

## Functions used in the Tiddlywinks World Ratings (2002 version)

*Patrick Barrie*

Here for your delectation and delight are the actual functions used to calculate tiddlywinks world ratings. A description of why the functions are as they are is given in an article to be published in the *Journal of Applied Statistics* (2002).

Ratings are calculated on a tournament-by-tournament basis, and are published on the web site of the English Tiddlywinks Association, <http://www.etwa.org>.

The input parameters are the pre-tournament ratings and Rating Reliability Factor (RRF) values for each player involved, together with the game scores in the tournament. The RRF values of each player  $i$  are initially converted into an estimated error in rating ( $\hat{\sigma}_i$ ) by:

$$\hat{\sigma}_i = 350 - 2.8RRF_i$$

The following procedure is then adopted for each player.

### Calculation of tournament rating

The tournament rating  $R_{\text{tmt}}$  of each player is calculated by iteration so that:

$$\sum_{j=1}^{N_{\text{games}}} \text{PredictedScore}(R_{\text{tmt}}, R_{\text{partners}}, R_{\text{opponents}}) = \text{Actual Points Achieved}$$

where the PredictedScore function in each game given by:

$$\begin{aligned} \text{PredictedScore (pairs)} &= 3.5 + 3.55 \operatorname{erf} \left( \frac{R_{\text{tmt}} + R_{\text{partner}} - R_{\text{opponent1}} - R_{\text{opponent2}}}{1600} \right) \\ \text{PredictedScore (singles)} &= 3.5 + 3.55 \operatorname{erf} \left( \frac{R_{\text{tmt}} - R_{\text{opponent}}}{800} \right) \end{aligned}$$

where erf is the statistical error function.

### Calculation of estimated error in the tournament rating

The estimated error in the calculated tournament rating has two contributions:

(a) The estimated error in  $R_{\text{tmt}}$  due to the number of games played is:

$$\hat{\sigma}_{\text{games}} = \frac{400 \sqrt{N_{\text{singles}} + 2N_{\text{pairs}}}}{N_{\text{singles}} + N_{\text{pairs}}}$$

(b) The estimated error in  $R_{\text{tmt}}$  due to the uncertainties in the ratings of partners and opponents is given by:

$$\hat{\sigma}_{\text{others}} = \frac{1}{N_{\text{games}}} \sqrt{\sum_i (\hat{i}_i \hat{\sigma}_i)^2} \quad (7)$$

where  $\hat{\sigma}_i$  is the uncertainty in rating of player  $i$  and

$$\begin{aligned} \hat{i}_i = & \text{number of singles-singles games against player } i \\ & + \text{number of pairs-pairs games against } i \\ & + 2 \times \text{number of pairs-singles games against } i \\ & + 0.5 \times \text{number of singles-pairs games against } i. \\ & - \text{number of pairs-pairs games partnering } i \\ & - \text{number of pairs-singles games partnering } i \end{aligned}$$

These two uncertainties are then combined to give an overall estimated error in tournament rating,  $\hat{\sigma}_{\text{tmt}}$ :

$$\hat{\sigma}_{\text{tmt}} = \sqrt{\hat{\sigma}_{\text{games}}^2 + \hat{\sigma}_{\text{others}}^2}$$

#### Calculation of new rating and uncertainty

The provisional new rating is given by:

$$\begin{aligned} R_{\text{new}} &= \frac{R_{\text{old}} \hat{\sigma}_{\text{tmt}}^2 + R_{\text{tmt}} \hat{\sigma}_{\text{old}}^2}{\hat{\sigma}_{\text{tmt}}^2 + \hat{\sigma}_{\text{old}}^2} & \text{if } \hat{\sigma}_{\text{old}}^2 \leq 210 \\ R_{\text{new}} &= \frac{R_{\text{old}} \hat{\sigma}_{\text{tmt}}^2 + R_{\text{tmt}} 210^2}{\hat{\sigma}_{\text{tmt}}^2 + 210^2} & \text{if } \hat{\sigma}_{\text{old}}^2 \geq 210 \end{aligned}$$

The provisional new uncertainty is given by:

$$\hat{\sigma}_{\text{new}} = \frac{\hat{\sigma}_{\text{tmt}} \hat{\sigma}_{\text{old}}}{\sqrt{(\hat{\sigma}_{\text{tmt}}^2 + \hat{\sigma}_{\text{old}}^2)}}$$

subject to the constraint the  $\hat{\sigma}_{\text{new}}$  is not allowed to be less than 70 rating points.

#### Adjustments for players with ratings comparable (or lower) than nominal beginners

$$\text{If } R_{\text{new}} < 1500, \text{ then: } R_{\text{new,adjusted}} = 1300 + 200 \exp\left(\frac{R_{\text{new}} - 1500}{200}\right)$$

(subject to the constraint that  $R_{\text{new}}$  is not allowed to be less than 1320).

$$\text{If } R_{\text{new}} < 1550, \text{ then: } \hat{\sigma}_{\text{new,adjusted}} = \sqrt{\hat{\sigma}_{\text{new}}^2 + 100(1550 - R_{\text{new,adjusted}})}$$

(subject to the constraint that  $\hat{\sigma}_{\text{new}}$  is not allowed to exceed 348).

### Treatment of tournament newcomers

The uncertainty in rating of a tournament newcomer is set at 350 rating points.

The initial rating of a tournament newcomer is taken to be:

- $1680 - \frac{360}{\sqrt{N_{\text{pairs}} + 2N_{\text{singles}}}}$  for the purposes of calculating the first rating of the newcomer
- 1500 for the purposes of calculating ratings of players involved in games against the newcomer
- 1400 for the purposes of calculating ratings of players involved in games partnering the newcomer

### Treatment of inactive players

No adjustment is made in rating or uncertainty is made for players who have played a tournament game within the last 4 months.

For players who have not played in the last 4 months, the rating uncertainty is increased by:

$$\hat{\sigma}_{i,adjusted} = \hat{\sigma}_i + 5\sqrt{N_{\text{months}} - 4}$$

when calculating new ratings for tournaments that are “open”, provided that there has not already been an open tournament that month.

Players who have not played a tournament in the last 372 days are removed from the published ratings. If they do play another tournament, they are given an additional increase in uncertainty, and an input rating given by:

$$R = R_{\text{last}} - 0.15(R_{\text{last}} - 1500) \quad \text{if } R_{\text{last}} > 1500$$
$$R = R_{\text{last}} + 0.5(1500 - R_{\text{last}}) \quad \text{if } R_{\text{last}} < 1500$$