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ANNALS OF ENTERTAINMENT

The Formula

What if you built a machine to predict hit movies?

by Malcolm Gladwell

1.

One sunny afternoon not long ago, Dick Copaken sat in a booth at Daniel, one of those hushed, exclusive restaurants on Manhattan's Upper East Side where the waiters glide spectrally from table to table. He was wearing a starched button-down shirt and a blue blazer. Every strand of his thinning hair was in place, and he spoke calmly and slowly, his large pink Charlie Brown head bobbing along evenly as he did. Copaken spent many years as a partner at the white-shoe Washington, D.C., firm Covington & Burling, and he has a lawyer's gravitas. One of his best friends calls him, admiringly, "relentless." He likes to tell stories. Yet he is not, strictly, a storyteller, because storytellers are people who know when to leave things out, and Copaken never leaves anything out: each detail is adduced, considered, and

laid on the table—and then adjusted and readjusted so that the corners of the new fact are flush with the corners of the fact that preceded it. This is especially true when Copaken is talking about things that he really cares about, such as questions of international law or his grandchildren or, most of all, the movies.

Dick Copaken loves the movies. His friend Richard Light, a statistician at Harvard, remembers summer vacations on Cape Cod with the Copakens, when Copaken would take his children and the Light children to the movies every day. "Fourteen nights out of fourteen," Light said. "Dick would say at seven o'clock, 'Hey, who's up for the movies?' And, all by himself, he would take the six kids to the movies. The kids had the time of their lives. And Dick would come back and give, with a completely straight face, a rigorous analysis of how each movie was put

together, and the direction and the special effects and the animation." This is a man who has seen two or three movies a week for the past fifty years, who has filed hundreds of plots and characters and scenes away in his mind, and at Daniel he was talking about a movie that touched him as much as any he'd ever seen.

"Nobody's heard of it," he said, and he clearly regarded this fact as a minor tragedy. "It's called 'Dear Frankie.' I watched it on a Virgin Atlantic flight because it was the only movie they had that I hadn't already seen. I had very low expectations. But I was blown away." He began, in his lawyer-like manner, to lay out the plot. It takes place in Scotland. A woman has fled an abusive relationship with her infant son and is living in a port town. The boy, now nine, is deaf, and misses the father he has never known. His mother has told him that his

father is a sailor on a ship that rarely comes to shore, and has suggested that he write his father letters. These she intercepts, and replies to, writing as if she were the father. One day, the boy finds out that what he thinks is his father's ship is coming to shore. The mother has to find a man to stand in for the father. She does. The two fall in love. Unexpectedly, the real father reëmerges. He's dying, and demands to see his son. The mother panics. Then the little boy reveals his secret: he knew about his mother's ruse all along.

"I was in tears over this movie," Copaken said. "You know, sometimes when you see a movie in the air you're in such an out-of-body mood that things get exaggerated. So when I got home I sat down and saw it another time. I was bawling again, even though I knew what was coming." Copaken shook his head, and then looked away. His cheeks were flushed. His voice was suddenly thick. There he was, a buttoned-down corporate lawyer, in a hushed restaurant where there is practically a sign on the wall forbidding displays of human emotion—and he was crying, a third time. "That absolutely hits me," he said, his face still turned away. "He knew all along

what the mother was doing." He stopped to collect himself. "I can't even retell the damn story without getting emotional."

He tried to explain why he was crying. There was the little boy, first of all. He was just about the same age as Copaken's grandson Jacob. So maybe that was part of it. Perhaps, as well, he was reacting to the idea of an absent parent. His own parents, Albert and Silvia, ran a modest community-law practice in Kansas City, and would shut down their office whenever Copaken or his brother had any kind of school activity or performance. In the Copaken world, it was an iron law that parents had to be present. He told a story about representing the Marshall Islands in negotiations with the U.S. government during the Cold War. A missile-testing range on the island was considered to be strategically critical. The case was enormously complex—involving something like fifty federal agencies and five countries—and, just as the negotiations were scheduled to begin, Copaken learned of a conflict: his eldest daughter was performing the lead role in a sixth-grade production of "The Wiz." "I made an instant decision," Copaken said. He told the President of the Marshall Islands that his daughter had to come first.

Half an hour passed. "I get a frantic call from the State Department, very high levels: 'Dick, I got a call from the President of the Marshall Islands. What's going on?' I told him. He said, 'Dick, are you putting in jeopardy the national security of the United States for a sixth-grade production?' " In the end, the negotiations were suspended while Copaken flew home from Hawaii. "The point is," Copaken said, "that absence at crucial moments has been a worry to me, and maybe this movie just grabbed at that issue."

He stopped, seemingly dissatisfied. Was that really why he'd cried? Hollywood is awash in stories of bad fathers and abandoned children, and Copaken doesn't cry in fancy restaurants every time he thinks of one of them. When he tried to remember the last time he cried at the movies, he was stumped. So he must have been responding to something else, too—some detail, some unconscious emotional trigger in the combination of the mother and the boy and the Scottish seaside town and the ship and the hired surrogate and the dying father. To say that he cried at "Dear Frankie" because of that lonely fatherless boy was as inadequate as saying

that people cried at the death of Princess Diana because she was a beautiful princess. Surely it mattered as well that she was killed in the company of her lover, a man distrusted by the Royal Family. "t this "Romeo and Juliet"? And surely it mattered that she died in a tunnel, and that the tunnel was in Paris, and that she was chased by motorbikes, and that she was blond and her lover was dark—because each one of those additional narrative details has complicated emotional associations, and it is the subtle combination of all these associations that makes us laugh or choke up when we remember a certain movie, every single time, even when we're sitting in a fancy restaurant.

