Update to Confidence Intervals Around Computed Par

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The Par by Scoring Distribution method of setting par depends on the frequency of scores. Because of limited data, it is useful to establish confidence intervals around the observed frequencies. This helps with the judgement about whether to trust the observation enough to change par.

Before now, this confidence interval was established using the Normal approximation around the observed frequency of scores. For example, if 5 out of 10 players got a score of 3 or better, the observed rate was 50% with a confidence interval of 30% to 70%. This is translated into the probability that each throw was good enough for par by raising the frequency to inverse of the number of throws. (.5, .3, .7)^(1/3) = (79%, 67%, 89%). What was observed is that 79% of throws were good enough to get a 3, which exceeds the cutoff of 77%, so the data would say par 3. However, at the low end of the confidence interval only 67% of throws were good enough, so we can't be 90% confident that real underlying par is not 4.

For the refined confidence interval, three things change: First, the Refined Par by Scoring Distribution method recognizes that the last throw on every hole always goes in the target. Thus, the underlying theory is based on whether enough of the first s-1 throws are good enough.

Second, the count of trials is based on the success rate of each throw (except the last one), rather than the frequency of each score. The get a score of 3, the player needs to make two good-enough throws. So, if 5 out of 10 players get a score of 3, that implies that 10 out of 20 attempts to make a good-enough throw were successful.

Third, instead of the Normal approximation, I used the Wilson score interval.

The net result of these three changes is that if 5 out of 10 players get a score of 3, the observation is that 71% = (.5^(1/(3-1)) of the 20 throws that were not the last putt were good enough to get a 3. This is greater than the refined cutoff percentage of 68%, so the observation is that the hole is par 3. The confidence interval is 57% to 82%, so we cannot be 90% confident that the actual underlying par is not 4.