Math Goes to the Movies

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http://gonitsora.com/math-goes-movies/

Burkard Polster and Marty Ross

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This is an entertaining grab bag of mathematical and movie titbits that will delight mathematically minded movie buffs. The authors also have a website that includes links to relevant movie clips, and the whole project will appeal especially, perhaps, to students and teachers of mathematics. But I can do no better than to use the authors' own words to sum up the aim of *Math Goes to the Movies*:

> Our goal is to complement and significantly extend the available information about math in the movies…: in conjunction with our website, we have endeavoured to hunt down and to describe all the "good stuff", the scenes we believe are of general appeal and usefulness. Furthermore, our emphasis is really on the math and the fun of seeing it on the big screen, not on anything else. The flipside is that our book probably offers little to experts in cinema studies and serious movie critics.

This last sentence notwithstanding, the book is designed to be "functionally encyclopedic" in its detailed, cross-referenced lists: movies containing various levels and amounts of mathematics, famous topics and famous mathematicians who appear in movies, famous actors who have played those famous mathematicians, the mathematics consultants who have worked on these movies, and more. These lists constitute the last two chapters (or Part III) of the book. But *Math Goes to the Movies* is far more than lists of facts and figures about movie maths. Part I (Chapters 1-12) focuses on a number of films to which the authors devote more in-depth discussions— beginning with four of the most famous: *Good Will Hunting, A Beautiful Mind, Stand and Deliver*, and $$pi$$ — while Part II (Chapters 13-19) is organised in terms of key mathematical topics that feature in movies.

The opening chapter of the book begins with a discussion of *Good Will Hunting* from the point of view of the film's mathematics consultant, Patrick O'Donnell, whom Polster and Ross interviewed by telephone.

O'Donnell, a physics professor at the University of Toronto, was initially hired as an extra— to play a drunk man in a bar! He was "spotted" while he was having lunch at a restaurant near the university— but the movie people did their homework and tracked him to his office, where they were so impressed by the "jottings and wave functions and things" on his board that they invited him to be their consultant. As in most "mathematical" movies, the mathematics in *Good Will Hunting* is mostly confined to decorative "props"— blackboards full of equations— but these are vital to the feel and look of the film.

One of the first things O'Donnell noticed was that "none of the actors could write on a blackboard". Among his snippets from behind-the-scenes was the fact that if the actors had to "write and act at the same time", he had to choose material that was suitably "dumbed down". David Bayer— the Columbia University mathematics professor who served as consultant to *A Beautiful Mind*, the subject of Chapter 2— made a similar discovery. As most readers will know, this movie is based on the story of mathematician John Nash, and stars Russell Crowe. Mathematics lecturers in particular will enjoy this recollection from Bayer:

> Russell had actually been very nervous the day that he did the math lecture, where he wrote the problem out and talked to Jennifer [Connelly, who played his student] at the same time in the classroom. And everybody was sitting there astounded: "You mathematicians really talk and write at the same time?" Here we are taking like twenty takes and no-one was thinking that Russell was a yahoo and everyone is extremely impressed with it. They were basically feeling sympathetic with him that he was trying to pull that scene and they are looking at me, "You guys do this? You gotta be kidding."

In a related vein, Columbia mathematician Henry Pinkham, who was the consultant for *The Mirror Has Two Faces*, recalled that the movie's star, Jeff Bridges, who played a mathematics professor, "went to a lot of effort to learn lines that would be convincing from a mathematical point of view".

Another appealing feature of *Math Goes to the Movies* is its photos of some of the blackboard shots in these and other movies discussed— including whiteboards created by Polster and Ross when they acted as consultants for an episode of the TV series *City Homicide*. There's also a great shot in which Elizabeth Hurley (playing the Devil in *Bedazzled*) is pointing to a blackboard on which Fermat's Last Theorem is written, followed by "SHOW YOUR WORK". As the authors remark, "this appears to be a very funny jibe at Fermat, as if he were a negligent schoolboy for not including his proof". More importantly (for mathematical readers), Polster and Ross often expand upon the blackboards' mathematical content.

Indeed, much of the book is devoted to brief, accessible amplifications of some of the mathematics that features in the various movies: graph theory in *Good Will Hunting*; game theory in *A Beautiful Mind*; the nature of pi, the golden ratio, and the Fibonacci sequence (in $$pi,$$ and in the classic "teaching cartoon" *Donald in Mathmagic Land*); prime numbers (*The Cube*); calculus (*Stand and Deliver and The Mirror Has Two Faces*); group theory (*It's My Turn*, of which the authors say that to the best of their knowledge, this is "the only movie with a scene dedicated to a mathematical proof "); Pythagorean triples and Fermat's Last Theorem (*Star Trek, The Simpsons*, and the mathematical musical *Fermat's Last Tango*); the fourth dimension and hypercubes (*Cube 2*)— and more.

The authors' expositions are at a level suitable for the interested lay reader, student, or teacher; they include some neat techniques, such as using elementary number theory to eliminate an apparent counterexample to Fermat's Last Theorem that was used in *The Simpsons* (whereas using a calculator, the numbers chosen appear to "work", to an accuracy of nine digits). But as I implied in the previous paragraph, Polster and Ross also visit more complex territory, including "the famous 'snake lemma' from homological algebra" (*It's My Turn*). On the other hand, sometimes the authors simply mention mathematical ideas or equations used in movies— often pointing out where the film-makers got it slightly wrong; some readers may want to reach for pen and paper to fill in the gaps for themselves. And for those who like trying their hand at puzzles, there's a chapter called "Problem Corner", which lists an amazing number of interesting mathematics problems that have appeared in movies; answers and occasional working are provided.

The emphasis in *Math Goes to the Movies* is, naturally enough, on movies, not on television shows, so fans of *Numb3rs, Star Trek*, and so on will have to look elsewhere; but Polster and Ross do mention a few scenes from some of these series (and they give references for further information). For instance, the following excerpt— given in Chapter 19, which lists some of the deliberately funniest maths scenes in movies (as opposed to the bloopers of Chapter 18) — may keep *Big Bang Theory* fans happy:

> SHELDON: There's some poor woman who's gonna pin her hopes on my sperm. What if she winds up with a toddler who doesn't know if he should use an integral or a differential to solve for the area under a curve?
>
> LEONARD: I'm sure she'll still love him.
>
> SHELDON: I wouldn't.

Or perhaps this scene will remind some readers why they don't like this series… but either way, there's no doubt something for everyone here. The authors' own favourite comic scene has Abbott and Costello "proving" that $7\times13 = 28$, in the 1941 movie *In the Navy*; this scene, and its method of "proof ", is discussed in more detail in a chapter of its own (Chapter 10). To mention just two more of the many "funny scenes" listed, there's the wonderfully wry puzzle-solving exchange between Katharine Hepburn and Spencer Tracy in *Desk Set*, and, on a purely trivial level, Woody Allen's quirky response to his drill sergeant in *Love and Death:*

> SERGEANT: One, two, one, two, one, two…
>
> BORIS (ALLEN): Three comes next, if you're having any trouble.

All in all, *Math Goes to the Movies* is a fun read for anyone interested in mathematics, and doubly fun if you're interested in movies too.

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