Of course, the optimal combination of all those elements is a mystery. That's why it's so hard to make a really memorable movie, and why we reward so richly the few people who can. But suppose you really, really loved the movies, and suppose you were a relentless type, and suppose you used all of the skills you'd learned during the course of your career at the highest rungs of the law to put together an international team of story experts. Do you think you could figure it out?

2.

The most famous dictum about Hollywood belongs to the screenwriter William Goldman. "Nobody knows anything," Goldman wrote in "Adventures in the Screen Trade" a couple of decades ago. "Not one person in the entire motion picture field knows for a certainty what's going to work. Every time out it's a guess." One of the highest-grossing movies in history, ""Raiders of the Lost Ark," was offered to every studio in Hollywood, Goldman writes, and every one of them turned it down except Paramount: "Why did Paramount say yes? Because nobody knows anything. And why did all the other studios say no? Because nobody knows anything. And why did Universal, the mightiest studio of all, pass on Star Wars? . . . Because nobody, nobody—not now, not ever—knows the least goddamn thing about what is or isn't going to work at the box office."

What Goldman was saying was a version of something that has long been argued about art: that there is no way of getting beyond one's own impressions to arrive at some larger, objective truth. There are no rules to art, only the infinite variety of subjective experience. "Beauty is no

quality in things themselves," the eighteenth-century Scottish philosopher David Hume wrote. "It exists merely in the mind which contemplates them; and each mind perceives a different beauty." Hume might as well have said that nobody knows anything.

But Hume had a Scottish counterpart, Lord Kames, and Lord Kames was equally convinced that traits like beauty, sublimity, and grandeur were indeed reducible to a rational system of rules and precepts. He devised principles of congruity, propriety, and perspicuity: an elevated subject, for instance, must be expressed in elevated language; sound and signification should be in concordance; a woman was most attractive when in distress; depicted misfortunes must never occur by chance. He genuinely thought that the superiority of Virgil's hexameters to Horace's could be demonstrated with Euclidean precision, and for every Hume, it seems, there has always been a Kames—someone arguing that if nobody knows anything it is only because nobody's looking hard enough.

In a small New York loft, just below Union Square, for

example, there is a tech startup called Platinum Blue that consults for companies in the music business. Record executives have tended to be Humean: though they can tell you how they feel when they listen to a song, they don't believe anyone can know with confidence whether a song is going to be a hit, and, historically, fewer than twenty per cent of the songs picked as hits by music executives have fulfilled those expectations. Platinum Blue thinks it can do better. It has a proprietary computer program that uses "spectral deconvolution software" to measure the mathematical relationships among all of a song's structural components: melody, harmony, beat, tempo, rhythm, octave, pitch, chord progression, cadence, sonic brilliance, frequency, and so on. On the basis of that analysis, the firm believes it can predict whether a song is likely to become a hit with eighty-per-cent accuracy. Platinum Blue is staunchly Kamesian, and, if you have a field dominated by those who say there are no rules, it is almost inevitable that someone will come along and say that there are. The head of Platinum Blue is a man named Mike McCready, and the service he is providing for the music business is an exact model of

what Dick Copaken would like to do for the movie business.

McCready is in his thirties, baldish and laconic, with rectangular hipster glasses. His offices are in a large, open room, with a row of windows looking east, across the rooftops of downtown Manhattan. In the middle of the room is a conference table, and one morning recently McCready sat down and opened his laptop to demonstrate the Platinum Blue technology. On his screen was a cluster of thousands of white dots, resembling a cloud. This was a "map" of the songs his group had run through its software: each dot represented a single song, and each song was positioned in the cloud according to its particular mathematical signature. "You could have one piano sonata by Beethoven at this end and another one here," McCready said, pointing at the opposite end, "as long as they have completely different chord progressions and completely different melodic structures."

McCready then hit a button on his computer, which had the effect of eliminating all the songs that had not made the Billboard Top 30 in the past five years. The screen went from an undifferentiated cloud to sixty discrete clusters. This is what the universe of

hit songs from the past five years looks like structurally; hits come out of a small, predictable, and highly conserved set of mathematical patterns. "We take a new CD far in advance of its release date," McCready said. "We analyze all twelve tracks. Then we overlay them on top of the already existing hit clusters, and what we can tell a record company is which of those songs conform to the mathematical pattern of past hits. Now, that doesn't mean that they will be hits. But what we are saying is that, almost certainly, songs that fall outside these clusters will not be —regardless of how much they sound and feel like hit songs, and regardless of how positive your call-out research or focus-group research is." Four years ago, when McCready was working with a similar version of the program at a firm in Barcelona, he ran thirty just-released albums, chosen at random, through his system. One stood out. The computer said that nine of the fourteen songs on the album had clear hit potential —which was unheard of. Nobody in his group knew much about the artist or had even listened to the record before, but the numbers said the album was going to be big, and McCready and his crew were of the belief that numbers do not lie. "Right

around that time, a local newspaper came by and asked us what we were doing," McCready said. "We explained the hit-prediction thing, and that we were really turned on to a record by this artist called Norah Jones." The record was "Come Away with Me." It went on to sell twenty million copies and win eight Grammy awards.

3.

The strength of McCready's analysis is its precision. This past spring, for instance, he analyzed "Crazy," by Gnarls Barkley. The computer calculated, first of all, the song's Hit Grade—that is, how close it was to the center of any of those sixty hit clusters. Its Hit Grade was 755, on a scale where anything above 700 is exceptional. The computer also found that "Crazy" belonged to the same hit cluster as Dido's "Thank You," James Blunt's "You're Beautiful," and Ashanti's "Baby," as well as older hits like "Let Me Be There," by Olivia Newton-John, and "One Sweet Day," by Mariah Carey, so that listeners who liked any of those songs would probably like "Crazy," too. Finally, the computer gave "Crazy" a Periodicity Grade—which refers to the fact that, at any given time,

only twelve to fifteen hit clusters are "active," because from month to month the particular mathematical patterns that excite music listeners will shift around. "Crazy" 's periodicity score was 658—which suggested a very good fit with current tastes. The data said, in other words, that "Crazy" was almost certainly going to be huge—and, sure enough, it was.

