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Concepts in Uncertainty—Four brief teaching notes

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Concepts in Uncertainty—Four brief teaching notes

July 12, 2011

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Table of Contents

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Introduction

In Spring 2010 I taught—for the first time—an undergraduate required subject in *project evaluation* (1.011). In the course of that teaching, I wrote and distributed several teaching notes, which were intended to illustrate for the student various systems concepts. The ones included here focused on the theme of *uncertainty* and how one deals with it.

The first two teaching notes deal with uncertainly in weather prediction and other natural phenomena. The first built on a "snowstorm that never happened" in Boston, as dire forecasts for snow were not indeed realized in February 2010. The paper tries to explain why this kind of thing can happen, given the relationship between storm tracks and amounts of fallen snow at a particular site. The second deals with tsunamis and the state-of-the-art in prediction of tsunamis, which occur as a result of earthquakes. This was motivated by an earthquake that took place in Chile, which many were concerned would lead to tsunamis across the Pacific, with dire effects on islands such as Guam and potentially even Japan. Here big tsunamis were predicted but didn't occur. Again, we used that example to highlight uncertainties and why errors of this sort were made.

The third and fourth teaching notes deal with professional American football and decision-making under uncertainty. I tried to write these so that one didn't have to be expert in the rules of football to follow the argument. In November 2009, New England Patriots coach Bill Belichick, made a quite controversial decision trying to convert a first down on a fourth down play in the last two minutes of a game with the Indianapolis Colts. The Patriots were leading at the time and a successful first down would have allowed the Patriots to retain possession of the ball, guaranteeing a win. His gamble failed; the Patriots did not make the first down and so surrendered the ball, and ultimately lost the game. So the third teaching note tried to explain why Belichick—widely hailed as one of the best coaches in NFL football history--- could have made such a "blunder." The fourth teaching note was a follow up and was concerned with the concept of rationality. Economists use the "rational actor" model to "predict" what people will do when faced with various choices. Often the economists are wrong in their predictions because their definition of rationality may well differ from that of the people actually making the decisions. We illustrate that by considering metrics other than simply maximizing the probability of winning the football game, as in teaching note 3. We included an "embarrassment factor," which reflects some football coaches concern with appearing foolish when they make a gamble that fails. So they may make an "irrational" decision in the eyes of some, because they are not maximizing their team's chance to win, but also include in their calculation how embarrassed they might be by their decision, which the coach sees as entirely rational.

These teaching notes would be of interest to the reader who is concerned with teaching uncertainty concepts to undergraduates, and may be of value to those who teach introductory graduate classes as well. Any comments on the substance, content, clarity, and value of the approach would be greatly appreciated.

Teaching Note I--How Little Mistakes Can Lead to Big Differences in Outcomes: The Weather

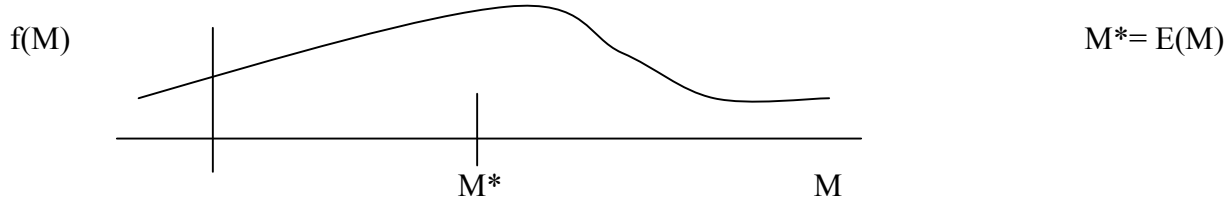
February 25, 2010

This is a highly simplified view of a complex physical phenomenon—a winter storm— intended to provide some lessons in why little mistakes in predicting events can lead to big differences in outcomes that people care about. It was "inspired" by the snowstorm that recently did not happen in the Boston Metro area.

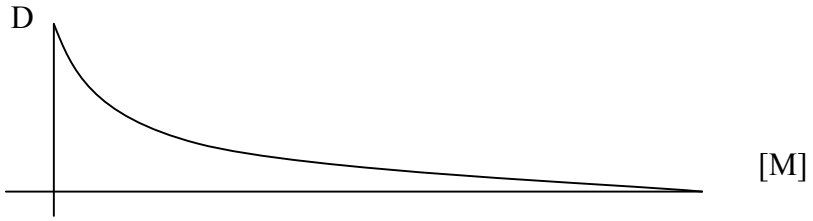
In mid-February, a large storm front was approaching Boston, leading to dire forecasts of heavy snow, in turn leading to many event cancellations and school closings. I live 17 miles west of the city and instead of a snowstorm ended up with a dusting of less than 1/2". In Boston itself, the streets were merely wet. So let's see how this "mistake" happened.

Consider the following diagram. It shows a hypothetical storm track (the vertical line) passing some distance M from my home at L.

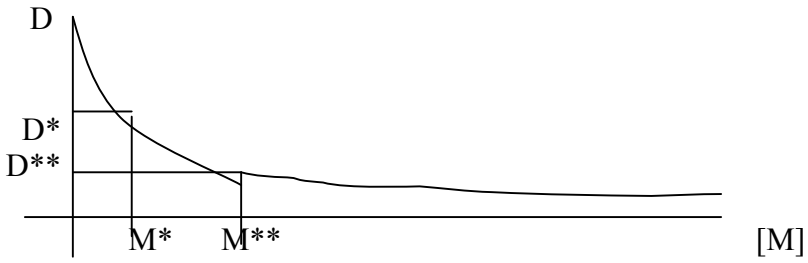
We know M is a random variable which, let us assume, we can characterize by a probability density function (pdf). We also know that the pdf changes over time. As the storm approaches, we usually can be more confident about M, so the pdf will exhibit less variance. But let's not worry about that.



Now let's further assume we know the relationship between M and the amount of snow D that my home sees. Again, we recognize this is a gross oversimplification. The snowfall will change as the storm parameters change (intensity which is a function of time, velocity of the storm—the slower it is, the more snow falls--, and doubtless other factors).



Suppose the prediction for the storm track is M* from my house. Likely, the meteorologist would use the mean value of M – i.e. M* for that guess. This means the prediction for snow depth is D*, in this instance 12". But suppose the storm shifts and the actual value (instantiation) of M is M**



So the actual snowfall is D**; in the instance of the storm that lead to this note, D** is a much smaller number than the predicted amount, like just about zero!

On National Public Radio the next day, the indication was that the meteorologists missed the storm track by about 40-50 miles. In the grand scheme, maybe that is a pretty good prediction—the "little mistake" in the title of this note. Maybe the meteorologists were popping bottles of champagne to celebrate how close their prediction had come to the actual track. But if D* is 12" and D** is about zero, that is a pretty big difference **in outcomes** as observed by the "stakeholders," such as people being impacted by the storm and making plans based on the predictions.

Now it can work the other way too, of course. There have been occasions when I have shoveled 12" of "snow flurries after midnight" off my driveway the next morning.
So why can't we make better predictions?

Well, that's a story for another day but here is a newspaper article on snow forecasting, another on hurricane tracking and a third on another difficult to predict meteorological phenomena, tornadoes.

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Scientists develop more accurate snow forecasts--USA Today (Feb. 26, 2010)
The research appears in the February (2010) issue of the journal Weather and Forecasting.
By Doyle Rice

http://content.usatoday.com/communities/sciencefair/post/2010/02/snow-forecasting-made-easy/1

Jim Steenburgh of the University of Utah skis through powder snow in Alta, Utah. Steenburgh and one of his students developed a new simple method to predict snow density -- whether fresh snow is powdery or wet and heavy -- and thus snowfall amounts.

