

SOCCER SHOOTOUT SIMULATION

by: Dr. Stanley Hartzler
Illinois Mathematics and Science Academy

In a local soccer league when a game ends in a tie, there is an overtime period. If the score is still tied after the overtime period, then a "shootout" occurs. Five players are selected from each team. These players each take turns shooting at the goal from the penalty spot. If the score is still tied after each team's five players shoot, another set of five players from each team is selected to shoot. This continues on with the third five, and, if needed, rotates through the top five again, and so on until the tie is broken.

Because it can be so important, a coach keeps records on who the team's better shootout kickers are. Two coaches have tested their teams with 24 practice kicks each and recorded the results.

Each soccer team has fifteen players. The uniform numbers are listed below, along with the number of goals made out of 24 attempts in a shootout situation.

Number of Shootout Goals Out of 24

| <u>Uniform Number</u> | <u>Thunderbolts</u> | <u>Ninjas</u> |
|---------------------------|---------------------|---------------|
| 1 | 19 | 13 |
| 2 | 9 | |
| 3 | | 20 |
| 4 | 11 | 2 |
| 5 | 18 | 9 |
| 6 | 3 | 6 |
| 7 | 13 | 14 |
| 8 | 15 | 5 |
| 9 | 4 | 12 |
| 10 | 11 | 9 |
| 11 | | 17 |
| 12 | 6 | |
| 13 | 22 | 21 |
| 14 | 7 | 8 |
| 15 | 12 | |
| 16 | | 11 |
| 17 | 24 | |
| 18 | | 12 |
| 19 | 16 | 12 |

THE SIMULATION

You will need: 720 red beads
 720 blue beads
 30 opaque containers (paper lunch bags would work nicely)

- Rank order the members of the Thunderbolts in terms of their shootout ability.
- Rank-order the Ninjas in the same fashion.
- Determine the *shootout goal probability* for each team member based upon the observed results. For example, the shootout goal probability for player # 15 on the Thunderbolts is 0.50 because he made 12 out of his 24 opportunities at a shootout.
- Label each container with a different team name and player number. In each container put colored beads to model the number of goals that player made out of 24 attempts. Blue beads will represent goals and red beads represent misses:

Example: Player #16 for the Ninjas will score 11 goals in 24 attempts. Put 11 blue beads and 13 red beads in the jar labeled Ninjas #16.

Do the same for each player on the team, placing 24 beads in each players' container.

- Two members of the class are chosen, one to represent each team. They each draw a bead at random from the five containers which represent their team's best five players. The beads are replaced in their original containers, then, if the score is still tied, an additional round is played using the containers which represent the second best five players on each team. This pattern continues until the tie is broken. Record the final score.

Pai Lai announced to the class that it is possible to use a calculator to randomly produce natural numbers 1 through 24. Try this simulation again using random numbers generated by the calculator. Compare your results with the first simulation. Over a long period of time, which team would you expect to win more shootouts? 🍷