New computer model thinks it's a football coach

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Chuck Bower. Image courtesy of Indiana University.

It's a cliché in football that every fan thinks he's a coach. Now there's a computer that thinks it's a coach. Indiana University scientist Chuck Bower and two partners have created ZEUS, a computer model of football as it's played in the National Football League, based on years of NFL statistics. ZEUS runs on an off-the-shelf laptop, perfect for a football sideline or a coach's booth, and it does what a coach needs to do during a game but can't -- calculate the consequences of a decision before he calls the next play.

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"Just what I need," groans every harassed head coach. "Another critic."

Not this time. Indiana University scientist Chuck Bower and two partners from the business world, Frank Frigo of Louisville, Ky., and Bo Durickovic of Austin, Texas, have created ZEUS, a computer model of football as it's played in the National Football League, based on years of NFL statistics. ZEUS runs on an off-the-shelf laptop, perfect for a football sideline or a coach's booth above the playing field.

ZEUS is designed to do what a coach needs to do during a game but can't -- calculate the consequences of a decision before he calls the next play. Accept the penalty or decline it? Challenge the official's call or not? Go for it on fourth down or punt? Go for one extra point or two after the touchdown?

These are the kinds of decisions that often determine the outcome of a game, especially a close one. In many situations the decision is obvious, but sometimes it's not clear which choice offers the best chance to win. That's where ZEUS comes in.

Bower emphasized that ZEUS is not a substitute for coaching skills. "It's a valuable addition to a coaching staff's tools, and one that can provide that elusive edge over the competition," he said. "The ZEUS engine is powerful enough to simulate the equivalent of every game played in the history of the NFL in less than a second. ZEUS can objectively assess crucial play-calling decisions with startling accuracy."

Another application of ZEUS involves "player position value." NFL data are available that are conversions of individual player performance into usable statistical input, including players in the non-ball-handling positions. An example is the work of Aaron Schatz and collaborators at Football Outsiders as detailed in their book Football Prospectus 2005, Bower said.

"With the help of this data, ZEUS can convert a player's performance to net wins per season," Bower said. "This is a great aid to NFL managers who must work within a team salary cap. For example, suppose a team is trying to decide whether they should re-sign an aging Pro Bowl running back and a veteran tackle with average ability. They have the alternative choice of acquiring a Pro Bowl tackle and then drafting in the second round a running back whom they regard highly but consider under-rated, which would potentially save the team $1 million in salary. Which path should they take? ZEUS can project how many additional wins per season each move should provide."

Information about ZEUS is available at http://www.pigskinrevolution.com/index.html.

ZEUS was built through extensive research into NFL game logs, historical statistics and the behavioral traits of coaches.

"The core model replicates, with amazing accuracy, the play-calling and statistical outputs of typical NFL teams," Bower said. ZEUS can also be customized for the offense and defense of a particular NFL team and its opponent. Then, with the capability of performing more than a million game simulations in a matter of seconds, it can assess critical play choices on their relative merits.

"ZEUS takes the relative output of the simulation and performs an objective analysis of statistical significance and skill sensitivity. There is simply not a more accurate way to assess a critical play-calling decision in football," Bower said.

Fortunately, very good statistical data are available from the NFL on a team-by-team basis. Using these data, distribution curves were developed for the probabilistic outcomes of every possible play choice. Through continued refinement, a core model was developed that very

accurately replicates how typical NFL teams perform against each other, Bower explained.

After millions of simulations had been performed, a comparison of several key statistics was conducted against actual NFL historical data. In categories such as average score differential, points, time of possession, rushing and passing yardage, kicking distances and field goal success rates, the results of ZEUS were "spot on," Bower said, as can be seen at http://www.pigskinrevolution.com/comparisonslide.html.

Only then was ZEUS used to assess critical play calling. The remarkably close correlation between ZEUS analysis and the best available NFL historical data is shown at http://www.pigskinrevolution.com/palmerslide.html.

But isn't football inherently different from other areas where game theory has been applied?

"Surprisingly, games like chess and backgammon are tactically very similar to games like football and baseball," Bower said. "While the physical nature of the game is very different, the situational nature is strikingly similar. A football coach is constantly making decisions with respect to multiple variables (score, field position, down, yards to a first down, etc.). Sophisticated computer models and simulations were introduced in chess and backgammon more than 20 years ago, and much has been learned. To say that technology has revolutionized these games would be an understatement. There is absolutely no reason that ZEUS cannot have an equally revolutionary impact on professional sports such as football and baseball."

ZEUS is currently designed to accommodate NFL rules and the statistical range of NFL teams. However, the model can provide a reasonably accurate assessment of many critical decisions in the college

game as well.

"With some modification, a very powerful product could be developed to assist the college coach," Bower said. "Considering the already intense recruiting competition among college programs, technology may ultimately provide the edge needed to succeed at the highest level."

Source: Indiana University