So how much snow are we going to get? The seemingly endless parade of wild winter storms has Americans wondering how much snow the next storm will bring, and they expect their local meteorologists to have all the answers. A new forecasting method may soon be available to help.

When predicting snow amounts as a winter storm approaches, it's key for meteorologists to know the water content of the snow that's likely to fall. If the atmosphere is waterlogged, it will dump thick, cement-like snow, while a drier atmosphere produces fluffy, powdery snow.

Meteorologists at the University of Utah say they've come up with an easy way to predict snowfall amounts and density.

"We've developed a formula that predicts the water content of snow as a function of temperature and wind speed," says the study's senior author, Jim Steenburgh, a professor of atmospheric sciences at the University of Utah.

The method has been adopted by the National Weather Service for use throughout Utah, and the scientists say it could be adjusted for use anywhere.

"This is about improving snowfall amount forecasts -- how much snow is going to fall," says Steenburgh. "As a nice side benefit for the ski community, this will tell you whether you're going to get powder or concrete when it snows."

The new method "is also helpful to avalanche forecasters," says the study's first author, Trevor Alcott, a doctoral student in atmospheric sciences. "We're forecasting snow density, which is related to the stability of freshly fallen snow."

According to the National Snow and Ice Data Center, 10 inches of fresh snow can contain as little as 0.10 inch of water (light and fluffy) or as much as 4 inches of water (heavy and wet), depending on crystal structure, wind speed, temperature, and other factors.

The Utah research team studied 457 winter storms during eight years at the Wasatch

Range at Utah's Alta Ski Area. Alta provided numerous snowstorms that could be analyzed and used to develop the snow density formula.

The snow depth of the new snow was divided by the depth of water measured by a rain gauge to determine actual snow density and see what variables best correlated with it.

The study showed that only two variables -- crest-level wind speeds and temperatures -- were needed to predict snow densities. "It's the KISS method -- keep it simple, stupid," Steenburgh says. "How much can we strip down the number of variables analyzed and get a good result?"

Forget gut instinct, computer models and mathematics tell forecasters where storms go
SETH BORENSTEIN
AP Science Writer
September 1, 2010

http://www.foxnews.com/us/2010/09/01/forget-gut-instinct-models-mathematics-tell-forecasters-storms/

WASHINGTON (AP) — Sophisticated computer models that replaced instinct with cold, hard math have helped forecasters predict where a storm like Hurricane Earl is going about twice as accurately as 20 years ago.

And last year, they proved it: The three-day forecast was as accurate as the here-it-comes, one-day warning used to be in the 1980s. In the 2009 hurricane season, the one-day forecast predicting where a storm would hit was off by only 53 miles on average.

But Earl is the type of storm — big and in a tricky location — that can defy expectations. Its predicted track shows the eye passing just off the East Coast,dancing so close to shore that a slight wobble could turn that miss into a mess.

Even if the eye remains offshore, high winds that extend 200 miles from the center could reach inland.

A small shift could "bring the center of Earl directly in contact with the Outer Banks, hence the need for the (hurricane) warning," National Hurricane Center Director Bill Read said Wednesday.

East Coast storms can be more predictable than those in the Gulf of Mexico because they don't usually make the sharp twists and turns taken by some gulf storms.

Still, MIT meteorology professor Kerry Emanuel called Earl "a forecasting nightmare in a way."

That's why Read and others emphasize that the forecast isn't a precise projection of Earl's

movements. It's a line surrounded by a "cone of uncertainty."

About one out of three times, the eye of the storm will move out of the cone, said Timothy Schott, tropical cyclone program leader for the National Weather Service in Silver Spring, Md.

"We're very confident about the track. We're confident about the intensity," Read said. But because of uncertainties, the track can't be narrowed to "a skinny line on a map," he said. "That's why we have errors."

However, those errors are nothing compared with what they used to be.

When Max Mayfield joined the hurricane center in 1972, forecasters had some computer models, but their calculations were based more on history, not the physics of the current atmosphere.

Mostly forecasters used their knowledge and plain old "feel," said Mayfield, who later became the center's director and is now retired.

In 1972, the average two-day forecast was off by about 450 miles; last year it was 81 miles. The margin of error used to be so big that when a storm hit the Leeward Islands — far to the southeast of the U.S. — forecasters started alerts for Florida and up the East Coast, Mayfield said.

He credits the improved forecasts to better observations of storms and improved computer models.

"We have a lot more confidence in the models than we used to," Mayfield said.

Many — if not most — of the models now look at the shifting dynamics of the atmosphere to see what forces are guiding a hurricane. That type of calculation takes faster computers, which are now more readily available.

Hurricanes avoid high-pressure systems — which almost act like brick walls — and follow low pressure troughs, which act like bowling alley gutters guiding storms. The models essentially predict where the walls and gutters will be.

In some ways, those computer models have gotten so reliable that hurricane specialists half-jokingly grouse that they will soon become messengers instead of forecasters, said Hugh Willoughby, a professor at Florida International University and former head of the weather service's hurricane research division.

There are also far more computer models churning data and making predictions, said MIT's Emanuel. That makes a consensus more likely, he said.

But the weather service's Schott said that's only half the story. Despite years of research, forecasters still have not significantly improved their forecasts on storm intensity. They aren't certain why storms suddenly get weaker or stronger.

That's why planes and drones are continuously flown into Earl for more information, especially about the way energy is exchanged between the ocean and the storm itself, Schott said.

"While we pride ourselves that the track forecast is getting better and better, we remain humbled by the uncertainties of the science we don't yet understand," Schott said. "This is not an algebra question where there's only one right answer."

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AP video journalist Tony Winton contributed to this report from Miami.

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Online
National Hurricane Center: www.nhc.noaa.gov

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A twister poses big challenge for meteorologists
By Stephanie Ebbert
Globe Staff June 3, 2011

http://www.boston.com/news/local/massachusetts/articles/2011/06/03/a_twister_poses_big_challenge_for_meteorologists/

The extreme weather that roared through New England Wednesday had been forecast for days. But the tornado that touched down in Springfield descended stealthily and suddenly, forming over the
Connecticut River as horrified commuters sat in rush hour traffic on nearby Memorial Bridge.

“They’re the worst kinds of storms, always have been, always will be,’’ said Harvey Leonard, Channel 5’s chief meteorologist. “There’s only so much you can do with actual warnings of a tornado.’’

The storms’ wrath highlights the imprecision of a forecasting system that is stunning in its ability to predict and track storms, but unable to pinpoint precisely where or when a tornado will touch down.

“Until a tornado drops from the clouds, it’s a thunderstorm,’’ said Peter Judge, spokesman for the Massachusetts Emergency Management Agency. “If you watch this stuff on TV, it’s amazing how technology has grown to the point where they are able to predict, once it’s established itself, which direction, what speed, what communities are in harm’s way. But the problem is for that first community that it drops down on.’’
Although meteorologists are still assessing the damage to confirm the path and strength of the tornadoes that struck Western and Central Massachusetts, the preliminary investigation suggests that a tornado first touched down in Westfield about 4:15 p.m., said Robert Thompson, the National Weather Service meteorologist in charge of the investigation. The tornado then touched down in Springfield, Monson and Sturbridge. A second and possibly

a third then struck Westfield and Springfield and Sturbridge again.

