**Data S1** The derivation of Colley’s rating

Let *ri* be the Colley’s rating.

First, the winning percentage based on Laplacian’s rule is defined by $r\_{i}=\frac{W\_{i}+1}{N\_{i}+2}$.

Since all teams begin with *rk*=1/2, then the number of times player *i* win can be written as

$$W\_{i}=\frac{W\_{i}-L\_{i}}{2}+\frac{W\_{i}+L\_{i}}{2}=\frac{W\_{i}-L\_{i}}{2}+\frac{N\_{i}}{2}=\frac{W\_{i}-L\_{i}}{2}+\sum\_{k=1}^{N\_{i}}\frac{1}{2}≈\frac{W\_{i}-L\_{i}}{2}+\sum\_{k\in O\_{i}}^{}r\_{k}$$

where *Oi* is the set of opponents of player *i*.

After substitute Wi,

$$r\_{i}=\frac{W\_{i}+1}{N\_{i}+2}=\frac{\frac{W\_{i}-L\_{i}}{2}+\sum\_{k\in O\_{i}}^{}r\_{k}+1}{N\_{i}+2}.$$

Then, multiplying by Ni+2,

$$(N\_{i}+2)r\_{i}=\frac{W\_{i}-L\_{i}}{2}+\sum\_{k\in O\_{i}}^{}r\_{k}+1.$$

Next, $\sum\_{k\in O\_{i}}^{}r\_{k}$ is subtracted from both sides of equation to obtain,

$$(N\_{i}+2)r\_{i}-\sum\_{k\in O\_{i}}^{}r\_{k}=\frac{W\_{i}-L\_{i}}{2}+1.$$

Finally, *Cr=b* is obtained.