aimed at a general audience, the process of image enhancement is not described in detail. An additional section offers a brief glimpse of deeper math using functions and derivatives, and the readers are told they can skip this section if they don't have the requisite background. It is a nice inclusion, but at a single page it could have been more detailed. Still, the discussion is clear and informative, and readers should have a better understanding of how image enhancement works.

Is this book a product tie-in for the show, …or is it a book about mathematics?

In terms of detail this book is rather light. The chapter on geographic profiling has a wonderful discussion of how each piece of a given equation relates to the rationale used in geographic profiling. The discussion of DNA profiling is just as detailed. The chapters on change-point detection and graph theory both have adequate discussions, but some chapters are woefully vague.

For example, in the chapter on data mining, many forms of data mining are discussed, but none is explained in any depth. This is an area I know nothing about, and so I had hoped I would walk away with a better understanding of neural networks and other forms of data mining. Instead I learned just enough to realize that I still knew nothing. Why not devote a few pages to providing some additional detail, as in the chapter on image enhancement? If twenty-five pages can be used to provide episode summaries, why can't a few pages be used to better explain data mining?

My frustration with this book is that when it succeeds, it provides great insight, but most of the time it falls short.

My other frustration has to do with the continual inclusion of material from the television show. Only four out of thirteen chapters are motivated by real-world cases in which mathematics played a vital role. The remaining chapters begin with a plot synopsis of some episode as motivation for the discussion. The topic is explored, but eventually we find ourselves once again reading about how Don and Charlie get the bad guys using math.

Why?

Is this book a product tie-in for the show, a marketing ploy, or is this a book about mathematics?

I get the impression the authors can't decide. If mathematics is as useful as this book claims, then shouldn't there be plenty of actual cases where math played a role? Why should the authors have to resort to using television fiction to make their case? In fact, they answer this question by presenting numerous cases where math played a role. So, the fiction isn't needed, but it overwhelmingly overshadows the real world in this book. Couple that with the episode guide in the appendix, and the entire book feels less like a book about math and more like something concocted in a marketing meeting.

Some people will argue that Charlie Eppes and *NUMB3RS* provide a way to reach people about the power of math. I cannot argue that point. It is nice having a figure in popular entertainment who puts an accessible and interesting face on a subject that is often disliked. Those same people could also argue that using Charlie in a book like this does much the same thing. People who would not ordinarily read a book about math might just pick this one up because the presentation is accessible: Charlie, a fictional character, provides the link to the applications of math.

But I disagree. The discussion of real-world cases riveted me. The chapter on statistics involved a discussion of a nurse nicknamed the "Angel of Death". Statistics led to her indictment but wasn't used in her trial. The chapter provided a wonderful look at the power and limitations of math in crime solving. If instead a fictional television episode were used as the basis for that discussion, then such an approach merely brings us back to the first line of the appendix: Is any of this real? Does it take a team of writers and mathematical consultants to come up with bizarre scenarios where math might actually be of use? When every chapter relies on fiction, then yes, it begins to feel that way. On the other hand, point to enough real cases and suddenly math is being used every day in a tangible way.

This leads to the efficacy of having a character like Charlie. *NUMB3RS* is entering its fifth season, but does public perception about math remain the same? Does having a mathematician on television increase the number of math majors? Has Charlie helped in any way?

The problem is that *NUMB3RS* is ultimately a crime drama, and Charlie is its gimmick. Most crime dramas have a gimmick. *CSI* has its forensic technicians, *Bones* has its anthropologist, *Criminal Minds* has its profilers, and the new drama *The Mentalist* proudly displays its gimmick in the title. *NUMB3RS* isn't really about mathematics; it's about selling a crime drama in a market crowded with similar shows. The math is used as a gimmick, so the mathematics will always be secondary. A similar approach is taken in *The Numbers Behind NUMB3RS,* so the mathematics in the book suffers a similar fate.

Strangely, if someone came to me wanting to know if math was ever really used in the real world, I would probably point them to this book. It's inoffensive, accessible, and filled with enough information that they would probably finish the book with the sense that math is out there being used. Devlin and Lorden have brought together interesting and insightful information about certain areas of math and crime solving, and I appreciate their effort.

But, and I want to emphasize the following caveat, I am disappointed with this book. Yes, the book is interesting, but only when the authors take the time to delve into the subject matter. Too much of this book feels like the commercials that punctuate the television show—short snippets of vague descriptions designed to titillate but not educate. My feeling is this approach will do nothing to help the public perception of math, will gain few converts, and will ultimately be forgotten like so many thirty-second ads.

Finally, we should have enough confidence in our chosen field to feel comfortable writing a book about mathematics that does not need gimmicks. *The Numbers Behind NUMB3RS* shows us a glimmer of how this could be done. I just wish the authors had chosen to put their faith in the power of math to make its own case instead of giving in to what seems like marketing pressure.

That said, I also cannot deny the results of clever marketing—it got me watching again.