B2 Soccer Tournament Simulation

For another example, we consider the following situation. About 30 years ago, FIFA, the world governing body of soccer, changed the scoring system for the World Cup. Before, a win had counted 2 points and a draw 1 point. They changed it so that a win counted 3 points and a draw 1 point. The question is: *what is the chance that this change actually affects the outcome?*

Specifically, the first round of the World Cup is run in pools. In each pool there are 4 teams who play each other once. The top 2 teams from each pool advance. The goal is to estimate what percentage of the time the change in scoring affects the set of qualifiers (assuming no change in behavior of the teams).

For that, we need to simulate the games. Then see if the scoring system matters. One thing we need for our simulation is to know how often draws occur. Because it was the first thing that popped into my head, my simulation assumes all teams are equally good, and each game has a $1/3$ chance of a draw.

So I produced code that uses randomness to simulate the result of the 6 games and returns a pair of vectors giving the number of Wins and Draws for each team. The function header is the following, where `POOL` is the number of teams in the pool. It uses a nested loop so that for every pair of distinct numbers in the range 1 up to `POOL`, it generates a random number and updates the output vectors accordingly.

```matlab
function [wins,draws] = roundRobin(POOL)
```

Now it was time to create a function that takes these vectors, and determines who qualifies. For example, if the vectors were `wins = [1 2 1 0]` and `draws = [1 1 2 0]`, then the two qualifying teams are 2 and 3, regardless of the scoring system. But if `wins = [1 0 2 0]` and `draws = [1 3 1 1]`, then under the old system teams 1 and 2 were tied but not under the new system.

We do not want to get into how the tie-breaker works. Instead we will do the following. Say a team is a **definite qualifier** if at least 2 teams score less than it; say a team is a **potential qualifier** if less than 2 teams are ahead of it and less than 2 teams are behind it. We will just assume that *the scoring system matters if the set of definite qualifiers is different or if the set of potential qualifiers is different.*
So I created a function with the following header, where **QUALS** is the number of teams that qualify per pool, **wins** and **draws** are the vectors from above, and **WIN_POINTS** is either 2 or 3. It returns a pair of logical vectors: whether each team is a definite or potential qualifier. The function has a loop where for each team it calculates how many teams it is behind and how many teams it is level with, and based on that determines whether the team is a definite qualifier, potential qualifier, or neither.

```matlab
function [ definite, potential ] = qualifiers(QUALS, wins, draws, WIN_POINTS)
```

Finally, we need a driver that oversees the simulation, and calculates statistics. Inside a loop, the driver calls **roundRobin**, then calls **qualifiers** with both the old and new scoring system, and updates a counter if the results are different.

```matlab
soccerDriver.m, roundRobin.m, qualifiers.m
```