What will we know on Tuesday at 7pm?

Andrew Gelman[1] and Nate Silver[2]

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On the evening of November 8, 1988, I was working with my colleague Gary King in his Harvard office.   Gary somehow had gotten his hands on a pair of tickets to Michael Dukakis's victory party in Boston, and we were trying to decide whether to go. Dukakis was expected to lose, but . . . who could say, right? We had the TV on, and the first state to report, at 7pm, was Kentucky, which Bush had won by over 10 points. Gary informed me that the election was over: Kentucky, at the time, was near the political center of America, and there was no way that Dukakis would do much better nationally than he did in Kentucky. So we saved ourselves a subway ride and kept on working.

What about this year's election night? Can you play along at home with the election and decide at 7pm what is happening? We will perform some calculations using vote margin (as we learned of Kentucky in 1988) and some using only the tally of states won or lost.

This year, the polls close at 7pm Eastern Time in six states, which I will list in decreasing order of Barack Obama's predicted vote margin[3]: Vermont (Obama predicted to win by 21%), Vigrinia (+5%), Indiana (-2%), Georgia (-5%), South Carolina (-11%), and Kentucky (-15%). The map has certainly changed since the days when Kentucky was a swing state.

Real-time predictions given vote margins in the early states

We'll start by assuming you'll know the vote margin (either as exactly tabulated or as estimated from exit polls) in each of these states, and that you take a simple average of Virginia, Indiana, Georgia, South Carolina, and Kentucky. (I'll exclude Vermont because it is the smallest of this set of states and farthest from the national median.) Based on current poll aggregates, we expect the five-state average vote margin to be -5.7%; that is, McCain should beat Obama by an average

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[1] Department of Statistics and Department of Political Science, Columbia University, gelman@stat.columbia.edu, http://www.stat.columbia.edu/~gelman
[2] Baseball Prospectus, http://fivethirtyeight.com

[3] All our calculations derive from 10,000 simulations of the state-by-state presidential election vote margins as of Monday 2 November, based on the poll aggregation method described by Silver (2008). We earlier analyzed a similar set of simulations to estimate the probability that a single vote will be decisive (Gelman, Silver, and Edlin, 2008). See Lock and Gelman (2008) for further discussion of the decomposition of a forecast into national and state-by-state components and Erikson and Wlezien (2008) and Campbell (2008) for more on forecasting presidential elections.

of 5.7 percentage points on the way to winning Kentucky, South Carolina, Georgia, Indiana, and losing Virginia.[4]

If the expected happens, what have we learned? Let's start by asking what we can say before *any* election returns are in. Obama is expected to win the national popular vote by 4.8 percentage points, with an expected electoral vote total of 340 (compared to 270 needed for victory), and a 96% chance of winning the electoral vote (with a 0.2% chance of a tie in the electoral college). The top row of Figure 1 shows the forecast distributions of Obama's popular and electoral vote shares.

Now, what if the vote margin in Virginia, Indiana, Georgia, South Carolina, and Kentucky were to equal the expected -5.7%? We pipe this assumption through our model by calculating, for each of our 10,000 simulations, the average vote margin in these five states, and then restricting our analysis to the subset of simulations for which this vote margin is within 1 percentage point of its expected value (that is, between -6.7% and -4.7%). Out of our 10,000 simulations, 2800 fall in this range; that is, we predict there is a 28% chance that McCain's average vote margin in these five states will be between 4.7% and 6.7%. What is of more interest is what happens if this occurs. Considering this subset of simulations, Obama's expected national popular vote margin is +4.7%, his expected electoral vote total is 343, and the conditional probability of an Obama victory is 100%: he wins the electoral college in all 2800 simulations in this condition. The bottom row of Figure 1 shows the forecast distributions of Obama's popular and electoral vote shares, conditional on him doing exactly as expected in the first round of states.

So if the 7pm states go as expected, we'll know a lot.

How about other possibilities? We repeat the above calculation under scenarios in which Obama's average vote margin in Virginia, Indiana, Georgia, South Carolina, and Kentucky takes on each possible value between -12% and +1%; based on our simulations, there is a 97% chance that the average 7pm vote margin (excluding Vermont) will fall in this range.

