Risky Business Week 6

Revisiting the 2PAT when trailing by two touchdowns

There is a classic problem in football analytics that was solved many years ago. When trailing by two touchdowns late in the game it is almost always correct to go for two after the first touchdown. The logic follows that if you convert you will only need a simple extra point on the second score, and if you fail, you still have the option to attempt a two-point conversion. All of this assumes that you get a stop and score a second time, which of course is required under all reasonable scenarios with few exceptions. Such was the case when the Eagles attempted a two-point conversion trailing by 8 points with 5:54 remaining in the game on Thursday night against the Tampa Bay Buccaneers.

Prior to this decision, there were a couple of notable fourth downs in the 4th quarter that set up the scenario in question.

- 12:43 remaining in the game and Eagles face fourth-and-10 at the Bucs' 28 yardline trailing 28-14
  - There wasn't much equity at stake here for the Eagles, but a custom simulation indicates the field goal attempt was slightly correct (about 0.5% GWC).
- 9:04 remaining in the game and the Bucs face fourth-and-3 at the Eagles' 45 yard line leading 28-14
  - Arians was questioned for his aggression, but we concur with the decision. Again, not much equity at stake for the Bucs as they are in a dominant game state but we see it as essentially a pick-em decision with a very slight lean toward the first down attempt.

When the Eagles decided to go for two with 5:54 remaining in the game, Troy Aikman could not conceal his skepticism bordering on disapproval. Sorry Troy but even though it is rarely exercised, the value of this strategy has been settled for quite some time. Before we get into the proof, we should note that an extensive custom simulation by the EdjSports model shows the two-point conversion attempt to produce about 1.5% more wins on average for the Eagles in this situation. Since the Eagles are already huge underdogs at this point (~9.5% GWC), this is a very significant _relative_ improvement of nearly 16%. The reason we can support this strategy with such confidence is that it can be represented in a fairly straightforward decision tree. We will remove some of the outlier scenarios that involve more than two possessions as they are rare and present themselves under both winning parlays.

There are four key factors that must be considered for the trailing team:

- 2 PAT success rate ("P")
- 1 PAT success rate ("K")
- GWC at the start of overtime ("T")
- 'Stop and Score' ("S")
    - This is the percentage of time the Eagles can stop the Bucs from scoring on the subsequent possession and then follow up with a touchdown.

2 PAT Winning Parlay:

(P x S x (K + ((1-K) x T)) + ((1-P) x S x P x T)

1 PAT Winning Parlay:

(K x S x K x T) + ((1-K) x S x P x T)

It turns out the 'stop and score' only affects the magnitude of the difference but will not flip the decision regarding 1PAT vs 2PAT. Here are some comparisons of how the 2PAT success rate and Overtime GWC interact with overall GWC. Values of 15% and 35% for the "Stop and Score" were used for reference, and a standard assumption of 95% for the 1 PAT:

2 PAT Success Rate	Overtime GWC	2 PAT overall GWC	1 PAT overall GWC
35%	40%	6.5	5.5
	50%	6.8	6.9
	60%	7.2	8.3
45%	40%	8.0	5.6
	50%	8.4	6.9
	60%	8.8	8.3
55%	40%	9.5	5.6
	50%	9.9	7.0
	60%	10.3	8.4
65%	40%	10.8	5.6
	50%	11.2	7.0
	60%	11.6	8.4

*Assuming 15% 'stop and score' and 95% 1 PAT success

2 PAT Success Rate	Overtime GWC	2 PAT overall GWC	1 PAT overall GWC
35%	40%	15.1	12.9
	50%	15.9	16.1
	60%	16.8	19.3
45%	40%	18.7	13.0
	50%	19.7	16.2
	60%	20.6	19.4
55%	40%	22.1	13.0
	50%	23.1	16.3
	60%	24.1	19.5
65%	40%	25.3	13.1
	50%	26.2	16.4
	60%	27.1	19.6

*Assuming 35% stop and score and 95% 1 PAT success

While some of these assumptions are unrealistic, the tables provide some perspective on the dominant strategy of attempting a two-point conversion after the first score. There are very few cases where this doesn't hold, and we can see how the 'stop and score' only affects magnitude but not direction in the decision. Also, a rule of thumb emerges that going for two is the right choice if your success rate is approximately 70% or greater than your chances of winning in overtime. With an NFL average two-point conversion rate near 50% it is clear the Eagles approach is correct in almost all practical circumstances.