Belichick – Part 2

J.Sussman March 10, 2010 6pm

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
Pats win with probability (1-P3)	1	0	w
Pats lose with probability P3	0	0	0

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

		W	E	V=[Ww+Ee]
Pats make first down with probability P1	Pats win with probability=1	1	0	w
	Pats lose with probability=0	0	0	0
Pats fail to make first down with probability (1-P1)	Pats win with probability (1-P2)	1	0	w
	Pats lose with probability P2	0	-1	-e

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!

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