In the unlikely event that McCain gets an average vote margin of 12 percentage points in the five 7pm states, we would forecast a 1.3% margin for McCain in the national popular vote, an expected 265 electoral votes for McCain, and a 38% chance of him winning the electoral college (with a 60% chance of Obama winning and a 2% chance of a tie).

At the other extreme, if Obama happens to get an average vote margin of 1 percentage point in these early states, we predict his national popular vote margin to be 10% with 394 electoral votes and a 100% chance of winning.

What about the possibilities in between? Figure 2 shows Obama's expected popular vote margin, the expected division of electoral votes, and the probability of each candidate winning,

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[4] For simplicity, we are calculating a simple average of the five vote margins, not weighted by state population, electoral votes, or turnout.

under the different scenarios. According to these simulations, if McCain hasn't secured an average vote margin of at least 9 percentage points in Virginia, Indiana, Georgia, South Carolina, and Kentucky, he can pretty much throw in the towel. And if Obama loses these states by an average of more than 10 points, we might be up all night.

Real-time predictions given only the state winners

What if the TV stations are not reporting vote margins but just winners? With six states reporting at 7pm, there are 64 possible outcomes. Some of these are impossible or uninteresting, however: if McCain wins Vermont, or if Obama wins South Carolina or Kentucky, the election is over. What remains are Virginia, Indiana, and Georgia.

Table 1 gives the eight possibilities, our forecast probability of each happening, and Obama's expected popular vote margin, electoral vote margin, and win probability under each scenario. The only interesting possibility is if McCain sweeps all three states: then it is a contest, and we would then give him an even chance of pulling it out.

We would then have to wait until 7:30pm Eastern time, when we hear from Ohio, North Carolina, and West Virginia. Our current forecasts give Obama less than a 1% lead in North Carolina as and a 2% lead in Ohio, with McCain having a 10% lead in West Virginia. But in the (unlikely) event of McCain sweeping Virginia, Indiana, and Georgia, the story would change. At that point, Obama would be expected to lose Ohio, North Carolina, and West Virginia, by margins of 3, 5, and 15 percentage points, respectively. If McCain's chances are still alive at 7pm, there's an 87% chance he'll win all three of these must-win states that close the polls at 7:30.

Onward to 8:00, when most of the remaining eastern states close the polls. The 8pm states range from Maryland and Massachusetts (where Obama is forecast to win by 23 and 19 points, respectively) to Oklahoma and Alabama (predicted McCain victory margins of 27 and 24 points). Conditional on McCain winning the key early states of Virginia, Indiana, Ohio, and North Carolina, these predictions shift by about 5 percentage points in his favor.

The states to watch at 8pm—if there's anything worth watching at all—are New Hampshire, Pennsylvania, and Florida, for which McCain's predicted vote margins, conditional on his previous success, would be -3%, -2%, and +4%. At this point, winning Pennsylvania would pretty much guarantee victory for McCain; his other possibilities are winning New Hampshire and Florida (which would give him an expected 277 electoral votes and a 79% chance of winning, with an amazing 12% chance of a tied electoral college), and winning Florida alone (the most likely possibility, with an 80% chance of happening) which would take him to an expected 264 electoral votes and a 33% chance of winning.

At this point, McCain would have an 80% chance of winning both Missouri and Florida, which would move him up to an expected 281 electoral votes and a 66% chance of winning (compared

to 30% for Obama and a 4% chance of a tie, at this point). The next most likely possibility is McCain winning Missouri but losing Florida, in which case his expected electoral vote count drops to 243 and his probability of winning declines to 3%.[5]

If McCain wins Virginia, Indiana, Ohio, North Carolina, and Florida, while losing Pennslyvania, we'll have to keep the TV on. The news at 8:30 won't help much: at this point, McCain would be expected to win handily in Arkansas, the only state to close the polls at that time. At 9pm we'll hear from a bunch of states further west, including Colorado (with Obama expected to win by less than 1% at this point), New Mexico (Obama expected to win by 4%), Minnesota (Obama by 4%), Wisconsin (Obama by 5%), and Michigan (Obama by 6%). If Obama wins all five of these, he has a 97% chance of winning. If McCain wins any of them (most likely Colorado), he's almost home free, with a 90% chance of an electoral vote win, and if McCain wins two or more, he's basically won the election.