“This was not a surprise by any means that we were getting heavy-duty weather,’’ said Bill Babcock, a meteorologist with the National Weather Service in Taunton. A tornado watch had been issued for most of the state by 1 p.m.

By 4:18 p.m., a severe thunderstorm warning posed the possibility of a tornado in Springfield and Chicopee.

But the tornado warning did not come for Springfield until 4:30 p.m., just two minutes before it touched down there.

“My warning was looking out the window and seeing it coming to our building,’’ said Tom Walsh, the communications director for Springfield’s mayor, Domenic J. Sarno, who watched the funnel cloud forming from a City Hall window where aides were monitoring the news. “The minute I saw the debris, I immediately recognized what it was and ran through City Hall to get down into the basement.’’

On Fox25 News, chief meteorologist Kevin Lemanowicz had just done a cut-in about 4:26 p.m. noting the storm could bring a tornado. “We could see it in Doppler radar before there was a tornado warning,’’ he said.

But the tornado warnings are issued by the National Weather Service’s Storm Prediction Center and are not issued until a tornado can be confirmed.

“It’s a ‘nowcast situation,’ rather than a forecast situation,’’ Lemanowicz said. “All you can do is watch everything develop and warn people in the path of the storms that do come up.’’

Meteorologists say they are limited in their ability to precisely predict tornadoes, even with today’s sophisticated radar systems. They say their radar capability from Eastern Massachusetts is somewhat limited as far out as Springfield.

“Springfield is far enough away that the lowest the radar sees is about 5,000 feet above the ground,’’ said Babcock, noting that meteorologists lose some detail on storms closer to the ground.

“That is a limitation that you’re not going to get with a radar in Eastern Massachusetts because radar essentially goes in a straight line, but the earth’s surface is curved,’’ he added.

Regardless, specialists said, tornado warnings are not issued much farther in advance than the 10 minutes’ notice that Governor Deval Patrick said Springfield got.

“Ten minutes is actually a pretty good warning,’’ said Channel 5 staff meteorologist Mike Wankum. “The national average is 11 minutes’ warning time. The goal is to try to get it to 20 minutes.’’

The warnings are not aimed at giving homeowners time to go inside and save their treasures. “Sometimes people get a tornado warning and run back upstairs when they should be down in the basement,’’ Wankum said. “We’re giving you enough warning to save your life.’’

The warnings can give other towns in the path of a tornado up to an hour of advance warning, Leonard said.

Leonard weighed in on the region’s unusually powerful tornadoes from his vacation in Israel, where he finds himself explaining to other travelers that tornadoes are not unknown in Massachusetts.

The Bay State actually averages three tornadoes a year, and the Worcester tornado of 1953 was one of the 20 deadliest tornadoes in the United States, he said.

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Teaching Note II--The Tsunami That Wasn't

March 7, 2010

We recently wrote about the snowstorm that "never happened" in New England. The predictions were for substantial snow, but those predictions proved wrong and only rain or very light snow occurred in much of the region. The perspective of the meteorologists in the area was, "sorry we missed it – these things happen." The previous note discussed how a deviation in track of a few miles – not that big a mistake – could create substantially different outcomes on the ground where it matters to people (stakeholders, if you will).

Now we have just had a major earthquake, 8.8 on the Richter scale, in Chile. This is among the biggest earthquakes recorded in history. One of the after-effects of earthquakes can be the development of devastating tsunamis, which can wreak havoc around the globe, thousands of miles away. With an earthquake this large, there was real concern about what might happen in the Pacific basin, including places like Guam, the state of Hawaii, and even Japan. The authorities made predictions of a substantial tsunami but, in a similar outcome to the New England snowstorm, those very strong tsunamis did not develop; rather, much more modest waves were felt, creating virtually no problems in the affected communities.

What was different here were the comments of the scientists who had made the tsunami prediction. They expressed regret for the "false alarm," but went on to say they now understood why that tsunami was less intense than predicted and they were going to "change their models" of tsunami behavior and expected to do better in the future. I heard no such commentaries from the meteorologists in the Boston situation—they regretted the poor prediction but didn't talk about what they had learned and how they would try to do better in the future, although I grant I could have missed it.

These different reactions may reflect the state of the art of prediction in these two domains. Perhaps with tsunamis we are still learning at a fundamental level what drives the intensity of the tsunami, while perhaps in the case of snowstorms our models have reached the point where more instantiations will do very little to allow us to make better predictions. One could say (maybe) that in the case of snowstorms, we have reached the point of "irreducible uncertainty". It would be interesting to ask some domain experts in the two fields.

I imagine in the case both of snowstorms and the tsunamis that the predictors are risk-averse. They would rather make predictions that are too severe, allowing people to prepare for the worst, as opposed to missing on the low side with the snowstorm and tsunami being bigger than the predictions.

Another point on tsunamis: I wonder when we first hypothesized the relationship between tsunamis and earthquakes and were able to empirically link a particular earthquake with a corresponding tsunami. One can have "local" tsunamis, in the vicinity of the earthquake; this happened in the Chile earthquake. So we have known that for some time.

But what about a tsunami occurring at a substantial distance from the earthquake? In 2010, we are able to pass on tsunami warnings in real-time around the globe when an earthquake happens. 200 years ago, the warning would have been impossible, and even the linking of an earthquake in Chile

to a tsunami in Japan, after the fact, would have been quite difficult given the period of time between an earthquake in Chile and news of the earthquake reaching Japan – on the scale perhaps of months after a tsunami generated by that earthquake had occurred. Someone would have had to "remember" a tsunami occurred in Japan some hours later than the earthquake occurred back in Chile. Just a thought.

Here's a news article on the difficulties in predicting tsunamis, and coverage of the especially tragic tsunami in Japan in March 2011

Quake Finds Tsunami Forecasts Still Limited – NY Times (March 2, 2010)
By KENNETH CHANG
Published: March 2, 2010

http://www.nytimes.com/2010/03/03/science/03tsunami.html

A wider network of buoys and better computer models gave forecasters in Hawaii on Saturday a much better picture of the approaching tsunami than they would have had in the past, but they admit that their models were not refined enough to declare whether a full-scale evacuation was really needed. When a magnitude 8.8 earthquake buckled the ocean floor off Chile on Saturday, there were concerns of a repeat of the 2004 disaster in which a giant earthquake off Indonesia generated a tsunami that killed thousands of people hours later in Sri Lanka and India. In Hawaii, it was 8:34 p.m. Friday. The magnitude of an earthquake gives an expectation of the size of the resulting tsunami, and with an 8.8 magnitude, the scientists at the Pacific Tsunami Warning Center expected a dangerous tsunami. Coastlines around the Pacific were put on alert, and the beaches in Hawaii were evacuated well in advance of the arrival of the tsunami. But the waves there turned out to be smaller than what was initially expected, causing little or no damage, pointing to the still incomplete knowledge in the art and science of tsunami forecasting. Charles McCreery, the center's director, said some early forecasts predicted that waves as high as eight feet could wash into parts of Hawaii. There were direct historical precedents. In 1960, a magnitude 9.5 earthquake off Chile, the largest earthquake ever recorded, generated a tsunami that killed 61 people in Hawaii and more than 100 in Japan. In 1837, a smaller quake, estimated at magnitude 8.5, also generated a deadly tsunami that hit Hawaii with waves as high as 20 feet. But not all magnitude 8.8 earthquakes generate equally large tsunamis. If the earthquake occurs in shallower water, the uplift of the sea floor would displace less water, setting off a smaller tsunami. The seismic signals provide some clues, but not definitive information.