If "Crazy" hadn't scored so high, though, the Platinum Blue people would have given the song's producers broad suggestions for fixing it. McCready said, "We can tell a producer, 'These are the elements that seem to be pushing your song into the hit cluster. These are the variables that are pulling your song away from the hit cluster. The problem seems to be in your bass line.' And the producer will make a bunch of mixes, where they do something different with the bass lines—increase the decibel level, or muddy it up. Then they come back to us. And we say, 'Whatever you were doing with mix No. 3, do a little bit more of that and you'll be back inside the hit cluster.'"

McCready stressed that his system didn't take the art out of hit-making. Someone still had to figure out what to do

with mix No. 3, and it was entirely possible that whatever needed to be done to put the song in the hit cluster wouldn't work, because it would make the song sound wrong—and in order to be a hit a song had to sound right. Still, for the first time you wouldn't be guessing about what needed to be done. You would know. And what you needed to know in order to fix the song was much simpler than anyone would have thought. McCready didn't care about who the artist was, or the cleverness of the lyrics. He didn't even have a way of feeding lyrics into his computer. He cared only about a song's underlying mathematical structure. "If you go back to the popular melodies written by Beethoven and Mozart three hundred years ago," he went on, "they conform to the same mathematical patterns that we are looking at today. What sounded like a beautiful melody to them sounds like a beautiful melody to us. What has changed is simply that we have come up with new styles and new instruments. Our brains are wired in a way—we assume—that keeps us coming back, again and again, to the same answers, the same pleasure centers." He had sales data and Top 30 lists and deconvolution software, and it seemed to him that if you put them

together you had an objective way of measuring something like beauty. "We think we've figured out how the brain works regarding musical taste," McCready said.

It requires a very particular kind of person, of course, to see the world as a code waiting to be broken. Hume once called Kames "the most arrogant man in the world," and to take this side of the argument you have to be. Kames was also a brilliant lawyer, and no doubt that matters as well, because to be a good lawyer is to be invested with a reverence for rules. (Hume defied his family's efforts to make him a lawyer.) And to think like Kames you probably have to be an outsider. Kames was born Henry Home, to a farming family, and grew up in the sparsely populated cropping-and-fishing county of Berwickshire; he became Lord Kames late in life, after he was elevated to the bench. (Hume was born and reared in Edinburgh.) His early published work was about law and its history, but he soon wandered into morality, religion, anthropology, soil chemistry, plant nutrition, and the physical sciences, and once asked his friend Benjamin Franklin to explain the movement of smoke in chimneys. Those

who believe in the power of broad patterns and rules, rather than the authority of individuals or institutions, are not intimidated by the boundaries and hierarchies of knowledge. They don't defer to the superior expertise of insiders; they set up shop in a small loft somewhere downtown and take on the whole music industry at once. The difference between Hume and Kames is, finally, a difference in kind, not degree. You're either a Kamesian or you're not. And if you were to create an archetypal Kamesian—to combine lawyerliness, outsidership, and supreme self-confidence in one dapper, Charlie Brown-headed combination? You'd end up with Dick Copaken.

"I remember when I was a sophomore in high school and I went into the bathroom once to wash my hands," Copaken said. "I noticed the bubbles on the sink, and it fascinated me the way these bubbles would form and move around and float and reform, and I sat there totally transfixed. My father called me, and I didn't hear him. Finally, he comes in. 'Son. What the . . . are you all right?' I said, 'Bubbles, Dad, look what they do.' He said, 'Son, if you're going to waste your time, waste it on something that may have some future consequence.' Well, I kind of rose to the challenge. That summer, I

bicycled a couple of miles to a library in Kansas City and I spent every day reading every book and article I could find on bubbles."

Bubbles looked completely random, but young Copaken wasn't convinced. He built a bubble-making device involving an aerator from a fish tank, and at school he pleaded with the math department to teach him the quadratic equations he needed to show why the bubbles formed the way they did. Then he devised an experiment, and ended up with a bronze medal at the International Science Fair. His interest in bubbles was genuine, but the truth is that almost anything could have caught Copaken's eye: pop songs, movies, the movement of chimney smoke. What drew him was not so much solving this particular problem as the general principle that problems were solvable—that he, little Dick Copaken from Kansas City, could climb on his bicycle and ride to the library and figure out something that his father thought wasn't worth figuring out.

Copaken has written a memoir of his experience defending the tiny Puerto Rican islands of Culebra and Vieques against the U.S.

Navy, which had been using their beaches for target practice. It is a riveting story. Copaken takes on the vast Navy bureaucracy, armed only with arcane provisions of environmental law. He investigates the nesting grounds of the endangered hawksbill turtle, and the mating habits of a tiny yet extremely loud tree frog known as the coqui, and at one point he transports four frozen whale heads from the Bahamas to Harvard Medical School. Copaken wins. The Navy loses.

The memoir reads like a David-and-Goliath story. It isn't. David changed the rules on Goliath. He brought a slingshot to a sword fight. People like Copaken, though, don't change the rules; they believe in rules. Copaken would have agreed to sword-on-sword combat. But then he would have asked the referee for a stay, deposed Goliath and his team at great length, and papered him with brief after brief until he conceded that his weapon did not qualify as a sword under §48(B)(6) (e) of the Samaria Convention of 321 B.C. (The Philistines would have settled.) And whereas David knew that he couldn't win a conventional fight with Goliath, the conviction that sustained Copaken's long

battle with the Navy was, to the contrary, that so long as the battle remained conventional—so long as it followed the familiar pathways of the law and of due process—he really could win. Dick Copaken didn't think he was an underdog at all. If you believe in rules, Goliath is just another Philistine, and the Navy is just another plaintiff. As for the ineffable mystery of the Hollywood blockbuster? Well, Mr. Goldman, you may not know anything. But I do.