Again, though, we only estimate a 4% chance overall of this happening. Most likely the election will be over by 7pm.

Discussion

For future elections it would be fun to set up an online widget so that users could enter election returns as they are happening, and the relevant probabilities would pop out. It would also be desirable to connect this to election returns by county and even precinct.   TV networks aren't supposed to make early calls of the election but maybe there's be some way of doing this informally. And, of course, all these inferences are only as good as the forecasting model.

References

Campbell, J. E. (2008). Forecasting the 2008 national elections. *PS: Political Science and Politics* **41**, 679-681.

Erikson, R. S., and Wlezien, C. (2008). Leading economic indicators, the polls, and the presidential vote. *PS: Political Science and Politics* **41**, 703-707.

Gelman, A., Silver, N., and Edlin, A. (2008). What is the probability your vote will make a difference?

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[5] The 13-electoral-vote difference in McCain's prospects winning or losing New Hampshire represent that state's own 4 electoral votes plus an expected 9 electoral votes that represent expected gains elsewhere, as inferred by McCain's performance in New Hampshire. All of this is conditional on him having won Virginia, Indiana, Ohio, and North Carolina already.

Lock, K., and Gelman, A. (2008). Bayesian combination of state polls and election forecasts. Technical report, Department of Statistics, Columbia University.

