RANDOM WALKS IN TENNIS

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Tennis is one of the most popular sports around the world. In the history of sports, people have always wanted to predict the winners. Knowing the past performance of two tennis players in a singles match and assuming that they will play at the same levels as in the past, how well can we predict who is going to win? To answer this question, we need to investigate how the outcome of a match depends on the point winning probabilities. In [3] a stochastic model is proposed to illustrate this relation, but no calculating formula is provided. To fully analyze the problem, we will first derive the necessary formulas and then use them to show, as one would expect, that when the top players meet in a match, the outcome is highly unpredictable.

This problem will be an excellent project for a mathematical modeling class. While the basic model is easy to understand for anyone with minimal knowledge in probability theory, the problem is open ended. Variations and extensions of the basic model will be ideal assignments for independent studies.

1. ABC of Tennis Scoring. We will briefly introduce the rules for tennis scoring. The reader is referred to [2] or other rule books for more details. Consider a singles match in which two players participate. A game is finished when one player receives at least 4 points with a two-point margin. Derived from the face values of French coins, the values of the first three points earned by a player are 15, 15, and 10, respectively. When a player wins the first point, the score is 15:0 (or 0:15). When the scores are a tie at 40-all or above, it is called a *deuce*. If the server scores (or loses) the point after deuce, it is *advantage in* (or *advantage out*). If the server wins the next point following 40:0, 40:15, 40:30, or advantage in, he takes the game.

A set is finished when one player wins at least 6 games with a two-game margin. If the score reaches 6-all, a tiebreaker game will be played to decide who takes the set. Thus, the possible winning scores in a set are: 6:0, 6:1, 6:2, 6:3, 6:4, 7:5, 7:6. Before the tiebreaking system was introduced in the early 70s, the score of a set frequently went over 20 games. For example, on June 21, 1969, in the longest singles match ever played at Wimbledon, Richard Gonzalez defeated Charles Pasarell 22-24, 1-6, 16-14, 6-3, 11-9.

A match consists of three or five sets, played as the best of three or five. If one player is much better than the other, one set will be enough to determine who is the better player and therefore the indisputable winner. If, however, the two players are very close, more sets should be played to demonstrate who is more superior. Ideally the match should be long enough so that the better player has almost a sure chance of winning and short enough so that the players will not be totally wrecked.