4.

Dick Copaken has a friend named Nick Meaney. They met on a case years ago. Meaney has thick dark hair. He is younger and much taller than Copaken, and seems to regard his friend with affectionate amusement. Meaney's background is in risk management, and for years he'd been wanting to bring the principles of that world to the movie business. In 2003, Meaney and Copaken were driving through the English countryside to Durham when Meaney told Copaken about a friend of his from college. The friend and his business partner were students of popular narrative: the sort who write essays for obscure journals serving the small band of people who think deeply about, say, the

evolution of the pilot episode in transnational TV crime dramas. And, for some time, they had been developing a system for evaluating the commercial potential of stories. The two men, Meaney told Copaken, had broken down the elements of screenplay narrative into multiple categories, and then drawn on their encyclopedic knowledge of television and film to assign scripts a score in each of those categories—creating a giant screenplay report card. The system was extraordinarily elaborate. It was under constant refinement. It was also top secret. Henceforth, Copaken and Meaney would refer to the two men publicly only as "Mr. Pink" and "Mr. Brown," an homage to "Reservoir Dogs."

"The guy had a big wall, and he started putting up little Post-its covering everything you can think of," Copaken said. It was unclear whether he was talking about Mr. Pink or Mr. Brown or possibly some Obi-Wan Kenobi figure from whom Mr. Pink and Mr. Brown first learned their trade. "You know, the star wears a blue shirt. The star doesn't zip up his pants. Whatever. So he put all these factors up and began moving them around as the scripts were either successful or

unsuccessful, and he began grouping them and eventually this evolved to a kind of ad-hoc analytical system. He had no theory as to what would work, he just wanted to know what did work."

Copaken and Meaney also shared a fascination with a powerful kind of computerized learning system called an artificial neural network. Neural networks are used for data mining—to look for patterns in very large amounts of data. In recent years, they have become a critical tool in many industries, and what Copaken and Meaney realized, when they thought about Mr. Pink and Mr. Brown, was that it might now be possible to bring neural networks to Hollywood. They could treat screenplays as mathematical propositions, using Mr. Pink and Mr. Brown's categories and scores as the motion-picture equivalents of melody, harmony, beat, tempo, rhythm, octave, pitch, chord progression, cadence, sonic brilliance, and frequency.

Copaken and Meaney brought in a former colleague of Meaney's named Sean Verity, and the three of them signed up Mr. Pink and Mr. Brown. They

called their company Epagogix—a reference to Aristotle's discussion of epagogic, or inductive, learning—and they started with a "training set" of screenplays that Mr. Pink and Mr. Brown had graded. Copaken and Meaney won't disclose how many scripts were in the training set. But let's say it was two hundred. Those scores—along with the U.S. box-office receipts for each of the films made from those screenplays—were fed into a neural network built by a computer scientist of Meaney's acquaintance. "I can't tell you his name," Meaney said, "but he's English to his bootstraps." Mr. Bootstraps then went to work, trying to use Mr. Pink and Mr. Brown's scoring data to predict the box-office receipts of every movie in the training set. He started with the first film and had the neural network make a guess: maybe it said that the hero's moral crisis in act one, which rated a 7 on the 10-point moral-crisis scale, was worth \$7 million, and having a gorgeous red-headed eighteen-year-old female lead whose characterization came in at 6.5 was worth \$3 million and a 9-point bonding moment between the male lead and a four-year-old boy in act three was worth \$2 million, and so on, putting a dollar figure on every grade on Mr. Pink and Mr. Brown's report card until the system came up with a

prediction. Then it compared its guess with how that movie actually did. Was it close? Of course not. The neural network then went back and tried again. If it had guessed \$20 million and the movie actually made \$110 million, it would reweight the movie's Pink/Brown scores and run the numbers a second time. And then it would take the formula that worked best on Movie One and apply it to Movie Two, and tweak that until it had a formula that worked on Movies One and Two, and take that formula to Movie Three, and then to four and five, and on through all two hundred movies, whereupon it would go back through all the movies again, through hundreds of thousands of iterations, until it had worked out a formula that did the best possible job of predicting the financial success of every one of the movies in its database.

That formula, the theory goes, can then be applied to new scripts. If you were developing a \$75-million buddy picture for Bruce Willis and Colin Farrell, Epagogix says, it can tell you, based on past experience, what that script's particular combination of narrative elements can be expected to make at the box office. If the

formula says it's a \$50-million script, you pull the plug. "We shoot turkeys," Meaney said. He had seen Mr. Bootstraps and the neural network in action: "It can sometimes go on for hours. If you look at the computer, you see lots of flashing numbers in a gigantic grid. It's like 'The Matrix.' There are a lot of computations. The guy is there, the whole time, looking at it. It eventually stops flashing, and it tells us what it thinks the American box-office will be. A number comes out."

The way the neural network thinks is not that different from the way a Hollywood executive thinks: if you pitch a movie to a studio, the executive uses an ad-hoc algorithm—perfected through years of trial and error—to put a value on all the components in the story. Neural networks, though, can handle problems that have a great many variables, and they never play favorites—which means (at least in theory) that as long as you can give the neural network the same range of information that a human decision-maker has, it ought to come out ahead. That's what the University of Arizona computer scientist Hsinchun Chen demonstrated ten years ago, when he built a neural

network to predict winners at the dog track. Chen used the ten variables that greyhound experts told him they used in making their bets—like fastest time and winning percentage and results for the past seven races—and trained his system with the results of two hundred races. Then he went to the greyhound track in Tucson and challenged three dog-racing handicappers to a contest. Everyone picked winners in a hundred races, at a modest two dollars a bet. The experts lost \$71.40, \$61.20, and \$70.20, respectively. Chen won \$124.80. It wasn't close, and one of the main reasons was the special interest the neural network showed in something called "race grade": greyhounds are moved up and down through a number of divisions, according to their ability, and dogs have a big edge when they've just been bumped down a level and a big handicap when they've just been bumped up. "The experts know race grade exists, but they don't weight it sufficiently," Chen said. "They are all looking at win percentage, place percentage, or thinking about the dogs' times."