Silver, N. (2008). Frequently asked questions. http://www.fivethirtyeight.com/2008/03/frequently-asked-questions-last-revised.html
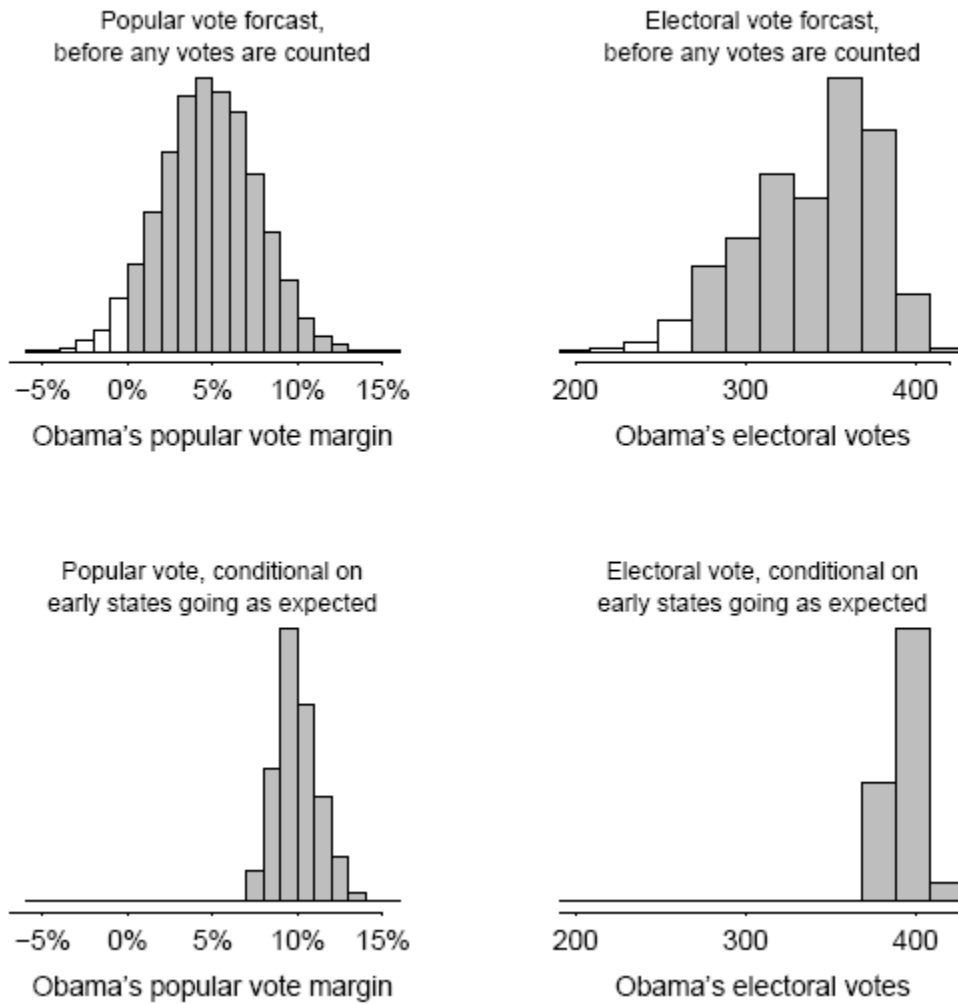
Figure 1. Uncertainty distribution for the presidential election outcome, expressed as Obama's popular vote margin and his electoral vote total. Top row is based on a poll-based forecast the day before the election; bottom row is based on these forecasts, conditional on the states whose polls close at 7pm going as expected. The averages of the distributions in the top and bottom row are the same, but the distributions on the bottom show less variation: the vote margins of the early states will tell us a lot.
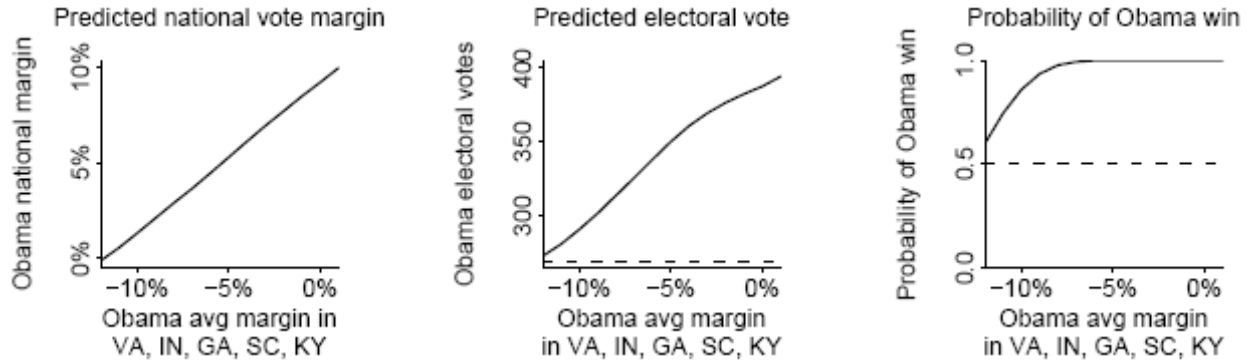
Figure 2. Election predictions at 7pm Eastern time, after the polls close in Virginia, Indiana, Georgia, South Carolina, and Kentucky. Obama's average vote margin in these five states is predicted to be -5.7 percentage points, but it could plausibly fall between -12 and +1 percentage point. For each of these possible outcomes, we compute Obama's expected share of the national popular vote, his expected electoral vote total, and the probability he will win in the electoral college. Unless McCain's average vote margin in these five states is at least 9 percentage points, we can confidently call the election for Obama at this point.

VA	IN	GA	Probability of scenario	Popular vote Obama-McC	Electoral vote Oba	McC	Probability of O.win	M.win	Tie
McC	McC	McC	7%	0.2%	268	270	.47	.49	.04
McC	McC	Oba	0						
McC	Oba	McC	0						
McC	Oba	Oba	0						
Oba	McC	McC	66%	+4.0%	330	208	.99	.01	.00
Oba	McC	Oba	<1%						
Oba	Oba	McC	22%	+7.4%	375	162	1.00	.00	.00
Oba	Oba	Oba	5%	+9.9%	399	139	1.00	.00	.00

Table 1. Scenarios of interest at 7pm Eastern time, with the first states reporting. In order to have a chance, McCain needs to win Virginia in this first round (in which case he would almost certainly win Indiana and Georgia as well).