**RE24 and Base/Out Expectancy for Decision Making**

I was wrong about sabermetrics.

Being a mathematician, I thought that sabermetrics gurus were nothing more than people able to find useful combinations of basic counting statistics. Mea Culpa, I was wrong. I discovered this when I thought I had come up with a novel idea for a way to measure a player’s contribution to teams total runs.

My idea: look at the average runs scored in a given state (e.g. ‘bases loaded, no outs’ the average inning runs is about 2.3) and look at what happens in your given at bat. Suppose in this situation you strike out. Because the average inning runs for ‘bases loaded, 1 out’ is about 1.5, your at bat accounts for roughly -0.8 runs in value. The transition from 2.3 average to 1.5 average is your contribution.

I simply reinvented RE24 which has been around for over **30** years. But, I still believe there is value to be added using this line of thinking. This will be the first article in a series that discusses using these ideas for decision making in baseball.

**Base/Out States**

RE24 stands for Run Expectancy based on 24 base/out states. The important thing here is understanding what base/out states are. In each at bat, a player comes to the plate in a certain *state*. The state refers to runners being on certain bases and how many outs there are. One example: ‘Runners on 1st and 2nd, no outs’ is a state.

An at-bat always transitions you between states. The number of outs can change, the locations of the runners can change, or both, or neither. The important thing is that each state has an average number of runs yet-to-be-scored in the inning. For instance, with a runner on third and 1 out, a team will score on average 0.865 more runs in that inning. The full list of expected runs for the base/out state is listed below (source: <https://library.fangraphs.com/misc/re24/> (hyperlink))

**RE24**

How can this table lead to a stat? Using that table we can assign an amount of ‘added value’ to each player’s at bat. Let’s look at a specific example to highlight this. If you come up with a runner on third and 1 out, almost certainly you are going to be asked to hit a sacrifice fly. You’ll get credit for an RBI, but you didn’t do all the work associated with that run. How much credit should you get?

The run expectancy for ‘runner on 3rd, 1 out’ is 0.865. Your at-bat transitioned from ‘runner on 3rd, 1 out’ to ‘no one on, 2 outs’ state, a decrease in run expectancy from 0.865 to .095. However, 1 run was scored. Therefore, your contribution to that run is **runs scored** – **starting state expectancy + ending state expectancy = 1-0.865 + .095=0.23.** That is, your skill in successfully completing the sacrifice fly adds 0.23 runs of value to your team. Put another way, roughly 23% of the work of a run from a sac fly is done by the player doing the sacrifice.

If you had botched the sacrifice, then you would have transitioned from the ‘runner on third, 1 out’ state to the ‘runner on third, 2 outs’ state without having any runs scored. In this case, you get credit with **0-0.865+0.413=-0.452** (using the same formula)**.** You reduced the amount of runs your team will score on average by 0.45.

If you go through each player’s at bats on the season and add up these values you get the players **RE24**, a measure of how many runs you added to your team’s total relative to league average.

**Base/Out Expectancy for Decision Making: An Example**

I don’t want to talk about RE24, I want to talk about the base/out expectancy matrix. I claim that you can use this matrix for decision making in-game. This article will be the first in a series that discusses how to use this idea. Let’s look at a very simply case that doesn’t require us to simulate at-bats (that will be dealt with in a later article). Let’s talk about base stealing. Our central question: What steal percentage is good enough to warrant stealing?

Let’s suppose that you are on first with no outs. This state has a base/out expectancy of 0.831. If you successfully steal 2nd, your base/out expectancy goes all the way up to 1.068. A successful steal ads 0.237 runs of average value. If you miss, you have transitioned to the ‘no-one on, 1 out’ state which has value 0.243, a decrease of 0.588 runs. What probability of a successful steal warrants this risk?

The solution: about 71.2%.

If your successful steal percentage is at least 71.2%, then if you are on first with no outs, you should steal second **every chance you get**.

**When should you steal in other cases?**

We just computed that, on 1st with no-one out, you need a successful steal about 71% of the time for it to be worth it to steal. What about other cases? I mean, different outs, runners on different bases. The following table shows what your successful steal rate needs to be in each base/out state in order for stealing to increase your run expectancy on average. That is, if your steal rate is at least the value shown, stealing is a good idea. Note: for runners on 1st and 3rd, we assume 2nd base is being stolen and for runners on 1st and 2nd we assume 3rd base is being stolen.

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| --- | --- | --- | --- |
| **Base State** | **No Outs** | **1 Out** | **2 Outs** |
| **1st** | 71.2% | 71.7% | 70.1% |
| **2nd** | 69.7% | 71.3% | 73.8% |
| **1st and 2nd** | 67.5% | 75% | 72.8% |
| **1st and 3rd** | 75.3% | 77.4% | 83% |

**Conclusions and Minutiae**

The utility provided by the base/out matrix allows us to do many computations like the above. We could (and will) simulate things like ‘when is it worth it to intentionally walk a player?’ or ‘When should you let a player swing away rather than sacrifice with a runner on third?’ and many others.

The conclusions from the critical steal percentage matrix suggest that 1st and 3rd is the worth time to steal. However, 1st and 3rd is often seen as a good time to steal because throwing to get the runner at 2nd may allow the runner at 3rd to score. So, catchers don’t often throw. Therefore, **your steal rate is much higher if runners are on 1st and 3rd than other settings.** This is why you still see many people steal with runners on 1st and 3rd even though it is, in isolation, not very good value.