Copaken and Meaney figured that Hollywood's experts also had biases and skipped over things that really mattered. If a neural network won at the track, why not Hollywood?

"One of the most powerful aspects of what we do is the ruthless objectivity of our system," Copaken said. "It doesn't care about maintaining relationships with stars or agents or getting invited to someone's party. It doesn't care about climbing the corporate ladder. It has one master and one master only: how do you get to bigger box-office? Nobody else in Hollywood is like that."

In the summer of 2003, Copaken approached Josh Berger, a senior executive at Warner Bros. in Europe. Meaney was opposed to the idea: in his mind, it was too early. "I just screamed at Dick," he said. But Copaken was adamant. He had Mr. Bootstraps, Mr. Pink, and Mr. Brown run sixteen television pilots through the neural network, and try to predict the size of each show's eventual audience. "I told Josh, 'Stick this in a drawer, and I'll come back at the end of the season and we can check to see how we did,' " Copaken said. In January of 2004, Copaken tabulated the results. In six cases, Epagogix guessed the number of American homes that would tune in to a show to within .06 per cent. In thirteen of the sixteen cases, its predictions were within two per cent. Berger was floored. "It was incredible,"

he recalls. "It was like someone saying to you, 'We're going to show you how to count cards in Vegas.' It had that sort of quality."

Copaken then approached another Hollywood studio. He was given nine unreleased movies to analyze. Mr. Pink, Mr. Brown, and Mr. Bootstraps worked only from the script—without reference to the stars or the director or the marketing budget or the producer. On three of the films—two of which were low-budget—the Epagogix estimates were way off. On the remaining six—including two of the studio's biggest-budget productions—they correctly identified whether the film would make or lose money. On one film, the studio thought it had a picture that would make a good deal more than \$100 million. Epagogix said \$49 million. The movie made less than \$40 million. On another, a big-budget picture, the team's estimate came within \$1.2 million of the final gross. On a number of films, they were surprisingly close. "They were basically within a few million," a senior executive at the studio said. "It was shocking. It was kind of weird." Had the studio used Epagogix on those nine scripts before filming

started, it could have saved tens of millions of dollars. "I was impressed by a couple of things," another executive at the same studio said. "I was impressed by the things they thought mattered to a movie. They weren't the things that we typically give credit to. They cared about the venue, and whether it was a love story, and very specific things about the plot that they were convinced determined the outcome more than anything else. It felt very objective. And they could care less about whether the lead was Tom Cruise or Tom Jones."

The Epagogix team knocked on other doors that weren't quite so welcoming. This was the problem with being a Kamesian. Your belief in a rule-bound universe was what gave you, an outsider, a claim to real expertise. But you were still an outsider. You were still Dick Copaken, the blue-blazered corporate lawyer who majored in bubbles as a little boy in Kansas City, and a couple of guys from the risk-management business, and three men called Pink, Brown, and Bootstraps—and none of you had ever made a movie in your life. And what were you saying? That stars didn't matter, that the director didn't matter, and that all that mattered was story—and, by the way, that you understood story the way the people on the inside, people who had

spent a lifetime in the motion-picture business, didn't. "They called, and they said they had a way of predicting box-office success or failure, which is everyone's fantasy," one former studio chief recalled. "I said to them, 'I hope you're right.'" The executive seemed to think of the Epagogix team as a small band of Martians who had somehow slipped their U.F.O. past security. "In reality, there are so many circumstances that can affect a movie's success," the executive went on. "Maybe the actor or actress has an external problem. Or this great actor, for whatever reason, just fails. You have to fire a director. Or September 11th or some other thing happens. There are many people who have come forward saying they have a way of predicting box-office success, but so far nobody has been able to do it. I think we know something. We just don't know enough. I still believe in something called that magical thing—talent, the unexpected. The movie god has to shine on you." You were either a Kamesian or you weren't, and this person wasn't: "My first reaction to those guys? Bullshit."

5.

A few months ago, Dick Copaken agreed to lift the cloud of unknowing surrounding Epagogix, at least in part. He laid down three conditions: the meeting was to be in London, Mr. Pink and Mr. Brown would continue to be known only as Mr. Pink and Mr. Brown, and no mention was to be made of the team's current projects. After much discussion, an agreement was reached. Epagogix would analyze the 2005 movie "The Interpreter," which was directed by Sydney Pollack and starred Sean Penn and Nicole Kidman. "The Interpreter" had a complicated history, having gone through countless revisions, and there was a feeling that it could have done much better at the box office. If ever there was an ideal case study for the alleged wizardry of Epagogix, this was it.

The first draft of the movie was written by Charles Randolph, a philosophy professor turned screenwriter. It opened in the fictional African country of Matobo. Two men in a Land Rover pull up to a soccer stadium. A group of children lead them to a

room inside the building. On the ground is a row of corpses.