Just five years ago, there would have been no midocean tsunami buoys between Chile and Hawaii, and forecasters would have been left guessing at the size of the waves until they hit. This time, there was a buoy several hundred miles off Peru that recorded the tsunami as it sped by at more than 400 miles per hour, three hours after the earthquake. "For this case, we had to pretty much base our forecast on one dot, because of the timing," said Vasily V. Titov, a researcher at the Pacific Marine Environmental Laboratory in Seattle who developed one of the three models used by the warning center. In 2004, there were six tsunami buoys. Now there are 39. The data from the one buoy was enough for the computer model to figure out that the tsunami was smaller and less destructive. At 6:24 a.m. Saturday in Hawaii, about five hours before the arrival of the tsunami there, the

tsunami center put out a bulletin with predictions that the wave might reach four feet at Hilo, where the bay tends to amplify the waves, and much lower elsewhere. “In general, all of the numbers were bigger initially and went down,” Dr. McCreery said. The waves at Hilo were a bit less than three feet. Dr. Titov said his model predicted the wave heights fairly accurately. This time, there were no deaths, and the tsunami pushed waters, at most, only a few feet above normal. “It looks like we nailed it, at least for U.S. coastlines,” Dr. Titov said.

But officials said the decision to order an evacuation in Hawaii, the first since 1994, was the right one given the uncertainties of the models. “We’re still in the incipient stages of using these models to constrain our forecasts,” Dr. McCreery said. “There are still lots of improvements we need to make before we can rely on them totally for our decision making.” For one thing, the models do not provide estimates of how far off they might be. “We had to do what we did, because there was too much uncertainty to say it was safe to not evacuate,” Dr. McCreery said. Dr. Titov agreed. He pointed out that the models indicated that the thrust of the tsunami’s energy passed south of Hawaii. When officials say that Hawaii dodged a bullet, “It’s almost literally true,” Dr. Titov said.

Quake, Tsunami Slam Japan Death Toll in the Hundreds; Government Orders Mass Evacuation Near Damaged Nuclear Plants –Asia News (March 12, 2011)

By CHESTER DAWSON in Sendai, Japan, DAISUKE WAKABAYASHI in Fukushima Prefecture and JURO OSAWA in Tokyo

http://online.wsj.com/article/SB10001424052748704399804576193650432765520.html

Tens of thousands of Self-Defense Forces searched desperately for survivors in earthquake-ravaged northern Japan on Saturday as rescue and relief efforts went into full force, even as concerns rose that a radiation leak may have occurred at a nuclear-power facility in the country.

More than 200,000 Japanese were ferried to relief shelters and millions of homes were left without power and water after the country's most powerful quake ever struck on Friday.

Rescue efforts accelerated as police, fire department and defense forces deployed to severely affected areas. Low-flying government rescue helicopters, including Japanese Self Defense Force Blackhawks, hovered low over houses with roof tiles ripped asunder, looking for survivors. Further up the coast toward Sendai, entire roads and bridges were washed away. A few cars could be seen carefully navigating twisted and sand-strewn roads in an apparent attempt to flee, or survey the damage to their communities. No more than a handful of pedestrians could be seen for hundreds of miles up the coast.
An estimated 3,400 buildings have been partially or completely destroyed. In Sukagawa, a small town located in Fukushima Prefecture, about 200 people stood in line to receive water supplies through the night at an emergency distribution center, and water was rationed to a maximum of about 2.6 gallons per household. A team of rescue workers from Singapore arrived in Tokyo on Saturday afternoon, bound for Fukushima Prefectutre,

Japan's foreign ministry said.

"Power is cut in some parts of town, but what we need is water and food," said Dai Iwaya, a 37-year old city project and fiscal planning officer. Homes are in various states of disrepair, with fallen roof shingles and concrete blocks strewn about.

WSJ's Daisuke Wakabayashi reports from Northern Japan, where the extent of the devastation from a 8.9-magnitude earthquake and subsequent Tsunami became even clearer with the arrival of daylight Saturday morning.

Northeast Japan was a wasteland Saturday morning after the country's earthquake triggered a 30-foot tsunami. The cascade of destruction killed hundreds, forced tens of thousands of people from their homes and raised fears of a radioactive release from damaged nuclear power reactors.

Sendai, a city of one million people, was among the hardest-hit areas of the nation. An aerial tour by helicopter Saturday morning near the local airport here showed a dead zone of small planes, helicopters and cars strewn half-submerged in green-brown water. Along the coast north of the airport, oil-storage tanks burned brightly, sending a funnel of pitch-black smoke nearly a mile into the sky. Fires also burned in industrial parks ringing the area, nearly 24 hours after Friday's 8.9-magnitude earthquake, one of the world's five strongest over the past century, ground life across the country to a halt.

Japan's northeast appeared to have been subject to the most severe damage, as powerful waves swallowed warehouses and fishing boats and swept across neighborhoods and rice paddies. Damage and disruption was aggravated by more than 100 powerful aftershocks in the hours after the first jolt.

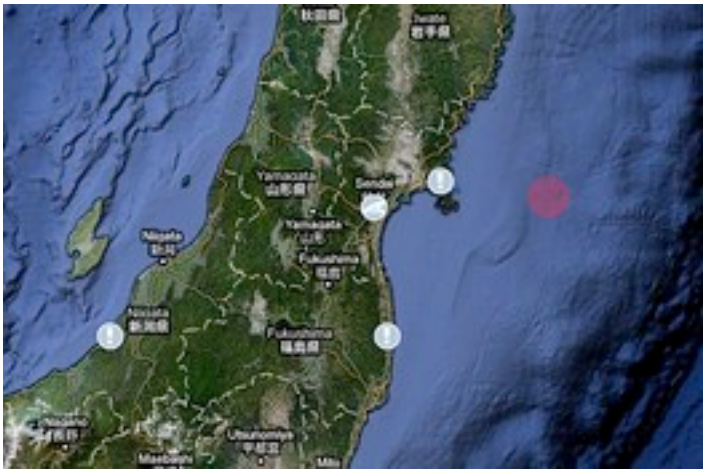
As of 5 p.m. Saturday, Japan's official toll stood at 605 dead, 654 missing, according to police, with more than 1,000 injured.

A building at a troubled Japanese nuclear power facility collapsed Saturday afternoon with smoke billowing out, and officials responded by expanding the evacuation perimeter to a 12-mile radius and saying they were preparing to stockpile iodine supplies "just in case."

Officials declined, however, to say whether the explosion had occurred specifically at the Fukushima Daiichi No. 1 nuclear reactor, or to confirm media reports that a sharp increase in radiation outside the site had been detected.
Earlier in the day, Tokyo Electric Power Co. had been taking emergency measures to avert a meltdown of a stricken nuclear-power plant hit by Friday's massive tsunami in northern Japan. Those steps appeared to be bringing down the dangerous pressures that had built up in the container, a Tepco spokesman said Saturday afternoon.
Previously, the utility had said there was a risk of a meltdown in the core after the quake cut off power to pumps providing cooling water. That, in turn, could lead to heating of the core, the risk of a meltdown, and the release of radiation.
Kyodo/Reuters

Japan Quake's Effects

View Interactive



See a map of post-earthquake events in Japan, Hawaii and the U.S. West Coast.

The impact of the quake's first jolt, which hit at 2:46 p.m. on a clear Friday afternoon, was felt around the country, including in Tokyo. There, office buildings swayed. Trains, buses and phone service stopped. Millions of households lost power.

