Thirty years ago if you’d wanted to invest your money, you would have probably entrusted it to a cigar-smoking, gray-haired sage who’d been a Wall Street player for decades. He would have been a big node in the old boys’ network, steeped in the traditions and lore of stock trading that dated back, with only minor mutations, to the days of the robber barons. True, he would base his decisions in part on “the numbers,” but he would base them equally as much on his personal relationships, the rules of thumb inherited from his mentors, and on gut instinct.
much on everyone’s lips was Michael seems to be appearing. For instance, members of this new method do indeed optimistic that the answer is yes, and glimpse that are still the industry mainstay?

In June 2004, a genial assortment of business people, sports luminaries, and academics convened in Los Angeles to discuss whether the same sort of revolution might be brewing in the world of sports. The meeting was underwritten by SFI Business Network members Legg Mason Funds Management Inc. and Credit Suisse First Boston, and hosted by the Trust Company of the West. The question on the table: Can game theory, complexity science, or even neuropsychology lend useful insights into how to build better teams, rank teams and value players, and predict tournament outcomes better than the simple methods that are still the industry mainstay?

Many of the participants were optimistic that the answer is yes, and glimmers of this new method do indeed seem to be appearing. For instance, much on everyone’s lips was Michael Lewis’s 2003 bestseller, Moneyball. The book follows the story of the Oakland Athletics as they came up with a new and unconventional set of yardsticks for valuing players, and, in the process revolutionized the way baseball is managed. With only a shoestring budget, the A’s, as they are known, put together a first-rate team using players who had been passed over by all the big shots of the Major Leagues.

Ranking Teams—The Worst Way is to Have a Tournament”

Ranking teams is a messy exercise, said Ken Massey, a visiting professor of mathematics at Hollins University. He is in a position to know. Massey publishes the well-known Massey Ratings on his web site, primarily as a hobby. These ratings are used as part of the formula for the BCS (Bow Championship Series) Rankings each year to determine which college football teams should face each other in the NCAA championship bowls. Massey outlined several kinds of mathematical models that people have used to try to capture the dynamics of teams or other institutions competing for the same prize. These included classical linear statistical methods, Markov Chains (which are the crux of the Google search engine), maximum likelihood models (on which the Massey Ratings are based), and neural networks.

“People are often confused with the BCS Rankings,” Massey said, “because they think that when the championship game is played, that’s the definitive answer as to which is the best team.”

But team sports are so high-dimensional, he said, the very idea of creating a one-dimensional list of teams in order of merit, not to mention the notion of singling out the team that is “best,” is inherently artificial. To make matters more difficult, the data sets in sports tend to be very small and very noisy. Luck, weather, and injuries play big roles in game outcomes. So do hard-to-quantify psychological factors such as slumps and home-field advantage. Even the random ordering of team face-offs in a tournament can introduce statistical artifacts into the rankings, Massey said. In addition, he discussed some of the ways even the good models can go wrong: sometimes they lead to strange rankings that put bad teams over good, or even more absurdly, rank teams in circular relation to one another, the same way paper beats rock beats scissors beats paper.

“The worst way to figure out the best team is to have a tournament,” he said.

And yet, that is what’s called for. Massey said that at best his maximum likelihood model is able to predict roughly 75 percent of games in baseball and about 66 percent in the NFL. The rest, he said, is where all the fun of watching and arguing about sports is found.

Scott E. Page, SFI External Faculty member and a complex systems professor at the University of Michigan, agreed that linear models can never capture the complexity of interactions inherent to team sports, and spoke of a better way to search for useful patterns that human intuition can’t spot. He calls it the General Manager’s Backpack Problem: given a finite budget, your job is to look at players on a few key dimensions (pitch speed, batting average, forty-yard dash time, or similar criteria) and put together the best team you can through an auction competing against other teams.

“It’s a nightmare problem,” Page said. “It’s beyond NP hard!”—which is an engineer’s way of saying that in practice you can never solve it no matter how big a computer you sic on it.

This brought Page to the centerpiece of his talk, the simple strategy game called Colonel Blotto. In Colonel Blotto, each of two opposing sides is given an army of equal size and must compete for control over a set number of territories. Each side assigns any

IF AN NFL COACH WERE TO GO BY ROMER’S CHART AND RUN ON THE FOURTH DOWN AND FAILED, IT WOULD PROBABLY BE HIS LAST SEASON COACHING, NEVER MIND THAT IT MAY BE A SUPERIOR STRATEGY OVER THE LONG RUN.
number of available troops to each territory. After all the troops have been placed, the total number of troops in each territory becomes revealed to both sides. The side with the greatest number of troops in a territory wins it.

In its basic form, there is no best strategy for winning Colonel Blotto; it is overwhelmingly a game of luck.

However, Page showed how through introducing externalities (such as interactions or nonlinearities) into the game, thereby rendering it more complex, meaningful strategy options emerge. As he put it, “Complexification (of the strategic environment) leads to simplification (of the strategies).”

For example, if it turns out that controlling France and Germany also gives you extra “bonus” influence on Luxembourg and Belgium, you have a strong strategic incentive to invest troops in those two countries. Negative externalities are also possible: for instance, placing more troops in a particular region might paradoxically destabilize it by stoking native resentment. Discerning and exploiting such nonlinearities is key to forming useful strategies.

By analogy, Page said, the General Manager’s Backpack Problem becomes more tractable with a more complex model of players.

“Our obsessive focus on outcomes over process is key to forming useful strategies. Instead of simply summing up a player’s vector of attributes,” he said, “look for interactions between them.”