Cut to the United Nations, where we meet Silvia Broome, a young woman who works as an interpreter. She goes to the U.N. Security Service and relates a terrifying story. The previous night, while working late in the interpreter's booth, she overheard two people plotting the assassination of Matobo's murderous dictator, Edmund Zuwanie, who is coming to New York to address the General Assembly. She says that the plotters saw her, and that her life may be in danger. The officer assigned to her case, Tobin Keller, is skeptical, particularly when he learns that she, too, is from Matobo, and that her parents were killed in the country's civil war. But after Broome suffers a series of threatening incidents Keller starts to believe her. His job is to protect Zuwanie, but he now feels moved to act as Broome's bodyguard as well. A quiet, slightly ambiguous romantic attraction begins to develop between them. Zuwanie's visit draws closer. Broome's job is to be his interpreter. On the day of the speech, Broome ends up in the greenroom with Zuwanie. Keller suddenly realizes the truth: that she has made up the whole story as a way of bringing Zuwanie to justice. He rushes to the

greenroom. Broome, it seems, has poisoned Zuwanie and is withholding the antidote unless he goes onstage and confesses to the murder of his countrymen. He does. Broome escapes. A doctor takes a look at the poison. It's harmless. The doctor turns to the dictator, who has just been tricked into writing his own prison sentence: "You were never in danger, Mr. Zuwanie."

Randolph says that the film he was thinking of while he was writing "The Interpreter" was Francis Ford Coppola's classic "The Conversation." He wanted to make a spare, stark movie about an isolated figure. "She's a terrorist," Randolph said of Silvia Broome. "She comes to this country to do a very specific task, and when that task is done she's gone again. I wanted to write about this idea of a noble terrorist, who tried to achieve her ends with a character assassination, not a real assassination." Randolph realized that most moviegoers—and most Hollywood executives—prefer characters who have psychological motivations. But he wasn't trying to make "Die Hard." "Look, I'm the son of a preacher," he said. "I believe that ideology motivates people."

In 2004, Sydney Pollack signed on to direct the project. He loved the idea of an interpreter at the United Nations and the conceit of an overheard conversation. But he wanted to make a commercial movie, and parts of the script didn't feel right to him. He didn't like the twist at the end, for instance. "I felt like I had been tricked, because in fact there was no threat," Pollack said. "As much as I liked the original script, I felt like an audience would somehow, at the end, feel cheated." Pollack also felt that audiences would want much more from Silvia Broome's relationship with Tobin Keller. "I've never been able to do a movie without a love story in it," he said. "For me, the heart of it is always the man and the woman and who they are and what they are going through." Pollack brought Randolph back for rewrites. He then hired Scott Frank and Steven Zaillian, two of the most highly sought-after screenwriters in Hollywood—and after several months the story was turned inside out. Now Broome didn't tell the story of overhearing that conversation. It actually happened. She wasn't a terrorist anymore. She was a victim. She "t an isolated figure. She was given a social life. She wasn't manipulating Keller. Their relationship was more

prominent. A series of new characters—political allies and opponents of Zuwanie's—were added, as was a scene in Brooklyn where a bus explodes, almost killing Broome. "I remember when I came on 'Minority Report,' and started over," said Frank, who wrote many of the new scenes for "The Interpreter." "There weren't many characters. When I finished, there were two mysteries and a hundred characters. I have diarrhea of the plot. This movie cried out for that. There are never enough suspects and red herrings."

The lingering problem, though, was the ending. If Broome wasn't after Zuwanie, who was? "We struggled," Pollack said. "It was a long process, to the point where we almost gave up." In the end, Zuwanie was made the engineer of the plot: he fakes the attempt on his life in order to justify his attacks on his enemies back home. Zuwanie hires a man to shoot him, and then another of Zuwanie's men shoots the assassin before he can do the job—and in the chaos Broome ends up with a gun in her hand, training it on Zuwanie. "The end was the hardest part," Frank said. "All these balls were in the air. But I couldn't find a satisfying way to resolve it. We had to put a gun in the hand of a pacifist. I couldn't quite sew it up in the right

way. Sydney kept saying, 'You're so close.' But I kept saying, 'Yeah, but I don't believe what I'm writing.' I wonder if I did a disservice to 'The Interpreter.' I don't know that I made it better. I may have just made it different."

This, then, was the question for Epagogix: If Pollack's goal was to make "The Interpreter" a more commercial movie, how well did he succeed? And could he have done better?

6.

The debriefing took place in central London, behind the glass walls of the private dining room of a Mayfair restaurant. The waiters came in waves, murmuring their announcements of the latest arrival from the kitchen. The table was round. Copaken, dapper as always in his navy blazer, sat next to Sean Verity, followed by Meaney, Mr. Brown, and Mr. Pink. Mr. Brown was very tall, and seemed to have a northern English accent. Mr. Pink was slender and graying, and had an air of authority about him. His academic training was in biochemistry. He said he thought that, in the highly emotional business of Hollywood, having a

scientific background was quite useful. There was no sign of Mr. Bootstraps.

Mr. Pink began by explaining the origins of their system. "There were certain historical events that allowed us to go back and test how appealing one film was against another," he said. "The very simple one is that in the English market, in the sixties on Sunday night, religious programming aired on the major networks. Nobody watched it. And, as soon as that finished, movies came on. There were no lead-ins, and only two competing channels. Plus, across the country you had a situation where the commercial sector was playing a whole variety of movies against the standard, the BBC. It might be a John Wayne movie in Yorkshire, and a musical in Somerset, and the BBC would be the same movie everywhere. So you had a control. It was very pure and very simple. That was a unique opportunity to try and make some guesstimates as to why movies were doing what they were doing."

Brown nodded. "We built a body of evidence until we had something systematic," he said.

Pink estimated that they had analyzed thousands of movies. "The thing is that not everything comes to you as a script. For a long period, we worked for a broadcaster who used to send us a couple of paragraphs. We made our predictions based on that much. Having the script is actually too much information sometimes. You're trying to replicate what the audience is doing. They're trying to make a choice between three movies, and all they have at that point is whatever they've seen in TV Guide or on any trailer they've seen. We have to take a piece here and a piece here. Take a couple of reference points. When I look at a story, there are certain things I'm looking for—certain themes, and characters you immediately focus on." He thought for a moment. "That's not to deny that it matters whether the lead character wears a hat," he added, in a way that suggested he and Mr. Brown had actually thought long and hard about leads and hats.