Japanese spent the rest of the day and night watching televised images of fires, collapsed buildings and deadly debris-filled waves, delivered by news anchors in hard hats. Powerful aftershocks emanating from off the eastern coast shook the country and its people.

The quake's footprint spread at about 3 a.m. local time, as new seismic activity rippled through the center to the country's western coast, raising the specter of a series of quakes extending throughout the country, which sits atop crisscrossing fault lines on the so-called Pacific Rim of Fire.

"I really thought I was going to die," Yuhei Sakaibara, a reporter for the local Sendai newspaper, said in a telephone interview Friday night. "Dishes went flying in every direction

and huge cracks ripped up the walls. When I got outside, I saw that several houses in the neighborhood had collapsed."

In a town of about 12,500 residents in neighboring Fukushima prefecture—at the outskirts of the worst-damaged areas—roads were cracked. Goro Okawara, a 68-year-old farmer who said he was in the fields when the first quake hit, said he thought the temblor would last 30 seconds but "it just kept going and kept getting worse and worse."

The traditional kawara tiles on Mr. Okawara's roof "came flying off," he said, crumbling and spraying red clay blocks in all directions. A glass door shattered. A crater appeared in his driveway. Nearby, he said, the crematorium where his family was planning a funeral for a relative Saturday had collapsed. At the local cemetery, many headstones were snapped in half.

Some 100,000 people had left Fukushima province by early Saturday, Kyodo reported.

The damage slammed a nation that has had its prolonged share of miseries. A long economic decline saw Japan recently slip behind China as the world's second-largest economy. A series of scandals have not only discredited and paralyzed its political leadership, but also tarred institutions from elite universities to the ancient sumo sport.

Japan's long-deadlocked parliament appeared initially to have set aside political bickering and rallied around calls for unity and new measures to keep the quake from further weakening the economy.

With damage estimates likely to mount quickly, news of the quake—which struck near the close of trading Friday on the Tokyo Stock Exchange—may pummel Japanese shares next week. Should the already debt-burdened government be forced to issues trillions of yen in reconstruction bonds, the move would affect the Japanese fixed-income market and weigh on Japan's already-weakened credit rating from the world's major rating agencies.

Teaching Note III--Did Belichick Make the Right Call?

February 19, 2010

Back in November, 2009, Coach Bill Belichick (BB) of the New England Patriots made a highly controversial decision late in a game with the Indianapolis Colts. The Pats had the ball on their own 29-yard line with a 4th and 2 with only 2 minutes or so to go in the game. BB had two options. The conventional choice would have been to punt the ball to the Colts. In that case, the Colts would have had the ball on their own 30 (or so), 70 yards from the winning touchdown. If the Pats went for the first down, and made it, they would retain possession and be able to run out the clock and win. If they didn't, the Colts would take over on the Pats 29, 29 yards away from the winning touchdown.

BB went for the first down and failed to make it. The Colts took over and scored a touchdown winning the game. Belichick was castigated by the fans and the press for his "mistake".

BB is widely perceived as a coaching genius. Did he just have a brain cramp?

Let's think about this:

Suppose BB's assessment of the probabilities is as follows:

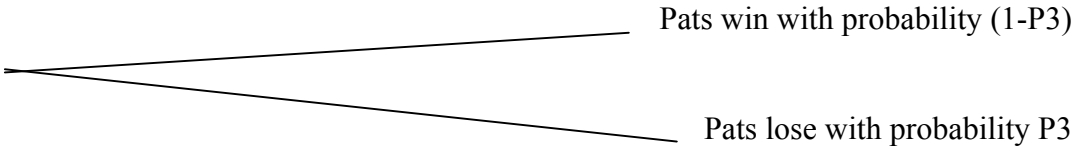
P(Pats make the first down) = P1 (in which case the Patriots win with probability = 1)

P(Colts win if they start from the Pats 29) = P2

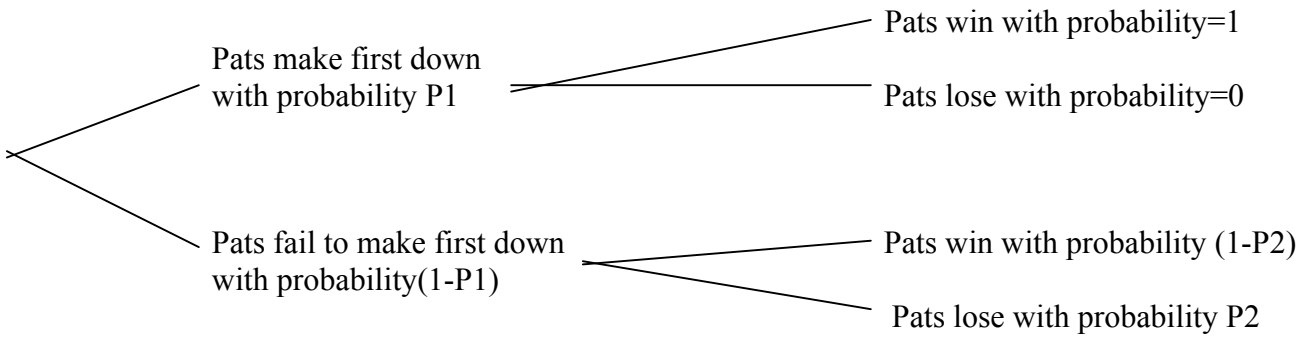
P(Colts win if they start from their own 30) = P3

Here are the decision trees.

They punt



They try for the first down



If BB chooses to punt, the Pats' chance of winning are simply 1-P3
If BB tries for the first down, the Pats' chance of winning is
P1 +(1-P1) (1-P2) = 1- P2(1-P1)

In this second case, they have 2 chances to win—they make the first down, in which case they win with certainty or they fail to make the first down in which case, they can still win if the Colts fail to score from the Pats 29.

So I am speculating that BB felt he had a good chance to make the first down, so let's say
BB thinks P1=0.8.

So, again, the Pats' chance of winning if they punt are 1-P3. Their chance of winning if they go for the first down are 1-P2(0.2).

What should BB do?

So if 1-0.2(P2) > 1-P3, BB should go for the first down.

Rearranging:

If 0.2P2< P3, BB should go for the first down.

So, if for example, BB believes P2 = .7 and P3= .5, you should try for the first down

But if P2 = .7 and P3 = .1, you should punt.

You can try it for some other numbers.

When fans, asked by the radio host on talk radio if they thought BB had made the right or wrong decision—in the real situation, they went for the first down--- they would say thing like "Obviously, it was the wrong decision. They didn't make it and lost the game, didn't they?" That doesn't prove it was a bad decision, anymore than it would prove it was a good decision if the Pats made the first down, thereby winning the game. The point is that the outcome of this one-time event doesn't tell us whether it was a good decision or not. However, it may cause BB to reevaluate his expert estimates of P1, P2 and P3.

Now, on a more serious note, consider the snowstorms that brought Washington to a standstill. Some

people were saying “it looks like global cooling, not global warming is going on”. Just as BB wasn’t wrong simply because his strategy didn’t work that one time, a big snowstorm in Washington doesn’t tell us anything about climate change. And to be evenhanded, the folks out in Vancouver for the Winter Olympics who are saying the unusually warm temperatures are evidence of global warming are equally incorrect. One instantiation tells us very little.