He argued that this should make the problem of picking players and building an effective team around a well-thought-out strategy easier, not harder as one might expect. He also said it could lead to a more interesting “meta-game,” in which different managers pursue a range of finely minced strategies and counterstrategies.

To Punt or Not to Punt

David Romer, a professor of political economy at U.C. Berkeley, then turned to the subject of punting. Specifically, he’s analyzed the common decision faced by NFL coaches of whether to punt or go for the first down. Romer has programmed a complex model that analyzes the vast, chess-like tree of contingencies sprawling before the future of any decision of whether or not to punt. Romer used the model to derive a graph prescribing when a team should kick and when it should “go for it.”

Romer argued that his model shows that NFL football teams are punting much too often; they are following imitative rules of thumb that coaches have always used that are strategically poor. This pack mentality also exists in markets, causing financial bubbles. For instance, his graph shows that if a team has fourth down and one yard to go on their own 10-yard line—90 yards from the end zone—they should nevertheless go for the first down. This runs counter to the conventional wisdom, which holds that the ball should be sent as far away from the goal line as possible, even if it means giving the ball to the opposing team. Romer estimates that by following his model (and assuming that the opposing team doesn’t follow this strategy), the average NFL team would win one more game per season than it does now—a considerable gain.

The next two speakers were stars of the sporting world: Norman Chow, offensive coordinator for University of Southern California, and Paul DePodesta, general manager for the Los Angeles Dodgers, and before that, one of the stars of Moneyball. Both men affirmed that many of sports’ standard procedures and strategies exist mainly through momentum and tradition. They also agreed that even if some of these traditions are exposed as non-optimal, supplanting them will be difficult.

“In college football, people are reluctant to try new things because you
have to win a World Series or you’re nothing.”

**Basketball or Moneyball**

Dean Oliver, author of the book *Basketball on Paper*, is the creator of RoboScout, a software program that watches basketball games and analyzes them with a keen statistical eye. In much the same way the Oakland A’s crunched the numbers to find new, better criteria for valuing baseball players, RoboScout looks for—and apparently finds—factors that can better predict the outcome of basketball match-ups.

Oliver used the specific example of the Los Angeles Lakers versus the Detroit Pistons NBA finals in 2004. First he listed the most common rationales people had given before the finals for favoring the Lakers at eight-to-one. These included statements such as, “The Lakers can turn up the heat any time they want to,” “They have the two best players,” and so on. Next he ran through the rationalizations people had offered after the Detroit Pistons won, such as, “The Lakers didn’t want it badly enough,” and “Detroit controlled the tempo.”

Oliver quipped at this point, “Everybody has to be right both before and after.”

He then went on to deflate all of those arguments, calling them superficial. “Both of these sets of reasons are immeasurable,” he said, “and therefore unmanageable. If you can measure it, you can manage it; if not, not.”

In analyzing the same games, RoboScout came up with several non-standard observations that would have predicted the Pistons’ victory. For example, RoboScout observed that the Lakers couldn’t get easy buckets, the Pistons forced the Lakers inside, and the Pistons controlled the offensive glass. (You can read more about RoboScout at www.82games.com.) Oliver said that tools such as RoboScout aren’t used much yet, although they are starting to catch on with management. He predicted coaches would soon follow suit.

**Emotions in the Game**

Colin Camerer, a Caltech economist who studies the cognitive basis of economic decision making, strategic thinking, and risk taking—in a word, “neuroeconomics”—spoke of the need to inject psychology into game theory. Game theory involves the formal analysis of situations where completely rational individuals strive to maximize their own gains by competing or cooperating with others according to an established set of rules. The theory captures certain aspects of economics and strategy extremely well, Camerer said, but is deafeningly silent on all sorts of other factors—things like pride, herd mentality, and emotional attachment—that influence economic and strategic decisions in real life.

USC’s Chow touched on this issue earlier in the day. “One word has been left out in all of this so far,” he said: “Emotion. Football is a game of emotions, no question. The human element is so important...These are twenty-year-old kids playing in front of a crowd of fifty thousand people. Some of them are afraid, some of them are nervous, some of them are giddy. Some players choke under pressure while some really thrive.” Managing all that is at least as important in his job as coordinating plays, he said.

Camerer agreed, commenting, “A five hundred-page book on game theory won’t even have ‘emotion’ in the index. And here’s the coach telling us it’s the most important thing.”

According to Camerer, game theory not only leaves out emotion, it also assumes things about people that aren’t true. For example, game theory assumes we all chase the logical conclusions of our strategies to infinity, while in reality most people can only think a handful of steps into the future, if that. He also documented the fact that people often misapply or under-use the information they possess in predictable ways.

Essentially Camerer was proposing that a better understanding of people in neuropsychological terms might be able to supply analysts with new variables and insights for structuring their models. For example, DePodesta suggested that someday it may become possible to “brain type” players in order to better predict what kind of training is best for them and how they will react to pressure or deal with success.

People like DePodesta, Oliver, and most of the other speakers believe it should be possible to develop a more rigorous science of what leads to success in sports. This generated discussion regarding the emerging synthesis between pro sports and science, and the role that SFI might play in advancing that research agenda. Sports may seem an odd research subject—many think it’s not serious—but it is awash in data, and the rules are well defined. It is a good environment for researchers to cut their teeth, providing insights into complex systems with human actors. Sports metaphors are often invoked by politicians and business people, and there’s a reason. Features of the sporting world: heterogeneity, strategy, adaptation, creation and implementation of rules of thumb, the rise and fall of dynasties (think Rome, think Enron, think Cowboys), also apply to the business and policy worlds.