"There's always a pattern," he went on. "There are certain stories that come back, time and time again, and that always work. You know, whenever we go into a market—and we work in fifty markets—the initial thing people say is 'What do you know about our market?' The assumption is that, say, Japan is different

from us—that there has to be something else going on there. But, basically, they're just like us. It's the consistency of these reappearing things that I find amazing."

"Biblical stories are a classic case," Mr. Brown put in. "There is something about what they're telling and the message that's coming out that seems to be so universal. With Mel Gibson's 'The Passion,' people always say, 'Who could have predicted that?' And the answer is, we could have."

They had looked at "The Interpreter" scripts a few weeks earlier. The process typically takes them a day. They read, they graded, and then they compared notes, because Mr. Pink was the sort who went for "Yojimbo" and Mr. Brown's favorite movie was "Alien" (the first one), so they didn't always agree. Mr. Brown couldn't remember a single script he'd read where he thought there wasn't room for improvement, and Mr. Pink, when asked the same question, could come up with just one: "Lethal Weapon." "A friend of mine gave me the shooting script before it came out, and I remember reading it and thinking, It's all there. It was

all on the page." Once Mr. Pink and Mr. Brown had scored "The Interpreter," they gave their analyses to Mr. Bootstraps, who did fifteen runs through the neural network: the original Randolph script, the shooting script, and certain variants of the plot that Epagogix devised. Mr. Bootstraps then passed his results to Copaken, who wrote them up. The Epagogix reports are always written by Copaken, and they are models of lawyerly thoroughness. This one ran to thirty-eight pages. He had finished the final draft the night before, very late. He looked fresh as a daisy.

Mr. Pink started with the original script. "My pure reaction? I found it very difficult to read. I got confused. I had to reread bits. We do this a lot. If a project takes more than an hour to read, then there's something going on that I'm not terribly keen on."

"It didn't feel to me like a mass-appeal movie," Mr. Brown added. "It seemed more niche."

When Mr. Bootstraps ran Randolph's original draft through the neural network, the computer called it a \$33-million movie—an

"intelligent" thriller, in the same commercial range as "The Constant Gardener" or "Out of Sight." According to the formula, the final shooting script was a \$69-million picture (an estimate that came within \$4 million of the actual box-office). Mr. Brown wasn't surprised. The shooting script, he said, "felt more like an American movie, where the first one seemed European in style."

Everyone agreed, though, that Pollack could have done much better. There was, first of all, the matter of the United Nations. "They had a unique opportunity to get inside the building," Mr. Pink said. "But I came away thinking that it could have been set in any boxy office tower in Manhattan. An opportunity was missed. That's when we get irritated—when there are opportunities that could very easily be turned into something that would actually have had an impact."

"Locale is an extra character," Mr. Brown said. "But in this case it's a very bland character that didn't really help."

In the Epagogix secret formula, it seemed, locale matters a great deal. "You know, there's a big difference between city and countryside," Mr. Pink said.

"It can have a huge effect on a movie's ability to draw in viewers. And writers just do not take advantage of it. We have a certain set of values that we attach to certain places."

Mr. Pink and Mr. Brown ticked off the movies and television shows that they thought understood the importance of locale: "Crimson Tide," "Lawrence of Arabia," "Lost," "Survivor," "Castaway," "Deliverance." Mr. Pink said, "The desert island is something that we have always recognized as a pungent backdrop, but it's not used that often. In the same way, prisons can be a powerful environment, because they are so well defined." The U.N. could have been like that, but it wasn't. Then there was the problem of starting, as both scripts did, in Africa—and not just Africa but a fictional country in Africa. The whole team found that crazy. "Audiences are pretty parochial, by and large," Mr. Pink said. "If you start off by telling them, 'We're going to begin this movie in Africa,' you're going to lose them. They've bought their tickets. But when they come out they're going to say, 'It was all right. But it was Africa.'" The whole thing seemed to leave Mr. Pink quite

distressed. He looked at Mr. Brown beseechingly.

Mr. Brown changed the subject. "It's amazing how often quite little things, quite small aspects, can spoil everything," he said. "I remember seeing the trailer for 'V for Vendetta' and deciding against it right there, for one very simple reason: there was a ridiculous mask on the main character. If you can't see the face of the character, you can't tell what that person is thinking. You can't tell who they are. With 'Spider-Man' and 'Superman,' though, you do see the face, so you respond to them."

The team once gave a studio a script analysis in which almost everything they suggested was, in Hollywood terms, small. They wanted the lead to jump off the page a little more. They wanted the lead to have a young sidekick—a relatively minor character—to connect with a younger demographic, and they wanted the city where the film was set to be much more of a presence. The neural network put the potential value of better characterization at an extra \$2.46 million in U.S. box-office revenue; the value of locale adjustment at \$4.92 million; the value of a sidekick at \$12.3 million—

and the value of all three together (given the resulting synergies) at \$24.6 million. That's another \$25 million for a few weeks of rewrites and maybe a day or two of extra filming. Mr. Bootstraps, incidentally, ran the numbers and concluded that the script would make \$47 million if the suggested changes were not made. The changes were not made. The movie made \$50 million.

Mr. Pink and Mr. Brown went on to discuss the second "Interpreter" screenplay, the shooting script. They thought the ending was implausible. Charles Randolph had originally suggested that the Tobin Keller character be black, not white, in order to create the frisson of bringing together a white African and a black American. Mr. Pink and Mr. Brown independently came to the same conclusion. Apparently, the neural network ran the numbers on movies that paired black and white leads—"Lethal Weapon," "The Crying Game," "Independence Day," "Men in Black," "Die Another Day," "The Pelican Brief"—and found that the black-white combination could increase box-office revenue. The computer did the same kind of analysis on Scott Frank's "diarrhea of the plot," and found that there were too many villains. And if Silvia Broome was going to be in

danger, Mr. Bootstraps made clear, she really had to be in danger.

