LS88: Sports Analytics

Breakeven Probability

Breakeven Probability

A proposition:

- ➔ We're going to flip a coin with probability p of coming up heads
- ➔ You're going to put $100 at stake
- ➔ If the coin comes up tails, I win the $100
- ➔ If the coin comes up heads, I pay you $1000

What probability of success p for the coin flip would make this a fair game for you?

Ie. you would net $0 in the long run if we were to play this game many times

Breakeven Probability

1%? 5%? 10%? 25%? 50%?

How do we compute this breakeven probability?

$$\text{Game value to you} = -\$100 \times (1 - p) + \$1000 \times p$$

Breakeven Probability

How do we compute this breakeven probability?

$$0 = \text{Game value to you}$$

$$\Rightarrow p_{\text{Breakeven}} = \frac{1}{11}$$

Breakeven Probability and Baseball

Ian Desmond and tagging up from first:

- ➔ Ian Desmond reached first base with 0 outs
- ➔ David Dahl flied out
- ➔ Desmond attempted to tag up from first base to take second base
- ➔ He was thrown out leaving the Rockies with no one on and now two outs

Breakeven Probability and Baseball

The proposition:

- ➔ Stay at first base with the current win probability of 69.89%*
- ➔ Try to take second by tagging up
  - ◆ If Desmond was successful, the win probability would rise to 72.68%*
  - ◆ If he was unsuccessful, the win probability dropped to 64.15%*
- ➔ What would Ian Desmond's probability of success have to be to make this an even proposition?

*Win probabilities computed from https://gregstoll.dyndns.org/~gregstoll/baseball/stats.html#V.-1.7.1.2.2007.2017

Breakeven Probability and Baseball

Here is the value of trying to tag up

$$\text{Win Probability from tag up} = WP_{(\text{Second, 1 out})} \times p + WP_{(\text{None on, 2 out})} \times (1-p)$$

This becomes a fair proposition if it's equal to our current win probability

$$\text{Win Probability from tag up} = WP_{(\text{First,1 out})}$$

Breakeven Probability and Baseball

If we know *p*, we can determine which strategy is better

Alternatively, we can solve for *p* to get the *breakeven probability*

$$WP_{\text{(First,1 out)}} = WP_{\text{(Second, 1 out)}} \times p + WP_{\text{(None on, 2 out)}} \times (1-p)$$

$$\Rightarrow p_{\text{Breakeven}} = \frac{WP_{\text{(First,1 out)}} - WP_{\text{(None on, 2 out)}}}{WP_{\text{(Second, 1 out)}} - WP_{\text{(None on, 2 out)}}}$$

From the model Win Probabilities, we get

$$p_{\text{Breakeven}} = 67.29\%$$

Breakeven Probability and Baseball

Revisiting the lab, the run expectancy for stealing a base

$$\text{Run Expectancy of a steal Attempt} = RE_{\text{SB}} \cdot p + RE_{\text{CS}} \cdot (1 - p)$$

$$RE_{\text{Current}} = RE_{\text{SB}} \cdot p + RE_{\text{CS}} \cdot (1 - p)$$

$$\Rightarrow p_{\text{Breakeven}} = \frac{RE_{\text{Current}} - RE_{\text{CS}}}{RE_{\text{SB}} - RE_{\text{CS}}}$$

Breakeven Probability and Baseball

- ➔ We find the typical breakeven probability is about 70%
  Baserunner needs to have at least a 70% chance to make it worthwhile
- ➔ If the breakeven probability is high, it makes the steal attempt *worse*
  90% means the baserunner needs to be almost guaranteed to make it
- ➔ If the breakeven probability is low, the steal attempt is more valuable
  The benefit of the steal is high compared to the downside even if unsuccessful