Back to football—my own sense of this is that BB felt Peyton Manning, the Colts quarterback, had a very good chance to drive the Colts to a winning touchdown whether the Colts started on the Pats’ 29 or their own 30. Manning was playing very well, and the Pats defense seemed bushed. Let’s say BB thought P2 = .8 and P3 = .6 In this case, the chances of the Pats winning if they punt is .4

The chances the Pats win if they go for it = 1-.8 (1-P1), so if BB believes his chances of making the first down is > .25, he should go for it.

I personally think it was the right call and so by definition did BB, but as Mrs. Albert Einstein supposedly said about her husband, “Ah, what does he know?”

Here are three contemporaneous articles about the game. The first is a straight news report; the second is a “how could Belichick be so stupid” article and the third says Belichick made the right call based on 20,000 simulations of the situation.

Belichick's 4th-down gamble fails; Manning leads Colts back from 17 points down
ESPNBoston.com

http://scores.espn.go.com/nfl/recap?gameId=291115011

INDIANAPOLIS -- Bill Belichick risked everything on one play Sunday night.

Bill Belichick's gamble will be debated in New England for a long time, Mike Reiss writes.

Story

The Patriots' defense is willing to take its share of the blame, Chris Forsberg writes. Story

After the New England coach failed on a stunning gamble deep in his own territory, Manning threw a 1-yard touchdown pass to Reggie Wayne with 13 seconds left that rallied the unbeaten Colts to a 35-34 win over the Patriots.

"It's a bummer," Patriots quarterback Tom Brady said.

Needing a first down to seal the game, Belichick decided to go for it on fourth-and-2 from his own 28 with 2:08 to go. The Patriots called their second timeout of the drive, leaving them with none, to set up the play: A short pass from Brady to Kevin Faulk, something the 2007 NFL MVP had repeatedly used to burn Indy's young, depleted pass defense all night.

Not this time.

Faulk made a juggling catch but safety Melvin Bullitt, who replaced Bob Sanders in the lineup, came straight up the field and drove the Patriots running back into the ground a half-yard short of the marker.

"We tried to win the game on that play," Belichick explained. "I thought we could make the yard. We had a good play, we completed it. I don't know how we couldn't get a yard."

It was the most improbable victory for the Colts (9-0) in their 18-game regular-season winning streak, which is now tied for the second-longest in league history with, of all teams, New England.

The Colts trailed by 17 points early in the fourth quarter. This marked the first time Belichick's Patriots had lost when leading by at least 13 in the final period.

"When you see them going for it on fourth down, you get a little nervous, but our defense blitzed them, pressured them and got the stop," Manning said. "It certainly changed our philosophy. In practice, we're going 60 or 70 yards. So we figure we're going to have to go five, six, seven plays. In the huddle, I said, 'Obviously, we need a touchdown, but let's not be in a hurry.'"

The Patriots didn't dare second-guess their coach, though everybody else did.

"That fourth-down play, that's one of your best plays, and you go to one of your best guys," Brady said. "We've got our offense on the field. We have over 450 yards of offense at the time. We've got a lot of great players on our offense. They stopped us."

The miss gave Manning 1 minute, 57 seconds and all three timeouts -- an eternity for the three-time MVP -- and he went right to work.

Manning hooked up with Wayne for 14 yards. He let Joseph Addai carry the ball for 13 yards, down to the Patriots 1. He sent Addai inside again on first-and-goal, the same play Addai scored on to win the 2006 AFC Championship Game, but he got nothing. So Manning went back to Wayne in the end for the win.

Manning's deft play-calling left New England with only one option: A 9-yard pass to Wes Welker that ran out the clock.

It wasn't the first time Belichick tried it this season. At Atlanta, he went for it on fourth-and-1 from his own 24. But that was in the third quarter -- not with a seemingly secure victory in serious jeopardy.

Indy is now 9-0 for the third time in five years and only plays one team with a record better than 5-4 the rest of the way, Denver at 6-3.

New coach Jim Caldwell still has not lost, and Manning, who was 28 of 44 for 327 yards with four touchdowns and two interceptions, now has eight 300-yard games this season. The NFL's single-season record is 10 and he passed Fran Tarkenton for fourth on the career victories list with one that he will always remember.

New England (6-3) has lost five of the last six in this series, one that has often had long-term implications. Since 2003, the regular-season winner has claimed the AFC title four times and become the Super Bowl champion three times.

And the Pats now trail Indy by three full games, and a tiebreak, with seven games remaining, meaning they'll likely have to return to Indy if there is a rematch.

"Give the Colts credit," Belichick said. "That's why the Colts are the Colts. They're a good football team. That's about as close as it gets."

Brady was 29 of 42 for 375 yards with three touchdowns and one interception. Randy Moss finished with nine catches for a season-high 179 yards and two TDs, while Welker had nine receptions for 94 yards.

Manning made sure that wasn't quite enough.

Wayne caught 10 passes for 126 yards and two touchdowns.

The difference in this classic was that Brady dominated early, Manning when it mattered most.

After trading jabs in the first quarter, Brady took control in the second. He led the Pats to a tiebreaking field goal, hooked up with Moss on a 63-yard TD pass that floated perfectly over the hands of safety Antoine Bethea and then threw a 9-yard TD pass to Julian Edelman to give New England a 24-7 lead with 7:19 left in the half.

That was more points than Indy had allowed in any game this season.

"That man [Brady] will make you pay dearly if you don't get to him," Colts defensive end Robert Mathis said. "Even when we're behind, we know the game is not over."

Manning proved the theory still holds.

He answered with a 20-yard TD pass to Wayne, making it 24-14 at the half and after Brady connected with Moss for a 5-yard TD early in the fourth, Manning worked his magic again.

He took the Colts 79 yards in five plays, finding Pierre Garcon for a 29-yard score to get within 10. After Stephen Gostkowski booted a 36-yard field goal, Manning gave the ball to Addai for a 4-yard TD run with 2:23 to go. That made it 34-28.

Indy then elected to kick the ball deep instead of trying an onside kick, prompting Belichick to make his unusual decision -- and Manning made him pay.

"Reggie called the last play," Manning said. "I threw a fade to him earlier in the game. He wanted the slant. He just kept fighting through and made an extended catch. Maybe not his best catch ever, but it sure was timely."

Belichick flunked his open-book test
Patriots genius puts himself in a corner with faulty logic
Originally Published: November 16, 2009

By Gene Wojciechowski
ESPN.com

http://sports.espn.go.com/espn/columns/story?columnist=wojciechowski_gene&id=4660392&sportCat=nfl

The New England Patriots should be 7-2 today. They should be getting treatment for welts caused by postgame backslaps. They should be basking in the afterglow of going to Indianapolis and beating Peyton Manning and the Colts at Hearing Loss Stadium.

Instead, they're 6-3 and getting treatment for shock. Not only did they lose a game but they probably lost something more important: home-field advantage in the AFC playoffs.

And oh, by the way, it's all Bill Belichick's fault.

Maybe his headset was too tight and it squeezed the blood from his brain. Maybe it was so loud in Lucas Oil Stadium on Sunday night that he said, "No," but quarterback Tom Brady thought he said, "Go."

Or maybe one of the greatest coaches who ever stood on an NFL sideline screwed up. Maybe it's just that simple.

With 2 minutes, 8 seconds remaining in the game, with the ball on the Patriots' 28-yard line, and with one of the best quarterbacks in the history of the game standing at his side, Belichick decided to go for it. Not play it safe and punt. Not make the Colts drive 50, 60, 70 yards for the game-winning touchdown. But go for it in a "Top Gun" "I've got a need for speed" sort of way, even though everybody is staring at their TVs and saying -- no, screaming -- "What is he doing?!"