"Our feeling—and Dick, you may have to jump in here—is that the notion of a woman in peril is a very powerful narrative element," Mr. Pink said. He glanced apprehensively at Copaken, evidently concerned that what he was about to say might fall in the sensitive category of the proprietary. "How powerful?" He chose his words carefully. "Well above average. And the problem is that we lack a sense of how much danger she is in, so an opportunity is missed. There were times when you were thinking, Is this something she has created herself? Is someone actually after her? You are confused. There is an element of doubt, and that ambiguity makes it possible to doubt the danger of the situation." Of course, all that ambiguity was there because in the Randolph script she was making it all up, and we were supposed to doubt the danger of the situation. But Mr. Pink and Mr. Brown believed that, once you decided you weren't going to make a European-style niche movie, you had to abandon ambiguity altogether.

"You've got to make the peril real," Mr. Pink said.

The Epagogix revise of "The Interpreter" starts with an upbeat Silvia Broome walking into the United Nations, flirting with the security guard. The two men plotting the assassination later see her and chase her through the labyrinthine corridors of what could only be the U.N. building. The ambiguous threats to Broome's life are now explicit. At one point in the Epagogix version, a villain pushes Broome's Vespa off one of Manhattan's iconic East River bridges. She hangs on to her motorbike for dear life, as it swings precariously over the edge of the parapet. Tobin Keller, in a police helicopter, swoops into view: "As she clings to Tobin's muscular body while the two of them are hoisted up into the hovering helicopter, we sense that she is feeling more than relief." In the Epagogix ending, Broome stabs one of Zuwanie's security men with a knife. Zuwanie storms off the stage, holds a press conference, and is shot dead by a friend of Broome's brother. Broome cradles the dying man in her arms. He "dies peacefully," with "a smile on his blood-spattered face." Then she gets appointed Matobo's U.N. ambassador. She turns to Keller. "'This time,' she notes with a wry smile . . . 'you will have to protect me.'"

" Bootstraps's verdict was

that this version would result in a U.S. box-office of \$111 million.

"It's funny," Mr. Pink said. "This past weekend, 'The Bodyguard' was on TV. Remember that piece of"—he winced—"entertainment? Which is about a bodyguard and a woman. The final scene is that they are right back together. It is very clearly and deliberately sown. That is the commercial way, if you want more bodies in the seats."

"You have to either consummate it or allow for the possibility of that," Copaken agreed.

They were thinking now of what would happen if they abandoned all fealty to the original, and simply pushed the movie's premise as far as they could possibly go.

Mr. Pink went on, "If Dick had said, 'You can take this project wherever you want,' we probably would have ended up with something a lot closer to 'The Bodyguard'—where you have a much more romantic film, a much more powerful focus to the two characters—without all the political stuff going on in the background. You go for the emotions on a very basic level. What would be the upper limit

on that? You know, the upper limit of anything these days is probably still 'Titanic.' I'm not saying we could do six hundred million dollars. But it could be two hundred million."

7.

It was clear that the whole conversation was beginning to make Mr. Pink uncomfortable. He didn't like "The Bodyguard." Even the title made him wince. He was the sort who liked "Yojimbo," after all. The question went around the room: What would you do with "The Interpreter"? Sean Verity wanted to juice up the action-adventure elements and push it to the \$150- to \$160-million range. Meaney wanted to do without expensive stars: he didn't think they were worth the money. Copaken wanted more violence, and he also favored making Keller black. But he didn't want to go all the way to "The Bodyguard," either. This was a man who loved "Dear Frankie" as much as any film he'd seen in recent memory, and "Dear Frankie" had a domestic box-office gross of \$1.3 million. If you followed the rules of Epagogix, there wouldn't be any movies like "Dear Frankie." The neural network had one master, the market, and answered one

question: how do you get to bigger box-office? But once a movie had made you vulnerable—once you couldn't even retell the damn story without getting emotional—you couldn't be content with just one master anymore.

That was the thing about the formula: it didn't make the task of filmmaking easier. It made it harder. So long as nobody knows anything, you've got license to do whatever you want. You can start a movie in Africa. You can have male and female leads not go off together—all in the name of making something new. Once you came to think that you knew something, though, you had to decide just how much money you were willing to risk for your vision. Did the Epagogix team know what the answer to that question was? Of course not. That question required imagination, and they weren't in the imagination business. They were technicians with tools: computer programs and analytical systems and proprietary software that calculated mathematical relationships among a laundry list of structural variables. At Platinum Blue, Mike McCready could tell you that the bass line was pushing your song out of the center of hit cluster 31. But

he couldn't tell you exactly how to fix the bass line, and he couldn't guarantee that the redone version would still sound like a hit, and you didn't see him releasing his own album of computer-validated pop music. A Kamesian had only to read Lord Kames to appreciate the distinction. The most arrogant man in the world was a terrible writer: clunky, dense, prolix. He knew the rules of art. But that didn't make him an artist.

Mr. Brown spoke last. "I don't think it needs to be a big-budget picture," he said. "I think we do what we can with the original script to make it a strong story, with an ending that is memorable, and then do a slow release. A low-budget picture. One that builds through word of mouth—something like that." He was confident that he had the means to turn a \$69-million script into a \$111-million movie, and then again into a \$150- to \$200-million blockbuster. But it had been a long afternoon, and part of him had a stubborn attachment to "The Interpreter" in something like its original form. Mr. Bootstraps might have disagreed. But Mr. Bootstraps was nowhere to be seen.