



Supplemental Details

Decision Model – Key Assumptions

In order to focus as much as possible on the most important elements of the decision, we have had to make a number of simplifying assumptions in the spreadsheet model. Inevitably, this means that the model is somewhat less like the “real world”, however, we think it still captures the essence of the decision problem.

The main assumptions are as follows:-

- I. your team is three match points behind; an opponent has infringed, and the referee has awarded a close-in penalty in your team’s favour, in a position close to the touchline
- II. the referee has indicated that there is only time for one more passage of play, so this is a last ditch situation (you clarify with the referee that he will not interpret a hand kick over the touchline as a passage of play, i.e. there is time for a lineout and maul)
- III. you are required to make a choice on the spot and confirm it verbally to the referee; once you have done so, your choice is considered final and irrevocable
- IV. it is assumed that you do not opt for a scrum, or simply tap and go, so now two options remain; they are mutually exclusive i.e. one, and only one, option may be selected:

Option A: **‘Take the Points’** i.e. choose the penalty kick;
OR
Option B: **‘Go for It’** i.e. kick for a lineout in the corner
- V. the match points payoffs in the event of success are standard so known with certainty, 3 points for a penalty goal scored; 5 points for a try scored
- VI. if Option A is successful, **your team scores 3 points and draws**; if Option B is successful, **it scores 5 points and wins the game**

- VII. we exclude the conversion attempt, as a try is sufficient to win the game in this scenario
- VIII. for simplicity, there is no other indirect payoff potentially resting on the option chosen, such as bonus points, being eliminated from or progressing in a tournament, any monetary incentives etc.; the incentives available are simply the points to draw or win the game
- IX. the decision-maker can estimate five probabilities as set out in the spreadsheet model (note they are only an estimation – you cannot know the future)
- X. the decision-maker is risk neutral (that’s a technical assumption) and behaves rationally i.e. selects the best mathematical option available (behavioural economics research suggests that often people do not, and that elements such as pressure may cause choking, but we will leave that aside for now)
- XI. we exclude imaginable extreme scenarios such as rebounds off the goal posts back into play under Option A; or the possibility that the kick for a line-out goes out on the full under Option B; however, the try only has to be scored within the next passage of play, it does not necessarily need to accrue directly from the line-out and maul
- XII. all match officials and all players operate with full integrity, e.g. there is no match fixing; also, there is technical capacity available to check if scores have been successfully made or not

Then with the probability estimates entered, our engine calculates the expected points score under each option. Then the option that yields the highest number of points in expectation is chosen. If the expected points totals are equal, a fair coin is tossed as a tie-breaker.

Then the option chosen is implemented and nature takes over. The kicker kicks or the lineout is taken. So the actual outcome is random: does the kicker slip, is there a gust of wind etc?



A note on Expectation

The approach we've taken is to treat the setting as an economic / decision science problem - so we work with probabilities and payoffs in expectation. Expectation simply means the possible payoff (gain or loss) from an outcome, multiplied by the probability, as estimated beforehand, that the outcome will occur.

Worked example: your team is attempting a penalty goal kick. Your historic match data shows that from that pitch location, the kicker has made the kick successfully 250 times from 1000 attempted kicks. Let us interpret that as a probability of 25 in 100 (or 25% or 0.25 in decimals).

The possible outcomes of the kick are mutually exclusive - the kicker can only either succeed or miss – so the probability that the kicker will miss is 75 times out of 100 kicks (or 75% or 0.75 in decimals).

Your team's expected payoff (or gain in expectation) from the kick, before it is taken, is 0.75 expected match points. The calculation is as follows:-

PENALTY KICK ATTEMPT		
i. Kick is successful		
OR		
ii. Kick is missed		
Probability of a kick being taken	100%	a
Probability of kick success	25%	b
Probability of kick miss	75%	c = (a - b)
Payoff if success = match points	3	d
Expected payoff if success	0,75	e = (d * b)
Payoff if a miss	0	f
Expected payoff if a miss	0	g = (f * c)
Expected payoff (or gain in expectation)	0,75	e + g