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AMERICA'S NEXT TOP MODEL

As old methods fail to quell ongoing Wall Street turmoil, decision makers may soon be hunting for "America's Next Top Model"—computer model, that is.

Some contestants will likely come from a new breed of social science simulations called "agent-based models" (ABMs). The idea is to use the huge number of calculations available to modern computers to mimic hundreds—even millions—of virtual traders, or "agents" and the multitude of transactions made every day. As agents trade with and learn from one another, large-scale effects like trading volume, or price volatility naturally emerge.

IN WITH THE NEW BOSS

Recently, the models garnered op-ed praise in the New York Times and Scientific American, promising to help us understand complex situations like electric power markets and the current financial crisis. The modelers claim success in simulating events such as the deregulation of the Illinois electricity market in 2007 or the 2001 Nasdaq switchover from trading in sixteenths of a dollar to decimals. They caution however—echoing the sentiment of more traditional economists—that ABMs might easily be misunderstood.

"I think we could definitely over-hype this stuff," said Scott Page, a complex systems and ABM expert at the University of Michigan. "We couldn't say what the Dow's going to be in, say, 2065." But, he continued, there are some situations where ABMs are the best tools available, such as modeling how markets change with time, and how investors change strategies to adapt.

Page and other proponents of agent-based modeling, like Rob Axtell of George Mason University, say that their models are more suited to testing the effects of specific policies rather than trying to predict things like stock prices. "Agent-based models can do some things, but can't solve all problems," said Axtell.

Each agent is an autonomous collection of data and computational rules that tell the entity how to act on information it both has and receives. For example, agents often start out with endowments of "money" that they seek to grow through trading shares of a given stock. They use information about the market, such as price and volume, to decide when to buy or sell. As they trade, they learn from experience, adapting to changing conditions.

As might be expected, the models' efficacy often depends on how the agents are programmed to behave. Some agents are programmed using data collected from surveys of how actual people and companies make decisions. Others obey basic, naïve rules such as "be greedy," which then can change as the agent learns from its interactions with others.

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"I start them out with random ‘personalities’, and over time their ‘personalities’ change [as the agents learn from experience]...evolving in ways that you certainly didn't plan on," said Leigh Tesfatsion, economist and mathematician at Iowa State. Because agents can evolve and adapt, they are well suited to testing systems for vulnerability to behaviors, such as trading strategies, not yet used—or even discovered—in the real world. Testing for previously undiscovered possibilities proves difficult with old methods.

QUESTIONABLE ASSUMPTIONS

Traditional economic models are often sets of complex equations, derived from basic assumptions about how people or companies behave. Often, these models assume that people act rationally—not because economists necessarily have a skewed view of human nature, but rather because rationality allows their math to work. ABMs, on the other hand, don’t have to solve equations that seek to generalize how people behave; they grow general market behaviors, like price volatility, from the ground up, in silico.

This technique scored a victory in 2001 when two computational economists, Vince Darley and Alex Outkin, designed a model to examine the effects of the Nasdaq switch from trading in sixteenths of a dollar to decimals. Their model predicted, among other things, that trading volume would rise and buyers and sellers would have a harder time agreeing on how to price assets. When the switchover occurred, Nasdaq research indicated that most of Darley and Outkin’s predictions panned out.

A more recent model found use when the Illinois Commerce Commission was slated to deregulate the state’s electric power market in 2007. In the aftermath of the California power deregulation debacle—which led to power outages and price spikes—the commission was concerned that companies might be able to manipulate the market to the detriment of customers. They contacted Charles Macal at Argonne National Laboratory to build a computer simulation of the electric grid with virtual companies competing for revenue. The “firms” could learn from their actions and the actions of others, developing different strategies along the way.

Macal and colleagues found that some of those strategies led to behaviors like hoarding, where a company withholds capacity, trying to drive up prices. His team’s findings were used to support independent oversight of the deregulated market.

"It's just one other input into policy,” said Macal, who continued on to explain that legislators must decide how seriously to take the models.

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OUT OF BALANCE

After Nasdaq and Illinois, proponents of ABMs think their method might find use testing the effects of new policies on other markets, such as those for securities or housing. Traditional models describe well what happens once policies are in place, their effects having settled to equilibrium—a balanced state—where prices accurately reflect supply and demand. However, with assets, like stocks, undergoing huge daily price swings, the US economy seems far from balanced.

"The assumption is that there is an equilibrium state, and that may not be true," said Macal. "We're all kind of assuming that in two or three years, the economy will be back in a steady equilibrium…but we don't really care about that, we're worried about what's happening today," he continued.

"In agent-based models, the world is changing around them and the agents try to adapt," explained Blake LeBaron, economist at Brandeis University, famous for building an early agent-based virtual stock market. He's careful to caution, however, that better models may not be able to prevent future bubbles and crashes. Using the analogy of forest fires, he suggested that ABMs might help in designing policies that could contain or minimize damage.

"You may not be able to eliminate all forest fires," he explained, "but you can choose between lots of little fires and one big one."

Agent-based modelers like LeBaron do not claim that their virtual worlds are the best tools for every situation, but they do hold promise to explain behaviors previously inaccessible to older models. How ABMs are applied ultimately depends on legislators, regulators, and decision makers recognizing when they are, or aren't, the right tool for the job.

LINKS:

Cause of the meltdown:
http://www.thislife.org/radio_episode.aspx?episode=355

Failure of AIG's models:
http://online.wsj.com/article/SB122538449722784635.html

Times Op-Ed:
http://www.nytimes.com/2008/10/01/opinion/01buchanan.html

SciAm Op-Ed:
http://www.sciam.com/article.cfm?id=after-the-crash&print=true

On agent-based models:
http://www.econ.iastate.edu/tesfatsi/ace.htm#Welcome

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Neural Networks:
http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/cs11/report.html

Bernanke's Computer model:
http://www.npr.org/templates/story/story.php?storyId=95076198

http://www.theregister.co.uk/2008/10/03/us_economy_model/

Comparison of Climate and Financial models:
http://blog.wired.com/wiredscience/2008/10/climate-models.html

Argonne Power Grid:
http://www.physorg.com/news146852416.html

Darley and Outkin:
http://www.worldscibooks.com/economics/6217.html

On equilibrium models:
http://www3.interscience.wiley.com/journal/121507412/abstract?CRETRY=1&SRETRY=0

www.santafe.edu/~jdf/papers/08-03-014.pdf

On rationality:
www.gmu.edu/jbc/Tyler/rationality.pdf

Homo Economicus:
http://www.sciam.com/article.cfm?id=the-prospects-for-homo-economicus

California Debacle:
http://dir.salon.com/story/news/feature/2001/01/30/deregulation_mess/

LeBaron's artificial santa fe stock market:
http://www.econ.iastate.edu/tesfatsi/blake.sfisum.pdf