

Card counting

Hadley Wickham

Blackjack is an extremely popular casino game, where the aim is get closest to 21 points, without going over. If the optimal strategy is followed, then the house advantage is only 1%, and card counting techniques give the motivated player the ability to decrease the house advantage even further, to the point that the advantage lies with the player. This module explores card counting with simulation. It's interesting for students because many have played blackjack, and card counting has been in the news recently with the release of the movie "21", based the famous MIT blackjack team.

This module has two important statistical challenges, designing a simulation and understanding estimation, testing and power, and one computational challenge, working with mutable objects. These challenges are described in more depth below.

Simulation

This module provides an introduction to non-trivial simulation that requires keeping tracking of multiple states (cards in the shoe, dealer's cards, player's cards, card count, ...). Students can be introduced to this complexity gradually, building up from a simple simulation to one that accurately models real life. Mathematically inclined students can read the original JASA paper (Baldwin et al., 1956) from which the modern optimal strategy is derived. This can lead to discussions about when theoretical/mathematical approaches work well, and when computational approaches are easier.

Estimation errors, testing and power

Running the simulation leads to great discussion about estimation and accuracy. Many websites publish tables of advantages of various methods, but give no estimate of error. How can we use simulation to estimate this error? This leads naturally to discussions of testing and power:

- If we have a fixed amount of error we are willing to tolerate, how many runs do we need to do?
- How can we compare two methods? Can we say with certainty that one is better than another?

Mutable objects

To deal with the multiple states in the simulation it is much easier to work with mutable objects. Students tend to be familiar with mutable objects from other programming languages (e.g. Java, C++, C#, javascript, ...), but the main object systems in R (S3 & S4) are not mutable. This module provides a good opportunity to drive home R's default copy-on-modify semantics, introduce students to alternative systems in R, and discuss some of the advantages and disadvantages of mutable state.

References

Roger R. Baldwin, Wilbert E. Cantey, Herbert Maisel, and James P. McDermott. The optimum strategy in blackjack. *Journal of the American Statistical Association*, 51(275):429–439, 1956. ISSN 01621459.