Not me. I knew what Brady was going to do. He was going to drop into the shotgun formation and try to use a hard count to coax the anxious Indianapolis defensive line into a 5-yard penalty. Fourth down would become a gift first down.

And it did.

For the Colts.

Patriots running back Kevin Faulk bobbled Brady's pass long enough for the Colts to knock him just short of the first-down line. Belichick couldn't challenge the mark because he was out of timeouts. And, hello, here comes one of the other best quarterbacks in the history of

the game -- Manning.

Four plays later, Indianapolis has a 35-34 victory and a 9-0 record and is driving the lead car in the AFC Home-Field Advantage 500.

The Patriots? Well, did you see Brady's face as the Colts covered those 29 yards? It was a combo facial platter of seething anger, disbelief and "How did we just lose this game?" And the postgame handshake between Belichick and Indianapolis coach Jim Caldwell was as warm as an ice floe.

You can rationalize the decision any way you want, but Belichick cost New England a crucial victory. Two yards isn't six inches. This wasn't a gimme quarterback sneak; it was a pass, meaning lots of things can -- and did -- go wrong. The first wrong thing was going for the first down. The second wrong thing was Faulk's bobble. The third wrong thing was not having any timeouts to challenge the mark of the ball after Melvin Bullitt's tackle.

Both Brady and Belichick defended the call. Of course, they did. That's what they're supposed to do. What, Brady is going to say the Patriots' offense, which finished with 477 total yards, couldn't finish with 479? He's going to argue against the fourth-down play? No way.

But where Belichick's logic springs a very large leak is why he chose Brady and fourth-and-2 over the Patriots' defense and first-and-70. That's about how many yards Manning presumably would have had to cover in the final 120 seconds (with one Colts timeout).

If Belichick was worried that his defense couldn't stop the Colts from scoring a touchdown from 70 yards out, why would he possibly think it could stop them from scoring one from 29 yards out? Brain freeze.

Giving Manning two minutes and one timeout from his own 30 is taking a chance. He's that good. But giving him two minutes with the equivalent of two timeouts from your 29 is football suicide. Just the thought of that scenario should have served as an ammonia capsule under Belichick's nose. Punt.

Instead, Belichick made the wrong choice at the wrong time against the wrong quarterback. As an added bonus, he sent a big bouquet of "I don't trust you" flowers to the New England defense. He rolled the bones on one play rather than taking his chances with however many plays -- six, seven? -- Indianapolis would have had in those remaining 120 seconds.

Belichick has done so many things right during his Patriots coaching career that it's a stunner when he does something so wrong. But this was a total miscalculation of the percentages. In the pressure of the moment, he forgot how to do the football math.

Manning, Caldwell and the Colts were presented a gift late Sunday night. I just never imagined Belichick would be the guy who wrapped it.

Gene Wojciechowski is the senior national columnist for ESPN.com.

Belichick Made The Right Call
November 16, 2009

http://www.sportsmogul.com/content/belichick.html

Last night, near the end of an important game against the Indianapolis Colts in Week 10, the New England Patriots faced 4th-and-2 on their own 28-yard-line. The Patriots were ahead by 6 points, with 2 minutes and 8 seconds left on the clock. Conventional wisdom said the Patriots should punt the ball, to force Manning to try to drive the length of the field for a game-winning score. Instead, the Patriots went for it and failed to convert. The Colts went on to win.

Commentators have argued about whether Coach Belichick showed too little faith in his defense, or too much faith in his offense. It has nothing do with faith. It's all about giving your team the best chance of winning. And the numbers say that Belichick made the right call.

To assess whether Belichick chose wisely, I used Football Mogul 2010 to simulate the situation that the Patriots faced. Football Mogul had access to every detail of the game, including current rosters and playbooks for each team. It even takes into account the weather and wind, and the fatigue level of the New England defense.

Specifically, I simulated the remainder of the game exactly 20,000 times. For 10,000 of these simulations, the Patriots went for it on 4th-on-2. For the other 10,000 simulations, the Patriots punted.

We could look at this simply in terms of what chance the Colts had to drive down the field and score, depending on whether or not the Patriots punted. However, that doesn't take into account all of the things that can happen during a football game. For example, in some of the simulations when the Patriots went for it, the Colts got an interception return for a touchdown. This gave Indy the lead, but also gave Brady two minutes to drive down the field for a game-winning field goal. Similarly, the "safe" choice to punt sometimes resulted in a blocked punt and an instant touchdown for the Colts. Thus, the only way to accurately find the best call is to simulate the exact game situation thousands of times, taking into account all of the different possible results that can happen in an NFL game.

The verdict: Belichick made the right call.

Breaking down the numbers, we see that when the Patriots went for it, they got the first down in 55.2% of all the simulations. After the first down, they won the game 94.3% of the time (the Colts' one timeout gives them the chance to get the ball back and still score a last-second touchdown, which they were able to do about 1 time in 20, even when the Patriots got the first down).

When the Patriots went for it and didn't convert, the Colts won the game 76.1% of the time. Most of these were because Peyton drove the ball 28 yards for the score. But

sometimes the Colts won for another reason. For example, the Colts might score a quick touchdown, leaving Brady enough time to get a winning field goal, but still having enough time to score on the following kickoff return (leading to the Colts winning 42-37).

All-in-all, Belichick's call to go for it gave the Patriots a 62.8% chance of winning the game.

On the flip side, punting the ball only gave the Patriots a 41.3% chance of winning the game. That's right; the Colts won the game 58.7% of the time when the Patriots punted.

So, not only did Belichick make the right call. It wasn't even close. He made the call that increased his team's chance of winning by more than 50% (from 41.3% to 62.8%).

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Teaching Note IV--Belichick's Call: Another Perspective

March 10, 2010

Now, suppose our question is a different one. We now want to *predict* what decision BB (or some other coach) will make before the fact. Let us assume we are all agreed on the values of P1, P2 and P3 to take that out of the mix.

But let's add in another twist—call it the embarrassment factor. Football coaches often make the decision that will avoid embarrassment rather than the decision that gives them the best chance to win.

In this instance, the conventional decision would be to punt. Almost no-one would criticize a coach who punted even if the team lost.

Now BB is interested only in winning and doesn't care about embarrassment. So the earlier decision trees applies. But suppose we have a less confident coach (LC). He cares only about avoiding embarrassment and not at all about winning. In this case, the coach would always punt, unless s/he is certain that the Patriots will make the first down (P1=1)

A more general approach is the following:

Each result on our decision trees now has two outcomes:

Did the Patriots win? If they win, W=1 and if not W=0
Is the coach embarrassed by the outcome? If embarrassed, E= -1 and if not E=0

Now BB doesn't worry about embarrassment—only winning—and LC really wants to avoid embarrassment at all costs—if s/he wins, fine—but first and foremost s/he wants not to be embarrassed! So we know how to solve the BB case and the LC case too. But consider a more nuanced coach who balances winning and embarrassment. Let w be the weight Coach NN (for nuanced) places on winning and e be the weight NN places on embarrassment, where

$$w+e=1$$

So for BB, w=1 and e=0
For LC, w=0 and e=1

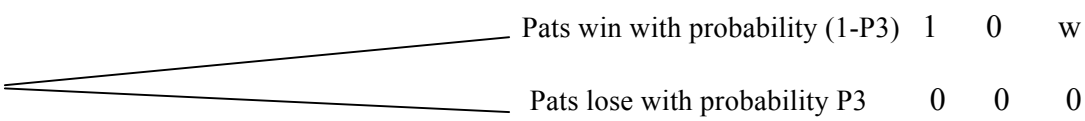
Let's now do our decision trees again and calculate the value of each outcome, using W, E and the weights w and e.

Here are the decision trees.

The choice is punt

Here are the decision trees.

They punt **W E V=Ww+Ee**



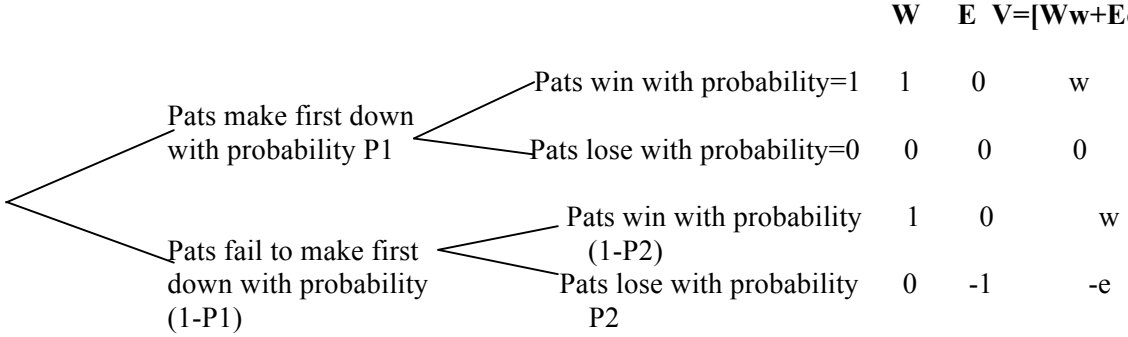
The value (V) of this strategy is simply as follows:

$$V^* = w(1-P3)$$

Note there is no embarrassment! How could there be? They took the conventional choice

The choice is to try for the first down.

Here are the decision trees



In this case,,

$$V^{**} = w(P1) + w(1-P1)(1-P2) + (-e)(1-P1)(P2)$$

The third term shows embarrassment coming into play. They tried for the first down, didn't make and lost. We assume if they try for the first down, don't make it, but still win, no embarrassment occurs

So for NN to go for it,

$$V^{**} > V^*$$

So let's see what P1 has to be for NN to try for the first down, as a function of P2, P3, w and e.

Rearranging term, we eventually obtain:

$$P1 > 1 - \frac{wP3}{P2}$$

as the condition for the coach going for the first down. Note that e is in this expression implicitly

since w + e = 1

So suppose that P2= .8 and P3= .6

Then P1 > 1- .75w is the condition for trying for the first down.

If the coach is BB, w= 1 and P1> .25. So the coach who just cares about winning and cares nothing about embarrassment will go for the first down even with a relatively low P1.

Coach LC who has an e=1 and a w=0, will punt unless s/he believes P1 = 1

Let's suppose Coach NN cares about winning and embarrassment about equally, so w=.5, e= .5. For Coach NN, P1 must be > .625 for him/her to go for the first down

And if w= 2/3 (.66666…), for that coach, s/he will try if s/he thinks P1> .5, a toss-up.

Try it for other values of P2 and P3 and see what happens

So, if you are interested in predicting what the coach will do in this situation, you have to know what his/her w and e are. Are we dealing with BB, LC or the many versions of NN? Beyond that, we likely need to recognize that w and e will likely change for an individual over time. And some of that may be unknowable to us—the coach had a fight with his star player at half time and is distracted. So this prediction is non-trivial.

The question of predicting what a football coach will do is not earthshaking. But other predictions may be more important, such as predicting what mode a traveler will choose—public transit or car—or what a shipper will choose—truck or rail. Many economic models assume the chooser will maximize the value to him/her in making the choice and will make an "economically rational" selection. Of course, what the economist modeling the situation thinks is economically rational and what the chooser decides to do can be different. In our football example, if the modeler thought that all football coaches maximized the chances simply of winning -- a "rational" decision – they would make bad predictions of what the coach would do because they didn't recognize the coach's rationality gave some weight to embarrassment too!

Here's an article about Belichick playing to win rather than not to lose which captures some of the philosophy of this teaching note

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Belichick's 4th-down call: Hardly outrageous
by Mike Nadel on November 15, 2009

http://www.chicagonow.com/blogs/mike-nadel-baldest-truth/2009/11/all-is-right-in-the.html

Before the Patriots went for it on fourth-and-less-than-2-yards, NBC's Cris Collinsworth said he was "absolutely stunned ... (but) I should never be stunned by Bill Belichick."

Only after the Patriots came up inches short, giving the ball to Peyton Manning's Colts with 2 minutes left inside the New England 30, and only after Manning won the game by throwing a TD pass to Reggie Wayne with 13 seconds left, did Collinsworth call Belichick's decision "outrageous."

I'm a Collinsworth fan, but this was a classic second-guess in what should have been a classic first-guess situation.

In this respect, Collinsworth was no better than the doorman at my apartment building. When I arrived home after covering the Blackhawks game for AP, John The Doorman confronted me with: "Can you believe what Belichick did? You don't bet everything on one play!"

I had listened to the game's finish on the radio on the way home from the hockey game and then watched the replay at home. And, yes, I CAN believe what Belichick did.

This man has made educated gambles many, many, many times over the years - including at the end of the first of three Super Bowls he and Tom Brady won together.

Consistently, Belichick's credo has been: Play to win instead of playing not to lose.

So he asked himself: Would I rather punt the ball away to the Colts with 2 minutes to go and hope Peyton Manning doesn't beat us with a 70-yard drive? Or would I rather trust Tom Brady and my offense to gain a yard and a half to win the game?

I probably would have punted, but I understand why Belichick went for it. And in a league full of coaches who are afraid to try to win, I am loathe to criticize a proven, championship coach who refuses to play not to lose.

"Coach being aggressive," Brady said later, "and I love that about him."

Brady also pointed out that Manning had just marched the Colts downfield quickly to make it a 6-point game. And there was no reason to think Peyton couldn't do it again, especially with the Patriots' defense gassed.

Look, if Brady & Co. pick up the 4 1/2 feet, Manning never sees the field again, the Patriots win, the Colts are no longer undefeated and Belichick is bold, aggressive and courageous.

Because the play falls short, Belichick is the village idiot? Please.

Cocky, condescending and secretive, Belichick isn't my cup of tea. And I hated what he had to say about the decision afterward, when he used the occasion to criticize where the officials spotted the ball.

That simply underscored Belichick's real screwup: He wasted his final two time-outs just before the play, leaving himself no chance to stop the clock or to challenge an officiating call.

Had he used better time-out and clock management, he'd have been able to throw his little red flag - though I think he would have lost the challenge.

Belichick should have taken responsibility and explained himself without pointing fingers at others.

His decision wasn't outrageous - or at least it shouldn't have been to anybody with more football knowledge than John The Doorman.

Nor was it particularly stunning.

It's what Belichick does, and it's worked pretty well to this point.

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Concluding Comments

These four teaching notes contain several approaches to explaining and illustrating concepts in uncertainty and making decisions in an uncertain environment. We drew on actual current events in an attempt to make the subject more relevant and lively for the students. My hope is that colleagues will find some pedagogic value in these teaching notes and will use them in their own classes or perhaps follow the approach of finding current events that illustrate important concepts in serious or lighthearted ways.